

## **TOWARDS AN EVALUATION FRAMEWORK FOR KNOWLEDGE MANAGEMENT SYSTEMS<sup>1</sup>**

### **Abstract**

In this paper we develop a theory driven evaluation framework for Knowledge Management Systems (KMS). The framework builds on theoretical foundations underlying organizational Knowledge Management (KM) to identify the facilitators of different KM activities in organizations. These facilitators are then used to form a benchmark for evaluating KMS. Specifically, organizations selecting KMS can use the framework to identify gaps and overlaps in facilities provided by individual tools in support of knowledge management activities. In addition, the framework can be applied to identify gaps and overlaps in the support provided to KM activities by the KMS market as a whole.

### **Introduction**

Knowledge based organizations possess unique information and knowledge that affords them competitive advantage (McLure Wasko and Faraj, 2005; Metaxiotis et al., 2005). The ability to learn, adapt, and change are now viewed as core competencies in the new knowledge-based economy and the importance of Knowledge Management (KM) processes to organizational performance are now widely recognized (Gartner Group, 2002, Metaxiotis et al., 2005, Sabherwal and Sabherwal, 2005, Tanriverdi, 2005). As early as 2000, an industry study by KPMG found, for example, that the majority of participating companies (81% of 423 companies) engaged in some KM practices or initiatives, usually with the aid of technology. KM is now expected to deliver a wide range of organizational benefits including improved decision making, increased productivity, decreased time to market, and improved product quality (Lam and Chua, 2005; Sabherwal and Sabherwal, 2005). However, despite the apparent value of KM, organizations remain in the early stages of understanding KM implications (Metaxiotis et al., 2005). For instance, the lack of a codified, generally accepted framework for KM (Metaxiotis et al.,

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2005) has resulted in reliance upon diverse approaches to KM practices that have, nonetheless, failed to adequately meet the KM needs of organizations (Rubenstein-Montano, 2001).

The importance of Knowledge Management as an approach to solving a number of current business problems has led to the development and implementation of a range of supporting technologies generally referred to as Knowledge Management Systems (KMS). Investments in such systems are frequently viewed as strategic (Wickramasinghe, 2003) and it has been widely argued that KMS not only supports but also enhances KM initiatives (Metaxiotis et al., 2005). KPMG (2000) reported, however, that KMS often did not support effective KM. Lam and Chua (2005) identified content deficiencies and a mismatch between the organization and the KMS as two root causes for the abandonment of knowledge management systems projects. The symptoms of these root causes include a lack of understanding of how the system will support KM and poor understanding of the KM problem.

The above problems are compounded by the availability of a plethora of tools and technologies. As an example, consider the following list of generic KMS solution types offered to readers of the KMWorld website, where a solution type often requires the use of several products (for which many alternatives often exist): business intelligence; business process management; collaboration tools; competitive intelligence; content management; customer relationship management; document management; email management; enterprise application integration; enterprise search; image, forms, document capture; intellectual property management; opinion portals; records management, regulatory compliance; and workflow management. Similarly, the Gartner group publishes yearly technology “hype cycles” which review the state of practice in various technology areas. In 2005, there have been not one but more than ten different hype cycles for specialized KM technologies. Some of these relate to CRM technologies; to intelligence and data warehousing; to collaboration and communication; to content management; to E-Learning; to the high-performance workplace; and to portal ecosystems. Obviously the task for managers wishing to choose tools to support efficient management of their organization’s knowledge is not trivial.

This paper seeks to support organizations facing a KMS selection decision by developing an evaluation framework for KMS. At the core of this framework is the establishment of a link between organizational KM activities and a set of KMS capabilities. This link is created by looking at the individual KM activities in organizations and identifying theoretically based facilitators for each activity. KMS can then be evaluated vis-à-vis these facilitators, in terms of their support for the organization’s KM needs. The framework can be used to assess the level of support offered by selected technologies for organizational KM and to identify gaps or overlaps in this support.

The paper is structured around individual KM activities. We begin with a definition of organizational KM in order to identify the key underlying activities. We then study each activity in order to identify its main facilitators. Having developed an understanding of what facilitates KM in organizations, we then use an example to demonstrate how these facilitators are mapped onto a representative KMS and how the technology’s support for KM can be evaluated. The paper concludes with a discussion of the contribution of the proposed framework. It also highlights a higher level contribution of the framework in identifying overall gaps in the KMS market, suggesting where development efforts should focus.

### **Knowledge Management Facilitators**

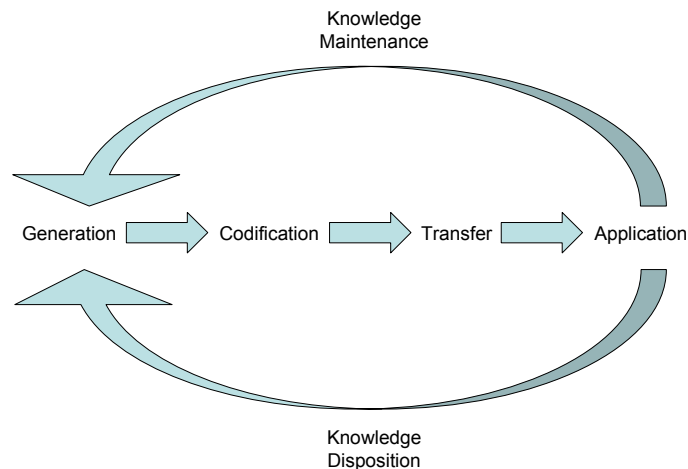
Defining KM is complex, partly as a consequence of the difficulty of defining knowledge itself (Assudani, 2005; Metaxiotis et al., 2005). A widely accepted distinction applied to knowledge in the context of KM is that between tacit and explicit knowledge. Tacit knowledge is highly personal and hard to formalize, while explicit knowledge is comparatively easy to formalize and therefore readily

communicated (Nonaka, 1994<sup>2</sup>). In addition, the literature frequently makes distinctions between knowledge, information, and data with knowledge being viewed as adding context, meaning, and action to information and data (Alavi and Leidner, 2001; Powell and Swart, 2005). In defining KM, Metaxiotis et al. (2005) suggested that the following definition, which seeks to embrace the range of KM projects presented by Davenport et al. (1998), represents a certain measure of agreement among KM researchers:

“Knowledge management is concerned with the exploitation and development of the knowledge assets of an organization with a view to furthering the organisation’s objectives. The knowledge to be managed includes both explicit, documented knowledge, and tacit, subjective knowledge.” (Rowley, 2000, pg. 327)

Taking a more prescriptive approach to defining KM (Rubenstein-Montano et al., 2001), Alavi and Leidner (2001) define KMS as the technologies which support specific organizational KM activities. The four KM activities identified in the context of KMS are knowledge creation, knowledge codification, knowledge transfer, and knowledge application. In addition to these four activities, Boisot (2002) points out that the process of forgetting old knowledge plays an important role in the generation of new knowledge. Knowledge disposition is also highlighted by de Holan and Phillips (2004) who found empirical evidence suggesting that forgetting processes are important to organizational learning and the ability to retain new knowledge. Not only forgetting but also maintaining the relevancy and currency of knowledge are important components of KM (Rubenstein-Montano et al., 2001). Thus, this paper identifies knowledge maintenance and knowledge disposition as two additional activities of considerable importance to KM.

**Figure 1 – Knowledge Management Activities**



Since this paper aims to provide guidance to the implementation of KMS, it follows the prescriptive approach to defining KMS shown in Figure 1. Figure 1, which we elaborate upon in the following section, incorporates the four KM activities identified by Alavi and Leidner (2001) as well as the additional activities of knowledge maintenance and knowledge disposition. These two activities are

<sup>2</sup> Although originally Polanyi (1967) referred to each piece of knowledge as having both a tacit and an explicit dimension, Nonaka (1994) popularized the distinction between tacit and explicit knowledge, which we cite in this work.

added as feedback loops, reflecting changes in the organizational knowledge pool over time. Theoretical support for the inclusion of feedback loops as important KM activities comes from Argyris and Schön (1978) who argued:

“When the error detected and corrected permits the organization to carry on its present policies or achieve its present objectives, then that error-and-correction process is single-loop learning. ... Double-loop learning occurs when error is detected and corrected in ways that involve the modification of an organization’s underlying norms, policies and objectives.” (pg. 2-3)

Organizations therefore need to support knowledge maintenance and knowledge disposition in order to support organizational learning. Double-loop learning, in particular, has been generally overlooked in KM frameworks (Metaxiotis et al., 2005; Rubenstein-Montano et al., 2001).

Although Figure 1 implies a specific order to KM activities, the introduction of feedback mechanisms limits the importance of the order in which the activities are presented in a framework (Rubenstein-Montano et al., 2001). Thus, the framework should not be viewed as positing that KM activities are always initiated by knowledge generation. In addition, as a framework for organizational knowledge processes, there is no expectation that all activities will be performed by a single individual. For instance, knowledge generation by one individual may lead to knowledge maintenance actions by another individual. Finally, the framework should not be interpreted as necessitating all steps since it is certainly possible for newly generated knowledge to be applied without codification or transfer (notably by informal interactions).

Reviewing the KM activities presented in Figure 1 can provide some indication of possible opportunities for KMS technologies to support and facilitate KM. For example, technology can focus on supporting knowledge transfer, or knowledge generation (Ruggles, 1997). KM activities are, however, complex organizational tasks (Wakefield, 2005). Therefore, in order to develop a better understanding of how KMS can facilitate the KM activities shown here, it is necessary to first elaborate upon the nature of each activity. This elaboration will serve to identify the underlying facilitators of each KM activity, which can be more readily connected to specific supporting technologies.

## **Knowledge Generation**

Knowledge generation can be defined as the process of developing new knowledge from data, information, prior knowledge, and personal experience (Sabherwal and Sabherwal, 2005). In knowledge generation the whole can be worth more than the sum of the parts as small inputs of individual know-how can lead to the generation of considerable new knowledge (Boisot, 2002). Organizational knowledge can be created or acquired through various organizational learning processes (Stein, 1995; Walsh and Ungson, 1991) with Choo (2001) arguing that the knowledge generation process is initiated by the recognition of a knowledge-gap situation that is impeding the organization. This gap is resolved by the generation of new knowledge through knowledge conversion, knowledge building, and knowledge linking (Choo, 2001). Although knowledge linking is primarily concerned with knowledge creation by means of alliances with other organizations, knowledge conversion and knowledge building provide relevant insight to KM and are discussed below.

**Knowledge conversion.** Knowledge conversion can be explained using Nonaka’s (1994) theory of organizational knowledge creation. According to this theory, new knowledge is created in a process of continuous conversion between the tacit knowledge of individual insights and the explicit knowledge used by the organization. Socialization (from tacit to tacit), combination (from explicit to explicit), externalization (from tacit to explicit), and internalization (from explicit to tacit) are identified as the four processes of conversion. Knowledge generation begins with new tacit knowledge being acquired by

individuals through hands-on experience. Socialization, which involves the construction of a “field of interaction,” follows with members of the field of interaction sharing experiences and perspectives. The ensuing dialogue permits the conceptualization of the tacit knowledge and triggers externalization. The newly generated knowledge is then combined with existing explicit knowledge and the resulting concepts articulated through experimentation and then internalized. Once this process of knowledge creation is complete, the new knowledge is stored by the organization if an evaluation suggests that it is useful. Knowledge conversion holds individual learning and socialization as the key activities in the generation of new knowledge with the other activities serving primarily as channels through which new knowledge is communicated and stored.

**Knowledge building.** Knowledge building (Leonard-Barton, 1995) sees the organization as identifying and nurturing activities that lead to the accumulation of knowledge. This knowledge is then used by the organization to strengthen its core capabilities and provide it with distinct competencies which afford competitive advantage. Knowledge building activities include shared problem solving, experimenting (trial and error) and prototyping, implementing and integrating new processes and tools, and importing external knowledge.

**Facilitators of Knowledge Generation.** Summarizing the preceding discussion, there are nine key facilitators of knowledge conversion and knowledge building. These facilitators are: the ability to identify a need for knowledge, socialization, externalization, knowledge evaluation and combination, internalization, knowledge building capabilities (e.g. experimentation and prototyping) and knowledge importation capabilities. In addition, socialization and externalization are themselves facilitated by the presence of a shared framework (Markus et al., 2002).

### **Knowledge Codification**

The presence of possible lags between the externalization of knowledge by a knowledge holder and its internalization by a recipient, as well as the need to transfer knowledge without direct interaction between the two, introduces the need to codify organizational knowledge and store it in some form of organizational memory (Stein, 1995). Organizational memory can be broadly defined as “sets of knowledge retention devices, such as people and documents, that collect, store, and provide access to the organization’s experience.” (Olivera, 2000, p. 815). Although an organization’s memory resides in more than just technology based repositories (Walsh and Ungson, 1991) the focus of knowledge codification is only on the capture, representation, and storage of knowledge in computerised knowledge bases (Ruggles, 1997).

Stein (1995) identified acquisition, retention, maintenance, and retrieval as the defining processes of organizational memory in general. Stein and Zwass (1995) elaborated on the process of acquisition, suggesting that it involves both the explication or externalization of knowledge and the subsequent encoding of this knowledge. The importance of explication to knowledge codification has also been noted by other authors (e.g. Boisot, 2002; Carlile 2004) while Boisot (2002) also suggested that codification requires some abstraction capability on the part of the individual. Abstraction refers to the ability to categorize new knowledge and requires some prior understanding of knowledge context. Codified knowledge is more readily exchanged once abstracted. Finally, Nevo and Wand (2005) argue that metaknowledge is also important for the management of organizational memory.

**Facilitators of Knowledge Codification.** Based on the preceding discussion, there are six facilitators of knowledge codification. First, externalization plays a role not only in knowledge generation but also in codification. Second, encoding the knowledge into a physical storage capability is needed to facilitate retention and maintenance of the codified knowledge. Third, a search and retrieval mechanism is needed to retrieve codified knowledge from the organizational memory. Fourth, categorization and the

availability of shared frameworks (such as ontology) are important facilitators of abstraction (Boisot, 2002). Finally, metaknowledge is often required for the effective management of organizational memory.

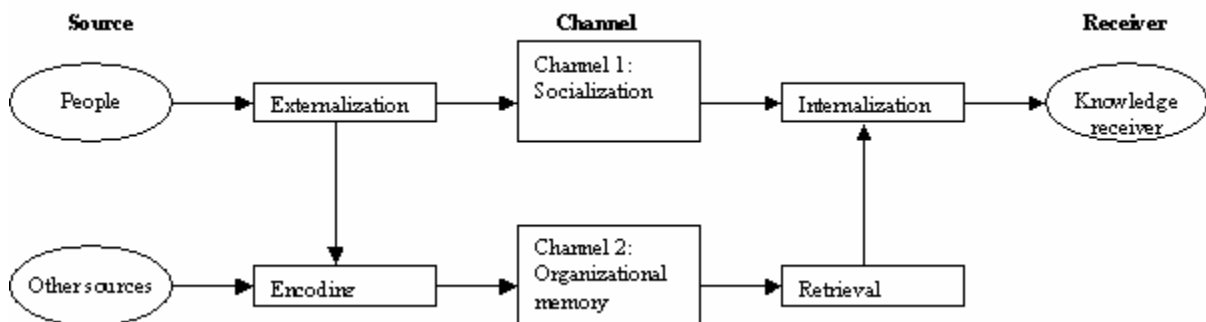
### Knowledge Transfer

Knowledge transfer is the most common phrase used to describe the movement of knowledge from one location to another (Carlile, 2004). The transfer of knowledge can occur among individuals, groups, departments, or organizations (Sabherwal and Sabherwal, 2005) with the effectiveness of the transfer being directly impacted by the availability of a common framework upon which to base the transfer efforts (Carlile, 2004; Wakefield, 2005).

The mechanisms underlying knowledge transfer can be analyzed using the communication theory presented by Shannon and Weaver (1949) which views a communication system as consisting of five elements: the source which produces a message, the transmitter which transforms the message into a transferable signal, the communication channel which serves as the transfer medium, the receiver which acts to invert the operation of the transmitter, and the destination or intended recipient of the message. We use this model to study how knowledge transfer occurs in organizations, both directly through socialization and indirectly through the retrieval of codified knowledge. Figure 2 presents a model for these two channels which also highlights the distinct facilitators of each channel.

**Socialization.** The socialization channel is based on the process of socialization outlined by Nonaka (1994). Socialization can be described in terms of the idea of communities of practice presented by Brown and Duguid (1991). Such communities involve members of a close workgroup that share tacit knowledge and experiences in order to overcome the inadequacy of canonical organizational practices in handling practical problems. Socialization is a personal, informal communication channel in which knowledge is transmitted immediately upon externalization rather than being encoded and captured in a physical storage facility (such as an organizational memory information system). Communicated knowledge must be internalized by the knowledge receiver upon reception.

**Figure 2 - Knowledge Transfer and Communication Channels**



**Retrieval of codified knowledge.** The second communication channel is that of organizational memory and, more particularly, codified organizational memory (Stein, 1995). The organizational memory channel is more formal than the socialization channel and introduces additional activities to the process of knowledge transmission. At the initiation point of this communication channel, knowledge is encoded into a physical knowledge store. Knowledge contributed to this store, which comes from

individuals, continues to first be externalized but is subsequently encoded for storage rather than being communicated to a knowledge recipient. The knowledge store retains the knowledge until it is requested and retrieved by a receiver who must then internalize it.

**Facilitators of Knowledge Transfer.** The preceding discussion suggests seven facilitators of knowledge transfer. First, as with previous KM activities, externalization, internalization, and the presence of shared frameworks are important for knowledge transfer through socialization. In addition, the need for the indirect communication channel also requires that knowledge be encoded into some physical storage facility. Second, a very important facilitator of knowledge transfer is an ability to find the knowledge. Thus, awareness of “who knows what” in the organization (Nevo and Wand, 2005; Powell and Swart, 2005) and the availability of overall good search and retrieval mechanisms are important facilitators of the codified channel. Finally, authors have identified the importance of trust in the knowledge source as a facilitator of knowledge transfer (e.g. Szulanski, 2000). The availability of some metaknowledge (such as author profiles or the date on which the knowledge was updated) is therefore also considered a facilitator of knowledge transfer.

### **Knowledge Application**

Cabrera and Cabrera (2002) noted that although considerable research has examined the challenges associated with encouraging knowledge contribution (e.g. Bock et al., 2005; McLure Wasko and Faraj, 2005), encouraging the use of knowledge contributions is equally important and comparatively under-researched. This is despite the fact that failure to use organizational knowledge stores represents a clear waste of resources and missed opportunities to secure competitive advantage (Alavi and Leidner, 2001; Stein, 1995). Stein (1995) suggested that environmental cues, problems, and new projects trigger the need for knowledge. Knowledge seekers are then motivated to retrieve existing knowledge if they value past outcomes from doing so, if they are aware of the existence of the desired knowledge, if they have the ability to search for, locate, and decode the desired knowledge, and if the cost of retrieving the knowledge is lower than the cost of re-generating it (Stein, 1995). Willingness to search for and use existing knowledge can be negatively impacted by other factors such as a diminished perception of personal efficacy and a loss of power that may result from doing so (Lam and Chua, 2005).

Majchrzak et al. (2004) studied the stages of knowledge reuse in innovative contexts. Of the six stages reported, four can be generalized to KM contexts beyond those of an innovative nature. These are: need identification, searching for knowledge, evaluation of findings, and application of relevant findings. The importance of evaluating findings is highlighted by authors such as Boisot (2002) who argued that - prior to using acquired knowledge- individuals must interpret and make sense of it in a process of integration with their existing knowledge. This is not, however, uncontroversial as authors such as Sabherwal and Sabherwal (2005) have suggested that it is not necessary for knowledge to be understood in order to be applied. Rather, it is sufficient that the knowledge merely be used somehow to guide decisions or actions. There is, in any case, a need to identify which knowledge is relevant to a situation and this need warrants the inclusion of an evaluation step in the knowledge application process.

**Facilitators of Knowledge Application.** The preceding discussion suggests four facilitators of knowledge application. Specifically, as highlighted above, needs identification and an ability to locate relevant knowledge via search and retrieval mechanisms or identifying “who knows what” in the organization, are important facilitators. In addition, since an ability to determine the relevance of the knowledge and to potentially understand it are considered important for knowledge application, the presence of metaknowledge (knowledge about the knowledge) is another key facilitator of knowledge application (Majchrzak et al., 2004).

## Feedback Mechanisms

Wickramasinghe (2003) noted the importance of ensuring that KM provides appropriate, relevant knowledge. Ensuring the suitability and relevance of knowledge requires feedback loops aimed at knowledge maintenance and disposition. Although maintenance and disposal activities have received only limited attention in the KM frameworks presented thus far in the literature (Rubenstein-Montano et al., 2001), the importance of knowledge maintenance (Boisot, 2002; Liao, 2002; Stein, 1995) and knowledge disposition (Boisot, 2002; de Holan and Phillips, 2004; Rubenstein-Montano et al., 2001) to knowledge management warrant their inclusion here.

**Knowledge Maintenance.** Prior to the use of information systems it was generally felt that only well-codified knowledge and abstract knowledge that had been subjected to social validation was fit for storage (Boisot, 2002). However, with the introduction of information systems, there has been a greater tendency to retain knowledge at various stages of its development. Since this knowledge has not necessarily been evaluated and validated by the organization, there is an increased need for knowledge maintenance activities. Dilnutt (2002), for instance, noted the importance of including a process to maintain the quality and content of the knowledge in any knowledge management implementation. The sharing and application of knowledge are important drivers of the knowledge maintenance process. When knowledge is shared, the implied peer review and the additional testing that comes from further application of the knowledge serve to introduce an inherent correction process and to support quality control (Markus et al., 2002). For this process to offer value to organizational KM, it is necessary to provide a mechanism for ensuring that all identified changes are incorporated into organizational memory. In addition to the need to update and correct knowledge, de Holan and Phillips (2004) observed that organizational memory decays and must therefore be periodically refreshed if it is not to be forgotten.

**Knowledge Disposition.** Despite the value of organizational memory and the effort expended to create such memory, there are times when it is necessary for an organization to “forget” (de Holan and Phillips, 2004). By its nature, organizational memory can reinforce efforts to modify current knowledge and thereby make an organization resistant to more fundamental change (Alavi and Leidner, 2001; Argyris and Schön, 1978). Carlile (2004) noted the difficulty of abandoning knowledge and observed that the path-dependent character of knowledge begins to negatively impact outcomes as the novelty of a situation increases. In such situations, reliance on obsolete knowledge has been called the “curse of knowledge.” Although the need to forget has been acknowledged in the literature, consideration for forgetting in KM has been limited (de Holan and Phillips, 2004) despite the fact that unlearning renders information in knowledge repositories obsolete (Wang and Ariguzo, 2004). This is a salient omission since, as Boisot (2002) has noted, managing a firm’s knowledge does not mean maximizing it.

Organizational forgetting has been defined by de Holan and Phillips (2004) “as the loss, voluntary or otherwise, of organizational knowledge” and the importance of forgetting to the learning of new things has been highlighted by a number of researchers. In addition to the intentional forgetting of established knowledge, which they called purging, de Holan and Phillips identified three other modes of organizational forgetting. These are the accidental forgetting of established knowledge which they labelled degradation, the accidental forgetting of new knowledge which is referred to as dissipation, and the intentional forgetting of new knowledge which is referred to as suspension. Purging and degradation are of particular relevance to the management of organizational memory while dissipation and suspension impact what is eventually incorporated into organizational memory. de Holan and Phillips (2004) found, for instance, that new knowledge was readily forgotten (dissipated) and thus not incorporated into organizational memory while old knowledge stubbornly remained in organizational memory despite efforts to purge it. Of particular importance to the process of knowledge disposition was their observation that the rate at which new knowledge dissipated increased with increased incompatibility between new

and existing knowledge. Hence they concluded that organizations that are successful innovators would be more capable of purging.

**Facilitators of Feedback Mechanisms.** The preceding discussion suggests that knowledge review and evaluation capabilities, and in particular peer-reviews are important facilitators of knowledge maintenance and disposition. In addition, knowledge maintenance also requires records management capabilities such as versioning and purging (a facilitator similar to the ‘combination’ facilitator in knowledge generation).

**Summary of KM Activities and Facilitators**

Thus far we have identified the facilitators of each KM activity in order to create an evaluation framework for KMS. Table 1 provides a summary of the KM activities along with the corresponding facilitators (highlighted with grey squares). A review of Table 1 reveals that some facilitators are important to a number of KM activities and highlights the key role of facilitators such as the ability to externalize knowledge, the availability of metaknowledge, and the existence of shared frameworks, which support three of the five KM activities. Prior research has anticipated some of these findings with, for example, the broad role played by externalization being in accordance with the importance assigned to this facilitator by Carlile (2004) and Nonaka (1994). Other facilitators with broad roles are shared frameworks and search and retrieval capabilities. The need for improvement in the support provided by KMS for these facilitators is highlighted by authors such as Alavi and Leidner (2001) who cite research findings which indicate that the majority of organizations feel that their best knowledge is inaccessible and that they frequently repeat past mistakes.

**Table 1 - KM Activities and Associated Facilitators**

Knowledge Management Activities	Facilitators													
	Needs identification	Socialization	Externalization	Knowledge review and evaluation	Internalization	Knowledge building capabilities	Knowledge importation capabilities	Shared Framework	Physical storage	Categorization	Search and Retrieval	Identifying "who knows what"	Metaknowledge	Records management
Generation														
Codification														
Transfer														
Application														
Feedback Mechanisms														

We suggest that an organization approaching a KM project should first evaluate its needs in terms of KM activities and follow with studying the relevant facilitators of each activity. The organization can then move on to selecting the most suitable KMS to support its KM goals, based on the facilitators

supported by the considered systems. We further suggest that in selecting the KMS, the organization needs to focus on two aspects of the system: first, does the specific tool provide the functionality needed to facilitate the KMS activity? And second, how does the functionality provided by this tool fit with other tools already in use in the organization? The framework developed here can be used to address both questions, by charting the support that the tool (and all other organizational KMS considered or in place) provide in terms of facilitating the required KM activities.

To better understand how organizations can use the framework to evaluate their KMS, the next section offers an example of KMS evaluation using the facilitators described in Table 1.

### **Evaluating Knowledge Management Systems**

KMS have been defined as “a line of systems which target professional and managerial activities by focusing on creating, gathering, organizing and disseminating an organization’s ‘knowledge’” (Benbya and Belbaly, 2005, pg. 204). The repository model and the network model are the two most prominent models of KMS found in the literature (Wakefield, 2005). The repository model emphasizes creation, storage and retrieval of knowledge while the network model emphasizes social interaction and communication channels as means for transferring knowledge. These two models align, respectively, with the codification and personalization approaches to KM outlined by Hansen et al. (1999). In accordance with these two approaches, Alavi and Leidner (2001) reported that the three most common applications of IS to KM are the coding and sharing of best practices, the creation of knowledge directories, and the creation of knowledge networks. Alavi and Leidner also observed that KMS implementations have frequently focused on codified knowledge despite assertions that IS can effectively support the management of both explicit and tacit knowledge (Schultze and Leidner, 2002; Wakefield, 2005). Thus, we undertake in this section to provide a more detailed view of the relationship between KM and KMS in order to better establish how KMS technologies can be used to support the full spectrum of KM activities.

As noted in the introduction to this paper, there are numerous technology solutions available for organizations wishing to better manage their knowledge. However, as Gartner (2005) observed, KM is not simply about implementing an information system but rather it is a business program for managing a company’s intellectual assets. As such, the application of information technology to KM should be strongly aligned with the overall KM practices and activities in the organization. Moreover, Markus et al. (2002) have noted that the same design principles (KM facilitators in our case) can generally be delivered by a range of alternative technical features. Since the implementation of technology support for KM often involves a variety of tools, it is also important that organizations align these tools in and of themselves. In other words, there are two dimensions that organizations should evaluate: the extent of support provided for relevant KM facilitators and the extent of overlap among different tools considered for implementation. This approach provides a good balance for organizations, delivering the greatest support with the lowest investment.

Consider, for example, a hypothetical company looking at a potential KM solution such as the Enterprise product suite offered by Hummingbird ([www.hummingbird.com](http://www.hummingbird.com)). Table 2 offers a demonstration of how this product suite can be analyzed using the framework suggested in this paper. In Table 2, the shaded squares represent support of the tool for a facilitator while the partially shaded squares represent partial support. Partial support mainly implies that the support is limited to the scope of the tool as opposed to the overall organizational knowledge pool. For example, partial support in search and retrieval means that the user is able to search records within the specific tool but not conduct a global search of the organizational knowledge pool. In identifying support for facilitators the following guidelines were used:

- *Needs identification*: the tool enables users to identify knowledge gaps (e.g. a business intelligence tool which highlights unexplained patterns)
- *Socialization*: the tool provides some communication channels among organization members
- *Externalization*: the tool enables organization members to express their knowledge in a way that can be captured and communicated (e.g. create documentation of projects)
- *Knowledge review and evaluation*: the tool provides the ability to review knowledge, identify dated knowledge, evaluate knowledge based on known criteria, etc.
- *Internalization*: the tool facilitates the understanding of the knowledge (e.g. graphing or presentation capabilities)
- *Knowledge building capabilities*: the tool provides knowledge building capabilities such as brainstorming, prototyping, or others.
- *Knowledge importation capabilities*: the tool opens a channel to knowledge external to the organization
- *Shared framework*: the tool provides a taxonomy, ontology, or a similar facility
- *Physical storage*: the tool includes a knowledge repository of some sort
- *Categorization*: the tool enables the storage of knowledge according to predefined categories or provides support for identifying categories of knowledge
- *Search and retrieval*: the tool provides search and retrieval capabilities
- *Identifying “who knows what”*: the tool offers a knowledge map or similar, or presents knowledge along with its current owner or creator
- *Metaknowledge*: the tool provides the ability to tag knowledge either automatically or according to a predefined schema (the latter was identified as partial support).
- *Records management*: the tool provides basic records management and archival capabilities

Analyzing the information contained in Table 2 yields some valuable insights for the organization. At the support level, the analysis indicates that strong support is provided for knowledge generation, codification, and for the feedback mechanisms of maintenance and disposition. Weaker support is provided for knowledge transfer and application, mainly in terms of facilitating the transfer of non-codified knowledge. Nevertheless, some support for these activities is provided, mainly by the IM component. The organization should now evaluate its need and decide whether a supplementary tool would be useful, one that focuses on person-to-person communications (examples would be expertise locators, knowledge maps, or similar). Another insight for the organization is in terms of overlap in the support provided by some of the individual components. For example, using the eight KMS modules included in Table 2 provides the organization with very strong support for storing and managing codified knowledge. The organization may, however, be better off selecting a single content management component and supplementing it with other components (BI, workflow, etc.) according to its needs. In addition, minimizing the overlap in KM support can assist with efforts to avoid the creation of data silos while also reducing integration efforts, data duplication, and confusion within the organization regarding the choice of tool for a given task.

Moving away from the specific example of Hummingbird and looking at the wide array of KMS available to organizations, the framework proposed here can be applied by organizations to analyze the KMS market and devise an implementation strategy for KMS. A review of some current KMS technologies reveals a wide range of efforts that appear aimed at supporting the KMS facilitators summarized in Table 1. For instance, technology developed by Autonomy attempts to understand the actual content of any type of electronic information regardless of format or storage location. This technology offers support for knowledge generation, knowledge transfer, and knowledge application. A number of other vendors such as Hummingbird and OpenText have been expanding their product feature sets and adding optional modules to their product range with the result being that they are increasingly able to deliver a KMS implementation that supports many of the facilitators of KM by assembling and integrating a suite of suitable modules. Such products often integrate technologies such as shared

workspaces which support socialization, externalization, evaluation, and internalization with content management which supports physical storage, categorization, and search and retrieval. Additional modules such as the e-learning module and the archive module can also be integrated to provide support for other KM facilitators including knowledge importation and records management.

**Table 2 – An Application of the Evaluation Framework<sup>3</sup>**

Hummingbird's Enterprise Suite	Knowledge Generation						Knowledge Codification				Knowledge Transfer						Knowledge Application			Feed-back									
	Needs identification	Socialization	Externalization	Knowledge review and evaluation	Internalization	Knowledge building capabilities	Knowledge importation capabilities	Shared Framework	Records management	Externalization	Shared Framework	Physical storage	Categorization	Search and Retrieval	Metaknowledge	Socialization	Externalization	Internalization	Shared Framework	Physical storage	Search and Retrieval	Identifying "who knows what"	Metaknowledge	Search and Retrieval	Needs identification	Identifying "who knows what"	Metaknowledge	Knowledge review and evaluation	Records management
Business Intelligence (BI)																													
Document Management (DM)																													
Collaboration																													
Records Management (RM)																													
Instant Messaging (IM)																													
Knowledge Management (KM)																													
Content Integration																													
Workflow																													

<sup>3</sup> The tools identified in this table refer to specific modules of the Hummingbird Enterprise Suite. For more details on each module and its associated functionality please refer to the Hummingbird web site at [www.hummingbird.com](http://www.hummingbird.com)

It is important to note, however, that although several technological features may support a process, it would not be reasonable to expect a single feature or capability to provide comprehensive support. Thus, although e-learning suites can support knowledge importation, importation can also be supported by other technologies such as web conferencing and federated search capabilities which permit users to search across a wide range of knowledge repositories including those external to the organization. On the other hand, more focused, cost effective KMS implementations can be achieved by avoiding the introduction of several features which serve essentially the same role in facilitating KM. It might not, for instance, be cost effective to implement and support both video conferencing and web conferencing. It must, however, also be remembered that the determination of the support provided for a particular KM facilitator is subject to some interpretation and depends on such things as how the technology is implemented. For example, Enterprise IM might be expected to support knowledge importation if implemented in a manner that extends its functionality outside of the bounds of the enterprise.

In addition to an evaluation of individual facilitators, it is important to recognize that the facilitators work in concert to support KM activities (recall Table 1). A KMS implementation, for instance, that fails to provide adequate support for needs identification will hamper the organization's ability to improve knowledge generation. Consequently, KMS implementation strategies must consider the range of available technologies and identify a strategic mix of systems that work in concert to support the relevant facilitators of KM activities. The approach presented here provides a tool for this purpose as it permits any particular KMS technology and its intended implementation to be assessed for fit with the KM facilitators. An entire KMS implementation plan can be likewise evaluated to ensure that it does not have gaps, redundancies, or misplaced emphasis.

## **Discussion**

Walls et al. (1992) suggested that an IS design theory be both grounded in theory and provide guidance to practitioners. This paper has therefore sought to develop a theoretical framework for the evaluation of KM. The framework elucidates concrete facilitators of KM activities that can be used to enhance the development and implementation of KMS. Wiig et al. (1997) argued that the worst errors in KM come from solving the wrong problem or from selecting the wrong solution. This work can serve to counteract such errors by providing insights into both the nature of KM problems and the selection of suitable solutions. With the movement of KM from the management of strictly codified explicit knowledge to the management of both explicit and tacit knowledge (Sabherwal and Sabherwal, 2005) and given the link between dynamic style KM that manages both explicit and tacit knowledge and increased business performance (Wakefield, 2005), the importance of such insights can only be expected to increase.

Past KM frameworks have often neglected to include feedback mechanisms (Metaxiotis et al., 2005; Rubenstein-Montano et al., 2001). Thus, from a theoretical perspective, this paper makes explicit the incorporation of the knowledge maintenance and knowledge disposition feedback mechanisms into a KM framework with the resulting insight that this important KM activity receives only limited support from existing KM technologies.

The decomposition of KM activities into underlying facilitators can provide practitioners with a valuable tool for the assessment of KMS which holds the potential to improve the selection and implementation of KMS. For instance, Sabherwal and Sabherwal (2005) argued that knowledge generation is the most important KM activity in innovative industries. Drawing on such awareness, practitioners can use the facilitators of knowledge generation identified in this paper as evaluation criteria in the selection of KMS. In addition, facilitators that are under-supported can now become the focus of further development efforts. The limited support for feedback mechanisms, for instance, calls for further

development of tools that facilitate peer review of knowledge store contributions and routine review of organizational memory as well as tools which help organizations purge old knowledge in favour of new knowledge. Further developments of tools that aid in the identification of needs and encourage users to act on such needs are also warranted. Enhancements to intelligent agents, which operate in the background to provide users with knowledge based on their current work context, and similar technologies, is one possible approach to addressing this gap. Finally, the role of importation in knowledge generation might suggest that systems such as human resources information systems could be viewed as KM support systems in accordance with Alavi and Leidner (2001) who argued that the distinction between knowledge management systems and other information systems is ambiguous.

The contribution of the proposed framework is not limited to the organizational level. The facilitators identified in this paper can be used to evaluate the state of the practice of KMS development and identify gaps and overlaps at the KMS market level. Such analysis will be valuable in determining the maturity of the KMS market, in identifying future trends of development, and in better understanding the extent of technology support for organizational KM practices.

### **Limitations and Future Research**

The paper describes the development of a theory based evaluation framework for KMS. An example was used to demonstrate the applicability of the framework to organizations. This example does not, however, provide an in-depth test of the framework or its broad applicability. A more rigorous test of the proposed framework is therefore warranted, beginning with the development of sound propositions.

As with any other IS, KMS might also bear some organizational risks. For example, a significant risk is the loss of information. It has been claimed (Boisot, 2002) that this risk will increase as organizations become more successful at the abstraction and codification of organizational knowledge. Thus, future research should recognize such risks and seek to identify how KMS can be better planned to address them. It cannot, for instance, be assumed that all knowledge managed by a KMS is good or valuable (Schultze and Leidner, 2002). This paper has not sought to address the negative aspects of knowledge management and how they might be affected by KMS.

It could be expected that the implementation of some KMS technologies, while supporting certain KM facilitators, may impede others. For example, the introduction of automated business processes might help to ensure that current organizational knowledge is accessible but could reasonably be expected to impede the introduction of new knowledge. This paper has not made any attempt to identify such problems and further understanding of the issues would certainly be valuable. In addition, no attempt was made in this research to evaluate the relative importance of each facilitator. Incorporating such an assessment into this work may provide additional useful insights.

Finally, knowledge management practices may consist of a wide range of activities beyond the scope of information systems such as organizational structure and human resources policies (Cabrera and Cabrera, 2002). Although Holsapple (2005) argues that modern KM cannot be separated from IS, due consideration must be given to such factors and how they impact a KMS implementation.

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