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CREATING BUSINESS VALUE THROUGH INFORMATION TECHNOLOGY: THE EFFECTS OF CHIEF INFORMATION OFFICER AND TOP MANAGEMENT TEAM CHARACTERISTICS

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Abstract

In this research, we examined the effects of (1) business-related and strategic IT-related knowledge of the chief information officer (CIO) and the top management team (TMT) and (2) engagements between the CIO and members of the top management team on firms' success in using information technology (IT) to support their business strategies and value-chain activities. Using a cross-sectional field study of 169 companies, our research found that CIOs with high strategic IT and business-related knowledge enjoyed significantly greater participation in top management teams. Further, CIO's strategic IT and business knowledge and their participation in top management teams influenced their firms' extent of IT deployment in business strategies and value-chain activities. The strength of these relationships was most prominent where firms viewed information technology's role as fundamentally transforming their business processes or industry structure. Further, interestingly, we found no direct impact of the top management team's IT knowledge or reporting relationship of the CIO with the CEO on the firms' extent of IT deployment.

1. INTRODUCTION

With the acknowledged potential of information technologies (IT) to enable sustained organizational success in their value chain activities, business relationships, and market-oriented strategies (Davenport and Short 1990; Hammer 1990; Porter and Millar 1985; Venkatraman 1991), increasingly greater attention has begun to be centered on management's ability to realize the business value from their firms' investments in IT products and services (Elam et al. 1988; Keen 1991; Mata, Fuerst, and Barney 1995). The ability of firms' senior IS and business executives to guide and influence actions related to the management and use of information technologies in their firms' value chain activities and business strategies has been recognized as a critical competency (Sambamurthy and Zmud 1992, 1994). Senior IS executives, particularly the firm's Chief Information Officer (CIO), are anticipated to provide a strategic direction to their firm's IT activities and play a critical role in directing the firm's IT management and use initiatives (Applegate and Elam 1992; Earl and Feeny 1994). At the same time, the firm's top management team, comprising of the Chief Executive Officer (CEO), the Chief Operating Officer (COO), the Chief Financial Officer (CFO), and other senior business executives responsible for the key business or functional areas, also plays an influential role in shaping the firm's strategic initiatives (Hambrick and Mason 1984).

Prescriptive writings, anecdotal narratives, and some empirical research seem to underscore the important influences of the CIO and the top management team on their firms' success with IT use. For example, writers have suggested that the CIO's technical and business knowledge are important elements of their ability to shape their firm's IT initiatives (Synott 1987; Rockart, Bullen, and Ball 1982; Earl 1989). At the same time, an IT-literate business management is also regarded as necessary for enhancing the organization's ability to sustain IT-based innovation (Keen 1991; Boynton, Zmud, and Jacobs 1994). Further, the nature of the relationships between the firm's CIO and the senior business executives have also been regarded as contributing to the firms' success with IT-based innovation; for instance, Keen argues that "IT successes generally reflect an effective relationship between business managers and Information Services managers and their staffs" (p. 215). Further, he

suggests that “dialogue is needed most right at the top of the firm. It is no exaggeration to say that nothing will contribute more to a firm’s ability to take charge of change related to or fueled by IT than to have the firm’s business and IS leaders make the issues of economics and integration and mutual priority” (p. 219). Similarly, Earl and Feeny argue that, “It is only through dialogue with the CEO and other executives that the CIO can tease out the motivations, meanings, and priorities; know the mind of the business, sense the impending changes, and maintain the relevance and timeliness of the IS effort” (p. 14).

However, most existing ideas about the influence of the CIO and the top management team on firms’ success with IT use have been derived from anecdotal narratives (for example, Stoddard 1986), prescriptive writings (Freeman 1969; Keen 1991; Rockwell 1968), or case studies (Earl and Feeny 1994; Feeny, Edwards, and Simpson 1992). Jarvenpaa and Ives (1991) conducted one of the few large sample empirical studies to examine the influence of the CEO’s participation and involvement on their firms’ success with the progressive use of IT. However, their study focused only upon the CEO’s characteristics and they recommended that future studies expand their focus to the entire top management team. Our goal in this study is to rigorously test existing prescriptions through a large sample survey in order to provide a more robust foundation for managerial practice and future research.

Specifically, our study focuses attention upon two key questions: (i) How do the business and IT knowledge of the CIO and top management teams influence their firms’ success with IT use? (ii) How do the ongoing behaviors of interaction between the CIO and the top management team influence their firms’ success with IT use? Data for examining these questions were gathered through a large sample survey involving participating firms’ senior IS executives (mostly the CIO) and members of the top management team as respondents. In the next section, we present the conceptual model and research hypotheses. Subsequently, we present the details of the research methodology. Finally, we present the results of the data analysis and hypotheses and discuss the implications of the study for research and practice.

2. CONCEPTUAL MODEL AND RESEARCH HYPOTHESES

The theoretical basis for this study emerges from two distinct bases: first, the resource-based view of organizations suggests that managerial knowledge is a crucial organizational asset (Conner and Prahalad in press); particularly, in the context of technological innovation, the existence of appropriate levels of managerial and technical knowledge influence the organizational ability to deploy information technologies in the organization’s business activities (Cohen and Levinthal 1990). Second, the theory of symbolic interactionism suggests that the nature of interactions among key business and technology managers not only enhances their mutual knowledge about the business and technology issues, but also signals the organizational role and importance of technology-based innovation in business activities (Trevino, Daft, and Lengel 1990). While a detailed elaboration of these theories is outside the space limitations of this paper, Figure 1 illustrates that the CIO and top management team’s business and IT knowledge as well as the nature of the interactions among them are two crucial determinants of the firms’ success with IT use. In the following sections, we provide a more detailed description of our conceptual model and hypotheses.

2.1 CIO/Top Management Team (TMT) Knowledge

Prior conceptualizations of IT management practice suggest that two forms of knowledge are necessary for successful IT-based innovation: strategic IT-related knowledge and business knowledge (Boynton, Zmud, and Jacobs 1994; Keen 1991; Coopriider and Victor 1993). Strategic IT-related knowledge encompasses the potential and limitations of an organization’s IT infrastructure, IT actions of the competitors, and the potential of emerging information technologies for an organization’s business. This definition reflects a strategic view of IT knowledge in contrast with knowledge that is associated with elements such as systems development, networking, and/or programming expertise. Writers on effective IT management practice contend that it is such strategic IT-knowledge that is more relevant for CIOs and top management teams (Rockart, Bullen and Ball 1982; Keen 1991). Business knowledge encompasses the business strategies, organizational work processes, the firm’s products and services, industry recipes for success, and competitor strengths, weaknesses, and potential actions.

In firms where the CIO and the top management team possess high levels of business and strategic IT-related knowledge, such knowledge becomes an organizational asset and increases prospects that the company will be able to blend the requisite

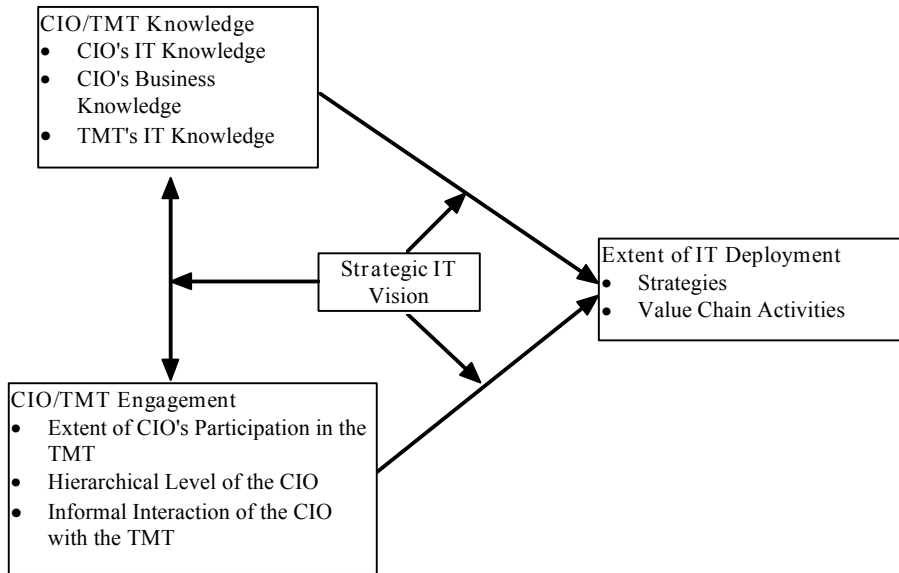


Figure 1. Research Model

business and IT-knowledge and set up the “push-pull” dynamics necessary for technological innovation (Zmud 1984; Winter 1987). CIOs with high strategic IT-knowledge should be better able to advise the top management team on IT issues, such as appropriate technologies in which to invest, investment timing, and the level of investment. With the recent trend for hiring CIOs from outside the IS function (Applegate and Elam 1992), we anticipate that the CIOs in firms will vary widely in their level of strategic IT knowledge.

As IT becomes more important to a firm’s business, the top management teams’ strategic-IT knowledge should also be an important determinant of the firms’ competence with IT use. Keen argues that when top management teams do not possess a high strategic IT-knowledge, they might abdicate key IT initiatives to their CIO or the IS department and suggests that such conditions are likely to impair the organization’s effective use of IT.

Business knowledge reflects an awareness of relationships between the organization and its stakeholders, and the firm’s means of competing in its marketplaces. Business-related knowledge provides managers with the ability to assimilate changes in the environment, understand how the changes might affect the organization, and understand how the firm can exploit the changes to commercial ends (Cohen and Levinthal 1990). Although business knowledge is clearly important to the top management team members (Kotter 1982), the impacts of TMT members’ business knowledge are outside the scope of this study. Therefore, their business knowledge was not assessed.

Prior MIS literature advocates the need for CIOs to possess a general-business orientation, in addition to an IT orientation (Boynton, Zmud and Jacobs 1994; Rockart 1988). Feeny, Edwards and Simpson found that the top IS executive should be able to contribute beyond the IS functional role. In their study of new IS executives, Applegate and Elam found that CIOs must possess “a broad business perspective” (p. 469) and a knowledge of the organization and business expertise. Stephens et al. (1992) suggest that an enhanced level of business-related knowledge is what distinguishes an IS executive from an IS functional manager.

Therefore, as illustrated in Figure 1, the focus of this study is upon CIOs strategic-IT and business knowledge and the top management teams’ strategic IT knowledge as important elements of their firms’ managerial knowledge. This knowledge is anticipated to influence the firms’ success with IT use.

2.2 CIO/TMT Engagements

CIO/TMT engagements refer to the different types of interactions (formal and informal) between members of the top management team and the CIO. The frequency and richness of such interactions provide the other element of the “push-pull” dynamics required for effective and sustained IT-based innovation (Zmud 1984); for example, Lind and Zmud (1991) found that rich interactions between technical and managerial personnel in organizations contributed to increased levels of IT-based innovativeness. Thus, engagements provide the forum for the CIO and the TMT members to articulate their strategic IT and business knowledge and blend them into innovation initiatives. These engagements also provide opportunities for the CIO and TMT members to share ideas and develop a better understanding of the other’s environment. Using media richness (Daft and Lengel 1986) as a theoretical basis, Watson (1990) argued that information could be disseminated more effectively between the CIO and members of the TMT through richer channels, especially face-to-face communications.

CIO/TMT engagements share a symbiotic relationship with knowledge: on one hand, richer and more engagements facilitate the development of more managerial knowledge (Henderson 1990; Rockart 1988), while higher managerial knowledge also facilitates greater engagements (Reich 1992). Therefore, we hypothesize that:

Hypothesis H1: The amount of CIO/TMT strategic IT and business knowledge will be positively associated with the level of TMT/CIO engagements.

The IT literature suggests three possible means of providing TMT/CIO engagements: (1) the hierarchical level of the CIO in the firm, or distance from the CEO (Feeny, Edwards and Simpson 1992; Keen 1991; Watson 1990); (2) the extent of the CIO’s participation in the top management team (Cash et al. 1992; Watson 1990); and (3) the frequency of informal interactions between TMT members and the CIO (Lederer and Mendelow 1988; Rohan 1988). These three indicators reflect the potential avenues available for the CIO and the TMT member to access richer channels and will be used in this study to reflect the extent of engagements that occur between the CIO and the TMT.

2.3 Extent of IT Deployment

Sabherwal and King (1991) found that most frameworks for understanding the success of IT deployment are rooted in the concepts of generic business strategies and value-chain activities (Porter 1980, 1985; Porter and Millar 1985). Porter identifies three generic strategies: altering the industry structure, improving the existing lines of business, and creating new products and services. IT-based innovations can be used in enhancing a firm’s ability to sustain these competitive strategies (Porter and Millar 1985). Further, Porter and Millar identify ways in which IT-based innovations can be used to enhance firms’ value-chain activities. Therefore, the use of IT to support business strategies and value-chain activities are one indicator of the effectiveness of IT use in organizations, particularly when the phenomenon of interest is at the organizational level (DeLone and McLean 1992).

Following the rationale outlined earlier, CIO/TMT knowledge and engagements are expected to influence the extent of IT deployment. Higher levels of CIO/TMT strategic IT and business knowledge should increase firms’ ability to identify potentially successful business strategies and critical value chain activities and the ways in which IT could enhance the conduct of these strategies and activities. Although prior studies have not examined the relationship at the CIO/TMT level, Boynton, Zmud and Jacobs found that high levels of IS and business unit knowledge enhanced their firms’ success with IT use. Similar results were found by Coopridge and Victor, while Kaiser and Srinivasan (1982) found that the lack of either IT or business knowledge contributed to IS failures.

CIO/TMT engagements are anticipated to facilitate rich communications between the CIO and TMT members and enable them to more effectively communicate initiatives for utilizing IT to support their strategies and value-chain activities (Keen 1991). Engagements between the CIO and the top management team have been found to be a major factor in effectively leveraging a firm’s IT resources in their business strategies and activities (Feeny, Edwards and Simpson 1992; Jarvenpaa and Ives 1991). More frequent interactions between the CIO and line managers have also been shown to significantly affect a firm’s IT diffusion (Zmud, Boynton, and Jacobs 1986).

Therefore, we hypothesize that:

Hypothesis H2: CIO/TMT knowledge will significantly influence a greater extent of IT deployment in firms.

Hypothesis H3: Richer and more frequent CIO/TMT engagements will significantly influence a greater extent of IT deployment in firms.

2.4 Strategic IT Vision

Our conceptual model also identifies the influence of another key factor on the dynamics associated with CIO/TMT knowledge and engagements and firms' extent of IT deployment: the strategic IT vision. Strategic IT vision is defined as the shared, aspired future state of the role that information technology should play in the organization (Robbins and Duncan 1988; Zmud 1988). A strategic vision provides organizational meaning, symbols, and images to shape organizational members' behaviors and actions (Collins and Porras 1991); in this context, a strategic IT vision evokes organizational images of the role that IT will play in the firms' business activities and competitive strategies and how individual organizational members should structure their behaviors in support of such a role. In other words, a strategic IT vision connotes the institutional values placed upon the deployment of IT in business strategies and activities. Schein (1992) identifies four major categories of strategic IT visions. The first of these is referred to as *automate*, which perceives the ultimate role of IT as replacing expensive, unreliable human labor with information technology. This vision evokes an image of IT as saving money and improving quality. The second vision is *informate up*, which views IT as providing information to the higher levels of the organization more easily and efficiently to aid their organizational control and coordination roles. The third vision is *informate down*, where the information is distributed to lower levels of the organization in order to enhance the information reach of "front-line" organizational members and empower them with the relevant knowledge and information to perform effectively in their work environments. Thus, the informate up vision evokes an image of further tightening and consolidation of power and control by top management, whereas the informate down vision evokes an image of empowerment and autonomy in the organization. The final vision is *transform*, which perceives IT to be the vehicle for fundamentally altering the structure and conduct of the industry where the firm operates. This can be seen in the example of American Hospital Supply, who used its electronic order entry system to fundamentally alter the competitive structure of the hospital supply industry (Short and Venkatraman 1992). Scott-Morton (1991) describes firms as evolving their strategic IT vision in stages from *automate* to *informate* and, finally, to *transform*. Therefore, there is an evolutionary path that firms progress through as they mature in their IT deployment from automate to transform.

We regard the impact of strategic IT vision to be best explained through a configurational perspective, viz., that intensity of the relationship between CIO/TMT knowledge and engagements and extent of IT deployment will vary across the different strategic IT visions. In firms that adopt an automate vision, IT initiatives are essentially expected to support the prevailing business strategies by enhancing the efficiency and costliness with which competitive strategies are executed and value-chain activities are conducted. In such a context, the level of CIO/TMT business and strategic IT knowledge or the richness of their engagements might not be crucial influences on the extent of IT deployment. In contrast, in firms that articulate a transform vision, a much tighter coupling is required between the business and strategic IT knowledge and more richer forums of interaction are required in order to shape IT initiatives that alter the industry practice. Therefore, we anticipate that the relationship between CIO/TMT knowledge and engagements and extent of IT deployment will be different between the automate versus the transform visions of IT use. Therefore, we propose that:

Hypothesis H4: The intensity of the relationship between CIO/TMT knowledge and engagements will be stronger for firms that espouse a transform vision than for firms that espouse an automate vision.

Hypothesis H5: The impact of CIO/TMT knowledge on the extent of IT deployment will be stronger for firms that espouse a transform vision than for firms that espouse an automate vision.

Hypothesis H6: The impact of CIO/TMT engagements on the extent of IT deployment will be stronger for firms that espouse a transform vision than for firms that espouse an automate vision.

2.5 Extent of IT Diffusion

While the study's primary focus is upon the effects of CIO/TMT knowledge and engagements on the extent of IT deployment, the extent to which firms have diffused key information technologies into their prevailing IT infrastructure is anticipated to be another key influence. Studies of technology use have found that the accessibility and availability of the technology are an important determinant of its use (O'Reilly 1982). Therefore, we anticipate that firms where important technologies have been adopted and made widely available are more likely to use IT extensively in their business strategies and value-chain activities. Hence, the extent of IT diffusion is used in our research as a control variable.

In the next section, we present the details of our research design for evaluating these hypotheses.

3. RESEARCH DESIGN

Data were gathered through a large sample field survey that tapped the responses of senior IS executives (CIOs) and members of top management teams in the participating firms. TMT members included the CEO and other executives who reported directly to the CEO. To obtain data on the variables listed in Table 1, separate questionnaires were developed for the CIO and the TMT members. Table 1 identifies the respondent for each variable.

The sampling strategy involved cross-listing firms from *Fortune 500*, *Service Fortune 500*, and *Business Week 1000* with firms listed in the *IS Executive* database. The latter database was used to determine the names of the CIOs. The names of TMT members were gathered from *Standard & Poor's Register of Executives*. This resulted in a sampling frame of 1,120 medium to large U.S. firms from eight industries, including manufacturing, transportation, utilities, retail, banking and financial services, petroleum, food, and insurance. The CIO's questionnaire was mailed to the CIOs of the sampled firms and 235 usable responses were received, yielding a 21 percent response rate. About half of respondents identified themselves as having a title of vice president or above, and the rest were either directors or managers of IS. For the responding CIOs, a second questionnaire was sent to their firm's TMT members. A total of 265 useable TMT questionnaires were received from the 835 that were mailed to realize a response rate of 32 percent. These responses represented 169 firms where a questionnaire was received from both the CIO and at least one member of the TMT; responses from two or more TMT members were received from 83 of those firms. In order to assess any potential threats of non-response bias, firms representing the respondents and non-respondents were compared on sales, net income and number of employees. No significant differences were found between these two groups of firms.

Multiple questions were used to capture the operational definitions described in Table 1 for CIO's IT and business knowledge, TMT's IT knowledge, and the extent of IT deployment. The questionnaires were first tested for face validity with a group of IS practitioners and academicians involved in IT management research. Exploratory factor analysis was used on the data from the 169 responding firms to verify that the factor structure of these questions conformed to the intended constructs. All the questions for IT and business knowledge loaded as expected. For the extent of IT deployment, three factors were identified: (a) IT deployment to support business strategies, (b) IT deployment to support logistical value chain activities, and (c) IT deployment to support marketing value chain activities. The factor scores from these six factors were used in the data analysis described in the next section. Cronbach's alpha was calculated for all six factors, with 0.84 being the lowest value (0.80 and above are considered reliable measures). The remainder of the variables shown in Table 1 are single item variables. This data was used to analyze the six hypotheses.

4. ANALYSIS AND RESULTS

Data analysis was performed first by using the entire data sample to test the effects articulated in hypotheses H1 to H3; next, the data sample was categorized into subsets, according to the strategic IT vision, and analysis was conducted to test hypotheses H4 through H6. During the categorization by strategic IT vision, we discovered that only fifteen firms in our sample exhibited an automate vision; given this small sample size, analysis was not conducted within this subset of the data. Regression and canonical correlation analyses were used as the primary approaches to hypothesis testing.

Table 1. Operational Definitions and Respondents

Variable	Operational Definition	Respondent
CIO's IT knowledge	Understanding of potential and limitations of current and future IT and how competitors are using IT. Done on a five point scale from "extremely well informed" to "not well informed."	TMT Members
TMT's IT Knowledge	Same definition and scale as above.	CIO
CIO's Business Knowledge	Understanding of present and future products, markets and business processes, and the firm's basis of competition. Done on the same scale as above.	TMT Members
Hierarchical Proximity of CIO to CEO	The number of levels of management between the CIO and the CEO.	Secondary Data
Extent of CIO participation in the TMT	Level of CIO participation in TMT on four point scale from "formal member" to "rarely or never participates."	TMT Members
Informal Communication between CIO and TMT	The frequency of interaction between the TMT member and the CIO on a five point scale from "daily" to "once a year."	TMT Members
IT Vision	Used Feeney, Edwards and Simspon's (1992) operationalization of Schein's (1992) four IT visions.	TMT Members
Extent of IT Diffusion	Rate on a scale from 0 to 100 percent the extent to which five key technologies have been diffused within the firm.	CIO
Extent of IT Deployment (Strategic and Value Chain)	Rate the firm's success in applying IT to support eight business strategies and six value chain activities based on Porter (1980, 1985) and Porter and Millar (1985). This rating was done on a ten point scale with ten being the best firm in the industry in using IT to support the strategy or value chain activity.	TMT Members

For the regression models, the normality of the residuals and plots of the residual versus independent variable were examined to verify that there were no deviations from the assumptions underlying regression analysis. All the dependent variables were also checked to insure that their distribution approximated the normal curve. In addition, the regression models were examined to verify that no severe multi-collinearity threats existed (Belsley, Kuh, and Welsch 1980).

Since hypothesis H1 articulated an association between CIO/TMT knowledge and engagements, a canonical correlation analysis was used to examine this relationship. The results revealed one significant canonical variate ($R_C = .86$; $p = .0001$) and provided support for hypothesis H1. Further, within this relationship, the CIO's IT and business knowledge were found to be significant elements on the knowledge side and the extent of CIO participation in the top management team was found to a significant element on the engagements side (based on the significance of the canonical loadings and weights). Our interpretation of these results is that a strong synergistic relationship exists between the level of CIOs' business and strategic IT knowledge and their participation within top management teams. When CIOs have a good knowledge of their firms' business and a recognition of the potential and limitations of current and emerging IT for their firms' business, their ability to provide value-added and unique perspectives to other members of the top management team is enhanced (Applegate and Elam 1992; Earl and Feeny 1994; Watson 1990). Therefore, CIOs who possess such knowledge are more likely to participate actively within top management teams. At the same time, greater levels of participation within TMTs sensitize the CIOs to the firm's "business

of the business,” its long-term competitive challenges and opportunities, and the leverage points for current and emerging information technologies. As a result, such participation enables them to further improve their knowledge about the firm’s business.

In order to examine the strength of the relationship between CIO/TMT knowledge and engagements within the different categories of strategic IT visions, canonical correlation analyses were replicated within each of the three datasets. Within the datasets representing the informate up and informate down visions, no significant relationship was found between CIO/TMT knowledge and engagements. On the contrary, within the dataset representing the transform vision, the canonical function was found to be significant ($R_c = .67, p < .01$). Further, similar to the results at the level of the entire dataset, CIOs strategic IT and business knowledge were significant on the knowledge side and their degree of participation in the TMT on the engagements side. These results suggest that the relationship between CIO/TMT knowledge and engagements is significant only in those firms that articulated a *transform* IT vision; firms with an IT vision of *informate up* and *informate down* did not exhibit any significant relationship between CIO/TMT knowledge and engagements. Further, the relationship primarily exists between the extent of CIO participation in the TMT and their business and strategic IT knowledge. Therefore, support was found for hypothesis H4.

The effects of CIO/TMT knowledge on the extent of IT deployment were evaluated through regression analysis and the results are displayed in Table 2. The CIOs’ strategic IT and business knowledge were both found to be significant predictors of all the three dimensions of the extent of IT deployment.¹ These findings provide strong support for hypothesis H2. CIOs with higher levels of business and strategic IT knowledge appear to be better able to identify opportunities where IT can be utilized to support the firm’s strategies and value-chain activities. Absorptive capacity arguments seem to explain this finding: the CIOs’ superior business and IT knowledge confers them with the ability to identify innovative ways of blending technology capabilities and business requirements and stimulate innovative uses of IT. That is, the CIO is better able to recognize the potential of developments in the IT area, assimilate its potential for the firm, and exploit the development to enhance the firm’s competitive position. These results are consistent with the findings of previous studies, such as Boynton, Zmud and Jacobs, Cooperider and Victor, and Kaiser and Srinivasan.

Table 2. Regression Analysis of Joint Knowledge on Extent of IT Deployment

IT Vision (Wilk’s Lambda)	Business Strategy	Logistics Value-chain Activities	Marketing Value-chain Activities
All Visions - Overall Model (7.04) ****			
F _{4,141}	22.02 ****	4.55 ****	11.01 ****
R ²	0.38	0.11	0.24
Informate Up (1.26)			
F _{4,18}	2.75 *	1.74	1.90
R ²	0.38	0.28	0.30
Informate Down (1.68) *			
F _{4,51}	4.12 ***	1.64	2.15 *
R ²	0.26	0.12	0.15
Transform (5.07) ****			
F _{4,53}	13.98 ****	3.98 ***	8.10 ****
R ²	0.51	0.23	0.38

*p < .10 ** p < .05 *** p < .01 **** p < .001

¹A detailed description of the regression analysis results (beta scores, t-statistics, etc.) are available from the first author.

It is interesting to note that the TMT’s strategic IT knowledge was not found to significantly impact the extent of the firm’s IT deployment. These results are in contrast to propositions that the TMT’s strategic IT knowledge is highly important (Henderson 1990; Keen 1991). Some have even suggested that as TMT members develop their strategic IT knowledge, they may become less dependent upon the CIO for strategic IT leadership (Drucker 1988). This would result in a diminished importance of the CIO’s position in the organization. In contrast, the results of this study suggest that it is the CIO’s business and strategic IT knowledge, not the TMT’s strategic IT knowledge, that strongly influences the firm’s extent of IT deployment. It appears from our study that TMT members might rely on the CIO’s strategic IT knowledge, rather than investing in developing their own IT knowledge, in directing the firm’s effective use of IT.

Table 2 also shows the results of regression analyses within the three data subsets representing the different strategic IT visions. These results suggest that the relationship between CIO/TMT knowledge and extent of IT deployment is most significant in firms that articulate a *transform* vision. The relationship was found to be non-existent in firms that articulated an *informate up* vision and weak in firms that articulated an *informate down* IT vision. These results provide support for hypothesis H5.

Finally, regression analysis was also conducted to evaluate the effects of CIO/TMT engagements on the extent of IT deployment (Table 3). The regression results reveal that only the extent of CIO participation in the TMT had a significant relationship with the firm’s extent of IT deployment. However, the impact of CIO participation seems to be significant only in the case of IT deployment to support business strategies and marketing value chain activities. Overall, we observe support for hypothesis H3. The CIO’s participation in the TMT promotes an exchange of ideas and more effective communication between the CIO and other TMT members. This provides an opportunity for the CIO and TMT members to generate innovative ideas for IT deployment. There are two possible outcomes of the CIO’s greater participation in the TMT: First, through participation, the CIO is better able to communicate to other TMT members how IT can facilitate the firm’s strategies and insure that the IT strategy conforms to the firm’s overall strategy. Second, greater participation of the CIO in the TMT symbolizes to the rest of the organization the importance of IT to the firm; this in turn reinforces the institutional importance of IT and fosters greater IT use.

Table 3. Regression Analysis of TMT/CIO Engagements on Extent of IT Deployment

IT Vision (Wilk’s Lambda)	Business Strategy	Logistics Value-chain Activities	Marketing Value-chain Activities
All Visions - Overall Model (3.43) ****			
F _{4,141}	7.78 ****	0.91	4.51 ****
R ²	0.18	0.03	0.11
Informate Up (1.28)			
F _{4,18}	1.33	0.97	3.05 **
R ²	0.23	0.18	0.40
Informate Down (1.75) *			
F _{4,47}	2.46 **	3.67 ***	1.10
R ²	0.17	0.24	0.09
Transform (3.48) ****			
F _{4,52}	8.48 ****	0.90	7.34 ****
R ²	0.39	0.06	0.36

*p < .10 ** p < .05 *** p < .01 **** p < .001

Table 3 also presents the results of examining the above relationship within the different categories of IT vision. Again, a significant relationship was found to exist primarily in firms that had identified themselves as having a *transform* IT vision. The relationship did not exist for firms with an *informate up* IT vision and existed at a less significant level for firms with an *informate down* vision. From these results, support is found for hypothesis H6.

5. DISCUSSION OF RESULTS AND CONCLUSIONS

The goal of this study was to examine the impact of business and IT knowledge possessed by CIOs and the members of firms' top management teams, and the interactions among the CIO and the TMT members, on firms' success with IT use. In addition, the study also examined the impact of the strategic IT vision on the relationship between CIO/TMT knowledge and engagements and the extent of IT deployment. The following significant results emerged from this study: (i) the CIOs' business and IT knowledge have a significant influence on firms' extent of IT deployment, (ii) the degree to which CIOs participate as members of their firms' top management teams is also influential upon the firms' success with IT use, and (iii) the CIOs' knowledge and degree of participation in their firms' top management teams are significant influences on their firms' success with IT use in firms that articulate their strategic IT vision to be one of altering their industry through IT.

In addition to these significant findings, two non-significant findings are also interesting, because they appear to contradict the prevailing wisdom: top management teams' IT knowledge and the CIOs' hierarchical distance from the CEO were not significant influences on their firms' success with IT use. Writers on IT management practice have argued that top management teams in organizations must possess IT knowledge in order to enhance their understanding of the role of IT in their business activities and strategies and to ensure that they do not abdicate the IT deployment responsibilities entirely to their CIOs or their IS staff (Keen 1991). However, our results seem to indicate that the top management team's IT knowledge is not as critical as the level of the CIO's IT and business knowledge in directly impacting the firm's extent of IT deployment. At the same time, we also found that providing the knowledgeable CIO with access to the influential forum of the top management team was equally important in nurturing greater organizational IT use. Therefore, our study seems to suggest that having a CIO endowed with a high level of strategic IT and business knowledge and able to participate on top management teams is one effective pathway to enhanced IT use. Other researchers have also recommended greater participation of the CIO on top management teams (Earl and Feeny 1994; Feeny, Edwards and Simpson 1992).

While previous writers have recommended that top management teams should have high IT knowledge, our study is the first large scale empirical effort to examine the relative influences of CIO and TMT knowledge. Does our study mean that TMT IT knowledge is not important for enhanced IT use? On the contrary, we think that while such knowledge might not directly influence IT use, it could facilitate greater TMT understanding of, and involvement with, IT issues. In this context, it is useful to recall that Jarvenpaa and Ives found involvement to be significantly associated with IT use. Therefore, future research should examine how the strategic IT knowledge of top management teams facilitates organizational IT use. In this context, it is also interesting to consider that while Boynton, Zmud and Jacobs and Coopriider and Victor found the business managers' IT knowledge to be an important influence, our study differs from their's in two ways: (i) our focus was at the top management team level, while most of their focus was at the business management level and (ii) they viewed knowledge as a product of business managers' IT knowledge and IT managers' business knowledge; our study evaluated the relative effects of CIOs' and TMT members' knowledge.

Similarly, while Watson found that direct reporting relationship of the CIO with the CEO enhanced their understanding of the business, we did not find the reporting relationship to be important. In fact, we observed that only about 12% of the CIOs in our dataset had a direct reporting relationship with their CEO. Again, our explanation for these differences in results is that Watson did not examine the influence of alternative forms of engagements and focused only on the reporting relationship. Further, recent writings on IT management practice have begun to acknowledge that the extent of CIOs' participation on top management teams is more significant than the nature of their reporting relationships (Earl and Feeny 1994).

In order to assess the contributions of our findings in this study, it is important to examine some of its limitations. First, although our engagements construct refers to the total of all the formal and informal interactions among the CIO and the TMT members, our operationalization was developed at a more coarsely grained level; for example, we evaluated informal interactions through a single item questionnaire about the frequency of informal communications. Future research should operationalize this construct in a more robust manner to identify if our operationalization might have limited the observed influence of informal interactions. Further, some of the other measures were also based on single-item measures; future research should attempt to capture these variables, particularly strategic IT vision, through multi-item assessments.

Notwithstanding these limitations, the significant contribution of this study is that it brings the power and rigor of a large sample survey to examine some of the issues about the role of the CIO and top management teams that have previously been less researched or examined mainly through case studies. The results provide interesting insights about the critical role of CIO's knowledge and participation in top management teams. At the same time, the absence of significant effects due to TMTs' IT knowledge raises intriguing questions about how exactly the TMTs' IT knowledge might influence firms' success with IT use. As a result, we anticipate many fertile opportunities for future research, in addition to some of the issues posed in this paper. We hope that other researchers interested in IT management issues will be encouraged and stimulated to advance the findings of this research.

6. REFERENCES

- Applegate, L. M., and Elam, J. J. "New Information Systems Leaders: A Changing Role in a Changing World." *MIS Quarterly*, Volume 16, 1992, pp. 469-489.
- Belsley, D. A.; Kuh, E.; and Welsch, R. E. *Regression Diagnostics*. New York: John Wiley & Sons, 1980.
- Boynton, A. C.; Zmud, R. W.; and Jacobs, G. "The Influence of it Management Practices on it Use in Large Organizations." *MIS Quarterly*, Volume 18, 1994, pp. 299-318.
- Cash, J. I.; McFarlan, W. F.; McKenney, J.; and Applegate, L. *Corporate Information Systems Management: Text and Cases*. Homewood, Illinois: Richard D. Irwin, 1992.
- Cohen, W. M., and Levinthal, D. A. "Absorptive Capacity: A New Perspective on Learning and Innovation." *Administrative Science Quarterly*, Volume 35, 1990, pp. 128-152.
- Collins, J. C., and Porras, J. I. "Organizational Vision and Visionary Organizations." *California Management Review*, Volume 33, 1991, pp. 30-52.
- Conner, K. R., and Prahalad, C. K. "A Resource-Based Theory of the Firm: Knowledge versus Opportunism." *Organization Science*, in press.
- Coopridge, J. G., and Victor, K. M. "The Contribution of Shared Knowledge to Is Group Performance." In J. I. DeGross, R. P. Bostrom, and D. Robey, Editors, *Proceedings of the Fourteenth International Conference on Information Systems*. Orlando, Florida, 1993, pp. 285-297.
- Daft, R. L., and Lengel, R. H. "Organizational Information Requirements, Media Richness and Structural Design." *Management Sciences*, Volume 32, 1986, pp. 554-571.

- Davenport, T. H., and Short, J. E. "The New Industrial Engineering: Information Technology and Business Process Redesign." *Sloan Management Review*, Summer 1990, pp. 11-27.
- DeLone, W. H., and McLean, E. R. "Information Systems Success: The Quest for the Dependent Variable." *Information Systems Research*, Volume 3, 1992, pp. 60-95.
- Drucker, P. F. "The Coming of the New Organization." *Harvard Business Review*, Volume 66, Number 1, pp. 45-53.
- Earl, M. J. *Management Strategies for Information Technology*. London: Prentice Hall, 1989.
- Earl, M. J., and Feeny, D. F. "Is Your CIO Adding Value?" *Sloan Management Review*, Spring 1994, pp. 11-20.
- Elam, J.; Ginzberg, M.; Keen, P. G. W.; and Zmud, R. W., Editors. *Transforming the IS Organization: The Mission, the Framework, the Transition*. Washington, DC: ICIT Press, 1988.
- Feeny, D. F.; Edwards, B. R.; and Simpson, K. M. "Understanding the CEO/CIO Relationship." *MIS Quarterly*, Volume 16, 1992, pp. 435-448.
- Freeman, G. A., Jr. "The Role Top Management must Play in Mis Planning and Implementation." *Proceedings of the Founders' Conference of the Society for Management Information Systems*, 1969.
- Hambrick, D. C., and Mason, P. A. "Upper Echelons: The Organization as a Reflection of its Top Managers." *Academy of Management Review*, Volume 9, 1984, pp. 191-206.
- Hammer, M. "Reengineering Work: Don't Automate, Obliterate." *Harvard Business Review*, July-August 1990, pp. 104-114.
- Henderson J. C. "Plugging into Strategic Partnerships: The Critical IS Connection." *Sloan Management Review*, Volume 31, Number 3, 1990, pp. 7-18.
- Jarvenpaa, S. L., and Ives, B. "Executive Involvement and Participation in the Management of Information Technology." *MIS Quarterly*, Volume 15, 1991, pp. 205-227.
- Kaiser, K., and Srinivasan, A. "User-Analyst Differences: An Empirical Investigation of Attitudes Related to Systems Development." *Academy of Management Journal*, Volume 25, Number 3, 1982, pp. 630-646.
- Keen, P. G. W. *Shaping the Future*. Boston: Harvard Business School Press, 1991.
- Kotter, J. P. *The General Managers*. New York: Free Press, 1982.
- Lederer, A. L., and Mendelow, A. L. "Information Systems Planning: Top Management Takes Control." *Business Horizons*, Volume 31, Number 3, 1988, pp. 73-78.
- Lind, M., and Zmud, R. W. "The Influence of a Convergence in Understanding Between Technology Providers and Users on Information Technology Innovativeness." *Organization Science*, Volume 2, 1991, pp. 195-217.

- Mata, F. J.; Fuerst, W. L.; and Barney, J. B. "Information Technology and Sustained Competitive Advantage: A Resource-Based Analysis." *MIS Quarterly*, December 1995, pp. 487-506.
- O'Reilly, C. A. "Variations in The Decision Makers' Use of Information Sources: The Impact of Quality And Accessibility of Information." *Academy of Management Journal*, Volume 25, 1982, pp. 756-771.
- Porter, M. E. *Competitive Advantage: Creating and Sustaining Superior Performance*. New York: Free Press, 1985.
- Porter, M. E. *Competitive Strategy*. New York: Free Press 1980.
- Porter, M. E., and Millar V. E. "How Information Gives You Competitive Advantage." *Harvard Business Review*, Volume 63, Number 4, 1985, pp. 149-160.
- Reich, B. H. *Investigating the Linkage Between Business Objectives and Information Technology Objectives: A Multiple Case Study in the Insurance Industry*. Unpublished Ph.D. dissertation, University of British Columbia, 1992.
- Robbins S. R., and Duncan, R. B. "The Role of the CEO and Top Management in the Creation and Implementation of Strategic Vision." In D. C. Hambrick, Editor, *The Executive Effect: Concepts and Methods for Studying Top Managers*. Greenwich, Connecticut: JAI Press, 1988, pp. 205-233.
- Rockart, J. F. "The Line Takes the Leadership — IS Management in the Wired Society." *Sloan Management Review*, Volume 29, 1988, pp. 57-64.
- Rockart, J. F.; Bullen, C. V.; and Ball, L. "Future Role of the Information Systems Executive." *MIS Quarterly*, Volume 6, 1982, pp. 1-14.
- Rockwell, W. P. "MIS: A View from the Top." *Dun's Review*, Volume 92, Volume 4, 1968, pp. 20-22.
- Rohan, T. M. "Keeping in Touch with Technology." *Industry Week*, October 3, 1988, pp. 39-42.
- Sabherwal, R., and King, W. R. "Towards a Theory of Strategic Use of Information Resources." *Information & Management*, Volume 20, 1991, pp. 191-212.
- Sambamurthy, V., and Zmud, R. W. *IT Management Competency Assessment: A Tool for Creating Business Value Through IT*. Morristown, New Jersey: Financial Executives Research Foundation, 1994.
- Sambamurthy, V., and Zmud, R. W. *Managing IT for Success: The Empowering Business Partnership*. Morristown, New Jersey: Financial Executive Research Foundation, 1992.
- Schein, E. H. "The Role of the CEO in the Management of Change: The Case of Information Technology." In T. A. Kochan and M. Useem, Editors, *Transforming organizations*. Oxford: Oxford University Press, 1992.
- Scott-Morton, M. S. "IT-Induced Business Reconfiguration." In M. S. Scott Morton, Editor, *The Corporation of the 1990s: Information Technology and Organizational Transformation*. Oxford: Oxford University Press, 1991, pp. 3-23.

- Short, J. E., and Venkatraman, N. "Beyond Business Process Redesign: Redefining Baxter's Business Network." *Sloan Management Review*, Volume 34, Volume 1, 1992, pp. 7-21.
- Stephens, C. S.; Ledbetter, W. N.; Mitra, A.; and Ford, F. N. "Executive or Functional Manager? The Nature of the CIO's Job." *MIS Quarterly*, Volume 16, 1992, pp. 449-467.
- Stoddard, D. "OTISLINE." *Harvard Business School*, Case No. 9-186-304, 1986.
- Synott, W. R. "Putting a CIO in Charge." *Institutional Investor: Financial Technology Forum Supplement*, Volume 21, 1987, pp. 47-48.
- Trevino, L. K.; Daft, R. L.; and Lengel, R. H. "Understanding Managers' Media Choices: A Symbolic Interactionist Perspective." In J. Fulk and C. Steinfield, Editors, *Organizations and Communications Technology*. Newbury Park, California: Sage, 1990, pp. 71-94.
- Venkatraman, N. "IT-Induced Business Reconfiguration." In M. S. Scott Morton, Editor, *The Corporation of the 1990s: Information Technology and Organizational Transformation*. Oxford: Oxford University Press, 1991, pp. 122-158.
- Watson, R. T. "Influences on the IS Manager's Perceptions of Key Issues: Information Scanning and the Relationship with the CEO." *MIS Quarterly*, June, 1990, pp. 217-231.
- Winter, S. G. "Knowledge and competence as Strategic Assets." In D. J. Teece, Editor, *The Competitive Challenge: Strategies for Industrial Innovation and Renewal*. Cambridge, Massachusetts: Ballinger Publishing Company, 1987, pp. 159-184.
- Zmud, R. W. "An Examination of 'Push-Pull' Theory Applied to Process Innovation in Knowledge Work." *Management Sciences*, Volume 30, Volume 6, 1984, pp. 727-738.
- Zmud, R. W. "Building Relationships throughout the Corporate Entity." In J. Elam, M. Ginzberg, P. Keen, and R. Zmud, Editors, *Transforming the IS Organization: The Mission, the Framework, the Transition*. Washington DC: ICIT Press, 1988.
- Zmud, R. W.; Boynton, A. C.; and Jacobs, G. C. "The Information Economy: A New Perspective for Effective Information Systems Management." *Data Base*, Fall, 1986, pp. 17-23.