Information Systems Research

Publication details, including instructions for authors and subscription information:
http://pubsonline.informs.org

The Influence of Business Managers' IT Competence on Championing IT

Geneviève Bassellier, Izak Benbasat, Blaize Horner Reich,

To cite this article:
Geneviève Bassellier, Izak Benbasat, Blaize Horner Reich, (2003) The Influence of Business Managers' IT Competence on Championing IT. Information Systems Research 14(4):317-336. http://dx.doi.org/10.1287/isre.14.4.317.24899

The Influence of Business Managers' IT Competence on Championing IT

Geneviève Bassellier • Izak Benbasat • Blaize Horner Reich
Faculty of Management, McGill University, Montréal, Quebec, Canada H3A 1G5
Sauder School of Business, University of British Columbia, Vancouver, British Columbia, Canada V6T 1Z2
Faculty of Business Administration, Simon Fraser University, Vancouver, British Columbia, Canada V5B 5K3
genevieve.bassellier@mcgill.ca • benbasat@sauder.ubc.ca • breich@sfu.ca

With the increased importance of IT in organizations, business managers are now expected to show stronger leadership in regard to its deployment of IT in organizations. This requires greater focus on their capability to understand and use IT resources effectively. This paper explores the concept of IT competence of business managers as a contributor to their intention to champion IT within their organizations. Based on the knowledge literature, IT competence is defined as "the set of IT-related knowledge and experience that a business manager possesses."

The relationship between IT knowledge, IT experience, and championing IT is tested empirically using Structural Equation Modeling with LISREL. Four hundred and four business managers from two large insurance organizations were surveyed. Specific areas of IT knowledge and IT experience were first identified and the first half of the data set was utilized to assess the measurement properties of the instrument in a confirmatory analysis. The contribution of IT knowledge and IT experience to their intention to champion IT was assessed using the second half of the data set. The results show that IT knowledge and IT experience together explain 34% of the variance in managers' intentions to champion IT. Recommendations are given as to how organizations can enhance their business managers IT knowledge and experience to achieve stronger IT leadership from line people.
(*IT Competence; IT Knowledge; IT Experience; Championing IT; Measuring IT Competence*)

1. Introduction

In the early days of organizational use of information technologies (IT), the main responsibility to acquire, implement, and maintain IT investments belonged to the specialists within the Information Systems (IS) department. Since the mid-1980s, as the strategic impact of IT became evident, researchers and practitioners alike have argued that the management of IT and leadership in IT must be a shared endeavour between IT professionals and line managers (Henderson 1990, Keen 1991, Rockart 1988, Sambamurthy and Zmud 1994, Smith 1996). A recent article in the *McKinsey Quarterly* (Brown et al. 2003) argues that new organizational structures that encourage IT and business units to share responsibility over the management of IT assets lead to a more efficient running of IT systems. This points to a new role for business managers. To achieve successful IT planning and IT implementation, it is essential for business managers to take a leadership position in these activities. These views are captured in the following quote from Rockart et al. (1996, p. 53):

> The success or failure of an organization's use of IT [...] is only partially dependent on the effectiveness

1047-7047/03/1404/0317
1526-5536 electronic ISSN

> of the IT organization. It is even more dependent on the capability of line managers at all levels to understand the capabilities of the IT resource and to use it effectively.

According to Rockart et al. (1996), line managers are more likely to assume leadership in regard to IT when they have the appropriate IT education and training. To test this proposition, this study focuses on business managers and investigates competencies in the IT domain that will enable them to assume a new leadership role in regards to IT (Rockart et al. 1996). Specifically, the study examines one particular dimension of this leadership role—the proactiveness of line managers in championing the use of IT within their organization.

The IT literature lacks an in-depth discussion of the specific competence construct and its measures. At the organizational level, Sambamurthy and Zmud (1994) developed a set of enterprisewide IT management competencies. However, at the individual level, no such work exists. For example, Reich and Benbasat (2000) observed that *shared knowledge* between business managers and IT professionals is an important enabler of the alignment of business and IT objectives. While IT knowledge of line managers and business knowledge of IT professionals were measured in their study, this was done in a qualitative, aggregate way in a case study setting. Reich and Benbasat (2000) have suggested that further work be undertaken to measure these constructs with more granularity in order to fully understand their nature and their influence. Only with such constructs and tests will it be possible to find out what *specific types* of IT knowledge in business managers lead to IT leadership and successful IT utilization, and from this, to achieve an understanding of the kinds of knowledge that IS academics need to convey to current and future managers.

This paper reports on a study to test the influence of the IT competence of business managers on their intentions to champion the use of IT within their organization. Prior to testing the model, we first define, develop, and test an instrument to assess the levels of IT competence. Section 2 of this paper summarizes the literature supporting our definition of IT competence and describes how its dimensions and subdimensions are conceptualized. Section 2 also discusses the dependent variable, intentions to champion IT, and the hypotheses. Section 3 describes the testing of the model, including the development of measures and the validation process. Sampling design and confirmatory analysis are described in detail. The model is then examined by measuring the relationship between IT competence and a business manager's intentions to champion IT. Section 4 discusses the findings, identifies the limitations, and highlights the implications of this work. It is our hope that, with refinement, this instrument will prove valuable to researchers and practitioners alike, allowing them to map the IT competence in an organization, to identify factors blocking and enabling IT competence, and to implement corrective actions.

2. Conceptual Framework

The model that is to be tested in this study is shown in Figure 1. It is taken from previous conceptual work (Bassellier et al. 2001).

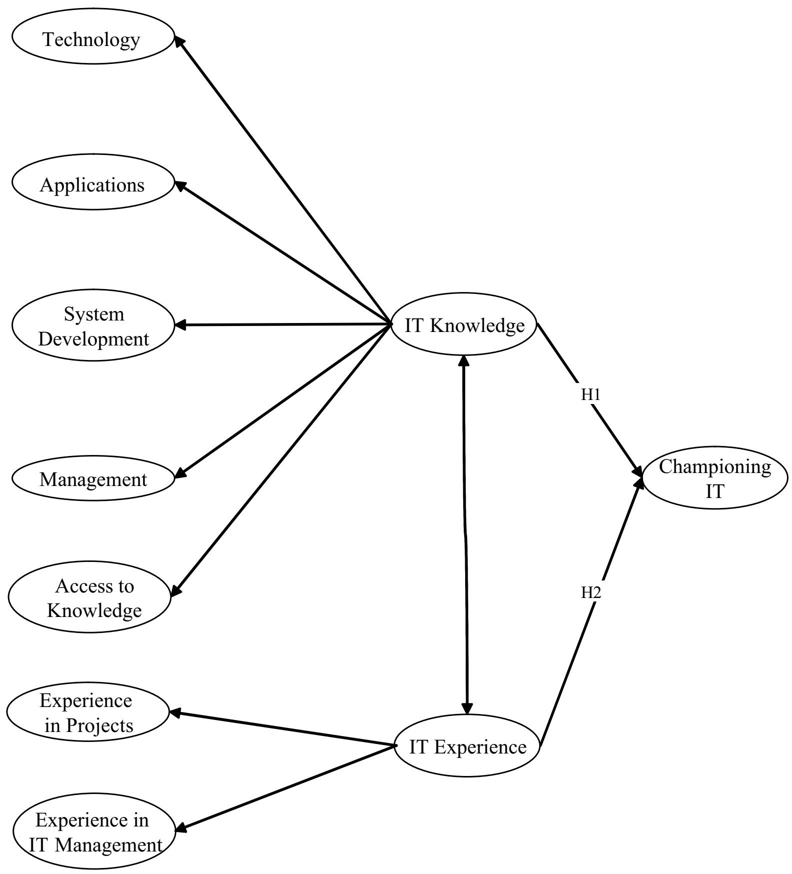
The next sections of this paper discuss the three major constructs in this model: IT knowledge, IT experience, and intention to champion IT, and describe the hypothesized the relationships among them.

2.1. IT Competence of Business Managers

In this study, competence is conceptualized as a duality, including the knowledge and experience of the business manager. Knowledge is a key part of competence, but as competence is grounded in everyday practice (Orlikowski 2002), knowledge on its own is not sufficient to represent competence. In that sense, competence is more than the knowledge possessed by individuals; it also encompasses the use or exploitation of such knowledge—the ability to put knowledge into practice (Brown and Duguid 1998). It is the process of search and learning—embracing different types of knowledge and activities—that will lead to performance (Karnøe 1995).

These two aspects of knowledge and practice are found at different levels in the literature. In their explanation of why some firms continually innovate, Cohen and Levinthal (1990) introduced the term "absorptive capacity" and suggested that it

Figure 1 Model to Be Tested



refers "not only to the acquisition or assimilation of information by an organization, but also to the organization's ability to exploit it" (Cohen and Levinthal 1990, p. 131). At the individual level, common knowledge refers to the commonality of vocabulary, conceptual knowledge, and experiences among individual specialists (Grant 1996), focusing on the importance of both knowledge and practice. In the practitioner literature, according to Forrester Research, the new technology executive is one "who appreciates technology's capabilities and uses technology as a lever to deliver outstanding business results" (Smith 1996, p. 39).

Other frameworks have sought to expand on the concept of knowledge either by dividing it into explicit and tacit forms, or by adding the concept of *knowing*. According to Cook and Brown (1999), knowing refers to the ability to put knowledge into practice, and knowledge is seen as something someone possesses. They refer to *knowing* as belonging to an epistemology of practice, and *knowledge* as being part of an epistemology of possession. Knowledge is also specialized—a usable body of facts and concepts relevant for a particular job (Boyatzis 1982). We can further distinguish between these concepts by noting that knowledge is static and is something we *use* in action, while knowing is dynamic and is *part* of the action.

Many organizational studies use the taxonomy of knowledge that distinguishes *tacit* from *explicit* knowledge. Based on this taxonomy, explicit knowledge is knowledge that can be taught, read, and explained (Nonaka 1994, Polanyi 1967, Ryle 1949). Polanyi (1967) identified that knowledge consists of more than the explicit, formal knowledge that can be clearly transmitted using systematic language. Individuals also know how to do things that they may not be able to render in an explicit fashion (Polanyi 1967). Although most people can walk without difficulty, for example, few can explain the mechanics and techniques that make us able to walk. Therefore, tacit knowledge is gained through personal experience and is not easily transmittable (Nonaka 1994, Polanyi 1967, Ryle 1949). One main challenge with this taxonomy is that while the concept of tacit knowledge is intuitively easy to understand, it is difficult to model and capture.

The relationship between these two taxonomies is complex. Despite the greater recognition of the importance of knowing as a distinct element from knowledge, how this fits with the explicit-tacit taxonomy is not clear. Some argue that tacit knowledge is distinct from knowing (Cook and Brown 1999), while others claim that it is a form of knowing (Orlikowski 2002). However, both perspectives highlight the role of *action* in knowing.

What emerges from these studies is the importance of a multidimensional perspective of competence. Based on this, it becomes essential to look at what people *do* as well as at what they *possess* to understand competence. The nature of competence is therefore defined by the knowledge and experience of business managers. The knowledge dimension captures the specialized knowledge that is relevant to becoming competent with IT. The experience dimension captures the activities that business managers engage in to deepen their tacit knowledge and their knowing.

Business managers who are competent in IT possess *IT knowledge* and *IT experience*, though their primary area of expertise is likely be in an area other than IT. Each component of competence is discussed further in the next two sections.

2.1.1. IT Knowledge. By knowledge, we refer to specialized knowledge possessed by individuals: how well they understand fundamental IT concepts, how well informed they are about IT in their organization. IT knowledge enables business managers to communicate with IT people, and just as importantly, to understand the value of IT for their business units. As Keen (1991) noted, the main difficulty faced by managers resides not in a lack of awareness of IT or an unwillingness to participate in its management, but rather in a lack of the vocabulary and skills needed to participate in its different facets.

We evaluated the breadth and depth of the knowledge that reflect a business manager's level of IT competence. In terms of breadth, we first confirmed that our model focuses on the *IT* knowledge of business managers and excludes their business knowledge. Business managers are assumed to be familiar with their own external and internal business environment. Therefore, only those areas of knowledge within the IT domain are included in the IT competence construct. They are: (1) technology, (2) applications, (3) system development, (4) management of IT, and (5) access to IT knowledge.

These areas taken together represent the broad range of knowledge that a person can have in the IT domain. Definitions and some supporting literature are shown in Table 1.

The first four components (technology, applications, system development, and management of IT) are based on the framework for IT knowledge in an MBA program (Silver et al. 1995). These components encompass the ideas suggested in the literature. For example, some studies have looked at the importance of being informed of IT assets and opportunities (Vitale et al. 1986), understanding the value and potential of IT (Boynton et al. 1994), being aware of the limitations of current and future IT, knowing how the firm competes using IT (Armstrong and Sambamurthy 1999), having a vision regarding how IT contributes to business value, and being aware of the integration of business strategic planning and IT strategic planning (Sambamurthy and Zmud 1994).

The areas identified in the framework encompass the different levels at which IT is managed: (1) at the level of projects (implementing technology and applications using system development methods) and (2) at the organizational level of managing IT resources and specifying the vision for IT. This knowledge about the management of IT is needed to allow the task of managing IT to be shared by IT professionals and the rest of the firm's management.

Table 1 Linking the Areas of Explicit IT Knowledge with Supporting Research

Areas of IT Knowledge	Definition	Research Support
Technology	Current and emergent technologies that are both generic to all industries and specific to the organization and its competitors	Armstrong and Sambamurthy (1999) Keen (1991) Silver et al. (1995) Vitale et al. (1986)
Applications	Current and emerging IT application portfolio, where applications refer to the ways IT is or could be used by organizations to achieve their business goals (e.g., in order processing, decision support, or financial control)	Silver et al. (1995) Vitale et al. (1986)
System development	Involves an understanding of both systems development methods and project management practices in order to understand the potential benefits, dangers, and limitations of IT	Applegate et al. (1999) Keen (1991) Silver et al. (1995) Vitale et al. (1986)
Management of IT	IT management is composed of activities similar to those used in other areas—vision and goal setting, allocation of resources, and monitoring of progress.	Keen (1991) Silver et al. (1995) Sambamurthy and Zmud (1994)
Access to IT knowledge	Knowing who to contact to obtain more information about IT—both inside and outside of the organization—(e.g., colleagues, vendors, etc.) and secondary sources of knowledge (e.g., libraries, the Web)	Kogut and Zander (1992)

The fifth component—access to IT knowledge, or knowing "who knows what"—is justified by the fact that people who have access to IT knowledge inside or outside the organization effectively have a higher level of IT knowledge than those who do not. Managers who know who to contact or where to look to obtain more information about IT both inside and outside of the organization (e.g., colleagues, vendors, libraries, the Web, etc.) increase their level of competence by leveraging the knowledge of others. The presence of this type of knowledge within an organization allows for the development of an effective working relationship among line managers and IT staff and can enable more effective IT leadership.

In terms of depth of IT knowledge, we assume that a business manager needs less IT knowledge than does an IT professional. As Keen (1991, p. 52) suggests, "the relationship between IT and business managers has to be one of mutual understanding—not of the details of each other's activities, knowledge, and skill base, but of the other's needs, constraints, and contributions to an organizational venture partnership." Therefore, the knowledge in the research model focuses on the understanding of benefits of different types of IT, not on their specific features.

2.1.2. IT Experience. By experience, we refer to the activities taking place in the particular organizational context of the business manager's work. Experience is a *situated* action (Orlikowski 2002). Although prescriptive advice regarding the need for experience is widespread, a careful delineation of what this should constitute has not yet been formulated. As with IT knowledge, the depth and the breadth of experience are integrated in the framework. The breadth refers to the diversity of activities in which experience occurs. Nonaka (1994) suggested that the *variety* of the experience influences its quality, which implies that managers should be involved in a diversity of activities.

Paralleling the areas of IT knowledge, experience can be gained at the level of projects and at the organizational level of managing IT. IT projects generally progress through several phases: initiation, cost-benefit analysis, development, and implementation. With respect to project experience, involvement in any of the stages of this life cycle is included as a potential source of increased competence (Vitale et al. 1986). Managers' involvement in directing the overall IT function can also augment their IT competence. All managerial activities—including vision and strategy setting, planning and budgeting, and policy

Table 2 Linking the Areas of IT Experience with Supporting Research

Areas of IT Experience	Definition	Research Support
Experience in IT projects	Involvement in the life cycle of IT projects, such as initiation, cost-benefit analysis, development, and implementation	Keen (1991) Reich and Benbasat (2000) Rockart et al. (1996) Vitale et al. (1986)
Experience in the management of IT	Involvement in directing the overall IT function, such as vision and strategy setting, planning and budgeting, and policy setting	Reich and Benbasat (2000) Zmud (1988)

setting—are needed to guide the use of IT within an organization. Definitions and some supporting literature are shown in Table 2.

The depth of experience can be linked to the intensity of experience. Nonaka (1994, p. 22) suggested that the "embodiment of knowledge through a deep personal commitment into bodily experience" influenced the quality of experience. The importance of intense experience is also found in the concept of absorptive capacity. According to Cohen and Levinthal (1990), intensity of effort in assimilating and using knowledge is critical in the development of effective absorptive capacity. IT experience increases business managers' understanding of IT, which in turn enables them to increase their leadership in the IT domain. The level of responsibility taken in the different activities represents the depth or intensity of the experience. Although experience does not reflect competence equally across all people, a person with more intense and more frequent experience will likely have a higher level of competence than a person with less frequent or less intense experience.

2.2. Championing IT

There are many definitions in the management (e.g., Maidique 1980) and IT literatures (Beath 1991) about the role and responsibilities of champions. These usually include the line manager's role in promoting or advocating the use of technological or other innovations in organizations. "Champions articulate a compelling vision about the positive impact of information technology on the organization" (Howell and Higgins 1990, p. 43). In this research, we use a more limited view of the championship role and define it as follows. First, a management champion should be proactive in promoting and supporting IT utilization. Second, although champions need to support, promote, and advocate IT utilization in their organizations, they cannot, in most circumstances, successfully implement IT projects in isolation from, and without the cooperation of, the IT department. Hence, to promote IT, the manager has to work closely with the organizational unit responsible for developing IT. Therefore, a manager's intention to further develop their partnerships with the IT department is considered to be part of the championship role, as it is an indication of the desires to elevate and promote the role of the IT unit in their organizations.

The choice of these two dimensions is supported by the results of interviews with 22 CIOs in medium and large North American companies regarding IT-competent business managers (Chan and Reich 1998). In these interviews, the CIO identified behaviors and characteristics of IT-competent business managers that are related to the organization's effective use of IT. Examples of the proactive role of managers in promoting IT included the following: "take the initiative and identify new IT requirements and opportunities," "be more aware of the fact that business decisions may have IT implications," and "be more realistic in their needs and in their requirements." This can be related to Rockart's (1988) suggestion that the optimum outcome of IT competence would be to have executives who, like George David of the Otis Elevator Company, propose and implement "a major change in how the company used information systems" (p. 57). He argues that line managers need to take a strong role in both conception and implementation of information systems to "actively exploit information technology resources" (Rockart 1988, p. 63).

While the goal of senior managers identifying and steering the course of information systems is appropriate for the CEO and top management team, another path to successful implementation is a more balanced *partnership* approach (Henderson 1990, Nelson and Cooprider 1996). CIOs interviewed by Chan and Reich (1998) identified that the aspect of partnership reflected the belief that the stronger the relationship between IT and business is, the more effectively IT can be deployed in support of business goals. This was expressed as "active partners in any new development," "a bunch of people working together trying to apply knowledge to information," "cross-functional teams to build whatever needs to be built," and "a sense of community." The literature supports the notion that partnerships between IT and line management lead to IT success by fostering successful project implementation (Bashein and Markus 1997, Preiser-Houy 1999), IT-based innovation (Boynton et al. 1994), sustainable competitive advantage (Henderson 1990, Ross et al. 1996), and an ability to cope with business and technological changes (Feeny and Willcocks 1998, Rockart et al. 1996). In this dimension, the desired outcome of having IT-competent managers is their willingness to build a strong "relationship asset" between the IT unit and line managers (Ross et al. 1996). In this view, an IT-competent business manager would seek out and partner with the IT department in order to promote and maximize the value of IT within the company.

Because this study was cross-sectional in design and therefore could not measure future behavior, we used self-reported intentions as a surrogate measure for their willingness to champion IT. This approach is supported by the theory of reasoned action (Fishbein and Ajzen 1975), according to which *intentions* (of managers) are the most important determinant of behavior. Items measuring these two dimensions are listed in Appendix 1.

2.3. Hypotheses to Be Tested

Rockart et al. (1996) indicated that line managers are more likely to assume leadership in regard to IT when they have the appropriate IT education and training. From the work of Ross et al. (1996), we learn that IT-competent managers would be more willing to build a strong "relationship asset" between the IT unit and line managers. Hence, we can extrapolate that an IT-competent business manager would seek out and partner with the IT department in order to promote and maximize the value of IT within the company.

Except for the two studies cited above, there is a paucity of work in the IT literature that links IT competence to championing IT in organizations. However, the literature on "knowledge" allows us to make predictions about such relationships. For example, Rogers (1995) discusses the role of knowledge (existence of an innovation and how it works) in influencing persuasion, which in turn influences decision and implementation. Churchman (1971) notes that knowledge goes beyond being a collection of information; it has the meaning of action and potential for action. Sveiby (1997) refers to knowledge as "a capacity to act." Thus, we would expect an IT-competent manager to be more likely to take action to champion IT than one who lacks such competence.

Cohen and Levinthal (1990) showed that the accumulation of knowledge enhances organizations' ability to recognize and assimilate new ideas, as well as their ability to convert this knowledge into further innovations. Hence, an IT-competent manager is more likely to understand and promote the use of new IT innovations, which is important given the rapid changes and advances in the use of IT technology.

Based on the theory of reasoned action (Fishbein and Ajzen 1975) we know that beliefs influence attitudes, which in turn influence the intentions toward a particular behavior. Interestingly, Fishbein and Ajzen (1975) view knowledge as a belief held by an individual, though Jasperson et al. (2003) argue for a link from knowledge to beliefs. In this study, the behavior in question is "championing IT." If a manager has positive beliefs about the use of IT, based on his knowledge of IT, then this should influence favorable attitudes and intentions towards such behavior.

We thus propose the following hypotheses:

Hypothesis 1. *IT knowledge in business people positively influences their intentions to champion IT in their organizations.*

Hypothesis 2. *IT experience in business people positively influences their intentions to champion IT in their organizations.*

3. Method

To test the model, we first developed scales for IT knowledge and IT experience by following a series of steps. First, from the literature, we developed the initial items and then tested their measurement properties on a small scale, using exploratory analysis. Next, we conducted a full-scale test of the measurement properties and of the structural model. Each of these procedures is reported below.

3.1. Item Development

The starting point for item development was the previous empirical and theoretical literature (see Bassellier et al. 2001 for details). The model shown in Figure 1 builds on this literature. Using it as a guide, we developed items based on previous research (see Tables 1 and 2) and supplemented this with new items that capture the different dimensions of the constructs and subconstructs that are represented in the model.

In developing the measure for IT knowledge and experience, our focus was in capturing managers' perceptions of their own knowledge and experience, not an objective measure of these constructs. As it is this perception of self-efficacy that will influence the managers' behavior (Bandura 1977), we considered it more relevant to assess this perception than to obtain an objective measure of competence.

Discussions held with faculty members and graduate students at our own institutions helped us to review the resulting set of items. We also obtained feedback following a presentation in an academic workshop sponsored by the Society for Information Management, where leading academics working on IT competence were in attendance. The IT knowledge and experience constructs were further discussed with a sample of 22 CIOs of leading firms (Chan and Reich 1998) as part of an empirical research study investigating the ways that CIOs enhance the IT competence of their managers.

We next submitted the initial set of items to a card-sorting test (Moore and Benbasat 1991) in which nine academics grouped the list of items into predefined categories. In general, the sorting resulted in a satisfactory classification of the items into the different dimensions of IT knowledge and experience, as shown in Figure 1. It was necessary to modify some items in order to improve the clarity and comprehension of the wording used and also some items were deleted at this stage.

The items and scales were then subjected to two rounds of pilot testing. First, 37 students enrolled in two Executive MBA courses completed a questionnaire that included these items, and commented on its length, wording, and instructions. Second, we spent approximately one hour each with four non-IT business managers who commented on the coverage of the items. Their suggestions on the clarity of the instrument resulted in formatting and wording changes.

3.2. Instrument Pretesting and Refinement

A local insurance company agreed to help us in testing the reliability of the measures developed. A total of 48 questionnaires were sent to the managers in the company, from the vice presidents down to first-level managers. In total, 42 respondents returned questionnaires, giving a response rate of 88%. The results of the reliability tests are shown in Table 3.

Based on the results of this pilot test, we further modified the instrument. Our goal was to make it more valid and reliable by clarifying, rephrasing, or eliminating problematic, obscure, and poorly answered items. These changes did not affect the overall structure shown in Figure 1. The resulting instrument contained 36 items to measure the dimensions of IT knowledge and experience shown in Figure 1. A five-point Likert-type scale was used. The specific anchors used for the end of the scales are also listed in Appendix 1. Questions about demographic characteristics of the respondents and other questions

Table 3 Reliability Estimates in Pretesting

Dimensions	Subdimensions	# items	Alpha
IT knowledge	Knowledge of technology	5	0.86
	Knowledge of applications	6	0.86
	Knowledge of system development	6	0.94
	Knowledge of management of IT	13	0.96
	Access to IT knowledge	3	0.81
IT experience	Experience in IT projects	6	0.93
	Experience in management of IT	6	0.90

related to the test of nomological validity were also included.

3.3. Procedure

We empirically verified the model in Figure 1 using the items shown in Appendix 1. The test was conducted with the cooperation of two organizations, both insurance companies in North America. One company sells car and home insurance ($3.22 CAD billion in revenues, 5,144 employees) the other insures workers against loss of employment income ($1.6 billion CAD in revenues, 2,500 employees). Target respondents were business managers—meaning those who supervise other people—at all hierarchical levels (see Table 4). In each company, the questionnaire was distributed to each non-IT manager in the organization. The cover letter was signed by the CIO. The respondents mailed the surveys directly back to the researchers.

Nine hundred and fifty two questionnaires were distributed; 467 were returned for a response rate of 49% (car and home insurance company: 346/737 = 47%; workers insurance company: 121/215 = 56%). The 404 usable questionnaires were included in the analysis. In the final sample, 63% of the respondents were male; 68% were in the 35–50 age range. Average tenure in the current organization was 12 years. The respondents are from different hierarchical levels and have different levels of education (Table 4).

These firms can be considered representative of the insurance industry as a whole, in the sense that insurance-related functions such as product development, actuarial analysis to set rates and prices, marketing, and policyholder service are performed. On another level, these firms are also representative of highly information-intensive organizations in any industry because both the product and the process of distribution can be digitized. To be effective, these firms rely heavily on their ability to process, store, and use information.

Table 4 Sample Demographics

	Frequency ($n = 404$)*	Percentage
Hierarchical distance from the CEO		
1–2 levels	65	16
3–4 levels	224	55
>4 levels	113	28
Educational level		
High school	103	25
College diploma	94	23
Bachelors	136	34
Graduate	56	14

Note. *Figures may not add up due to missing data.

Within the insurance industry, these firms can be considered representative of the high end of regulated companies. They are protected by legislation, but each company has won the respect of their peers through innovation, fiscal responsibility, and efficient management. Therefore, they are most likely to be ranked in the middle when compared with private and other regulated organizations in the financial services industry.

Within both of these organizations, the IT department is centralized. They are essentially single-product companies (auto insurance and worker insurance, respectively) and central control of IT planning and most development is considered to be an effective governance model. Very little of their core operations are outsourced, although outside help is used for large and innovative projects. Both organizations have mature IT departments, with stable employee populations. These IT departments have been implementing applications for their organization for at least 30 years, and much organizational memory and expertise are available to the firm. Most processes have been supported by IT applications for many years, with refinements and replacements being done regularly, such as a companywide enterprise system in one of the organizations.

PCs have been used extensively in both organizations for some time, and they are experimenting with some use of newer technology. Web services are being developed in both companies to provide better service to policyholders. These organizations, being regulated and therefore to some extent protected and being part of the financial services industry and therefore somewhat conservative, are not on the bleeding edge of technology. However, they have made extensive process improvements and have supported these with the appropriate technology.

Mean and standard deviations for all variables are listed in Appendix 1. Values for the experience items represent an aggregation of the two levels of responsibilities that were assessed: participation and leadership. A large proportion of the respondents answered for only one level. When both figures were provided (58%), we took the value of whichever was higher. Other aggregation schemes, such as additive or multiplicative adjustment, were not theoretically or conceptually justified. Despite this adjustment, means for the experience variables remains low, showing that the experience of our respondents in IT activities, either at the project or at the management level, is not extensive.

The model was tested using LISREL 8.5 (Jöreskog and Sörbom 1996) with maximum-likelihood estimation procedures and the covariance matrix. The model presented in Figure 1 suggests two levels of factors, or latent variables. The first-order factors are the five dimensions of IT knowledge (technologies, applications, system development, management of IT, and access to IT knowledge) and the two dimensions of IT experience (IT projects, management of IT). For each of these seven factors, we developed indicators that uniquely measure that dimension of knowledge or experience. Then the seven factors at the first order measure two second-order factors: *IT knowledge* and *IT experience*.

The data set was randomly split in two. With the first half, we assessed the measurement properties of the first-order factors by testing for unidimensionality and convergent validity, internal consistency, and discriminant validity. The second half was used to test the higher-order model as it relates to the dependent variable. Using the second half, the impact of IT competence on the dependent variable, as well as the convergent validity of the higher-order structures of IT knowledge and IT experience, were tested. Both halves of the data set exceed the recommended sample size of approximately 200 (Hair et al. 1998). Procedures for the measurement and structural models are reported below.

3.4. Assessment of Measurement Properties

We assessed the measurement properties of the constructs in Figure 1 using confirmatory analysis. Confirmatory factor analysis allows the a priori specification of the relationships between the constructs and their indicators. The hypothesized relationships are then tested against the data.

With the first half of the data, we assessed the measurement properties of the first-order factors of IT competence. In other words, we tested the fit of the *initial* 36 items specified to load on seven dimensions under IT knowledge and IT experience (see items in Appendix 1 and model in Figure 1). Several steps were taken to test for these measurement properties. First, the fit of the overall model was tested. Then the measurement properties of each factor were tested and changes were made, when needed, to improve the validity of the scales. Lastly, the fit of the overall model, including the changes in the scales, was retested.

Statistics in Table 5 show mixed results for the fit of this initial model with the data when compared with thresholds values suggested by the literature. The χ^2 statistic, Goodness-of-Fit Index (GFI) and Root Mean Square Residual statistic (RMSR) are absolute indices representing the ability of the model to reproduce the actual covariance matrix. The χ^2 statistic (1,236.10, $p > 0.00$) is large and significant, implying that the null hypothesis of covariance matrix equality is rejected, indicating poor model fit. The overall degree of fit is not good, as reflected with a GFI of 0.75, below the recommended values of 0.90 (Gefen et al. 2000). The standardized RMSR characterizes the residual variance of the observed variables; as high values suggest high residual variance, smaller values are better (Gefen et al. 2000).

Incremental fit measures comparing the model to the null model (single-factor model with no measure-

Table 5 Goodness-of-Fit Indices for the IT Competence Measurement Model

	Initial Model	Revised Model	Desired Levels
Total number of items	36	30	
χ^2	1,236.10	686.47	smaller
df	573	384	—
χ^2/df	2.16	1.79	<3.0
GFI	0.75	0.81	>0.9
AGFI	0.70	0.78	>0.8
Standardized RMR	0.063	0.00	<0.05
RMSEA	0.076	0.063	0.05–0.08
NFI	0.80	0.86	>0.90
CFI	0.88	0.92	>0.90

ment error) and parsimonious fit measures relating the goodness of fit of the model to the number of estimated coefficients required to achieve the level of fit are used to complement the absolute indices (Hair et al. 1998). The Adjusted Goodness-of-Fit Index (AGFI) and the Normed Fit Index (NFI) are statistics between zero and one that compare the proposed model to the null model, with a value of one indicating a perfect fit. The AGFI is the GFI adjusted by the ratio of degrees of freedom for the proposed model to the degrees of freedom for the null model. The value of 0.70 is lower than the recommended value of 0.80 (Gefen et al. 2000). The NFI gives a relative comparison of the proposed model to the null model. A value of 1.0 indicates a perfect fit, but values of 0.90 or greater usually indicate an acceptable level of fit (Hair et al. 1998). The observed value of 0.80 is below this recommended threshold.

Because it is possible to obtain a better-fitting model by estimating more parameters, we use the parsimonious fit indices to evaluate the fit of the model relative to the number of estimated coefficients (or, conversely, the degrees of freedom) needed to achieve that level of fit. Among those indices are the normed χ^2 (χ^2/df), which adjusts the χ^2 by the degree of freedom, and the Root Mean Square Error of Approximation statistic (RMSEA), a measure of discrepancy per degree of freedom. Appropriate values for the normed χ^2 should exceed one and should be less than two or three in a conservative test, or five in a more liberal test (Hair et al. 1998). The initial model has an acceptable normed χ^2 of 2.16. The RMSEA value of 0.076 is also within the acceptable range of 0.05 to 0.08 (Hair et al. 1998).

Based on these results, with only the parsimonious fit indices suggesting an acceptable fit, we concluded that the fit of the initial first-order factor model is not satisfactory. To improve the overall fit, we assessed measurement properties of each dimension and undertook modifications. As described in Sethi and King (1994), the objective of this approach is to isolate and locate the misspecifications in each dimension. Once each dimension meets the reliability and validity criteria, the revised full model can be retested. In a complex model, this "piecewise model fitting" approach helps to identify the part of the model with a poor fit (Bollen 1989). The measurement properties tested for each individual dimension are the unidimensionality and convergent validity, reliability, and discriminant validity.

Unidimensionality and convergent validity ensure that all items measure a single underlying construct (Bagozzi and Fornell 1982). For each dimension, the refinement of the scale followed an iterative procedure, where only one item was changed at every step (Jöreskog 1993). Modifications were based on factor loadings and modification indices (values calculated for each unestimated relationship possible in a specified model) and were performed only when theoretically justified. The specific steps undertaken to refine the scales and obtain parsimonious meaningful sets of indicators are detailed in Appendix 2. Standardized factor loadings were expected to meet the minimum recommended value of 0.70, which indicates that the indicator reliability is over 0.50 (Hair et al. 1998). We modified the model until all parameter estimates and overall fit measures for each dimension were considered satisfactory. The items deleted were very similar to other items belonging to the same scale, and the shared variance was reflected by high modification indices for correlation of the error terms. We dropped a total of six items as a result of this procedure (items dropped are identified in Appendix 1).

The *internal consistency* of each dimension was assessed by examining estimates of composite reliability and variance (Hair et al. 1998). Composite reliability reflects the degree to which the construct is represented by the indicators. The overall amount of variance in the indicators accounted for by the construct reflects the extent to which the indicators are truly representative of the construct. All results, as reported in Table 6, exceed the recommended value of 0.7 for composite reliability and of 0.5 for variance explained (Hair et al. 1998).

Discriminant validity reflects the extent to which the measures for each dimension are distinctively different from each other. It was assessed using a chi-square difference test (Venkatraman 1989). For each pair of constructs, the fit of the previously identified model was compared with the fit of a model where the two constructs are said not to be distinct. Constraining the correlation between the

Table 6 Estimates of Composite Reliability and Variance Extracted

Dimensions	# items	Composite Reliability	Variance Extracted
Knowledge of technologies	5	0.88	0.60
Knowledge of applications	4	0.88	0.64
Knowledge of system development	5	0.94	0.75
Knowledge of management of IT	5	0.89	0.62
Access to IT knowledge	3	0.77	0.53
Experience in IT projects	4	0.86	0.61
Experience in management of IT	4	0.92	0.75

pairs of constructs to be 1.0 suggests that all the items measure the same construct. A significant difference between the χ^2 measures is supportive of discriminant validity (Venkatraman 1989). Table 7 reports the results of 21 pairwise tests. All chi-square differences are significant at the $p < 0.01$ level, indicating strong support for discriminant validity. In addition, the estimated correlations between all pairs of constructs (Figure 2) are below the threshold value of 0.90 (Bagozzi et al. 1991), reflecting that the constructs are distinct.

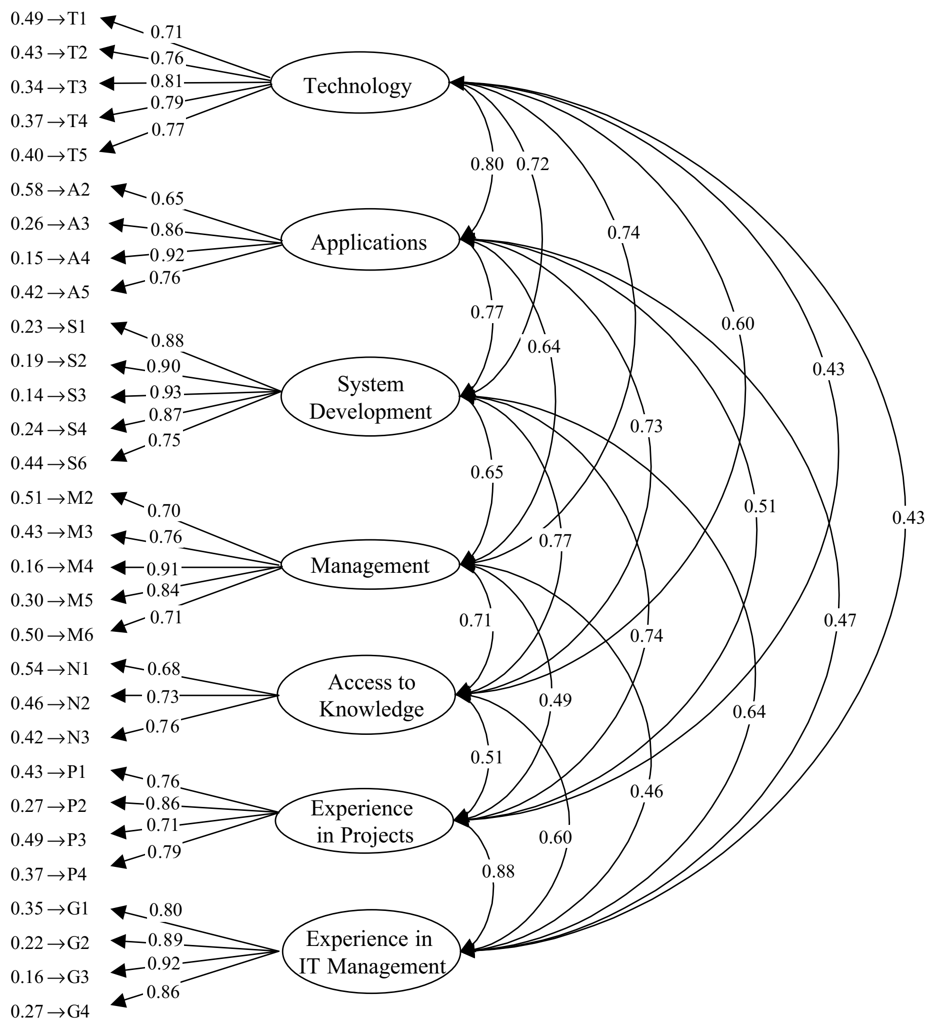
With each dimension exhibiting properties of good reliability and validity, the fit of this revised model can now be assessed. The model—which now includes 30 items—is satisfactory and shows good and improved model parameters (Table 5, "revised model" column). All the items, except two, have satisfactory standardized factor loadings (Figure 2). One item in the "knowledge of applications" and

Table 7 Assessment of Discriminant Validity

Dimensions	Constrained Model χ^2 (df)	Unconstrained Model χ^2 (df)	$\Delta\chi^{2*}$
Knowledge of technologies with			
Knowledge of applications	193.16 (27)	69.57 (26)	123.59
Knowledge of system development	407.15 (35)	102.91 (34)	304.24
Knowledge of management of IT	548.13 (35)	71.65 (34)	476.48
Access to IT knowledge	109.88 (20)	51.44 (19)	58.44
Experience in IT projects	461.36 (27)	61.19 (26)	400.17
Experience in management of IT	652.60 (27)	53.65 (26)	598.95
Knowledge of applications with			
Knowledge of system development	254.56 (27)	53.04 (26)	201.52
Knowledge of management of IT	423.74 (27)	47.98 (26)	375.76
Access to IT knowledge	95.55 (14)	32.75 (13)	62.80
Experience in IT projects	382.35 (20)	31.46 (19)	350.89
Experience in management of IT	432.41 (20)	15.60 (19)	416.81
Knowledge of system development with			
Knowledge of management of IT	553.69 (35)	86.14 (34)	467.55
Access to IT knowledge	100.15 (20)	42.51 (19)	57.64
Experience in IT projects	265.97 (27)	68.85 (26)	197.12
Experience in management of IT	596.44 (27)	54.16 (26)	542.28
Knowledge of management of IT with			
Access to IT knowledge	96.67 (20)	33.62 (19)	63.05
Experience in IT projects	448.67 (27)	60.67 (26)	388.00
Experience in management of IT	684.68 (27)	67.99 (26)	616.69
Access to IT knowledge with			
Experience in IT projects	104.60 (14)	14.48 (13)	90.12
Experience in management of IT	124.63 (14)	17.84 (13)	106.79
Experience in IT projects with			
Experience in management of IT	100.11 (20)	35.07 (19)	65.04

Note. *All differences are significant (for one degree of freedom) at 0.01 level.

Figure 2 **Final Measurement Model of IT Competence (Using First Half of Data Set)**



another in the "access to IT knowledge" measures are slightly below the desired level, but still in an acceptable range, i.e., above the 0.6 threshold suggested by Chin (1998).

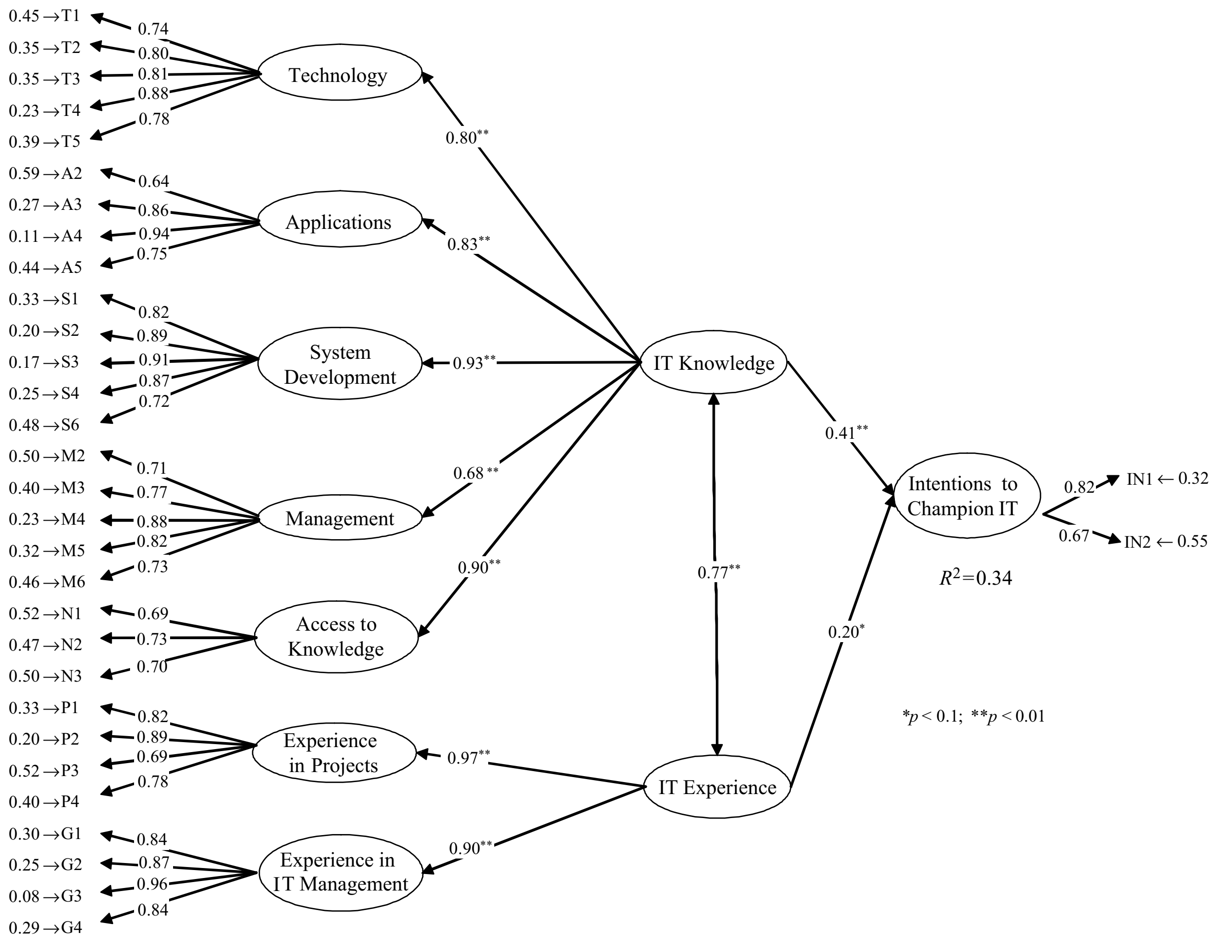
With the measurement properties of the first-order model tested and providing satisfactory results, the overall model and its relationship to the dependent variable is investigated next, using the second half of the data set.

3.5. Model Testing

Using the second half of the data, we tested the higher-order model as it relates to the dependent variable. We hypothesized that it is the managers' overall level of IT knowledge and of IT experience that directly impacts their intentions to promote IT. Results in the form of standardized parameters for the second-order factor model are presented in Figure 3.

The model in Figure 3 explains 34% of the variance in the business manager's intention to champion IT. This is a very satisfactory result, especially if we take into account that the purpose of this study is to assess the contribution of IT knowledge and IT experience to the managers' intentions to champion IT, and not to maximize the explanation in the variance of the dependent variable. Results also provide support for the research hypotheses. With directional relationships explicitly indicated in the hypotheses, one-tailed

Figure 3 Results of Model Testing



t-values are used to test for significance. The path linking IT experience to IT leadership is significant at 0.10, while the path linking IT knowledge is significant at 0.01. The lower significance of IT experience may be because of the lower means and variance for this variable. The overall model fit is satisfactory (Table 8).

Results also support the testing of the higher-order factor structure of IT competence. A higher-order factor suggests that the correlations among the first-order factors are governed by higher-level factors. Higher-order factors are therefore relevant when the correlation among the lower-order factors is high. Our representation of IT competence suggests that the structure of interrelationship among the seven first-order factors is part of the IT knowl-

Table 8 Goodness-of-Fit Indices for the Model of IT Competence

	Model of IT Competence (Figure 3)	Desired Levels
χ^2	835.39	Smaller
df	454	—
χ^2/df	1.84	<3.0
p	0.00	
Target coefficient	0.90	
GFI	0.79	>0.9
AGFI	0.76	>0.8
RMR		<0.05
RMSEA	0.065	0.05–0.08
NFI	0.85	>0.90
Model AIC	983.39	Smaller
CFI	0.92	>0.90

Table 9 **Correlation Between First-Order Latent Variables (Second Half of Data Set)**

	1	2	3	4	5	6
1. Knowledge of technologies	1.00					
2. Knowledge of applications	0.77*	1.00				
3. Knowledge of system development	0.75	0.78	1.00			
4. Knowledge of management of IT	0.49	0.53	0.59	1.00		
5. Access to IT knowledge	0.70	0.71	0.80	0.75	1.00	
6. Experience in IT projects	0.47	0.54	0.76	0.53	0.70	1.00
7. Experience in management of IT	0.46	0.53	0.68	0.52	0.70	0.87

Note. *All correlations are significant at 0.01 level.

edge and IT experience constructs. In other words, the domain of the IT knowledge and IT experience constructs are captured by the first-order factors. This representation is supported by the pattern of intercorrelations at each level. When observing the pattern of intercorrelations between the first-order latent variables representation (Table 9), we found high and significant correlations between the first-order factors belonging to knowledge and those belonging to experience.

The role of IT knowledge and IT experience as second-order factors is to explain the covariance between the seven first-order factors. These second-order factors introduce new regressions of the first-order factors on the second-order factors. Convergent validity of the second-order factors model is well supported by the results. The dimension "knowledge of management of IT" has a factor loading of 0.68, slightly below the recommended value of 0.70 (Chin 1998). All other dimensions are well above this threshold value, ranging from 0.80 to 0.97. This shows that the second-order factors are connected to the first-order ones with strong paths.[1]

We can also assess the completeness of our constructs by examining their ability to predict the measured overall IT knowledge and IT experience. In an additional survey question, respondents were asked to assess their overall level of IT knowledge and of IT experience (one item each). The second-order factor IT knowledge explains 71% of the variance in the overall IT knowledge. The second-order factor IT experience explains 79% of the variance in the overall IT experience. From these results, we conclude that our model of IT competence captures the dual ideas of knowledge and experience.

To summarize, the model of IT competence representing IT knowledge and IT experience as second- and higher-order factors shows satisfactory results. The statistical significance of the loadings (Figure 3) and overall fit indices (Table 8) support the model.

4. Discussion and Concluding Comments

Shared knowledge (between line and IT management) supports IT success (Sambamurthy and Zmud 1994, Nelson and Cooprider 1996). The research reported in this paper measures one side of the shared knowledge construct, and its impact at the individual level. It tests a model of the IT knowledge and experience of business managers and their contribution to intentions to champion IT in their organizations. IT knowledge covers the areas of technologies, applications, system development, and management, as well as knowledge of where to access more IT knowledge both inside and outside one's organization. IT experience involves working on IT projects and in the management of IT in the organization. With a better understanding of the kinds of knowledge and experience involved in IT competence, further investigation testing their impact at the dyad level (partnerships) and at the organizational level (IT and organizational success) will be possible.

This research has accomplished several important goals. Specific dimensions of IT knowledge and experience in business managers were identified.[2] A sound measurement instrument for IT knowledge and experience that has good psychometric properties and satisfactory levels of convergent, discriminant, and nomological validity was developed. It was

[1] A model that includes IT competence as a *third-order* factor accounting for the correlation between IT knowledge and IT experience and influencing the intentions of business people to promote IT was also tested and provided satisfactory results. Additional details are available on demand.

[2] As technologies are transient, the list should be updated to reflect the evolution of technologies. The objective is to create a list of items that a business manager who is well versed in IT would be familiar with.

shown that business managers' level of IT knowledge and experience influence their intentions to champion IT use. Thirty-four percent of respondents' intentions towards two important IT leadership behaviors are explained in the model: Creating strong relationships with IT people as well as supporting and promoting IT in their organizations. Thus, the research has demonstrated with strong empirical evidence the role and importance of having IT-competent business managers, a commonly offered prescription that to date was based on a limited set of research work.

This instrument can be used in new survey research studies to surmount some of the limitations we have identified. First, more work can be done to improve the coverage of the construct. For example, cognitive elements could be added to the knowledge and experience to achieve a more comprehensive coverage of IT competence since the prescriptive literature (Rockart et al. 1996, Sambamurthy and Zmud 1994) suggests that managers should have a "process view" of the organization and that the vision to transform the organization with IT should influence leadership. Attempts should be made to measure and test the role and impact of these additional cognitive elements. The inclusion of hands-on experience from personal use of technology by the managers can also be considered. Experimenting with and using IT can develop a familiarity with current technologies and may encourage the manager to take a more global interest in IT. Because personal use of computers increases one's experience, such use may also reflect a greater personal ability to innovate with IT. Although empirical evidence does not support the importance of managers' personal use of IT (Jarvenpaa and Ives 1991), new studies may define and measure the full extent and complexity of the personal use, especially as it pertains to influencing IT leadership. It may be interesting to look at how such personal use fits with the experience at the IT project and at the IT management levels.

Second, further development on the dependent (criterion) variable side is also needed. Although intentions have been shown to be good predictors of behavior, it is important to understand as well the relationship between IT knowledge and experience and actual IT leadership, in the form of promoting the use of IT in organizations, along with IT deployment in support of organizational activities and business strategies. Further understanding of how these competencies may be instrumental in enabling competitive positioning, be it through the appropriateness of new, IT-enabled organizational forms, or through new IT-based process structures can also be investigated in future research.

Thirdly, the model can be expanded in several ways. First, IT knowledge and experience of business managers is one side contributing to the shared knowledge among business managers and IT professionals. Commonality of vocabulary and experiences between individual specialists allows communication and integration of knowledge among members of an organization, which will in turn contribute to the creation of competitive advantage (Grant 1996). Thus, we have the other side, representing that the business knowledge in IT professionals should also be investigated, as a complement to bridge the gap between these two groups. Second, a next step can also include the identification of antecedents of IT competence. We believe factors such as background and job history (e.g., IT rotation) are promising variables to study. Third, other moderating factors that influence the intentions of managers to champion IT, such as the degree to which IT is a competitive weapon in a given industry, could be added to the model. Fourth, model testing was done based on data from organizations in the insurance industry. Future research should also test the applicability of the instrument to industries other than insurance, and to different-sized organizations.

One finding that is of concern is the level of IT experience, which, as indicated by the data, is low both compared to IT knowledge and in absolute terms. Hands-on experience with IT projects and IT management are critical to building IT competence in business managers. Junior managers should be seconded to project teams and encouraged to manage the IT budget, plan, and people in their area. This should be done systematically, since a higher level of experience predicts higher IT competence. This prescriptive advice may be difficult to follow if the IT function is centralized, since having a single organizational unit responsible for IT management may not enable the sharing of the knowledge and experiences necessary for wide-scale deployment and innovation with IT. Research by Chan and Reich (1998) has shown that most companies focus on narrow software-related training and do not teach more conceptual topics such as project management or IT management. Results for the current study suggests that courses in IT that instill specialized knowledge should be wide in scope, and include technology, applications, management, and systems development.

Acknowledgment
The authors sincerely thank Dr. Yolande Chan for her work on this research project.

Appendix 1. List of Items

Item	Dimensions/Question	Scale	Mean (std dev)
	Knowledge of Technologies		
T1	What is your general knowledge of personal computer?	a	4.223 (0.85)
T2	What is your general knowledge of client-server?	a	3.163 (1.15)
T3	What is your general knowledge of LAN?	a	3.406 (1.12)
T4	What is your general knowledge of imagery technology?	a	3.025 (1.08)
T5	What is your general knowledge of multimedia?	a	3.050 (1.05)
	Knowledge of Application		
*A1**	*What is your general knowledge of e-mail?*	*a*	*4.554 (0.63)*
A2	What is your general knowledge of WWW?	a	3.782 (1.08)
A3	What is your general knowledge of electronic data interchange?	a	2.584 (1.28)
A4	What is your general knowledge of e-commerce?	a	2.609 (1.27)
A5	What is your general knowledge of Groupware?	a	2.238 (1.11)
*A6**	*What is your general knowledge of Enterprise Resource Planning?*	*a*	*2.495 (1.22)*
	Knowledge of System Development		
S1	What is your general knowledge of traditional system development life cycle?	a	2.094 (1.22)
S2	What is your general knowledge of end-user computing?	a	2.411 (1.26)
S3	What is your general knowledge of prototyping?	a	2.213 (1.24)
S4	What is your general knowledge of outsourcing?	a	2.450 (1.22)
*S5**	*What is your general knowledge of acquisition of software packages?*	*a*	*2.708 (1.19)*
S6	What is your general knowledge of project management practices?	a	3.084 (1.24)
	Knowledge of Management of IT		
*M1**	*Indicate your level of knowledge about the current hardware (e.g., computers, communication networks) assets of your business unit?*	*b*	*2.866 (1.13)*
M2	Indicate your level of knowledge about the current IS applications (including software, data) assets of *your business unit?*	b	2.970 (1.12)
M3	How informed are you about the IT budget in *your business unit?*	b	1.921 (1.17)
M4	How informed are you about the IT strategies in *your business unit?*	b	2.421 (1.22)
M5	How informed are you about the IT policies in *your business unit?*	b	2.317 (1.14)
M6	How informed are you about the IT vision statements in *your business unit?*	b	1.896 (1.11)
*M7**	*How knowledgeable are you about your competitors' use of IT?*	*c*	*2.084 (1.10)*
	Knowledge of Access to Information		
N1	How knowledgeable are you about IT or business people to contact within your organization as source of information about IT?	c	3.277 (1.04)
N2	How knowledgeable are you about IT or business people to contact outside your organization as source of information about IT?	c	2.094 (1.07)
N3	How knowledgeable are you about secondary sources of knowledge as source of information about IT?	c	2.554 (1.06)

Appendix 1 (cont'd.)

Item	Dimensions/Question	Scale	Mean (std dev)
	Experience in IT Projects		
P1	How often have you participated in and/or led in initiating new IS projects?	d	2.342 (1.33)
P2	How often have you participated in and/or led in identifying the cost and benefits of IS projects before they are developed; preparation of business cases?	d	1.955 (1.28)
P3	How often have you participated in and/or led in managing information systems projects?	d	2.005 (1.26)
P4	How often have you participated in and/or led in developing information systems?	d	1.733 (1.18)
*P5**	*How often have you participated in and/or led in implementing information systems projects?*	*d*	*2.089 (1.27)*
	Experience in General Management of IT		
G1	How often have you participated in and/or led in creating an IT vision statement regarding how IT contributes to business value and strategy?	d	1.376 (0.89)
G2	How often have you participated in and/or led in developing IT strategy?	d	1.599 (1.10)
G3	How often have you participated in and/or led in creating IT policies?	d	1.485 (0.98)
G4	How often have you participated in and/or led in setting IT budgets?	d	1.485 (0.99)
	Intentions to Champion IT		
IN1	To what extent do you intend to create or strengthen partnership/alliances with IT people within your organization?	e	3.055 (1.16)
IN2	To what extent do you intend to support/promote the use of IT in your division?	e	3.945 (1.06)

Note. *Items dropped after testing of measurement properties.
Scale
a. 1. never heard of–3. know about them in general–5. understand their value to the organization
b. 1. uninformed–5. very well informed
c. 1. not at all knowledgeable–5. extremely knowledgeable
d. 1. never–5. many times
e. 1. very little extent–5. very great extent

Appendix 2. Steps for Scale Refinement

Factor 1 Knowledge of Technologies

Items	# items	df	χ^2	p	χ^2/df	RMSEA	GFI	AGFI	CFI
T1…T5	5	5	12.18	0.00	2.44	0.085	0.98	0.93	0.94

(1) Results show satisfactory fit. No modifications were performed.

Factor 2 Knowledge of Applications

Items	# items	df	χ^2	p	χ^2/df	RMSEA	GFI	AGFI	CFI
A1…A6	6	9	77.51	0.00	8.61	0.195	89	0.73	0.89
(A2…A6)	5	5	48.24	0.00	9.65	0.107	0.91	0.74	0.92
(A2…A5)	4	2	2.56	0.00	1.28	0.037	0.99	0.97	1

(1) Modification index (26.95) indicated a high error correlation between A1 and A2. A1 was dropped because of its low loading factor (0.35).

(2) A high error correlation was also found between A6 and A4 (MI = 17.50) and A6 and A5 (MI = 38.66). A6 is dropped in the interest of parsimony.

Factor 3 Knowledge of System Development

Items	# items	df	χ^2	p	χ^2/df	RMSEA	GFI	AGFI	CFI
S1…S6	6	9	77.78	0.00	8.64	0.195	0.89	0.73	0.94
S1…S4, S6	5	5	26.29	0.00	5.26	0.146	0.95	0.85	0.98

(1) The initial model does not show satisfactory results. A high modification index is indicated between S5 and S6 (24.11) and S5 and S4 (18.55), reflecting strong correlation between their error terms. For parsimony, S5 was dropped. Indices then show excellent fit.

Factor 4 Knowledge of Management of IT

Items	# items	df	χ^2	p	χ^2/df	RMSEA	GFI	AGFI	CFI
M1…M7	7	14	84.21	0.00	6.02	0.158	0.89	0.79	0.91
M2…M7	6	9	12.89	0.00	1.43	0.046	0.98	0.95	0.99
M2…M6	5	5	6.98	0.00	1.40	0.044	0.99	0.96	1

(1) High and unexpected error correlation between M1 and M2 (MI = 63.63). M1, with the lowest factor loading (0.69), is removed.

(2) Although the model shows satisfactory fit, M7 is dropped because of its low factor loading (0.51).

Factor 5 Knowledge of Access to Information

Items	# items	df	χ^2	p	χ^2/df	RMSEA	GFI	AGFI	CFI
(N1...N3), (M2, M3, M4, M5, M6)	8	19	33.62	0.02	1.77	0.062	0.96	0.92	0.98

With only three items, statistical fit cannot be obtained (degree of freedom being equal to 0). Therefore, these three items were added to the items of Factor 4 (M1, M3, M4, M5, M6), and a two-factor model was tested.

(1) Results show excellent fit. No modifications were performed.

Factor 6 Experience in IT Projects

Items	# items	df	χ^2	p	χ^2/df	RMSEA	GFI	AGFI	CFI
P1...P5	5	5	21.66	0.000	4.33	0.129	0.96	0.88	0.97
P1...P4	4	2	5.72	0.057	2.86	0.096	0.99	0.93	0.99

(1) P5 was dropped because of the high error correlation with P2 (MI = 12.64) and no justification for it.

Factor 7 Experience in Management of IT

Items	# items	df	χ^2	p	χ^2/df	RMSEA	GFI	AGFI	CFI
G1...G4	4	2	5.25	0.07	2.63	0.090	0.99	0.94	0.99

(1) The initial model shows acceptable results, and therefore no modifications were performed.

References

Applegate, L. M., W. F. McFarlan, J. McKinney. 1999. *Corporate Information Systems Management: Text and Cases*. McGraw-Hill, Boston, MA.

Armstrong, C. P., V. Sambamurthy. 1999. Information technology assimilation in firms: The influence of senior leadership and IT infrastructure. *Inform. Systems Res.* **10**(4) 304–342.

Bagozzi, R. P., C. Fornell. 1982. Theoretical concepts, measurement, and meaning. C. Fornell, ed. *A Second Generation of Multivariate Analysis*, Vol. 2. Praeger, New York, 5–23.

——, Y. Yi, L. W. Phillips. 1991. Assessing construct validity in organizational research. *Admin. Sci. Quart.* **36** 421–458.

Bandura, A. 1977. Self-efficacy: Toward a unifying theory of behavioral change. *Psych. Rev.* **84**(2) 191–215.

Bashein, B. J., M. L. Markus. 1997. A credibility equation for IT specialists. *Sloan Management Rev.* **38**(4) 35–44.

Bassellier, G., B. H. Reich, I. Benbasat. 2001. Information technology competence of business managers: A definition and research model. *J. Management Inform. Systems* **17**(4) 159–182.

Bollen, K. A. 1989. *Structural Equations with Latent Variables.* Wiley, New York.

Boyatzis, R. E. 1982. *The Competent Manager: A Model for Effective Performance*. John Wiley and Sons, New York.

Boynton, A. C., R. W. Zmud, G. C. Jacobs. 1994. The influence of IT management practice on IT use in large organizations. *MIS Quart.* **18**(3) 299–318.

Brown, B., J. M. Kaplan, T. Weber. 2003. Recentralizing IT. *McKinsey Quart.* (2) 19–22.

Brown, J. S., P. Duguid. 1998. Organizing knowledge. *California Management Rev.* **40**(3) 90–111.

Chan, Y. E., B. H. Reich. 1998. Information technology competence summary report. Unpublished research paper, Queen's University, Kingston, Ontario, Canada.

Chin, W. W. 1998. Issues and opinions on structural equation modeling. *MIS Quart.* **21**(1) vii–xvi.

Churchman, C. W. 1971. *The Design of Inquiring Systems: Basic Concepts of Systems and Organization*. Basic Books, Inc., New York.

Cohen, W. M., D. A. Levinthal. 1990. Absorptive capacity: A new perspective on learning and innovation. *Admin. Sci. Quart.* **35**(March) 128–152.

Cook, S. D. N., J. S. Brown. 1999. Bridging epistemologies: The generative dance between organizational knowledge and organizational knowing. *Organ. Sci.* **10**(4) 381–400.

Feeny, D. F., L. P. Willcocks. 1998. Core IS capabilities for exploiting information technology. *Sloan Management Rev.* **39**(3) 9–21.

Fishbein, M., I. Ajzen. 1975. *Belief, Attitude, Intention, and Behavior: An Introduction to Theory and Research*. Addison Wesley Longman, Reading, MA.

Gefen, D., D. W. Straub, M.-C. Boudreau. 2000. Structural equation modeling and regression: Guidelines for research practice. *Comm. Assoc. Inform. Systems* **4**(7).

Grant, R. 1996. Prospering in dynamically competitive environments: Organizational capability as knowledge integration. *Organ. Sci.* **7**(4) 375–387.

Hair, J. F., R. E. Anderson, R. L. Tatham, W. C. Black. 1998. *Multivariate Data Analysis*, 5th ed. Prentice Hall, Englewood Cliffs, NJ.

Henderson, J. C. 1990. Plugging into strategic partnerships: The critical IS connection. *Sloan Management Rev.* **31**(3) 7–18.

Howell, J. M., C. A. Higgins. 1990. Champions of change: Identifying, understanding, and supporting champions of technological innovations. *Organ. Dynam.* **19**(1) 40–55.

Jarvenpaa, S. L., B. Ives. 1991. Executive involvement and participation in the management of information technology. *MIS Quart.* **15**(2) 205–221.

Jasperson, J. L., R. W. Zmud, V. Sambamurthy. 2003. The role of individuals' knowledge in explanations about the post-adoptive use of enterprise IT applications. Working paper, Michael Price College of Business, University of Oklahoma, Norman, OK.

Jöreskog, K. G. 1993. Testing structural equation models. K. A. Bollen, J. S. Long, eds. *Testing Structural Equations Models*. Sage, Newbury Park, CA, 294–316.

——, D. Sörbom. 1996. *LISREL VIII User's Guide*. Scientific Software Inc., Mooresville, IN.

Karnøe, P. 1995. Competence as process and the social embeddeness of competence building. *Proc. Acad. Management 1995 Annual Meeting*, Vancouver, B.C., 427–431.

Keen, P. G. W. 1991. *Shaping the Future: Business Design Through Information Technology*. Harvard Business School Press, Boston, MA.

Kogut, B., U. Zander. 1992. Knowledge of the firm, combinative capabilities, and the replication of technology. *Organ. Sci.* **3**(3) 383–397.

Maidique, M. A. 1980. Entrepreneurs, champions, and technological innovation. *Sloan Management Rev.* **21**(2) 59–76.

Moore, G. C., I. Benbasat. 1991. Development of an instrument to measure the perception of adopting an information technology innovation. *Inform. Systems Res.* **2**(3) 192–222.

Nelson, K. M., J. G. Cooprider. 1996. The contribution of shared knowledge to IS group performance. *MIS Quart.* **20**(4) 409–432.

Nonaka, I. 1994. A dynamic theory of organizational knowledge creation. *Organ. Sci.* **5**(1) 14–37.

Orlikowski, W. J. 2002. Knowing in practice: Enacting a collective capability in distributed organizing. *Organ. Sci.* **13**(3) 249–273.

Polanyi, M. 1967. *Tacit Dimension*. Routledge & Kegan Paul, London, U.K.

Preiser-Houy, L. 1999. Building high-quality working relationships between information systems specialists and business clients: The impacts of is role, tactics and institutional context. Ph.D. dissertation, Claremont Graduate University, Claremont, CA.

Reich, B. H., I. Benbasat. 2000. Factors that influence the social dimension of alignment between business and information technology objectives. *MIS Quart.* **24**(1) 81–111.

Rockart, J. F. 1988. The line takes the leadership—IS management in a wired society. *Sloan Management Rev.* **29**(4) 57–64.

——, M. J. Earl, J. W. Ross. 1996. Eight imperatives for the new IT organization. *Sloan Management Rev.* **38**(1) 43–55.

Rogers, E. M. 1995. *Diffusion of Innovations*, 4th ed. The Free Press, New York.

Ross, J. W., C. M. Beath, D. L. Goodhue. 1996. Developing long-term competitiveness through IT assets. *Sloan Management Rev.* **38**(1) 31–42.

Ryle, G. 1949. *The Concept of Mind*. Hutchinson & Co, London, U.K.

Sambamurthy, V., R. W. Zmud. 1994. *IT Management Competency Assessment: A Tool for Creating Business Value Through IT*. Financial Executives Research Foundation, Morristown, NJ.

Sethi, V., W. R. King. 1994. Development of measures to assess the extent to which an information technology application provides competitive advantage. *Management Sci.* **40**(12) 1601–1627.

Silver, M. S., M. L. Markus, C. M. Beath. 1995. The information technology interaction model: A foundation for the MBA core course. *MIS Quart.* **19**(3) 361–390.

Smith, J. B. 1996. Becoming the new technology executive. *CIO Canada* **41**(6) 39–46.

Sveiby, K. E. 1997. The new organizational wealth, managing and measuring knowledge-based assets. Berret-Koehler Publishers Inc., San Francisco, CA.

Venkatraman, N. 1989. Strategic orientation of business enterprises: The construct, dimensionality, and measurement. *Management Sci.* **35**(8) 942–962.

Vitale, M. R., B. Ives, C. M. Beath. 1986. Linking information technology and corporate strategy: An organizational view. *Proc. Seventh Internat. Conf. Inform. Systems*, San Diego, CA, 265–276.

Zmud, R. W. 1988. Building relationships throughout the corporate entity. J. J. Elam, M. J. Ginzberg, P. G. W. Keen, R. W. Zmud, eds. *Transforming The IS Organization: The Mission, The Framework, The Transition*. ICIT Press, Washington, D.C., 55–82.

Robert Zmud, Senior Editor. This paper was received on July 25, 2002, and was with the authors 9 months for 2 revisions.