A Knowledge Management Success Model: Theoretical Development and Empirical Validation

UDAY R. KULKARNI, SURY RAVINDRAN, AND RONALD FREEZE

UDAY R. KULKARNI is an Associate Professor of Information Systems at the W.P. Carey School of Business, Arizona State University. He received his B.S. in Electrical Engineering from the Indian Institute of Technology, Bombay, India, his MBA from the Indian Institute of Management, Calcutta, India, and his Ph.D. in Management Information Systems from the University of Wisconsin, Milwaukee. Prior to his doctoral studies, he was employed for five years in corporate planning and control areas. His current research interests include the use of relational views for decision support and application of artificial intelligence techniques to manufacturing problems. He has published articles in *IEEE Transactions on Knowledge and Data Engineering, Decision Sciences Journal, Journal of Management Information Systems, Decision Support Systems,* and *European Journal of Operations Research.*

SURY RAVINDRAN is an Assistant Professor of Information Systems at the W.P. Carey School of Business, Arizona State University. He received his M.S. in Operations Management from the Indian Institute of Management, Calcutta, India, his B.Tech. in Chemical Engineering from the Indian Institute of Technology, Madras, India, and his Ph.D. in Business Administration–Information Systems from the University of Texas at Austin. He has published articles in *Management Science, Journal of Management Information Systems, Communications of the ACM,* and *IEEE Transactions on Systems, Man and Cybernetics.* Prior to entering academia, he worked for firms such as Price Waterhouse India and Texas Instruments India. His research interests include innovative practices and trends in the IT industry, and value of IT investments. Currently, he is working on research projects in the area of knowledge management.

RONALD FREEZE is a visiting Assistant Professor of Information Systems at the W.P. Carey School of Business, Arizona State University. He received his Ph.D. in Information Systems at Arizona State University. His broad research area is knowledge management. His research has been published in the *Journal of Knowledge Management* as well as AMCIS, ICIS, and HICSS conference proceedings.

ABSTRACT: We examine a knowledge management (KM) success model that incorporates the quality of available knowledge and KM systems built to share and reuse knowledge such as determinants of users' perception of usefulness and user satisfaction with an organization's KM practices. Perceived usefulness and user satisfaction, in turn, affect knowledge use, which in our model is a measure of how well knowledge sharing and reuse activities are internalized by an organization. Our model includes organizational support structure as a contributing factor to the success of KM

Journal of Management Information Systems / Winter 2006–7, Vol. 23, No. 3, pp. 309–347.

0742–1222 / 2007 $9.50 + 0.00.
DOI 10.2753/MIS0742-1222230311

system implementation. Data collected from 150 knowledge workers from a variety of organizations confirmed 10 of 13 hypothesized relationships. Notably, the organizational support factors of leadership commitment, supervisor and coworker support, as well as incentives, directly or indirectly supported shared knowledge quality and knowledge use. In line with the proposed model, the study lends support to the argument that, in addition to KM systems quality, firms must pay careful attention to championing and goal setting as well as designing adequate reward systems for the ultimate success of these efforts. This is one of the first studies that encompasses both the supply (knowledge contribution) and demand (knowledge reuse) sides of KM in the same model. It provides more than anecdotal evidence of factors that determine successful KM system implementations. Unlike earlier studies that only deal with knowledge-sharing incentives or quality of shared knowledge, we present and empirically validate an integrated model that includes knowledge sharing and knowledge quality and their links to the desired outcome—namely, knowledge reuse.

KEY WORDS AND PHRASES: information systems success, knowledge management, knowledge management success, knowledge management systems, knowledge quality, knowledge reuse, knowledge sharing, system quality, user satisfaction.

KNOWLEDGE MANAGEMENT (KM) IS EVOLVING into a strategically important area for most organizations. Broadly, KM can be viewed as the process by which organizations leverage and extract value from their intellectual or knowledge assets. Knowledge has been described as information combined with experience, context, interpretation, and reflection [19]. Knowledge is embedded and flows through multiple entities within a firm, including individuals with domain expertise, specific best-known methods, or lessons learned from similar experiences, documents, routines, systems, and methods.

Managing this diverse set of assets successfully, so that value is delivered to the firm as well as the individuals (knowledge workers) who use these assets, is an enormous task. The knowledge-based perspective of the firm [17, 64, 78] postulates that knowledge assets produce long-term benefits such as competitive advantage and sustainability in the face of a fluctuating economic climate. The long-term nature of returns makes it extremely difficult to measure the success of KM initiatives in terms of business benefits, which are presumed to reflect the effectiveness of a KM strategy. As a result, there is a lack of adequate theoretical modeling and empirical examination of factors leading to KM success. Therefore, in this paper, we develop and empirically test a theoretical model of KM success, part of which is derived from prior information systems (IS) research. We chose to partially base our model on the IS success models of DeLone and McLean (D&M) [23, 24] and Seddon [76, 77] because they have a history of successful application and empirical testing.

We have designed our study as a cross-sectional study of KM practice and its success. There are two significant departures we have made from the D&M and Seddon IS success models. The first departure is that we have looked at KM system imple-

mentation–related endeavors (also loosely referred to as KM initiatives or efforts in the literature) of a firm and not KM systems in isolation. KM initiatives (according to the ensemble view of the information technology [IT] artifact described later) include, in addition to the KM system, the development of organizational arrangements, policies, processes, and incentives to enable the effective management and use of the technology or KM system. In this study, we look at the management and organizational factors, including leadership, supervisor, and work group support, and the use of incentives to encourage knowledge sharing and reuse. The second departure is that instead of studying a single system in a particular organization, we resort to a more generalized, broader study across different organizations. (Strictly speaking, the D&M model is not restricted to the success of a single system, but that is the way most prior researchers have used that model.) In this way, we have used the D&M and Seddon models as guiding frameworks. We therefore have built our own justification and support for our proposed empirical model. Thus the D&M and Seddon models are used to justify some of the factors in our model. We use other theoretical bases for some of the other (organizational) factors included in the model.

We recognize that ITs play an important role in the firm's ability to apply existing knowledge effectively and to create new knowledge [3]. Advanced technologies (e.g., secure intranets, browsers with dashboards and portals, intelligent search techniques, semantic modeling of knowledge ontologies, contextual taxonomies) may be successfully deployed in KM systems to manage intra- and interfirm knowledge. KM, however, is intrinsically a multidisciplinary concept drawing on organizational learning, organizational behavior, organizational strategy, sociology, and so on [5]. Hence, we include organizational factors that can affect the success of IT in our research.

KM systems are ineffective if they are not used. As pointed out by the chief information officer (CIO) of grocery distributor and retailer Giant Eagle, the prevailing competitive culture among managers in this organization acted as a barrier to knowledge sharing and use of the KM systems, and this was an issue that had to be addressed by showing them the benefits of using the system [68]. In a similar vein, other evaluations [19, 72] of KM practices in a number of firms have shown that lack of attention to social and cultural aspects may be impairing the effectiveness of purely technological implementations. It is clear that the IT component (which is the KM system) of the KM initiatives undertaken by a firm must be complemented by a set of organizational mechanisms that encourage and promote the sharing/reuse of organizational knowledge.

In this view, termed as the *ensemble view of technology artifacts* [51], an IT artifact[1] may be a central element, but it is only one element in a "package" that also includes the components required to apply that technical artifact to some socioeconomic activity. Kling and Scacchi [51] further develop this ensemble view to include the commitments, additional resources such as training, skilled staff, and support services, and the development of organizational arrangements, policies, and incentives to enable the effective management and use of new technologies.

Instead of taking a narrow tool view of the IT artifact, we create a model that takes the ensemble view of the artifact, and include some key organizational factors that

complement the technology—that is, the knowledge management system (KMS). One critical aspect of KM initiatives undertaken by a firm is contained in the work flows and processes that encompass the process capability aspect of the overall management of knowledge within an organization. Our model focuses on the usefulness of systems (KM systems) from a user's viewpoint and, instead of a separate process capability construct, it includes scale items on work flow in the knowledge use construct described later. Moreover, it is augmented by management and organizational support factors.

In our model, a KM system (which corresponds to the tool view of the IT artifact) is a component. We present an empirically testable model that proposes that a combination of existing knowledge assets, KM systems, and organizational/social factors affect the success of KM system implementation.

KM Success Model

WE START WITH A DISCUSSION OF HOW PRIOR RESEARCH in the area of IS can be built upon to fit the context of KM. Our KM success model uses ideas and constructs from the IS success models described below. Transitioning from IS success to KM success requires the consideration and inclusion of appropriate organizational factors drawn from organizational behavior, economics, and other areas of research.

IS Success Model

DeLone and McLean [23] compiled a taxonomy of six IS success categories (Information Quality, System Quality, IS Use, User Satisfaction, Individual Impact, and Organizational Impact) from a comprehensive review of different IS success measures and proposed a model including "temporal and causal" interdependencies between these categories. IS researchers have validated the measures and empirically tested the associations among them [45, 71, 77, 79, 80]. D&M [24] made refinements to their original model based an evaluation of the rich research stream that emanated from their initial model.

One significant refinement of D&M's model is presented in Seddon [76]. Seddon argued that D&M combined process and variance models of IS success depending on three distinct meanings that can be attributed to the IS Use measure. One meaning of IS Use, a variable that proxies for the *benefits from use,* gives rise to a variance model that links information quality and system quality to IS success defined in terms of benefits from IS Use. It is this meaning that is most relevant to our context, as we elaborate later. Based on this meaning, Seddon respecified D&M's model using perceptual measures of net benefits of an IS, namely, Perceived Usefulness and User Satisfaction, as surrogates for IS success (for a diagrammatic representation of the model, see [76]). Rai et al. [71] tested major aspects of Seddon's model in the context of a semi-volitional university student IS and found evidence for supporting the relationships.

The variables of interest to our current research from Seddon's model are IS Use, Perceived Usefulness, User Satisfaction, Information Quality, and System Quality. According to Seddon, Perceived Usefulness (which replaces the D&M IS Use variable) is "the degree to which a person believes that a particular system has enhanced his or her job (or his or her organization's) performance" [76, p. 246]. The other variables are consistent with D&M's model; Information Quality measures semantic success, System Quality measures technical success, and User Satisfaction measures effectiveness success [24]. Information Quality and System Quality are independent variables. The argument for including *both* of these as determinants of IS success is that even a high-quality system can produce useless results if the needed information is wrong or inadequate. Additional evidence to support using these two as independent variables is available [27, 46]. Finally, IS Use is defined by Seddon [76] as resulting from expectation of net benefits from using an IS—implying that IS Use is a consequence of IS success and not an intrinsic characteristic of IS success; therefore, it is separated from the rest of the model.

Transitioning from IS Success to KM Success

We strive to retain as many as possible major elements of the IS success model. In transforming the model to the KM context, some of the IS-specific meanings of its components need to evolve. One needs to recognize that there are two conceptual differences in making the transition: one is the move from *information* to *knowledge* and the other is from a single *information system* to *KM system implementation.* Both of these differences lead to changes in the characterization of the constructs involved, as well as the relationships between them in a success model.

In making the change from information to knowledge, IS researchers have recognized that knowledge is a multidimensional construct with more complex characteristics than those of information. One perspective defines knowledge as an object to be stored, manipulated, and so on; another extends this concept by emphasizing organization of knowledge to facilitate access; and a third goes further by viewing knowledge as a process of simultaneously knowing and acting, as in "applying expertise" [15, 61, 83]. A different perspective of knowledge postulates that knowledge does not exist without the knower; it is "shaped by one's initial stock of knowledge and the inflow of new stimuli" [29, p. 267]. Further along this direction, knowledge is defined as an "understanding gained through experience or study; the sum or range of what has been perceived, discovered, and learned" [75, p. 619]. Note that these differing perspectives view knowledge along the explicit–tacit dimensions of Nonaka [63].

The IS success model measures the success of a single IS. The antecedents and outcomes are in the context of a *system.* We extend this narrow context to a setting where a firm augments the KM system implementation with management and organizational support factors (in line with the ensemble view of the IT artifact). Deploying a KM system is a part of an overall KM initiative. It may involve structural/procedural changes in an organization to facilitate knowledge sharing and use. It may be geared toward upgrading the knowledge content itself (documenting insights gained from

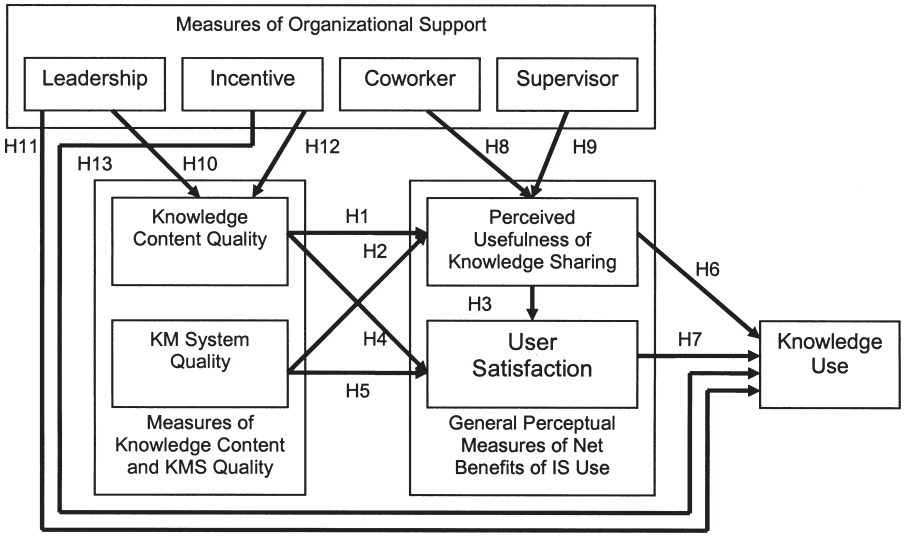

Figure 1. KM Success Model

prior successes and failures, purchasing external research reports, and so on). It may also include deploying a repository of knowledge documents with sophisticated search mechanisms and an intuitive taxonomy (a KM system). A KM success model needs to cover the effect of all of these different types of activities. It differs from the KM system success model [47], which proposes a specialization of D&M's IS success model to a specific type of IS—that is, a KM *system.* Our KM success model is shown in Figure 1 and a summary of constructs appearing in the model and their definitions are provided in Table 1. A more comprehensive view of KM must include the specific processes required to acquire, convert/store, retrieve, and apply knowledge (as in the Knowledge Process Capability construct of Gold et al. [34]).

Our first set of seven hypotheses are adapted from the IS success model and involve the antecedents of Perceived Usefulness of Knowledge Sharing, User Satisfaction, and Knowledge Use.

We use the term *knowledge sharing* to mean both contributing to and using available knowledge. Perceived Usefulness of Knowledge Sharing is an appropriate and practical intermediate measure of success in the context of knowledge and is similar to Seddon's perceived usefulness measure. The difference is that in the IS success model, Perceived Usefulness is an indicator tied to a *particular system.* In our model, Perceived Usefulness of Knowledge Sharing is an overall measure of usefulness of KM initiatives, not tied to a single system. We attempt to capture the quality of knowledge in a construct called *Knowledge Content Quality.* This is the quality of information residing in the electronic repositories, and includes the quality of documents, reports, lessons learned, and so forth, in structured and unstructured formats. Analogous to Information Quality in the IS success model, the Knowledge Content Quality measure in our model is designed to be a much broader construct capturing the richness and

Table 1. Construct Definitions

Construct	Definition
Explicit knowledge use	Degree to which a knowledge worker believes he or she has incorporated procedures for the capture and use of knowledge of various types into decision-making activities, routine and otherwise.
Perceived usefulness of knowledge sharing	Subjective evaluation of the extent to which the person believes that contributing to and using available and knowledge-sharing capabilities existing within the organization improve his or her job performance, productivity, effectiveness, ease of doing the job, and so on.
User satisfaction	Subjective evaluation of the various outcomes due to the knowledge sharing/retrieval capabilities existing within the organization, including ease of getting the information/ knowledge needed, satisfaction with the access to knowledge, adequacy of the information/knowledge to meet one's needs.
Knowledge content quality	Quality of knowledge of various kinds, including its relevance, accuracy, timeliness, applicability, comprehensibility, presentation formats, extent of insight, availability of expertise and advice, and so on.
KM system	Any system that automates the input, storage, transfer, and retrieval of knowledge. These may include contextual taxonomy for knowledge (meta knowledge), systems for capturing various types of knowledge from useful lessons learned, systems for classifying knowledge documents, systems for locating the relevant experts, technology to facilitate sharing of expertise (groupware, video-conferencing, and so on), repositories for structured as well as unstructured information, and so on.
KM system quality	Quality of KM systems described above. Includes accessibility (from anywhere/anytime), ease of use for retrieval as well as input, output flexibility to meet the needs, search capability, documentation, and so on.
Organizational support Supervisor Coworker Leadership Incentive	Supervisor and coworker support is a subjective measure of the extent of encouragement provided to and experienced by a knowledge worker in sharing/using solutions to work-related problems, openness of communication, opportunity for face-to-face and electronic meetings to share/use knowledge, and so on. Leadership is a subjective measure of commitment to KM by the top levels of management, exhibited via understanding of the role of KM in business, strategy, and goals set with respect to KM. Incentive refers to formal appraisal and recognition of efforts by knowledge workers for furthering knowledge sharing and reuse.

diversity of knowledge as compared to information and is explained further in the next section. If the quality of knowledge content is high, then a knowledge worker is more likely to perceive that KM initiatives contribute to enhanced job performance, hence the belief that Knowledge Content Quality leads to Perceived Usefulness of Knowledge Sharing.

Hypothesis 1: Higher level of Knowledge Content Quality leads to higher level of Perceived Usefulness of Knowledge Sharing.

Many KM initiatives rely on IT as an important enabler. A KM system is an IT-based system to support and enhance the organizational process of knowledge capture, storage/retrieval, and application [3]. Although an overemphasis on IT at the expense of organizational factors may lead to failure [19], KM systems do play a supporting role in the success of KM in organizations. *KM System Quality* in our model is a measure of how well the KM systems support and enhance KM-related activities. In contrast to some prior studies that have operationalized IS Quality by a simplified measure called Ease of Use (and measured it by asking, "Is the system easy to use?" and "Is it user-friendly?") [27, 71], our measure of KM System Quality captures multiple dimensions of the quality of a KM system. If the use of KM systems is volitional (the most likely scenario), the Perceived Usefulness of Knowledge Sharing is likely to depend on the quality of knowledge content available to knowledge workers as well as the quality of a KM system. Knowledge workers may find value in sharing and using knowledge (Perceived Usefulness of Knowledge Sharing) if the quality of knowledge (Knowledge Content Quality) is adequate and the KM system reduces the extra effort required to share (find or contribute) and use knowledge.

Hypothesis 2: Higher level of KM System Quality leads to higher level of Perceived Usefulness of Knowledge Sharing.

In line with the IS success model, we propose that Knowledge Content Quality, KM System Quality, and Perceived Usefulness of Knowledge Sharing together determine the level of overall *User Satisfaction,* which, like its equivalent in the IS success model [25, 27, 71], is a subjective measure of the various outcomes of the knowledge sharing, retrieval, and knowledge reuse capabilities existing within the firm as a result of the KM initiatives undertaken.

Hypothesis 3: Higher level of Perceived Usefulness of Knowledge Sharing leads to higher level of User Satisfaction.

Hypothesis 4: Higher level of Knowledge Content Quality leads to higher level of User Satisfaction.

Hypothesis 5: Higher level of KM System Quality leads to higher level of User Satisfaction.

Similar to Seddon's IS Use measure, we define a construct named *Knowledge Use* (resulting from KM success). Although researchers have successfully measured IS Use in terms of frequency of use, time of use, number of accesses, usage patterns,

system dependency, and so on, none of these are directly applicable to Knowledge Use. It is more appropriate to measure Knowledge Use in terms of internalization of work flows and work practices that emphasize the capture, sharing, and use of organizational knowledge. For instance, do the knowledge workers leverage the institutional knowledge base of the firm to make decisions? Do they follow a debriefing process at the end of a project to document lessons learned? This view of Knowledge Use, which emphasizes embedding knowledge-sharing activities in the design of knowledge-intensive processes, is embraced by organizations that are successful in this regard [59]. Joachim Döring, president of Siemen's Information and Communication Networks, had his star salespeople map the complex solutions-selling process and identify broad categories of business and technical knowledge relevant to each stage of the process in order to consciously make knowledge sharing a routine practice [56].

It is interesting to note the difference between D&M [23, 24] and Seddon [76] in the treatment of IS Use. The D&M model includes a causal path from User Satisfaction to System Dependence (same as IS Use), as well as one from System Dependence to Perceived Usefulness. Seddon [76] includes only one causal relationship leading from User Satisfaction to IS Use; the model does not propose that Perceived Usefulness causes IS Use or vice versa. In line with Seddon's IS success model, we propose that User Satisfaction causes Knowledge Use. Further, we argue that a relationship between usefulness and use is entirely possible in the KM context. According to Davis [21], in the context of user acceptance of IT, Perceived Usefulness relates to improving job performance. We believe this also applies to the KM context. Therefore, the extent to which shared knowledge is deemed essential for a knowledge worker's job performance may reflect its Perceived Usefulness. If so, a knowledge worker will participate in KM initiatives to enhance his or her job performance. This suggests adding a causal path from Perceived Usefulness of Knowledge Sharing to Knowledge Use. Thus,

Hypothesis 6: Higher level of Perceived Usefulness of Knowledge Sharing leads to higher level of Knowledge Use.

Hypothesis 7: Higher level of User Satisfaction leads to higher level of Knowledge Use.

Organizational Factors

There is no argument that IT is an important enabler of KM efforts. KM systems and electronic networks allow knowledge workers to share, store, and retrieve documents and other knowledge objects that may be used in their work. However, KM success requires a complete solution; merely providing an IT-based KM system with access to knowledge repositories does not guarantee that knowledge workers will use the system to retrieve the knowledge contained therein or share their knowledge with others by making it available in the repository. Careful attention must be paid to the knowledge sharing attitude among coworkers and supervisors, incentives for contributing and using knowledge, as well as the need for organizational leadership and

direction to facilitate the KM efforts [26].[2] The KM research literature (e.g., [20, 54]) recognizes a variety of enabling factors relating to organizational culture and climate, which manifests itself in the behavior of the people in a firm. It is people who are at the center of KM initiatives. Managing them and embedding a culture of knowledge sharing and reuse in their minds is perhaps the most important factor (e.g., [58]) in this respect.

In line with this view, a new feature of our model is our recognition that benefits accruing from KM efforts depend on organizational factors. Prior research offers anecdotal evidence and some empirical support for the premise that benefits of knowledge sharing and use are more likely in the presence of a positive knowledge-sharing culture. Businesses and consultants involved in KM project implementations consistently emphasize the importance of organizational factors in the success of such efforts [3]. A relevant question here is, "Do certain organizational cultures foster knowledge creation?" A primary effectiveness determinant of KM systems is the nature of the organization's culture [2]. Performance of the knowledge worker is influenced by management and organization, IT, and workplace design [20]. Leadership style and organizational culture, along with commitment and trust, have been described as factors that affect the willingness and openness of the people in tacit knowledge sharing [53].

In the words of Peter Engstrom, Vice President for Corporate Knowledge Creation at Science Applications International Corporation, a research and engineering company that helps organizations involved with KM, "You have to systematically embed knowledge sharing into the culture as opposed to overlaying it on top. You can't bolt it on and force people to use it" [68]. The managing partner at Knowledge Transformation Partners, a KM consultancy firm based in New York City echoed this view: "The biggest misconception that IT leaders make is that knowledge management is about technology. . . . Usually people begin a KM project by focusing on the technology needs, whether they want a database or a portal. But the key is people and process" [48]. Many KM projects are specifically aimed at developing a knowledge-intensive culture by encouraging and aggregating behaviors such as knowledge sharing (as opposed to hoarding) [20]. "Perhaps the most significant hurdle to effective KM is organizational culture," observed Gold et al. [34, p. 189] in a study that identified a construct called *cultural infrastructure* to measure organizational support for KM and found that it contributed significantly to organizational effectiveness (a success measure) via a two-stage structural model. To define and investigate the influence of organizational factors on KM success, we look at research studies that define culture and how cultural factors influence organizational performance.

Organizational culture is a complex construct encompassing structures used by employees to perform tasks [8]. It includes, among other aspects, behavior of and attitude toward coworkers and supervisors, as well as incentives and rewards for desired performance norms [42]. Culture has been defined as embedded values and preferences about what a firm should strive to attain and how it should do so [81]. Such values are typically shaped by senior management in an organization. Culture represents practices and ground rules brought about by social interactions in an organizational context, such as interactions among coworkers and supervisors. These rules

can have a major effect on knowledge creation, sharing, and use by influencing employees' perceptions of what is acceptable and useful to their firm [73].

The effect of culture on knowledge creation and use is manifested in behaviors and perceptions. For instance, values that cause employees to regard their colleagues as partners are likely to result in behavior that creates useful knowledge that can be used by them [22]. Success of KM initiatives may depend on the prevailing norms that employees associate with sharing and use of knowledge. If the general belief is that knowledge sharing and use of shared knowledge decrease power and increase personal risk, the desired perception of the utility of knowledge sharing and use may not be forthcoming [22]. Beliefs about potential usefulness of shared knowledge and reuse of knowledge contributions from outside sources arise from interactions among coworkers. These beliefs can often be reinforced by their supervisors.

In the context of employees in a firm learning to use IT, Gallivan et al. [32] emphasized that a comprehensive and realistic view must consider not just the individual but also the work group and organizational-level influences. Two work groups from different firms that were expected to use IT in their jobs applied the technology in contrasting ways: one group encouraged the use of IT while the other avoided using IT. The underlying cause was found to be that the social settings were different in the two groups and firms. Applying this same reasoning to KM efforts (where an organization wishes to promote a culture of using KM systems put in place), we argue that knowledge workers share their beliefs and intentions to behave in specific ways and are influenced by the guidance and insights offered by their coworkers, supervisors, and senior management; thus, these influences are expected to strongly determine the sharing and usage of knowledge residing in KM systems. In addition to these, there are factors such as extrinsic rewards [12] as well as reciprocity, trust, cooperation, and pro-sharing norms [49, 52, 82] that are expected to affect the success of KM initiatives in an organization. Reciprocity, trust, cooperation, and pro-sharing norms are people-related factors, and we argue that they are subsumed in the individual-, group-, and organization-level factors involving coworker, supervisor, and leadership support for KM initiatives that we include in our model.

Thus, our model operationalizes organizational support (for KM initiatives and efforts) via four separate dimensions—*Supervisor, Coworker, Leadership,* and *Incentive.* Supervisor and Coworker refer to the attitudes toward knowledge sharing and use within an employee's work team, consisting of coworkers and immediate supervisors. Leadership encapsulates the role and commitment of top management in setting KM strategy, goals, and so on, while Incentive measures the level of a firm's incentives and rewards to encourage knowledge sharing and reuse.

To further understand how organizational factors influence KM success, we look to social exchange and structuration theories from the social sciences and agency theory from microeconomics. Social exchange theory [11] informs us about the influence of attitudes of an employee's work team on his or her perception of usefulness of knowledge sharing. Within a workplace, there are exchanges that occur between an individual and his or her supervisor and peers or coworkers. It is possible that the supervisor and work team of an employee are regarded as surrogates for the organization in the

mind of the employee. Thus, all three are important to employees (knowledge workers in our setting) because they shape attitudes and performance. Social exchange theory [11] suggests that an individual's interactions with others are characterized by interdependency and anchored in self-interest; also, they require trust, which is self-generated by the exchanges themselves in an incremental fashion. Participation in exchanges leads to "currencies"—that is, outcomes or benefits received from the organization, supervisor, or coworkers. One form of "currency" is attitudinal; this includes satisfaction, commitment, and perceptions of usefulness. The attitudes and behaviors offered to and transferred between employees and supervisors are for reasons other than pure economic benefit. In our current KM setting, the perceived usefulness or value of knowledge sharing is an attitude that can be positively reinforced by employees interacting with coworkers and immediate supervisors in their day-to-day work. A knowledge worker's sense of what is acceptable evolves from these interactions. If every team views KM as having potential value (perceived usefulness), it will lead to a reinforcement of the success of KM efforts.

Based on the reasoning discussed in the preceding paragraphs, we formulate the following hypotheses:

Hypothesis 8: Higher level of Coworker leads to higher level of Perceived Usefulness of Knowledge Sharing.

Hypothesis 9: Higher level of Supervisor leads to higher level of Perceived Usefulness of Knowledge Sharing.

If KM is considered to be less about managing knowledge and more about managing knowledge workers whose work depends on what they know and can learn from others, structuration theory [33] may provide an alternative approach aimed at deriving further insights into this issue. In an organization with multiple agents (knowledge workers) having multiple goals (possibly divergent objectives), it is necessary to share resources (e.g., knowledge) and work toward some common goals; this requires interaction and coordination among the agents. Giddens's three dimensions of structure as a basis of interaction are *Signification, Domination,* and *Legitimation.* Of these, Domination and Legitimation provide the insight into how an organization's leadership influences the quality of shared knowledge and its reuse. Domination is the realization of who has the authority. In the KM context, the people in authority can influence the KM-related actions (contribution, use, and so on) of individuals who possess the relevant sharable knowledge and also of those who can possibly benefit from reusing available knowledge. Domination can manifest itself in the form of strong leadership for KM—viewing KM as having strategic importance, promoting an organization-wide climate of knowledge sharing, and so on. Legitimation is knowing what is acceptable and what to expect. In our setting, organizational leadership sets the norms and expectations with respect to knowledge exchange and reuse. Legitimation can occur when knowledge workers receive positive signals about the desirability and acceptability of KM practices and its benefits. Because KM is a complex issue, it follows that the more commitment the senior management shows to

sharing knowledge and promoting its potential benefits, the more the knowledge workers will look favorably on knowledge sharing and reuse.

The above observations lead us to the following hypotheses:

Hypothesis 10: Higher level of Leadership leads to higher level of Knowledge Content Quality.

Hypothesis 11: Higher level of Leadership leads to higher level of Knowledge Use.

Markus [58] makes several interesting observations about the use of incentives combined with the role of senior management in promoting knowledge contributions to knowledge repositories as well as knowledge reuse, as described here. One challenge is to mitigate "free rider" behavior, where employees attempt to leverage the knowledge contributions of colleagues without exerting sufficient effort of their own to provide high-quality knowledge content for use by others [49]. While explicit reward systems (e.g., promotions and bonuses) can enable knowledge contributions as well as reuse, they may be insufficient in the absence of other driving forces. Employees also share and reuse knowledge because it enhances their reputation among colleagues. This requires, however, senior management to establish and support organizational norms by demonstrating their commitment to KM efforts.

In addition, microeconomic (agency) theory provides support for use of explicit incentives and rewards to induce desired actions. This theory has been used in compensation studies in accounting and finance to show how incentives based on both short- and long-term performance measures are necessary to motivate managers [31, 38, 43]. If knowledge creation, sharing, and reuse are outcomes of interest to the firm, similar reasoning can be applied by an organization to achieve goals in the KM context. Specifically, providing rewards and incentives and including support for KM as part of performance assessment will positively influence the desired behavior of knowledge workers [12]. If there is a positive organizational commitment in terms of offering both tangible and intangible incentives and rewards, then the effort exerted in sharing and reusing knowledge is likely to be modest. Hence, we contend that the organizational support factor of Incentive is an antecedent of Knowledge Content Quality as well as Knowledge Use.

Hypothesis 12: Higher level of Incentive leads to higher level of Knowledge Content Quality.

Hypothesis 13: Higher level of Incentive leads to higher level of Knowledge Use.

Finally, for comparison with the IS success model, it is conceivable that the KM success model could include linkages with a box labeled "other measures of net benefits of KM initiatives," similar to Seddon [76] and updated D&M [24] IS success models, which use an analogous set of constructs called "other measures of net benefits of IS Use." In the long run, successful KM initiatives will result in better knowledge, KM systems, and internalization of good knowledge sharing and reuse work practices. This may lead to net benefits to individuals in the form of measurable im-

provements in work efficiencies, productivity, and on-the-job effectiveness, eventually resulting in higher profits. As pointed out by earlier researchers (e.g., [54]) measuring that component of performance attributable to KM is nontrivial. There are some studies that use perceptual outcome measures like knowledge satisfaction (e.g., [9]), and others that use firm performance measures such as return on assets (ROA) (e.g., [10]). These latter studies can be questioned because sometimes they do not extract that part of ROA that is due to reasons other than KM.

To the organization, KM may result in net benefits that accrue in the form of intangible knowledge assets that enhance the organization's sustainable competitive advantage and its value. As pointed out above, such intangible and long-term benefits cannot be directly attributed to KM initiatives alone. Controlling for all the other influences on such long-term benefits is a complex task and is deemed outside the scope of the present study. In fact, the effect of KM perceptual outcome measures (e.g., knowledge sharing, knowledge use) on firm performance (e.g., ROA) has not been well studied [18, 19], in part because it is difficult to empirically establish the link; there is an implicit assumption that desirable KM outcomes lead to desirable firm performance outcomes.

Operationalization of Measures

KNOWLEDGE IS A VERY BROAD CONCEPT RANGING from tacit to explicit. We believe that our model is applicable to knowledge of both types. In the first part of this section, we briefly describe the different types of knowledge and the scope of our study. We then describe the basis for operationalizing our measures and designing a survey comprising our knowledge-related independent constructs—quality of knowledge content captured and retained within a firm and quality of the KM systems in the organization. We then describe the operationalization of organizational factors and the dependent measures. Finally, we review the sources referenced for and the process of instrument development, and the exploratory factor analysis results.

Knowledge Types

The richness and multidimensionality of knowledge has led researchers to recognize that knowledge is composed of at least two distinct types, tacit and explicit, and observe that every organization may possess varying levels of capability in different areas. The difference in emphasis on different types of knowledge could be due to the industry, the type of business (manufacturing, service, and so on), or the business strategy of the organization. Both types of knowledge cannot be managed in the same manner. The *personalization strategy* [41] relies extensively on the identification of experts and the areas of their expertise. This strategy views knowledge transfer as occurring through direct contact, such as apprenticeship and mentoring. The most important ingredients are expert knowledge, and the ability of an organization to facilitate the contact and collaboration between the mentor and the trainee. On the

other hand, according to Hansen et al. [41], the *codification strategy* relies extensively on the ability of the organization to *codify*—capture, store, and reuse—the available knowledge. The most important ingredients are encapsulating knowledge into reusable objects, having a system of classification, storage, and efficiently retrieving relevant objects at the right time and place.

For the purpose of this research, we focus on the explicit form of knowledge and issues associated with its management. The reasons for this are many: One is that the explicit form of knowledge is by itself a rich, varied, and substantial subset of knowledge as explained below. The second reason is that, as pointed out by Hansen et al. [41], the management issues with explicit knowledge are qualitatively different from those of tacit knowledge. The third reason is that the knowledge workers' perspective, incentives, ability, and motivation in sharing tacit knowledge are, to a large extent, different from those associated with explicit knowledge. For these reasons, we believe that the model of KM success may not be uniformly applicable across the two different types of knowledge. In order for the model to be applicable across different types of knowledge, one would need to separately measure many of the constructs and study their possible varying effects. We leave this aspect of our study to future research.

Explicit knowledge represents knowledge that is retained for future reference. This includes text-based reports (e.g., project, technical, research), manuals (policies, operations, troubleshooting, and so on), or rich media artifacts (diagrams, audio and video clips). This "field of information (codified knowledge) can include statistics, maps, procedures, analyses" [60, p. 112]. Efficiently organizing this knowledge for easy access and targeted search is a goal in many organizations. When creating these documents (knowledge objects), the writer keeps in mind that they are for public consumption and accordingly "broaden the context," perhaps by removing specific references that are not required. Ackerman and Halverson [1] report that it is necessary to remove some contextual information, which may not be comprehensible to the novice user in a different work or functional area. Explicit knowledge could go a step further and include the rationale behind an item, that is, something to help a knowledge user understand the document and the subject the same way the author understood it, but in a different context [38].

Knowledge Content Quality and KM System Quality

The Knowledge Content Quality construct in our model required the recognition of the type and quality of knowledge available. The Information Quality measure of the IS success model focuses on precision and relevance of information [71]. While information quality is a multi-attribute construct, and an important area of research in itself (e.g., [7, 36, 84]), our focus is on a more comprehensive measure of knowledge quality. Therefore, the quality of knowledge content is determined by the ability to present the knowledge via appropriate presentation formats (e.g., text, graphics, video), as well as the usefulness of the content to the user.

In addition, a KM system will have to index the repository contents using an appropriate classification scheme that is consistent across the organization. This is an attribute of system quality and another factor in KM success—initial scale items for KM System Quality were adapted from the Ease of Use construct in prior surveys [71] because it served as a surrogate for System Quality in previous research on IS success. Because of our focus on explicit knowledge, we use a broader set of scale items, including whether or not tools and systems were in place to meet varying needs. Our system quality scale items addressed each of the following: utilization of multiple search criteria, accessibility from multiple locations, ability to add relevant documents, and adequacy of documentation.

Organizational Factors

Our initial set of 15 survey questions was designed to measure the underlying organizational support for KM efforts in terms of the four categories mentioned earlier: Supervisor, Coworker, Leadership, and Incentive. The questions on Supervisor and Coworker support dealt with (1) holding regular meetings to share work-related knowledge, (2) encouragement to share effective solutions to work-related issues, and (3) support for open communication. The scale items on Leadership covered (1) understanding about KM at top levels of management, (2) senior level participation in setting direction for KM, (3) senior management's demonstration of commitment to KM, and (4) periodic review of effectiveness of KM practices. Finally, the questions on Incentive included promoting knowledge-sharing behavior by (1) building it into appraisal systems and (2) rewarding teamwork.

KM Success Measures

As in previous research studies, Perceived Usefulness of Knowledge Sharing captured the user's perception of the effect of knowledge sharing on job performance, productivity, and job effectiveness, and asked if knowledge sharing made it easier for the knowledge worker to accomplish his or her job. We used five scale items to measure Perceived Usefulness of Knowledge Sharing.

We used three survey questions to measure User Satisfaction. Our scale items were designed to measure the knowledge workers' beliefs on whether (1) the knowledge-sharing capabilities within their business unit made it easier for them to obtain the needed knowledge, (2) they were satisfied with the knowledge obtained, and (3) the available knowledge was adequate in meeting their needs.

To measure Knowledge Use, we developed a set of questions to capture respondents' perceptions of the degree to which knowledge-based decision making (e.g., incorporation of documented explicit knowledge) and knowledge capture were prevalent in their work. These questions also included the quality of the classification scheme for facilitating the ease of use of knowledge. McKinsey and Company addressed this issue by encouraging a self-organizing and evolutionary classification process [57].

Instrument Development

Initial scale items for several of our constructs were taken from multiple sources. KM System Quality and Knowledge Content Quality were adapted from an Ease of Use and Information Quality constructs [71]. Measures for Perceived Usefulness and User Satisfaction, as measures of success, were drawn from several studies [25, 27, 71]. Knowledge Use was adapted from the Goodhue and Thompson [35] dependence measures. Gold et al. [34] measured an aspect of organizational culture in their survey instrument from which our organizational structure–related questions were adapted. All items were operationalized as a five-point Likert scale ranging from 1 "strongly disagree" to 5 "strongly agree."

All scale items were discussed with a focus group of eight executive MBA students with an average of eight years of middle to upper managerial experience, who were also familiar with KM and KM systems. Based on the feedback obtained, some questions were rephrased and some dropped. Two constructs (Knowledge Content Quality and Incentive) consisted of two scale items each—this is not uncommon, as there are earlier research studies [12, 16, 37, 70, 82] that have used two scale constructs; for example, extrinsic rewards [12] is a two-item construct, as is quality of information [16]. A pilot study of 65 respondents from the same population provided further indication of the appropriateness of the questions. Our final survey instrument is reproduced in Tables 2, 3, and 4, which show the scale items along with the results of the exploratory factor analysis as explained in the next section.

Data Collection, Analysis, and Results

THE SURVEY DESCRIBED IN THE PREVIOUS SECTION was administered to a group of 150 midlevel managers enrolled in the executive MBA and part-time professional MBA programs at one of the largest urban universities in the United States. The participants had an average of over six years of managerial experience distributed across various functional areas. Job positions of the respondents included engineers (e.g., software systems, electrical, and project), managers (e.g., project, marketing, process, and manufacturing), analysts (market, account, and financial), and directors (operations and software development). Scrutiny of their job responsibilities showed that they would be routinely involved with knowledge work. There was also substantial cross-industry representation by way of firms, including Charles Schwab, Honeywell, Intel, Motorola, Pinnacle West, and The Vanguard Group. After eliminating incomplete surveys, there were 111 usable responses. From our scrutiny of the 39 unusable responses, we note that (1) 22 of the respondents had no KM program in their function and (2) the other 17 had omitted to fill out one or another section of the survey—for example, the responses on incentives were missing or the section on leadership was blank. Rather than imputing responses to these surveys, we decided to drop them from the sample.

Table 2. Explicit Knowledge—Factor Loadings

Survey question	Content quality	System quality	Use
Knowledge artifacts available for my work			
Have useful content	0.897		
Come in multiple formats (text, graphics, video, and so on)	0.564*		
Knowledge management system			
There are systems/tools available to me to locate knowledge		0.718	
The system/tools allow search using multiple criteria		0.851	
The system is accessible from anywhere by anyone		0.814	
The system is easy to use or adequately documented		0.845	
The system allows me to add useful knowledge		0.710	
Knowledge use			
I refer to shared knowledge in my work			0.845
In my group, using shared knowledge is a part of the work flow			0.782
I find that the scheme for classifying knowledge is easy to understand and use		Loads on both factors	
Cronbach's alpha	0.571	0.893	0.757
Percent variances explained	35.5	19.8	17.4

Notes: Omitted loadings are < 0.34. * Retained because it appears to be a relevant scale item. Cronbach's alpha decreases when any scale item is deleted.

Results of Factor Analysis

We conducted a preliminary exploratory factor analyses on the first set of 70 usable responses to test the validity of the constructs in our theoretical model. This resulted in identification of several distinct factors relating to the dependent and independent variables laid out in our model (see Tables 2, 3, and 4). In general, all items loaded above a value of 0.7 on the predicted factor and below a value of 0.35 on any other dimension (with the exception of Knowledge Content Quality, as noted in Table 2). Also, in the case of Knowledge Use, there was one item that loaded on more than one factor—this was dropped from subsequent analysis. We note that overall, Cronbach's alpha values were satisfactory, exceeding the cutoff level of 0.7 recommended by Nunnally [65], with the exception noted in Table 2. Finally, in all cases, item-to-total correlations were above 0.6.

The knowledge-related survey items grouped into three dimensions representing Knowledge Content Quality, KM System Quality, and Knowledge Use as expected. Table 2 presents the results of the factor analysis. The next part of the survey, which

Table 3. Organizational Support—Factor Loadings

Survey question	Supervisor	Coworker	Leadership	Incentive
My immediate supervisor				
Encourages me to share solutions to work-related problems	0.775			
Organizes regular meetings to share knowledge	0.758			
Encourages—by action and words—sharing of knowledge	0.848			
My immediate coworkers				
Encourage open communication even if it means disagreement		0.852		
Encourage—by action and words—sharing of knowledge		0.816		
Encourage each other to share solutions to work-related problems		0.819		
How does the organization leadership value KM?				
There is a general understanding at the top levels of management about how KM is applied to the business			0.855	
There is board-level (or equivalent) representation for KM			0.776	
Senior management demonstrates commitment and action with respect to KM policy, guidelines, and activities			0.846	
Senior management periodically reviews the effectiveness of KM to the whole company			0.836	
Are incentives and mechanisms put in place to encourage knowledge sharing?				
Knowledge sharing is monitored and built into the appraisal system				0.871
Individuals are visibly rewarded for teamwork				0.724
Cronbach's alpha	0.845	0.871	0.904	0.860
Percent variance explained	24.4	18.9	18.4	17.6

Notes: Omitted loadings are < 0.35. Cronbach's alpha decreases if any scale item is deleted.

Table 4. Intangible Benefits—Factor Loadings

Survey question	Perceived usefulness	User satisfaction
I believe the knowledge-sharing capabilities existing within my business unit		
Improve my job performance	0.857	
Increase my job productivity	0.851	
Enhance my effectiveness on the job	0.907	
Make it easier to do my job	0.887	
Are useful in my job	0.866	
I believe because of the knowledge-sharing capabilities existing within my business unit		
I find it easy to get the knowledge/information I need to do my job		0.762
I am satisfied with the knowledge I am able to access to do my job		0.879
I find that the knowledge available to me meets my needs adequately		0.860
Cronbach's alpha	0.947	0.836
Percent variance explained	50.0	30.3

Notes: Omitted loadings are < 0.33. Cronbach's alpha decreases if any scale item is deleted.

dealt with organizational factors, included questions regarding supervisor and coworker support for knowledge sharing, as well as senior management's commitment to KM, and incentives and rewards for knowledge sharing. The factor analysis grouped these scale items into four constructs—Supervisor, Coworker, Leadership, and Incentive. Table 3 presents details of these four dimensions. The scale items on Perceived Usefulness of Knowledge Sharing and User Satisfaction grouped appropriately into two factors. Detailed results are presented in Table 4.

For each of the dependent and independent constructs, Table 5 shows that variances explained were higher than 70 percent. The table also lists minimum, maximum, mean, and standard deviation for each measure. These descriptive statistics were calculated by summing and averaging the survey responses associated with each construct.

We then conducted confirmatory factor analyses (CFAs) of the constructs suggested by the exploratory analysis described above. The LISREL 8.54 and EQS programs utilizing maximum likelihood were used in the analysis of multiple scale-item constructs and estimation of fit indices for the structural equation model. The maximum likelihood procedure was chosen because of its known capability of providing good estimations at relatively small sample sizes ($N < 250$). The nonnormed fit index (NNFI) and comparative fit index (CFI) (for testing goodness of fit of the latent factors and the structural model) were chosen due to their sensitivity to both simple and complex model misspecifications and their suitability for small sample sizes. NNFI and CFI values greater than 0.9 indicate a good model fit [44].

Table 5. Factor Analysis

Construct	Variance explained (percent)	Mean	Standard deviation	Minimum	Maximum
Perceived usefulness	82.6	3.96	0.94	1	5
User satisfaction	75.4	3.23	0.92	1	5
Supervisor	76.3	3.51	1.02	1	5
Coworker	79.5	3.66	0.90	1	5
Leadership	77.8	2.85	1.03	1	5
Incentive	79.4	2.71	1.08	1	5
Knowledge content quality	70.3	3.41	0.88	1	5
Knowledge management system quality	70.4	3.02	1.07	1	5
Knowledge use	80.5	3.36	1.01	1	5

Figure 2 presents results of analysis (standardized factor loadings and correlations) for the two constructs: Perceived Usefulness of Knowledge Sharing and User Satisfaction. Figure 3 shows similar results for the constructs representing the four organizational variables Supervisor, Coworker, Leadership, and Incentives. Figure 4 presents details of the measurement model for the three constructs Knowledge Content Quality, KM System Quality, and Knowledge Use. Note that the model achieved good overall fit. Moreover, all factor loadings for the constructs are significant at the 0.01 level.

For the CFAs, each survey scale item was allowed to load only onto its associated latent construct. Convergent validity of constructs was assessed with three ad hoc tests recommended by Anderson and Gerbing [4]. First, all standardized factor loadings were significant at $\alpha < 0.01$ for each latent variable, which indicates good convergent validity. Second, variances extracted (shown in Table 5) are higher than the 0.5 lower bound recommended by Fornell and Larker [30]. Third, reliabilities presented in Table 6 also exceeded the recommended cutoff level of 0.7 (with the exception of Knowledge Content Quality). We also note that the correlation between the Perceived Usefulness and User Satisfaction is 0.57, while the correlation between the four organizational variables ranges between 0.47 and 0.63, indicating good discriminant validity between the constructs. In the case of the three knowledge constructs (content quality, systems quality, and use), the correlations range between 0.63 and 0.76. Another test of discriminant validity prescribed by Anderson and Gerbing [4] specifies that the squared correlation between a pair of constructs should be lower than the variance extracted estimate of each construct. We applied this test to each pair of constructs and found that every combination met this criterion (see Table 7).

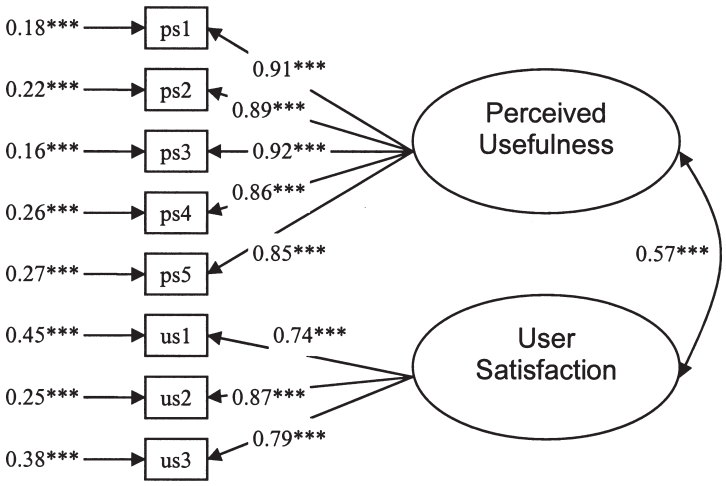

Figure 2. Measurement Model and CFA—Perceived Usefulness and User Satisfaction
$N = 111$; degrees of freedom (df) = 19; $\chi^2 = 69.5$; root mean square error of approximation (RMSEA) = 0.18; nonnormed fit index (NNFI) = 0.93; comparative fit index (CFI) = 0.95; standardized root mean residual (SRMR) = 0.054. *** indicates significance at the 1 percent level.

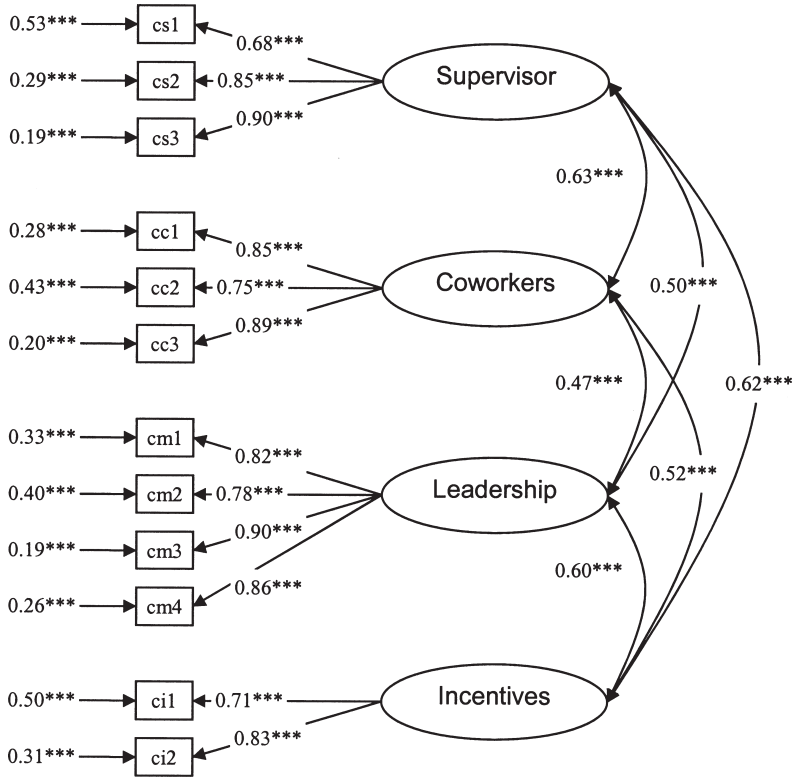

Figure 3. Measurement Model and CFA—Organizational Factors
$N = 111$; df = 48; $\chi^2 = 74.7$; RMSEA = 0.068; NNFI = 0.97; CFI = 0.98; SRMR = 0.051.
*** indicates significance at the 1 percent level.

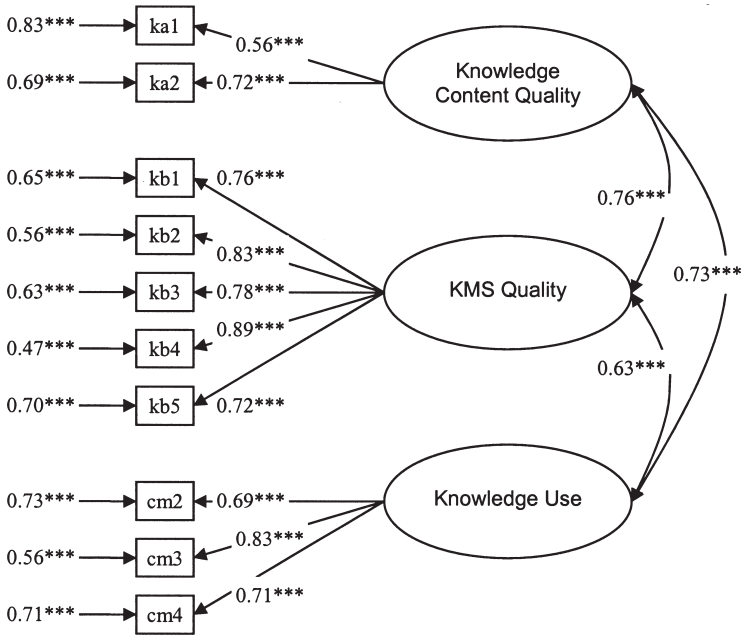

Figure 4. Measurement Model and CFA—Explicit Knowledge
$N = 111$; df = 32; $\chi^2 = 74.78$; RMSEA = 0.1110; NNFI = 0.890; CFI = 0.922; SRMR = 0.063. *** indicates significance at the 1 percent level.

Table 6. Reliability Measures

Construct name	Reliability
Perceived usefulness	0.95
User satisfaction	0.84
Supervisor	0.84
Coworker	0.87
Leadership	0.90
Incentive	0.86
Knowledge content quality	0.57
KM systems quality	0.89
Lessons learned	0.93
Knowledge use	0.78

Results of Model Estimation

Using the seemingly unrelated regression (SUR) simultaneous equation estimation procedure, we tested the validity of the KM success model. SUR allows for the possibility of correlated error terms across regression equations. We also ran the estimation procedure using LISREL 8.54 to verify the robustness of the results, which are discussed in the following paragraphs.[3] The model appears to be robust because these results are very similar.

Table 7. Squared Correlations Between Constructs Versus Variances Extracted

Variable	Knowledge quality	System quality	Supervisor	Coworker	Leadership	Incentive	Perceived usefulness	User satisfaction	Knowledge use
Knowledge quality	**0.513**								
System quality	0.396	**0.671**							
Supervisor	0.255	0.099	**0.763**						
Coworker	0.166	0.114	0.300	**0.795**					
Leadership	0.358	0.362	0.183	0.155	**0.778**				
Incentive	0.277	0.282	0.243	0.156	0.213	**0.794**			
Perceived usefulness	0.047	0.022	0.110	0.084	0.062	0.004	**0.826**		
User satisfaction	0.260	0.280	0.093	0.139	0.229	0.080	0.188	**0.754**	
Knowledge use	0.493	0.464	0.265	0.254	0.288	0.310	0.051	0.161	**0.496**

Note: Diagonal elements (in boldface) represent variances extracted; other cells denote squared correlations.

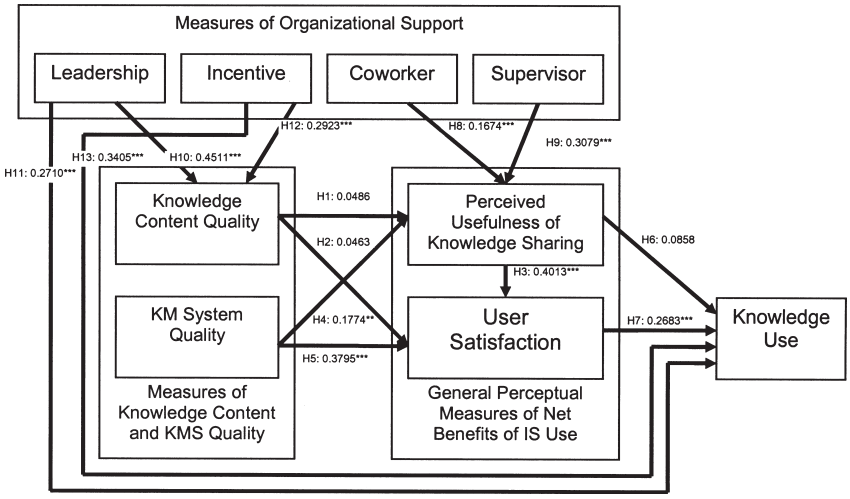

Figure 5. KM Success Model SUR Estimation Results
** and *** indicate significance at the 5 percent and 1 percent levels, respectively.

Figure 5 and Table 8 present the results of the SUR estimation procedure for the empirical model while Figure 6 presents the LISREL estimation procedure results. For the SUR estimation, the values of the dependent and independent constructs were computed using factor (principal component) analysis with varimax rotation. Detailed analysis of the results is presented below.

Both Knowledge Content Quality and KM System Quality are significant and important determinants of Knowledge Use through their intermediate effect on User Satisfaction with KM initiatives (H4, H5, and H7). Anecdotal evidence from other studies of organizations generally tends to echo these results. Elliott [28] reported that those organizations that are successful in packaging knowledge for use by their customers and other internal users ("casual" users who have to interpret the available knowledge and place it in their context) have done so by making the knowledge easily accessible (a measure of KM System Quality) and by providing a service [58] that makes use of intermediation by high level human experts as in "Ask Ernie," a service provided by Ernst & Young.

Moreover, organizational variables (Supervisor, Coworker, Leadership, and Incentive) have a significant positive effect on Knowledge Use—both directly and indirectly (H8–H13). Specifically, Leadership and Incentive have a direct influence on Knowledge Use (H11 and H13), implying that success of KM efforts through use of available knowledge starts with securing buy-in and commitment of senior management. Along with this commitment, organizations need to put in place a set of incentives aimed at promoting knowledge sharing and teamwork. In a climate of downsizing and attrition due to retirements, crucial organizational knowledge can easily be lost to a firm. To prevent such losses, knowledge sharing is critical, but this is something that does not occur naturally with employees. According to Hubert Saint Onge, Principal of Business and IT Consultancy at Saintonge Alliance, mandating knowledge sharing

Table 8. Overall Knowledge Capability Parameter Estimates

Regression equation 1

$$\text{Knowledge use (KU)} = \alpha_1 + \beta_{11} * \textit{User Satisfaction} + \beta_{12} * \textit{Perceived Usefulness} + \beta_{13} * \textit{Incentive} + \beta_{14} * \textit{Leadership} + \varepsilon_1$$

Regression equation 2

$$\text{User satisfaction quality (US)} = \alpha_2 + \beta_{21} * \textit{Perceived Usefulness} + \beta_{22} * \textit{Knowledge Content Quality} + \beta_{23} * \textit{Knowledge Management System} + \beta_2$$

Regression equation 3

$$\text{Perceived usefulness (PU)} = \alpha_3 + \beta_{31} * \textit{Knowledge Content Quality} + \beta_{32} * \textit{Supervisor} + \beta_{33} * \textit{Coworker} + \varepsilon_3$$

Regression equation 4

$$\text{Knowledge content quality (KQ)} = \alpha_4 + \beta_{41} * \textit{Incentive} + \beta_{42} * \textit{Leadership} + \varepsilon_4$$

	SUR estimates							
	Equation 1—KU		Equation 2—US		Equation 3—PU		Equation 4—KQ	
Variable	Parameter estimate	*t*-statistic (*p*-value)	Parameter estimate	*t*-statistic (*p*-value)	Parameter estimate	*t*-statistic (*p*-value)	Parameter estimate	*t*-statistic (*p*-value)
User satisfaction	0.2995***	2.93 (0.0041)						
Perceived usefulness	–0.0812	–0.86 (0.3935)	0.4762***	6.21 (0.0001)				
Knowledge content quality			0.1456*	1.63 (0.0955)	0.0252	0.27 (0.7833)		
KM system quality			0.3045***	3.37 (0.0010)	0.0463	0.48 (0.5865)		
Supervisor					0.1690*	1.57 (0.0987)		
Coworker					0.3035***	2.77 (0.0066)		
Leadership	0.2013**	1.92 (0.0469)					0.3572***	3.72 (0.0003)
Incentive	0.2642***	2.78 (0.0065)					0.2353**	2.5 (0.0159)
N = 111								
System weighted *R*-squared = 0.3236								

Notes: All *p*-values are for two-sided tests of significance (because all hypotheses have predicted signs of the coefficients, if we use one-tailed *p*-values, the levels of significance are stronger). *, **, and *** indicate significance at the 10 percent, 5 percent, and 1 percent levels, respectively.

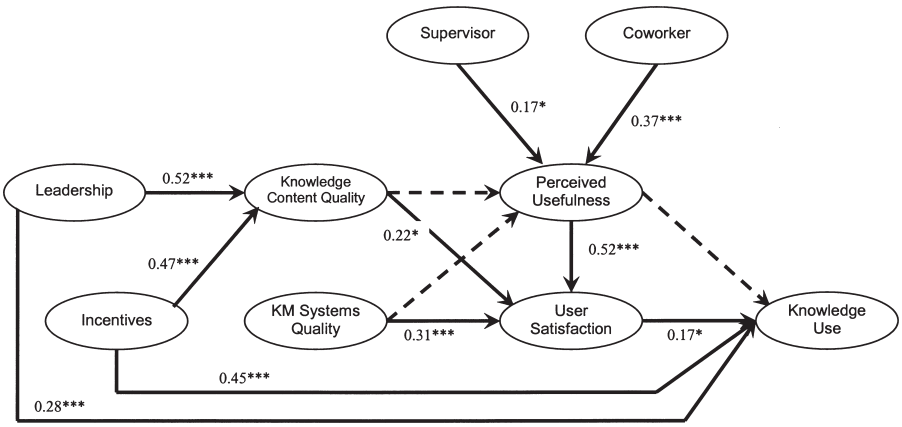

Figure 6. LISREL Structural Model Estimation Results
$N = 111$; df = 395; $\chi^2 = 826.0$; RMSEA = 0.10; NNFI = 0.92; CFI = 0.92; SRMR = 0.24.
*, **, and *** indicate significance at the 10 percent, 5 percent, and 1 percent levels, respectively.

and use will not work, but mechanisms such as linking KM to performance reviews, creating a safe environment for people to share, and recognizing those who contribute will induce the desired outcomes [68]. Grudin [39], in a study of systems that support collaborative work, pointed out that promoting contributions to knowledge bases and encouraging the use of such shared knowledge requires the opportunity cost to users of the system be offset by appropriate incentives. Ackerman and Halverson made a similar observation in the context of the use of organizational memory systems (both for contributions and usage), which are "subject to the issue of incentives. . . . not only is there the cost of storage and indexing, there may be additional costs in retrieval and interpretation of information" [1, p. 42]. In a study of a consulting firm code named Alpha, Orlikowski et al. [67] reported that one reason for the lack of use of Lotus Notes for knowledge sharing among consultants was lack of incentives to contribute. Markus [58] cited a study conducted at Booz Allen showing that the motivation of consultants to share and use shared knowledge is reinforced by the presence of explicit rewards announced by the firm.

The same article [58] reported another study of enterprise resource planning (ERP) systems involving knowledge sharing and use between two implementation teams. It was discovered here that even the provision of appropriate incentives was insufficient to fully overcome the inertia of the participants. The failures were attributed partly to the lack of commitment of the leadership to knowledge sharing and partly to technological and KM system weaknesses. British Petroleum introduced videoconferencing and other tools to encourage knowledge sharing between virtual teams on certain challenging field tasks. When senior managers found that the technology was not being used, they investigated and found the team members lacked understanding of the purpose behind the introduction of the tools and how it could help their work. They achieved success only after setting up "coaches" or champions drawn from the

senior ranks, who provided the required level of leadership for the encouragement of this project. Our findings thus validate what has been succinctly stated by Brown and Duguid [14]: documenting and using knowledge takes more than IT and KM systems. It takes "organizational work" involving the use of champions and facilitators.

As posited in H7, User Satisfaction with KM initiatives significantly affects Knowledge Use. To determine the implications for practice, we note that User Satisfaction is affected by the Knowledge Content Quality, as well as by KM System Quality (H4 and H5). Further, Knowledge Content Quality significantly depends on levels of Leadership and Incentive (H10 and H12). The inference is that an organization, in order to ensure that its KM efforts are successful, must work on multiple fronts: building a KM system of "high quality," securing senior management commitment and providing an appropriate incentive structure to promote knowledge contributions and reuse, and ensuring high quality of knowledge content that can be adapted as necessitated by the context.

Note that Leadership and Incentive (H11 and H13) exert a direct as well as indirect effect on Knowledge Use. This suggests that building a sophisticated KMS may be neither a necessary nor a sufficient condition to realize adequate sharing of knowledge in an organization. What is important is that the leadership must identify the nature of knowledge and how knowledge sharing can be embedded within the existing organizational processes, possibly with the help of available IT infrastructure. This is reiterated by a number of researchers in their studies of experiences of various organizations. KM consultants such as Shir Nir of Knowledge Transformation Partners point out that CIOs must evaluate the existing IT infrastructure for its adequacy for KM and whether improvements are necessary only after organizational issues are examined [48]. Executives must look at the strategic need for KM followed by a review of the current processes and the readiness of the corporate culture for technology-based changes, in the absence of which the technology will be underutilized.

KM System Quality is still a significant determinant of Knowledge Use (via User Satisfaction; H5 and H7). As suggested by Markus [58], knowledge use may depend on how remote and dissimilar knowledge users are from knowledge "generators." Users from different functional areas or with differences in terms of breadth and depth of knowledge may face difficulty in defining search terms (when using a KMS) while using even "carefully packaged knowledge," or locating experts and expertise. Users who do not know the right jargon, terminology, questions to ask, or symptoms to report will "drown in unnecessary, unhelpful or conflicting" knowledge [1, p. 40]. It is therefore important to develop and provide users a system with a feature-rich interface that will retrieve and present different types of knowledge in an efficient manner. Alternatively, the system may put them in touch with experts who can provide the needed knowledge and help them interpret and apply the available knowledge.

As the results indicate, Perceived Usefulness of Knowledge Sharing reinforces User Satisfaction, which, in turn, results in Knowledge Use (H3 and H7). The strategy for an organization to increase Perceived Usefulness of Knowledge Sharing can be developed by looking at its antecedents of Supervisor and Coworker (H8 and H9). The

implication is that an organization must work to promote strong teamwork within employees' work groups, whereby supervisors and coworkers provide encouragement for contributing to as well as using available knowledge gained and stored in the form of explicit knowledge. As succinctly stated by Gordon Larson, Chief Knowledge Officer of CNA, a Chicago-based insurance firm, "what makes employees share and use shared knowledge . . . is the communication between supervisors and employees (to the effect that these activities) can be beneficial and can help on the job performance"; success stories are published in an internal newsletter called *Inside Scoop* [74].

Note that the effect of Knowledge Content Quality on Perceived Usefulness of Knowledge Sharing (H1) and the direct effect of Perceived Usefulness of Knowledge Sharing on Knowledge Use (H6) were not statistically significant. A possible explanation may be that KM efforts in many organizations are still in a nascent stage. Therefore, the mere existence of reusable knowledge may be adequate for some employees who are willing to examine and adapt such shared knowledge for their own work situations and thus perceive the usefulness of knowledge sharing. However, such limited perception of usefulness of sharing may not be enough to also drive the internalization of the practice of knowledge use in the organization. There may be other explanations for this apparent paradox. For example, it has been noted that the task of searching through a knowledge base using a KMS is often entrusted by senior employees to those who are junior and may be less experienced [66]. It is difficult for such employees to accurately judge the content quality even though they know the task and the context in which the knowledge search is being done [13]. Thus, content quality may be silently factored out of perceptions of usefulness. Other possibilities are (1) the abundance of knowledge content in the available knowledge base makes it easy to locate the required knowledge objects [18] and (2) the variety of knowledge objects makes it easier to use all content which appears to be contextually useful [40]. As a logical consequence, knowledge use is unaffected by perceived usefulness, with the result that knowledge workers build knowledge use into their work practices as a natural act. It is possible that knowledge workers use high-quality content in an inappropriate setting or low-quality content in an appropriate setting; therefore, knowledge is being used regardless of its perceived usefulness [69].

Equally paradoxically, we also observe that KM System Quality does not significantly affect Perceived Usefulness (H2). This is a departure from empirical studies of IS success models. Perhaps, even if the "system" is no more than a repository that allows storage and retrieval of knowledge documents and does not contain sophisticated features such as classification into various categories, index-based search, or remote access, the mere existence of any kind of "system" is a sufficient motivator for its use. At a later point in time, with the addition and implementation of user-friendly interfaces and other features, system quality may indeed influence user perceptions. Alternatively, the people who actually use the system to search for and retrieve knowledge content may be technologically "savvy," which makes them oblivious to the "goodness," that is, the reliability and user-friendliness of the system, or perhaps its "deficiencies," such as a dearth of advanced indexing or inability to use phonetic

word translations. They may be able to find work-arounds to compensate for such inadequacies. In the case of "information overload," where the system fails to filter out content that may not be useful, the users may be able to more than offset the extra time they need to manually sift through the content by accomplishing their decision tasks much more efficiently than they would have without the aid of the system.

Another possibility is based on the iterative or multistep nature of the process of locating and retrieving knowledge documents using a KM system. The first results are partly filtered by the capabilities of the system and further refined by the users of the system based on their evaluation of quality [69]. In the absence of a credible rating scheme, evaluation of quality becomes nontrivial. Even if the rating scheme is not perfect, users may be inclined to accept the system with its "flaws" and the knowledge content in spite of indifferent quality levels. This further explains the noneffect of these factors on perceived usefulness and in turn on knowledge use.

Conclusion

WE DEVELOPED AND TESTED A KM SUCCESS MODEL derived from the IS success model of DeLone and McLean [23, 24] and Seddon [76]. Our model was enriched by research in the area of KM by Alavi and Leidner [3], Davenport and Prusak [19], Davenport et al. [20], and others. Thus far, the emphasis in KM-related IS research has been on improving KM applications and systems and their implementation across corporate intranets—that is, the focus has been on technology. Although ample anecdotal evidence exists, KM research has paid limited attention to creating a formal empirical model with organizational factors that can complement the technology. One objective of this study is to incorporate both knowledge contributions (in the form of shared knowledge quality) and knowledge use as outcomes of KM initiatives undertaken by a firm in a model involving their antecedents—comprising both technology and organizational factors.

Contributions

An important element of our study is the identification of the organizational dimension and measures that enable knowledge sharing and reuse, a step beyond the cultural infrastructure factors of earlier research (e.g., [34]). Another contribution of this study is the integration of approaches from social, organizational, and economic theories to show that they converge to provide consistent directions for KM research. The development of our model's constructs is based on theories drawn from these diverse disciplines; we show how insights from social exchange and structuration theories can be reconciled with those from microeconomic (agency) theory in the context of KM.

Most prior research in KM focuses on the "supply" side of knowledge, which involves resources and efforts needed to stimulate knowledge creation and storage; for

example, creating knowledge repositories, expertise yellow pages, and so on. Our model includes both the supply and demand sides of KM. Analogous to the IS Use measure of the IS Success model, our Knowledge Use construct includes reuse of knowledge. We believe that the ultimate realization of knowledge sharing and reuse can occur when knowledge-related activities are embedded in organizational processes in which knowledge workers participate. Hence, our Knowledge Use construct measures the extent to which these activities are incorporated into work practices. Our model enables the measurement of the results of KM efforts as reflected in the levels of knowledge content quality, KM system quality, and knowledge use, in the broad area of *explicit knowledge.*

Implications

Our findings contribute to further the understanding of the way in which KM efforts should be implemented in organizations. The statistical results confirm anecdotal evidence that organizational factors involving people (namely, leadership commitment and supervisor and coworker support for reinforcing KM initiatives) are as important as the technology that supports these KM initiatives. Without these "people" factors, what may happen is that even the most enthusiastic knowledge worker may eventually dismiss the potential benefits of KM if he or she does not see others with the same level of enthusiasm.

Our results clearly indicate that the commitment exhibited by the senior leadership affects quality of shared knowledge as well as the extent of knowledge use. Some of the KM practitioner comments we encountered were "the reason some groups in our unit are more successful than others in knowledge sharing and reuse is their focus on customer rather than product, people viewed as assets not costs, and emphasis on openness not secrecy." We interpret these remarks to mean that the practice of defining desirable behavior and enticing staff into exhibiting that behavior may lead to conformance but not to commitment. Therefore, senior management should take on the role of exemplar and not that of a mere coach. In fact, our results closely mirror these views and suggest concrete steps firms can take in this regard. Some of the steps as expressed by these same senior managers were (1) have senior-level KM advocates; (2) associate KM with unit, group, and individual goals and objectives; (3) cultivate communities of practice and interest; and (4) use feedback to improve KM.

One way by which the organizational leadership can demonstrate commitment to KM is by having top management assume the visible role of knowledge champions. The knowledge champions should spearhead the tasks of crafting a KM strategy for the firm, setting goals, and emphasizing the potential benefits of KM. Other important actions include instituting policies and procedures for rewards, recognition, and incentives, and promoting internalization of knowledge sharing and reuse practices. In firms where KM responsibility is decentralized and distributed among business units, there should be consistency in the actions of multiple champions. The champions must enlist participation of supervisors in the initiatives in order to shape em-

ployee attitudes toward knowledge sharing. As KM initiatives mature, their value to employees is likely to increase.

Moreover, incentives and rewards (even if they are nonmonetary) are a necessary condition behind KM success. Organizations must take note that incentives and rewards are required both to stimulate sharing of knowledge (in the form of "high-quality" content) and use of the shared knowledge. In this regard, views most often expressed by managers included "turn on the faucet . . . move up from mere words of encouragement to actually rewarding employees for sharing," and "by rewarding both giving and taking, create a global, not local view of the organization." The Siemens case study [56] elaborating the successful implementation of their ShareNet KM system is a prominent example of this approach. Once again, the specific steps an organization can take are (1) reward knowledge sharing and reuse and (2) bring human resources into the picture to ensure that training, awards, and compensation reflect KM goals. Further research into the kinds of incentives that are relatively more or less effective is needed to expand this research. It is entirely possible that if knowledge content is either unavailable because of lack of sharing or fails to meet a base level, knowledge workers may rapidly lose interest in KM as a whole. Needless to say, ensuring the quality of any KM system (in terms of its features, user-friendliness, indexing and classification scheme, and so forth) is of paramount importance—the initial design stage is where the system must be structured to build in the requisite features because a bad design can effectively destroy the KM initiatives of a firm.

At the local level, attitudes and actions of supervisors and coworkers influence how knowledge sharing is perceived by employees. Organizations may find that it helps their knowledge-sharing efforts to arrange periodic meetings between and among work groups. At these meetings, feedback can be provided and success stories of knowledge sharing and reuse can be exchanged. This may help to instill the desired "knowledge culture" among the individuals.

The quality of knowledge as well as that of the systems that facilitate its diffusion determines the users' satisfaction level, ultimately leading to its sustained use. In a sales-solutions knowledge-sharing initiative in a large telecommunications firm, field sales persons call on product experts for sales support. A new KM initiative in the firm captures the knowledge exchanged in electronic dialogs (e-mails, chats, and so on) and retains the extracted knowledge in a sales knowledge base (SKB). Incentives are offered for both good questions and answers as rated by the employees, and filters based on employee ratings of knowledge populate the SKB. In the initial stages, the firm expects the SKB knowledge components to be used regardless of the rating levels; possibly because of the "newness" of the initiative, the perceived usefulness is high. Management foresees that as the ratings-based incentive system stabilizes, however, employees will become more discerning between "high" and "low" quality of knowledge. In a similar vein, our analysis shows that knowledge content quality does not significantly affect perceived usefulness. We should interpret this result very carefully, however. Perhaps as an organization matures in its KM pursuits and the size of its knowledge base increases, it should invest in improving the quality of knowledge content and the relevance of the retrieved knowledge.

Of equal importance is the insight that can be drawn from the nonsignificant findings of our study. As we speculated earlier, a knowledge rating scheme that provides incentives for credible (believable) ratings may be required to attract more users to the KM system. Refining and improving the design of the system by incorporating "better" filters and classification, as well as providing training to inexperienced users, may also enlarge the user base. Thus, a "critical" mass may be attained more quickly making the KM efforts a viable and sustainable long-term resource for competitive advantage. These insights provide avenues for future research that will enrich the body of knowledge in this area.

Limitations and Future Research

One limitation of this study is that it considered only explicit knowledge. To study differences across industries or business types, it may be necessary to distinguish between explicit and tacit knowledge and measure Knowledge Content Quality, KM System Quality, and Knowledge Use levels in these different types of knowledge. For example, one can argue that success in the high-tech industry may be more dependent on the quality of its technical expertise (a form of tacit knowledge), whereas the transportation industry may rely more on operational knowledge available through lessons learned (a form of explicit knowledge). Similarly, variations may be observed in businesses of different types—manufacturing versus service. In a semiconductor manufacturing plant that uses highly sophisticated machinery, we may see that lessons learned are captured and documented by way of "best known methods," which become crucial in reducing downtime in order to attain the target yields. On the other hand, service-oriented businesses, such as resorts and casinos that deal with a large number of customers, need to create and reuse models of customer profiles to excel in their business. Harrah's Casinos, a service business in the gaming industry, for example, builds data-mining models and tests their effectiveness through field experiments; the best models are stored and reused [55]. This is an example of their emphasis on effective use of explicit knowledge. Such extensions may allow for more specific recommendations.

Our model studies knowledge sharing and use from a knowledge worker's perspective as an indication of success of a KM initiative. In this view, the knowledge processes are treated at a high level of abstraction. A more detailed approach is to treat knowledge processes at a much more granular level as some of the other researchers (e.g., [34]) have done, for example, by treating the nature of identification and vetting processes, and by analyzing work flow steps that facilitate capture of identified knowledge as separate constructs. Future research can include these variables to understand the antecedents of KM success.

There is no doubt that obtaining objective measures of actual performance improvements directly attributable to KM initiatives would have strengthened the study. In the absence of such measures, it is perhaps better to gather users' perceptions that act as proxies for performance. Moreover, in a cross-sectional study such as ours, when one is studying the generalized effect of multiple KM initiatives across a number of

organizations, the units of measure for business benefits can be problematic. Different businesses would be invariably using their own metrics for business performance (e.g., cycle time, back orders, bids won, customer satisfaction). Aggregation of such diverse measures is difficult, if not impossible, in a cross-sectional study. Future research can be aimed at an in-depth study of one KM initiative in a particular setting, which could be further enhanced by longitudinally measuring the business benefits.

The nature of our empirical model allows multiple avenues for further research as partially outlined here. Another issue worthy of empirical examination and one we are currently examining is that of complementarities between KM factors and organizational factors. Intuitively, it is feasible that a higher level of knowledge quality combined with a higher level of KM System Quality or Incentive may lead to supermodular benefits [62]. Similarly, complementarities can also exist between capabilities in different knowledge areas. Verifying complementarity through supermodular benefits is nontrivial and requires rigorous statistical methods [6]. Another worthwhile direction is to examine the aforementioned beliefs about differences governed by the characteristics of the particular industry or business. A larger number of respondents from multiple industries will be needed for such analysis. Resulting findings can make more specific recommendations allowing businesses to invest more prudently in resources while planning KM initiatives.

According to some KM practitioners, for KM to be effective, one must not begin and end with improving how well work gets done. It should also improve what gets done. Further, an organization should reexamine the processes for discovering and creating new knowledge as well as refining existing knowledge. In other words, business processes provide the critical connecting factors that bridge KM and business results or performance. Thus, KM efforts must include identification of knowledge-intensive work processes and work flows that are deemed important for the type of business, and the IT and systems support needed to facilitate knowledge sharing. Such infrastructural changes can eventually aid in transforming knowledge-intensive business processes. These qualitative insights provide rich avenues for future research.

Acknowledgments: The authors are grateful to the editor and the anonymous reviewers for their insights and suggestions, which have substantially strengthened this paper. This research was supported by a grant from the Small Grant Program at Arizona State University, W.P. Carey School of Business. The first two authors are listed in alphabetical order.

NOTES

1. An IT artifact is seen by some as conforming to the "tool" view of technology described by Kling: "A computing resource [that] is best conceptualized as a particular piece of equipment, application or technique which provides specifiable information processing capabilities" [50, p. 308].

2. We reiterate that there is a process component to KM, representing the processes embedded in an organization for capture, sharing, and retrieval of knowledge, and this is partially captured in our Knowledge Use construct.

3. The value of coefficients from the LISREL procedure may differ slightly from the SUR estimation coefficients but, qualitatively, there is no difference; also, the levels of significance are virtually the same.

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