Knowledge Management: An Organizational Capabilities Perspective

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ABSTRACT: A hallmark of the new economy is the ability of organizations to realize economic value from their collection of knowledge assets as well as their assets of information, production distribution, and affiliation. Despite the competitive necessity of becoming a knowledge-based organization, senior managers have found it difficult to transform their firms through programs of knowledge management. This

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is particularly true if their organizations have long histories of process and a tradition of business success. This research examines the issue of effective knowledge management from the perspective of organizational capabilities. This perspective suggests that a knowledge infrastructure consisting of technology, structure, and culture along with a knowledge process architecture of acquisition, conversion, application, and protection are essential organizational capabilities or "preconditions" for effective knowledge management. Through analysis of surveys collected from over 300 senior executives, this research empirically models and uncovers key aspects of these dimensions. The results provide a basis for understanding the competitive predisposition of a firm as it enters a program of knowledge management.

KEY WORDS AND PHRASES: knowledge capability, knowledge culture, knowledge integration, knowledge management, knowledge management processes, knowledge management structures, organizational capabilities, organizational structure, social capital, structural equation modeling, technology infrastructure

PERHAPS THE MOST DRAMATIC EVOLUTION IN BUSINESS over the past decade is the dawn of the new economy. The velocity and dynamic nature of the new marketplace has created a competitive incentive among many companies to consolidate and reconcile their knowledge assets as a means of creating value that is sustainable over time. In order to achieve competitive sustainability, many firms are launching extensive knowledge management efforts. Unfortunately, many knowledge management projects are, in reality, information projects. When these projects yield some consolidation of data but little innovation in products and services, the concept of knowledge management is cast in doubt. Clearly, the quest to move beyond information management and into the realm of knowledge management is a complex undertaking involving the development of structures that allow the firm to recognize, create, transform, and distribute knowledge.

Importantly, organizations may not be equally predisposed for successful launch and maintenance of knowledge management initiatives. Therefore, a key to understanding the success and failure of knowledge management within organizations is the identification and assessment of preconditions that are necessary for the effort to flourish. These preconditions are described broadly as "capabilities" or "resources" within the organizational behavior literature [67, 72, 73]. Utilizing this theoretical foundation, the objective of this research is to provide a definitional and empirical context for assessing key organizational capabilities that directly impact an organization's drive toward successful knowledge management.

Knowledge Management Capabilities: Infrastructure and Processes

TO COMPETE EFFECTIVELY, FIRMS MUST LEVERAGE their existing knowledge and create new knowledge that favorably positions them in their chosen markets. In order to

accomplish this, firms must develop an "absorptive capacity"—the ability to use prior knowledge to recognize the value of new information, assimilate it, and apply it to create new knowledge and capabilities [25]. In essence, all new resources, including knowledge, are created through two generic processes, combination and exchange [85]. Combination and exchange of knowledge for creation of new knowledge requires the presence of social capital [83]. Social capital is "the sum of actual and potential resources embedded within, available through, and derived from the network of relationships possessed by a social unit."

Three key infrastructures, *technical, structural,* and *cultural,* enable maximization of social capital. Structural infrastructure refers to the presence of norms and trust mechanisms [87, 89, 94]. Shared contexts comprise the cultural dimension [4, 34, 74, 101]. The technological dimension addresses the technology-enabled ties that exist within the firm [19, 30, 33, 73, 74, 98]. In order to leverage infrastructure, knowledge management (KM) processes must also be present in order to store, transform, and transport knowledge throughout the organization [1, 4, 48, 73, 86, 87, 91, 96, 97]. These processes enable the organization to capture, reconcile, and transfer knowledge in an efficient manner. Grant [49] provides a framework for defining the process aspects of knowledge integration. According to this framework, integration of knowledge is dependent upon three aspects: efficiency of integration, scope of integration, and flexibility of integration. The frequency and variability of processes are key determinants of efficiency of integration. The more frequently a company carries out its knowledge management processes, the more routine the norms and more efficient the integration process. The more variable the knowledge management processes, the more a company must handle exceptions, and, consequently, the less efficient the integration of knowledge. The variety of knowledge that is integrated through the presence of requisite processes defines the scope of integration. Finally, flexibility of integration refers to the manner in which an organization can combine its knowledge. Together, the perspectives of infrastructure and process provide a useful theoretical foundation for defining important aspects of organizational capability. The following sections further develop the content and theoretical grounding of these dimensions.

Infrastructure Capabilities

Technology

Technology comprises a crucial element of the structural dimension needed to mobilize social capital for the creation of new knowledge. Through the linkage of information and communication systems in an organization, previously fragmented flows of information and knowledge can be integrated [6, 37, 98]. These linkages can also eliminate barriers to communication that naturally occur between different parts of the organization. Since technology is multifaceted, the organization must invest in a comprehensive infrastructure that supports the various types of knowledge and communication that are critical. The technological dimensions that are part of effective

knowledge management include business intelligence, collaboration, distributed learning, knowledge discovery, knowledge mapping, opportunity generation, as well as security [49, 73].

Business intelligence technologies enable a firm to generate knowledge regarding its competition and broader economic environment. Collaboration and distributed learning technologies allow individuals within the organization to collaborate, thereby eliminating the structural and geographical impediments that may have previously prevented such interaction. Knowledge discovery technologies allow the firm to find new knowledge that is either internal or external to the firm. Knowledge mapping technologies allow the firm to effectively track sources of knowledge, creating a catalog of internal organizational knowledge. Knowledge application technologies enable a firm to use its existing knowledge. Opportunity generation technologies allow the firm to track knowledge about its customers, partners, employees, or suppliers. In addition to these aspects of creating, transferring, and storing knowledge through technological infrastructure, the organization must take steps to ensure that knowledge is not stolen or used inappropriately.

Structure

Organizational structure is important in leveraging technological architecture. Although intended to rationalize individual functions or units within an organization, structural elements have often had the unintended consequence of inhibiting collaboration and sharing of knowledge across internal organizational boundaries. For example, structures that promote individualistic behavior in which locations, divisions, and functions are rewarded for "hoarding" information can inhibit effective knowledge management across the organization [89]. In fact, the optimization of knowledge sharing within a functional area can many times suboptimize the sharing of knowledge across the firm. Taken to a larger level, the optimization of knowledge sharing within the firm can suboptimize sharing across a supply chain. In essence, it is important that organizational structures be designed for flexibility (as opposed to rigidity) so that they encourage sharing and collaboration across boundaries within the organization and across the supply chain.

Whereas the objective of this discussion is not to promote a specific organizational structure, two distinct structures have received favorable discussion with respect to effective knowledge management. In their systems-based approach, Sanchez and Mahoney [94] suggest that a modular organizational design combined with a modular product design can reduce the costs of coordination and adaptation, thereby increasing strategic flexibility. Nonaka and Takeuchi [87] develop a new organizational structure, the hypertext organization, that enables their five-stage process of knowledge creation to occur efficiently within the organization. In general, this is a combination of a formal organizational structure and a non-hierarchical, self-organizing organizational structure. However, a similar effect can be achieved through maintaining the formal hierarchical structure and adding the dimension of flexibility.

Along with policy and process, an organization's system of rewards and incentives can determine the channels from which knowledge is accessed and how it flows [73]. These systems can also create barriers to effective knowledge management activities. Incentive systems should be structured so that workers are motivated and rewarded, for taking the time to generate new knowledge (i.e., learn), share their knowledge, and help others outside their own divisions or functions [5, 89]. It is the combination of these KM structural dimensions, an organization's formal organizational structure, and incentive systems that make up an organization's overall knowledge management structure.

Culture

Perhaps the most significant hurdle to effective knowledge management is organizational culture. Shaping culture is central in a firm's ability to manage its knowledge more effectively [30, 31, 34, 73]. Interaction between individuals is essential in the innovation process [7, 8, 74]. Dialogue between individuals or groups are often the basis for the creation of new ideas and can therefore be viewed as having the potential for creating knowledge. Employee interaction should be encouraged, both formally and informally, so that relationships, contacts, and perspectives are shared by those not working side by side [89]. This type of interaction and collaboration is important when attempting to transmit tacit knowledge between individuals or convert tacit knowledge into explicit knowledge, thereby transforming it from individual to organizational level [84, 85, 86, 87]. In addition, employees should have the ability to self-organize their own knowledge and practice networks to facilitate solutions to new or existing problems and to generate or share knowledge [89].

As noted by many scholars and practitioners, an important component of culture is corporate vision [29, 73]. A vision that permeates the organization can provide people with a needed sense of purpose that transcends everyday activities [73]. The overall vision is intended to generate a clear organizational purpose and prompt the necessary changes in the organization so that it can achieve its desired future goals [66, 87]. The vision can incorporate not only a vision statement that conveys a clear and unambiguous statement of the future and desired direction of the organization, but it can also incorporate a system of organizational values. Through an articulated and communicated vision, it is important to engender a sense of involvement and contribution among employees [32, 89].

Along with vision, a system of corporate values determines the types of knowledge that are desired and the types of knowledge related activities that are tolerated and encouraged [73, 76, 80]. Explicitly stated visions, including value statements, can encourage the growth of knowledge within the firm. Trust and openness are commonly cited as two of these explicitly stated values that promote knowledge management behaviors [101]. In general, emphasis in vision statements and value systems should be placed on the components of the organization that encourage effective knowledge management processes to occur. However, the creation of a vision and set

of organizational values is not enough: They must be effectively communicated throughout the entire organization [87, 89].

Process Capabilities

Although it is important for an organization to manage knowledge internally, it is equally important to effectively manage external knowledge as well [41]. Researchers have identified many key aspects to this knowledge management process: capture, transfer, and use [34]; acquire, collaborate, integrate, experiment [73]; create, transfer, assemble, integrate, and exploit [98]; create, transfer, use [95, 96]; and create, process [63]. An examination of these various characteristics enables us to group them into four broad dimensions of process capability—acquiring knowledge, converting it into useful form, applying or using it, and protecting it.

Acquisition Process

Acquisition-oriented knowledge management processes are those oriented toward obtaining knowledge. Many terms have been used to describe these processes: acquire, seek, generate, create, capture, and collaborate. All of these terms have a common theme—the accumulation of knowledge. Innovation, another aspect of acquisition, is the creation of new knowledge from the application of existing knowledge. This requires concerted effort and a high degree of experience in recognizing and capturing new knowledge [36]. Improved use of existing knowledge and more effective acquisition of new knowledge is also a key aspect of acquisition [62, 99]. Two examples of these processes are benchmarking and collaboration. Through benchmarking, an organization identifies outstanding practices from organizations (including itself), then assesses the current state of a particular process to identify gaps and problems [89]. Once these practices and variances have been identified, the organization can then capture the knowledge for use internally.

The creation of organizational knowledge requires the sharing and dissemination (i.e., collaboration) of personal experiences [62]. Collaboration takes place at two levels within the organization: between individuals and between the organization and its network of business partners. Collaboration between individuals brings together individual differences (e.g., cognitive style, preferred tools, backgrounds, experiences) and can be used to create knowledge [73]. This assumes that interaction between the individuals will promote learning [98]. Collaboration between individuals is also the basis for the socialization of knowledge [87]. Collaboration between organizations is also a potential source of knowledge [39, 60, 61, 62]. Core capabilities are increasingly based on an organization's ability to find and create knowledge [73]. Collaboration with other firms is critical to knowledge acquisition [48, 49, 68, 79]. Technology sharing, personnel movement, and linkages between the organization and alliance partners or joint venture partners have all been shown to assist with the accumulation of knowledge [60, 62]. However, the ability to acquire knowledge is partly based on

an organization's absorptive capacity [25]. This is because all the necessary skills for innovation may not be found within a single organization [61, 73].

Conversion Process

Conversion-oriented knowledge management processes are those oriented toward making existing knowledge useful. Some of the processes that enable knowledge conversion are a firm's ability to organize [30, 89], integrate [49], combine, structure, coordinate [81, 82, 94], or distribute knowledge [31, 32, 104].

An organization must develop a framework for organizing or structuring its knowledge [30, 89]. Without common representation standards, no consistency or common dialogue of knowledge would exist. This would make the asset difficult to effectively manage. Knowledge about a particular subject may reside in different parts of the organization or in different systems within the organization. Combining or integrating this knowledge reduces redundancy, enhances consistent representation, and improves efficiency by eliminating excess volume [30, 49]. These processes also enable the organization to replace knowledge that has become outdated. The different knowledge of many individuals must be integrated to maximize efficiency. Thus, a primary goal of any organization should be to integrate the specialized knowledge of many individuals [49]. Four commonly cited mechanisms for facilitating integration are rules and directives, sequencing, routines, and group problem solving and decision-making.

Application Processes

Application-based processes are those oriented toward the actual use of the knowledge. Interestingly, little discussion has been devoted to the outcomes of the effective application of knowledge. Effective application seems to be largely assumed or implied as opposed to treated explicitly. For example, Nonaka and Takeuchi [87] discuss an organization's ability to create knowledge, but seem to assume that once it is created, it will be applied effectively. Process characteristics that have been associated with the application of knowledge within the literature include storage, retrieval, application, contribution, and sharing [1, 4].

Effective storage and retrieval mechanisms enable the organization to quickly access knowledge. To remain competitive, organizations must create, capture, and locate organizational knowledge. In addition, organizational knowledge and expertise must be shared [64, 69, 71]. Perhaps the most significant example of the importance of sharing knowledge comes from the Linux operating system. This product continues to be openly developed (i.e., anyone that wants can make modifications to the program and the source code is freely available). As a result of this sharing of knowledge, product development times have accelerated, functionality has increased rapidly, and its adoption has become widespread. In a discussion of customer support knowledge, Davenport and Klahr [30] note that the effective application of knowledge has helped companies improve their efficiency and reduce costs.

Protection Processes

Security-oriented knowledge management processes are those designed to protect the knowledge within an organization from illegal or inappropriate use or theft. For a firm to generate and preserve a competitive advantage, it is vital that its knowledge be protected [91]. Similar to application-oriented processes, this has also received little attention in the literature. Many may assume that a firm can protect its knowledge via patents, trademarks, copyrights, and so on. However, not all knowledge can be defined according to property laws and property rights [91]. Because protecting knowledge is inherently difficult, it should not be abandoned or marginalized. Steps can be taken to protect the asset, such as incentive alignment, employee conduct rules, or job designs. In addition, an organization can develop technology that restricts or tracks access to vital knowledge. Irrespective of the difficulty in protecting knowledge, it is a process that is important for an organization. For an asset to be the source of a competitive advantage, it needs to be rare and inimitable [13]. Without security-oriented processes, knowledge loses these important qualities.

Synthesis of the prior discussion suggests that organizational capability to effectively initiate and maintain programs of knowledge management can be framed along broad dimensions of infrastructure and process. Infrastructure capability can be further subdivided along definitional lines of technical, structural, and cultural capability. Process capability can be further subdivided along definitional lines of acquisition, conversion, application, and protection capability. As illustrated in Figure 1, these dimensions reflect an additive capability to launch and sustain a program of change through knowledge management [17, 18, 72]. In other words, these constructs are not higher-level abstractions of their underlying dimensions. Instead, they are a combination or additive sum of their respective factors. This is consistent with the notion of a "capability" or a "resource" in the organizational behavior literature [67, 72, 73]. In the next section, we develop scales based on the elements of capabilities and then formally test the model.

Survey Measures and Items

To assess the validity of our research model, measures of the three subdimensions of infrastructure capability (technology, structure, culture), four subdimensions of process capability (acquisition, conversion, application, protection), and single dimension of effectiveness are developed. Since single item measures generally frame concepts narrowly, the measurement of complex organizational phenomenon is typically done through multiple-item measures. Multiple-item measures are generally thought to enhance confidence that the constructs of interest are being accurately assessed and the measurement of the variable will be more consistent [23, 88]. Multiple-item measures are used for most variables to improve the reliability and validity of the measures. In addition, variables are measured with Likert-type scales that provide the advantage of standardizing and quantifying relative effects. The next section discusses the measures for each variable of interest. Due to the lack of empirical

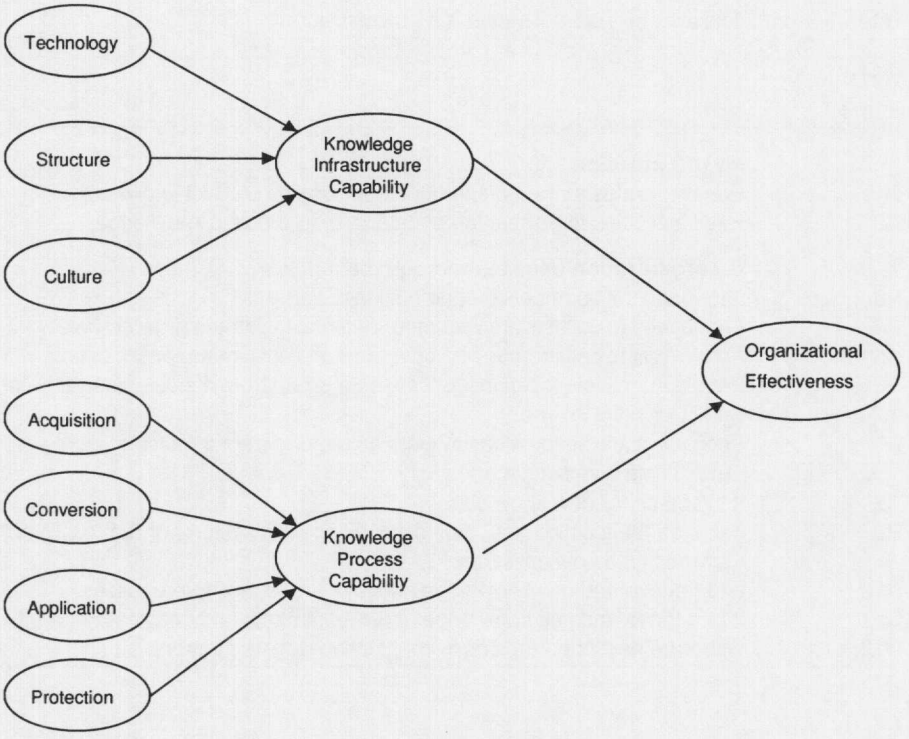

Figure 1. Knowledge Management Capabilities and Organizational Effectiveness

investigation into the subject of knowledge management, these measures are largely derived from theoretical statements made in the literature or from assessments within the practitioner literature on knowledge management. The initial set of items was assessed through a q-sort technique. Items that were consistently misclassified were dropped from the initial set, producing the items discussed in the following section.

Knowledge Infrastructure Elements

Technological Knowledge Management Infrastructure

The technical systems within an organization determine how knowledge travels throughout the enterprise and how knowledge is accessed [73]. Initially, common representation schemes for capture of knowledge should exist across the organization [30, 89]. Business intelligence technologies support knowledge regarding a firm's competition and environment and should be noticeable and accessible. Collaboration technologies and distributed learning technologies allow individuals within the organization to work together and collaborate interactively. Collaboration is seen as one of the key manners in which knowledge is transmitted and created within the organization [49, 74, 87, 89, 98]. Knowledge discovery technologies allow a firm to search for new knowledge that is either internal or external. Knowledge mapping

Table 1. Item Measures of Technological KM Infrastructure

Variable Name	Item
	My organization . . .
TI1	Has clear rules for formatting or categorizing its product knowledge.
TI2	Has clear rules for formatting or categorizing process knowledge.
	My organization uses technology that allows . . .
TI3	It to monitor its competition and business partners.
TI4	Employees to collaborate with other persons inside the organization.
TI5	Employees to collaborate with other persons outside the organization.
TI6	People in multiple locations to learn as a group from a single source or at a single point in time.
TI7	People in multiple locations to learn as a group from a multiple source or at multiple points in time.
TI8	It to search for new knowledge.
TI9	It to map the location (i.e., an individual, specific system, or database) of specific types of knowledge.
TI10	It to retrieve and use knowledge about its products and processes.
TI11	It to retrieve and use knowledge about its markets and competition.
TI12	Generate new opportunities in conjunction with its partners.

technologies allow a firm to track its sources of internal and external knowledge so that individuals in need of a specific type of knowledge know where it resides. Knowledge application technologies enable a firm to use its existing knowledge. Opportunity generation technologies allow a firm to generate and store knowledge about it customers, partners, employees, or suppliers. The items generated through literature and refined through rounds of q-sorting are listed in Table 1. All items are measured using seven-point Likert scales.

Structural Knowledge Management Infrastructure

The knowledge management structure within an organization also has multiple dimensions. The formal organizational structures within an organization may encourage or inhibit interactions among employees, a practice seen as vital in the effective management of knowledge [49, 87, 89, 94]. The structures must be flexible to encourage these vital interactions as well as to give the firm the flexibility to adapt to an ever-changing environment [78, 80, 94]. In addition to the organizational structure, incentive systems are also needed to encourage knowledge creation and sharing activities [56, 73, 75, 89].

Cultural Knowledge Management Infrastructure

The general organizational culture should be supportive and encouraging of knowledge-related activities [31, 34, 35]. This is accomplished by stressing the importance

of employee interaction for building relationships and contacts that enable the sharing of different perspectives [74, 76, 89]. This type of interaction is important when managing tacit knowledge [84, 85]. A clear corporate vision that stresses the organization's goals and values (i.e., valuing knowledge) and the role that knowledge plays in achieving those goals [66, 87] are fundamental parts of a strong knowledge culture. Senior management support of knowledge practices within the organization is also vital to the cultural dimension [15, 20, 26, 86, 92]. A portion of that support comes in the form of monitoring the knowledge within the organization so that errors can be noted and corrected [33].

Knowledge Management Process Elements

Acquisition-Oriented Processes

Part of managing knowledge within the organization is developing processes that acquire knowledge. Two primary means for collecting knowledge are (1) to seek and acquire entirely new knowledge, or (2) create new knowledge out of existing knowledge through collaboration between individuals and between business partners [26, 60, 73, 87].

Conversion-Oriented Processes

An organization must also acquire the ability to make knowledge useful (i.e., convert it into useful form). There are numerous aspects to this process characteristic. The organization must organize and structure knowledge, thereby making it easier to access and distribute it within the organization [83, 87, 89]. Through combining or integrating knowledge, redundancy can be reduced and efficiency can be improved by reducing excess volume [14, 28, 30, 49]. In addition, the coordination and conversion of specialized knowledge represents a fundamental aspect of transformation [49, 102, 103]. Firms must carefully transform aspects of tacit knowledge into explicit knowledge. If the firm does not recognize transferable components of tacit knowledge, efficiencies in production and innovation may be lost. However, firms must also be careful not to overuse technology and process to capture tacit knowledge. Such overuse may rob the firm of a valuable resource, as knowledge becomes marginalized through its transformation from rich tacit form to an explicit form suitable for digital storage and transmission.

Application-Oriented Processes

Knowledge application-oriented processes are those processes oriented toward the use of knowledge. Effective storage and retrieval mechanisms allow for quick and easy access. In addition, sharing knowledge with outsiders is seen as an effective way to improve knowledge about competitors and the industry and to acquire local knowledge [1, 4]. This knowledge can be used to adjust strategic direction, solve new problems, and improve efficiency.

Security-Oriented Processes

Security-oriented processes are designed to protect the knowledge from inappropriate or illegal use or from theft. Protection is vital if the knowledge is used to generate or preserve a competitive advantage [91]. Although part of the protection mechanism can be built into the technology infrastructure, other forms of protection should also be established that govern the behavior and conduct of employees and align incentives [3, 20, 52, 91]. These steps will help to prevent inappropriate use of the knowledge (although nothing can guarantee complete protection).

Capabilities and Organizational Effectiveness

As implied in the preceding discussion, a central tenet underlying the existence of knowledge management capabilities is their association with aspects of organizational effectiveness [25, 33, 84, 87]. As noted by observers in strategic management, organizational effectiveness is not a well-developed concept and is likely more complex in terms of description and dimensions than aggregated measures or financial ratios [21, 53, 54, 93, 100]. However, similar to any organizational resource, effective knowledge management through the development of capabilities should contribute to key aspects of organizational performance. In particular, the organization should experience a learning effect in which it improves over time in its capabilities for creating value [16, 38, 44, 58, 67, 70]. Therefore, while it seems that capturing the contribution of knowledge capabilities in terms of bottom line figures [such as return on investment (ROI), return on equity (ROE), etc.] may be significantly confounded by many uncontrollable business, economic, and environmental factors, other less confounded contributions of performance may provide insight into the value-added aspect of this organizational resource. Reconciling the insights and recommendations of recent literature within knowledge management with performance based assessment of the strategic management literature, we sought to identify the key contributions of knowledge management capability. Such contributions may include: improved ability to innovate, improved coordination of efforts, and rapid commercialization of new products. Other contributions may include: the ability to anticipate surprises, responsiveness to market change, and reduced redundancy of information/knowledge. These criteria are not tied to the fluctuations in financial ratios. Yet, they provide a foundation for determining the relative contribution of knowledge management capability to organizational effectiveness. Whereas other outcomes are certainly feasible, the items of Table 2 provide a robust set of measures for assessing the predictive validity of the capabilities constructs developed in the preceding sections.

Data Collection

The use of key organizational informants has been an effective approach in many research contexts [57]. Typically, these respondents are senior in the organization, residing at vice president or above. The support for their use stems from their knowl-

Table 2. Item Measures of Organizational Effectiveness

Variable Name	Item
	Over the past two years, my organization has improved its ability to . . .
KE1	Innovate new products/services.
KE2	Identify new business opportunities.
KE3	Coordinate the development efforts of different units.
KE4	Anticipate potential market opportunities for new products/services.
KE5	Rapidly commercialize new innovations.
KE6	Adapt quickly to unanticipated changes.
KE7	Anticipate surprises and crises.
KE8	Quickly adapt its goals and objectives to industry/market changes.
KE9	Decrease market response times.
KE10	React to new information about the industry or market.
KE11	Be responsive to new market demands.
KE12	Avoid overlapping development of corporate initiatives.
KE13	Streamline its internal processes.
KE14	Reduce redundancy of information and knowledge.

edge of the organization and its strategy. The use of key informants for knowledge management purposes can come from those in the organization that have access to, and use of, the organization's knowledge. This can be virtually anyone in the organization. However, for this study, those individuals must also be able to describe the structural elements of the organization in addition to the knowledge-oriented processes. Therefore, the respondent profile considered ideal for this study is a senior executive similar to those targeted in studies of strategic management. These organizational respondents use knowledge for accomplishment of their tasks and can also provide commentary of the organization's knowledge activity. Huber and Power [57] propose several guidelines for improving the accuracy of reports gathered from key respondents. These principles are adhered to in the development of this research design. Potential organizational respondents were profiled and the instrument was pretested among this constituency to ensure that these respondents understood the questions and could provide informed responses.

Data was collected through formal survey of 1,000 senior executives. The items of Tables 1–8 were included as part of a larger survey conducted by a major consulting firm. The items were randomly dispersed throughout the questionnaire and were anchored by seven-point Likert scales ranging from 1 = strongly disagree to 7 = strongly agree. Of the 1,000 surveys, 323 were deemed usable. Remaining questionnaires (7) were removed from further analysis due to multiple or missing responses. In sum, the data collection process yielded assessments of 323 executives of knowledge management activities within their respective firms.

Of the responses analyzed, 58 percent are finance and manufacturing firms. The sales profile also indicates a bias toward larger firms with 89 percent of the sample

Table 3. Item Measures of Structural KM Infrastructure

Variable Name	Item
	My organization('s) . . .
SI1	Structure* of departments and divisions inhibits interaction and sharing of knowledge.
SI2	Structure promotes collective rather than individualistic behavior.
SI3	Structure facilitates the discovery of new knowledge.
SI4	Structure facilitates the creation of new knowledge.
SI5	Bases our performance on knowledge creation.
SI6	Has a standardized reward system for sharing knowledge.
SI7	Designs processes to facilitate knowledge exchange across functional boundaries.
SI8	Has a large number of strategic alliances with other firms.
SI9	Encourages employees to go where they need for knowledge regardless of structure.
SI10	Managers frequently examine knowledge for errors/mistakes.
SI11	Structure facilitates the transfer of new knowledge across structural boundaries.
SI12	Employees are readily accessible.

* Structure is defined as the rules, policies, procedures, processes, hierarchy of reporting relationships, incentive systems, and departmental boundaries that organize tasks within the firm.

Table 4. Item Measures of Cultural KM Infrastructure

Variable Name	Item
	In my organization . . .
CI1	Employees understand the importance of knowledge to corporate success.
CI2	High levels of participation are expected in capturing and transferring knowledge.
CI3	Employees are encouraged to explore and experiment.
CI4	On-the-job training and learning are valued.
CI5	Employees are valued for their individual expertise.
CI6	Employees are encouraged to ask others for assistance when needed.
CI7	Employees are encouraged to interact with other groups.
CI8	Employees are encouraged to discuss their work with people in other workgroups.
CI9	Overall organizational vision is clearly stated.
CI10	Overall organizational objectives are clearly stated.
CI11	Shares its knowledge with other organizations (e.g. partners, trade groups).
CI12	The benefits of sharing knowledge outweigh the costs.
CI13	Senior management clearly supports the role of knowledge in our firm's success.

Table 5. Item Measures of KM Acquisition Process

Variable Name	Item
	My organization . . .
AP1	Has processes for acquiring knowledge about our customers.
AP2	Has processes for generating new knowledge from existing knowledge.
AP3	Has processes for acquiring knowledge about our suppliers.
AP4	Uses feedback from projects to improve subsequent projects.
AP5	Has processes for distributing knowledge throughout the organization.
AP6	Has processes for exchanging knowledge with our business partners.
AP7	Has processes for interorganizational collaboration.
AP8	Has processes for acquiring knowledge about new products/services within our industry.
AP9	Has processes for acquiring knowledge about competitors within our industry.
AP10	Has processes for benchmarking performance.
AP11	Has teams devoted to identifying best practice.
AP12	Has processes for exchanging knowledge between individuals.

Table 6. Item Measures of KM Conversion Process

Variable Name	Item
	My Organization . . .
CP1	Has processes for converting knowledge into the design of new products/services.
CP2	Has processes for converting competitive intelligence into plans of action.
CP3	Has processes for filtering knowledge.
CP4	Has processes for transferring organizational knowledge to individuals.
CP5	Has processes for absorbing knowledge from individuals into the organization
CP6	Has processes for absorbing knowledge from business partners into the organization.
CP7	Has processes for distributing knowledge throughout the organization.
CP8	Has processes for integrating different sources and types of knowledge.
CP9	Has processes for organizing knowledge.
CP10	Has processes for replacing outdated knowledge.

having sales of over $100 million. Although the larger firm has the obvious advantage of having a potentially broader profile of knowledge activity, the bias does limit the generalizability of the study. The respondents themselves had senior representation, with 86 percent assuming the position of chief operating officer, chief financial officer, vice president, or chief executive officer.

Table 7. Item Measures of KM Application Process

Variable Name	Item
	My organization . . .
AP1	Has processes for applying knowledge learned from mistakes.
AP2	Has processes for applying knowledge learned from experiences.
AP3	Has processes for using knowledge in development of new products/ services.
AP4	Has processes for using knowledge to solve new problems.
AP5	Matches sources of knowledge to problems and challenges.
AP6	Uses knowledge to improve efficiency.
AP7	Uses knowledge to adjust strategic direction.
AP8	Is able to locate and apply knowledge to changing competitive conditions.
AP9	Makes knowledge accessible to those who need it.
AP10	Takes advantage of new knowledge.
AP11	Quickly applies knowledge to critical competitive needs.
AP12	Quickly links sources of knowledge in solving problems.

Table 8. Item Measures of KM Protection Process

Variable Name	Item
	My organization . . .
PP1	Has processes to protect knowledge from inappropriate use inside the organization.
PP2	Has processes to protect knowledge from inappropriate use outside the organization.
PP3	Has processes to protect knowledge from theft from within the organization.
PP4	Has processes to protect knowledge from theft from outside the organization.
PP5	Has incentives that encourage the protection of knowledge.
PP6	Has technology that restricts access to some sources of knowledge.
PP7	Has extensive polices and procedures for protecting trade secrets.
PP8	Values and protects knowledge embedded in individuals.
PP9	Knowledge that is restricted is clearly identified.
PP10	Clearly communicates the importance of protecting knowledge.

Methodology and Results

As developed in the previous sections, each of the item clusters (or scales) in Tables 1 through 8 represents an *a priori* measurement model of theoretical construct space. Given this theory driven approach to construct development, the analytical frame-

work of confirmatory factor analysis provides an appropriate means of assessing the efficacy of measurement among scale items and the consistency of a prespecified structural equation model with its associated network of theoretical concepts [40, 42, 43, 51, 65]. In essence, the expectation is that each of the developed scales will uniquely measure its associated factor and that this system of factors will represent the system of relationships illustrated in Figure 1 [9, 10, 11]. Complex variables such as these should be modeled with their theoretical networks and then as a collective system [10, 11, 45, 46, 65]. Proceeding in this manner provides the fullest evidence of measurement efficacy and also reduces the likelihood of confounds in full structural equation modeling which may arise due to excessive error in measurement. Working within this context, LISREL 8.1 is utilized as the analytical tool for testing statistical assumptions and estimation of the measurement and structural equation models discussed in the following sections.

Checks for Statistical Assumptions

Two important assumptions of confirmatory factor modeling are multivariate normality and model determinacy (or identification). Because multivariate normality is difficult to test, it is recommended that univariate normality among variables be initially tested. In essence, establishing univariate normality among of a collection of variates helps gain, though not guarantee, multivariate normality [51]. Such testing can be accomplished through examination of the moments around the mean of each variate's distribution [17]. Among the variables of this study, analysis of these statistics suggests no serious departures in univariate normality. As a further test of this statistical assumption, several multivariate tests of skewness and kurtosis were examined [51]. Checks of these statistics also suggest no serious departures from multivariate normality or excessive kurtosis.

As structural models become complex, there is no guaranteed approach for ensuring that model identification has been obtained [17, 18]. However, there are a number of diagnostics that can be utilized to gather evidence of identification. Perhaps the most readily obtainable measure comes from the estimation program itself. LISREL performs a simple test for identification during the estimation process and alerts the user of possible identification problems. In all models estimated in the present analysis, no such warnings were observed. However, this test is not robust in capturing all instances of unidentified models. Another method of testing identification involves multiple estimation of the structural model with differing starting values. Programs such as LISREL, which estimate parameters of structural models, provide the researcher with a means to specify an initial value for any coefficient. If a starting value is not specified, the program automatically computes them through likelihood or least-squares techniques [12, 22, 24, 27, 40, 59, 65]. If the model is identified, the solution of each model should converge at the same point each time. Such an approach was undertaken in each of the estimated models of this analysis. In all cases, solutions converged at the same point and were identical, thereby providing strong evidence of model identification.

Assessment of Unidimensionality, Reliability, and Discriminant Validity

To assess the strength of measurement between the items and associated constructs, three measurement models are estimated. In each estimated model, items that cross load or demonstrate poor reliability are dropped and the model is then reestimated. This is done to ensure strength of measurement at the item level such that estimates among constructs are not confounded [2, 9, 77, 90]. The first model examines the system of relationships among measures of KM infrastructure (technological, structure, culture). As illustrated in Figure 2, parameter estimates, fit indices, and observed residuals imply that the hypothesized dimensions of KM infrastructure provide a good fit for the observed covariances among the collection of item measures. The model χ^2 value is 841.78 with 350 degrees of freedom. Although χ^2 is not significant and rather large, the normed χ^2 is 2.88 suggesting strong fit relative to degrees of freedom. In addition, the normed and non-normed fit indices are very high, suggesting good model fit. All indicator reliabilities are sufficiently high and statistically different from zero. The residual matrix for the model contains no values significantly different from zero and the composite reliabilities of each construct are all above 0.80. In short, the fit statistics seem to suggest that each scale is capturing a significant amount of variation in these latent dimensions of KM infrastructure. Importantly, the estimated correlation between all construct pairs is below the suggested cutoff of 0.90 [9, 10, 42, 43] and implies distinctness in construct content or discriminant validity.

The second measurement model examines the system of relationships among measures of KM process. As illustrated in Figure 3, parameter estimates, fit indices, and observed residuals imply that the dimensions acquisition, conversion, application, and protection are reasonable representations of the covariances among their respective item measures. The model χ^2 value is 1001.22 with 344 degrees of freedom. Again, χ^2 is not significant and rather large. However, the normed χ^2 is 2.91, suggesting strong fit relative to degrees of freedom [2]. Similar to the previous model, the normed and non-normed fit indices are very high and suggest good model fit. The estimated correlation between all construct pairs is below the suggested cutoff of 0.90 [9, 10, 42]. This implies distinctness in construct content or discriminant validity. Examination of the residual matrix and modification indices also supports the validity of this model.

A central tenet of KM capability is that it will have a direct and positive association with organizational effectiveness. Importantly, performance may not always be a direct measure of capabilities but is instead a state which should, but may not always, follow successful KM capabilities. As illustrated in Figure 4, fit measures as well as parameter estimates suggest that this model of organizational effectiveness is a good fit for the observed covariances in the sample. The observed χ^2 is 241.78 ($df = 63$; $p = 0.001$), the non-normed fit index is a rather high 0.93, and normed fit index is 0.89. RMSR is 0.06 and all indicator reliabilities are sufficiently high and statistically different from zero.

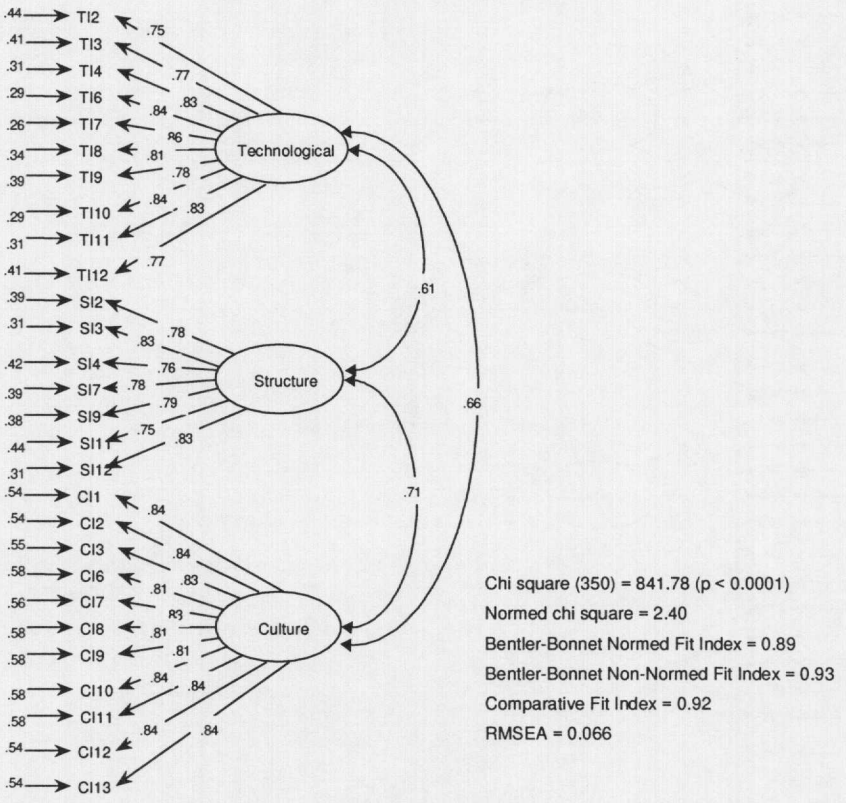

Figure 2. A Measurement Model of KM Infrastructure Capability

Assessment of the Structural Equation Model

As theorized, distinct causal paths from infrastructure and process capabilities predict alternative outcomes with respect to organizational effectiveness. As shown in Figure 5, the hypothesized model seems to provide a reasonable fit for the observed covariances. The observed χ^2 for this model is 2820.78 (df = 2327; p = 0.0001). Associated fit indices (goodness of fit, adjusted goodness of fit) either meet or exceed recommended levels. In addition, the path coefficients of the estimated model support the theorized relationships of Figure 1 in direction and magnitude. Particularly strong links of this model are the paths between the measured infrastructure constructs of technology, structure, and culture and their formative, unobserved construct of knowledge infrastructure capability. These results imply that infrastructure capabilities are an additive phenomenon, consistent with the theoretical definition developed by Leonard [73]. These results are mirrored by the pattern of loadings between the unobserved dimension of process capability and its measured dimensions of acquisition, conversion, application, and protection. In terms of associative order and interpretation, these formative constructs are predicted by, or a function of, their underlying dimensions. Therefore, the construct is interpreted as a mathematical composite of its

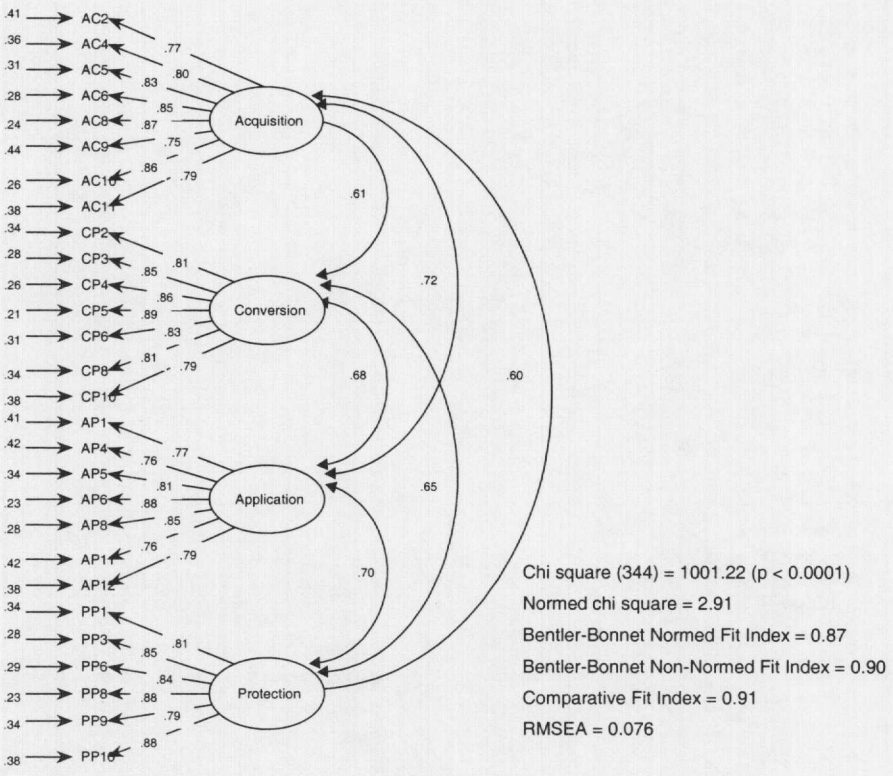

Figure 3. A Measurement Model of KM Process Capability

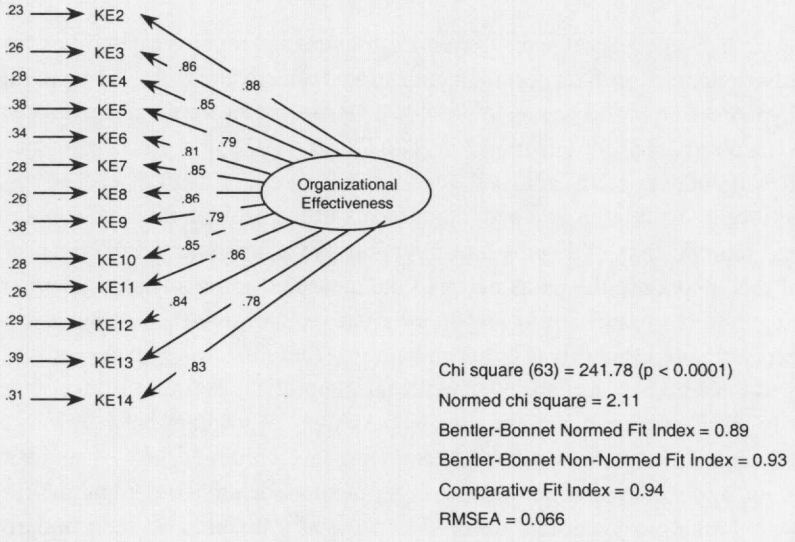

Figure 4. A Measurement Model of Organizational Effectiveness

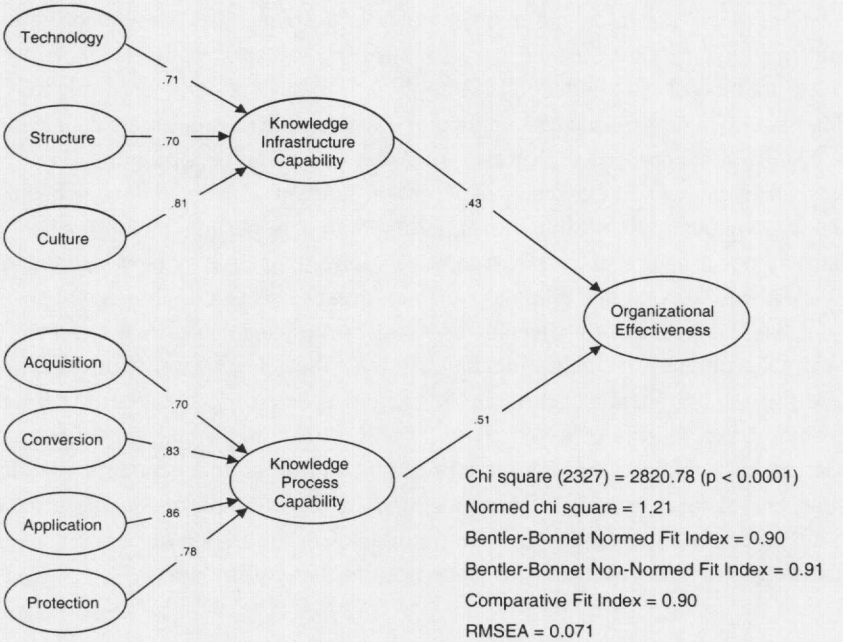

Figure 5. A Structural Model of Infrastructure and Process Capabilities

dimensions. Importantly, no single dimension of infrastructure or process capability is adequate in describing the phenomena. Each of the dimensions contributes uniquely to the overall capability.

As also illustrated in Figure 5, the paths between infrastructure and process capabilities and the performance variable are positive and of high magnitude. Again, this implies that both capabilities contribute uniquely to the achievement of organizational effectiveness. Such results seem to underscore the importance of tightly aligned process and infrastructure capabilities in creating conditions favorable for firm success. It is important to note that the mathematical manifestation of these relationships is consistent with developed theoretical perspectives outlined in the opening sections of this paper. The contribution of these results is a more precise definitional aspect of these dimensions and some insight into the magnitude of their association. Although the reported model fits (particularly the reported chi squares) may be considered somewhat moderate in strength, it is important to balance the fit measures with the complexity of the model (measured by the high degrees of freedom). The strength of item loadings, consistency in directional path, and match to theory seem to strongly imply that the model illustrated in Figure 1 provides valid insight into the relationship between organizational effectiveness and KM capabilities that predict its existence.

Limitations of Results

Although this research presents strong evidence regarding the impact of KM capabilities on KM effectiveness, the results should be interpreted in light of the study's

limitations. First, the study suffers from potential response bias associated with the "single informant." Such practice is typical of survey research. Still, it is by no means an ideal method of data collection. Multiple informants and structured methods of triangulation are perhaps the best method of obtaining the most accurate data regarding organizational properties. However, such methods potentially limit the number of issues which can be addressed and also limit the amount of useful data which can be collected. Nonetheless, possible over-reporting or underreporting of certain phenomenon may occur as a result of the executive's job satisfaction or personal and role characteristics. Second, the preponderance of larger firms is a double-edged sword. On one hand, it increases the diversity of KM activities, and therefore the variance in the variables of interest. On the other hand, it limits the generalizability of the results. In addition, an argument can certainly be made that larger organizations are not the most innovative sources of KM activity. Finally, "true" confirmation of theoretical models is best obtained through model reestimation on an independent or holdout sample. Due to the complexity of the model, and the single sample, model reestimation was not attempted. Therefore, while the findings seem strong in terms of content and construct validity, the results of this study need further confirmation.

Implications and Future Research

IN THIS PAPER, WE HAVE FOCUSED ON THE DISCUSSION AND ANALYSIS of knowledge management to core capabilities that are needed to facilitate its success. We believe this to be a very important distinction because many organizations tend to launch programs of knowledge management without due consideration of the firm's capabilities to guarantee any measure of success [31, 73]. Through analysis of theory and empirical testing, this research strongly supports the notion that firms may possess a predisposition for successful knowledge management through the development of key capabilities. Our theory and analysis are based on two broad frameworks—social capital's role in creating intellectual capital [83] and knowledge integration's role in creating knowledge synthesis [55, 73]. From the perspective of social capital, firms create and disseminate knowledge through networks of relationships and norms. Our results imply that technology, structure, and culture form a definitional basis for the theoretical framework of social capital. As implied by the theory of social capital, these dimensions are an additive phenomenon of a larger infrastructure capability that positively impacts key aspects of organizational effectiveness. Our results also imply that process capabilities of acquisition, conversion, application, and protection form an operational perspective for the framework of knowledge combination and exchange that underlies the theory of knowledge integration. These dimensions also form an additive construct of process capability that is positively related to organizational effectiveness. Together, these results suggest that theories of knowledge capabilities provide a rich resource for developing empirically based studies and that capabilities can provide a useful benchmark for managing knowledge management within the firm. In the sections that follow, we more fully develop these important implications.

Capabilities: Implications for Research

Similar to many emerging concepts in the field of management and technology, the constructs and theory surrounding knowledge in terms of its content, use, and role within the organization are complex. Knowledge spans many levels of analysis. Researchers may analyze knowledge for insights into its content (a domain perspective), insights into its use and impact on individuals (a decision-making perspective), insights into its creation, memory, and use within a firm (an organizational perspective), or for insights into its exchange between individuals and organizations (a market perspective). This analysis has approached knowledge management from the perspective of the organization. Working within this perspective, the study has demonstrated the utility of a capabilities framework for operationalizing salient aspects of key variables. This perspective follows a resource-based view of the firm that recognizes the value-creation potential of any organization as a sum of its collective capabilities in terms of capital, knowledge, and capabilities. A direct implication for future research is that this perspective offers extremely useful insights not only in terms of theory, but also in terms of operationalizing and empirically testing key relationships.

The results of the analysis suggest that organizational capabilities are complex not only in definition, but also in operationalization. For infrastructure and process capabilities, a second order factor structure provides the best empirical model for capturing the variances among the collected measures. These results are likely to be consistent for other constructs of capability, management, and success within the realm of knowledge management or similar forms of organizational change [47, 50, 55]. Under-operationalization of variables associated with complex phenomena is always a danger within the context of research. A useful approach in such contexts may be to define key dimensions or themes that either reflect or combine to form larger constructs. In the present context, theory dictated such an approach, and care was taken to operationalize key dimensions through multiple rounds of item purification. Such approaches seem to be the norm rather than the exception for studies within this context. The item measures developed in this research exhibit good qualities of reliability and validity and should provide a useful tool for further inquiry into the capability-perspective of knowledge management. The clustering of firms based on capabilities, examination of discriminant functions based on context or environmental variables, or the evolution of capabilities over time can provide useful insight into the dynamics of the knowledge resource and its contribution to performance. The establishment of these constructs and associated item measures imply that such studies can and should be launched by the community of research.

Perhaps the most interesting implication of these results lie in the form of structural model fitted to the observed data. In this study, we approach model development from the perspective of formative effects. The results imply that knowledge capabilities are additive in nature. Infrastructure capability is a sum of technological capability, structural capability, and cultural capability. Likewise, process capabilities are an additive effect of acquisition capability, conversion capability, application capability,

and protection capability. This is an important distinction because many forms of second order factor models are reflective in nature. In such an instance, the first order dimensions are reflections, rather than additive effects of the second order factor. For researchers assessing the presence or impact of capabilities, these results imply that such measurement should consider magnitude as well as existence. In other words, aspects of capabilities may exist but not be sufficient in amount to completely define a complete capability. For example, a firm may exhibit some evidence of technological, structural, and cultural capability without exhibiting the larger construct of infrastructure capability. Within the formative perspective of second-order factor modeling, both magnitude and existence of capabilities are important in assessing the knowledge resource of the organization. A potentially useful area of future research is to utilize this perspective and the definitional context for establishing empirical thresholds of capability across firms, industries, and other consortia. In addition, understanding the sequence of development and underlying facets of capabilities will provide a road map for other organizations planning to undertake knowledge management efforts. In absence of such research, managers must use their judgment to sequentially build these capabilities.

Capabilities: Implications for Practice

For many managers, programs of change can be complex and frustrating. In many situations, the best intentions, along with copious amounts of human and financial resources, are devoted to creating a knowledge-based organization with little or no result. In these situations, key management within the firm may doubt the viability of knowledge as a corporate resource and slip back into "tried and true" patterns of gathering, applying, and disseminating sources of knowledge. Although the results of this research cannot address all potential obstacles that managers may face in their quest to create knowledge-based organizations, it does imply that certain firms may be predisposed for successful transformation. Specifically, firms that exhibit expertise along dimensions of infrastructure and process elements will tend to be conducive to adopting knowledge-based capabilities that are key for organizational success. In the absence of these capabilities, a program of transformation through knowledge management may be doomed before it begins. Clearly, the results of this analysis suggest that managers must first assess the underlying knowledge capability of the firm before setting milestones and expectations for the knowledge management effort.

The developed measures can also provide a useful benchmark for determining the disposition of the firm to leverage existing knowledge. As implied in the results, rather than focusing the initial effort of the knowledge management effort entirely on codifying and classifying knowledge or entirely on creating an environment for knowledge sharing, a more successful approach may be to invest in change efforts along both dimensions. This seems particularly true when the results are reconciled with aspects of organizational performance. As demonstrated in this study, both infrastructure and process capabilities predict performance. Therefore, managers should be careful not to optimize one aspect of the knowledge management effort. To do so may suboptimize

the entire effort. As noted by Davenport et al. [31], this tendency to optimize one aspect of knowledge management can cause these projects to produce detrimental effects in customer service and innovation. In essence, a singular focus on process capabilities through reengineering and technology can rob the firm of rich knowledge resources. The firm attempts to over codify tacit knowledge and, in doing so, destroys or alters robust sources of knowledge. This can result in products and services that lose their market appeal and premium pricing because customers view them as a commodity. Some observers note this effect within the world of consulting. As noted by Hansen et al. [52], some consulting organizations have treated their offerings as commodities through overuse of technology to capture and disseminate knowledge. Reconciled with the results of this research, such firms likely suffer from an overemphasis on process capabilities. Likewise, firms may also overemphasize infrastructure capability, thereby losing efficiencies in the capture and transfer of knowledge.

Clearly, managers seeking to establish effective programs of knowledge management must balance both the content of organizational knowledge (tacit and explicit) and capabilities to leverage knowledge (infrastructure and process). As illustrated in Figure 6, the outcomes of alignment in capability and content are key to realize the full benefits of knowledge management without suffering the negative consequences of imbalance between content and capability. Also, the firm must realize that knowledge management represents a collection of initiatives rather than a single project. As illustrated, application of process capability to explicit knowledge is codification of knowledge. In essence, these projects attempt to apply a high tech approach for capturing and storing sources of knowledge. Application of infrastructure capability to explicit knowledge is an integration initiative. Here, the goal is to combine and synthesize knowledge constructs for the development of new knowledge objects. Clearly, managers must understand that codification or integration initiatives applied to tacit knowledge can yield less than desirable results. Alignment of capability and content are crucial elements for the success of a knowledge management initiative. Process capabilities applied to tacit knowledge result in mining for elements of knowledge that can be shared and for process mechanisms that can provide context for captured forms of knowledge. This is a "high tech" and "high touch" initiative that seeks to leverage the efficiency aspect of process capability, yet preserve the richness of the tacit knowledge content. Finally, infrastructure capability applied to tacit knowledge results in growth of new knowledge through sharing and exchange mechanisms. This "high touch" approach seeks to develop new models of organizational governance to enhance knowledge creation. Importantly, it is possible for organizations to launch growth and mining based knowledge management initiatives targeted for explicit knowledge content. The results of this misalignment can be cost overruns, lack of access to codifiable knowledge, and unneeded bureaucracy.

Importantly, the organization should launch and maintain initiatives within each grid of Figure 6. The knowledge portfolio should be reconciled with competitive conditions and not be too dominant towards any single perspective. The firm should strive to balance the efficiencies of process capabilities with the knowledge creation potential of infrastructure capabilities. Overdominance in a perspective can rob the

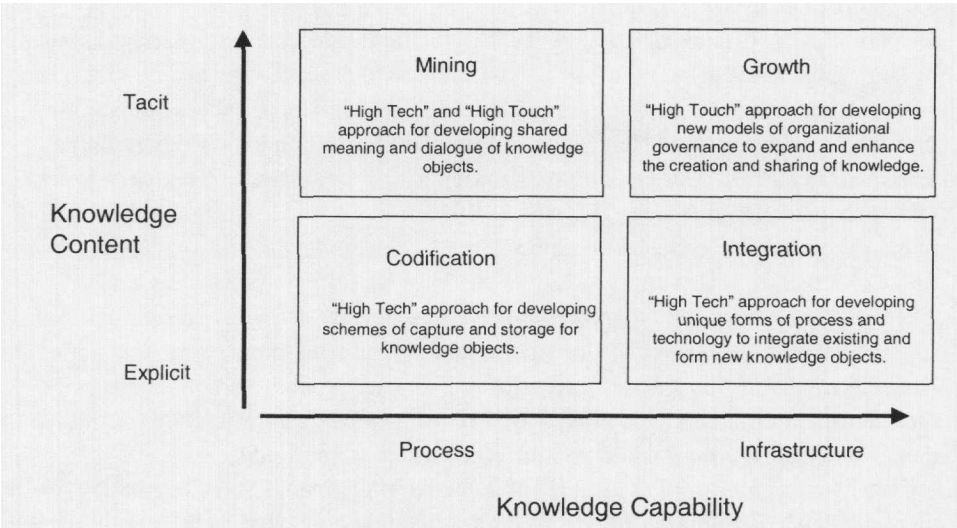

Figure 6. A Portfolio of Knowledge Opportunity

tacit knowledge or cost the firm efficiencies in knowledge dissemination. This research provides a useful perspective for managers seeking to strike this critical balance.

From the previous sections, it is clear that the research presented in this paper has established a useful starting point and raised several new questions that will require further investigation and analysis. New research will be needed to understand specific strategies and organizational programs for sustaining structures that facilitate knowledge management and lead to an increase in the effectiveness of organizations. The two salient capabilities established through this research should help managers and researchers benchmark knowledge management efforts against best-in-class and also facilitate the identification of trajectories of knowledge management initiatives with respect to type and outcome. Such studies will be useful in understanding and guiding the transformation of organizations to entities that create, share, and learn from information, experience, and insight.

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