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A systems thinking framework for knowledge management

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Abstract

Myriad frameworks have been developed for knowledge management. However, the field has been slow in formulating a generally accepted, comprehensive framework for knowledge management. This paper reviews the existing knowledge management frameworks and provides suggestions for what a general framework should include. The distinguishing feature of this research is that it emphasizes placing knowledge management in a larger context of systems thinking so that the influencing factors on its success or failure can better be recognized and understood.

Keywords: Knowledge management; Framework; Systems thinking

1. Introduction

Knowledge management is an emerging field that has commanded attention and support from the industrial community. Many organizations currently engage in knowledge management in order to leverage knowledge both within their organization and externally to their shareholders and customers. Knowledge management involves the creation of value from an organization's intangible assets. Alavi and Leidner [3] indicate that many organizations are developing information systems designed specifically to facilitate the sharing and integration of knowledge. Two key concerns for knowledge management arise from this approach. First, knowledge management encompasses much more than technologies for facilitating knowledge sharing. In fact, practitioners are beginning to realize that people and the culture of the workplace are the driving factors that ultimately determine the success or failure of knowledge management initiatives [10,44]. Second, emphasis on technology forces a narrow view that may inhibit the growth and staying power of knowledge management.

Knowledge management is a young discipline for which a codified, generally accepted framework has not been established [9]. Despite this fact, a variety of approaches to knowledge management have been implemented across a variety of organizations. However, these approaches do not adequately fulfill the knowledge management needs of organizations. There is concern that knowledge management may

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simply be a passing fad — similar to business process reengineering (BPR) and the generally accepted notion that it has failed [11,16]. Liebowitz [32] and Liebowitz and Beckman [34] observe that knowledge management must be integrated within the strategic goals of the organization in order to fully realize its potential for enhancing organization performance.

This paper posits that knowledge management might possess more *staying power* as a discipline if discipline-wide, unifying theories and principles can be integrated with knowledge management processes, methodologies, tools, and techniques. In response to this hypothesis, this paper reviews the approaches to knowledge management that have been introduced to date and suggests directions for how such an overseeing framework might develop. In Section 2, this paper will identify and review the knowledge management frameworks that have been reported in the literature within the larger context of systems thinking. In Section 3, important insights gained from analyzing the current state of the art will be identified. Then, in Section 4, suggestions of future directions for developing a general framework for knowledge management are provided.

2. Frameworks review

2.1. Systems thinking

Systems thinking is a conceptual framework for problem-solving that considers problems in their entirety [23,46]. Problem-solving in this way involves pattern finding to enhance understanding of, and responsiveness to, the problem. Outcomes from systems thinking depend heavily on how a system is defined because systems thinking examines relationships between the various parts of the system. Boundaries must be set to distinguish what parts of the world are contained inside the system and what parts are considered the environment of the system. The environment of the system will influence problem-solving because it influences the system, but it is not part of the system [1,2].

A large conglomerate of methods, tools, and principles encompasses systems thinking, all with a common goal of understanding relationships within the system [30]. Systems thinking is championed on the premise that there are emergent properties of systems that do not exist when systems are decoupled into smaller parts. One example might be a driving problem where a driver is hitting red lights every couple of blocks. If the driver only notices the red lights, he will simply try to speed up in order to make the next light before it turns red. However, if he considers his car, the road, his speed changes, and the distance between lights, he might notice that every time he speeds up to make a light, it changes to red. That is, his speed is tripping the lights to force him to drive slower. If he notices this pattern, he can reduce his speed and drive through all green lights.

This example is particularly relevant for showing the power of knowledge management when placed in a systems thinking context. The people; the knowledge people have, share, and need; the culture for knowledge sharing (or lack thereof); organizational business strategies; and the technological infrastructure for knowledge management must all be considered for effective knowledge management initiatives. Systems thinking can enhance knowledge management through its ability to depict complex, dynamic processes and thus enhance understanding and the ability of knowledge management initiatives to respond to the needs of the organization [45]. A systems approach to knowledge management also addresses the concern raised by Tsoukas [51] regarding the lack of an *overseeing* framework in organizations to provide a general sense of direction for knowledge management initiatives.

A number of theoretical frameworks for problem-solving that adopt systems thinking have been presented in the literature. Some examples include Soft Systems Methodology [13,14], Spiral Dynamics [8], Systems Intervention Methodology [21], and Value Systems Theory [22]. Life cycle assessment [37,59] is a particular tool for systems thinking problem-solving that has been prominent in the literature. Such assessments look at entire cycles that exist in systems. This is important for knowledge management because eliciting and leveraging intellectual capital and learning are the result of synergies between different *parts* of the knowledge management cycle that are evident only when the cycle is considered in its entirety.

The concept of purposeful systems, formalized by Ackoff and Emery [2], is applicable to all of the systems frameworks where there is some goal and the system is bounded and created to achieve that goal (or goals), hence, the purpose of the system. Furthermore, Holland [25,26] and Shakun [47] introduce the concepts of adaptive and responsive systems, respectively, which are important and relevant for general systems thinking and, as will become apparent elsewhere in this paper, for a knowledge management framework. Adaptive systems change in response to changes in the system to better achieve the goal(s) or purpose of the system [25,26]. Responsive systems learn from the system's past performance to improve functioning and efficiency [47].

Systems thinking is important for knowledge management because it provides an overseeing framework to help ensure that the same general requirements are addressed by knowledge management endeavors across organizations (and with varying methodologies and tools).

2.2. Knowledge management frameworks

As previously mentioned, a number of individuals and organizations have developed frameworks for knowledge management. The frameworks can be classified as either prescriptive, descriptive, or a combination of the two. Prescriptive frameworks provide direction on the types of knowledge management procedures without providing specific details of how those procedures can/should be accomplished. In essence, they prescribe different ways to engage in knowledge management activities (i.e., suggest a knowledge management methodology). In contrast, descriptive frameworks characterize or describe knowledge management. These frameworks identify attributes of knowledge management important for their influence on the success or failure of knowledge management initiatives. The majority of frameworks presented in the literature to date are prescriptive frameworks. As such, the frameworks tend to be task-oriented. For initial knowledge management efforts, this was a natural direction in which to move because the processes involved in actually implementing knowledge management are tasks, or knowledge manipulation activities [28]. However, there are other important factors for successful knowledge management; this is a major finding of this paper as discussed in Section 3 and is consistent with previous research [28]. Table 1 lists a sample of frameworks and provides a brief description of each.

3. Analysis of knowledge management frameworks

Several key points, grouped in one of two more general classes of findings, emerge from a review of the existing knowledge management frameworks:

The frameworks are not consistent with systems thinking:
- (1) the frameworks are prescriptive in nature and thus center on knowledge management tasks; and
- (2) the frameworks do not address the notion of double-loop learning.

There is a lack of cohesiveness across frameworks:
- (3) there is no single definition of what constitutes a knowledge management framework; and
- (4) there are many concepts that are common to multiple frameworks, but the ordering or structure of the frameworks varies.

The first set of findings (1 and 2) relates to the idea that knowledge management is not consistent with systems thinking. This is because many of the knowledge management frameworks focus only on the knowledge cycle process or tasks — the movement of knowledge through the organization and the tasks required for facilitating such movement. Other critical elements of knowledge management such as integration of knowledge management with the strategic goals of the organization, the people involved in knowledge management activities, and the cultural context within which knowledge management is developed are neglected [17,33]. Based on the description of systems thinking given in Section 2.1, for knowledge management to be consistent with systems thinking, it must consider the entire knowledge management process: purpose of the or-

ganization (strategic objectives), knowledge, technology, learning, and people/culture. These parts can then be further divided into different types of knowledge, knowledge flows, knowledge tasks, learning, and technology and sub-groups of people/cultures within the organization.

The first finding — that the frameworks are primarily prescriptive — means that the frameworks

Table 1
A sample of knowledge management frameworks

Framework	Description
American Management Systems [49]	(1) Find [create knowledge centers], (2) Organize [motivate and recognize people] and (3) Share
Arthur Andersen Consulting [7]	(1) Evaluate, (2) Define the role of knowledge, (3) Create a knowledge strategy linked to business objectives, (4) Identify processes, cultures and technologies needed for implementation of a knowledge strategy and (5) Implement feedback mechanisms
Andersen Consulting [4,20]	(1) Acquire, (2) Create, (3) Synthesize, (4) Share, (5) Use to Achieve Organizational Goals, (6) Environment Conducive to Knowledge Sharing
Dataware Technologies [15]	(1) Identify the Business Problem, (2) Prepare for Change, (3) Create the KM Team, (4) Perform the Knowledge Audit and Analysis, (5) Define the Key Features of the Solution, (6) Implement the Building Blocks for KM and (7) Link Knowledge to People
Buckley and Carter [12]	Business process approach to knowledge management (no formal methodology
Centre for International Business, University of Leeds	but key knowledge processes are identified): (1) Knowledge Characteristics, (2) Value Added from Knowledge Combination, (3) Participants, (4) Knowledge Transfer Methods, (5) Governance and (6) Performance
The Delphi Group [18]	Specifics about a methodology have not been released, but the following are addressed: (1) Key Concepts and Frameworks for Knowledge Management, (2) How to Use Knowledge Management as a Competitive Tool, (3) The Cultural and Organizational Aspects of Knowledge Management, (4) Best Practices in Knowledge Management, (5) The Technology of Knowledge Management, (6) Market Analysis, (7) Justifying Knowledge Management and (8) Implementing Knowledge Management
Ernst & Young [19]	(1) Knowledge Generation, (2) Knowledge Representation, (3) Knowledge Codification and (4) Knowledge Application
Holsapple and Joshi [27] Kentucky Initiative for Knowledge Management	(1) Acquiring Knowledge [including Extracting, Interpreting and Transferring], (2) Selecting Knowledge [including Locating, Retrieving and Transferring], (3) Internalizing Knowledge [including Assessing, Targeting and Depositing], (4) Using Knowledge, (5) Generating Knowledge [including Monitoring, Evaluating, Producing and Transferring] and (6) Externalizing Knowledge [including Targeting, Producing and Transferring]
Holsapple and Joshi [28]	(1) Managerial Influences [including Leadership, Coordination, Control, Measurement], (2) Resource Influences [including Human, Knowledge, Financial, Material], (3) Environmental Influences [including Fashion, Markets, Competitors, Technology, Time, Climate] (4) Activities [including Acquire, Select, Internalize, Use], (5) Learning and Projection as Outcomes
Knowledge Associates [58]	(1) Acquire, (2) Develop, (3) Retain and (4) Share
The Knowledge Research Institute [57]	(1) Leverage Existing Knowledge, (2) Create New Knowledge, (3) Capture and Store Knowledge, (4) Organize and Transform Knowledge and (5) Deploy Knowledge.
Liebowitz [33]	(1) Transform Information into Knowledge, (2) Identify and Verify Knowledge, (33) Capture and Secure Knowledge, (4) Organize Knowledge, (5) Retrieve and Apply Knowledge, (6) Combine Knowledge, (7) Learn Knowledge, (8) Create Knowledge [loop back to (3)] and (9) Distribute/Sell Knowledge

Table 1 (*continued*)

Framework	Description
Liebowitz and Beckman [34]	(1) Identify [Determine core competencies, sourcing strategy and knowledge domains], (2) Capture [Formalize existing knowledge], (3) Select [Assess knowledge relevance, value, and accuracy and resolve conflicting knowledge], (4) Store [Represent corporate memory in knowledge repository] (5) Share [Distribute knowledge automatically to users based on interest and work and collaborate on knowledge work through virtual teams], (6) Apply [Retrieve and use knowledge in making decisions, solving problems, automating or supporting work, job aids and training], (7) Create [Discover new knowledge through research, experimenting, and creative thinking] and (8) Sell [Develop and market new knowledge-based products and services]
Marquardt [36]	(1) Acquisition, (2) Creation, (3) Transfer and Utilization and (4) Storage
Monsanto Company [29]	No formal knowledge management methodology: Use learning maps, values maps, information maps, knowledge maps, measurements, and information technology maps.
The Mutual Group [43]	Capital framework: (1) Gather Information [building an explicit knowledge infrastructure], (2) Learn [tacit knowledge development], (3) Transfer and (4) Act [developing capability through values deployment]
The National Technical University of Athens, Greece [5]	(1) Context [generating knowledge], (2) Knowledge Management Goals [organizing knowledge], (3) Strategy [developing and distributing knowledge] and (4) Culture
O'Dell [41] American Productivity and Quality Center	(1) Identify, (2) Collect, (3) Adapt, (4) Organize, (5) Apply, (6) Share and (7) Create
PriceWaterhouseCoopers [50]	(1) Find, (2) Filter [for relevance], (3) Format [to problem], (4) Forward [to right people] and (5) Feedback [from users]
Ruggles [42]	(1) Generation [including Creation, Acquisition, Synthesis, Fusion, Adaptation], (2) Codification [including Capture and Representation] and (3) Transfer
Skandia [48]	Universal Networking Intellectual Capital: Emphasizes (1) networking and knowledge sharing, (2) knowledge navigation by project teams, (3) intellectual capital development tool box
Van der Spek and de Hoog [52]	(1) Conceptualize [including Make an inventory of existing knowledge and Analyze strong and weak points], (2) Reflect [including Decide on required improvements and Make plans to improve process], (3) Act [including Secure knowledge, Combine knowledge, Distribute knowledge and Develop knowledge] and (4) Review [including Compare old and new situation and Evaluate achieved results]
Van der Spek and Spijkervet [53]	(1) Developing New Knowledge,(2) Securing New and Existing Knowledge, (3) Distributing Knowledge and (4) Combining Available Knowledge
Van Heijst et al. CIBIT, Netherlands [54]	(1) Development [creating new ideas, analyzing failures and examining current experiences], (2) Consolidation [storing individual knowledge, evaluation and indexing], (3) Distribution [informing users] and (4) Combination [combining disparate information and increasing access to distributed data]
Wielinga et al. University of Amsterdam [55]	Apply CommonKADS methodology to knowledge management: (1) Conceptualize [identify/inventory, represent, classify], (2) Reflect [models of knowledge development and creation, models for identifying knowledge resources and results] and (3) Act [combine and consolidate knowledge, integrate knowledge, develop and distribute knowledge]
Wiig [56]	(1) Creation and Sourcing (2) Compilation and Transformation, (3) Dissemination Application and (4) Value Realization

tend to be task-based and neglect other aspects of knowledge management. Hence, they do not provide a comprehensive, holistic approach to knowledge management as dictated by systems thinking. Some examples include Ernst & Young [19], Knowledge Associates [58], The Knowledge Research Institute [57], Liebowitz [33], Marquardt [36], O'Dell [41], and Ruggles [42]. In these examples, the frameworks include a set of activities for knowledge management where the emphasis is on the knowledge cycle. That is, they address how knowledge flows and is manipulated in the organization without consideration of factors that influence the knowledge cycle. Some examples of tasks include acquiring knowledge [32,50], generating or creating knowledge [19,32,35, 48], organizing knowledge [35], sharing knowledge [35,50] and using/applying knowledge [19,32].

However, finding 1 only claims that the *majority* of frameworks are prescriptive. Others, such as Andersen Consulting [4,20], Arthur Andersen [7], Buckley and Carter [12], the Delphi Group [18], and the National Technical University of Athens Greece [6] are descriptive frameworks. Dataware Technologies [15], and Holsapple and Joshi [28] present a hybrid of the two types of frameworks. Both descriptive and hybrid frameworks acknowledge non-task-oriented aspects of knowledge management such as cultural factors [4,5,7,15,18,20,28], linking knowledge management to strategic business objectives [4,7,20], and the need to include feedback loops for responding to changes in the knowledge management environment [4,7,20]. These feedback loops address issues of adaptability [25,26] and responsiveness [47] for enhanced outcomes of knowledge management efforts. Holsapple and Joshi [28] allude to the notion of strategic business objectives through their emphasis on leadership, planning, and coordination [28]. While the Arthur Andersen [7] and Andersen Consulting [4,20] frameworks address several of the key aspects necessary for a systems approach to knowledge management, Holsapple and Joshi [28] present the most comprehensive framework in the existing literature and are closely aligned with the recommendations in this paper. However, none of the descriptive or hybrid frameworks meets all of the criteria established in Section 4 of this paper.

The second finding addresses learning in knowledge management frameworks. The notion of learning is related to feedback loops as discussed in finding 2. Monsanto does not have a formal knowledge management framework, but the organization is one of the few that recognizes the concept of learning in knowledge management through its use of knowledge maps [29]. Liebowitz [33] and The Mutual Group [43] propose frameworks that include a learning component explicitly. However, the approaches remain fairly linear (except for a single feedback loop in Liebowitz [33]). This conclusion is consistent with the finding of Argyris and Schön [6] that double-loop learning is far less prevalent, and often missing, than single-loop learning in organizations. Argyris and Schön [6] distinguish between double- and single-loop learning where single-loop learning is that which organizations do for corrective purposes (incremental changes). Double-loop learning is generative; that is, double-loop learning involves learning on a more fundamental level where basic assumptions are changed. It is consistent with systems thinking because it involves the concept of emergent properties of systems where knowledge is learned and/or unlearned (i.e., emerges from the system) when relationships in the system are evaluated and understood. Feedback acts as a facilitator for synthesizing emergent properties (a basic tenant of systems thinking).

Some of the frameworks reviewed in this paper appear to recognize learning on some level but do not adequately address it. For example, the Knowledge Research Institute [57], O'Dell [41] and Wiig [56] all have a knowledge creation activity; and Van der Spek and Spijkervet [53] and Van Heijst et al. [54] include the development of knowledge. It can be argued that these activities contribute to learning, but they do not encompass it entirely because they are characterized as activities resulting in single-loop learning. The Holsapple and Joshi [28] and Ruggles [42] frameworks take learning a step further. Ruggles [42] identifies a series of activities that precipitate learning such as creation, synthesis and adaptation of knowledge. Holsapple and Joshi identify learning as an outcome of knowledge management activities in general [28]. Senge [46] argues that a complete learning mode should include both single- and double-loop learning. This finding asserts that double-loop learning is the type that is lacking in existing knowledge management frameworks [6]. Again, learning is im-

portant for facilitating an approach to knowledge management that is adaptive and responsive to the changing environment and culture of the organization within which knowledge management is taking place.

Findings 3 and 4 relate to the notion that there is a lack of cohesiveness in knowledge management initiatives, and they support the assertion by Beckman [9] that the knowledge management discipline lacks an enduring framework. The two points also strengthen this paper's claim that suggestions for how the field as a whole might begin to define its premises and theories is imperative. The third finding derives from the fact that the emphasis and components of the frameworks reviewed in this paper vary. Essentially, there is no fixed, commonly accepted notion of the necessary elements of a knowledge management framework. Since the frameworks tend to be prescriptive in nature, the lack of cohesiveness across frameworks deals with prescribing different tasks necessary for knowledge management. Some examples include Buckley and Carter [12] who introduce governance and performance, Ernst & Young [19] who do not include knowledge finding, and Van der Spek and Spijkervet [53] who include securing knowledge.

Even in the descriptive frameworks, consensus about what should be included in a knowledge management framework is lacking. For example, The National Technical Institute of Greece [5], Andersen Consulting [4,20], and the Delphi Group [18] include cultural factors in their framework but not learning or linkages with strategic business objectives. Holsapple and Joshi [28] incorporate learning and organizational culture into their framework, and Arthur Andersen [7] includes all of the key aspects indicated in this paper: cultural factors, linkage with strategic objectives, and feedback loops for learning. Buckley and Carter [12] take a different approach by emphasizing the business process.

More subtle differences in the frameworks are illustrated by the knowledge tasks. American Management Systems and PriceWaterhouseCoopers [50] begin with *finding knowledge*. Marquardt [36], Knowledge Associates [58], and Holsapple and Joshi [27] employ a similar element, except they term the activity *acquiring knowledge*. The subtle difference is that acquiring implies that the knowledge has already been found, and now it is actually obtained. Another slightly different concept is used by Ernst & Young [19], the National Technical University of Athens [5], Wiig [56], and Ruggles [42]. In these examples, the first step in knowledge management is to *generate knowledge*. In this case, the knowledge is actually being created rather than simply locating or obtaining preexisting knowledge. Ruggles [42] accepts a broader definition of knowledge generation than the others that includes knowledge acquisition. Van der Spek and Spijkervet [53] and Van Heijst et al. [54] title their analogous phase *knowledge development*. This brief review illustrates the variations that exist between the various frameworks even though there tend to be a number of commonalties between frameworks.

The preceding paragraph leads into the fourth finding, which refers to the organizational and structural differences of the frameworks. This finding is relevant for the prescriptive frameworks and is supported by looking at the flow of several frameworks. Some of the frameworks do not prescribe a particular flow for the framework such as Holsapple and Joshi [27,28] and Van der Spek and Spijkervet [53]. Others such as Van Heijst et al. [54] include *knowledge distribution* and *knowledge combination* elements (in that order) while Wiig [56] includes both of those components in his framework in the reverse order. Van der Spek and de Hoog [52] add another variation by combining the two into a single component of their framework.

Furthermore, the frameworks of Holsapple and Joshi [27], the Knowledge Research Institute [57], Liebowitz [33], Marquardt [36], and O'Dell [41] all include a *knowledge creation* component. However, O'Dell [41] includes this much later in his framework than the others. In fact, O'Dell [41] has knowledge creation as the last requirement in the framework. Marquardt [36] first suggests knowledge acquisition and then knowledge creation; the Knowledge Research Institute [57] lists these steps in the reverse order. Liebowitz [33] includes both knowledge finding and acquisition in his framework, but there is an additional up-front requirement of transforming information into knowledge.

At this point, it is also appropriate to note that in some cases, different types of knowledge are distinguished — for example, The Mutual Group [43] and

Holsapple and Joshi [28]. Here, distinction refers to the classification of knowledge as either explicit or tacit. Explicit knowledge is that which has been codified and expressed in formal language [39,40]. It can be represented, stored, shared, and effectively applied [9]. Tacit knowledge is knowledge that is difficult to express, represent, and communicate [39,40].

4. Recommended directions

Several recommendations for a discipline-wide framework emerge from our review of the existing knowledge management frameworks in Section 3. These recommendations highlight strengths of existing frameworks and identify their limitations in an effort to develop a single, unifying framework. The concept of systems thinking is a commonality across the recommendations. By bringing knowledge management in-line with systems thinking, the flaws in existing frameworks can be mitigated, and a general framework emerges. The concept of systems thinking infers that the framework should be a hybrid one that includes both prescriptive and descriptive elements. This facilitates a holistic approach that considers the necessary activities for knowledge management and the additional parts of the system that impact knowledge management activities such as business objectives, culture/people, and learning. While the order in which knowledge management activities are carried out can remain variable, a systems approach fosters an environment in which, on the whole, the same factors influence knowledge management initiatives so that outcomes become increasingly valid. Our recommendation for feedback and double-loop learning discussed later in this section also suggests that ordering of activities may not be important because things happen repeatedly and cyclically.

To expand on the statements in the preceding paragraph, systems thinking is important for a knowledge management framework because it facilitates the linkage between knowledge management initiatives and the strategic goals and objectives of an organization. This is accomplished via the overall view of the organization that emerges when a systems approach is adopted, and it helps to maintain a clear vision of *what* is being done and *why* it is being done. Essentially, such a linkage identifies the purpose of knowledge management initiatives [2]. To accomplish this, knowledge management must include significant planning to define an organization's problem/objective prior to undertaking knowledge management tasks.

Moreover, a knowledge management framework must recognize that knowledge management includes much more than just the knowledge cycle or knowledge management tasks. Thus, knowledge management cannot be thought of in the same way as general information systems. Holistic methodologies and processes that emphasize the organizational and cultural aspects of knowledge management need to be developed. Bob Buckman, CEO of Buckman Labs, has stated that 90% of the knowledge management effort in his organization is cultural. Similarly, Bobbitt [10] of Andersen Consulting cites their efforts as 80% cultural.

Hansen et al. [24] address the discussion of knowledge tasks vs. culture by classifying knowledge management approaches as either *codification* or *personalization* strategies. Codification strategies seek to document and store knowledge in databases, and personalization strategies seek to develop networks of people for communicating ideas. This distinction further supports the finding that current frameworks are as fragmented in their approach as organizations themselves [31]. These two approaches should be integrated into a single, systems approach that considers both the knowledge cycle (including storing and disseminating knowledge) and the cultural environment within which people share and communicate the knowledge they possess. Integrating cultural aspects of an organization must be people-driven. Technologies, methods, and tools used for different aspects of knowledge management should be built around the existing organizational culture. For example, the marketing groups at Mutual Investment work collaboratively and communication occurs across functional units. In contrast, fund managers in the investment fund group tend to work individually. Information is made available to all, but individual fund managers decide if and how to use it [38]. Of course, once knowledge is commu-

nicated and shared, technologies for storing and disseminating the knowledge to others must be utilized.

In addition, knowledge management is a continual process of incremental improvement and evolution — not a one-time effort. This point, along with the fact that a variety of frameworks include similar elements that are structured differently, suggests that a set of distinct, linear tasks may not be appropriate for knowledge management. Rather, there is a need for designing multiple feedback loops into the knowledge management process and allowing for multiple activities to occur simultaneously during the process. This leads to the notion of *learning* (double-loop learning in particular) in the knowledge management framework and is again consistent with systems thinking where the entire, evolutionary life cycle is considered by including feedback loops. Single-loop learning has already been addressed by a number of researchers [27,28,41,42,53,54,56,57]. The recommendation here is for the incorporation of both single-loop and double-loop learning into the knowledge management framework so that varying degrees of learning can occur. In double-loop learning, new knowledge is synthesized from the existing knowledge by combining it in new and innovative ways. This learning may result in changing or evolving parts of the knowledge management initiative being undertaken within the framework. Iterative feedback loops within and between steps in the knowledge management process are necessary elements to achieve double-loop learning and to have a learning organization. A hybrid framework is particularly important for this recommendation as prescribed tasks may lay the groundwork for double-loop learning, but feedback, interaction between individuals in the organization, and changing strategic objectives are all facilitators of double-loop learning.

Both the relevancy and currency of knowledge are important for robust knowledge management systems, activities, and outcomes. Feedback loops play an important role for such maintenance and updating of both the knowledge management process and the physical system. In addition to feedback loops, the knowledge management framework should include a prescription for facilitating the notions of double-loop learning and upkeep that include such things as creating new knowledge, combining knowledge and sharing knowledge.

The preceding discussion provides the basis of our recommended framework for knowledge management. The two primary recommendations are (1) the framework should be both prescriptive and descriptive (which will facilitate the second recommendation) and (2) knowledge management activities must be consistent with systems thinking. Then, there are a series of recommendations that follow from the second recommendation: (2a) the organizational strategies and goals must be linked to knowledge management, (2b) planning should occur before knowledge management activities are undertaken, (2c) cultural aspects of an organization must be recognized and knowledge management must occur in a manner compatible with the culture of the organization, and (2d) knowledge management is an evolutionary, iterative process directed by feedback loops and learning.

The recommendations presented by the authors of this paper build on some of the common themes presented by others in the knowledge management literature: (1) knowledge management tasks must be prescribed and should include such activities as finding, verifying, storing, organizing, sharing, and using knowledge, (2) there should be a distinction between explicit and tacit knowledge and each needs to be handled appropriately, and (3) single-loop learning (along with double-loop learning) should be part of the framework.

5. Summary

The findings and recommendations from our research possess a unifying theme: systems thinking. The primary finding is that current frameworks do not typically employ a systems approach. From this, the primary recommendation of this paper is that frameworks *should* be developed within the systems context. Furthermore, criteria for evaluating knowledge management frameworks within the context of systems thinking have been set forth in the paper. These can be used to benchmark frameworks and determine if this key recommendation is met. The frameworks should consider purpose/objective, knowledge, technology, learning, and people/culture

of the organization. The authors feel that a framework that is both prescriptive and descriptive is necessary to achieve a knowledge management framework that contains all of the criteria and is consistent with systems thinking.

The suggestions for addressing findings 1 and 2 should also result in alleviating findings 3 and 4. That is, bringing knowledge management in-line with systems thinking should, by definition of what systems thinking is, create an overseeing framework that will dictate a more cohesive definition of a knowledge management framework. Knowledge management remains a young, developing field, and existing frameworks include some but not all of the key attributes identified in this paper. This research hopefully provides a foundation upon which future research will build.

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