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AN EXAMINATION OF MANAGERIAL STRATEGIES FOR INCREASING INFORMATION TECHNOLOGY PENETRATION IN ORGANIZATIONS

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ABSTRACT

This paper describes an empirical study comparing two competing perspectives for explaining information technology (IT) penetration in organizations. IT penetration is defined as the extent to which IT is embedded within an organization's strategic, managerial, and operational work systems. With the first perspective, IT penetration is hypothesized to be related to the implementation of a comprehensive set of management processes for the information systems (IS) function. With the second perspective, IT penetration is hypothesized to be related to the effectiveness of IT-related interactions among an organization's managers.

To strengthen the study's research design, the hypotheses are examined separately across two samples of organizations. Senior IS executives completed the study's research instrument. Respondents in the first sample represented 132 large organizations across a variety of industries, while the respondents in the second sample represented 44 business units within a large, high technology firm. IT penetration and IT-related managerial interactions were measured at a subunit level, while IS management processes were measured at an organizational level. The study's findings supported the research hypotheses.

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Information technology (IT) is increasingly being applied to a broad range of operational, managerial, and strategic tasks in most organizations. Still, few organizations have been able to demonstrate consistent success applying IT, and wide variances in success can be observed across organizations. One possible explanation for this varying success lies with an organization's approach toward IT management, defined here as all managerial efforts associated with planning, organizing, controlling, and directing the introduction and use of IT within an organization.

While articles on IT management regularly appear in the popular, managerial, and research literature, much of this material is prescriptive in nature, anecdotal descriptions of IT management successes and failures, or both. Rigorous research has contributed very little to our understanding of the relationships between IT management strategies and the successful use of IT in organizations. Aside from a few exceptions, the IS research community has failed to provide a solid theoretical base from which to study IT management issues. The most popular theoretical notion, Nolan's Stage Hypothesis

(Nolan 1973, 1979), has been soundly criticized from a theoretical perspective (King and Kraemer 1984) and has gained little empirical support (Benbasat, et al. 1984). The other major theoretical framework, that evolving out of the work at the University of California at Irvine (King and Kraemer 1985), is still in its formative stages and has been targeted primarily at public sector organizations, which may not be generalizable to private, for-profit organizations.

The objective of this paper is to generate an improved understanding of the relationship between IT management practices and organizational success in applying IT. Here, success in applying IT is viewed as the degree to which IT has been embedded within an organization's strategic, managerial, and operational work systems (Zmud and Apple 1987). Henceforth, this is referred to as *IT penetration.*

To meet this objective, the paper first presents the two competing perspectives and develops two research hypotheses. The study's methodology and findings are then described. Finally, the implications of these findings are discussed.

PERSPECTIVES ON IT MANAGEMENT

Two perspectives are proposed regarding the manner in which IS managerial efforts affect IT penetration within organizational subunits.

A First Perspective

An IS function has evolved in most organizations as the major provider of IT products and services. Historically, this occurred for three main reasons: few general managers felt comfortable dealing with either the technology or with vendors; the initial high cost of IT resources focused senior management's attention on efficiency concerns, thus encouraging IT specialization; and, economies-of-scale encouraged the centralization of IT operations and services. As a result, IT managerial issues tended to be viewed as distinct from other management issues, and the information system function grew such that it tended to be loosely connected to other organizational subunits (Lucas 1984; Saunders 1986).

Within the IS literature, IT managerial issues have historically been framed as being relevant only within the confines of the IS function. Changes have been recognized regarding the organizational roles served by this IS function, such that the initial "manufacturer" role has been supplemented with "distributor" and "broker" roles (Zmud 1984b). Still, this first perspective firmly holds the view that the IS function maintains primary control of and influence over IT penetration. By adopting such a perspective, greater IT penetration should be observed in those organizations whose IS function has developed and installed a rich set of processes for planning, organizing, controlling, and directing the introduction and use of IT.

A Second Perspective

Despite the crucial role served by the IS function in most organizations, examinations of IT-intensive firms indicate that subunits across these organizations are positioning themselves closer, both physically and managerially, to their IT resources (Benjamin, Dickson and Rockart 1985; Gerrity and Rockart 1986; Keen 1981). Such dispersion of IT resources and decision making responsibilities to managers throughout an organization can be explained, at least in part, via Thompson's (1967) predictions regarding the location of organizational components and the nature of subunit interdependencies:

> The thrust of Thompson's argument is that organizational subunits would act to minimize inter unit coordination costs arising from subunit interdependencies. It seems reasonable to conjecture that much of the dispersal of IT resources and management responsibilities stems from actions taken by subunits to reduce these coordination costs that arise between the IS function, as the provider of IT products and services, and organizational subunits, as users of IT products and services. As IT resources are perceived by subunit managers as becoming relatively less expensive and less difficult to use, subunits are likely to bypass the IS function, thereby avoiding the accompanying coordination costs, by acquiring needed IT products and services on their own. [Boynton and Zmud 1987, p. 61.]

Such an IT organizational context might best be thought of as an *information economy* within the organization (Zmud, Boynton and Jacobs 1986). The information economy metaphor suggests that IT use

can be driven by any of an organization's managers able to recognize and exploit opportunities for applying IT-based products and services.

Interestingly, the theoretical arguments and empirical findings from the innovation and R&D literature reflect a view of the introduction of new technology similar to this second perspective. Because many organizations have already adopted a broad range of IT resources, examining the extent to which IT resources are used across a variety of organizational tasks (e.g., IT penetration) is essentially an examination of post-adoption innovative behavior. Research into the implementation of single information systems borrows extensively from the innovation and organizational change literature (Ginzberg 1979; Keen 1981; Kwon and Zmud 1987). Studies of the determinants of IT penetration would appear to benefit as well from these robust innovation and R&D literature.

In this literature, a "push-pull" paradigm, e.g., the *joint recognition* by technology suppliers and users of an organizational need and a technology that promises to meet this need, has been found theoretically useful in explaining technology transfer and diffusion (Zmud 1984a). We believe "push-pull" theory to be particularly appropriate regarding IT penetration given the malleability of IT resources. Thus, an organization's success in achieving a high level of IT penetration is posited to result through the combined efforts of (1) the organization's IS managers "pushing" (marketing) IT products and services to general managers and (2) the organization's general managers "pulling" (requesting) IT products and services into their subunits. This second perspective thus proposes that there should be greater IT penetration in those organizations characterized by frequent IT-related interactions among all of an organization's managers, including those within the IS function.

THE RESEARCH MODEL

The research model proposed here compares and contrasts two sets of organizational processes, each representing a perspective on IT management, that explain variation in organizational IT penetration:

Perspective 1 — A well-developed set of IS management processes is crucial to organizational efforts to attain high levels of IT penetration.

Perspective 2 — A well-orchestrated set of IT-related managerial interactions is crucial to organizational efforts to attain high levels of IT penetration.

Figure 1 portrays this model, illustrating the relationships among its major constructs: IT penetration, IS management processes, and IT-related managerial interactions. Each of these constructs are defined below.

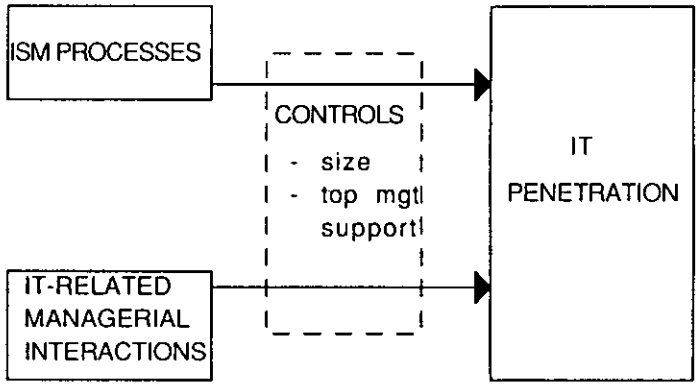

Figure 1. Research Model

IT Penetration

As stated earlier, IT penetration refers to an organization's overall success in embedding IT within its work systems. One means of conceptualizing IT penetration makes use of Anthony's (1965) framework, one of the most enduring frameworks in the IS literature. Adopting this framework, IT penetration is assessed by examining the extent to which IT is being applied to an organization's operational control, managerial control, and strategic planning activities. An additional aspect of IT penetration not captured through Anthony's framework involves IT applications directed at gaining competitive advantage (Ives and Learmonth 1984; Wiseman 1985). Thus, IT penetration is defined here as the extent to which an organization has applied IT for operational control, managerial control, strategic planning, and competitive thrust applications.

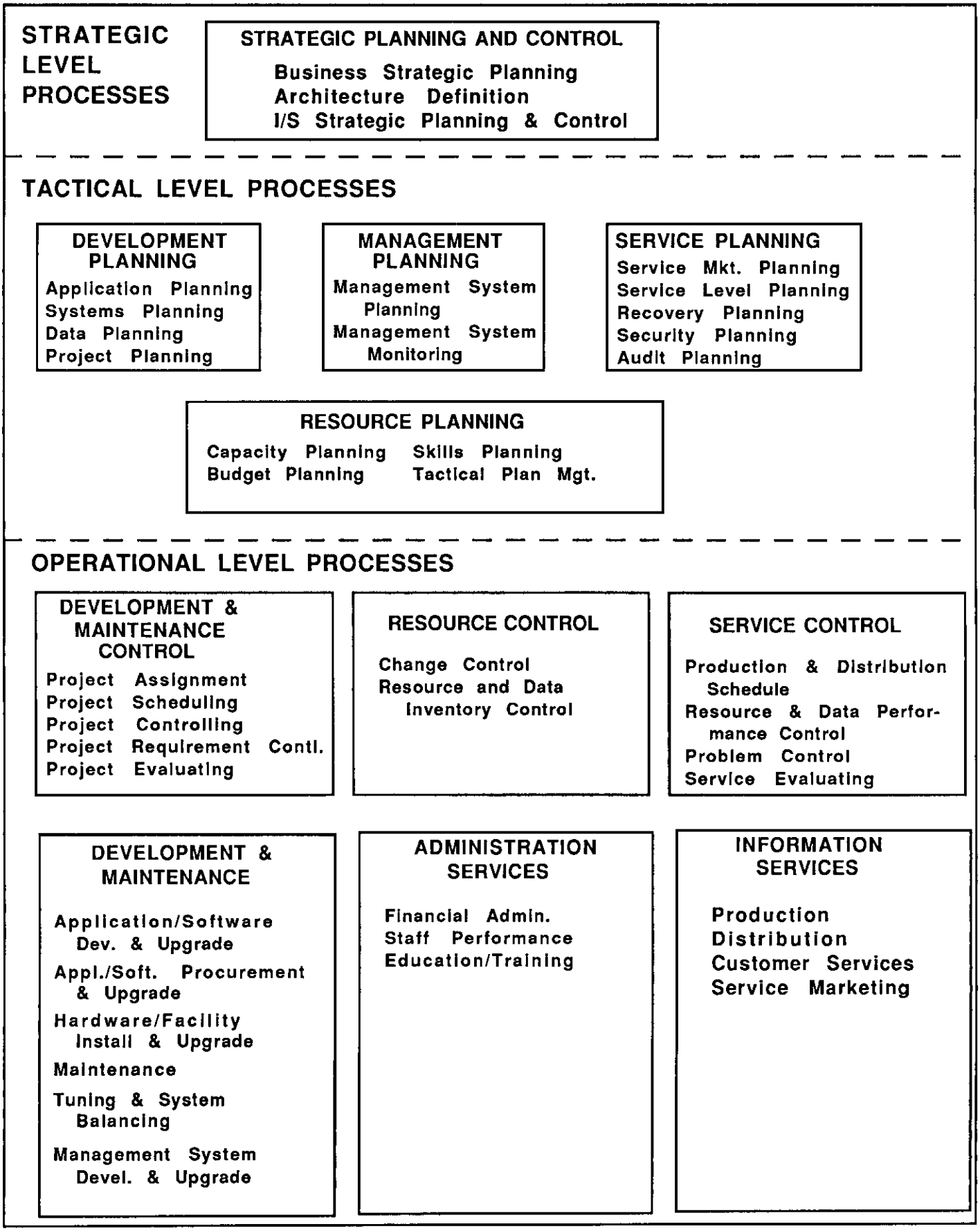

Figure 2. Information Systems Management Processes

Information Systems Management Processes

A research program begun by IBM in 1979 has developed a set of eleven IS management (ISM) process groups which together form a comprehensive model of the management activities undertaken by an organization's IS function (Van Schaik 1985). Each ISM process group consists of a number of management activities associated with managing an organization's IS function (see Figure 2). Although not conducted in a manner consistent with the guidelines imposed by the rigorous scientific research, we believe the results of the IBM research program to be of high face and content validity. These results provide a solid baseline for more rigorous research into IT management issues. Thus, the state of development of an organization's IS management processes is defined here as the extent to which the organization has effectively implemented the management activities included within the eleven ISM process groups.

IT-Related Managerial Interactions

While the "push-pull" theory has not yet received substantial empirical validation, an awareness of the conditions that operate to bring together organizational needs and appropriate technological solutions does exist. Two factors believed to be crucial in developing such conditions are (1) the perceptions held by an organization's managers regarding a new technology and (2) intra-organizational information flows regarding the new technology.

Three attributes of a new technology are consistently found to be associated with successful adoption behaviors (Tornatzky and Klein 1982). Put simply, managers are more likely to adopt new technologies when they perceive the technologies as:

- o possessing a relative advantage over current procedures as well as competing alternatives
- o not being too complex for the adopting unit
- o being compatible with existing operations and strategies

Exactly how are accurate perceptions regarding new technologies developed?

A well-supported observation of the technology diffusion and R&D literature indicates that information about new technologies enters organizations through a two-step process (Allen 1977; Fischer 1980; Rogers 1983). Technical gatekeepers serve as the channels through which information on new technologies is transmitted to those individuals with the authority or influence to introduce technological solutions into organizational work systems. IS managers clearly serve such a role with IT in most organizations. How do these technical specialists become knowledgeable about organizational operations and strategies so that they can act as gatekeepers? It is likely that a reverse two-step process occurs in which line managers transmit relevant information to IS managers. Moreover, the better the relations between these two groups of managers, the more likely both of these learning processes will occur.

An organization's IT-related managerial interactions can thus be measured by three variables: the *quality of the relations* between IS managers and line managers, the *knowledge that IS managers possess* regarding organizational activities, and the *knowledge that general managers possess* regarding the potential and value of IT.

Research Hypotheses

Based on the proceeding discussion, the following hypothesis is made:

Hypothesis 1: The relationship between an organization's IT-related managerial interactions and IT penetration will be stronger than that between the organization's IS management processes and IT penetration.

The study also provides an opportunity to test the "push-pull" theory by examining the effects of IS manager and general manager knowledge:

Hypothesis 2: A variable combining the knowledge that IS managers possess of organizational activities and the knowledge that general managers possess of IT has a stronger relationship with IT penetration than the relationships between IT penetration and IS manager knowledge, general manager knowledge, or the quality of the relations between IS management and line management, where each is represented as a single variable.
In other words, in this second hypothesis, we predict that IT penetration will be greatest in those organizations where the potential for "push-pull" dynamics to occur is highest, i.e., where IS managers are knowledgeable about the organization's

operations and strategies and general managers are knowledgeable about the potential and value of IT.

Control Variables

Two factors often found to be associated with technology adoption decisions, organizational size and top management support, are incorporated within the research model as control variables. Organizational size is viewed as a proxy variable for organizational specialization and slack. Larger organizations generally have access to more and higher quality resources (equipment and staff) and can afford to bear higher risks with new investments. Where top management is supportive of new technology initiatives, projects tend to be given sufficient resources, higher risk projects are undertaken, and the organizational reward system is likely to encourage behaviors consistent with those necessary to achieve project success.

METHODOLOGY

The research design and data collection procedures used in this study were chosen to test the hypotheses in a field setting. In order to increase both the richness of the study and the generality of findings, two samples of organizations were identified. Analyzing each sample separately in testing our research hypotheses provides a much stronger test of the research model than would be the case if one sample were used.

The first sample, referred to as Sample 1, consisted of firms belonging to GUIDE International, a professional association of firms operating large computer systems manufactured by IBM Corporation. Questionnaires were mailed to 365 firms across a variety of industries. One hundred thirty-two completed questionnaires were returned, for a response rate of 36%.

The second sample, referred to as Sample 2, consisted of geographically-dispersed IS groups within one large, high-technology firm. Each IS group and the division it supports were treated as separate organizations in the study. Of the 60 IS groups contacted, 44 returned completed questionnaires, for a response rate of 73%.

Unit of Analysis

It is both difficult and inappropriate to either define or operationalize many constructs at an organizational level of analysis. Organizations are usually composed of multiple work systems, with the subunits characterized by differing structures, management processes, cultures, goals, and environments (Scott 1981). This is particularly true for large, complex organizations such as those sampled in this study. Because of this, we believe that IT penetration and IT-related managerial interactions (e.g., IS manager knowledge, general manager knowledge, and manager relations) are more accurately assessed at a subunit level of analysis.

Within each organization, the three business units receiving the largest amount of IS services and support from the IS function were identified. These business units are referred to as units A, B and C. On average in Sample 1, unit A received 38% of these IS services and support, unit B, 23%, and unit C, 14%. On average in Sample 2, unit A received 48% of these IS services and support, unit B, 26%, and unit C, 13%.

The state of development of an organization's IS management processes were measured at an organizational level of analysis, e.g., in terms of the corporate IS group. This decision was based on discussions with practitioners who felt that the management processes implemented by corporate IS groups address organization-wide concerns rather than those of specific subunits. Similarly, the study's control variables were measured at an organizational level of analysis.

Procedure

The research instrument was mailed to the senior IS executive in each organization. The limitations of using a single source to represent a company's position is well recognized. This problem was resolved in part by asking the individual primarily responsible for the organization's IT-related activities, the senior IS executive, to respond to the questionnaire. In most organizations, the senior IS executive would be expected to be the most knowledgeable individual in the organization regarding the study's research issues. Also, in order to tap alternative perspectives, the senior IS executive was encouraged to complete the instrument at a staff meeting attended by other IS managers. Follow-up communications with a number of respondents indicated that this did occur at many sites. In other cases, the instrument was completed by the senior executive or by a member of this executive's senior staff. It was not possible to

compile a definitive breakdown of how respondents completed the questionnaire.

To help ensure the face validity of the instrument, we included practitioners extensively during the instrument design process. In addition, the study received substantial support from GUIDE International (Sample 1) and from senior executives in the high technology manufacturer (Sample 2). We believe that the instruments' high face validity (supported retrospectively in communications with a number of respondents) and this strong support provided respondents with sufficient motivation to complete the questionnaire in an accurate manner.

Instrument Construction and Assessment

Since most of the constructs involved with our research model have not previously been empirically examined, developing the study's measures became a major undertaking. Accordingly, we applied a variety of instrument analysis techniques to assess the reliability and construct validity of these measures. Descriptive statistics (see Table 1) indicate that no major ceiling or floor effects are present. This is important given that many of the questions address potentially sensitive issues. Also, the range in responses to these questions indicates that the respondents provided what often were self-critical appraisals of their organizations. Additional support for the validity of these measures can be seen from the values within a construct. In most cases, higher values are obtained where expected. For example, greater IT penetration is observed with cost reduction and management support applications than is observed with strategic planning and competitive thrust applications. The scales used to measure each of the study's constructs are now described.

IT Penetration. A four-item scale was used to assess subunit IT penetration:

- **Cost Reduction:** Information systems developed to reduce the cost of a business's activities.
- **Management Support:** Information systems developed to assist managers in monitoring, controlling, and planning a business's activities.
- **Strategy Planning:** Information systems developed to assist managers in formulating strategies.
- **Competitive Thrust:** Information systems developed to establish a competitive advantage in the market place.

Specifically, respondents were asked to rate the three subunits' use of each type of information system on a five-point scale: no use at all (1), just starting (2), used to some extent (3), used to a great extent (4), "industry leader" in this area (5).

Factor and correlational analyses on each item were performed at the subunit level for both samples. No stable patterns were observed. As a consequence, these four items were not aggregated into a single dependent variable for IT penetration.

IS Management Processes. The extent to which each IS group had implemented the 42 ISM activities defined by the IBM research project was assessed by having respondents indicate, on a five-point scale, if an activity was not implemented (1), partially implemented but not that effective (2), partially implemented and effective (3), fully implemented but not that effective (4), fully implemented and effective (5). Detailed descriptions (Van Schaik 1985) of the ISM activities were provided to the respondents, an example of which follows:

PROCESS #1 BUSINESS STRATEGIC PLANNING

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

- Define IS mission based on enterprise mission and objectives.
- Define IS policies.
- Define business processes, information and information flow of the enterprise (including IS).
- Define enterprise requirements for information (including IS) through the strategic time period.

Factor analysis was used to examine the validity of the original grouping of these 42 management activities (Van Schaik 1985) and to develop the

Table 1. Descriptive Statistics of Study Measures

	SAMPLE 1		SAMPLE 2		
sample size	122		44		
	Mean	SD	Mean	SD	Significance Level
IS Management Processes					
Project Management	3.91	.79	3.85	.82	
Strategic Planning	2.79	.87	3.16	.96	*
Services Control	3.06	.80	3.78	.87	***
Services Planning	2.96	.76	3.49	.81	***
Resource Planning	3.16	.88	3.98	.85	***
IS Function Management	2.81	.88	3.15	.98	*
IS Services	4.07	.85	4.00	1.03	
Development & Maintenance	3.57	.81	4.07	.74	***
IT-Related Managerial Interactions					
Unit Pull (A)	3.46	.70	3.81	.83	**
Unit Pull (B)	3.40	.67	3.74	.77	**
Unit Pull (C)	3.28	.81	3.66	.81	*
Relations (A)	3.55	.65	3.25	.57	**
Relations (B)	3.53	.63	3.28	.62	*
Relations (C)	3.46	.67	3.37	.62	
IS Push (A)	3.73	.79	3.67	.75	
IS Push (B)	3.54	.77	3.45	.70	
IS Push (C)	3.37	.84	3.14	.69	
CONTROL VARIABLES					
IS Headcount	411	768	646	1085	
Level of IS Exec	1.94	.61	2.00	1.00	
Top Mgt Relations	3.48	.65	3.43	.67	
DEPENDENT VARIABLES					
Cost Reduction (A)	3.41	.88	3.70	.75	
Cost Reduction (B)	3.38	.94	3.65	.72	
Cost Reduction (C)	3.15	1.01	3.34	.78	
Management Support (A)	3.40	.82	3.65	.70	
Management Support (B)	3.50	.80	3.55	.71	
Management Support (C)	3.46	.77	3.65	.78	
Strategic Planning (A)	2.30	.87	2.75	1.08	**
Strategic Planning (B)	2.40	.97	2.60	.98	
Strategic Planning (C)	2.40	.97	2.82	1.16	*
Competitive Thrust (A)	2.89	1.30	3.04	1.43	
Competitive Thrust (B)	2.45	1.33	2.60	1.33	
Competitive Thrust (C)	2.52	1.29	2.40	1.35	

* = .05
** = .01
*** = .001

measures to be used in assessing Hypothesis 1. Because of the large number of activities to be factor analyzed, the two samples were combined. The results of this factor analysis (shown in Table 2) produced eight factors, each consisting of from 4 to 9 activities, similar to the original ISM process groups. These eight factors were then used as the variables representing an organization's IS management processes (see Table 2).

IT-Related Managerial Interactions. Three scales were constructed to assess the IT-related managerial interactions for each subunit: managerial relations, IS manager knowledge of each unit ("IS push"); and, unit manager knowledge of the potential and value of IT use ("unit pull"). A "push-pull" variable was then created by calculating the product of the variables representing "IS push" and "unit pull." The items used to assess each of these variables are given in Appendix A.

Analyses were conducted at a subunit level of analysis for each organization across the two samples of organizations. Three factor analyses were applied to confirm the construct validity of the scales for Sample 1, for Sample 2, and for a data set composed of both samples. As can be seen in Table 3, quite consistent response patterns are observed for these IT-related managerial interaction items. While differences do arise with factor loadings and with specific item/factor pairings, the items representing specific variables consistently load together. (The last two items given in Table 3 were included to assess "unit dependency on IT," a construct not utilized in our final research model. Including these items in the factor analysis stabilized the factor structures.) Additional evidence of acceptable convergent and divergent measurement properties is provided through the mono-method multi-trait analysis reported in Table 4, which also reports scale reliabilities using coefficient alpha.

Control Variables. The head count of the IS group, as reported by respondents, was used to represent organizational size. While there was considerable variance in this measure (see Table 1), the mean value for IS head count indicates that these are large organizations with large IS groups.

Two scales were used to represent top management support for IT. First, respondents were asked to indicate the number of reporting levels separating a firm's senior information executive and its chief executive officer. Second, five items, listed in Appendix A, were used to construct a scale representing the favorableness of the relations between a firm's senior IS managers and its senior executives. A factor analysis resulted in all five items loading on a single factor. Coefficient alpha values for Samples 1 and 2, respectively, were .78 and .83.

Analysis Strategy

The following analysis strategy was undertaken in testing Hypothesis 1:

1. Stepwise regressions were run to determine the set of IS management processes that most significantly explained variation in the four IT penetration measures.

2. Stepwise regressions were run to determine the set of IT-related managerial interactions that most significantly explained variation in the four IT penetration measures.

3. Hierarchical regressions were run for each IT penetration measure with the independent variables being entered in the following order: the control variables, the significant IS management processes identified in Step 1, and the significant IT-related managerial interactions identified in Step 2.

4. Hierarchical regressions were run for each IT penetration measure with the independent variables being entered in the following order: the control variables, the significant IT-related managerial interactions identified in Step 2, and the significant IS management processes identified in Step 1.

5. The final regression model used to explain variance in each IT penetration variable was selected from either the model obtained in Step 3 or Step 4, depending on which explained the greater amount of variance in IT penetration with the variable set entering immediately after the control variables.

If Step 3 produced the final regression model, the IS management process variables had the greater effect on IT penetration. If Step 4 produced the final regression model, the IT-related managerial interactions had the greater effect on IT penetration.

Table 2. Resultant Factor Structure for the ISM Process Scales

Factor	Eigen Value	Sample 1 Reliability	Sample 2 Reliability	Item	Loading
Project Management	3.71	.84	.87	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 Planning	3.41	.81	.83	business strategic planning	.68
				architecture definition	.79
				IS strategic planning and control	.75
				data planning	.64
				systems planning	.43
Services Control	3.13	.80	.86	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	.76	.81	service market planning	.51
				skills 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	.77	.78	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	.66	.80	product and distribution scheduling	.49
				hardware and facility installation	.52
				production	.75
				distribution	.75
IS Function Management	2.67	.72	.77	tactical plan management	.42
				management systems planning	.72
				management systems monitoring	.60
				management systems development	.60
				staff performance	.52
Development & Maintenance	1.81	.62	.51	audit planning	.46
				application software development	.40
				maintenance	.64
				tuning and systems balancing	.42

Table 3. Factor Analyses of IT-Related Managerial Interaction Scales

	Sample 1 Factors			Sample 2 Factors			Combined Factors		
(a) Unit A									
IS knows unit's operations	.73	.27	.23	.38	-.14	.73	.66	.23	.30
IS knows unit's strategies	.67	.15	.30	.18	.05	.80	.60	.15	.39
Communication problems	.77	-.03	-.07	.19	.60	-.12	.74	-.00	-.09
Satisfied with relations	.76	.19	-.16	.08	.87	.03	.81	.10	-.15
Unit mgt evaluation of IS	.76	.20	.04	.17	.81	-.03	.74	.18	.02
IT as competitive weapon	.22	.68	.11	.63	.47	.25	.32	.64	.07
IT for clerical productivity	.23	.57	-.01	.71	-.05	.16	.19	.61	.02
IT for professional product	.03	.77	-.26	.79	.37	-.14	.02	.81	-.20
Pressure for IT integration	.05	.53	.15	.65	.29	-.01	-.00	.72	.14
Impact of one hour shutdown	.04	.11	.83	-.27	-.06	.63	-.03	.09	.84
Impact of two week shutdown	.05	-.07	.85	-.49	.47	.49	.04	-.09	.82
(b) Unit B									
IS knows unit's operations	.84	-.08	.17	.36	.27	.75	.80	-.03	.22
IS knows unit's strategies	.71	.07	.30	.30	.02	.72	.66	.07	.32
Communication problems	.62	.27	-.21	.11	.75	.08	.67	.19	-.20
Satisfied with relations	.71	.41	-.17	.09	.77	.09	.76	.25	-.20
Unit mgt evaluation of IS	.63	.35	.08	.04	.81	-.03	.61	.33	.05
IT as competitive weapon	.19	.44	.37	.31	.58	.12	.28	.44	.25
IT for clerical productivity	.35	.73	-.07	.85	.13	-.08	.31	.74	-.13
IT for professional product	.16	.82	.01	.79	.21	-.15	.13	.85	-.02
Pressure for IT integration	-.02	.54	.30	.66	.13	.24	-.00	.64	.26
Impact of one hour shutdown	-.03	.07	.84	-.28	.01	.73	-.03	.10	.84
Impact of two week shutdown	.09	.07	.74	-.35	.06	.56	.07	.06	.76
(c) Unit C									
IS knows unit's operations	.71	.11	.33	.72	.09	.15	.71	.10	.24
IS knows unit's strategies	.56	.37	.46	.65	-.27	.39	.60	.25	.39
Communication problems	.19	.75	.04	.10	.71	.02	.20	.72	.02
Satisfied with relations	.22	.82	.18	.28	.71	-.05	.24	.80	.13
Unit mgt evaluation of IS	.11	.82	.05	.09	.77	.25	.11	.88	.09
IT as competitive weapon	.45	.36	.21	.65	.27	-.20	.52	.30	.11
IT for clerical productivity	.82	.17	-.01	.68	.14	.12	.81	.14	-.00
IT for professional product	.75	.34	-.13	.72	.21	.19	.75	.29	-.06
Pressure for IT integration	.69	.04	.14	.69	.23	.12	.66	.06	.17
Impact of one hour shutdown	-.01	.08	.86	.01	.15	.89	.03	.08	.86
Impact of two week shutdown	.22	.09	.80	.35	.04	.63	.25	.07	.80

Table 4. Results of Mono-Method Multi-Trait and Reliability Analyses for IT-Related Managerial Interaction Scales.

Scale	Relations	IS Push	Unit Pull
(a) Unit A			
Relations	----	.46***	.26***
Communication problems	.80***	.42*	.16*
Satisfied with relations	.88***	.36***	.25***
Unit mgt evaluation of IS	.74***	.36***	.30***
IS Push	.46***	----	.30***
IS knows unit's operations	.44***	.86***	.31***
IS knows unit's strategies	.39***	.92***	.25***
Unit Pull	.31***	.31***	---
IT as competitve weapon	.30***	.35***	.73***
IT for clerical productivity	.21***	.23***	.62***
IT for professional productivity	.14	.09	.75***
Pressure for IT integration	.07	.18*	.73***
Reliability (Sample 1)	.75	.75	.62
Reliability (Sample 2)	.75	.70	.76
(b) Unit B			
Relations	----	.81***	.31***
Communication problems	.84***	.33***	.25***
Satisfied with relations	.88***	.42***	.34***
Unit mgt evaluation of IS	.66***	.34***	.36***
IS Push	.44***	----	.31***
IS knows unit's operations	.46***	.88***	.23***
IS knows unit's strategies	.34***	.91***	.32***
Unit Pull	.37***	.32***	----
IT as competitive weapon	.29***	.27***	.62***
IT for clerical productivity	.39***	.29***	.71***
IT for professional productivity	.32***	.16*	.77***
Pressure for IT integration	.10	.17*	.72***
Reliability (Sample 1)	.75	.74	.62
Reliability (Sample 2)	.75	.78	.73
(c) Unit C			
Relations	----	.40***	.45***
Communication problems	.82***	.29***	.34***
Satisfied with relations	.87***	.37***	.43***
Unit mgt evaluation of IS	.70***	.29***	.32***
IS Push	.40***	----	.57***
IS knows unit's operations	.30***	.88***	.51***
IS knows unit's strategies	.41***	.91***	.51***
Unit Pull	.45***	.57***	----
IT as competitive weapon	.36***	.43***	.66***
IT for clerical productivity	.35***	.49***	.78***
IT for Professional productivity	.41***	.42***	.82***
Pressure for IT integration	.25***	.38***	.74***
Reliability (Sample 1)	.77	.79	.74
Reliability (Sample 2)	.65	.64	.73

* = .05
** = .01
*** = .001

Hypothesis 2 was assessed through the frequency with which the "push-pull" variable, the product of IS management knowledge and general management knowledge, appeared in this final regression model.

RESULTS

Prior to reporting the findings regarding the two research hypotheses, the two samples were compared through the descriptive statistics given in Table 1. The samples are quite similar in terms of the control variables (IS head count and top management support), IT penetration (aside from strategic planning), and IS managers' knowledge of unit activities. However, significant differences do arise with other measures. First, the Sample 2 organizations were further along in their implementation of six of the eight IS management processes variables. The only two IS management processes groups process scales for which comparability was observed, project management and IS services, are very traditional IS management activities. Second, unit managers in Sample 2 were perceived to be more aware of the potential and value of IT use. This is to be expected given that the parent organization is a high-technology manufacturer. Third, higher quality IS/unit relations were perceived to exist within the Sample 1 organizations. A plausible explanation is that the more knowledgeable Sample 2 unit managers are more demanding in their interactions with IS managers.

These findings suggest that the Sample 2 organizations are more experienced in their use of IT and more mature in their management of IT. Such a distinction proved useful in interpreting the study's results.

Evidence Regarding the Research Hypotheses

The results of the hierarchical regression analyses are summarized in Table 5. A total of 24 regression models were estimated, one for each subunit in both samples across the four IT penetration variables. Nineteen of these models proved significant. Detailed results for each model are provided in Appendix B.

Rather large differences can be seen in the amount of variance explained with these models. Two plausible explanations are offered. First, more variance tends to be explained where more variance exists within the dependent variable. Second, the generally larger amount of explained variance with Sample 2 is most likely caused by the smaller sample size and the fact that organizational "culture" was, to a large extent, controlled because these organizations belong to a single parent corporation.

Hypothesis 1. Variables representing IS management processes and IT-related managerial interactions entered into 18 of the regression models (see Table 5). In 15 of these 18 models, IT-related managerial interactions dominated IS management processes (nine of eleven instances with Sample 1; six of seven instances with Sample 2). These findings are very supportive of Hypothesis 1.

Hypothesis 2. As shown in Table 6, the "push-pull" variable was observed to enter the regression models with the highest frequency of the IT-related managerial interaction variables. This was particularly evident with unit A, that subunit obtaining the largest amount of IT services and support, and with Sample 1, the organizations characterized earlier as less experienced and less mature in their management of IT. These findings provide *limited support* for Hypothesis 2.

Discussion

Strong support for Hypothesis 1 is evident. IS management processes infrequently emerged as significant variables. In fact, a negative effect on IT penetration was observed with the two control-oriented IS management processes (services control, and development and maintenance). Interestingly, the more recent application areas, e.g., strategic planning and competitive thrust, which are characterized by both lower IT penetration values and larger variances, seem most effected by the IS management processes variables.

The crucial role of subunit managers in IT penetration is underscored by the frequency with which the "push-pull" and "unit pull" variables appear in the regression models as indicated in support of Hypothesis 1. However, "push-pull" dynamics were observed most frequently with the more established application areas, e.g., cost reduction and management support. This suggests that organizational mechanisms to facilitate such dynamics evolve over time. Also, notice that the "unit pull" and "IS push" variables seem particularly important for competitive thrust applications, given that they appear in five of the six regression models. Organizational mechanisms facilitating "push-pull"

Table 5. Summary of Hierarchical Regression Results[a,b]

SAMPLE 1:	Unit A				Unit B				Unit C			
	CR	MS	SP	CT	CR	MS	SP	CT	CR	MS	SP	CT
R^2	.11	.07	.17	.18	.17	.21	.07	.18	.21	.14	.25	.18
ISM Processes												
Project Management												
Strategic Planning												
Services Control				1-								
Services Planning						2						
Resource Planning												
IS Function Mgt				1					1			
IS services												
Develop & Maint			2-								2-	
IT-Related Managerial Interactions												
push-pull	1	1	1		1							
unit pull											1	1
IS push								1		1		
relations						1						
Controls												
IS headcount					X				X			
CIO level									X		X	
Top Mgt Relations							X	X			X	X

SAMPLE 2:	Unit A				Unit B				Unit C			
	CR	MS	SP	CT	CR	MS	SP	CT	CR	MS	SP	CT
R^2	.41	.42	.60	.46	.05	.25	.21	.25	.19	.14	.25	.44
ISM Processes												
Project Management				2								
Strategic Planning												
Services Control												
Services Planning			1									
Resource Planning												
IS Function Mgt												
IS services												
Develop & Maint												
IT-Related Managerial Interactions												
push-pull		1				1						
unit pull	1			1								1
IS push								1				
relations												
Controls												
IS headcount		X-	X-									
CIO level			X							X		
Top Mgt Relations										X		

[a] A '1' in the body of the table indicates that the variable entered into the regression immediately after any control variable; a '2' indicates the variable entered after those noted with a '1'.

[b] A '-' superscript in the body of the table indicates that the variable has a negative effect on the dependent variable.

Table 6. Frequency that the independent Variables appear in the Regression Models.

		Samples		Units			IT Penetration			
	Total	1	2	A	B	C	CR	MS	SP	CT
ISM Process	8	6	2	5	1	2	1	1	3	3
Project Management	1		1	1						1
Strategic Planning										
Services Control	1	1		1						1
Services Planning	2	1	1	1	1			1	1	
Resource Planning										
IS Function Mgt	2	2		1		1	1			1
IS Services										
Develop & Maint	2	2		1		1			2	
IT-Related Managerial Interactions	15	9	6	6	5	4	3	5	2	5
push-pull	6	4	2	4	2		2	3	1	
unit pull	5	2	3	2			1		1	
IS push	3	2	1		2	3		1		3
relations	1	1			1	1		1		2
Control	13	8	5	3	3	7	3	3	5	2
IS headcount	4	2	2	2	1	1	2	1	1	
CIO level	4	2	2	1		3	1	1	2	
Top Mgt Relations	5	4	1		2	3		1	2	2

dynamics are not apparent for this very recent application area. Finally, the "IS/unit relations" variable appeared only once in the regression models.

It is important to discuss differences between samples to clarify the findings discussed above. With Sample 1, the "push-pull" variable dominated the unit A models while the control variables dominated the models for units B and C. The Sample 2 results differed from the Sample 1 results in two main ways. First, fewer of the IS management processes variables entered the regression models. Second, fewer independent variables entered the unit B and unit C regression models. Such findings suggest that the greater experience and maturity of these organizations, along with their greater homogeneity, may have dampened out certain of the effects of independent variables.

Differences across units A, B, and C were also observed. Generally, the "push-pull" variable was most important for the unit A models while the "unit pull" and top management support variables were most important for the unit C models. This observation is consistent with a political view of organizational computing (King and Kraemer 1985), where facilitating norms, structures, and processes are likely to be directed toward those subunits already receiving substantial IT services and support. Extraordinary effort, such as subunit manager "product championing" or overt top management support, is apparently needed to induce organizational members to direct their

attention toward IT initiatives in lower priority subunits.

LIMITATIONS

Three limitations with the research methodology attenuate the strength of the study's findings. First, the mono-method, single respondent design suggests that biases might well exist within the survey responses. Such a strategy, however, was the only way by which these two samples of organizations could be reached. Given the early stage of this research, we believe the value of a large, diversified set of field sites outweighs the potential bias in responses. Additionally, our analysis of the study's instruments suggests that such biases, where they exist, are minimal. Second, the single-item IT penetration measures are not robust measures of this construct. Alternative measures, however, are lacking. Recognizing the weaknesses of this measure, we limited our interpretation of findings to patterns among the IT penetration variables. Finally, our organizational samples involved large organizations with large, centralized IS groups. These results should not be generalized to other organizational contexts.

CONCLUSIONS

Previous research on IT management has focused on the capability of an organization's IS managers to effectively and efficiently plan, organize, direct and control IT resources and activities. The results of this study suggest that a reorientation in the focus of IT management research is needed: a reorientation toward managing an organization's IT-related managerial interactions, particularly those that occur at a subunit level. As with many other organizational behaviors, it appears that formal and informal maneuverings among influential and knowledgeable individuals are a crucial driving force behind an organizations ability to apply IT in support of business strategies and operations.

Surprisingly, very little is known about IT-related managerial interactions. What exactly is the nature of effective interactions? What are the determinants of such interactions? Which organizational mechanisms are most effective in facilitating such interactions? In particular, what are the relationships among IS management processes and these IT-related managerial interactions? There is much fertile ground available to researchers interested in examining these and related issues.

That IT-related managerial interactions might be a critical factor in explaining interorganizational differences regarding IT penetration should not be that surprising. The technology diffusion and R&D management literature have consistently demonstrated the importance of interpersonal networks in the spread of new technologies. It is through such networks that organizational members learn about new technologies, about opportunities to apply these technologies, and about the support available in efforts to apply the technologies. Similarly, the information systems implementation literature has consistently demonstrated the desirability of user/designer interactions. What is not as easily understood is why this issue has been overlooked in IT management research. Those few IT management studies that have focused on managerial interactions, such as planning and steering committees, have tended to focus on agendas rather than behaviors (Boynton and Zmud 1987). We hope that these results stimulate an interest by the IS research community in undertaking research projects that begin to unravel the organizational processes, and their determinants, that are active within those organizations that consistently achieve high levels of IT penetration.

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APPENDIX A

This appendix lists the items used in the instruments assessing two of the study's constructs: IT-related managerial interactions and top management relations.

IT-Related Managerial Interactions:

Relations	a. Overall, to what extent do your IS managers experience difficulty in getting their ideas across to the managers in each unit?
	b. Overall, to what extent are you satisfied with the relations between your IS management team and the managers within each unit?
	c. In your view how would each unit's senior management evaluate the performance of your IS managers?
IS Push	d. How informed is your IS management team about the business operations of each unit?
	e. How informed is your IS management team about the business strategies of each unit?
Unit Pull	f. In your view, to what extent does each unit's management team recognize the potential of IT as a competitive weapon?
	g. In your view, to what extent does each unit's management team recognize IT as a tool to increase the productivity of clerical employees?
	h. In your view, to what extent does each unit's management team recognize IT as a tool to increase the productivity of professional employees?
	i. In your view, to what extent is there pressure put on your IS management team from each unit to integrate data processing, office automation, and telecommunications technologies?

Items	Cues
a b f g h i	no extent (1), little extent (2), some extent (3), great extent (4), very great extent (5)
c	poor (1), adequate (2), good (3), very good (4), excellent (5)
d e	not (1), a little (2), somewhat (3), greatly (4), very greatly (5)

Top Management Relations:

a. In your view, how would the enterprise's more influential senior managers evaluate the performance of your IS management?
b. In your view, to what extent do the enterprise's more influential senior managers recognize the potential of IT as a competitive weapon?
c. To what extent would you describe yourself as being an active member of the enterprise's senior management team?
d. To what extent would you describe yourself as being an active member of that group of senior managers most influential in setting the enterprise's strategic direction?
e. During the past three months, how often have you met directly with any of the enterprise's more influential senior managers?

Items	Cues
a	poor (1), adequate (2), good (3), very good (4), excellent (5)
b c d	no extent (1), little extent (2), some extent (3), great extent (4), very great extent (5)
e	not once (1), once or twice (2), three to five times (3), six to ten times (4), more than ten times (5)

APPENDIX B

This appendix gives the regression models obtained in testing the research hypotheses.

Table B.1. Sample 1, Unit A

Dependent Variable	Independent Variables	Beta	Model R^2	% R^2
cost reduction			.11*	
	CIO level			
	log (IS headcount)			
	TM relations			
	push-pull	+***		.05
management support			.07	
	CIO level			
	log (IS headcount)			
	TM relations			
	push-pull	+*		.04
strategic planning			.17***	
	CIO level			
	log (IS headcount)			
	TM relations			
	push-pull	+**		.05
	devel. & maint.	-*		.04
competitive thrust			.16***	
	CIO level			
	log (IS headcount)			
	TM relation			
	IS function mgt	+*		.04
	services control	-*		.03

* = .05
** = .01
*** = .001

Table B.2. Sample 1, Unit B

Dependent Variable	Independent Variables	Beta	Model R^2	% R^2
cost reduction			.17***	
	CIO level			
	log (IS headcount)	+*		
	TM relations			
	push-pull	+***		.09
management support			.21***	
	CIO level			
	log (IS headcount)			
	TM relations			
	relations	+***		.15
	services planning	+*		.04
strategic planning			.07*	
	CIO level			
	log (IS headcount)			
	TM relations	+**		
competitive thrust			.18***	
	CIO level			
	log (IS headcount)			
	TM relation	+**		
	IS push	+**		.04

* = .05
** = .01
*** = .001

Table B.3. Sample 1, Unit C

Dependent Variable	Independent Variables	Beta	Model R^2	% R^2
cost reduction			.21***	
	CIO level	+**		
	log (IS headcount)	+*		
	TM relations			
	IS function mgt	+**		.06
management support			.14**	
	CIO level			
	log (IS headcount)			
	TM relations			
	IS push	+**		.10
strategic planning			.25***	
	CIO level	+*		
	log (IS headcount)			
	TM relations	+*		
	unit pull	+***		.11
	devel. & maint.	-*		.03
competitive thrust			.18***	
	CIO level			
	log (IS headcount)			
	TM relation	+**		
	unit pull	+**		.06

* = .05
** = .01
*** = .001

Table B.4. Sample 2, Unit A

Dependent Variable	Independent Variables	Beta	Model R^2	% R^2
cost reduction			.41***	
	CIO level			
	log (IS headcount)			
	TM relations			
	unit pull	+***		.27
management support			.42***	
	CIO level			
	log (IS headcount)	-*		
	TM relations			
	push-pull	+***		.23
strategic planning			.60***	
	CIO level	+***		
	log (IS headcount)	-**		
	TM relations			
competitive thrust			.46***	
	CIO level			
	log (IS headcount)			
	TM relation			
	unit pull	+**		.14
	project mgt	+*		.09

* = .05
** = .01
*** = .001

Table B.5. Sample 2, Unit B

Dependent Variable	Independent Variables	Beta	Model R^2	% R^2
cost reduction			.05	
	CIO level log (IS headcount) TM relations			
	push-pull	+***		.09
management support			.25*	
	CIO level log (IS headcount) TM relations			
	push-pull	+**		.17
strategic planning			.21*	
	CIO level log (IS headcount) TM relations			
competitive thrust			.25*	
	CIO level log (IS headcount) TM relation			
	IS push	+*		.12

* = .05
** = .01
*** = .001

Table B.6. Sample 2, Unit C

Dependent Variable	Independent Variables	Beta	Model R^2	% R^2
cost reduction			.19	
	CIO level log (IS headcount) TM relations			
management support			.14	
	CIO level log (IS headcount) TM relations			
strategic planning			.25*	
	CIO level log (IS headcount) TM relations	+* +**		
competitive thrust			.44***	
	CIO level log (IS headcount) TM relation			
	IS push	+***		.23

* = .05
** = .01
*** = .001