We address how individuals’ (workers) knowledge needs influence the design of knowledge management systems (KMS), enabling knowledge creation and utilization. It is evident that KMS technologies and activities are indiscriminately deployed in most organizations with little regard to the actual context of their adoption. Moreover, it is apparent that the extant literature pertaining to knowledge management projects is frequently deficient in identifying the variety of factors indicative for successful KMS. This presents an obvious business practice and research gap that requires a critical analysis of the necessary intervention that will actually improve how workers can leverage and form organization-wide knowledge. This research involved an extensive review of the literature, a grounded theory methodological approach and rigorous data collection and synthesis through an empirical case analysis (Parsons Brinckerhoff and Samsung). The contribution of this study is the formulation of a model for designing KMS based upon the design science paradigm, which aspires to create artifacts that are interdependent of people and organizations. The essential proposition is that KMS design and implementation must be contextualized in relation to knowledge needs and that these will differ for various organizational settings. The findings present valuable insights and further understanding of the way in which KMS design efforts should be focused.

Introduction

Managing organizational knowledge remains a key strategic agenda for organizations (Mayasandra, Pan, & Leidner, 2011). In a 2006 survey led by The Economist, chief executive officers (CEOs) ranked knowledge management (KM; 36%) second to sales and marketing (56%) as the most important area in realizing corporate strategy goals over the next 3 years (Economist Intelligence Unit, 2006). Meanwhile, the follow-up 2007 Economist survey showed that more than 50% of CEOs believed knowledge management to be the most vital area for strategic investment (Economist Intelligence Unit, 2006, 2007). Respondents from the 2006 Economist survey predicted that within 3 years investments in technology would have resulted in improved customer relationship management (39%), improved sales and marketing (34%), and improved knowledge management (33%; Economist Intelligence Unit, 2006). Gartner’s CIO Agenda report (2010) predicts that “creating new products, services, and innovation support” will be the number one priority for information technology (IT) units by 2013 (up from fifth in 2009), followed in second place by “improving the efficiency and effectiveness of business processes” (down from first place in 2009). The “use of information analytics in decision-making” is predicted to rank third in 2013, rising three ranking from its sixth place in 2009 (Gartner EXP, 2010).

With the purpose of improving the organization’s efficiency and effectiveness through better decisions, organizations consciously design and deploy knowledge management solutions that support utilization of existing knowledge and new knowledge creation (Braganza,
Companies implement knowledge management tools with hope of improving how knowledge is created and used in individual and group decision making. Examples of common KM tools include:

- Establishing corporate libraries
- Building intranets
- Sharing best practices
- Building databases
- Leading training programs
- Installing groupware
- Creating virtual organizations

Regardless of these efforts, the measurable benefits remain elusive for most organizations, as shown by the 70% reported failure rate of knowledge management initiatives (Davenport & Glaser, 2002; Desouza & Awazu, 2005; Wing & Chua, 2005). Some companies report even higher failure rates of up to 84% (Lucier & Torsilieri, 1997). Knowledge management activities and technologies are indiscriminately deployed in most organizations, without regard to the actual context into which they are being brought (Ambrosio, 2000; Malhotra, 2005; Rigby, Reichheld, & Schefter, 2002). Moreover, the literature pertaining to knowledge management projects tends to focus on cataloging the variety of factors indicative of successful KMSs, instead of analyzing the design of an organizational intervention that will actually improve how employees leverage existing and create new personal, group, and organization-wide knowledge. Organizations need actionable know-how that describes how to build meaningful and value-adding KM solutions (Desouza & Awazu, 2005).

One of the fundamental management failures appears to stem from the introduction of a new tool that does not satisfy the users’ needs (Cooper, 2003; Desouza & Paquette, 2011; Stenmark & Lindgren, 2004; Wing & Chua, 2005). For example, software vendors frequently convince organizations that KM is attainable via the application of any one of the many technical solutions on the market. Detailed analysis shows that technical solutions vary widely in terms of functionalities, with some oriented towards design of portals, others enabling synchronous or asynchronous voice or video communication, some used as a planning and controlling tool for knowledge capabilities in companies (knowledge maps), others used as highly efficient document-search solutions (Janev & Vraneš, 2005). Technical solutions often do not deliver what users expect due to misalignment of user needs and solution capabilities (Chua & Lam, 2005; Davenport & Glaser, 2002; Desouza & Awazu, 2005; McDermott, 1999; Velasquez, Durecikova, & Sabherwal, 2009; Wing & Chua, 2005). Organizations are lulled into deploying a content management system (i.e., a database of best practices) that solves the issue of accessing data, when they may instead have benefited from a simpler searchable database of experts that enables employees to contact appropriate coworkers for collaborative problem solving. In addition, software vendors often market their solutions as “KMS” regardless of the (potentially very narrow) focus of the information science (IS) solution (i.e. Balmisse et al., 2007; Janev & Vraneš, 2005).

Markus, Majchrzak, and Gasser (2002) also acknowledge that one of the important reasons why knowledge workers are not supported appropriately is that many KM initiatives avoid using existing IS systems; instead, they opt to implement new and sometimes duplicate systems. This results in employees having access to expert systems, decisions support systems, discussion boards, content management systems, etc., which were not integrated nor aligned into their work practices. Such a variety of tools results in a “tool glut” or a “solution fatigue,” resulting in an aversion to adopting new systems. Knowledge management thus was not connected to the work of the enterprise (Seeley, 2002), defeating the primary purpose of a KMS. With such an approach, many companies design a “parallel universe,” where dealing with knowledge is disconnected from the working practices of their employees (Smith & McKeen, 2004).

Massey, Montoya-Weiss, and O’Driscoll (2002) argue, “there has been very little research on how to successfully develop and implement KMS to enhance performance, particularly in core business processes” (p. 271). The lack of such research gave rise to calls by practitioners for guidelines on how to build and implement KMS and how to facilitate organizational change to promote knowledge sharing (Alavi & Leidner, 2002; cf. Moffett, McAdam, & Parkinson, 2003). Based on a thorough review of existing literature, we pose the research question: How do workers’ knowledge needs influence the design of a KMS for supporting and enabling knowledge creation and utilization? To answer this question, we formulated a model for designing a KMS incorporating the design science paradigm. Our basic premise is that KMS must fit user needs and that these needs will differ across an organization. In the next section, we outline our research approach and briefly discuss the design science paradigm. Following this, we outline our research methodology. Then we outline the creation of the KMS model, beginning with the theoretical basis that guided the development of the conceptual model. Next, we describe the validation process of the preliminary model to gauge feedback and what necessary revisions were made. This is followed by details of the evaluation cycle for our refined KMS design model, a discussion of the findings and the implications of our research, and finally our conclusions.

Research Approach and Methodology

Design Science Paradigm

Design and behavioral science are two distinct, but complementary research paradigms (Hevner, March, Park, & Ram, 2004; March & Smith, 1995). The design science
paradigm has its roots in engineering and the sciences of the artificial (Simon, 1996) and is fundamentally a problem-solving approach. Design science research aspires to create artifacts that are interdependent with people and organizations (Hevner et al., 2004; March & Smith, 1995). The artifacts are constructs, models, methods, and instantiations (Denning, 1997). Constructs provide the language in which problems and solutions are defined and communicated (Schön, 1983), which characterize a phenomenon (Pries-Heje & Baskerville, 2008). Models use constructs to represent a real-world situation, the design problem, and its solution space (Simon, 1996). Models frequently represent the connection between problem and solution components enabling exploration of the effects of design decisions and changes in context. They describe tasks and situations (Pries-Heje & Baskerville, 2008). Methods provide guidance on how to solve problems. These can range from formal, mathematical algorithms that explicitly define the search process to informal, textual descriptions of best practice approaches, or some combination. Instantiations are physical implementations (Pries-Heje & Baskerville, 2008). They demonstrate feasibility, enabling concrete assessment of an artifact’s suitability to its intentions. Such artifacts are not exempt from natural laws or behavioral theories. On the contrary, their creation relies on existing kernel theories that are applied, tested, modified, and extended through the experience, creativity, intuition, and problem-solving capabilities of the researcher.

Design science research requires the creation of an innovative, purposeful artifact for a specified and relevant problem domain. For the artifact to be effective, it must yield utility for the specified problem in terms of it being a valuable solution. Hence, thorough evaluation of the artifact using established methods is crucial. Artifacts may be evaluated in terms of functionality, completeness, accuracy, fit with the organization, and other relevant quality attributes. Novelty is crucial because the artifact must be innovative, solving a heretofore unsolved problem or solving a known problem in a more-effective or efficient manner.

March and Smith (1995) identify two design processes: build and evaluate. Purposeful artifacts are first built to address unsolved problems. Then they must be evaluated with respect to the utility provided in solving those problems. Additionally, Hevner (2007) depicted three cycles in design science: the relevance cycle that connects design science research and the problem environment through the specification of requirements and field testing, the design cycle that connects building and evaluating artifacts, and the rigor cycle that connects design science research and developing knowledge bases. Design science is inherently iterative where the initial artifact needs to be evaluated and redesigned until a satisfactory solution is found. The search for solutions is guided by “satisficing”—searching stops when an artifact that “works well for the specified class of problems” is found (Hevner et al., 2004, p. 89). Fundamental questions on utility (“What does it do?”) and its demonstration (“Does it really do that?”) are salient.

**Research Methodology**

In our research, the KMS design model was built as follows. First, based on a rigorous literature review, a model that prescribes the appropriate KMS choices for particular organizational context was conceptualized and proposed. Second, the relevance and potential utility of the model were evaluated through an exploratory case study in Parsons Brinckerhoff (New York, NY), a knowledge-intensive engineering company. Third, the initially proposed model was refined based on the findings. Fourth, the refined model, and its utility were then evaluated and subsequently further improved through another setting. We did an in-depth exploratory qualitative case study at Samsung Electronics in Seoul, South Korea.

Data collection sites and key informants chosen for participation were of the revelatory type, and findings from both build and evaluation phases were analytically generalized. In terms of data collection and analysis, we followed the principles of the grounded theory research approach (Glaser & Strauss, 1967; McAdam, Leonard, Henderson, & Hazlett, 2008). Grounded theory research is well suited for theory building and “theory-driven empirical research” (Melnyk & Handfield, 1998). Existing theories were used to create an initial construct, which was, through the empirical part of the study, iteratively tested and amended. With practitioner-based insights and inputs, where multiple sources of data were embraced, we were engaged in a recursive sense-making process.

The interview guide was constructed with the intention to explore the key issues of the phenomena under research (Miles & Huberman, 1994). Additionally, follow-up discussions and presentations were performed, which is crucially important. They enhanced construct validity as they further explored constructs, patterns, interrelations, and particular situations of the firm. In the case of Parsons Brinckerhoff, the synthesis of the interview and findings was reviewed by the interviewee and one context was replaced by a better, more illustrative example. In the case of Samsung Electronics, the findings from the interview were presented to the interviewee and were amended and confirmed to arrive at a final form as presented in the text below.

Purposive sampling was used in each organization to choose the most knowledgeable experts. We identified the key informants in each case study through reviewing the organization’s formal structure and discussions with knowledgeable external consultants. Data recording involved transcriptions of the digitally recorded interviews. These were done with an MP3 player/recorder when conducted face-to-face, and by using PrettyMay Voice Plugin (version Business 3.0.2.16) for Skype communication software (version 3.6.0.248). Interview transcriptions accounted for over 50 pages of text. In the data analysis phase, data were summarized using three summarizing mechanisms typically used in grounded theory research: noting patterns and themes, counting/listing, and making contrasts/comparisons (Miles & Huberman, 1994). Noting patterns and themes was done
to find support for our preconceived conceptualization of the constructs under research and also to analyze novel concepts. Counting and listing were conducted to make lists. In particular, they were used to identify KMS functionalities in place in each of the eight knowledge work contexts. Contrasting and comparisons were used to find similarities and dissimilarities of KMS functionalities in each of the six knowledge work phases and in each of the eight knowledge work contexts. As the number of interviews performed was manageable, we did not use a coding template. Rather, our interview protocol consisted of long-form interview questions and supporting documents with definitions of key constructs. Specifically, the questions were grouped by constructs of knowledge management, knowledge management strategy, knowledge management systems, knowledge work, knowledge needs, overall concept, and detailed KMS design model. Mostly, responses thus followed that same order. Where they did not, and where novel concepts and ideas occurred, we used marginal remarks in the interview transcripts, as suggested by Miles and Huberman (1994, p. 67). As there are two cycles in this research, specifics of the research methods and material in each cycle will be introduced in detail in the sections below.

The KMS Model Construction

Designing the Model

Three major theoretical premises guided the model development. First, task technology fit theory (Goodhue & Thompson, 1995; Zigurs & Buckland, 1998) was taken as the conceptual notion for construction of the KMS design model and was amended to the fit the KM context. Second, we drew on the process value of it theory (Barua, Kriebel, & Mukhopadhyay, 1995; Sambamurthy, 2001; Tallon, Kraemer, & Gurbaxani, 2000). Third, evolutionary information processing theory (Li & Kettinger, 2006) as the one that adequately explains the dynamics of the knowledge creation and utilization process. They outline a six-stage iterative process of (1) problem recognition, (2) goal setting, (3) generation of tentative knowledge variation, (4) knowledge selection, (5) knowledge retention, and (6) resource management. The outline of the KMS design model is given in Figure 1. Each of the elements of the model are explained below.

KMS characteristics. Knowledge management system characteristics represent the technology part of the construct. We sought to identify all the possible technological solutions available to the KMS designer. We analyzed the existing literature (i.e., Balmisse, Meingan, & Passerini, 2007; Barron, Chiang, & Storey, 1999; Garfield, 2006; Janev & Vraneš, 2005; Liao, 2005; Pan & Leidner, 2003) and business practices to arrive at five broad types of KMS: (1) explicit knowledge exchange type, (2) tacit knowledge exchange type, (3) connectivity between humans type, (4) collaborative work type, and (5) knowledge discovery type.

With explicit knowledge exchange (EKX), the focus is on providing efficient access to the codified expertise. These tools have specific focus on the compilation, organization, and replenishment of the knowledge base in the form of information in databases, documents in document manage-
ment systems (such as SharePoint), etc., where it can be accessed by employees. With tacit knowledge exchange (TKX), the focus is on enabling capture of the difficult to get to tacit knowledge through unconventional means, such as videotaping a particular solution to a problem that is otherwise difficult to explain in words, or using toolkits to free collaborating parties from the need to express themselves in words. Connection between human knowledge sources (CON) focuses on enabling quick location of knowledge holders in the enterprise. Collaborative knowledge creation tools (COL) focuses on enabling joint knowledge creation through asynchronous or synchronous communication, which results in explicit or tacit knowledge generation. The fifth and last type of KMS used in this research is knowledge discovery from explicit sources (KD), where tools deal with the analysis of large amounts of unexploited explicit data. They support structured queries and replies, drawing upon text and data analysis, such as text-, web-, and data-mining, and case-based reasoning.

Knowledge needs. Employees need to interact with organizational knowledge during their work assignments; as such, the answers to questions such as how and which knowledge is (could be) utilized and how new knowledge is (could be) created, depends on the organizational context. This concurs with knowledge management success frameworks, which argue that to build a successful KMS, it is vital to know how knowledge workers use and create knowledge in their work practices (Holsapple, 2002; Massey et al., 2002). Most critically, a KMS needs to support everyday practices of knowledge utilization and creation throughout work practices, leading to the importance of business context analysis through the knowledge needs lens (Stenmark & Lindgren, 2004). The literature review and its synthesis revealed that they can be conceptualized through three contingent elements: (a) task domain, (b) type of knowledge, and (c) volatility of knowledge. For the task domain, focused and broad tasks were distinguished. With focused tasks, employees do not need to collaborate with other specialists from other domains, but rather solve problems alone or with others from the same knowledge area (Choudhury & Sampler, 1997; Pisano, 1994). With broad tasks, employees are required to work with employees from other units within an organization through dynamic interaction, communication, and coordination (Kusunoki, Nonaka, & Nagata, 1998). Such tasks require varied knowledge domains to be combined when solutions are sought. The second element of the knowledge needs construct is type of knowledge. Here, informational (know-what) and procedural (know-how) types of knowledge were distinguished. The first is equivalent to knowing what one needs to know about a topic. It focuses on beliefs about information, relationships among variables. For example, knowing average rainfall in the area for the last 50 years is informational knowledge, which can be used to inform the choice of material suitable for the roof of a house. The second type of knowledge is equivalent to knowing how to go about accomplishing a task. This type of knowledge focuses on the processes or means that should be used to perform the required tasks. For example, learning how to measure the volume flow for a river is gaining procedural knowledge. Task volatility indicates the lifespan of knowledge required to perform everyday work. For some areas of work, new knowledge must be continuously created, and for some, it can be stored and reused over longer periods. Some business problems involve answering questions that have never been asked in quite the same way before (Goodhue, 1995). In addition, knowledge becomes obsolete more or less rapidly (Dennis & Vessey, 2005).

These three elements influence the way knowledge work happens as well as the KMS support needed in particular business context. All possible combinations give us eight possible work contexts in which knowledge work occurs as shown in Table 1.

Knowledge work. We performed a rigorous literature review to understand how knowledge is utilized and created and how organizations can preserve it to capitalize upon it in the future. This element of the construct uncovers the process of how knowledge work happens. Decisions are made by individuals who need to be provided with the best environment to create new knowledge and to utilize existing knowledge to guide decision making that benefits the
These five activities will flourish (Garvin, 1993). To be successful, knowledge management initiatives have to strive for creation of such an environment in which knowledge quickly and efficiently throughout the organization. They make decisions by systematic problem solving, experimentation with new approaches, learning from one’s own experience and history, learning from the experiences and best practices of others, and transferring knowledge capitalizes upon existing knowledge. Rather, new knowledge is created through (a) blind variations of behavior when adapting to environmental change (b) selective survival of best variations, and (c) retention and duplication of surviving variations (Campbell, 1974).

Knowledge needs–KMS fit profiles. Finally, the KMS design model artifact was constructed in the form of “ideal fit profiles,” which direct appropriate technology solutions for particular knowledge work contexts. Figure 3 illustrates the proposed conceptual framework.

After conceptualization of each of the constructs, relations between them were substantiated drawing on the literature of knowledge management, information technology, and information systems. We were looking for success stories in the area of which kind of technological solution worked well in particular occasion and why (i.e., Garfield, 2006; Janev & Vraneš, 2005). Moreover, theoretical concepts were searched for and applied analytically to the given situation. For example, the Becerra-Fernandez & Sabherwal (2001) study linked Nonaka and Takeuchi’s (1995) SECI framework and its knowledge creation stages of socialization, externalization, combination, and internalization, with knowledge processes of knowledge sharing, knowledge discovery, knowledge capture, and knowledge application. The strength of their work lies in their advice on which knowledge processes are supported by which type of KMS technology. However, they oversimplify the link between knowledge needs of organizational subunits-departments and the four SECI knowledge creation stages. They link one department to one SECI knowledge creation stage, arguing that it is enough to cover that one process by appropriate KMS technology. For example, a biomedical office in the National Aeronautics and Space Administration (NASA) reportedly could benefit from better-supported internalization, whereas a Public Affairs Office could benefit by the improved combination (Becerra-Fernandez & Sabherwal 2001). With such thinking, they neglected all other aspects of knowledge creation and utilization. They repeatedly produced, selected, and the surviving knowledge is stored in organizational memory. Their model breaks down knowledge creation and utilization into the stages of problem recognition, goal setting, generation of knowledge variation, knowledge selection, knowledge retention, and resource management, while explaining the role of information and knowledge. Information functions as a trigger for knowledge creation, where “tentative” knowledge variations are applied and then selected based on feedback, goals, and resource information. Two competing forces, exploration of new alternatives and exploitation of old certainties push together for the creation of new knowledge. Existing knowledge from past activities resides in organizational memory and when accessed influences present problem solving. This core of Li and Kettinger’s theory, which explains how knowledge work happens (Figure 2), was taken as the core of the knowledge work construct in our research. Being process-oriented was one of the reasons why the evolutionary information process theory was chosen to explain how knowledge work happens. Li and Kettinger’s (2006) model articulates how human problem solving is conducted through a series of operations that transform existing knowledge from organizational memory into one that hopefully solves the current problem. The evolutionary view also suggests that the creation of knowledge does not follow a linear pattern of problem-heuristic search for solutions that capitalizes upon existing knowledge. Rather, new knowledge is created through (a) blind variations of behavior when adapting to environmental change (b) selective survival of best variations, and (c) retention and duplication of surviving variations (Campbell, 1974).

<table>
<thead>
<tr>
<th>Work context</th>
<th>Task domain</th>
<th>Knowledge volatility</th>
<th>Type of knowledge</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Focused</td>
<td>Low</td>
<td>Informational</td>
</tr>
<tr>
<td>2</td>
<td>Focused</td>
<td>Low</td>
<td>Procedural</td>
</tr>
<tr>
<td>3</td>
<td>Focused</td>
<td>High</td>
<td>Informational</td>
</tr>
<tr>
<td>4</td>
<td>Focused</td>
<td>High</td>
<td>Procedural</td>
</tr>
<tr>
<td>5</td>
<td>Broad</td>
<td>Low</td>
<td>Informational</td>
</tr>
<tr>
<td>6</td>
<td>Broad</td>
<td>Low</td>
<td>Procedural</td>
</tr>
<tr>
<td>7</td>
<td>Broad</td>
<td>High</td>
<td>Informational</td>
</tr>
<tr>
<td>8</td>
<td>Broad</td>
<td>High</td>
<td>Procedural</td>
</tr>
</tbody>
</table>

TABLE 1. Eight possible work contexts.
work, and KMS technology choices were so proposed. They represent the essence of the model with the initial, theoretical approach shown in Table 2.

As per design science guidelines, the artifact was proposed in the build phase strictly based on existing research. Before assessing usability of the proposed (theory-based) model, which is the goal of the “evaluate” phase in design science and a preliminary check was conducted of the model. An attempt was made to assess and validate the core of the model before asking about its actual usability. Initial interviews with the key informant, the KM executive of the company, were conducted. These interviews revealed that there were stark differences in the KM practices found in business organizations versus the academic literature.

Assessing the KMS Model: A Case Study of Parsons Brinckerhoff

Parsons Brinckerhoff (PB) is a knowledge intensive engineering company well suited to be a case study because
of their existing recognition of the issues of knowledge management and learning. Parsons Brinckerhoff has an excellent reputation as the #1 U.S. company in road and highway design, mass transit, and rail design, and #2 in bridge design and airport design (Roads & Bridges, 2007).

We ensured that the case site offered us the opportunity to study the eight different organizational settings (as listed in Table 2), which correspond to the design model profiles, and in effect represent mini cases within a company. The eight organizational settings were analyzed and distilled to find the most appropriate technology for each of the knowledge work stages. Therefore, a complete model that included all the eight different knowledge needs profiles was created.

A senior knowledge management executive was interviewed to gain insights about the relevance of the design of the model and its applicability. The KM executive led KM teams and therefore had highly developed theories-in-use, which the executive was invited to articulate. The interviewed executive represented the “well-informed informant” who was able to reflect upon and discuss KMS and KM issues (Balogun, 2006). When asked about the overall concept of the model, the KM executive noted:

I like this approach as it emphasizes the role of an individual. Knowledge management is about making people work smarter and, in turn, getting smarter, more flexible people, who can learn and adapt more effectively in a fast-changing business market. There is consensus here at Parsons Brinckerhoff that the knowledge synthesis takes place in the mind of the individual who needs to make a decision. So, the organization as a whole can intervene by supporting how employees find, understand, and interpret data and information when making decisions.

There was clear support for the process-oriented approach to developing KM solutions, as evidenced by numerous comments throughout the discussion, for example:

. . . . We started off similarly as others. We opened a KM department, which was detached from operations. In an operational sort of way—we thought we would have knowledge officers, managers, editors, all those “K” roles separately from operations. Well, we still are organizationally detached, but it is just because my people and me dedicate 95% of our time for knowledge-related efforts. You can see us as internal consultants. But the lesson we learned and I try to share is that in those early days, we did most of our jobs from our office right here. These days we—just like consultants—visit client’s sites. Our job is in helping inside the happening—where work really gets done. We need to see how knowledge could be better leveraged inside the processes. That is where workers apply what they know. And this is where KM mechanisms need to be introduced and this is where activities such as knowledge seek, capture, application, etc., need to happen.

It may be argued that the process value of IT theory (Barua et al., 1995; Barua & Mukhopadhyay, 2000; Sambamurthy, 2001; Tallon et al., 2000) forms an underlying approach to KMS design and development. As IT can only create business value (make work more efficient and effective) through enabling and supporting processes, it is natural that “the best tools integrate seamlessly into the work process” (Cooper, 2003, p. 128). However, the KM executive elaborates that this is very difficult to achieve due to “two worlds of business- and computer-people.”

I hate to say this, but I have found that IT is in love with IT solutions generally and tend not to either understand the complexities of global business requirements or not appreciate them. This is not surprising as the converse is true as well with respect to global business experts and their understanding and interest in the subtleties of IT. You don’t have to go very far in tracking the progress of any IT development progress to begin to see the tendency of IT to “decide” what’s best for the business abandoning business requirements they find confusing or unimportant to the detriment of the final product’s ability to meet the business unit’s needs. Solution: give your KM team clout and teeth. If your KM team has knowledge base wide enough to cover technological and the business bases, that is.

### TABLE 2. Theory-based model.

<table>
<thead>
<tr>
<th>Work context</th>
<th>Knowledge work phases</th>
</tr>
</thead>
<tbody>
<tr>
<td>Task domain</td>
<td>Knowledge volatility</td>
</tr>
<tr>
<td>1 Focused</td>
<td>Low</td>
</tr>
<tr>
<td>2 Focused</td>
<td>Low</td>
</tr>
<tr>
<td>3 Focused</td>
<td>High</td>
</tr>
<tr>
<td>4 Focused</td>
<td>High</td>
</tr>
<tr>
<td>5 Broad</td>
<td>Low</td>
</tr>
<tr>
<td>6 Broad</td>
<td>Low</td>
</tr>
<tr>
<td>7 Broad</td>
<td>High</td>
</tr>
<tr>
<td>8 Broad</td>
<td>High</td>
</tr>
</tbody>
</table>

Note. KMS = Knowledge management systems; TKX = tacit knowledge exchange; EKX = explicit knowledge exchange; CON = connectivity between human knowledge sources; COL = collaborative knowledge creation; KD = knowledge discovery from explicit sources.
The importance and role of individual knowledge creation and utilization was a recurring theme in line with the following comment:

. . . . When it comes to solving a problem and making decisions, it is of crucial importance for the company to identify who has what domain of expertise, and for employees then to be able to find help through other experts or through relevant information.

Similarly, another KM executive voiced that knowledge efforts need to be sourced from the knowledge workers’ perspective.

Companies need to move away from knowledge being treated for knowledge sake. You need to provide people with the right information where I mean information at its widest sense, whether being an e-mail, a talk, or just a hunch, which comes from observing someone else. However, this is not enough. You need to help them interpret that information in the confines of their work. . . . And where knowledge is needed, it is truly needed. No place else. This is the line of fire where so-called KM should be tangible. No one needs anything for its own sake.

When asked about critical success factors for supporting knowledge workers with IT, the KM executive agreed that when looking at KMS as a part of a wider KM solution, the KMS needs to be closely integrated and act as a supporting and enabling tool for the knowledge worker.

Just look at yourself when you try to hang a poster picture in your room. You don’t really need a concrete-mixer or a sledge-hammer, to do that, do you? Yet, if you are doing something else, maybe building a house-extension, you will need those tools for sure. My point is that they are all powerful tools, yet, needed in different situations. My other point is that it is interesting to see that when I meet software vendors who mix and match their products that they claim to be total and one-stop-shop solutions, they really are convinced that these tools are all that is needed for business. They don’t know how to analyze what is needed from the business perspective and they don’t assess objectively how their tool matches the business requirements. Tools that are not a match are useless and dangerous as they cost money and steal people’s attention from the real problems.

Consequently, there is support for the stance of our model that a KMS should be designed based on an understanding of employees’ knowledge needs to be able to successfully support and enable knowledge workers. Yet how to really do that remains a challenge. The statement below suggests that they do not follow a set of guidelines of how to do the systems analysis but that it occurs or happens in an ad hoc manner.

. . . . we don’t really have a formal process for planning the KM system. It is more of an ad hoc process, basically we [KM project teams] understand more or less what technology offers, and then we try to see how and where would people in a particular department or other particular organizational form [project], have a need—how they form solutions, how they answer queries, what they do, who they depend upon, etc.

Noting each of the constructs in knowledge needs-technology fit profile and discussing them with a KM executive, we found significant support for each. The Parsons Brinkerhoff KM executive corroborated our definition of the types of KMS and their necessity within the company. He stated:

There are different needs of knowledge workers and obviously, different tools will satisfy those needs. I agree with the categorization and I think it is meaningful, understandable and exhausts all the available options. In PB, we use a variety of solutions that are used to help people make decisions, to learn on previous experience, to come up with novel solutions, and to record what people have learned in the course of doing something. Yet, there is a need for a closer examination of how to get this done and which solution is best in which situation.

Knowledge work is the next construct of the model. This construct conceptualizes the task of the knowledge worker as she or he seeks for knowledge to solve the problem at hand. Our use of the evolutionary information processing theory to situate the conceptualization of knowledge work received positive support.

I understood the process after reading the definition document immediately. I have a similar construct in my mind, learning before, during, and learning after, but yours is more detailed. I tried running couple of my examples through it and they all worked. I think this model explains the workflow of any decision making in a very detailed manner.

Articulation of the decision-making process is useful for KM and KMS designers who can now inquire about the specifics of each employee’s work to be able to design appropriate organizational and technological mechanisms that match the needs of a user in each of these steps. An interviewee noted:

This explanation is very good as it explains discrete steps of how any knowledge worker actually performs his work. One can visualize which are the generic activities to be done while making decisions. I like it because it covers all knowledge-related activities such as the need for the discovery of problem and goal information, the need for resource information, and of course, the need for existing knowledge seeking, for example, when trying to find a solution to a problem [when generating a new knowledge variation]. This I would call “learning before.” The idea [tentative knowledge] is then tested versus problem, goal, and resource information, which is the next step. Here “learning during” can happen, as with every failed attempt one learns something and use that before reaching a final decision. Finally, if the solution is good, this knowledge should be retained for future use. This obviously explains our “learning after,” as you want to promote and reuse good experience. Now for the KMS, it can support these steps—or not. It should, though, where possible.
TABLE 3. Eight knowledge needs profiles at Parsons Brinckerhoff.

<table>
<thead>
<tr>
<th>Work context</th>
<th>Task domain</th>
<th>Knowledge volatility</th>
<th>Type of knowledge</th>
<th>Examples</th>
</tr>
</thead>
<tbody>
<tr>
<td>Focused</td>
<td>Low</td>
<td>Informational</td>
<td></td>
<td>Determine the average rainfall in a region for the last 50 years.</td>
</tr>
<tr>
<td>Focused</td>
<td>Procedural</td>
<td>Informational</td>
<td></td>
<td>Determine the proper method to measure a river’s bank erosion over time.</td>
</tr>
<tr>
<td>Focused</td>
<td>High</td>
<td>Informational</td>
<td></td>
<td>Establish the overall cost of steel for a bridge project.</td>
</tr>
<tr>
<td>Focused</td>
<td>High</td>
<td>Procedural</td>
<td></td>
<td>Determine the best way to handle PR in a crisis situation.</td>
</tr>
<tr>
<td>Broad</td>
<td>Low</td>
<td>Informational</td>
<td></td>
<td>Determine the overall volume of materials required for a building of specific architectural design.</td>
</tr>
<tr>
<td>Broad</td>
<td>Low</td>
<td>Procedural</td>
<td></td>
<td>Establish a change request process for a project that involves multiple stakeholders.</td>
</tr>
<tr>
<td>Broad</td>
<td>High</td>
<td>Informational</td>
<td></td>
<td>Determine the cost of project depending on how the weather affects the schedule for the project.</td>
</tr>
<tr>
<td>Broad</td>
<td>High</td>
<td>Procedural</td>
<td></td>
<td>Determine the best way to handle public comments and protests as they arise throughout the 5-year life span of a project.</td>
</tr>
</tbody>
</table>

Short description

Note. PR = Public relations.

This response is important from three perspectives. First, it shows support for the knowledge work construct. Second, a KM executive coined the “dry” names of the stage in the language of the practitioner (“learning before, during, after”). Knowledge management systems designers benefit from practitioner input in phrasing the questions that they will use to analyze knowledge needs in a given organizational context. Third, a KM executive understood not only the construct itself, but also its raison d’être. It is there to improve and explicate the activities that happen when a knowledge worker performs his or her job of making decisions based on the information received and knowledge available.

Finally, it is useful to conceptualize the knowledge needs construct (refer to Figure 3), which has significant influence on the choice and suitability of organizational and/or technological mechanisms chosen to encourage knowledge creation. The three elements of knowledge needs are the task domain (indicating the extent to which a unit’s achievement of its goals depends on the efforts of other subunits), the volatility of knowledge (indicating the life span of knowledge required to perform everyday work), and type of knowledge (required to perform everyday work).

When a KM executive was asked to identify examples of each of the eight profiles to check his understanding of the construct and to see if this theory-informed construct could be taken into real-world practice, the interviewee responded with the examples noted in Table 3.

The interviewee was also asked to comment on the construct and its usability:

I think these are well-chosen elements as I cannot think of an additional element that would, besides these, affect what we will be doing in terms of KM here. I think it is a great way of analyzing a person’s needs in terms of KM as I can see already the IT tools that would support these different situations would be different from one to another.

Consequently, there is support for the claim that the three elements of the construct be used to differentiate organizational settings. It was also useful to determine whether these knowledge needs profiles relate to a particular job, working process, department, or project as the KM executive noted:

I think this will vary from business to business. But people inside a particular department or process . . . many times they are doing very different things, and sometimes, they are doing very similar things. But I don’t think this is really important. I believe this is good for at least a job-level, as one can say, “OK, this is the type of work I do.”

This response influenced the KMS design and development process. It seems that even a stronger focus needs to be on a person (or job role) and not so much on a particular department or process. The unit of analysis is thus the element for which we want knowledge to be sought for, created, or reused.

In summary, through interviews, we found support for the proposed knowledge needs/KMS fit concept and support for each of the model constructs. One KM executive agreed that fitting technology to the knowledge needs is an essential element of KMS success; he also agreed with the KMS classification and stages of how knowledge work happens. The three characteristics of knowledge needs suitably defined how knowledge workers at PB create new and utilize existing organizational knowledge when making decisions in the course of their work.

As noted by the interviewee, the utility of the model would indeed be lower if it was difficult to use. We therefore crafted a short list of questions to complement the fit profiles table that a KMS designer could pose to improve the quality of how knowledge analysis questions are interpreted by the interviewee (knowledge worker). The questions needed to reflect the overall concept of the design model and touch on the most important relationships and constructs, as illustrated in Table 4.

The questions were framed as “conversation starters” for a KMS designer, when analyzing knowledge needs and knowledge work in a particular organizational context and
Furthermore, an important finding resulted from thoroughly arrived at a revised design model, as shown in Table 5. The informants agreed that contingency variables were well covered all the eight different knowledge needs profiles. The questions in Table 4 are important for analyzing the core of the model. We found that the fit profiles table might be too complex to be easily understood and applicable in practice.

**TABLE 4. Questions for the knowledge needs and organizational context analysis.**

<table>
<thead>
<tr>
<th>Question</th>
<th>Explanation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Q1: What does the knowledge worker need to solve and what are the business- and knowledge-related goals behind that?</td>
<td>The question is concerned with overall process- and business-orientation of both KM efforts in general and KMS design as technological support for a particular business problem. First, a business-related reason must exist to think about KMS support; KM efforts need to be oriented in improving how knowledge is created and utilized, with the goal to achieve the business-related goals.</td>
</tr>
<tr>
<td>Q2: What is the shelf life of knowledge that is needed in everyday decision making?</td>
<td>This question is concerned with the knowledge volatility in a particular context—high or low. How we deal with knowledge and what is the appropriate KMS depends on how much time that knowledge is current. Can the same knowledge be reused for performing tasks/make decisions, or is it rapidly changing and needs to be created continuously?</td>
</tr>
<tr>
<td>Q3: How do employees make decisions: on their own, by collaborating with people in the same knowledge domain, or with people from other knowledge domains?</td>
<td>The question is concerned with the way of performing the task or making decision. How do they solve a particular problem/makes a decision? On their own or in collaboration with others?</td>
</tr>
<tr>
<td>Q4: What kind of knowledge do they need to arrive at a solution? Is it a piece of information, a document? Or is it a procedure, how to do something?</td>
<td>This question is concerned with the type of knowledge needed to perform the task—procedural or informational? Is it know-what that is important in a particular context, or is it know-how? In other words, what kind of knowledge needs are there?</td>
</tr>
<tr>
<td>Q5: How do employees learn from experience before they make a decision?</td>
<td>Based on the above argument on how knowledge needs to be created and utilized when an employee tries to perform his or her activities (under Q1), an important underlying concept is learning. So in the course of daily work, employees need to learn “before” undertaking a task, learn “during” that task, and learn “after” the task (task, i.e., decision making). By looking through these three lenses, a KMS designer can answer the question of how learning and leveraging knowledge is done during everyday work. The argument for interest in how learning before making decisions is done is that it is highly likely that there is somebody out there who has already done something similar before. Thus, how can a KMS be designed in a way to provide up-front as much as possible information necessary for fulfilling the task? This question corresponds somewhat to the early phases of knowledge work, i.e., problem recognition and goal setting. The argument for learning after an event is that experience and insights should be captured and transferred to similar future occasions. This question corresponds somewhat to the late phases of knowledge work, i.e., tentative knowledge variation selection and knowledge retention. Again, the goal is to design such a KMS that will facilitate this. For example, ways to learn after include immediate project team meetings, codifying insights into a searchable database, and holding retrospect meetings. The logic behind learning during an event is that knowledge-related interventions can be introduced when making a decision while working on a project, as one can continuously learn before reaching the end of a project, for example. Again, the goal is to design such a KMS that will take into account how learning during is usually made.</td>
</tr>
<tr>
<td>Q6: How do employees learn doing the particular work?</td>
<td>This question corresponds somewhat to the late phases of knowledge work, i.e., tentative knowledge variation selection and knowledge retention. Again, the goal is to design such a KMS that will facilitate this. For example, ways to learn after include immediate project team meetings, codifying insights into a searchable database, and holding retrospect meetings. The logic behind learning during an event is that knowledge-related interventions can be introduced when making a decision while working on a project, as one can continuously learn before reaching the end of a project, for example. Again, the goal is to design such a KMS that will take into account how learning during is usually made.</td>
</tr>
<tr>
<td>Q7: How do they instigate double-loop learning, e.g., learning after a task?</td>
<td>This question is concerned with existing KMS support for knowledge workers at their tasks. It should be asked with each of the Q5–Q7 questions.</td>
</tr>
<tr>
<td>Q8: What are the KMS technologies supporting these activities?</td>
<td>This question is concerned with the knowledge needs–KMS fit profiles. This new instrument thus complements the fit profiles table; together they constitute a design model built based on the existing literature and amended through the exploratory study at Parsons-Brinckerhoff. As such, these eight different contexts represent a profile of the context within the company. These settings were discussed during the interviews to arrive at more-generalizable framings and to think through work situations that covered all the eight different knowledge needs profiles. The informants agreed that contingency variables were well chosen and that the different combinations account for most work contexts in organizations. Through the method of envisioning the most appropriate KMS technology for each of the knowledge work stages in each of the eight contexts, we arrived at a revised design model, as shown in Table 5. Furthermore, an important finding resulted from thoroughly analyzing the core of the model. We found that the fit profiles table might be too complex to be easily understood and applicable in practice. Besides knowledge needs–KMS fit profiles, an important part of the model is the set of questions for knowledge needs/knowledge work analysis. As suggested by the design science guidelines (Hevner et al., 2004; March &amp; Smith, 1995), it is most beneficial if the artifact includes a simple but effective means for its use. As one of the major goals of this design mode is to understand how to perform complex and demanding analysis of knowledge needs in a particular organizational context, the most natural support tool for a KMS designer is a list of questions that an interviewee might pose to the knowledge workers when trying to assess their knowledge needs. The questions in Table 4 are important for each of the models’ constructs when analyzing knowledge...</td>
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The KMS Model Evaluation Cycle: A Case Study of Samsung Electronics

The Research Methodology in the Evaluation Phase

After the build phase was completed, the KMS design model was evaluated. The objective of the evaluation phase was to further validate the core of the model and demonstrate the usability of the model to the intended users. An in-depth exploratory qualitative case study was designed and executed at Samsung Electronics, which enjoys a strong reputation of being one of the most innovative and successful knowledge-based organizations in the world (Desouza & Dombrowski, 2006; Edwards, 2006; Hesseldahl, 2006; Kim, Park, & Seol, 2007; Moon, Edwards, & Port, 2004). They were aware of the criticality of KM to their business. Before embarking on a KM process change, they had implemented organizational interventions such as brainstorming hours, blogging, costumer decision groups and focus groups, toolkits as a means to quick experimentation, idea mobilization, and introduced a variety of content management system and knowledge repositories. Moreover, they had substantial resources invested in communities of practice. ProTeams were intended to provide training and encouragement to employees to be creative, flexible, fast thinking, and to work well under pressure. There were more than 6,000 members (35% of all SE Gumi employees) organized in over 360 ProTeams (Balah, Uthicke, & Moon, 2008). Our case study was timely as they had recently undergone a KM organizational change project aimed at redesigning their KM efforts in the innovation process area.

... even though ... [SE Gumi] ... have invested hundreds of thousands of dollars into organizational changes that could be labeled as KM initiatives, we didn’t leverage knowledge as we should. After deep consideration, we came to the conclusion that our knowledge assets are underutilized in some areas and overutilized in others. We maybe overdid it, losing focus and intention somewhere along the way. I must note though, that we are not sorry for earlier investments. We gained tremendous experience that cannot be learned from reports or from just listening to others. This experience was lived by the organizational members. This experience helped us in finding the better way in the future design of our organization.

Intermediate results after the change were very positive. They were moving in the right direction: faster innovation of quality products aimed at the right customers (increase in the market share) and increase in the price premiums (increase in profits). Concerning faster and quality innovation, the number of ideas submitted for evaluation increased significantly. The same goes for the turnover rate of evaluated ideas (how fast ideas are reviewed and accepted or rejected for further evaluation and evolution).

We have truly been impressed with how fast ideas were posted, discussed, and reviewed. . . . We were also impressed by the variety of ideas. Some ideas were about new products on the existing technologies, some ideas were about futuristic products based on new technologies, and some ideas were just small improvement-type ideas about a particular aspect of work of employees. This is exactly what we hoped for to get. . . . Initial results are very promising.

We can see from the above statement that the company successfully designed a KM-related intervention, and was thus a suitable case site for our research. Data collection occurred through semistructured interviews with a key...
informant, short informal discussions with key knowledge workers, and through review of written materials. First, experts from the company who were involved in the KM-related organizational change project were queried on various aspects of the project. Through the course of these discussions, we learned that the Director of Organizational Development could answer questions on all aspects of the KM project and KMS design. The selection of this individual is in line with Nonaka and Takeuchi (1995), who argue that members of middle management, or more precisely “owners” of subunits or of processes—KM officers or KM-project managers—should be interviewed as they are in possession of sufficient knowledge and are adequately involved in the KM programs of the organization. Besides knowing the business value of such projects, this person was operationally involved in the design and deployment of future KM solutions, including design and implementation of KMS. The interviewee was thus able to assess applicability and usability of the KMS design model. He was also asked to reflect on past decisions and discuss how the model could help Samsung if they had to start the KM project all over again. In addition to in-depth interviews, key knowledge practitioners (Nonaka & Takeuchi, 1995) in the company were informally observed at their daily work and were queried to evaluate the appropriateness of the existing KMS design. The purpose was to assess the fit of their KMS to the context in which it is used, and to assess the value of the proposed design model. Key knowledge workers know which KMS functionalities would be useful in the context of their work, or at least can recognize a potentially useful KMS when they are presented with its options. Knowledge workers in the sample were selected through heuristic search of people who we could learn the most from, balanced by the access constraints. We opted for as-much-as- knowledgeable-and-available-employees-as-possible. This approach allowed for obtaining first-hand experience of the challenges at various organizational levels of a KM project by interacting with those directly involved.

Utility assessment was done by picking two different contexts in which managing knowledge is important and analyzing them from the KMS design model standpoints: (a) an application developer solving mobile phone software bugs, and (b) a software technology manager mobilizing innovative ideas. Drawing on the fit profiles table (Table 1), the interviewee was asked to discuss the suggestions (as proposed by the model) versus real-life KMS support in their work context. There were two goals: first, to assess which knowledge profile of the design model correlates with the real-world contexts that map to the model profiles, and second, to discuss if the KMS is appropriate for this context as envisioned by the model.

Context #1: A Mobile Phone Application Developer

The first context is the case of a mobile phone application developer. His job is to code new applications, debug existing ones, and test new technologies. The overall goal of the KM project was to intensify the rate of innovation: SE Gumi wanted to increase their volume of commercialized ideas that answer the explicit or implicit needs of their customers. For this employee, the goal then was to increase the number of phone users’ problems he or she successfully solved. From the organization’s perspective, this effort results in more problems solved more quickly. This developer therefore needs to have the right knowledge to solve such problems and have access to organizational memory (documents or individuals) where he or she can find and share additional knowledge. This employee also needs to identify possible “next release” software improvements based on problems or opportunities in the existing product release. The nature of his or her tasks is reliant on functional knowledge embodied in a specific group of engineers, elemental technologies, and information-processing devices. He or she does not need to collaborate with other specialists from other domains, but rather to solve problems alone or with others from the same knowledge area.

Context #2: Mobile Software Technology Manager

The second context is the case of a mobile software technology manager. One of this manager’s major assignments is to lead the development of technologies, specifically the software for mobile phones, including the core operating system and additional applications (i.e., that are included in a new range of smart phones such as epix, Touch, or Omnia). His or her goal is to increase the number and quality of software-related ideas that get commercialized in mobile phones. From the organization’s perspective, the result is more and better ideas being integrated in mobile phone’ software. For that, this manager needs to gather ideas from all over the company and from outside, and have them discussed and assessed from multiple organizational perspectives (i.e., technology, sales, marketing, production). The nature of this work is broad. It requires the mobile software technology manager to work with employees from other units within an organization through dynamic interaction, communication, and coordination. Such tasks require varied knowledge domains to be combined when solutions are sought. In this context, the knowledge needed for performing everyday work changes continuously, as adaptive solutions are applied to solve problems. This means that knowledge is time- and conditions-sensitive as is necessary to keep pace with changing requests, is continuously amended and refreshed, and new solutions are created. There is a constant need for rediscovery of new solutions and a constant need for evolutionary or revolutionary innovation. Managing a product is a typical procedural knowledge where not only know-what but know-how is needed. According to the knowledge needs concept of our model, this kind of context thus falls into the broad task domain, high volatility of knowledge, and procedural knowledge classifications.
Analysis and Findings

No alterations were proposed to the fit profiles table (see Table 1) even though we invited amendments at numerous occasions during the interview. The interviewee confirmed the basic tenant of the research (need for segmented approach), repeated the practical need for the design model, and confirmed the core of the model. With regard to that, consider the following comments:

Let me say that I like this concept. While kept uncluttered, it is also very powerful as it reminds you of all the important boxes you need to think about when designing a KM environment and mechanisms. I like it as it puts together the two worlds of the information architect and the process owner, and as it makes them clear for both of them. Maybe these parts are already in managers' subconscious; however, I guess they are not really as structured as in here. It is advantageous to have this as it shows the relationships between the elements of successful KMS design and the role of each of the model's core elements: the nature of work and the variety of possible information technology to support it. It would be much easier to talk with the project team members and specialists if this concept was in everyone's mind from the beginning.

Another goal of this phase was to evaluate the set of seven questions by assessing their wording and utility. The interviewee had significant experiences in designing KM solution and systems. Therefore, he was knowledgeable about what and how to ask knowledge workers when assessing their needs. Positive assessments were received on the questions:

I think you hit the nail here by adding these to the fit profiles table. My first thought when you presented the model was that “this is too complex.” Well, your model does describe very complex relationships. Therefore, it is natural to be complex on its own. The questions that you attached very simply ask about the constructs your model uses; I can see where each question is pointing. This is a very good interface to the model. Still, and this is a very serious comment, they need to be tweaked a little. As a whole, they are very confusing because you use different words for the same thing, for example, decision making, work, task. KMS designers will be using these questions when interacting with ordinary people. Use simpler words, use one word for the same construct, and you are fine.

Based on the feedback, we reworded a few questions accordingly: we also dropped conceptual phrases, such as “double-loop learning” and “knowledge domain.” In a follow-up interview and presentation, it was confirmed that the revised version is easier to understand and thus more useful. The revised list of questions is outlined in Table 6.

Serendipitously, Samsung Electronics also provided us an opportunity to study an ongoing organizational change management effort. This gave us additional insights into KM-related organizational change projects. We investigated how to use the proposed model for designing a KMS. We arrived at guidelines on how to use the model to analyze a particular business context, specify an appropriate KM system, and design other (organizational) parts of the KM solution. Practitioner guidelines for knowledge-related organizational change projects were outlined by proposing steps for such organizational endeavors. We discovered that design and deployment of a KM solution happens in a 6-step process (see Figure 4).

The KM-project steps follow the same logic of understand the challenge, set the goal, model the as-is and to-be situations, evaluate the results. In this sense, deployment of a KMS is no different from any other organizational change project, and KMS development is no different from other IS development projects. This is positive both for refocus and for the advancement of the KM research area, as researchers are encouraged to take advantage of the cumulative body of research in management and IS.

Discussion and Implications

This study makes several contributions to KMS initiatives. First, contrary to mainstream research, we have confirmed that developing one company-wide KM solution is of limited value. Not only do different knowledge challenges exist in organizations, but people also perform different tasks during the course of their daily work. This calls for a portfolio of KM solutions tailored to satisfy the knowledge needs of an individual. Second, we have introduced a model to guide the design of KMS based on knowledge needs. The model consists of “ideal” combinations of knowledge needs and characteristics of KMS, which should result in improved knowledge utilization and creation. The design model developed enables the KM community to critically evaluate efforts underway to leverage organizational knowledge with KMSs. The proposed model can also be applied to analyze successful and unsuccessful KMS implementations retroactively. Third, we have proposed practitioner guidelines on how to use the model to build KMSs as a part of knowledge-related organizational change projects.
Deploying a viable KMS calls for analyzing a particular environment (e.g., a business process), understanding the possible KMS functionalities, and choosing the ones that are appropriate for the business context in question. Within organizations, it is critical that managers be able to segment business environments (e.g., a call center or customer service unit has a different business environment than an engineering or accounting department), understand the nuances of how knowledge is created and utilized within the environments, and design appropriate KMS tools and technologies. In addition, we have found support for the claim that when KMS is implemented, an employee should not need to operate separate systems to accomplish his tasks; rather, the knowledge he needs should be delivered seamlessly—in the process—for employee to be able to create or utilize knowledge (Markus et al., 2002; Mondale, Scott, & Venters, 2006; Stenmark & Lindgren, 2004).

This research adopted three theoretical lenses to guide the research model development, namely task technology fit theory (TTFT), evolutionary information processing theory (EIPT), and process value of IT theory. First, this research enriched the TTFT by creating a specific artifact for the KMS environment. Moving into the specific KMS domain required adaptation and operationalization of the task, technology, and fit constructs. The “task” construct is replaced by a “knowledge needs” contingency variable, “KMS technology” replaces the “GSS technology,” and the “fit” is KMS-specific. Not only that, this research adds another construct to Zigurs and Bucklands’ (1998) constructs. Besides the knowledge needs and KMS constructs, the fit profiles depend on the construct of knowledge work. This construct is an essential part of the KMS design model. It adds the process perspective to the model, as it explains the stages in which knowledge creation and utilization happens and shows where and how organizational memory (KMS in case of electronic version of such memory) is needed. This is of course of crucial importance to the KMS design as we know that any IT must fit the process in which it is being used. Besides conceptualization of knowledge needs constructs and linking characterization of knowledge management functionalities to the knowledge needs and knowledge work constructs, another contribution of this research is the suggestion that adding another construct is a necessity (or at least a viability) when the parsimonial Zigurs and Bucklands’ TTFT concept is amended for use in specific contexts.

Our research also adds to the EIPT by adding a design view for KMS that supports and enables the problem-solving process as explained by Li and Kettinger (2006). However, the authors only provided a metadescription of the knowledge creation and utilization process. This explains any decision-making situation with varying characteristics (i.e., what kind of problem there is, how long does it take to solve it, etc.), but it is not contextual enough to inform how to design a digitally based KMS for a particular business process or subunit. Hence, KMS designers are not guided as to which type of technology would be suitable for particular business context. Our research contributes to the EIPT by proposing KMS functionalities contingent on knowledge needs for each of the EIPT knowledge work stages, thus adding further validation and enrichment to the EIPT.

Third, our research further validates the process value of IT theory (Barua et al., 1995; Barua & Mukhopadhyay, 2000; Sambamurthy, 2001; Tallon et al., 2000). Design of KM solutions and KM systems should be performed on a more granular level (i.e., process). Organizations today usually improve their operations through business process innovation, changing the way they “do things” and using contemporary IT to support and enable this. According to the process value of IT theory, effects and successes of IT solutions can only be measured through the process-prism, as processes define and encapsulate the context and enable evaluation of process and technological innovations. With our research we have shown that the same principle should be used in design and introduction of KM-related interventions; they should be done on a business- or work-process level rather than on organization-wide level. This makes it possible to analyze a particular business context, specify an appropriate KM system, and design other (organizational) parts of a KM solution. We have seen in the Samsung
Electronics Gumi case that KM needs to become embedded inside everyday work, and KMS functionalities need to be embedded inside existing IT environment (tools) that knowledge workers use.

This research also adds to the area of information systems development methodologies (ISDM). Earlier studies have proposed various information systems development methodologies (ISDM), which provide a consistent set of procedures to be followed (as well as tools, techniques, and documentation that can be used) to make the process of managing and developing information systems more efficient and effective (Yadav, Shaw, Webb, & Sutcu, 2001). We have devised a 6-step guideline for the design and deployment of a KM solution. These steps do not differ much from other organizational change projects and KMS development is at its core no different from any other IS development project. KM project steps follow the same logic of “understand the challenge, set the goal, model the as-is and to-be situations, evaluate the results.” Yet, to be successfully used in the KM area, KM-related particularities need to be known and understood. These were identified by this research.

Finally, our study makes an important contribution to the methodology of design science guidelines as put forward by (Hervner et al., 2004; March & Smith, 1995). According to Hervner et al. (2004), the mechanics of the “build” and the “evaluate” phases are straightforward. Purposeful artifacts are first built to address unsolved problems and then they must be evaluated with respect to the utility provided in solving those problems. Rigor in the build phase is derived from the effective use of the knowledge base: Artifacts should be built upon theoretical foundations provided in an existing cumulative body of knowledge. This model should then be evaluated through an empirical study, where methodological decisions are justified and appropriate for the research context (Hervner et al., 2004). However, we argue such an approach is dominantly positivistic and presumes that existing body of knowledge is sufficient for construction of an artifact. Moreover, this approach is contradictory when compared with another guideline that strictly requires the novelty of an artifact (that should solve previously unresolved problems). Then, is the existing body of knowledge on its own enough to construct a novel artifact that can go into the evaluation phase of a design science research? To reduce the risk of building a wrong initial model—rooted solely in existing literature—it is critical to add an exploratory empirical study to the build phase. This, we argue, adds a higher level of practical relevance and novelty of the model. It allowed us to test the basic propositions of the study, justify its relevance, and check if there are any additional constraints or constructs that are important. A set of in-depth interviews were performed with KM executives who represented a well-informed informants to (a) gain insights about relevance and potential applicability of the model; (b) receive feedback on the model, which will be used to amend and validate the tentative model suggestions. The empirical fieldwork conducted within Parsons Brinckerhoff enabled an in-depth analysis of current opinions and practices for KMS design. The highly qualitative approach revealed significant insights that were augmented into the new proposed KMS model. The a priori proposed model was thus improved through acquired practical insights. Moreover, the research instrument (interview protocol and the definitions document) were significantly amended during this additional step. For the evaluation phase, the goal was to demonstrate usability of the model to the users for whom it is intended—the KM managers who are responsible for design and deployment of KMS. We were seeking input on the utility of the model and the interview protocol was different from the one used in the exploratory part of the build phase. It is argued that adding an exploratory study in the build stage is critical. Only if the artifact is constructed effectively will it be found useful by the intended stakeholders. Without this step, we believe, the evaluation phase would surely not have yielded the results expected.

No single study is without limitations. We discuss them next to be able to provide a focus on how our findings should be assessed, and to arrive at future research venues. First, the true benefit of the artifact and its future versions will only be known after several implementations and iterations of designing the model itself (Gregor, 2006; Hervner et al., 2004). Second, the limited number of interviews could be seen as a limitation. Despite having only a few interviewees, there were number of steps undertaken to ensure the reliability of the findings. Though limited, our interviewees were knowledgeable experts who served as well-informed respondents. They had highly developed theories-in-use, which they were forced to articulate and could reflect upon the subject matter in particularly detailed and insightful fashion through their own interpretations. They were KM executives who planned, performed in, and sought numerous KM and KMS projects within their companies, and who had been well aware of operational and strategic issues surrounding the business and research area under investigation, involved in design and deployment of KM solutions, including design and implementation of KMS. Second, the case settings were companies who had had their share of long-term and rich experience in KM and KMS projects. Third, to achieve a higher degree of generalizability of the model, further research is needed. The proposed model may be revised and amended through analysis of findings from multiple case studies. Another limitation is concerned with using the fit as the proxy for KMS success. Is an internally consistent fit (as used in this and similar research; Drazin & Van de Ven, 1985; Zigurs & Buckland, 1998), i.e., a good enough measure to assess the model proposed? The top-level criterion of usefulness of the design is whether KMS is successful or not. Measuring success is vital in any organizational undertaking, especially when assessing impact of managerial interventions and when ascertaining if the expectations have been realized. IS scholars and practitioners point out that success should be measured through effects on the process that IS was intended to support or enable (Barua et al., 1995; Barua & Mukhopadhyay, 2000; Sambamurthy, 2001; Tallon et al., 2000). In this
process-oriented view, the organizational goals are inherently reflected in design of organizational and technological interventions; the latter were designed as a part of wider organizational strategies that lead to achievement of organizational goals. Hence, KMS success should be evaluated through assessment of performance of the process in which KMS is being used. Further research could thus be oriented towards definition of set of context-specific success measures to evaluate KMS success.

On a final note, such a model could be considered deterministic to the extent that it prescribes expectations about performance, based on characteristics of knowledge needs and technology. All of that, however, is not the intention of the model proposed. Its role is in the design phase when user requirements are being determined and IT functionalities designed. The model proposed should thus be seen as being embedded in the larger context of human actors, technology, and institutional properties, where technology is only one of many elements of social context that influence patterns of action (Barley, 1986; Orlikowski, 1992; Orlikowski & Barley, 2001; Zigurs & Buckland, 1998). We have seen in the previous discussion that IT is only one part of a KM solution. “Ideal” technological profiles are part of greater social agenda and of complex KM solutions in an organization and thus cannot be the sole guarantor for success of knowledge management systems, success of knowledge management initiatives, and/or improved organizational performance. Rather, such combinations are much more complex than the profiles in this research, but the model resulting from this research could be used as a starting point in technological context of the greater sociotechnological complexity.

Conclusion

Our model makes several advancements over the existing research. Our findings contribute to further the understanding of the way in which KM efforts should be implemented in organizations in several ways. First, developing one company-wide KM solution is not fruitful. Different knowledge challenges exist in organizations, and people perform different tasks in the course of their daily work. They need to utilize and create different knowledge when they perform these tasks and when they make decisions. This calls for a portfolio of KM solutions that are tailored to satisfy the knowledge needs of an individual. Knowledge needs, types of KMS design, and knowledge work, and how they interplay impacts KMS success. Each part of the research model has been grounded using the extant literatures of knowledge management, information systems, organizational learning, and strategic management. Following the design science guidelines closely, the model was evaluated through two exploratory studies to establish its face validity and to assess its utility. Additionally, practitioner guidelines on how to use the model to build KMSs as a part of knowledge-related organizational change projects were proposed. Together, as our findings show, the technology choices model and the guidelines for its use form a highly relevant KMS design model. The findings represent the first step towards a robust design science approach which supports a novel construction of appropriate KMS.

References


