Chapter XXV
IT Infrastructure Capabilities and Business Process Improvements:
Association with IT Governance Characteristics

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ABSTRACT

It has been widely discussed in the management information systems (MIS) literature that the outcomes of information technologies (IT) and systems may be subject to the influence of the characteristics of the organization, including those of the IT and business leadership. This study was conducted to examine the relationships that may exist between IT infrastructure capabilities (ITC), business process improvements (BPI), and such IT governance-related constructs as the reporting relationship between the chief executive officer (CEO) and chief information officer (CIO), and senior management support of IT and BPI projects. Using a sample of 243 multinational and Hong Kong-listed firms operating in Greater China, this study yielded empirical support for the perceived achievement of capabilities in some dimensions of the IT infrastructure in the companies under study. It was found that the BPI construct was related to the reporting relationship between the CEO and CIO (CEO-CIO distance), and to the levels of senior management support. The dimensions of the ITC construct were also investigated and identified by an exploratory factor analysis (EFA). Associations were found between the selected organizational constructs and the ITC dimensions, except in two hypothesized relationships. Those between CEO-CIO distance and the ITC

dimensions of data integration and training were not supported at the significance level of 0.05.

INTRODUCTION

The last decades have seen generous investment in information technologies (IT) by companies around the world (Mitra, 2005; Strassman, 2002), and expenditures for IT infrastructure are estimated to account for almost 60% of a company's IT budget (Byrd & Turner, 2000). As IT has increasingly been perceived as a critical business enabler, companies are eager to take advantage of IT to support their operational and strategic objectives. Despite the huge investments made in IT in recent decades, the effects of such investment are less than satisfactory in terms of organizational benefits (Dasgupta, Sarkis & Talluri, 1999; Hu & Plant, 2001). One of the reasons for this paradox is the mismanagement of IT projects, as shown in a number of notorious examples of IT failures (Grossman, 2003; Spitze, 2001). Against this background, a series of sensible questions can be asked. What are the factors that would favorably affect the outcomes of such investments in IT initiatives? What are the proper types and amounts of IT investment a company should make? The first one points to many aspects of IT planning, implementation and management while the second relates to the proper investment decisions that need to be made, perhaps jointly, by the senior IT and business leadership (Ein-Dor & Segev, 1978; Ross & Weill, 2002).

The IT literature has presented many organizational factors relevant to the successful adoption of IT, ranging from project management issues to user involvement, and senior management support (Caldeira & Ward, 2002; Chatterjee, Grewal & Sambamurthy, 2002). Ignoring or mismanaging these factors may subject the projects to the risk of failure (Sumner, 2000). Among the many organizational issues that are said to affect the investment, deployment and use of IT, are IT governance-related factors. As defined by Sambamurthy & Zmud (1999), "IT governance arrangements refers to the patterns of authority for key IT activities in business firms, including IT infrastructure, IT use, and project management" (p. 261). "The patterns of authority" could have many implications to the investment decisions, and running of the enterprise-wide IT initiatives. For instance, it may affect how much recognition and support an IT project could receive from the various levels of the organizations, and whether appropriate funding and resources would be allocated. In our article, the term "IT governance characteristics" focuses on the (a) reporting relationship between the chief executive and the IT leader, (b) the support and commitment of top management received by the IT projects, and (c) the support and commitment of top management on business process improvement. The former is used as a surrogate for the seniority of the IT leader as will be explained and discussed further in the next section. A review of the literature about enterprise IT and systems adoption indicates that many of the enterprise IT projects would not be successful unless the deployment of IT is accompanied by changes to business practices and processes (Davenport, 1998; Sumner, 2000; Wu, 2002). Thus, senior management's attitudes and commitment on business process changes would also be critical to the success of enterprise IT projects.

While many studies have discussed, and some empirically investigated the relationships among IT adoption, business process changes and such organizational factors as senior management support and the seniority of IT leadership, there is still a need for additional empirical evidence to support these concepts (Grover, Teng, Segars, & Fiedler, 1998). On the other hand, such studies mostly examined the relationships at a coarse level, and have not attempted to investigate what aspects of IT are affected by these IT governance factors and what aspects are not. It would be more interesting to investigate these associations with

IT at finer granularities, that is, considering the various dimensions of IT. Therefore, the primary goals of this study are (a) to conduct a thorough literature review on the selected IT governance factors in relation to enterprise IT and business process initiatives, (b) to explore more deeply the concept of IT infrastructure capabilities and define its constituent dimensions, (c) to produce a conceptual model highlighting the relationships between the IT governance-related constructs and these two types of initiatives, and (d) to conduct an empirical study to substantiate or disconfirm the relationships.

The remainder of this article is organized as follows. A review of the literature and the conceptual model are presented, the methodologies and guidelines of the study are discussed, the analysis and the findings are presented, and concluding remarks are made following a discussion of the findings and their implications.

LITERATURE REVIEW

IT Infrastructure Capabilities

IT infrastructure is important to an organization as it embodies many of the components necessary to support the organization's overall information architecture (Allen & Boynton, 1991; Mudie & Schafer, 1985). It has also been argued in the MIS literature that the enterprise architecture of an organization is composed of the technical, data, and application architectures; which jointly enable the processing, sharing and management of data resources across divisional and organizational boundaries (Spewak & Hill, 1993).

This broader view of IT infrastructure has earned the acceptance of many authors in IT or MIS (Mitchell & Zmud, 1999; Weill & Broadbent, 1999). Generally speaking, IT infrastructure capabilities (ITC) would consist of a wide spectrum of components, including the IT platforms, standards, and policies, and different types of service arrangements that support the information-related activities of an organization. Included in this definition are corporate network infrastructure, hardware platforms, common business systems such as data management and project management systems, and IT management and support services. Among the latter is education and training (Weill & Broadbent, 1999). In fact, training has been considered an important issue by studies in IT investment and management (Brancheau, Janz & Wetherbe, 1996; Mahmood & Mann, 1993; Palvia & Wang, 1995; Sakaguchi & Dibrell, 1998). Many of these studies (Mahmood & Mann, 1993) put the focus on training IT staff, while some (Sakaguchi & Dibrell, 1998) considered IT training for users to be a key construct of the measurement model of the global use of information technology.

In summary, the construct of ITC is a multidimensional concept that may include many aspects of IT, ranging from the network infrastructure that enables communications within and across organizational boundaries, a portfolio of hardware and system software that supports transaction processing and information analysis, documentation that clearly defines the policies and procedures of IT management, expertise in managing the IT platforms and various stakeholders, and the training of IT staff and users.

In recognition of the contribution of IT to organizational performance, IT capabilities measures such as the monetary measures of IT investment and perceptual ratings have been used as surrogates in research on the business value of IT. Attempts have been made in such studies to explore the impact of IT capabilities on an organization. The studies of Bharadwaj (2000), and Santhanam and Hartono (2003) have confirmed the relationships between IT capability and the financial performance measures of profit- and cost-related ratios. In both studies, IT capability was defined using a dichotomous variable, by which a value of 1 denotes a firm that has been elected by InformationWeek as an "IT leader," and a value of 0 denotes a non-IT leader. In the study

of Andersen and Segars (2001), the effects of IT on the decentralization of the decision structure and on the financial performance of firms in the apparel and textile industry were empirically investigated. The instrument for IT measured the extent to which electronic mail services, electronic data transmissions, the company-owned telecommunication network, and fiber distributed data interfaces are used in a company (Andersen & Segars, 2001). Other studies found that IT infrastructure such as electronic data interchange (EDI) and network infrastructure had a significant impact on improvements in business processes (Bhatt, 2000, 2001). In Bhatt (2000), two aspects of information system integration were measured: the degree of data integration, and the use of network communications. The use of EDI in Bhatt (2001) was measured using the following three items: (a) the extent to which the firm and its primary suppliers were linked by EDI, (b) the extent to which information on products and services could be distributed to suppliers by senior management using information systems, and (c) the extent to which information on products and services could be shared between the firm and its suppliers. Likewise, the relationships between IT diffusion and perceived productivity gain, and the mediating effects of the business process redesign construct for different types of information technologies such as electronic mail, relational database management systems, expert systems, imaging, and local area networks were examined and confirmed in the study of Grover et al. (1998).

The preceding literature review leads to two points that deserve further discussion. First, IT adoption or diffusion and business process changes are inter-related, according to the studies that have been discussed. Second, the instruments that were developed primarily measure the use of individual IT platforms, rather than multiple dimensions of the IT infrastructure. In fact, there is a paucity of studies on the development of standardized multi-dimensional instruments for measuring the ITC of firms. The development of such an instrument would be conducive to IT studies in that it would assist with the repetitive and systematic measurements of ITC (Santhanam & Hartono, 2003).

Business Process Improvements and IT Adoption

Business process redesign refers to the revolutionary approach of process changes, which often requires "rethinking," and a drastic transformation of current business practices and processes. This approach is also called business process reengineering (BPR) (Earl & Khan, 1994; Hammer, 1990). Academic studies have also found that many firms have successfully made use of a "milder" evolutionary approach, which is referred to as business process improvements (BPI) (Harkness, Kettinger, & Segars, 1996; Stoddard & Jarvenpaa, 1995). This latter approach calls for less drastic changes to existing practice and processes.

Regardless of the approach adopted, changes in business process aim at the betterment and simplification of current practices and processes, and are considered critical for the deployment of IT systems in many circumstances. The interrelationships between IT and BPR have been widely discussed in the academic studies on MIS and business process management (Wu, 2002). IT enables new practices that would have been impossible before the advent of the technologies or systems. A lack of, or poor, IT infrastructure will limit or jeopardize the success of business process changes. Conversely, deploying IT without proper changes to business processes could compromise the outcomes. Many have considered business process redesign to be an important organizational construct with the potential to affect the outcomes of IT adoption (Grover et al., 1998). While there is plenty of theoretical discussion of the relationship between IT and business process changes in the literature, many of the studies are qualitative in nature, each involving very few cases, and therefore

lack of generalizability (Grover et al., 1998). On the other hand, some studies discussed the issues with very limited empirical support (Grover et al., 1998). This points to a need for further studies to gather empirical evidence across firms for the abovementioned relationship.

Organizational Factors for IT Adoption and Business Process Changes

The MIS literature is abundant in the discussion of organizational factors and how they may affect the outcomes of IT adoption and business process changes. These studies have explored a wide variety of organizational issues in different system contexts (Caldeira & Ward, 2002; Davenport, 1998; Chatterjee et al., 2002; Ein-Dor & Segev, 1978). To name a few as examples, organizational issues or factors discussed in these studies include the seniority of IT leaders (Ein-Dor & Segev, 1978), senior management support and attitudes (Caldeira & Ward, 2002; Counihan, Finnegan, & Sammon, 2002; Davenport, 1998; Wixom & Watson, 2001), IT governance and decisions (Ross & Weill, 2002), and many project management practices (Ahituv, Neumann, & Zviran, 2002; Kimberly & Evanisko, 1981; Wixom & Watson, 2001).

Support and Commitment of Top Management

Among the aforementioned organizational factors, those concerning the roles and behavior of top management may matter a great deal and probably be increasingly important since many IT initiatives nowadays are enterprise-wide projects, analogous to what is described as Type III IS Innovation in Swanson's (1994) taxonomy of IS innovations. This type of project would require a clear strategy and institutionalized efforts to mobilize the functions and its stakeholders across the organization to participate in the adoption process (Swanson, 1994). In many circumstances, the attitudes and actions of the company's leadership would help facilitate and shape the adoption process (Chatterjee et al., 2002; Swanson, 1994). Many IT initiatives such as ERP, are boundary-spanning efforts which often require a wide range of stakeholders to participate, and to accept changes to the business practices and processes. Unswerving support from the top management is necessary to resolve any conflict of interest among the various parties involved (Davenport, 1998; Grover, Jeong, Kettinger, & Teng, 1995; Ross & Weill, 2002). A lack of such support would likely pose a threat to the projects (Bingi, Sharman, & Godla, 1999; Sumner, 2000).

That said, the IT leadership may have an important role to play within an organization, for instance, in marketing an IT or business process initiative to the organization and to secure the support and resources for the initiative. The seniority of the IT leadership is one of the "IT governance characteristics" to be investigated in this study. The following subsections will explore into the concepts about the roles and the seniority of the IT leadership as found in the IT-related literature.

The Roles and Seniority of IT Leadership

The seniority of the IT leader within an organization is considered an important factor in the success of the abovementioned projects (Ein-Dor & Segev, 1978). The IT leader, called the IT manager, IT director, or CIO, is the most senior executive responsible for the IT function of an organization. In this study, we shall use the term CIO to refer to IT heads regardless of their formal job titles. A summary of relevant discussions about the ranks and roles of the IT leadership are provided in Table 1.

IT heads in some organizations are positioned under the finance function (Jones & Arnett, 1993). As reported by a survey conducted in 1990, 40% of the CIOs who participated in the survey re-

Table 1. Findings and discussions about the IT leadership

Findings and Discussions	References
Seniority–Hierarchical Position	
• Seniority of the IT executive is one of the factors affecting IT/IS adoption.	(Ein-Dor & Segev, 1978)
• The use of IT for competitive advantages must be supported by the rank and role of the IT leader.	(Karimi et al., 1996)
• "Proximity" between CEO and CIO would help to secure resources and support.	(Jain, 1997)
• Reporting relationship ("CEO-CIO distance") moderates outcomes of IT investment.	(Li & Ye, 1999)
• The position of IS affects IT/IS adoption.	(Marble, 2003)
• CIO's rank is conducive to business process reengineering	(Teng et al., 1998)
Seniority–Membership of TMT (Top Management Team)	
• CIO's participation in top management team enhances business knowledge.	(Armstrong & Sambamurthy, 1999)
• CIO's membership in TMT is more important than his reporting relationship.	(Earl & Feeney, 1994)
• CIO is a member of TMT and it is equally important to be perceived as senior executive.	(Rockart et al., 1982)
Responsibilities and Skill Requirements	
• CIO should possess competencies in four areas: business leadership, technology leadership, organizational leadership and functional leadership.	(Earl, 1989)
• CIO markets, and changes the perceptions about the IT function.	(Earl & Feeney, 1994; Lucas, 1999)
• CIO pro-actively communicates with and solicits support from the TMT.	(Lucas, 1999)
Problems Encountered	
• A junior IT leader finds it difficult to communicate with top management.	(Cash et al. 1992)
• Many IT leaders are not accepted by others in the TMT as senior executives.	(Rothfeder, 1990; Runyan, 1990; Strassmann, 1994)

ported to the COO, and a much smaller percentage reported to the CEO (Rothfeder, 1990). In other organizations, this leader is often a member of the senior management team, shares the responsibility of business planning, enjoys a senior status and, equally important, is perceived as a senior executive (Rockart, Bullen, & Ball, 1982). It was found in a survey conducted in 2002 that 51% of CIOs reported to the CEO (Field, 2002). This shows a trend that an increasing number of companies recognizes the strategic role of the IT leader and the IT organization, and places him or her higher in the corporate structure.

The CIO bears full responsibility for promoting the use of IT to improve or transform the current business practices of an organization, building

relationships and soliciting support from the CEO and other executives (Lucas, 1999). In fact, one of the CIO's most challenging responsibilities is to manage the CEO's perceptions about IT—that is, to persuade the CEO to think that IT is an organizational asset, rather than a cost (Earl & Feeney, 1994; Lucas, 1999).

These responsibilities require quality bilateral communications with the chief executive and others in the top management team to achieve an appropriate degree of mutual understanding (or convergence) with each other (Johnson & Lederer, 2003). As the CIO does not possess authority over any of his or her peers in the senior management team, he or she must achieve these objectives through "influence behavior," rather than through authority. For instance, rational persuasion and personal appeal are the most effective forms of influence behavior in soliciting support from the senior management team (Enns, Huff, & Higgins, 2003).

However, many CIOs have reportedly failed to obtain the acceptance from their peers and are considered outsiders to the senior management team (Rothfeder, 1990; Runyan, 1990; Strassmann, 1994). This may create hurdles to their efforts in communicating with the senior executives, or participate effectively in strategic planning. One may find the communication problem more serious for a junior ranking CIO, or in firms with a culture of informal communications (Cash, McFarlan, Mckinney, & Applegate, 1992). Moreover, a low-ranking CIO may put his/her focus on handling daily operations, and managing his or her subordinates (Ives & Olson, 1981), likely at the expense of the more strategic responsibilities.

This problem has led to the view that a formal senior position in the organizational hierarchy would give the IT executive more authority and influence within the organization (Jain, 1997; Hambrick, 1981). Though some academics argue that a full membership in, and effective communication with the top management team are more important than a formal senior position, others believe that a formal place in the top management team would give the CIO many advantages in terms of closer bilateral communications, and enhanced understanding of business strategies (Feeny, Edwards & Simpson, 1992; Gupta, 1991; Raghunathan & Raghunathan, 1993; Watson, 1990). Some empirical studies seem to support the formal approach. Karimi, Gupta & Somers (1996) pointed out that successful competitive strategies must be supported by the rank and role of the CIO. Li and Ye (1999) also found that a closer reporting relationship between the CEO and CIO would be conducive to the productive use of IT. Accordingly, it is likely that a direct reporting relationship with the CEO may help a CIO execute his/her duties effectively.

Given these discussions, it would be interesting to determine how these IT governance characteristics would affect the achievement of IT infrastructure capabilities and business process improvements in the companies under study.

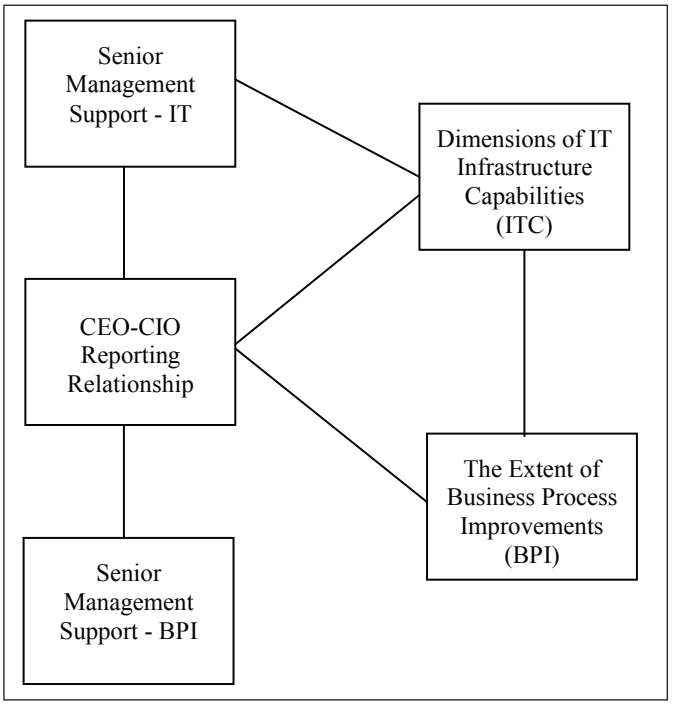
RESEARCH MODEL

To fulfill the objectives of this study, a research model is formulated to represent the key constructs and the conceptualized relationships, which will be discussed further in subsequent subsections. As depicted in Figure 1, the ITC dimensions and the extent of BPI are related, and these constructs are believed to be associated with the IT governance constructs of senior management support and CEO-CIO reporting relationship.

IT Infrastructure Capabilities

Following the broader definition presented in the last section (Weill & Broadbent, 1999), the construct of ITC is conceptualized to include items from five dimensions: network communications,

Figure 1. The conceptual model



data integration, hardware and system software, IT management and support, and training. The items of the first two dimensions, network communications and data integration, are based on a subset of items in the studies of Bhatt (2000, 2001); while training is derived from the study of Sakaguchi and Dibrell (1998) with modifications. The items of the dimensions of hardware and software, and IT management and support were developed after a thorough search through the literature on the subject (Allen & Boynton, 1991; Sambamurthy & Zmud, 1999; Spewak & Hill, 1993; Weill & Broadbent, 1999).

It must be noted that this construct and its subordinate dimensions aim at measuring the perceived "realized" capabilities of IT infrastructure, rather than what is anticipated by the respondents.

The Extent of Business Process Improvements

The extent of BPI refers to the perceived degree to which changes in processes have been implemented to improve the efficiency and effectiveness of a company. The construct includes five items to measure process improvement in terms of error prevention, quality, ease of use, and intra- and inter-firm coordination. The first three items have been adopted from the study of Bhatt (2000), while the items concerning intra- and interfirm coordination have been added in recognition of the increasingly important concepts of cross-boundary coordination (Kogut, 1985; Stock, Greis, & Kasarda, 1998).

This study supports the assumption that a relationship may exist between IT deployment and process improvements. IT can be an enabler

of changes to business processes, while the latter is necessary in many circumstances of IT deployment because automating inefficient processes would at best result in suboptimal outcomes (Hitt & Brynjolfsson, 1996; Stoddard & Jarvenpaa, 1995). Therefore, we put forward the following hypotheses:

$H_0$1: The perceived extent of a company's BPI and the perceived level of individual dimensions of ITC are positively related.

Senior Management Support and CEO-CIO Reporting Relationship

In this study, we have placed our focus on three IT governance-related constructs, namely senior management support of IT, senior management support of BPI, and the CEO-CIO reporting relationship. Senior management support is considered by many to be an important organizational factor for enterprise-wide IT and BPI projects (Ein-Dor & Segev, 1978; Grover et al., 1995; Sumner, 2000). The success of enterprise-wide projects requires the involvement of the user communities and the proper investment of resources (Nah, Zuckweiler, & Lau, 2003). The political roles played by senior executives in mitigating resistance to change and resolving conflicts between various interest groups must be accorded unequivocal importance (Davenport, 1998). Moreover, a supportive senior management team may influence the rest of the organization to take actions in favor of enterprise-wide initiatives. Senior management support in this study is a perceptual assessment, by the respondents, of the degree of support that top management gives to projects involving IT and BPI.

As a measure of the reporting relationship, the variable of CEO-CIO distance reflects how close or far apart the CIO is from the chief executive in the organizational structure. It can, therefore, be regarded as a surrogate of the seniority of the CIO. It is supposed that a CIO who reports directly to the chief executive will have a closer working relationship with him or her, and enjoy a higher status within the organization, than one who reports to other senior executives such as the COO or CFO.

We speculate that a high-ranking CIO would very likely have more opportunities to engage in high-quality two-way communications with the CEO and other senior executives, and a better understanding of business strategies than his or her low-ranking counterparts because of frequent participation in top management activities (Cash et al., 1992; Ives & Olson, 1981). This would be very important to the CIO in terms of the alignment of business and IT strategies, and his or her relationship with the senior management team. In addition to issues concerning communication and convergence between the senior IT and business leadership, having an IT governance structure in which the CIO is closer to the CEO and other senior executives may make it easier to implement the appropriate measures to secure from the rest of the organization the support and cooperation necessary for the success of an enterprise-wide initiative. For instance, a project bonus or award may be presented to the top performers of a project, or the contribution to the project may be considered as one of the important factors in annual staff performance appraisal.

We therefore posit that a CIO who enjoys a more senior position will be able to solicit stronger support for initiatives on IT and BPI, leading to more satisfactory outcomes for both types of projects. As the CIO is the head of the IT function, the status or importance of the IT function within the company is implied by his or her status. The following hypotheses are formulated:

$H_0$2: CEO-CIO distance as a measure of the CEO-CIO reporting relationship is negatively associated with the perceived level of senior management support of IT projects.

$H_0$3: CEO-CIO distance as a measure of the CEO-CIO reporting relationship is negatively associated with the perceived level of senior management support of BPI projects.

$H_0$4: The perceived level of the individual IT infrastructure capabilities dimensions of a company is positively associated with senior management support for IT projects.

$H_0$5: The perceived level of the individual dimensions of the IT infrastructure capabilities of a company is negatively associated with the CEO-CIO distance used as a measure of the CEO-CIO reporting relationship.

$H_0$6: The perceived extent of the BPI of a company is positively associated with senior management support for BPI projects.

$H_0$7: The perceived extent of the BPI of a company is negatively associated with the CEO-CIO distance used as a measure of the CEO-CIO reporting relationship.

RESEARCH METHODOLOGY

Data Sources

Perceptual data were collected by a postal survey. A survey package, containing a cover letter, a questionnaire booklet, and a return envelope with prepaid postage was sent to companies operating in different business sectors, including manufacturing, finance, logistics, wholesaling and retailing, and services. The 3,377 firms in the mailing list included 852 firms listed in the Stock Exchange of Hong Kong, and 2,525 multinationals operating in Hong Kong and China.

The cover letters, addressed to the chief executives or managing directors, solicited their support by explaining the objective of the research and the rules of confidentiality and anonymity, and asked them to forward the survey package, preferably to the IS executives, or to any officers nominated by them as appropriate to respond to the survey. A reminder postcard was sent to each nonresponding company at the end of the second week, and followed by telephone calls. These measures were taken to improve the response rate. In designing the study, serious consideration was given to the low response rates (around 10%) for social surveys conducted in Asian societies. This led to the decision to use a larger sampling frame for the survey.

Validity Guidelines and Research Procedures

Generally accepted guidelines in research (Churchill, 1979; Nunnally, 1978) were followed throughout the study, especially in the development of multi-item constructs. Items of individual constructs in this study were developed based on previously validated instruments and on a thorough review of the relevant literature. To ensure its face and content validity, the questionnaire was subject to a review and pretest, and then a pilot test.

An EFA was conducted for the sample, collected from the postal survey, on the ITC and the extent of BPI constructs to ascertain the convergent and divergent validity of the items under the dimensions (or subordinate constructs) in each construct. Items with factor loadings of 0.6 or above were retained for the constructs (Tracey, Vonderembse, & Lim, 1999), and those slightly below this cut-off point were reviewed for their importance and relevance to the objectives of the study following Dillon and Goldstein's (1984) guidelines. Internal consistencies were validated, and Cronbach's alpha coefficients equalling or exceeding 0.7 were considered acceptable (Kerlinger, 1973). In the purification process, items with corrected-item total correlations (CITC)

of less than 0.5 were eliminated, or rephrased if they were important, following Churchill's (1979) recommendations.

This study followed a two-stage approach. An EFA was first performed to determine the dimensions of the high-level constructs, namely, the ITC and the extent of BPI constructs. Subsequent to the EFA, firm-level indices were calculated for individual ITC dimensions, and for the extent of BPI respectively. For example, the BPI index of a firm was derived by averaging the firm's perceptual inputs to the five BPI question items. The index for the training dimension of ITC was computed by taking the average of the firm's inputs to the three training items and so on. A data analysis was then conducted using a nonparametric correlation analysis (Spearman's rho) to test the relationships between the ITC dimensions, and the other constructs.

Instrument Development and Pilot Test

Instruments for soliciting perceptual ratings of ITC and the extent of BPI were developed based on a review of the literature, and on pretested instruments used in prior studies. The ITC instrument contains 16 items: four on network communications, three on data integration, three on hardware and system software, three on IT management and support, and three on training. The network communications and data integration items were based on the studies of Bhatt (2000, 2001) with adjustments to the wording. The training items included IT training for staff and users and were based on the study of Sakaguchi and Dibrell (1998). The items of hardware and software, and those of IT management and support measured the perceptual assessment of the capacities of the hardware and software facilities, administrative standards and procedures, and support services. These items were considered important to achieving a comprehensive ITC construct (Allen & Boynton, 1991; Mitchell & Zmud, 1999; Mudie & Schafer, 1985; Spewak & Hill, 1993; Weill & Broadbent, 1999).

The extent of BPI consisted of five items to capture assessments of realized process changes in terms of error prevention, process quality, ease of use, and inter- and intra-firm coordination. The first three items were derived from Bhatt (2000), with adjustments to the wording, and the items of coordination were added to improve the comprehensiveness of the instrument.

The instrument items are based on a 5-point Likert scale, with 1 being equal to *strongly disagree,* 2 to *disagree,* 3 to *neutral,* 4 to *agree,* and 5 to *strongly agree.* As discussed previously, these instruments were reviewed and pretested by six MIS executives and two academics, followed by the pilot test involving 60 evening MBA students. Their comments concerning the comprehensiveness and wording of the questionnaire items led to improvements of the instruments. Cronbach's alpha coefficients were computed using the 51 usable cases collected from the pilot test. The ITC instrument demonstrated acceptable internal consistency (Kerlinger, 1973). The alpha coefficient of the BPI items was below the cut-off value of 0.7; these items were therefore rephrased.

Measures of the IT Governance Constructs

As discussed, this study used the reporting relationship between the CEO and CIO as a surrogate for the status of the CIO (and the IT function). The questionnaire included a question with four options. The question reads "The head of IT in your company reports to (1) the CEO, (2) the CFO, (3) the COO, and (4) others, please specify". The responses to option 4 were to be analyzed to determine the levels of the IT head and his or her supervisor within the structure of the organization. This question was recoded to form the CEO-CIO distance variable, whose values were 1 for a CIO who directly reported to the CEO, 2 for a CIO who reported to a senior officer other than the CEO, 3

for a CIO who reported to a manager on the next level downward in the organizational hierarchy, and so forth, to reflect the reporting distance of the IT head from the CEO. This coding method was adopted and expanded from that used in Li and Ye (1999).

Two questions were included to solicit perceptual ratings on senior management support: one for IT and the other for BPI projects. Both were 5-point Likert scale questions, with 1 indicating *strongly disagree,* 3 *not certain,* and 5 *strongly agree.*

To operationalize the nonparametric tests for the relationships between the IT governance constructs, ITC dimensions, and the extent of BPI construct, the BPI index (labeled BPI_I) and indices for the individual ITC dimensions (labeled ITC_IFC, ITC_DI, ITC_FM and ITC_TR) were computed, after the EFA, for each firm based on its responses to the survey.

ANALYSIS AND FINDINGS

Profiles of the Respondents

Three hundred and six questionnaires were returned, giving a response rate of 9.1%. For the sake of data quality, returned questionnaires with missing data and those filled out by relatively junior staff such as programmers were dropped. Therefore, 243 usable cases were retained in the sample, yielding an effective rate of 7.1%. Among the 243 responding companies, 65 (26.7%) were listed in Hong Kong, 64 (26.3%) in Europe, 41 (16.97%) in North America, and 60 (24.7%) in

Table 2. Profiles of the respondents

Personal Attributes	Frequency	
Years of Age		
25–30	49	(20.2%)
31–40	109	(44.9%)
> 40	76	(31.3%)
Unknown	9	(3.7%)
Total	243	(100.0%)
Education Level		
Secondary	1	(0.4%)
Post-secondary certificate/ diploma	25	(10.3%)
Bachelor's degree	125	(51.4%)
Master's degree	85	(35.0%)
Doctoral degree	2	(0.8%)
Unknown	5	(2.1%)
Total	243	(100.0%)

Personal Attributes	Frequency	
Years in Present Profession		
Less than 3 years	13	(5.3%)
3 to 6 years	45	(18.5%)
7 to 10 years	59	(24.3%)
11 to 14 years	44	(18.1%)
More than 14 years	79	(32.9%)
Unknown	3	(1.2%)
Total	243	(100.0%)
Seniority Level		
Chief executive	22	(9.1%)
Senior management	44	(18.1%)
Middle management	111	(45.7%)
Front-line supervisors & project leaders	53	(21.8%)
Unknown	13	(5.3%)
Total	243	(100.0%)

Table 3. The four factors of the IT infrastructure capabilities construct

Item	Description	IFC	DI	FM	TR	Alpha
NC1	Networks link the firm and its main suppliers.	0.772				
NC2	Networks link the firm and its main customers.	0.795				0.8222
DI1	The same information in the database is shared across the firm.		0.761			
DI2	Duplication of data is eliminated.		0.769			0.8206
DI3	Definitions of data elements are standardized.		0.629			
HS1	Server platforms have sufficient capacity.			0.652		
HS2	Regular preventive maintenance minimizes down time.			0.684		
MS1	The firm has the expertise to manage IT facilities.			0.713		0.8848
MS2	Users are happy with the IT services.			0.663		
MS3	IT administration standards and procedures are well defined.			0.613		
TR1	The company has effective IT training programmes.				0.752	
TR2	Training for users is sufficient.				0.799	0.8841
TR3	Training for IT personnel is sufficient.				0.771	

Note. IFC = interfirm communications, DI = data integration, FM = IT facilities and management, TR = training, Alpha = Cronbach's alpha (α).

Table 4. The extent of business process improvement construct and factor loadings

Item	Description	BPI	Alpha
BP1	Process changes help prevent defects and errors.	0.663	
BP2	Process standards are raised periodically.	0.728	0.8395
BP3	New processes are easier to work with.	0.738	
BP4	Work processes are improved to facilitate coordination within the firm.	0.814	
BP5	Work processes are improved to facilitate coordination with external parties.	0.644	

Note. BPI = the extent of business process improvement, Alpha = Cronbach's alpha (α).

other parts of Asia. The demographics of the respondents are presented in Table 2.

Exploratory Factor Analysis and Internal Consistency

Following the screening of returned questionnaires, an EFA was performed separately on the ITC and the extent of BPI items. Maximum likelihood was used as the extraction method and Varimax as the rotation method in this study. Items with factor loadings of less than the cut-off value of 0.6 were dropped from the construct (Tracey et al., 1999). The dimensions and their items (indicators) that satisfied the criterion are shown in Tables 3 and 4.

Table 5. Reporting relationships of IT leadership

Title of Supervisor	Frequency	CEO-CIO Distance Encoded
CEO/Managing Director	128 (52.7%)	1
Chief Financial Officer (CFO)	68 (28.0%)	2
Chief Operating Officer (COO)	44 (18.1%)	2
Others[1]	3 (1.2%)	2
	243 (100.0%)	

Note. Three job titles entered by the respondents indicated positions that are one level below the CEO.

The EFA not only led to the elimination of some indicators from the ITC construct but also to the merger of two conceptualized dimensions. Two items concerning intra-firm communications under the "Network Communications" dimension ("NC3: Personnel can efficiently exchange information using e-mail systems," and "NC4: Company units can readily access data and applications on the network") were found to have insignificant factor loadings. One item, "HS3: Both hardware and system software are upgraded frequently," under the "Hardware and System Software" dimension was also dropped for low loading. The indicators initially conceptualized under the "Hardware and System Software" and "IT management and support" dimensions were identified as belonging to a single factor, renamed "IT Facilities and Management." Consequently, the ITC construct was found to be composed of four dimensions: "Interfirm Communications" (IFC), "Data Integration" (DI), "IT Facilities and Management" (FM), and "Training" (TR). An EFA found that the extent of BPI is unidimensional and that all five items loaded under a single factor.

The items under the extent of BPI, and those under individual dimensions of the ITC construct were analysed separately for internal consistency (refer to Tables 3 and 4). The Cronbach's alpha coefficients for the ITC dimensions exceeded the cut-off value of 0.7 (Kerlinger, 1973). The Cronbach's alpha coefficient of the BPI construct was 0.8395, thus satisfying the threshold value of 0.7 (Kerlinger, 1973). In addition, the CITC (i.e. corrected-item total correlations) value of each item under these two constructs exceeded 0.5, meeting Churchill's (1979) guidelines.

Hypothesis Testing

Subsequent to the purification of measures and the EFA, the firm-level indices, namely BPI_I (for the extent of BPI construct), and ITC_IFC, ITC_DI, ITC_FM and ITC_TR (for the individual ITC dimensions) were calculated for each responding firm. The responses concerning the reporting relationship of the IT leadership were analyzed before recoding. In this sample, 128 (52.7%) IT leaders reported directly to the CEO or managing director, 68 (28.0%) to the chief financial officer (CFO), and 44 (18.1%) to the chief operating officer (COO). Three respondents indicated that their IT leaders reported to supervisors other than the CEO, CFO, and COO. Based on the job titles entered by respondents, we determined that these supervisors were one level below that of the CEO/Managing Director. Responses to this question item were then recoded to form the CEO-CIO distance variable (CC_DIST), which reflected how far the IT leader was from the CEO/Managing Director in the organization chart. As a result, 128 IT leaders in the sample

were assigned a value of "1," and the rest were assigned a value of "2" in the CEO-CIO distance variable (refer to Table 5).

In addition, the descriptive statistics of variables used in this study were computed and presented in Table 6, showing that the data does not conform to the assumption of normal distribution. This characteristic of data distribution and the fact that many variables are "ordered categories" justify the use of nonparametric statistical methods (Norusis, 2003).

Recall that the objectives of this study are to investigate whether the perceived level of ITC dimensions, and extent of BPI of a company

Table 6. Constructs, variables created, and descriptive statistics

Constructs	Variables Created	*N*	Mean	Std. Deviation
ITC Interfirm Communications	ITC_IFC	243	3.4486	0.91387
ITC Data Integration	ITC_DI	243	3.8299	0.75780
ITC IT Facilities and Management	ITC_FM	243	3.7407	0.74153
ITC Training	ITC_TR	243	3.1920	0.85960
The Extent of Business Process Improvement	BPI_I	243	3.4313	0.62272
Senior Management Support of IT Projects	MS_IT	242	3.8100	0.99200
Senior Management Support of BPI Projects	MS_BPI	242	3.8000	0.93500
CEO-CIO Reporting Relationship	CC_DIST	243	1.4733	0.50031

Note. ITC_IFC = Index of the ITC Interfirm Communication dimension, ITC_DI = Index of the ITC Data Integration dimension, ITC_FM = Index of the ITC IT Facilities and Management dimension, ITC_TR = Index of the ITC Training dimension, BPI_I = BPI Index, MS_IT = Management Support of IT, MS_BPI = Management Support of BPI, CC_DIST = CEO-CIO Distance.

Table 7. Correlation analysis (Spearman's rho)

Variables	ITC_IFC	ITC_DI	ITC_FM	ITC_TR	BPI_I	MS_IT	MS_BPI	CC_DIST
ITC_IFC	---	---	---	---				
ITC_DI	---	---	---	---				
ITC_FM	---	---	---	---				
ITC_TR	---	---	---	---				
BPI_I	0.333**	0.331**	0.548**	0.510**	---			
MS_IT	0.264**	0.298**	0.454**	0.355**	0.371**	---		
MS_BPI	0.279**	0.317**	0.424**	0.386**	0.445**	0.574**	---	
CC_DIST	-0.141*	-0.125	-0.187**	-0.114	-0.178**	-0.188**	-0.172**	---

Note. ITC_IFC = Index of the ITC Inter-firm Communication dimension, ITC_DI = Index of the ITC Data Integration dimension, ITC_FM = Index of the ITC IT Facilities and Management dimension, ITC_TR = Index of the ITC Training dimension, BPI_I = BPI Index, MS_IT = Management Support of IT, MS_BPI = Management Support of BPI, CC_DIST = CEO-CIO Distance.

** Correlation is significant at the 0.05 (2-tailed) level.*

*** Correlation is significant at the 0.01 (2-tailed) level.*

Table 8. Summary of findings

	Hypothesis	Finding
$H_0$1a:	ITC_IFC and BPI_I positively related	S[a]
$H_0$1b:	ITC_DI and BPI_I positively related	S[a]
$H_0$1c:	ITC_FM and BPI_I positively related	S[a]
$H_0$1d:	ITC_TR and BPI_I positively related	S[a]
$H_0$2:	CC_Dist and MS_IT negatively related	S[a]
$H_0$3:	CC_Dist and MS_BPI negatively related	S[a]
$H_0$4a:	ITC_IFC and MS_IT positively related	S[a]
$H_0$4b:	ITC_DI and MS_IT positively related	S[a]
$H_0$4c:	ITC_FM and MS_IT positively related	S[a]
$H_0$4d:	ITC_TR and MS_IT positively related	S[a]
$H_0$5a:	ITC_IFC and CC_Dist negatively related	S[b]
$H_0$5b:	ITC_DI and CC_Dist negatively related	NS
$H_0$5c:	ITC_FM and CC_Dist negatively related	S[a]
$H_0$5d:	ITC_TR and CC_Dist negatively related	NS
$H_0$6:	BPI_I and MS_BPI positively related	S[a]
$H_0$7:	BPI_I and CC_Dist negatively related	S[a]

Note. ITC_IFC = Index of the ITC Interfirm Communication dimension, ITC_DI = Index of the ITC Data Integration dimension, ITC_FM = Index of the ITC IT Facilities and Management dimension, ITC_TR = Index of the ITC Training dimension, BPI_I = BPI Index; MS_IT = Management Support of IT, MS_BPI = Management Support of BPI, CC_DIST = CEO-CIO Distance, NS = Not Significant.

[a] Significant at $p < 0.01$. [b] Significant at $p < 0.05$ (2-tailed).

are interrelated, and whether associations exist between the former constructs and the IT governance-related constructs of senior management support, and the status of the IT leader within that organization (using CEO-CIO distance as proxy). To fulfill these objectives, nonparametric tests were conducted. The findings are presented in Tables 7 and 8.

Using a nonparametric correlation analysis (Spearman's rho), the associations between the indices of individual dimensions of the ITC construct and the variables representing other constructs were tested. The indices computed for the individual ITC dimensions (namely, ITC_IFC, ITC_DI, ITC_FM, and ITC_TR) were first correlated to the BPI index (BPI_I), yielding statistical support for hypothesis 1 (refer to Tables 7 and 8 for the findings for $H_0$1a, $H_0$1b, $H_0$1c, $H_0$1d). The relationships between the individual indices of ITC dimensions and the variable of management support of IT projects (MS_IT) were tested, confirming hypothesis 4 (refer to Tables 7 and 8). Then, these indices for individual ITC dimensions were correlated to the variable of CEO-CIO distance (CC_DIST), and it was found that hypothesis 5 was only partially supported. While the negative associations between CC_DIST and ITC_IFC and ITC_FM were statistically supported, the ones

between CC_DIST and ITC_DI and ITC_TR were not (Refer to $H_0$5a, $H_0$5b, $H_0$5c, and $H_0$5d in Tables 7 and 8).

Nonparametric correlation analyses were also performed respectively for the relationships between the variables of CEO-CIO distance (CC_Dist), and senior management support of IT projects (MS_IT); between the variables of CEO-CIO distance (CC_Dist), and senior management support of BPI projects (MS_BPI); between the variables of BPI index (BPI_I) and senior management support of BPI projects (MS_BPI); and between the variables of BPI index (BPI_I) and CEO-CIO distance (CC_Dist). The resulting correlation coefficients (Spearman's rho) were statistically significant, hence confirming hypotheses $H_0$2, $H_0$3, $H_0$6, and $H_0$7.

DISCUSSIONS AND IMPLICATIONS

Discussions of Findings

This study demonstrated the positive correlation between the capabilities of individual dimensions of IT infrastructure and the extent of BPI, reinforcing the symbiotic relationship widely discussed in the MIS literature. As an extrapolation from this finding, we would like to point out that the special relationship of these constructs needs to be given special attention. In IT deployment projects, business process issues need be properly managed, or vice versa. As is often discussed in the literature, IT deployment without process amelioration might be a waste of opportunities for efficiency gains and IT investment, as in the cases of implementing an ERP, or a document management/workflows system. On the other hand, IT would give business process redesign initiatives new possibilities in business practice and methods. For instance, the installation of networking and communications facilities (and the Internet) would give a firm the opportunities to reexamine how to organize its project teams and work processes. Therefore, we incline towards the viewpoint that the role of each of these interacting constructs varies in different situations and according to enterprise objectives. It would be difficult to ascertain the cause–effect relationships between them. Given the mutual influence between IT and business process changes, success factors for both constructs need to be considered thoroughly and managed properly if improvements are to be made to IT and process management practices. Ignoring such factors will render the management model incomplete, thus exposing the project to the risk of failure.

Higher levels of management support and a closer reporting relationship between the CEO and CIO were found to be associated with better performance in BPI, and some dimensions of ITC, as perceived by the respondents. In parallel to these findings, a closer CEO-CIO reporting relationship was also associated with higher levels of senior management support. The statistical results appear to suggest that, regardless of company background, management support and the status of the IT leader (and that of the IT function) are among the key factors to successful outcomes in achieving the objectives of ITC and BPI. The reporting relationship of the CIO is initially dictated by the organizational structure of a company. A closer direct reporting relationship, indicating a senior ranking, might possibly put the CIO in a better position to communicate with and influence senior business executives in comparison to an indirect reporting relationship (Cash et al., 1992; Hambrick, 1981; Jain, 1997). As an executive has said in a survey of CIOs (Field, 2002), whom the CIO reports to does matter a great deal. A CIO who reports directly to the chief executive is perceived as being more important than one who does not, and what he says would therefore carry more weight among the audience (Field, 2002). The findings of this study have shed light on the general belief that positioning the CIO and his or her team prominently in the organization structure may help the organization achieve

better performance in IT and BPI projects. The findings of this study are in alignment with the propositions of Ein-Dor and Segev (1978).

The finding that who a CIO reports to is important is also consistent with what has been discussed in the ERP literature (Davenport, 1998; Willcocks & Sykes, 2000). These studies emphasized the importance of the support from senior executives in enterprise-wide projects, which often require changes to boundary-spanning processes. Business leaders should play a key role in mediating between different divisions to defuse difficult political situations concerning the interests of various stakeholders in these cases (Davenport, 1998). It would be of interest to IT practitioners and academic researchers to explore this issue further. However, we need to take note of the other school of thought that considers communication quality and membership in top management team as more important than a formal senior job title (Earl & Feeney, 1994). Earl and Feeney's opinion may not be in conflict with that of the other academics espousing a formal senior hierarchical position for the IT leader. A formal senior position may mean a greater chance to participate in the top management team. Moreover, it must be reminded that a closer reporting relationship in the organizational structure works only if the CIO is in possession of the right attributes to effectively perform his/her job (such as the personality, skills and commitment necessary for building a good and trustful working relationship with the business leaders). Violating this assumption may render the CIO unfit for the organization.

Noteworthy is the attempt in this study to understand and pinpoint the dimensions of the ITC and the extent of BPI constructs. An EFA showed that the latter is unidimensional and the former consists of four dimensions, namely inter-firm communications, data integration, IT facilities and management, and training.

Subsequent to the EFA, this study demonstrated the associations of each dimension of the ITC construct with the BPI construct and management support of IT projects. That is, the perceived levels in the extent of BPI, and senior management support are related to perceived levels of these individual aspects of IT. The CEO-CIO reporting relationship was found to relate significantly to the ITC dimensions of interfirm communications and IT facilities and management. These showed the associations between the organizational characteristics, particularly the chosen IT governance-related constructs, and enterprise IT capabilities. The reason for the insignificant relationships between the CEO-CIO reporting relationship and the ITC dimensions of data integration and training is unknown. Rather than contributing a speculative explanation, we would like to attribute these findings to data issues, and suggest that these relationships be retested using a different sample. As a consolation, the relationships were supported at the significance level of 0.10, indicating weak associations.

Academic and Professional Contributions

This study contributes to research by gathering empirical evidence on the associations between contextual constructs (such as senior management support and CEO-CIO reporting relationships), and the perceived levels of achievement in the various dimensions of ITC and BPI in Hong Kong-listed and multinational firms operating in Hong Kong and China. The influence of these constructs has been discussed in many studies, in some cases with limited empirical support, or in others with empirical findings that are weak in generalizability. The findings of this survey help fill the gaps that exist in the literature.

Executives and IT leaders are advised to learn to manage organizational constructs in conjunction with their enterprise-wide initiatives of IT adoption and BPI. Such organizational constructs as senior management support and CEO-CIO reporting relationship must be accorded paramount importance and managed cautiously. This also

implies that firms that regard IT and business process management as important capabilities should place their CIOs and IT functions in prominent and influential positions (Karimi, Gupta, & Somers, 1996). Moreover, the CIO and CEO should work closely together to produce a synergistic effect on the strategic alignment of business and IT, and in securing support from other senior executives.

While this has important implications for business and IT executives, academic researchers in the disciplines of MIS and business management need to appreciate these findings and view them as pointers to more in-depth studies in the future.

Finally, in this study the concept of the ITC construct was empirically explored and those of its dimensions, comprising not only capabilities in communications and systems management but also those in data integration and training, were identified. An attempt was also made to investigate which of these ITC dimensions were associated with the organizational constructs under study.

Limitations

Although generally accepted guidelines and principles in research were followed in this study (Churchill, 1979; Nunnally, 1978), it has some potential limitations. First, this study relied on the perceptual inputs of the same respondents for the multiple variables in the research model; therefore, the likelihood of common method bias cannot be entirely ruled out. Second, this study is limited by its cross-sectional sample. The empirical findings, therefore, have substantiated correlational, but not necessarily causal relationships. For instance, while it is known that CEO-CIO distance and senior management support are negatively related, it cannot be determined whether higher levels of senior management support are the result of a closer CEO-CIO relationship, or vice versa.

Further Studies

Consequently, it must be added that a longitudinal study would help clarify and reinforce the relationships reported in this study. The findings of this study also point to many opportunities for further research. Practitioner reports have pointed to an upward trend over the last decade of placing the CIO directly under the chief executive (Field, 2002; Rothfeder, 1990). This practice may have hinted that more companies are treating IT as a strategic asset, rather than a cost to an organization. Studies should be conducted to examine whether there exists an association between the positioning of the CIO and the objective of using IT as an enabler of competitive capabilities in the business world as Karimi et al. (1996) suggested. Similarly, it would be of interest to ascertain whether the abovementioned trend in CIO positioning has actually contributed to the effective use of IT in supporting business strategies.

As a last note on the further advancement of MIS research, we would like to advise that academic researchers should continue to strengthen the theoretical explanations for the influence of the organizational constructs mentioned above. On the further development of the ITC construct, we would like to suggest that the ITC items and conceptualised dimensions be validated using another data sample as a further confirmation of its dimensionality. Additional efforts in this area would contribute to the development of a comprehensive standard instrument for measuring ITC that supports repetitive and systematic studies across contexts (Santhanam & Hartono, 2003).

Conclusion

This study has yielded empirical findings that demonstrate the associations between the perceived levels of achievement in some ITC dimensions

and the organizational constructs, namely the BPI and IT governance constructs. Such associations may be regarded as hints that it is necessary for firms to properly manage these organizational factors, in the course of planning and executing any IT adoption and business process management initiatives. An in-depth understanding of the influence of various organizational factors may contribute to the further refinement of practice, and to better outcomes in IT adoption and business process management.

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