An investigation of factors that influence the management of knowledge in organizations

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Abstract

Modern organizations are increasingly seen as knowledge-based enterprises in which proactive knowledge management is important for competitiveness. This paper introduces a descriptive framework for understanding factors that influence the success of knowledge management (KM) initiatives in an organization. It identifies three main classes of influencing factors (managerial, resource, and environmental) and characterizes the individual factors in each class. A Delphi process was used to develop and assess the framework. The Delphi panel was comprised of 31 recognized researchers and practitioners in the KM field. The resultant framework can be used by researchers for KM issue and hypothesis generation, by practitioners for benchmarking KM practices, and by educators for helping organize the study of KM. © 2000 Elsevier Science B.V. All rights reserved.

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1. Introduction

There is growing recognition in the business community about the importance of knowledge as a critical resource for organizations (Holsapple and Whinston, 1987; Paradice and Courtney, 1989; Prahalad and Hamel, 1990; Nonaka, 1991; Drucker, 1993; Gartner, 1998). Traditionally, this resource has not been treated with the degree of systematic, deliberate, or explicit effort devoted to managing human, material, and financial resources. But in the 21st century, "… the firm that leaves knowledge to its own devices puts itself in

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severe jeopardy" (Ernst and Young, 1997b). Some practitioners and researchers believe that knowledge resources matter more than the conventionally tended resources (material, labor, capital), and "must be managed explicitly, not left to fend for itself" (Stewart, 1998). Already, more than 40% of Fortune 500 companies have chief knowledge officers addressing this concern (Roberts, 1996). Explicit, deliberate efforts at managing knowledge in organizations can benefit from an understanding of the factors, including managerial, financial, and environmental, that influence the success of knowledge management initiatives. Here, we report on a Delphi study performed to explore the factors that influence the success of KM. An international panel comprised of KM academicians and practitioners contributed to the iterative development and appraisal of a descriptive framework identifying factors that influence the management of knowledge in an organization.

This paper represents a substantial advance over the three-fold framework described in an earlier paper (Holsapple and Joshi, 2000). Derived from various literature sources, the influence component of the three-fold framework in Holsapple and Joshi (2000) served as a starting point for the Delphi study reported here. The Delphi study uncovered oversights in this early characterization of KM influences, introduced new elements, eliminated some elements, and refined elements based on panelist comments. Aside from framework improvements, other unique contributions of this paper include a positioning of influences with respect to the bigger picture of KM episodes, a report/analysis of qualitative/ quantitative assessments of the framework, and a discussion of several ways for researchers and practitioners to apply the framework.

By delineating factors that influence the management of knowledge in an organization, the Delphi study lays a foundation for systematic development and evaluation of technologies intended to aid a chief knowledge officer's (CKO) efforts. This foundation can also stimulate the formulation of issues and hypotheses for investigation by KM researchers. For practitioners, it furnishes a check-list of considerations to keep in mind when designing or evaluating an organization's practices. Prescriptions for how to successfully accomplish KM should be cognizant of the influence factors identified in the Delphi study.

We begin with background discussion about the management of knowledge, followed by a brief review of influences on the management of knowledge gleaned from the literature. Collectively, these contributed to the formation of an initial framework that was the starting point for the Delphi study. Next, the framework of KM influences resulting from the study is presented. This framework description is a synopsis of what was sent to panelists for critique and evaluation in the final Delphi round. The methodology for producing this framework is then described, including a profile of the panelists who participated in the study. An analysis of panelists' qualitative and quantitative responses is provided. Discussions of framework applications and limitations are also furnished.

2. The management of knowledge in organizations

An organization's knowledge workers use their knowledge handling skills, plus the knowledge at their disposal, in performing an assortment of knowledge activities. Such activities can be examined at various levels of analysis and characterized in various ways. Although it is outside this paper's scope to examine these variations, a brief characterization
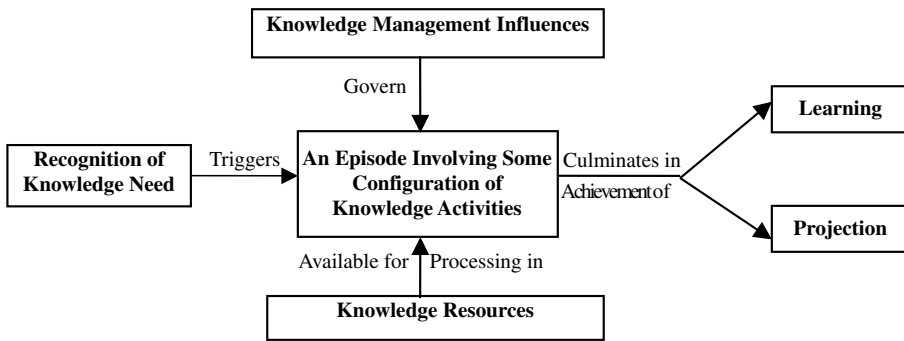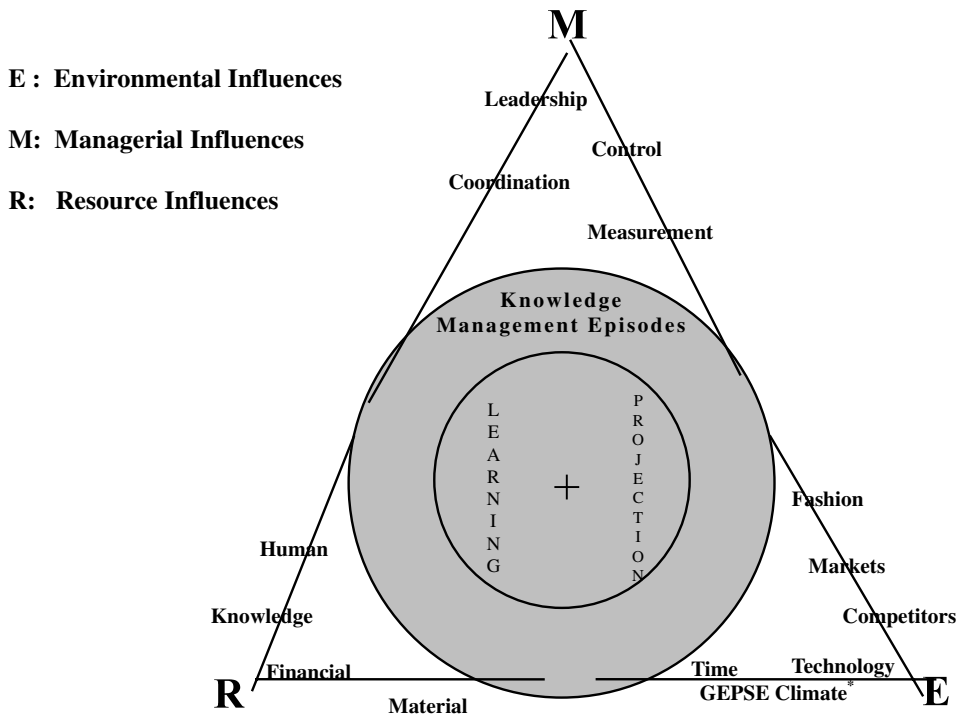
Fig. 1. Architecture of a KM episode.

of a generic set of knowledge activities serves to illustrate the idea. Based on a synthesis of activities identified in the KM literature, the following set has been advanced: acquiring knowledge (from sources external to the organization), selecting knowledge (from the organization's own resources), generating knowledge (by deriving it or discovering it), internalizing knowledge (through storage and/or distribution within the organization), and externalizing knowledge (either explicitly or implicitly in the organization's outputs) (Holsapple and Joshi, 2000).

A particular instance of a knowledge activity in an organization can be carried out by a human-based processor (e.g. an individual knowledge worker, a group), a computer-based processor (e.g. an intelligent agent), or a hybrid. Occurrences of specific processors performing specific activities are connected by knowledge flows. An operational objective of KM is to ensure that the right knowledge is available to the right processors, in the right representations and at the right times, for performing their knowledge activities (and to accomplish this for the right cost). The pursuit of this objective yields a panorama, unfolding over time, of specific instances of knowledge activities with their connecting knowledge flows. These specific instances of knowledge activities and their associated knowledge flows are termed knowledge management episodes (KME). Examples of KM episodes include making a decision, solving a problem, conducting an experiment, and performing a scenario analysis.

As illustrated in Fig. 1, each knowledge management episode is triggered by a knowledge need and culminates when that need is satisfied (or the effort is abandoned). A KME involves the execution (by humans and/or computers) of some configuration of knowledge activities operating on available knowledge resources to develop the needed knowledge. KM within and across episodes is both facilitated and constrained by various factors. At a micro-level, the factors influencing KM affect how knowledge activities are configured within an episode: which processors perform them, how well they are performed, which knowledge they operate on, and the sequence in which they are performed. At a macro-level, they affect the patterns of episodes that unfold in the management of knowledge.

By satisfying knowledge needs, KMEs result in learning and projection. That is, KM achieves direct returns along two dimensions of organizational performance: learning and projection. Together, learning and projecting are the basis of an organization's

E : Environmental Influences

M: Managerial Influences

R: Resource Influences

M

Leadership

Control

Coordination

Measurement

Knowledge Management Episodes

L E A R N I N G

P R O J E C T I O N

+

Fashion

Human

Markets

Knowledge

Competitors

Financial   Time   Technology

R   Material   GEPSE Climate*   **E**

* GEPSE Climate: Govt., Economic, Political, Social, and Educational Climate

Fig. 2. Influences on the management of knowledge.

innovations. The management of knowledge is inseparable from "the innovation process — defined as bringing ideas to market" (Amidon,1997). Indeed, in a top-line finding of a recent survey of Ernst and Young (1997a), executives see innovation as the greatest payoff from knowledge management, even though KM efforts have so far concentrated on achieving productivity gains. It is important to appreciate how organizations do, can, or should perform knowledge management as they endeavor to innovate, learn, and project. Such an appreciation can benefit from a framework that characterizes major influences on KM, which govern patterns of knowledge activities and the nature of knowledge resources on which they operate.

3. Factors that influence KM

In reviewing the literature, one encounters a very broad range of factors that possibly influence the success of KM initiatives (Holsapple and Joshi, 1999). These include: culture (Leonard-Barton, 1995; Arthur Andersen and APQC, 1996; Szulanski, 1996; van der Spek and Spijkervet, 1997), leadership (Arthur Andersen and APQC, 1996), technology (Arthur Andersen and APQC, 1996; van der Spek and Spijkervet, 1997), organizational

adjustments (Szulanski, 1996; van der Spek and Spijkervet, 1997), evaluation of knowledge management activities and/or knowledge resources (Wiig, 1993; Anderson and APQC, 1996; van der Spek and Spijkervet, 1997), governing/administering knowledge activities and/or knowledge resources (Wiig, 1993; Leonard-Barton, 1995; Szulanski, 1996; van der Spek and Spijkervet, 1997), employee motivation (Szulanski, 1996; van der Spek and Spijkervet, 1997), and external factors (van der Spek and Spijkervet, 1997).

As a starting point for the Delphi study, the various factors were synthesized into a single KM framework. This initial framework organized the factors into three categories: managerial influences, resource influences, and environmental influences (Holsapple and Joshi, 2000). Throughout the Delphi process, this basic organization remained intact. However, the process did introduce new factors into the managerial and environmental categories, as well as refining initial characterizations of the influence factors. We now describe the resultant framework of KM influences. This description is a synopsis of what Delphi panelists received for final critique and evaluation. Their reactions are described later in the paper.

The framework illustrated in Fig. 2 identifies three major kinds of forces that conspire to influence the knowledge management episodes that ultimately unfold in an organization. It identifies the main factors involved in each influence category, and the inner core represents essential results of KM episodes (i.e. projection and learning). Relating this to Fig. 1, it identifies what specific factors influence performance of knowledge activities acting on knowledge resources within and across KM episodes. In considering the three classes of KM influences, we focus on managerial influences as they are most apt to be under the control of persons responsible for KM initiatives.

3.1. Managerial influences

Managerial influences emanate from organizational participants responsible for administering the management of knowledge. The framework partitions these influences into four main factors: exhibiting leadership in the management of knowledge, coordinating the management of knowledge, controlling the management of knowledge, and measuring the management of knowledge. The notions of leadership, coordination, control, and measurement are not unique to KM. However, their impacts on KM are not widely known and their execution with respect to KM may require special techniques.

3.2. Coordination

Knowledge development (e.g. to propel innovation) is a primary driver of KM. It can be left to serendipity or be planned and structured. The planned approach requires coordination within and across KMEs, involving the determination of what knowledge activities to perform in what sequence, which participants will perform them, and what knowledge resources will be operated on by each.

Coordination refers to managing dependencies among activities (Malone and Crowston, 1994). It aims to harmonize activities in an organization by ensuring that proper resources are brought to bear at appropriate times and that they adequately relate to each other as activities unfold (Holsapple and Whinston, 1996). In the management of knowledge, dependencies that need to be managed include those among knowledge resources (e.g.

alignment of participants' knowledge with strategy, diffusion of knowledge among participants), those among knowledge activities (e.g. which activities are undertaken under varying circumstances), those between knowledge resources and other resources (e.g. what financial resources are to be allocated for knowledge activities), and those between resources and knowledge activities (e.g. use of knowledge activities to improve knowledge resources, knowledge resources among competing knowledge activities). The management of knowledge in an organization is strongly influenced by how such dependencies are managed.

Coordination involves not only managing dependencies, but marshaling sufficient skills for executing various activities, arrangement of those activities in time (within and across KM episodes), and integrating knowledge processing with an organization's operations (e.g. What knowledge activities are involved and necessary for managing inventory operations?). Coordination approaches suggested and used to manage dependencies in a knowledge-based organization include linking reward structures to knowledge sharing, establishing communications for knowledge sharing, and constructing programs to encourage learning (Marshall et al., 1996; Crowley, 1997; Rifkin, 1997).

3.3. Control

Control is concerned with ensuring that needed knowledge resources and processors are available in sufficient quality and quantity, subject to required security. Two critical issues here are protection of and quality of knowledge resources. Protecting knowledge resources from loss, obsolescence, unauthorized exposure, unauthorized modification, and erroneous assimilation is crucial for the effective management of knowledge. Approaches include legal protection (e.g. patents, copyrights), social protection (e.g. hiring people who can blend with the current culture and help sustain current values and norms), and technological protection (e.g. security safeguards). In establishing sufficient controls to govern the quality of knowledge used in an organization, management needs to consider two dimensions: knowledge validity and knowledge utility (Holsapple and Whinston, 1996). Validity is concerned with accuracy, consistency, and certainty; utility is concerned with clarity, meaning, relevance, and importance.

3.4. Measurement

In its most basic sense, measurement involves the valuation of knowledge resources and processors. It is also a basis for evaluation of leadership, coordination, and control; for identifying and recognizing value-adding activities and resources; for assessing and comparing the execution of knowledge activities; and for evaluating the impacts of an organization's KM (i.e. learning and projection) on bottom-line performance.

Although it is an under-implemented area (Hiebeler, 1996), measuring knowledge resources or activities and linking them to financial results is feasible (Lev, 1997; Malone, 1997; Stewart, 1997). The framework contends that KM initiatives are impacted by whether an organization attempts to measure its knowledge resources and/or performance of its knowledge activities, how it goes about measuring these, and how effective the measures are. Some organizations have already developed and applied indicators of knowledge resources of knowledge activity (e.g. Celemi (Sveiby, 1997)). Measurement

indicators need not be hard and financial, but can be soft and non-financial (Webber, 1997).

3.5. Leadership

A study conducted by Andersen and APQC revealed that one crucial reason why organizations are unable to effectively leverage knowledge is because of a "lack of commitment of top leadership to sharing organizational knowledge or there are too few role models who exhibit the desired behavior" (Hiebeler, 1996). Of the four managerial influences, leadership is primary. In alignment with the organization's purpose and strategy, it establishes enabling conditions for fruitful KM. Coordination, control, and measurement are contributors to establishing these conditions, but there is an additional aspect to fulfilling the leadership mission. This distinguishing characteristic of leadership is that of being a catalyst through such traits as inspiring, mentoring, setting examples, engendering trust and respect, instilling a cohesive and creative culture, listening, learning, teaching (e.g. through story-telling), and knowledge sharing.

The core competencies for effective leaders of knowledge-intensive organizations are being a catalyst, being a coordinator, exercising control, and being an evaluator. The KM leader creates conditions that allow participants to readily exercise and cultivate their knowledge manipulation skills, to contribute their own individual knowledge resources to the organization's pool of knowledge, and to have easy access to relevant knowledge resources. For ongoing success of KM initiatives, it is necessary to develop leaders at all levels of functionality or accountability. The execution and cultivation of leadership depends on an appreciation of knowledge resources, of knowledge activities, and of the other KM influences.

3.6. Resource influences

Financial resources put a ceiling on what can be expended on knowledge activities. Increasing the financial resources available for a knowledge activity (e.g. acquiring some needed knowledge) may affect the efficiency of that activity or the quality of its results (positively or negatively). Moreover, financial resource availability may affect the execution of leadership, coordination, control, and measurement. Knowledge manipulation skills of an organization's participants both constrain and facilitate KM. These skills are the essential mechanism for performing the knowledge activities that make up KM episodes. In the case of human participants, these skills are human resources. In case of computer-based participants, these skills are material resources. Human resources also influence KM by enabling or restricting the managerial influences.

Knowledge resources strongly influence KM in an organization. As the raw materials for knowledge activities, knowledge resources available in an organization necessarily influence its KM and the resultant learning, projection, and innovation. Some knowledge resources also affect KM by serving as the basis for coordination, control, measurement, and leadership. Major types of organizational knowledge resources include participants' knowledge (both human and computer-based), artifacts, culture, and strategy. Each can be examined along various attribute dimensions (e.g. tacit vs. explicit, descriptive vs. procedural vs. reasoning) and studied from the standpoint of its influence on KM.

3.7. Environmental influences

Managerial and resource influences on KM are internal to an organization. Factors external to an organization also affect its KM. The environment influences what knowledge resources should or can be acquired in the course of KM. It influences what knowledge manipulation skills (e.g. human or technological) are available. As Fig. 2 illustrates, environmental influences on KM are competition, fashion, markets, technology, time, and the GEPSE (governmental, economic, political, social, and educational) climate. Examples of these are many and varied. Organizations have little control over environmental influences. As such, they pose constraints on an organization's KM. However, the confluence of environmental influences can also present opportunities for improving KM.

While many possible KM influences have been proposed by various authors, the framework outlined in Fig. 2 is the result of a systematic research effort to identify and characterize the influencing factors in a comprehensive, unified, organized way. This was a collaborative effort involving a panel of KM practitioners and academicians. Their iterative critiques expanded and refined an initial framework synthesized from the literature to yield the one just described. We now describe this process, the panelists, and their evaluation of the final framework which serves as a starting point for investigating the importance of its factors to practitioners.

4. Methodology

A Delphi approach was used to develop the final framework from an initial framework, synthesized from the literature. Criteria chosen for framework critique and evaluation in this process were comprehensiveness, correctness, conciseness, and clarity. These four criteria are similar to criteria used for theory evaluation. Comprehensiveness is similar to scope criteria, conciseness relates to parsimony, clarity and correctness relate to construct specification (Kerlinger, 1986; Bacharach, 1989). Each criterion played a role in guiding the development of the framework and assessing the degree of its success.

The focus is on KM in business organizations, rather than in other social systems or for individuals. The objective of this research is to describe KM. No effort is made to prescribe how knowledge management should be done. However, a descriptive framework's elements may serve as building blocks in future research efforts to build and study prescriptive frameworks. The framework development was executed in a top-down fashion, progressively adding levels of greater detail. This cannot, of course, continue indefinitely; so, there is a detail boundary. An objective was to have at least two levels of detail. Relaxing the framework's detail boundaries is a topic for future research.

As it was developed, the initial and subsequent frameworks were evaluated against predefined standards. Drawn from the literature, these standards were influence elements from (1) a set of KM frameworks in the literature (Holsapple and Joshi, 1999), (2) a collection of "best practices" identified by KM practitioners (Leonard-Barton, 1995; Andersen and APQC, 1996; Ernst and Young, 1997a; Rifkin, 1997; Sveiby, 1997), (3) a set of issues raised by KM researchers and practitioners (Wiig, 1993; Ernst and Young,

1997b; Ruggles, 1997), (4) traits identified for knowledge-based organizations (Holsapple and Whinston, 1987; Nonaka, 1991; Hedlund, 1994; Leonard-Barton, 1995), and (5) a set of cases and surveys focusing on knowledge management in organizations (Leonard-Barton, 1995; Petrash, 1996; Rifkin, 1997; Stewart, 1997; Sveiby, 1997). Framework development in each Delphi round was guided by an effort to include influence factors suggested in these standards and by panelists, while meeting the chosen criteria within the research boundaries.

In the Delphi method, a panel of experts in some subject area is selected (Lindstone and Turoff, 1975). Each receives a statement of a problem in the subject area and a questionnaire with which his or her independent views regarding the problem are elicited. The panelists' responses are organized and analyzed by a moderator to produce a summary of their views. This summary, along with a questionnaire, is sent to each panelist. After reviewing and considering the summary responses, the panelists again independently respond to the questionnaire. When one panelist's view is very different from those of others, he or she is asked to provide an explanation that the moderator sends to all the participants. This process is repeated until a consensus on the problem is reached. If no consensus emerges within some prescribed time limit, then the moderator pools questionnaire responses and the most preferred alternative becomes the solution.

The Delphi methodology employed here follows a similar approach used by Bacon and Fitzgerald (1996) in devising an information technology framework. As in their case, our framework development involved two rounds, at which point all suggestions were either outside the boundaries or of insufficient significance to warrant a third round. The Delphi methodology serves dual purposes. Primarily, it is a means for gathering KM researchers' and practitioners' perspectives and critiques of the framework as a basis for revision and improvement. Secondarily, it gives a way to obtain independent assessments of the framework with respect to the criteria of correctness, clarity, conciseness, and completeness. Panelists were also asked for their views on the framework's benefits (if any). Fulfilling these purposes depended on contributions from a diverse panel of persons experienced in the KM field.

4.1. Panel profile

Because academic and commercial perspectives on KM can differ (Demarest, 1996), care was taken to include both researchers and practitioners in the study. By including both thinkers and doers in the field, the prospects for achieving completeness, correctness, and clarity are likely enhanced. A total of 122 candidates were identified for participation on the KM panel. In late 1996, a list was complied containing contributors to the KM literature, presenters at KM conferences, and faculty designating KM as a primary area in which they conduct research. Those for whom a mailing address could be readily determined became the 122 candidates invited to participate on the panel (by comparison, the Bacon and Fitzgerald (1996) study targeted 113 candidates). The result was a diverse set of candidates, each having an active interest and track record in KM practice and/or research. Of the 122 candidates invited to participate, 31 (25.4%) chose to do so (see acknowledgement). We regard this as a strong rate, given the time commitment required

Table 1
Primary perspectives for viewing KM

Primary perspectives	Frequency (%) ($N = 31$)
Information systems	22
Management	13
Strategic management	13
Computer science	9
Public administration	9
Philosophy	6
Cognitive sciences/artificial intelligence	3
Finance	3
Human centered design	3
Communication	3
Economics	3
Management science	3
Organizational behavior	3
Sociology	3
Innovation strategy	3
Value creation	3

of each panelist (in each round: reading a 20+ page document, analyzing it with respect to the four criteria, preparing a critique with suggestions).

The panelists' regions of principal work activity cover five continents, with a majority being active in North America. The panelists reported approaching the field of KM from a variety of perspectives as indicated in Table 1. There was an even balance in the number of researchers vs. practitioners. As Table 2 shows, there were 43% in each category, with the remainder considering themselves to be in both categories. Among those who completed the second round, there were 47% practitioners, 41% researchers, and the remainder in both categories. Among the practitioners, half identified themselves as consultants, while the other half had job titles involving CEO or CKO roles in organizations (see Table 3). In all, it is fair to say that the panelists represent a diverse array of backgrounds and viewpoints.

Panelist demographics are also indicative of participants' experience, interest, and involvement in the KM field. Experience in the field ranged from 1 to 15 years, with 60% having at least 5 years of KM involvement. All panelists have been active as contributors to the KM field (e.g. writing articles, manuals, reports, and books; giving

Table 2
Practitioners versus researcher balance

Practitioners/research	Frequency (%) (round one) $N = 31$	Frequency (%) (round two) $N = 17$
Practitioners	43	47
Research	43	41
Both	13	12

Table 3
Practitioners' job titles

Position	Frequency (%) ($N = 31$)
Consultant	50
CEO	17
Report to CKO/CLO	17
CKO	11
Information asset management director	6

presentations at KM-related conferences). Over 85% have done at least one KM conference presentation, with 50% having done at least 10.

4.2. First round procedure (completed in 1997)

A questionnaire for the panelists was designed, pilot tested, and refined (see Appendix A). It provided for structured elicitation of critiques in terms of the evaluation criteria (comprehensiveness, correctness, clarity, and conciseness). In addition to written critiques, panelists were asked to provide numeric evaluations in terms of Likert-scale items. A seven-point scale was used to allow for considerable discretion in making refined judgements about the degree of success in meeting each criteria (from "not at all success-ful" to "extremely successful"). If dissatisfaction with some aspect of the framework was expressed, the questionnaire probed for an elaboration of why and asked for suggestions of ways to make improvements.

The following items were mailed in the first round: a letter of invitation to participate, a self-addressed return postcard, the questionnaire, a paper describing the initial framework, and a self-addressed postpaid return envelope. Each candidate who received this mailing was asked to return the postcard indicating his or her willingness or unwillingness to participate on the panel. Those who chose to participate were asked to return their questionnaire responses within 6 weeks. Two weeks after that deadline, reminder letters were mailed to those who had not indicated unwillingness to participate, but who had yet to respond. In all, candidates were given about 12 weeks to respond.

Three database tables were created to record responses to demographic questions, scaled questions, and open-ended questions. The database tables were used in creating an analysis of responses. This document contained responses grouped by corresponding questionnaire items. For each questionnaire item, all comments and critiques were consid-ered, reviewed, and evaluated as a basis for organizing them. Responses for an item were first categorized into two groups: (1) to be considered in framework revision, and (2) beyond the research boundaries. Comments in the first group were further classified into three categories: (1) concerns that were repeated and/or seemed to be of major importance; (2) concerns that were not so frequent and/or as major, and; (3) concerns that occurred infrequently and/or seemed less critical.

Three criteria were used for classifying comments into the above categories. First, the strength and support of the argument/concern provided by the respondents (e.g. sufficient

justification for extensions, deletions, and/or additions, recommendations on how to incorporate their comments/concerns). Second, the respondents were also asked to indicate whether their comments were incidental, minor, substantial, or crucial; this ranking assisted us in classifying the comments. Lastly, the frequency of a concern/comment was also used to classify the comments. The response analysis document also provided graphical relative frequency distributions for Likert-scale items.

4.3. Second round procedure (completed in 1998)

In the second round, the initial framework was modified, refined, and extended based on the ideas that were stimulated by panelist responses. This effort was organized according to the response analysis document described above. The greatest effort was expended in dealing with responses that were frequent and/or appeared to be major; moderate efforts went into addressing concerns that were infrequent and/or not as major; the least effort was needed for minor concerns. Framework revisions made in the second round fell into three categories: (1) fundamental, (2) additive, and (3) clarifications.

The fundamental modifications involved extensive revisions by incorporating and developing new concepts stimulated by participants' comments, detailing and further characterizing the concepts existing in the initial framework, and further justifying the framework elements. Additive changes introduced new elements suggested by panelists, describing the nature of each and its relationships with other framework elements. Clarification was needed when an element was already present in the framework, but panelist comment indicated a need to explain it more clearly or emphasize it more. This process is further illustrated in the analysis section below. The time and effort expended in creating the second round's framework was comparable to that involved in developing the initial framework.

Panelists from the first round were invited to participate in the second round. Each received a mailing comprised of an invitation letter, a paper describing the revised framework, the responses analysis document, a questionnaire, and a self-addressed, postage-paid envelope. The second round questionnaire was very similar to that of the first round, except for the elimination of demographic questions.

Panelists were asked to reply within 6 weeks. After 8 weeks, those who had not responded were prompted to do so. In all, 12 weeks were allocated to receive responses, at which point there were 17 (55% of first-round panelists). Second-round responses were analyzed in the same manner as first-round responses. The resultant response analysis document showed substantial agreement with the round-two framework in terms of both qualitative and quantitative assessments. These assessments are described in the next section.

5. Analysis of Delphi responses

Second-round responses suggesting revision of the framework fell mainly into three categories: presentational changes, elaboration requests, and desire for prescriptions about KM conduct. The former includes clarification, explanation, and terminology changes to the framework description presented in this paper. The latter two categories mainly

involve extending the scope of this research, pushing beyond the descriptive, business, and detail boundaries now evident in the framework. Collectively, across the range of responses, no major or crippling reservations about the second-round framework were detected within the research boundaries. Here, we summarize second-round concerns expressed about the framework and comment on each.

1. More detail was requested by multiple respondents (but fewer than half). The requests for detail were varied. Some suggested that more examples be used, some asked for elaboration on benefits or underpinnings, and others requested further decomposition of existing levels. The most notable and repeated suggestion was that environment influences should be characterized in greater depth, beyond the two levels currently present. This is the least detailed part of the influence component. Recommendations for more detailed coverage of technology and culture as KM influences are also notable. *Comment:* The intent was to emphasize development of the managerial influences, as these tend to be the most controllable. Nevertheless, these detail suggestions are important to consider in any effort at further developing the framework. Building on what has been introduced here, all three classes of KM influences could be explored at more detailed levels.

2. Individual respondents perceived the following to be missing: (a) management influences should include quality, communication, education, deployment, organizational planning, strategy and objective setting, training, communication, internal marketing, reward factors, and organizational structure factors; (b) resource influences should include IT and customers; (c) environment influences should include products, services, customers, and suppliers; (d) the role of individual learning, knowledge results in the competency to perform, organizational culture, knowledge infrastructure, capability and competency, ability to deal with change, global cultures, technology push, competition, and inter-organizational culture. *Comment:* None of these was noted by more than one panelist. Many are present in the current version of the framework (e.g. suppliers, culture, quality) and could be presented in a fashion that highlights them. Others that are not explicitly stated in the framework (e.g. individual learning, education, communication) fit as sub-concepts related to currently existing elements. They could be considered in future efforts to add greater detail to the framework.

3. One respondent sees a need to delve deeper into the dynamics of the influences (for instance, identifying relationships among influences). *Comment:* In order to explain a phenomenon, it is extremely important and useful to identify the nature of relationships among the factors involved. Aside from recognizing that there are relationships, we do not hypothesize about their nature. A future research avenue is to develop and test models of relationships among the framework's influence factors.

4. One panelist perceived negative influences to be missing; examples include resistance to "changement," power preserving instinct, and "non-sharing" attitudes. *Comment:* The generic framework considers that influences can be both facilitators and inhibitors for the management of knowledge. For instance, the framework identifies leadership and culture as influencing factors. These can have negative or positive impacts on the management of knowledge. However, the framework does not identify or hypothesize about types of leadership or kinds of culture that may be detrimental or beneficial to
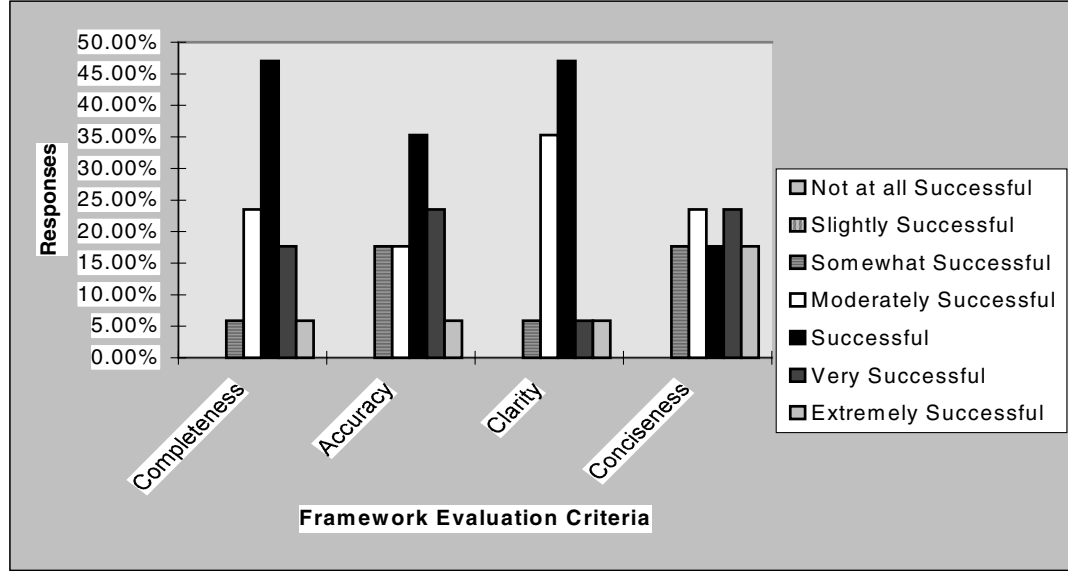
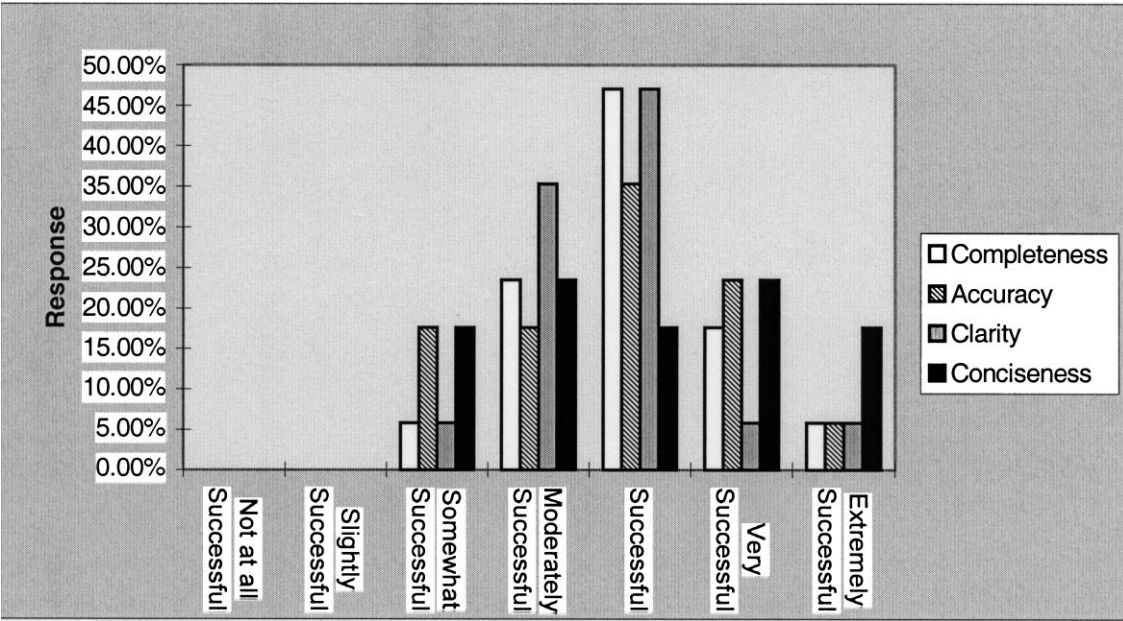Fig. 3. Responses for each of the framework's components.

Fig. 4. Responses for each of the frameworks' components.

KM. Future research identifying and classifying behaviors and events into facilitating (positive) and impeding (negative) influences would be very important for practitioners and is an interesting future research topic.

5. "Knowledge management is seen almost totally within the economic/market system; and 'management' is given a very hierarchical, instrumental and efficiency conceptualization. KM is concerned solely as something specialized corporate officers do, and all other aspects as manipulable in order to maximize output/competitiveness." This respondent suggests that it would be worthwhile to view knowledge management with respect to democratic communities striving for solidarity, mutual support, and spiritual growth by focusing on power relationships and pathologies of KM. *Comment:* As a boundary condition the generic framework focuses on business organizations. However, it may be possible to adapt the framework for describing KM phenomena in settings other than business (e.g. society, community, or national settings).

6. "Leadership section is not compelling — implementing KM is a process that needs sponsorship, understanding and process, not leadership as you define it. In my experience, instituting KM is an 'engineering' task that requires skill, perseverance and discipline — It 'gets done' in the trenches, and evangelists can just be in the way." *Comment:* Actually, the framework agrees that leadership is not simply evangelism and does indeed involve sponsorship and understanding. Leaders are not the only ones involved in the management of knowledge; the organization's participants are certainly working in the trenches of KM.

7. The coordination influence was generally well received (e.g. "very nice job on the coordination factor"). However, one panelist found the coordination concept "confusing". *Comment::* Although very important to the management of knowledge, coordination is a broad concept. In light of the literature on coordination theory, it can be investigated in greater detail. Future research can strive to identify sub-elements of this managerial influence factor (e.g. allocation, planning) and mechanisms of coordination (e.g. behavioral mechanisms such as employee motivation and trust; economic mechanisms such as incentive systems; educational mechanisms such as training or mentoring; technological mechanisms such as communication systems).

8. One panelist expressed a concern that there is an overlap between measurement and control factors. *Comment:* Although it is conceivable to measure without controlling or to control without measuring, these two factors can be highly inter-related. The dynamics of their interactions can be studied along the lines indicated for point 3.

Graphical displays of participants' responses to Likert-scale items in the second round are presented in Figs. 3 and 4. A *majority* of panelists gauged the framework's completeness, accuracy, clarity and conciseness as being in the *successful to extremely successful range*. Panelists rate the framework as at least somewhat successful on all criteria. Fig. 3 shows relative frequency distributions of responses for each criterion. It shows that at least 82% of the respondents rate each criterion as at least moderately successful; 94% indicate moderate or higher success for comprehensiveness and clarity. The mode for comprehensiveness, accuracy, and clarity is at the successful level. The conciseness criterion is bi-modal with modes of moderately successful and very successful. For each criterion, at least 59% of the respondents evaluated the framework as being in the successful to

extremely successful range. Fig. 4 presents relative frequency distributions for the four criteria, showing that no panelist deemed the framework as only "slightly" or "not at all" successful for any criterion. Even with the roughly comparable assessment of conciseness across the five remaining levels, it is clear that success (above the Likert mid-point) is the most common characterization of the framework.

6. Framework applications

The framework provides a relatively comprehensive description of elements to consider in studies, investigations, and prescriptions of KM. It serves as a basis for thinking about extensions and refinements that could yield an improved and/or more detailed framework of KM influences. It furnishes a language (i.e. a system of terms and concepts) for discourse about and study of KM influences, a basis for generating varied research issues to explore, a means for identifying factors with which KM practitioners should deal (i.e. a checklist of considerations), and a frame of reference for benchmarking KM practices as they relate to influences. Here, we briefly highlight some of these framework applications.

Planning for KM initiatives in an organization needs to be grounded on an ontology that identifies the elements of interest for conducting knowledge management. Fig. 1 suggests that an organization's KM ontology might include elements pertaining to knowledge management episodes, knowledge resources, knowledge activities, and influences on knowledge management. More specifically, the KM influence framework can be applied to develop a checklist of influence considerations to address in planning a KM initiative. Table 4 presents such a checklist for the managerial influences. The factors listed for each of these influences are extracted from the final framework description evaluated by panelists. The rightmost columns in the checklist are meant to indicate that each factor can be addressed within and/or across KMEs, depending on the scope of the initiative.

Each of the factors identified in Table 4 is not only a consideration for KM practitioners, but it is also a question of potential interest for KM researchers. The subjects suggested in these questions may be investigated individually, in relation to each other, or in relation to the constraints of resource and environmental influences. The framework can also be applied to help identify KM-related issues by juxtaposing influences with other concepts such as ethics, outsourcing, sharing, and competitiveness. Each leads to a host of specific issues, examples of which are shown in Table 5. Such a matrix can be further developed by selecting one concept and examining it in greater depth with respect to more detailed framework elements. This is illustrated in Table 6, by extending and elaborating on knowledge sharing issues using the KM influence components. Another example is the knowledge chain model, which develops the connection between managerial influences and competitiveness (Holsapple and Singh, 2000).

Table 6 shows an example of an exploration matrix to identify and organize issues related to knowledge sharing, an often-mentioned notion in the KM literature. For each of the framework's major elements, we can consider its connection to knowledge sharing. This matrix can be used by CKOs as a guide to help ensure coverage of major factors in developing or evaluating knowledge sharing strategies and initiatives in their organizations. It can help researchers systematically identify constructs that may impact

Table 4
A CKO checklist for KM initiatives

Managerial influence	Factors to consider	Episode scope	
		Within KME	Across KMEs
Leadership	Is there top-level commitment to KM initiatives? How does it manifest? Does it align with the organization's purpose and strategy? How is KM leadership cultivated at lower levels? How are conditions created that allow processors to do their best individual and collaborative knowledge work? How is a culture appropriate to knowledge work established? Is there technological support for KM leadership? How are best KM leadership practices recognized, preserved, and applied?		
Coordination	What knowledge activities are performed? How are they organized to accommodate dependencies? Which processors perform them? What knowledge resources are used and/or changed? Is the knowledge processing self-directed, guided, or dictated? What incentive structures are in place to secure efforts? How is the knowledge processing integrated with other operations? How are best KM coordination practices recognized, preserved, and applied? Is there technological support for KM coordination?		
Control	What regulations are in place to ensure quantity, quality, and security of knowledge resources and processors?		

Table 4 (*continued*)

Managerial influence	Factors to consider	Episode scope	
		Within KME	Across KMEs
	How are knowledge resources protected from loss, obsolescence, improper exposure/modification, and erroneous assimilation? Via legal, social, technical means? What validation controls are used to ensure sufficient accuracy, consistency, and certainty of knowledge resources? What utility controls are used to ensure sufficient clarity, meaning, relevance, and importance of knowledge resources? How are best KM control practices recognized, preserved, and applied? Is there technological support for KM control?		
Measurement	How are knowledge resources valued? How are processors evaluated? In what ways are effectiveness of knowledge activities, coordination approaches, knowledge controls, and knowledge management leadership assessed? What are the impacts of an organization's KM on its competitiveness and bottom-line performance? How is effectiveness of these measurement practices gauged? How are best KM measurement practices recognized, preserved, and applied? Is there technological support for KM measurement?		

Table 5
Some sample research issues

Aspect of KM	Concepts			
	Ethics	Outsourcing	Sharing	Competitiveness
Managerial influences	What are the ethical boundaries for implementing controls?	How are coordination and control performed when a KME or knowledge activity is outsourced?	What managerial actions can promote knowledge sharing?	Are there particular approaches to KM leadership, coordination, control, and measurement that yield competitive advantages?
Resource influences	Where does ownership of an individual's knowledge (attained in the organization or outside of it) reside? With the individual and/or organization?	What resource conditions trigger a need for KM outsourcing?	How widely shared should a particular knowledge resource be?	To what degree is competitiveness based on knowledge resources versus the ability of processors to operate on them?
Environment influences	To what extent should ethical values in handling knowledge within an organization be aligned with ethical norms of the GEPSE climate?	What environment factors (e.g. time, markets, technology, competitors) lead to the outsourcing of KM efforts (as enablers or drivers)?	Are there GEPSE impediments to knowledge sharing within an organization? Can these constraints be relaxed? Should they be relaxed?	Are there technologies for performing or supporting the activities and flows that occur in an organization's KM that can make the organization more competitive? Which ones? How so?

knowledge sharing. Such a matrix can help in designing research models by identifying research variables whose relationships are to be modeled. It can stimulate the identification of unexplored propositions and hypotheses related to organizational knowledge sharing (e.g. certain kinds of coordination, technology, or infrastructure to foster greater knowledge sharing).

In summary, this paper introduces a relatively comprehensive framework on which KM influence research and practice can develop. In the absence of a comprehensive framework, a field's "progress is but a fortunate combination of circumstances, research is fumbling in the dark, and dissemination of knowledge is a cumbersome process" (Vatter, 1947). This assertion is reinforced by the remark of a panelist who commented that, "The experience I have with my clients is that until they have a coherent vision (the perspective based on an overall framework model), they cannot focus on priorities, identify how to coordinate cross-organizational efforts, or identify overall benefits."

7. Limitations

The purpose of this research is to develop a comprehensive and unified framework that identifies and characterizes KM influences. Therefore, the scope and the focus is on addressing the question — "what are the major factors that govern KM within an organization." The framework does not prescribe methodologies to conduct KM effectively within an organization, nor does it attempt to measure the causal relationships between influences and outcomes (learning and projection). However, it does offer a foundation on which such investigations can be carried out.

Although a sizable, diverse panel was assembled, there is a possibility that ideas of even more panelists may have yielded a different framework. Similarly, had all panelists completed both rounds, it is possible that some major concern could have arisen, warranting a third round with framework modifications. Table 7 shows the median and mean of Likert-scale responses on every criterion for the first-round framework. These measures are shown for the group of panelists who completed the study and for the remainder who dropped out after the first round. On every criterion, the median score for the drop-out group was at least as high as that of the completion group. In other words, those who proceeded to the second round tended to view the first-round framework as being less successful than did those who did not continue. In terms of means, the comparison is more mixed across the criteria, especially when an outlier is included.

The analysis of panelists' responses and subsequent framework modifications are subject to the authors' perceptions, interpretations, and insights about how to accommodate respondents' critiques and suggestions. Nevertheless, at the least, this framework provides a platform for organizing and discussing varying perspectives. As observed by one panelist, "Even if one disagrees, your framework provides a basis for discussions and improvements."

8. Conclusion

KM is concerned with application of knowledge manipulation skills to perform

Table 6
Examples of knowledge sharing issues suggested by the KM framework

Aspects of KM	Issues of knowledge sharing in managing knowledge
Managerial influences	*Leadership* is concerned with building a trusting environment conducive to sharing knowledge. *Coordination* is concerned with developing and integrating reward and incentive systems that encourage knowledge sharing, as well as scheduling knowledge flows. *Control* is concerned with governing the content and channels of sharing (e.g. what can and cannot be shared and with whom it can be shared), ensuring that knowledge that is shared is of adequate quality and that sharing is not counterproductive (e.g. sharing of knowledge that may sabotage new initiatives). *Measurement* can aim at assessing and evaluating the knowledge sharing process. If sharing is linked to reward systems, how can sufficient credit be given to individuals/teams for sharing? What type of knowledge sharing is entitled for reward? How can we measure what and how much is shared, and its impacts on organizational performance?
Resource influences	Human participants' personal beliefs and experiences may affect their approaches to sharing. How can computer systems be employed to facilitate sharing? An organization's cultural knowledge resource will have a major impact on creating and maintaining a knowledge sharing environment. Infrastructure may dictate the channels of communications and sharing. Artifacts (such as office facilities and libraries) may affect knowledge sharing.
Environment influences	Technology advances may affect the modes and channels of sharing. It can create means to break knowledge-sharing barriers such as geographically dispersed locations. Government regulation can inhibit knowledge sharing. Actions of a competitor (e.g. to lure away employees) can dampen knowledge sharing.

certain activities that operate on organizational knowledge resources. KM is guided, facilitated, and constrained by certain influences. This paper has identified and characterized these KM influences in a relatively comprehensive framework constructed via a Delphi methodology. The Delphi panelists' responses to the open-ended and scaled items indicate a favorable view of the framework's completeness, accuracy, clarity, and conciseness.

This study improved on an initial KM influence framework by integrating insights and perspectives drawn from participants in diverse disciplines, having diverse backgrounds, and representing diverse connections to the KM field. As one of the participants pointed out, "The only way we will be able to arrive at a 'successful' (workable, sharable) definition is via a collaborative effort that draws from many disciplines, using principles of knowledge organization that have demonstrated their effectiveness. Then we can disagree and grow effectively through resolution of disagreements." The descriptive framework introduced here is a step toward this goal.

Specifically, major new influences identified within these categories that were not included in the initial framework are the managerial influence termed control, the

environmental influences of fashion, time pressure, and technology, and the knowledge resource influences from external participants. The many refinements ranged from terminological changes to more-detailed characterizations of elements (length restrictions do not allow full inclusion of these details here).

As such, the framework can be beneficial to researchers and practitioners in the KM field. However, in order to more fully appreciate the management of knowledge in organizations, it is important to go beyond a framework of influences on KM. Characterizations of organizational knowledge resources and of knowledge activities are needed. Frameworks for these can be developed in a fashion similar to that used to create the KM influences framework. Parallel Delphi study has been initiated to accomplish this (Holsapple and Joshi, 1998).

Acknowledgements

Appendix A. Instrument

Instructions: Please read the enclosed paper before filling out this instrument. This instrument consists of open-ended, scaled, and a few demographic questions.

The rating system for the scaled questions range from a low of 1 to a high of 7. In each case, please encircle the most appropriate rating.

Table 7
Comparison of panelists who completed the study to those who did not (scale: 1 = framework not at all successful; 7 = framework extremely successful)

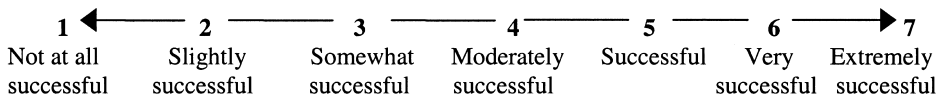| Panelist group	Measures of criteria at the end of round one							
	Completeness		Correctness		Clarity		Conciseness	
	Median	Mean	Median	Mean	Median	Mean	Median	Mean
Panelists who completed the study	4.00	4.40	4.00	4.07	4.00	4.50	4.50	4.29
Panelists who dropped out after round one (excluding an outlier[a])	5.00	4.23	5.00	4.50	5.00	4.50	5.00	4.72
Panelists who dropped out after round one (including the outlier[a])	4.50	3.95	4.75	4.15	4.50	4.15	4.50	4.35

[a] One participant who dropped out rated the round-one framework as a "1" for every criterion and offered no responses to open-ended questions for any criteria; none of the other participants gave the framework a rating of "1" for any of the criteria.

If there is insufficient space for responding to an open-ended question, feel free to continue your response on a separate sheet of paper and attach it to the instrument.

Specific responses of each participant will be treated anonymously. They will not be attributed to that participant in any presentations of the study's results. However, each participant's name and affiliation will be included in a list of contributors unless he/she desires to be excluded.
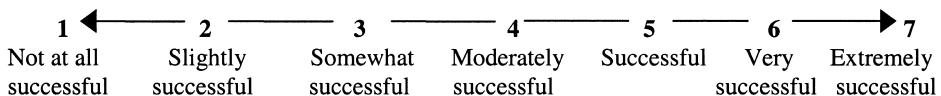
If you prefer NOT to be acknowledged in the contributors list, then please initial the following statement; otherwise leave it blank and you will be included in the list: I prefer NOT to be acknowledged as a participant —.

1. How successful is this framework in *identifying* all of the major kinds of influences on the management of knowledge?

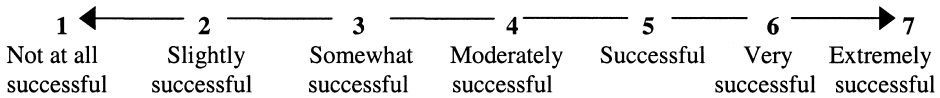| 1	2	3	4	5	6	7
Not at all successful	Slightly successful	Somewhat successful	Moderately successful	Successful	Very successful	Extremely successful

If all are not identified, what influences are missing and how important is each (I = incidental, M = minor, S = substantial, C = crucial)?

2. How successful is this framework in *accurately characterizing* the influences identified as affecting the management of knowledge?

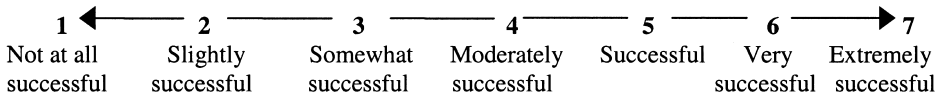| 1	2	3	4	5	6	7
Not at all successful	Slightly successful	Somewhat successful	Moderately successful	Successful	Very successful	Extremely successful

Please describe any inaccuracies:

How successful is this framework in *clearly presenting and describing* the influences identified as affecting the management of knowledge?

1	2	3	4	5	6	7
Not at all successful	Slightly successful	Somewhat successful	Moderately successful	Successful	Very successful	Extremely successful

What aspects, if any, need to be clarified?

3. How successful is this framework in concisely presenting the influences identified as affecting the management of knowledge?

1	2	3	4	5	6	7
Not at all successful	Slightly successful	Somewhat successful	Moderately successful	Successful	Very successful	Extremely successful

Please furnish suggestions, if any, on how to improve the framework's conciseness:

4. To what extent can this framework help researchers?
5. To what extent can this framework help practitioners?
6. Additional comments:

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