The Influence of IT Management Practice on IT Use in Large Organizations

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Abstract

This paper draws upon the absorptive capacity as the theoretical basis for a pragmatic explanation of key factors affecting information technology (IT) use in large, complex organizations. IT use is defined as the extent to which an organization deploys IT to support operational and strategic tasks. The study uses results from a survey of senior IT managers from 132 firms to examine hypothesized relationships among the following constructs: IT management climate, managerial IT knowledge, IT-management-process effectiveness, and IT use. A structural-equation model is developed using LISREL to assess the relative effects of and interrelationships among these constructs. The study's findings indicate that managerial IT knowledge is a dominant factor in explaining high levels of IT use and that both managerial IT knowledge and IT-management-process effectiveness are influenced by IT management climate.

Keywords: IT use, IT management, IT management processes, absorptive capacity

ISRL Categories: AE, AF, EF, EG, E

Introduction

The advantages to and the increasingly strategic necessity of applying information technology (IT) in supporting a broad range of organizational activities are generally recognized today by most managers. Moreover, the conviction that IT represents a critical organizational resource is expected to spread during the 1990s (Boynton, 1993; Boynton and Victor, 1991; Boynton, et al., 1993; Dertouzos, et al., 1989; Drucker, 1988; Peters, 1987; Piore and Sabel, 1984). While IT is used in many organizations, the extent to which it is applied creatively and to critical tasks varies widely. Many organizations, of course, have not intended to use IT to dramatically enhance organizational performance. Still, for many firms that have attempted to use IT in the hope of attaining truly significant gains in effectiveness and/or efficiency, results often fall far short of intentions.

The practice of IT management, e.g., the managerial efforts associated with planning, organizing, controlling, and directing the introduction and use of IT within an organization (Boynton and Zmud, 1987), has received close scrutiny from scholars, practicing managers, and consultants (Cash, et al., 1988; Kraemer, et al., 1989; Madnick, 1987; Marchand and Horton, 1986; Synnott and Gruber, 1981; Watson, et al., 1987; Wiseman, 1985). The aim of this manuscript is to provide a theoretical perspective and empirical findings, as well as subsequent management implications, regarding the influence of IT management practices in explaining variation in the dependent variable, IT use, across large, complex organizations. To that end, relationships among the following constructs are examined: IT management climate, managerial IT knowledge, IT-management-process effectiveness, and the level of IT use in support of an organization's operational and strategic activities.

To begin, the constructs and research hypotheses that populate our research model are defined. Next, an empirical study that assesses these hypotheses is described. Finally, the study's results are interpreted and the implications of these findings are discussed.

Development of Research Model and Hypotheses

IT serves an increasingly important role in many organizations in facilitating or enabling the introduction of new products or services and the improvement of operational or managerial work processes. The successful application of IT in such endeavors is inextricably linked with the effective management of a number of processes associated with the planning for, acquisition of, and implementation of an organization's portfolio of IT (Cash, et al., 1988; Cooper and Zmud, 1990; Kraemer, et al., 1989; Kwon and Zmud, 1987; Zmud, 1984). Why are some organizations able to exhibit greater success than others in managing such processes? The theory of absorptive capacity (Cohen and Levinthal, 1990) offers a promising theoretical base for examining this question.

Absorptive capacity theory, when applied to the domain of IT use, suggests that an organization's ability to effectively apply IT is dependent on the development of a mosaic of IT-related knowledge and processes that bind together the firm's IT managers and line managers. The theoretical insights of the theory of absorptive capacity thus provide a strong basis from which to examine the nature and importance of line/IT manager information exchanges, relationships, and partnerships (Henderson, 1990; Rockart, 1988) within the firm.

This study's conceptual focus is presented as Figure 1. In the figure, an organization's absorptive capacity is represented by two constructs, *managerial IT knowledge* and *IT-management-process effectiveness,* both of which are seen as (1) directly influencing organizational success in *using IT* (the third construct) in support of the firm's operational and strategic work activities, and (2) being directly influenced by the fourth construct, the firm's *IT management climate.* The remainder of this section defines these constructs, articulates research hypotheses to be explored through empirical analysis, and details the research model to be examined.

IT use

IT use is defined as the application of IT within an organization's operational and strategic activities (Ives and Jarvenpaa, 1991). More specifically, IT use involves the extent to which IT takes the form of cost reduction, management support, strategic planning, and competitive thrust applications: cost-reduction applications reduce the cost of business activities; management support applications assist managers' efforts to monitor, control, and design business activities; strategic planning applications support managers' efforts to formulate business strategies; and competitive thrust applications establish competitive advantage in the market place. Such a conceptualization reflects the wide variety of IT applications across firms in different industries, reflects that applications may be internally or externally focused, and recognizes that specific firms might choose to emphasize particular types of applications given both their business strategies and their histories of IT use.

Managerial IT knowledge

An organization's absorptive capacity reflects its capability to "absorb," through its internal knowledge structures, information regarding appropriate innovations so that these innovations can be applied in support of operational or strategic activities (Cohen and Levinthal, 1990). In this paper, the innovations of interest are those associated with IT. A major component of an organization's absorptive capacity regarding IT is represented by the conjunction of IT-related and business-related knowledge possessed by and exchanged among IT managers and business unit or line managers. In the abstract, it is this intertwined and dynamic pool of knowledge that represents the construct of *managerial IT knowledge.*

In their extensive review of the literature, Cohen and Levinthal (1990) suggest that complementary functions within an organization ought to be tightly intermeshed; even redundancy of knowledge and expertise may be desired to create cross-functional absorptive capacities. As Cohen and Levinthal (1990) point out:

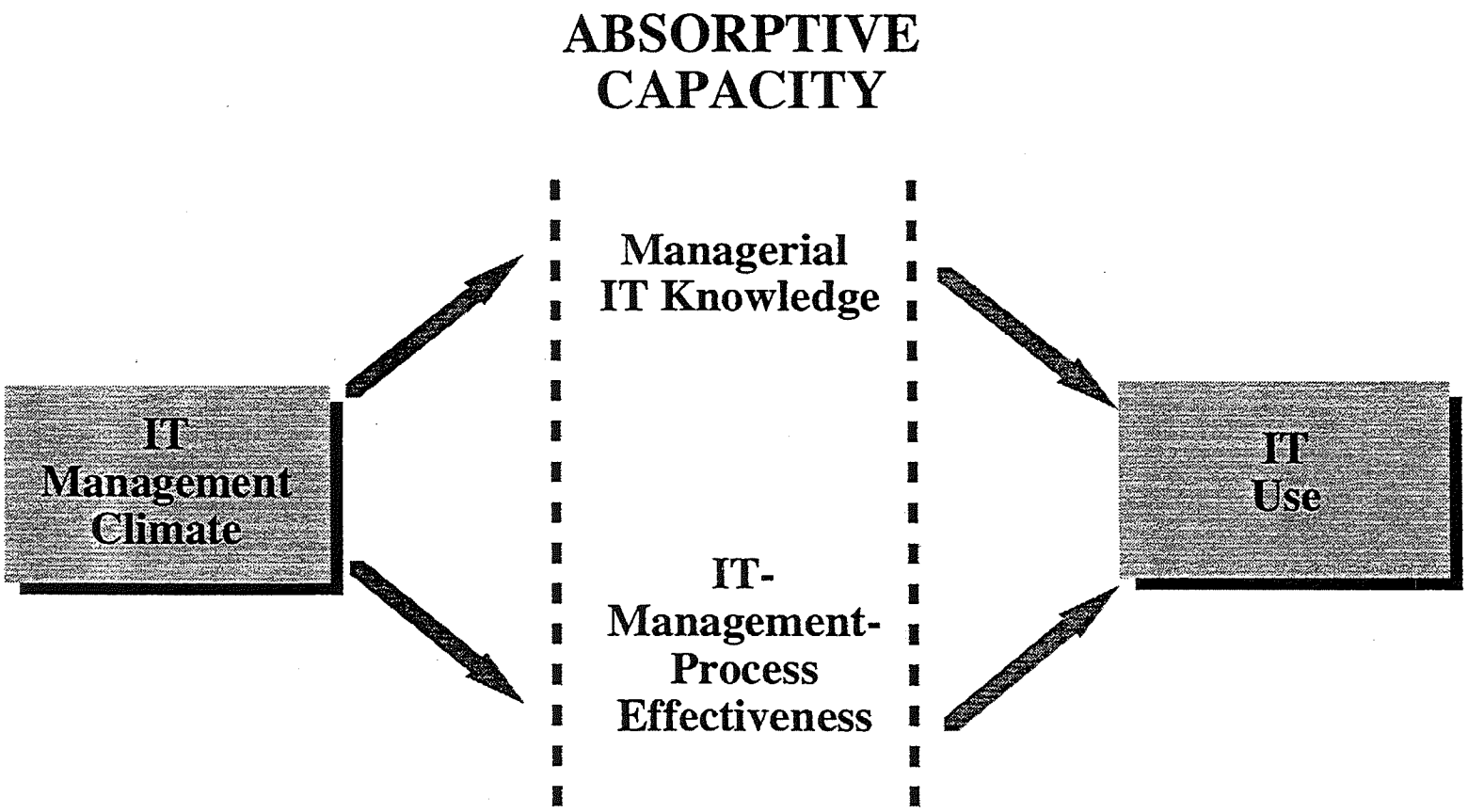


Figure 1. Research Model

> . . . Absorptive capacity refers not only to the acquisition or assimilation of information by an organization but also to the organization's ability to exploit it. Therefore, an organization's absorptive capacity does not simply depend on the organization's direct interface with the external environment. It also depends on the transfers of knowledge across and within subunits that may be quite removed from the original point of entry. Thus, to understand the sources of a firm's absorptive capacity, we focus on the structure of communication between the external environment and the organization, as well as among the subunits of the organization, and also on the character and distribution of expertise within the organization (p. 131-132).

Given this description, other research related to innovation and the ability to assimilate new ideas and put them into concrete action within the firm can be seen as falling within the conceptual foundation established by Cohen and Levinthal (1990). Research on new product development and on the management of innovation is generally quite supportive of the basic tenets of absorptive capacity by suggesting that information redundancy within the firm is a prerequisite for rapid innovation and flexible organization response to changing market conditions (Nonaka, 1989; 1991). As Nelson and Winter (1982) point out, an organization's capabilities—including absorptive capacity—do not reside in any single individual but depend on the mosaic of activities, interactions, and exchanges among a number of individuals. Cohen and Levinthal (1990) suggest that this mosaic represents the structure of knowledge within an organization, the overlapping extent of this knowledge, and the interactions that occur among individuals—all of which influence who knows what, who can help with what sort of problem, and who can exploit new information. We use this construct, managerial IT knowledge, to reflect the (ideally) overlapping know-how of IT and line managers (in particular, the knowledge IT managers possess about the business and strategic issues within the firm, and the knowledge line managers possess about the potential opportunities from applying IT within their business domain).

Research on the use of IT in different organizational settings points to knowledge structure as a key construct. Kenney and Florida (1988), for example, observed that Japanese firms are generally more successful in taking advantage of information technologies that provide flexibility and responsiveness than are traditional Western "mass production" organizations. Kenney and Florida posit that the primary reason for this success in Japanese firms is redundant knowledge and the robust exchange information that exists among technical specialists and general managers within the organization. This suggests that the knowledge structures characterized by extensive knowledge overlap and information exchanges among managers are related to an organization's ability to use new technologies in their operational and strategic fabrics.

Collectively, these research streams and the conceptual foundation of absorptive capacity itself suggest that knowledge structures are at the heart of a firm's ability to innovate and adapt to environmental change. This research coincides with the theoretical observations and normative prescriptions reflected in the important work of Rockart (1988) and Henderson (1990) supporting the significance of developing knowledgeable IT and line managers through the establishment of various types of partnership relationships. Such partnerships, through ensuing information exchanges, enrich organizational knowledge structures—and consequently absorptive capacity—related to IT innovation. Moreover, it is precisely such knowledge and increased absorptive capacity that enable the rich dialogues among IT and line managers through which truly innovative IT applications arise (Lind and Zmud, 1991). Together, these diverse sets of literature supporting the theoretical arguments associated with absorptive capacity and its relationship with organization innovation lead to our first research hypothesis:

Hypothesis 1: Higher levels of managerial IT knowledge will directly and positively influence an organization's extent of IT Use.

IT-management-process effectiveness

The second component of an organization's absorptive capacity regarding IT relates to the knowledge maintained within the organization's *IT management processes.* Historically, the intent of much of the IT management literature, both practitioner and academic, has been to

catalogue the nature of the activities associated with such processes and to prescribe guidelines for their implementation. One of the most comprehensive treatments of the processes associated with IT management was produced by a multi-year project by IBM Corporation consultants that identified 42 such processes (Van Schaik, 1985). The 11 IT-management-process groups identified by this IBM research are shown in Table 1. The management processes identified in the table are consistent with previous work on IT management in large, complex organizations (Allen, 1982; Cash, et al., 1988).

The overall conclusions of the IBM research were (1) that the quality of an organization's approach to IT management is heavily influenced by the extent to which the management activities associated with the 11 IT-management-process groups have been effectively implemented, and (2) that the level of effectiveness of the organization's IT management processes determines the extent to which an organization will successfully apply IT to its operational and strategic tasks. Although the IBM research program lacked the rigor observed in most academic research, the research was based on extensive field experience and years of practical development. Its premise that IT-management-process effectiveness serves a crucial role in IT use is consistent with similar views expressed in the academic literature (Allen, 1982; Cash, et al., 1988; Kraemer, et al., 1989; McFarlan, 1984; Rockness and Zmud, 1989).

Our perspective is that the organization's IT-management-process effectiveness represents the routines and procedures that embody the pragmatic knowledge, or know-how, organizations apply in fostering and furthering appropriate IT use. This knowledge structure, captured by formal management mechanisms, may be related to but is clearly distinct from "managerial IT knowledge," and is the second element comprising an organization's absorptive capacity, leading to our second research hypothesis:

Hypothesis 2: Higher levels of IT-management-process effectiveness will directly and positively influence an organization's extent of IT Use.

IT management climate

The role of climate in influencing an organization's ability to innovate has long been a subject of theoretical and empirical interest (for extensive treatments in the literature see: Pugh, et al., 1985; Tushman and Moore, 1982). Support for expecting a firm's "computing climate" to influence IT use can be seen in the "Process Model of Computing Change" developed by Kraemer, et al. (1989), in which numerous "climate" elements are included as key constructs associated with a firm's internal environment, computing management, and computing policies.

While climate has received considerable attention over the last 30 years (Falcione, et al., 1987), no two studies define it in exactly the same way. Nevertheless, the essence of the construct can be captured through the following definitions of climate:

- A set of attributes which can be perceived about a particular organization or its subsystems and that may be induced from the way that the organization and/or its subsystems deal with their members and environment (Hellriegel and Slocum, 1974, p. 256);
- Perceptions [of organizational members] that are psychologically meaningful molar descriptions that people can agree characterize a system's practices and procedures (Schneider, 1975, p. 474).

We sought to develop a conceptualization of IT management climate that was particularly relevant to joint IT/line manager information exchange and problem-solving activities as well as potentially related to the IT management processes established in the firm. Given the definitions provided here and the views of Ashforth (1985), IT management climate is conceived as the shared, enduring perceptions of salient aspects of the IT work environment, i.e., the organizational practices, procedures, and forms associated with IT-related activities, by an organization's (or organizational subsystem's) members.

Mining the rich practitioner literature describing firms that have been successful in applying IT, three likely dimensions of an effective IT management climate were identified: a strong *IT planning orientation;* a clear *IT vision;* and *management control structures,* such as standard policies, pro-

Table 1. IT Management Processes: IBM Model

Strategic Level Processes	Operational Level Processes
Strategic Planning and Control	Development & Maintenance Control
Business Strategic Planning	Project Assignment
Architecture Definition	Project Scheduling
IS Strategic Planning & Control	Project Control
	Project Requirement Control
	Project Evaluation
Tactical Level Processes	Resource Control
	Change Control
Development Planning	Resource & Data Inventory Control
Application Planning	
Systems Planning	Service Control
Data Planning	Production & Distribution Schedule
Project Planning	Resource & Data Performance Control
	Problem Control
Management Planning	Service Evaluation
Management System Planning	
Management System Monitoring	Development & Maintenance
	Application/Software Development & Upgrade
Service Planning	Application/Software Procurement & Upgrade
Service-Market Planning	Hardware/Facility Install & Upgrade
Service-Level Planning	Maintenance
Recovery Planning	Tuning & System Balancing
Security Planning	Management System Development & Upgrade
Audit Planning	
	Administration Services
Resource Planning	Financial Administration
Capacity Planning	Staff Performance
Budget Planning	Education/Training
Skills Planning	
Tactical-Plan Mgt.	Information Services
	Production
	Distribution
	Customer Services
	Service Marketing

cedures, and rules, that guide IT decision making throughout the organization. A strong IT planning orientation reflects high levels of commitment and high levels of effort to (1) identify innovative, useful IT applications throughout the firm, and (2) ensure the existence of an appropriate technical platform and sufficient managerial support for timely and effective implementation of those applications (Boynton and Zmud, 1987; Cash, et al., 1988). A clear IT vision would be represented by a stable, consensual view of the organizational role of IT and an understanding of how this role fits broad, strategic organizational concerns (Cash, et al., 1988; Rockart, 1988). Finally, Nolan (1973) and Cash, et al., (1988) provide articulate arguments for the important role served by IT management policies and controls in facilitating the use of IT.

Other relevant aspects of IT management climate are derived from the literatures on technology transfer and innovation. Tyre and Hauptman

(1989) identify three "response mechanisms" that enable organizations to adapt to innovation and technological change: (1) information search and coordination undertaken before a technology is put into place; (2) joint search, during both the startup process and the initial implementation period, by technology users within the firm and technology providers; and (3) functional overlap on a continuing basis between providers and users. These notions suggest three additional dimensions of IT management climate: the extent of *information sharing between IT providers and users;* the *locus of IT decision making;* and the extent of use of *temporary organizational arrangements,* such as task forces and teams.

We posit that these six dimensions of IT management climate will not influence IT innovation directly but, instead, will establish the conditions that allow for the enrichment of an organization's managerial IT knowledge and its IT-management-process effectiveness. In other words, an appropriate IT management climate induces both IT and line managers to embrace values and behaviors conducive to the development of both higher levels of managerial IT knowledge and more effective IT management processes. This position leads to two final hypotheses:

Hypothesis 3: Higher levels of IT management climate will directly and positively influence an organization's managerial IT knowledge.

Hypothesis 4: Higher levels of IT management climate will directly and positively influence an organization's IT-management-process effectiveness.

Detailed research model

The detailed research model to be examined is shown as Figure 2. Our intent is to assess the overall validity of the research model in order to develop an initial appreciation of the relative contributions of the model's constructs. Thus, the analysis and discussion will focus on the overall relationships among these constructs and the relative roles of the constructs in influencing IT use.

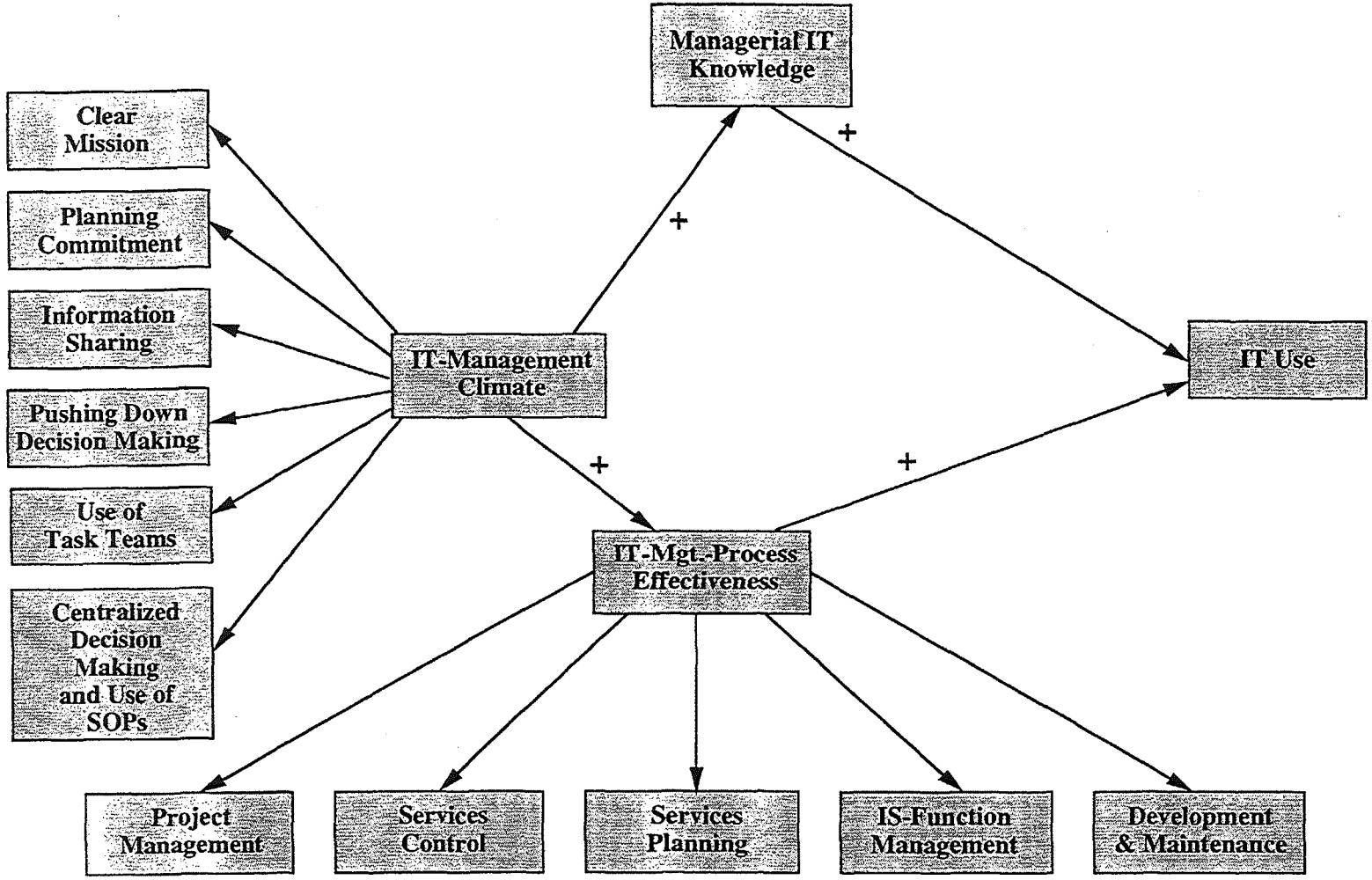
Research Methodology

This study employs a cross-sectional field survey of organizations belonging to GUIDE International, a professional association of commercial organizations that operate large computer systems manufactured by IBM. Questionnaires were mailed in 1986 to a random sample of 365 firms in a variety of industries; 132 completed questionnaires were received, producing a response rate of 36 percent—a response rate higher than that normally observed in comparable studies. We feel that this response rate, particularly in light of the survey length and the senior management respondents, reflects the relevance of the issues being examined to senior IT executives. Given that GUIDE consists of firms using large IBM mainframes, the corporate IT group in GUIDE organizations tends to serve a very influential role in determining their organization's IT practices and policies.

The state of development of an organization's IT management climate and the IT management processes are both operationalized at an *organizational* level. Such a research strategy is based on our belief, supported through our discussions with over 20 practitioners during extensive pretesting of the instruments, that these two constructs are largely determined in most organizations by the practices and policies of the corporate IS function. While we continue to believe that this assertion holds today, we are particularly confident of its validity regarding 1986, when these data were collected.

In operationalizing this study's other two constructs (IT use and managerial IT knowledge), an organizational unit of analysis would have been both difficult and inappropriate for the large, complex firms that were to constitute our sample. Large organizations are comprised of multiple work systems with units characterized by different structures, management processes, cultures, goals, and environments (Scott, 1981). This complexity is particularly true for multi-divisional organizations, whose various divisions might be applying IT in very distinct ways. Therefore, to avoid masking variance that occurs within business units, the level of data collection for IT use and managerial IT knowledge is that of the *business unit,* as is the level of analysis at which the research hypotheses are examined.

Responses regarding IT management knowledge and IT use were obtained for three business units in each organization—the three business units receiving the largest amount of IT services and



IS-Management-Process Variables

Figure 2. Proposed Research Model

support. This strategy for identifying business units, referred to herein as units A, B and C, was used to ensure that IT would not be perceived as an incidental resource for a particular business unit. On average, the business units designated as "A units" received 38 percent of an organization's IT services, "B units" received 23 percent, and "C units" received 14 percent. Note the rather large variance across the three business units. This supports the view that it is important to sample IT use at the business unit level.

Procedure

The research instrument was mailed to the senior IT executive in each organization with a letter from GUIDE International supporting the study. The limitations of using a single source to represent a company's position are well recognized. This problem was resolved, in part, by establishing an "expert" within the organization as the single source—the senior IT executive. Thus, in most of the organizations surveyed, the individual who completed the survey was the person most knowledgeable about the organization with regard to the variables of interest. In order to tap alternative perspectives, the senior IT executive was encouraged to complete the instrument at a staff meeting attended by other IT managers. Follow-up communications with a number of respondents indicated that this suggestion was, in fact, followed at many sites. In other cases, the instrument was completed solely by the senior IT executive or by a member of this executive's senior staff.

Instrument construction and assessment

Because these constructs had not previously been empirically examined in an IT context, instrument construction and assessment proved to be a major undertaking. A variety of analyses were applied to assess the reliability and construct validity of the measures. Descriptive statistics indicated no major ceiling or floor effects in the data, important in light of the potentially sensitive issues many of the questions addressed. Furthermore, the wide range of responses obtained indicates that respondents often provided critical self-appraisals of their organizations. In addition, consistent response patterns were generally observed within a construct's measures. For example, greater IT use was observed with the IT applications typically implemented first by firms (cost reduction and management support) than with the applications typically implemented later (strategic planning or competitive thrust). The remainder of this section provides detailed information on each of the study's measures.

IT Use

Four items were used to assess unit IT use. Each item addressed a distinct type of IT application:

1. **Cost reduction:** information systems developed to reduce the cost of business activities
2. **Management support:** information systems developed to assist in monitoring, controlling, and designing business activities
3. **Strategic planning:** information systems developed to assist in formulating business strategies
4. **Competitive thrust:** information systems developed to establish a competitive advantage in the market

Specifically, respondents were asked to rate the three units' (unit A, unit B, and unit C) use of each type of IT application on a five-point scale: (1) no use at all, (2) just starting, (3) used to some extent, (4) used to a great extent, and (5) "industry leader." To simplify analysis, responses were summed to form a single dependent variable representing IT use (coefficient alpha = 0.81). This relatively high coefficient alpha indicates that these items were highly correlated, and collapsing them into one variable improves the parsimony of the model with little lost in terms of variance explained.

Managerial IT Knowledge

For each unit, two scales were constructed and then *multiplicatively* combined to assess managerial IT knowledge: IT management's knowledge of the business unit (coefficient alpha = 0.70); and the line management's knowledge of the value and potential of IT (coefficient alpha = 0.78). It is important to note, however, that both of these measures reflect perceptions of the

senior IT executive respondents. The items composing these scales are listed in Appendix A. The results of a principal-component analysis with varimax rotation supports the construct validity of these items (see Table 2).

The theoretical basis of this measure's construction is "push-pull" theory (Zmud, 1984), which states that innovation is most likely to occur when awareness of an innovation (the "push") and need for the innovation (the "pull") are simultaneously felt. We feel such instances are most likely to occur in a specific business unit when IT managers, who inherently understand IT, are knowledgeable about the business unit and when line managers in the business unit, who inherently understand the business unit, are knowledgeable about IT. By multiplying the two scales, we mathematically increase the separation between respondents who respond low on both scales and those who respond high on both scales and, thus, introduce desired variance into the data set. Therefore, the multiplicative (rather than additive) aggregation reflects our belief that greater-than-linear returns accrue from this fusion of IT and line manager knowledge.

IT-Management-Process Effectiveness

The extent to which each IT group had implemented the 42 IT-management-process activities defined by the IBM research project (refer back to Table 1) was assessed by having respondents indicate, on a five-point scale, whether an activity was: (1) not implemented, (2) partially implemented but not fully effective, (3) partially implemented and effective, (4) fully implemented but not fully effective, or (5) fully implemented and effective. Detailed descriptions (IBM, 1981) of the IT processes were given to respondents. An example follows:

PROCESS #1 BUSINESS STRATEGIC PLANNING

Using all available inputs from the enterprise (formal and informal), this process defines the enterprise demands of its IT function through the strategic planning period and the freedom IT has in meeting these demands.

Define IT mission based on enterprise mission and objectives.

Define IT policies.

Define business processes, information and information flow of the enterprise (including IT).

Define enterprise requirements for information (including IT) through the strategic time period.

Factor analysis with varimax rotation was used to examine the structure of responses regarding these 42 IT management processes. The eight-factor solution derived (see Table 3) was consistent with an initial conceptualization of how the items would load given the findings of the original IBM study. An earlier examination of a reduced set of these data (Zmud, et al., 1987) found that only five of these variables significantly influenced IT use: project management, service control, service planning, IT function management, and application development and maintenance. In order to simplify the research model, only these five variables are used in this study.

IT Management Climate

A 23-item scale, whose items are listed in Appendix B, was developed to measure IT management climate. These items were derived, in part, from previous conceptual and empirical research on organizational climate (Falcione, et al., 1987; Schneider, 1975). Respondents were asked to rate the extent to which an item was characteristic of the IT function that they managed. The subsequent factor analysis with varimax rotation (see Table 4) produced six factors. (Item 20 was removed because it resulted in an unstable factor structure.) In general, the items loaded as expected.

Presentation of the final model

Following a preliminary analysis of the variables using factor analysis to reduce the variable set, a full structural-equation model with all variables present was generated. (For a full report on the methodological details underlying the development of the structural-equation model, contact the first author.) This model was reduced by careful theory trimming to obtain a final model (Figure 3) consistent with both the research model and the bounds of statistical significance (Duncan, 1975; Hayduk, 1987). Except for the IT-management-climate variables, all the variables in this final model were consistent with their initial conceptualizations.

Table 2. Factor Analyses of IT-Related Managerial Interaction Scales

	IS Mgr. Knowledge	Line Mgr. Knowledge	
(A) Unit A			
Eigenvalues	.93	1.51	.29
IS mgr knows biz unit's operations (a)	.66	.23	.30
IS mgr knows biz unit's strategies (b)	.60	.15	.39
Line mgr/IT as competitive weapon (c)	.32	.64	.07
Line mgr/IT for clerical productivity (d)	.19	.61	.02
Line mgr/IT for professional product (e)	.02	.81	−.20
(B) Unit B			
Eigenvalues	1.27	1.47	.23
IS mgr knows biz unit's operations (a)	.80	−.03	.22
IS mgr knows biz unit's strategies (b)	.66	.07	.32
Line mgr/IT as competitive weapon (c)	.28	.44	.25
Line mgr/IT for clerical productivity (d)	.31	.74	−.13
Line mgr/IT for professional product (e)	.13	.85	−.02
(C) Unit C			
Eigenvalues	2.35	.27	.23
IS mgr knows biz unit's operations (a)	.71	.10	.24
IS mgr knows biz unit's strategies (b)	.60	.25	.39
Line mgr/IT as competitive weapon (c)	.52	.30	.11
Line mgr/IT for clerical productivity (d)	.81	.14	−.00
Line mgr/IT for professional product (e)	.75	.29	−.06
(D) All Units Together			
IS mgr knows biz unit's operations (a)	.76	.14	.26
IS mgr knows biz unit's strategies (b)	.63	.21	.37
Line mgr/IT as competitive weapon (c)	.33	.49	.16
Line mgr/IT for clerical productivity (d)	.39	.54	−.03
Line mgr/IT for professional product (e)	.20	.68	−.13

Our initial concept of IT management climate as a six-dimensional construct was supported by factor analysis. Subsequent data reduction (via second-order factor analysis) produced a more parsimonious structure, however, that was consistent with both the organizational literature on the antecedents of innovation and with our initial intent to identify dimensions of climate that influence IT innovation processes. The three dimensions of IT management climate that appear in our final model include a factor we have labeled *organic structures* and two single-indicator measures labeled *mechanistic structures* and *temporary structures*. Such dimensions are consistent with other views of innovative climates within large, complex organizations (Jelinek and Schoonhoven, 1990) and suggest that the effective management of innovation in such organizations requires the simultaneous use of both tight and loose organizational structures.

Interpreting the final model

All parameter values among the variables shown in Figure 3 can be interpreted as standardized regression coefficients (Pedhazur, 1982). Thus, comparisons of the relative strengths of the various paths is reflected in the absolute sizes of these coefficients.

Table 3. Resultant Factor Structure for the IT Management Processes

Factor	Eigenvalue	Item	Loading
Project Management	3.71	Project planning	.53
		Project assignment	.69
		Project scheduling	.80
		Project controlling	.67
		Project requirement control	.65
		Application and software development	.55
		Application and software procurement	.41
		Education and training	.42
Strategic Management	3.41	Business strategic planning	.68
		Architecture definition	.79
		IS strategic planning and control	.75
		Data planning	.64
		Systems planning	.43
Services Control	3.13	Service level planning	.41
		Audit planning	.40
		Project controlling	.44
		Project requirement control	.45
		Project evaluating	.44
		Change control	.67
		Resource and data inventory control	.62
		Problem control	.43
		Service evaluating	.53
Services Planning	3.11	Service market planning	.51
		Skill planning	.40
		Budget planning	.48
		Tactical plan management	.43
		Service evaluation	.43
		Financial administration	.53
		Education and training	.46
		Customer services	.56
		Service marketing	.64
Resource Planning	3.05	Systems planning	.49
		Service level planning	.48
		Recovery planning	.74
		Security planning	.51
		Capacity planning	.57
		Resource and data performance control	.48
IS Services	2.68	Product and distribution scheduling	.49
		Hardware and facility installation	.52
		Production	.75
		Distribution	.75
IS Function Management	2.67	Tactical plan management	.42
		Management systems planning	.72
		Management systems monitoring	.60
		Management systems development	.60
		Staff peformance	.52
Development Maintenance	1.81	Audit planning	.46
		Application software develoment	.40
		Maintenance	.64
		Tuning and systems balancing	.42

Table 4. IT-Climate Factor Analysis

	Item #	Clear Mission Factor 1	Planning Commitment Factor 2	Information Sharing Factor 3	Push Down Decisions Factor 4	Task Teams Factor 5	Centralized Decisions Factor 6
Eigenvalues		3.25	2.72	1.91	1.94	2.24	1.37
DECENT1	1	0.13	0.15	0.04	−0.10	0.27	0.82
MECH1	2	−0.31	0.30	−0.13	0.54	0.30	0.08
PLAN1	3	−0.36	0.67	−0.03	0.12	0.58	0.13
PLAN2	4	0.01	0.72	0.28	−0.06	0.02	−0.13
MISSION1	5	−0.62	−0.07	−0.11	0.12	−0.14	0.24
TEMP1	6	0.02	0.16	0.05	0.19	0.75	−0.07
PLAN3	7	−0.12	0.77	−0.08	0.20	0.15	0.18
MECH2	8	0.25	−0.25	−0.03	0.58	0.23	−0.00
INFOSH1	9	0.35	0.26	0.43	−0.04	0.01	0.05
PLAN4	10	0.37	−0.61	−0.19	−0.30	0.13	0.05
PLAN5	11	0.01	0.42	0.07	−0.30	0.39	0.21
MECH2	12	0.02	0.16	−0.24	0.58	0.10	−0.23
MISSION2	13	0.67	−0.08	−0.09	0.01	0.12	−0.14
MISSION3	14	−0.44	−0.02	0.19	−0.05	−0.01	0.62
TEMP2	15	0.05	−0.04	0.05	−0.01	0.82	0.03
MISSION4	16	−0.67	0.26	0.06	0.01	0.14	−0.09
MECH3	17	−0.09	0.10	0.21	0.60	−0.35	−0.09
MISSION5	18	0.63	−0.29	−0.35	0.14	−0.03	0.10
MISSION6	19	0.72	0.21	0.32	0.08	0.01	0.10
INFOSH2	21	0.03	−0.03	−0.70	0.19	−0.25	−0.16
INFOSH3	22	−0.20	0.07	0.83	0.06	−0.10	0.02
MECH4	23	0.48	−0.31	−0.06	0.50	−0.01	0.13

Factor Number	Item Number	Cronbach	Variable Name
Factor 1 =	5,13,14,16,18	.78	Clear Mission
Factor 2 =	3,4,7,10,11	.73	Planning Commitment
Factor 3 =	9,21,22	.71	Information Sharing
Factor 4 =	2,8,12,17,23	.79	Push Down Decisions
Factor 5 =	6,15	.74*	Task Teams
Factor 6 =	1,14	.71*	Centralized Decisions

*Indicates correlation between two items.

Overall, Hypotheses 1, 3, and 4 were strongly supported, but Hypothesis 2 was not. Hypothesis 1 posited that higher levels of managerial IT knowledge were directly and positively related to the extent of IT use within an organization. This hypothesis was supported across all three business units sampled within each organization. Hypotheses 3 and 4 predicted that IT management climate will influence both managerial IT knowledge and IT management process effectiveness. Although not uniformly across all variables, these two hypotheses were supported by the findings. Hypothesis 2 argued that IT management process effectiveness influences IT use, but only a small effect was found, and minimal support for this hypothesis is provided.

Limitations of the research methodology

As with all research designs, this study's methodology has both strengths and weaknesses. It is necessary to acknowledge these weaknesses, if only to ensure that the

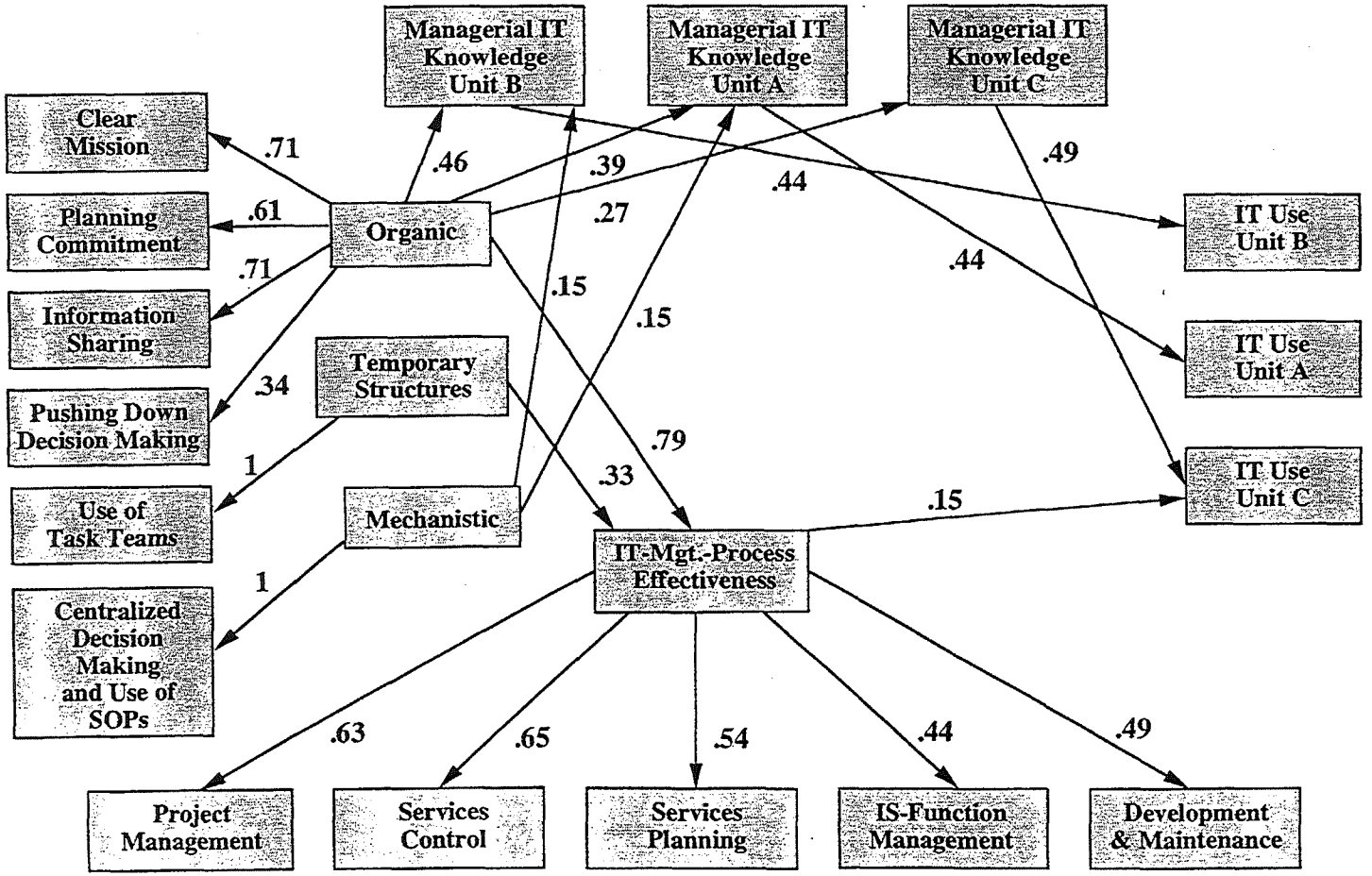


Figure 3. Model After Theory Trimming

study's results can be placed in an appropriate context as well as to enable future research to improve upon the present design.

As defined by Phillips (1981), the key informant method, i.e., interviewing one or more respondents chosen because they have special qualifications, is an effective means for collecting information about a social system. Campbell (1955) identifies two such criteria: the respondents should occupy roles that make them knowledgeable about the issues being researched; and they should be able and willing to communicate with the researchers. We opted to use a senior IT executive as a single, key informant within a firm because we had access to such individuals and because we felt such a strategy would enable us to achieve a greater and more diverse sample size. The size and nature of the sample of responding firms was critical, given the necessity to develop and validate new instrumentation and our analysis strategy. However, cogent arguments can be made that a study of this nature should pursue multiple informants. Not including user manager views in our assessment of absorptive capacity prevented us from capturing important data regarding user manager IT-related knowledge and exchanges with their IS manager counterparts. Ideally, future research into absorptive capacity should attempt to avoid this methodological pitfall by pragmatically obtaining multiple sources within single organizations.

The sampling frame, i.e., members of GUIDE International, was certainly not random because organizational access constraints precluded full randomization. Moreover, there is a lack of specific information to judge the characteristics of the different business units included in the sample. Differences in budget size, profitability, strategy, and basic technology could have significant effects on the outcome variable of interest in this study and present problems in generalizing the results to other organizations. Also, it would certainly have been preferred if our sample size had been higher. Although the response rate certainly falls within acceptable levels for survey research, the overall sample size for the factor and LISREL analyses is such that its acceptability borders on the debatable.

Common method variance may also be a problem. All data were collected from single sources through questionnaires. However, factor analyses did not suggest that the variables had a common source.

Our analysis strategy eliminated certain IT-management-process effectiveness factors based on the results of earlier analysis of this data set. This decision was made in the interest of parsimony and our understanding of the data set. Still, the study's findings should be interpreted with this in mind.

Finally, our decision to measure IT management climate at the organizational level rather than the subunit or departmental level could also be criticized. This decision may result in the hiding of variance that occurs in IT management climate within the firm across subunits or departments. However, given the importance of this construct in our theoretical model and the fact that the construct has not previously been measured, the organizational level of analysis was an acceptable starting point. And, as was stated earlier, we are convinced that at the time of data collection (1986) an organization's IT management climate was largely determined by actions and behaviors of the corporate information technology group.

Theoretical and Practical Implications

Absorptive theory, with its focus on organizational know-how and its exchange, does appear to offer specific and promising avenues for future research about IT innovation behavior (Cohen and Levinthal, 1990). Our findings clearly indicate that managerial IT knowledge is crucial for bringing about high levels of IT use within business units. As conjectured, managerial IT knowledge apparently does facilitate the rich information exchanges and joint problem solving among IT and line managers that are critical in enabling an organization to move beyond the more obvious IT applications toward applications that provide "higher-order" business value. But how does absorptive capacity facilitate IT usage? And what practices develop and unleash an organization's IT-related absorptive capacity?

This study's findings, the theoretical insights of absorptive capacity, and the practitioner research asserting the critical role played by proactive IT managers and their relationships with line

managers in promoting the effective use of IT (Henderson, 1990; Rockart, 1988) all converge on a single overriding issue: higher levels of IT use require the *synergistic combining* of IT-related and business-related knowledge. Future research developing a rich understanding of mechanisms for accomplishing such intertwining are thus needed, as are associated prescriptions for managerial action. In particular, such research must heed Attewell's (1992) recognition of the necessity of incorporating knowledge exchanges with external constituents, such as IT vendors, into research models examining IT use.

The exchange of information among IT providers (both internal and external) and line managers is as important in creating opportunities to leverage IT as is the role of overlapping information/knowledge exchanges for product and process innovation (Nonaka, 1989; 1991). Kenney and Florida (1988), in their discussion of Japanese firms and consequences of knowledge overlap and information exchange among managers, propose that it is precisely such knowledge overlap that leads to the continually learning organization. Learning is fostered by the ability of managers to discuss problems or opportunities effectively, exchange information openly, and possess a sufficient common degree of understanding about the information to be able to jointly work together toward common ends.

Unleashing an organization's absorptive capacity also appears to require an IT management climate within which IT and line managers have broad freedom, e.g., fabricated through organic climatic elements and the resultant informal interactions among IT and line managers, to apply their personal know-how and expertise in new and creative ways but which also provides sufficient direction, e.g., fabricated through mechanistic climatic elements, to appropriately focus this creativity. However, it is important to note that managerial IT knowledge proved to be a significant determinant of IT use for all three business units (unit A, unit B and unit C), whereas IT-management-process-effectiveness was a significant determinant of IT use for only that business unit (unit C) receiving the smallest proportion of IT services. It is perhaps not surprising that availability of formal IT management processes would be most beneficial to such business units.

Taken together, these suggest that an organization, when fabricating its IT infrastructure, might best err in favor of emphasizing the development of an effective state of managerial IT knowledge rather than an effective set of IT management processes. Most organizations, however, have historically tended to move in the opposite direction. Similarly, our findings suggest that an organization, in order to facilitate higher levels of IT use, might best err in favor of emphasizing the fabrication of an organic IT management climate rather than a mechanistic one. Again, however, many organizations have historically tended to move in the opposite direction.

Conclusion

This study is an initial attempt to conceptualize and empirically understand the complex relationships among managerial IT knowledge, IT management processes, and IT management climate regarding their influence, both individually and jointly, on IT use. The study's findings are encouraging and provide theoretical and practical insights into the complex realm of successful IT management. The findings also indicate that the theoretical notions surrounding the construct of absorptive capacity may prove to be important in efforts to develop our understanding of IT management practice and IT use.

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Appendix A

This appendix lists the items used in the instruments assessing management push-pull relations.

IS-Manager Knowledge	a. How informed is your IS management team about business operations of each unit?
	b. How informed is your IS management team about business strategies of each unit?
Line-Manager Knowledge	c. In your view, to what extent does each unit's management team recognize the potential of IT as a competitive weapon?
	d. In your view, to what extent does each unit's management team recognize IT as a tool to increase the productivity of clerical employees?
	e. In your view, to what extent does each unit's management team recognize IT as a tool to increase the productivity of professional employees?

Items	**Cue**
c d e	no extent (1), little extent (2), some extent (3), great extent (4), very great extent (5)
a b	not (1), a little (2), somewhat (3), greatly (4), very greatly (5)

Managerial IT knowledge was created by creating an interaction vairable

$$(a+b) \times (c+d+e).$$

Appendix B
Climate Survey

Circle the number which best represents your feelings.

CLIMATE OF YOUR **IS** GROUP

1. Decision making in our IS group tends to occur in a decentralized manner.

Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
1	2	3	4	5

2. In our IS group, operating rules and standard procedures play important roles in how decisions are handled.
3. Planning is seen as high-priority responsibility in our IS group.
4. Identifying ways to serve the enterprise with new information products and services occupies a considerable amount of our IS group's time.
5. Managers of different departments in our IS group seldom have conflicting goals and objectives.

6. Task forces are frequently used by our IS group to handle critical issues.
7. Our IS group dedicates a considerable amount of its resources to planning efforts.
8. Existing procedures and guidelines hinder individuals in our IS group from trying out new ideas.
9. Ideas tend to flow horizontally as well as vertically throughout our IS group.
10. The pressures that arise in handling day-to-day tasks keep our IS group from planning for its future.
11. Innovation is seen as being closely tied to the degree of success or failure of our IS group achievements.
12. There tends to be disagreement over important issues between the managers of the different departments in our IS group.
13. Decision-making responsibilities in our IS group are pushed down to the lowest possible level.
14. Our IS group often uses temporary teams in resolving problems that arise.
15. There is a strong feeling in our IS group that a common purpose exists.
16. Individuals in our IS group rely on formal lines of authority when handling important issues.
17. Managers within our IS group tend to disagree on the overall mission of IS within the enterprise.
18. The various departments within our IS group often seem to be moving in different directions.
19. Our IS group explicitly rewards individuals of departments for generating new ideas.
21. Individuals in our IS group rarely establish informal contacts with people outside of their own departments.
22. In our IS group, managers of different departments meet frequently to discuss important issues.
23. The large number of people that tend to get involved with important issues slows down the decision-making process within our IS group.