
Information Technology Competence of Business Managers: A Definition and Research Model

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ABSTRACT: This research explores the concept of the information technology (IT) competence of business managers, defined as the set of IT-related explicit and tacit knowledge that a business manager possesses that enables him or her to exhibit IT leadership in his or her area of business. A manager's knowledge of technologies, applications, systems development, and management of IT form his or her explicit IT knowledge. This domain further extends to include knowing who knows what, which enables the manager to leverage the knowledge of others. Tacit IT knowledge is conceptualized as a combination of experience and cognition. Experience relates to personal computing, IT projects, and overall management of IT. Cognition refers to two

mental models: the manager's process view and his or her vision for the role of IT. The outcomes expected from IT-competent business managers are chiefly two behaviors: an increased willingness to form partnerships with IT people and an increased propensity to lead and participate in IT projects.

KEY WORDS AND PHRASES: explicit and tacit knowledge, information technology competence, information-technology management.

Importance of Information Technology Competence in Business Managers

Only line managers are close enough to their business segments to see the most effective ways to utilize this resource. Only they possess the clout to embed IT into their strategies and to commit the necessary financial resources. Unless IT is included in line managers' strategy and tactics, and unless line managers can effectively understand and implement a process view of the world, the best IT organizations are almost powerless. [55, p. 53]

Since the advent of organizational use of information technologies (IT), the responsibility to acquire, implement, and maintain technology investments has belonged to the specialists within Information Systems departments. Yet current IT research suggests that the management of IT should be shared between IT professionals and line managers [29, 54, 55, 59, 60, 65, 66]. Business managers are now expected to deploy IT effectively and strategically [66], to assume ownership of IT projects within their domain of business responsibility [59, 60], to develop a partnership with IT professionals [56], and to take the leadership in IT implementation [55].

Many practitioners also suggest that keeping a company technologically competitive is a responsibility that should be shared by every member of the management team [67]. The Gartner Group notes that IT competence is required for an organization to prepare for its future [23]. It is becoming increasingly evident that a "business cannot afford technology-illiterate managers any more than it can afford business-illiterate IT professionals" [32, p. 121]. The importance of having IT-competent line managers was empirically shown in a recent study, which found shared knowledge between line managers and information systems (IS) professionals to be an important factor in bringing business objectives and IT objectives into alignment [53].

The notions of line-technology leadership and technologically competent managers are simple to prescribe, but difficult for an organization to implement without a roadmap and a clearly understood target. The concept of "core competence" has been defined and studied at the *organizational level* in the management literature [52] as well as in information systems, as exemplified by Sambamurthy and Zmud's work [59, 60, 61] on managerial IT competence. These latter authors state that such competency enables an organization "to effectively acquire, deploy and leverage its IT investments in pursuit of business strategies and in support of business activities" and

helps fulfill the objective of aligning IT strategies and business strategies [60, p. 2]. However, competence at the individual level is required for the creation of core competence at the organizational level. Research on this individual component is incomplete [47]. This paper explores the concept of the IT competence of individual business managers. Based on an examination of the literature in several disciplines and consultations with business and IT managers, we define the IT competence of business managers and identify its subdimensions. We also present a theoretical model of the link between IT competence and business-led technology leadership. The model is designed to be empirically tested and used to explore differences in the managers' leadership in IT projects and partnerships with IT departments.

Methodology

This research grew out of a study that identified a construct called "shared domain knowledge" as the most important factor in explaining the alignment of IT and business strategies [53]. In order to build upon these findings, we set out to broaden our understanding of this construct and to develop a theoretically grounded model to enable future research. We conducted a search of the literature in the disciplines that had studied the notions of competence and knowledge to inform our construction of a valid theoretical model of the relationship between IT competence and business leadership.

Our intent in this paper is to demonstrate that the way we define competence and its subconstructs has content validity. We use this term carefully, since we are not providing a measurement instrument. However, we want to ensure that the components of competence proposed herein provide an adequate coverage of the construct of the IT competence of business managers. To do this, we first describe the steps taken to develop the definition of IT competence and to identify its components.

We conducted two types of literature reviews. In the next section, we describe a review of the general literature on competence and how it has been operationalized and defined. Following that, we focus on the information systems literature to identify the components of the explicit and tacit types of IT knowledge, and then to further divide them into their subcomponents. 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. This step resulted in several additions to the model. We next interviewed an IT consultant, who was knowledgeable in both business and IT, and three line managers. These conversations focused on our construct and also on the characteristics of an IT-competent business manager. The IT competence construct was also discussed with a sample of 20 CIOs of leading firms [16] as part of an empirical research study investigating the ways in which the CIOs were increasing the IT competence of their managers and the expected outcomes of enhanced IT competence. In addition, discussions regarding the components of IT competence took place with two separate MBA classes.

The process of conducting the literature searches, thinking about the nature of the competence construct, and holding consultations was iterative rather than sequential. In response to the comments we received from both practitioners and academics in

information systems, we explored the IT competence literature further to place the discussions in a deeper theoretical context. The result is a construct that includes all dimensions relating to IT competence suggested in the literature or by our panels of practitioners. Although guidance is provided as to what items could be included in an instrument, development of a complete instrument and empirical testing is beyond the scope of this paper.

Definitions and Dimensions of Competence

THE CONCEPT OF "COMPETENCE" is used in many different areas of research, including psychology, education, management, human resources, and information systems. It is also used in a variety of ways—sometimes as a synonym for performance, other times as a skill or personality trait. It is sometimes referred to with different prefixes or suffixes, such as in the terms "competency," "meta-competence," or "supra-competence." These different uses generate some confusion as to the meaning of the concept. This confusion has been recognized in the literature [10, 14, 15, 51, 76]. In the IT literature, Marcolin and colleagues report that the proliferation of approaches on the concept of competence has hindered the creation of a cumulative body of knowledge [40].

Competence Versus Performance

Confusion arises when competence and performance are used interchangeably. Competence is the enabler, providing the means to a better performance [33]. By mixing competence and performance, outcome and process are confused. Because it is difficult to assess competence, performance is often used as a proxy for it. However, while these concepts are related, factors other than competence—such as motivation, effort, and supporting conditions—may influence performance [63]. Furthermore, competence does not necessarily imply performance.

In this study, we see competence as the potential that leads to an effective behavior. We are interested in investigating the capability that enables business managers to effectively apply IT in their business units. We also consider other factors that may influence the outcomes of competence (see the section on "The Outcomes of IT Competence of Business Managers"), but that are not part of the IT competence construct.

Competence is often used as "an umbrella term to cover almost anything that might directly or indirectly affect job performance" [76, p. 29]. The numerous definitions in various literatures can be grouped into three main ideas: competence as a skill, competence as a personality trait, and competence as knowledge. Each is described below. The third perspective is then developed into the IT competence construct.

Competence as a Skill

A large portion of the competence literature is discipline-specific and refers to the development of specific skills or "competencies" for a particular job or profession

[74]. The underlying idea in the skill-based approach is that there should be a fit between the employee's skills and the job requirements [18].

Marcolin and her colleagues define user competence "as the user's potential to apply technology to its fullest possible extent so as to maximize the user's performance on specific job tasks" [40]. This definition recognizes that competence is antecedent to performance, and adopts the skill-based approach by looking for the match between a user's abilities and the task at hand.

The skill-based approach assumes a predefined task. Competence is simply a "fit" between an individual and the task. This focus on a specific task can be useful when a firm is trying to hire someone or is attempting to create an effective training plan. However, it loses relevance in the context of line management leadership, since managerial roles do not necessarily imply *a priori* defined tasks. The skill-based approach also focuses on the minimum skills an employee needs to bring to the table to do an effective job. In the example of IT managers, the skill-based approach is thus insufficient to identify the competence that will enable a manager to identify new IT opportunities and behave proactively in regard to IT.

Competence as a Personality Trait

Other researchers use a broader definition of competence by including characteristics related to the individual [74]. Haynes defines competence as "generic knowledge, motive, trait, social role, or skill of a person linked to superior performance on the job" [27, p. 3]. The term "emotional competence," a learned capability based on emotional intelligence, is also used to represent this broader view in explaining outstanding performance at work [24].

These meta-competencies "represent the range of self-perceptions that exist about an individual manager's performance, encompassing also the irrationality and unpredictability of personal feelings" [14, p. 292]. They include general or specialized knowledge, physical and intellectual abilities, personality traits, motives, and self-images [31]. Viewing competence as a personality trait allows the inclusion of the dimensions of behavior that lie behind competent performance when discussing competence [75]. Competence thus comprises the qualities that help an individual have a successful career and are often used in the lifetime competency perspective.

This view of competence is too broad for our purposes, as we seek to explain what gives business managers the potential to leverage IT investments, not their entire career. Our focus is not on an individual job, nor is it on a lifetime of achievement. Rather, we focus on functional competency in a manager who is not part of the IT function. We therefore limit our definition of IT competence to the knowledge components of the meta-competence view.

Competence as Knowledge

Given the complexity of today's business environment, IT competence is needed to counter the myopic focus on technical skills [23]. To address the emerging role of IT

in organizations that goes beyond the simple execution of a task and requires a broader awareness, attention to non-task-specific competences is needed [47]. This awareness refers to a "familiarity with the capacities, advantages, limitations and impact of computer technology" [35].

Bringing knowledge into the competence definition broadens the concept by making it dynamic and interactive. This acknowledges that competence is not necessarily directly linked to a specific task but relates to the ability to transfer knowledge across tasks [14]. Competence is thus nonroutine, and embodies the ability to cope with complex and changing environments [31].

Knowledge theories express this richer sense of one's competence and define knowledge as more than skills possessed by an individual. Polanyi considered two types of knowledge: explicit and tacit [50]. Explicit knowledge is the formal knowledge that can be clearly transmitted using systematic language. This type of knowledge is not sufficient, alone, to describe one's competence. Being able to explain the rules in the game of chess does not make one a chess champion. One needs to be able to apply these rules to be competent [58]. The ability to perform well is tacit knowledge, or "know-how" [38, 58]. Practice, or experience, where the individual modifies his action based on the results of previous actions, builds competence through the enrichment of know-how [58]. Over time, individuals also develop worldviews that guide these direct experiences. These worldviews add a cognitive component to tacit knowledge that becomes embedded into an individual's action, commitment, and involvement in a specific context [45]. An individual often knows more than he or she realizes. One may be able to apply the rules for the game of chess without being able to explain them. These two components of tacit knowledge are further described in the section on "Tacit IT Knowledge."

At the organizational level, tacit and explicit knowledge are closely linked. In their explanation of why some firms continually innovate, Cohen and Levinthal introduced the term "absorptive capacity" and suggested that it refers "not only to the acquisition or assimilation of information by an organization, but also to the organization's ability to exploit it" [17, p. 131]. This knowledge-based approach to competence, and the idea that knowledge has explicit and implicit dimensions, leads to our definition of the IT competence of business managers. In the IT domain, Sambamurthy and Zmud define organizational level IT management competencies as "the capabilities, skills, and tacit know-how that an organization develops over time" [60, p. 2]. Forrester Research defines the concept of the new technology executive in a way that includes the two dimensions of knowledge. The new technology executive is one "who appreciates technology's capabilities and uses technology as a lever to deliver outstanding business results" [67, p. 39]. In keeping with both general management and IT literature, our definition of IT competence in business managers is as follows:

The set of IT-related explicit and tacit knowledge that a business manager possesses that enables him or her to exhibit IT leadership in his or her area of business.

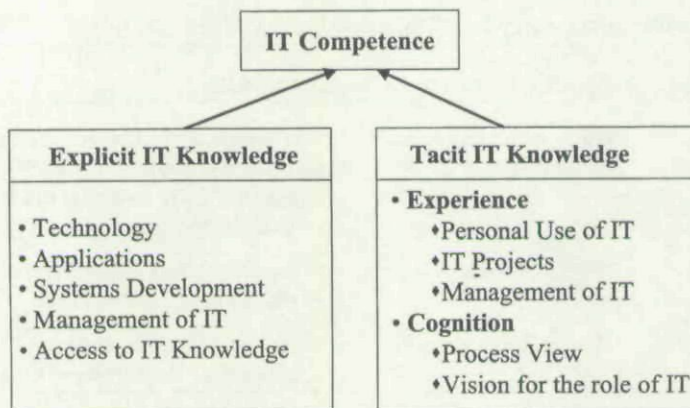


Figure 1. Model of IT Competence: Dimensions and Components

A business manager who is competent in IT possesses both explicit and tacit IT knowledge, although his or her primary area of expertise may be in an area other than IT or in general management. Figure 1 shows some of the components and dimensions of IT competence. These are discussed further in the next section.

IT Competence in Business Managers

IN THIS SECTION, WE DEVELOP A COMPREHENSIVE MODEL (Figure 1) of the two dimensions of IT competence: explicit and tacit knowledge. Elements in this model are based on an extensive review of the IT literature and consultations with individuals within the business and IT communities. The model is generic in nature, and is not directed at a particular type of technology, position, organization, or industry. For each element in the model, guidance for measurement is provided (see Tables 1 and 2).

Explicit IT knowledge

Although it has been suggested that business managers need to know about IT, the essential question is *What should they know in order to be IT competent?* Explicit IT knowledge is that which can be taught, read, and explained. Boyatzis defines it as specialized knowledge—a usable body of facts and concepts relevant for a particular job [10]. Explicit IT knowledge enables businesspeople to communicate with IT people.

Some studies have looked at the knowledge that business managers should possess to leverage IT within an organization. Some of the IT-related dimensions identified are:

- Being informed of information assets and information opportunities [72].
- Understanding the value and potential of IT influences [11].
- Knowing the potential and limitations of current and future IT, and knowing how the firm's competition is using IT [5, 6].

Table 1. Components of Explicit IT Knowledge

Components	Specific Elements	Sample Items
Technology	Current and emerging technologies	Knowledge about how technologies such as personal computers, client/server computing, LAN, and multimedia can be valuable to the organization
	Current assets	Knowledge about the existing technology portfolio in the business area
	Competitors' use of IT	Knowledge about how competitors use IT to support similar business areas
Applications	Current and emerging applications	Knowledge about how applications such as e-mail, intranet, and groupware can be valuable to the organization
	Current assets	Knowledge about the current application portfolio in the organization
System Development	Development methodologies	Knowledge about different development methodologies such as traditional system development life cycles, end-user development, prototyping, and access service providers can be valuable to the organization
	Project management practices	Knowledge about how project management practices such as staffing, scheduling, and budgeting are of value to the organization
Management of IT	IT planning and business deployment	Knowledge about the IT strategies, policies, and vision statements used in the organization
	Resource allocation	Knowledge about the allocation of financial and human resources for IT in the organization
Access to IT knowledge	Mapping of IT-knowledgeable people	Knowledge about IT-knowledgeable people within or outside the organization that one can contact when IT information is needed
	Mapping of secondary sources of IT knowledge	Knowledge about secondary sources of IT knowledge (e.g., Internet, journals, conferences)

Table 2. Components of Tacit IT Knowledge

Components	Specific Elements	Sample Items
Experience	Personal use of computers	Use of desktop software for personal productivity
	IT project experience	Participation and/or leadership in the following activities: <ul style="list-style-type: none"> • Initiation of new IT projects • Definition of the cost and benefits of a specific IT project • Management of IT projects • Development work within IT projects • Implementation of IT projects
	Management of IT	Participation and/or leadership in: <ul style="list-style-type: none"> • Creation of a clear IT vision of how IT contributes to business value and strategy • Development of IT strategy • Creation of IT policies within the enterprise • Setting IT budgets
Cognition	Process adaptiveness	Business activities are understood either as: <ul style="list-style-type: none"> • Activities located within the business areas • Activities that cross business areas but are within the organization • Activities that cross the organization boundaries and connect to customers and suppliers (Adapted from [60])
	Vision about the role of IT in the organization	IT is seen as a tool either to: <ul style="list-style-type: none"> • Automate: The role of information technology is to replace human labor and enhance human productivity through automation. • Informate down: The role of information technology is to provide information that gives a better picture of the operations and help employees gain better insights into their own activities. • Informate up: The role of information technology is to provide information that allows a clear and organized management view of the state of the business. • Transform: The role of IT is to fundamentally alter the industry or organization through new products or business strategies, often including redefinition of relationships with customers and suppliers. (Adapted from [64])

Other studies have created a broader net of knowledge, including business knowledge that is essential to make linkages with other units, to ensure a larger perspective, and to benefit from the fit between IT and the organizational context. This includes, for example:

- Knowledge about the organizational context, such as its environment, strategy, structure, culture, processes, and IT infrastructure [66].
- Knowledge of the "big picture," and of IT business [12].

To obtain a more complete overview of the existing areas of IT knowledge, we looked at the literature that identified the knowledge and skills needed by IT personnel (programmers, analysts, and managers) both in the technical and business domains in order to:

- successfully perform their jobs [36, 44]
- participate in the job market [70]
- gain knowledge for the IT profession [9, 48]

We then considered the knowledge that a business manager might be expected to have in order to gain IT competence, in two ways: in breadth and in depth. In terms of breadth, our model focuses on the IT knowledge of business managers and excludes their business knowledge. It is assumed that business managers know their own external and internal business environment. Therefore, only those areas of knowledge within the IT domain are included in the IT competence construct.

In terms of depth of IT knowledge, we assume that a business manager needs less IT knowledge than does an IT professional. As Keen 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" [77, p. 52]. The knowledge shown in the research model focuses on the "benefits" of different types of technology, not on their "features."

The components proposed for the knowledge dimension of IT competence 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 [66]. These components encompassed all other items suggested in the literature. The fifth component, access to knowledge—or knowing who knows what—reflects the knowledge network that a person creates [34]. This component reflects our belief that if a person has access to IT knowledge inside or outside the organization, he or she effectively has a higher level of IT knowledge than those who do not. While access to knowledge is not, strictly speaking, IT knowledge possessed by an individual, the practical difference in competence between a person with knowledgeable contacts versus one who has none is important to capture.

Each of these five components is explained in more detail below. Suggested items for the measurement of each individual component are also listed in Table 1. It is important to note that this list is a starting point meant to offer guidance in the development of an instrument for measuring competence and is therefore not extensive. In

addition, 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.

Technology

Technology refers to the basic components, as well as to all knowledge relevant "for assessing the IT infrastructure, for describing system features, and for examining the relationship between the capabilities of the existing infrastructure and the demands of the proposed system" [66, p. 379]. Line managers should be informed about their technology portfolio [72], and should be aware of their competitors' use of IT [5, 6]. Even if an organization obtains competitive advantage without applying emerging IT, knowledge about the next generation of IT may increase the level of competence of a line manager [32]. In order to make effective IT decisions, managers should have knowledge about novel IT that could have a significant impact on the organization, its products, or its customers [72].

Using these ideas, we have defined technology knowledge to include current and emergent technologies and knowledge that is both generic to all industries and specific to the organization and its competitors.

Applications

Applications refer to the ways IT is used or could be used by organizations to achieve their business goals (e.g., in order processing, decision support, or financial control). Line managers should be aware of the range of IT application types they may encounter and of the dynamics of these applications in organizations [66]. This implies knowledge about their current IT application portfolio, information architecture, and emerging applications [72], as well as business process knowledge.

We have defined applications knowledge as consisting of current and emerging applications, and generic and organization-specific applications. Examples of application knowledge are presented in Table 1. As noted in the Technology section, the specific application areas will need to be updated in future models.

The next two components in the framework differentiate between the two levels at which IT is managed: the level of projects that implement technology and applications, and the organizational level of managing IT resources and specifying the vision for IT.

Systems Development

In order to understand the potential benefits, dangers, and limitations of IT, familiarity with systems development practices is required [66]. The main ways to acquire a system are the traditional development life cycle, end-user development, purchasing software, and outsourcing [41]. Typically, since different types of projects are best

handled by different management approaches [3], more than one methodology needs to be known.

To succeed in systems development, knowledge about project management practices is also required, including the realities of systems development, the time needed to complete projects [32], the tradeoffs among system costs, schedules, and functionality, and the uncertainties associated with estimating system development completion times [72]. A recent study found that business managers' knowledge of project management was instrumental in increasing the shared understanding between IT and business managers [43]. Systems development knowledge thus involves an understanding of both systems development methods and project management practices. Proposed items for system development knowledge are presented in Table 1.

Management of IT

As the task of managing IT is best shared by IT professionals and the rest of the firm's management, there is a need for managers to possess knowledge about the activities related to the management of IT [66]. For many managers, the main difficulty resides not in the lack of awareness or in unwillingness to participate in IT management, but in a lack of the vocabulary and skills needed to participate in its different facets [32].

In our conceptualization, IT is another function in a business. In that respect, it is like marketing, accounting, or production. Good IT management is thus composed of activities similar to those used in other areas—vision and goal setting, allocation of resources, and monitoring of progress. The IT literature supports this broad view. For example, Silver et al. include knowledge of the firm's strategy and plans, IT planning, and resource allocation in their list of required knowledge elements [66]. Vision regarding how IT contributes to business value, and awareness of the integration of business strategic planning and IT strategic planning also reflect competence [60]. Proposed items for management of IT knowledge are listed in Table 1.

Access to IT knowledge

It is unreasonable to expect that a business manager know everything about IT. However, he or she may be expected to know something about sources of information—human and otherwise—both inside and outside the organization. At the technical level, this may entail knowing who understands complex technologies and being able to access and leverage that knowledge. A manager who knows whom to contact to get 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), increases his or her level of competence by developing the capabilities to use other people's knowledge. Knowing who knows what within a group is part of the group's combinative capacity [34]. 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. Proposed items for access to IT knowledge are presented in Table 1.

Tacit IT Knowledge

The need to couple tacit with explicit knowledge to create competence has been recognized by many IT and organizational behavior researchers [13, 25, 28, 32, 45, 46, 52, 60]. Although the concept of tacit knowledge is intuitively easy to understand, it is difficult to model. For this dimension of IT competence, we use two constructs to capture the notion of tacit IT knowledge: experience and cognition.

Nonaka suggested that tacit knowledge, "gained over time by trial and error and through intensity of effort," is of two types: *technical* and *cognitive* [45]. In our model, technical knowledge, or the "know-how" possessed by the manager is represented by the "experience" construct. Using experience as a proxy for tacit knowledge allows us to measure it, but suggests that similar experiences affect the creation of tacit knowledge similarly in different people. Although this is clearly not the case and each person will interpret his or her experience in a different way, we believe (as the model suggests) that a person with more experience will, on average, have developed a higher level of tacit knowledge than a person with less experience. Managers build their ability to develop relevant knowledge and understanding of IT over time through their participation in IT initiatives [62]. Experience is thus the basis for the development of tacit knowledge. Within a group, shared experience is a mechanism that creates collective tacit knowledge [38].

The *cognitive* component recognizes that tacit knowledge comprises more than doing things. It also includes vision or acumen. Cognitive elements of tacit knowledge refer to the working models of the world that an individual forms, including schemata, paradigms, beliefs, and viewpoints. These models provide perspectives for individuals to perceive and define their world and act as guiding visions [38, 45]. In relating this concept to IT knowledge, we propose two "working models": (1) perspectives on the organization of business activities and, (2) visions about how IT can be used in the organization. Together, these elements form the "cognition" component of tacit IT knowledge.

Each component proposed for the tacit dimension of IT competence is shown in Table 2 and is further described below.

IT Experience

The need for experience has been investigated in several studies. Experience, in addition to knowledge and skills of personnel, is a distinctive competence that helps companies obtain competitive advantage [68, 73].

Although prescriptive advice regarding the need for experience is widespread, a careful delineation of what this should constitute has not been formulated. Nonaka suggested that two variables influence the quality of experience through which individuals accumulate tacit knowledge. The first element is the *variety* of the experience, which suggests that managers should be involved in a diversity of activities. The second element is what Nonaka defines as "an embodiment of knowledge through a deep personal commitment into bodily experience" [45, p. 22]. This

second aspect suggests that the intensity of the experience is also of importance. The importance of intense experience is also found in the concept of absorptive capacity. According to Cohen and Levinthal, intensity of effort in assimilating and using knowledge is critical in the development of effective absorptive capacity [17, 62]. To operationalize this idea, the intensity of effort is reflected in the level of responsibility taken for different activities. (That is, active leadership is considered more intense than participation.)

We propose that experience be assessed by measuring both the diversity of experience (i.e., breadth) and the level of responsibility taken (i.e., intensity). For the diversity aspect, we have identified three distinct levels at which experience can be accumulated and measured: individual, IT project, and IT function. Details of each level as shown in Table 2 are discussed below.

Personal Use of IT

Although we did not initially include the personal use of computers in our model of IT experience, business managers suggested repeatedly that it is an important indicator of competence. IT researchers have also suggested the importance of personal use of IT for managers [19, 30]. A manager's experience using IT also reflects a personal innovativeness toward IT, and indicates a receptivity toward change [37]. Experimenting with and using IT develops a familiarity with current technologies and may encourage the manager to take a more global interest in IT.

IT Projects

IT projects generally progress through several phases: initiation, cost/benefit analysis, development, and implementation. Researchers have suggested that managers be involved in all of these stages. Line managers need to take leadership roles in the planning and implementation stages [54, 55] and to drive IT deployment [32]. Experience in project management (viz., during development and implementation) will increase the manager's expertise [32, 72]. With respect to project experience, involvement in any of the stages of the life cycle is included as a potential source of increased competence. The elements included in the assessment of experience with IT projects are listed in Table 2.

Management of IT

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 setting are needed to steer the use of IT within an organization. With IT-related knowledge, a manager can develop appropriate technology strategies that will create a clear vision for the role of IT within the firm. Strategic use of IT can be achieved only when top management's vision provides a context for planning [77]. Activities under the Management of IT are presented in Table 2.

Cognition

According to the IT literature and our interviews with CIOs, there are two important aspects of the cognitive element of tacit knowledge. The first is having a process-oriented view of the organization—that is, an ability to see beyond the tasks and hierarchy and to visualize the processes in one's organization. The second is the ability of an individual to see the transformational power of IT. Each is explained briefly below and is shown in Table 2.

Process View

Managers' ability to understand and implement a process view allows them to take advantage of the synergy between information systems and business processes [60], and is crucial in determining the success or failure of an organization's use of IT [55]. This ability to see the organizational activities in terms of the business process crossing functional areas represents the managers' process adaptiveness. This is their capability to carry out the restructuring of business processes in a continuous effort to adapt to changing environment and leverage IT opportunities [60]. Several of the CIOs who were shown a model of IT competence that included only explicit knowledge and experience expressed the view that the model should include a concept called process mapping. They argued that a line manager who can visualize the organization as a set of interrelated processes can often identify ways that IT can be used to leverage the firm, and can anticipate its effect on related activities. This "peripheral vision" makes it more likely that IT ideas will have a global beneficial effect rather than only a local effect. One CIO underscored the importance of business/process modeling by recalling the most productive IT-Business learning environment he had witnessed. He said:

This year, we launched a rather ambitious effort at doing a Global Business Model. Creating project teams to do the difficult work of this business model definition did more in terms of rapidly developing the awareness of every element of the technology—the solution, what works, how it works, how it all fits together, the infrastructure issues—than any single thing we have done.

—a CIO who oversees 800 IT people

As shown in Table 2, process adaptiveness can be measured from the low end, where an individual visualizes the organization as a set of tasks, to the high end, where the individual visualizes the organization as a value chain from supplier through to customer.

Vision for the Role of IT in the Organization

Whether or not they are aware of it, as business managers learn about and experiment with IT, they form assumptions about its role within the organization and a vision of what it can or cannot do [64]. Schein developed a four-level typology of IT vision:

"automate" (i.e., IT can execute tasks in a process), "informate down" (i.e., IT can send information to the actors in a task), "informate up" (i.e., IT can send information to the task actors and the organizational managers), and "transform" (i.e., IT can dramatically change or eliminate a task) [64]. These vision types were found to be the most powerful discriminators of success of the CEO/CIO relationships [20]. We therefore included vision for IT in our model, since it has the ability to influence an individual's willingness to engage in further education, experience, or IT leadership behaviors. An individual's IT vision may be the result of IT knowledge seeking or IT experiences, or it may have been developed from other activities or interests.

The Outcomes of IT Competence of Business Managers

A MAJOR PURPOSE OF DEFINING IT COMPETENCE is to investigate whether or not it leads to proactive behaviors toward IT. However, competence in IT is not sufficient to explain or predict IT leadership in an individual business manager. Factors such as motivation, the influence of superiors, and having the required resources and power in the organization to effect change are also likely to influence proactive behaviors toward IT. To take all these factors into account, we propose the use of the theory of planned behavior [1] to model the relationship between IT competence and its outcomes. The research model is presented in Figure 2.

This model could be described in terms of several components or constructs. The first is IT competence. Later we discuss how IT competence can be viewed as a set of beliefs influencing attitudes, and to some degree the other constructs of the model. First, however, we discuss attitudes, subjective norm, and perceived behavioral control. These constructs influence a person's intentions to take proactive steps toward IT, which then influences the actual proactive behavior toward IT.

IT Competence and the Theory of Planned Behavior

The theory of planned behavior (TPB) is an extension of the theory of reasoned action [22], a well-tested theory in the context of IT that offers an appropriate model of individual behaviors [8]. According to TPB, actual behavior is solely and directly determined by one's intention to perform the behavior. Three variables influence a person's intentions. The first is the individual's attitude toward the behavior, reflecting how the person feels about performing the behavior. The second is his or her subjective norms concerning the behavior, reflecting the extent to which the person thinks that others, such as peers and superiors, want him or her to perform the behavior. The third variable is perceived behavioral control, which accounts for conditions under which individuals do not have complete control over their behavior [69]. Perceived behavioral control tests for the existence of opportunity and resources to support proactive IT behaviors. The model accounts for motivations, since the intention to perform a behavior reflects an individual's motivation to do so [1].

Figure 2 shows how the elements in the TPB link IT competence to line technology leadership. Each element and relationship is discussed below.

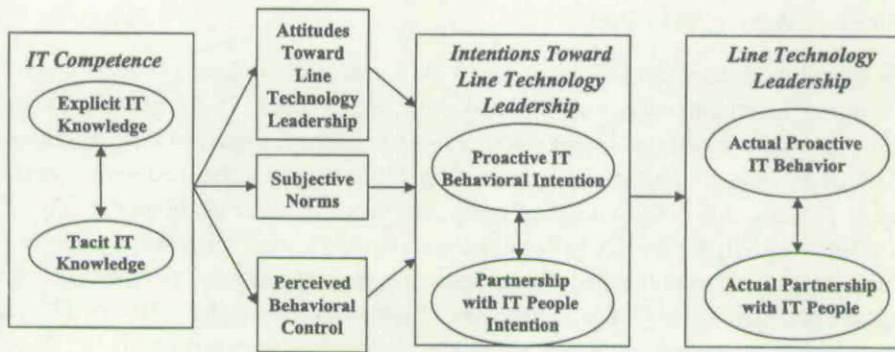


Figure 2. Research Model: IT Competence and Its Outcomes

Attitudes Regarding Line Technology Leadership

Attitudes toward a specific behavior are determined by beliefs concerning the consequences or outcomes of that behavior. As the subjective nature of knowledge represents personal beliefs that are deeply rooted in an individual's value system [45], individual IT competence, which is the individual's knowledge about IT in the broadest sense, can be seen as reflecting the individual's beliefs about IT. Thus knowledge influences beliefs. For example, knowing that IT can support an organization's strategy leads one to believe in the usefulness of IT. These beliefs will then influence the various elements of the TPB.

Hartwick and Barki found that an individual's participation in the development of an IS project influenced the attitude toward using the system developed [26]. In the same way, the "action" component of competence represented by the manager's experience with IT is expected to influence his or her attitude toward the technology. This is consistent with the cognitive dissonance theory, according to which individuals hold attitudes that are consistent with their actions [21]. Thus it is expected that a manager's experiences will influence his or her attitude toward utilizing IT.

Subjective Norms

Subjective norms are a function of two factors: what one believes important other individuals expect one to do and one's motivation to comply with those others [8]. We expect that IT competence will have an indirect effect on subjective norms. Hartwick and Barki demonstrated that subjective norms are influenced by the same variables as attitude [26]. The key element linking IT competence to subjective norms is the individual's belief about the use of IT [26]. According to this "false consensus" effect [57], individuals think that others hold the same beliefs as they do. Managers' IT competence, reflecting their beliefs about using IT, may thus influence their subjective norms about using IT. Furthermore, if an individual is known to be highly competent in IT, it is likely that others (e.g., superiors or peers) will be more willing to accept that individual taking on IT leadership roles.

Perceived Behavioral Control

Perceived behavioral control is similar to the locus of control, and reflects beliefs about the facilitating conditions [71] and about self-efficacy [7]. Facilitating conditions represent the availability of resources—such as time, organizational authority, and money needed to perform a behavior—and thus are not associated with competence. Self-efficacy is the individual's self-confidence in his or her ability to engage in a behavior. Higher levels of IT competence should increase the level of perceived efficacy. With relevant knowledge and experience, managers should be more likely to believe that their actions are legitimate [30, 39], thus increasing their self-confidence about their IT behavior and their level of perceived behavioral control.

Outcomes of IT Competence

In this section, we develop the constructs referred to as line-technology leadership.¹ In order to create the elements of this part of the model, we asked several IT and business managers to describe the results of having IT-competent managers in an organization. Many of their comments related to the creation and implementation of IT projects. Examples are:

We need the users to . . . be active partners in any new developments and to be realistic in their needs.

—a CIO who oversees 45 IT people

We are trying to get the business to be more knowledgeable consumers of IT development projects, . . . to better understand how to set scope appropriately, how to make sure that the non-technology aspects of the project are addressed, such as the changes to business process or the changes to job roles.

—a CIO who oversees 800 IT people

For the most part, though, respondents were quite vague about their goals with respect to IT competence. However, comments received from those who responded with specific ideas, as well as the academic literature [55], [25, 61], indicated that greater IT competence of business managers makes them more proactive in their participation in IT projects and in their willingness to develop a partnership with the IT department. Each of these elements is discussed below.

Proactive IT Behavior

Line leadership focuses on the proactive component of behavior—identifying the actions a manager takes in anticipation of future needs—in an attempt to direct the course of actions. IT research supports the idea that IT competence will lead to proactive IT behaviors. According to Rockart, only with the appropriate education and training are line managers more likely to assume leadership in regard to IT [55]. An individual with a high level of skills and knowledge (i.e., IT competence) will antici-

pate and seize opportunities to implement practices that add value [25]. They will exhibit a desire to assume leadership roles with respect to new technologies and new IT projects [61]. We therefore expect that IT competence will lead to proactive behaviors, after taking into account the elements in the theory of planned behavior.

Partnerships with IT people

Research strongly suggests that relationships are important to the successful innovation and deployment of IT. Partnership between IT and business is necessary for IT to change the way an organization competes [4]. Both organizational and personal relationships are important [29, 53]. According to Zmud, a strong relationship between business and IT managers will help an organization be innovative in the IT domain. He suggests that cross-domain actions lead to cooperation, which leads to partnerships, which in turn lead to innovation and IT deployment [77]. Rockart et al. describe an effective relationship as follows:

In an effective relationship, IT professionals and line managers work together to understand business opportunities, determine needed functionality, choose among technology options, and decide when urgent business needs demand sacrificing technical excellence for immediate, albeit incomplete, solutions. . . . These relationships demand that both IT and line managers accept accountability for systems projects, which is achievable only when both parties share their unique expertise. [55, p. 47]

It is our belief that IT competence in business managers will result in cross-domain actions—that is, a willingness on the part of business managers to engage in proactive IT behaviors and to develop strong relationships with IT managers.

Implications for Research and Practice

IN THIS SECTION, WE DISCUSS THE CONTRIBUTION AND LIMITATIONS of our research. We also suggest areas for further research and discuss the implications of our theory for business practice.

Contribution and Implications for Researchers

The issue of IT knowledge has been a topic of interest to IT academics for several decades [9, 49]. The focus of most of this research has been on identifying the IT skills needed for improving the performance of IT professionals. However, there has been an increasing call for enhancing the IT knowledge of line managers based on the observation that the success or failure of an organization's use of IT depends substantially on line leadership [54, 55]. Furthermore, empirical research has shown that greater IT competence of line managers benefits organizations by leading to better alignment between an organization's IT goals and its business goals [53].

In this paper we have proposed a definition and a model of the construct IT competence in business managers. Our definition and model are based on an extensive examination of the literature, both in the general domain of competence, and in the more specific domain of IT knowledge and skills. From the literature on knowledge, we have created the overarching framework of a two-dimensional IT competence construct. One dimension, explicit IT knowledge, represents the declarative components of IT competence. The other dimension, IT experience, represents the tacit or procedural components of IT competence [2, 45, 50]. We have identified the elements of each dimension.

By conducting a search in the literature and with various panels of experts, we have attempted to create a construct with a high level of content validity. Of course, the complete validation of this construct, including convergent and divergent validity, will require data collection in the field.

The IT competence of business managers is a complex construct. We believe that a necessary and sufficient condition for IT competence is the presence of both tacit and explicit knowledge. With the relevant knowledge and associated behaviors in the IT domain, an understanding of IT in the organizational context will follow [42]. This could lead to the creation of a vision for IT utilization, or the development of a new IT-enabled organizational form.

In conclusion, we have attempted to define and model a construct of IT competence that is posited to significantly influence the utilization of IT in organizations. Further refinement of this theoretical definition and the development of an operational definition are needed. We hope this will be accomplished through the joint efforts of IT researchers.

Implications for Practice

The model of IT competence, if validated empirically, carries with it far-reaching implications for organizations. Organizational actions such as training courses and technology demonstrations may fall far short of the goal of creating IT competence if they develop only the explicit IT knowledge of business managers. If experience is as important as the model suggests and as the knowledge creation literature has stated [45, 58], organizations need to systematically plan for their line managers to be directly engaged in the practice of IT management, both at the project and the IT function level.

Most organizations are insisting on line managers as coleaders of IT projects and cross-functional teams to design and implement them [16]. These are steps toward the creation of tacit IT knowledge. Many organizations, however, never transfer people into the IT department, even for a short rotation. In addition, most organizations rarely transfer their IT people into line positions. Either of these actions would enhance the IT competence of business managers.

If the model truly predicts line-technology leadership, organizations will need to consider how to help managers think of the organization as a set of processes rather than as functional silos, and they will need to consider how they can begin to under-

stand the transformational power of IT. These imperatives suggest actions such as participation in the business modeling phase of IT projects, and moving line managers through several departments in the early phases of their career. These actions need to be deliberately and systematically pursued over a period of years for any large-scale effect to take place.

A CIO acting alone cannot effect a change of this magnitude. As with the development of any core competence, building IT competence would have to become an organizational imperative, driven from top management and woven deeply into the organizational fabric. However, according to a CIO study [16], few organizations have this level of support for IT knowledge, nor have they created goals and tactics to achieve IT competence.

It is our hope that the model presented in this paper will allow researchers to empirically demonstrate the connection between IT competence and line technology leadership. When this has been accomplished, organizations will have solid evidence of the value of deeply involving business managers in IT management and IT projects, thereby creating IT competence.

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NOTE

1. Line-technology leadership is a first-order outcome of IT competence. Although there are undoubtedly second- and third-order outcomes, such as IT deployment and organizational success, these results are influenced by many more factors and therefore are not shown in the model.

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