A Holistic View of the Knowledge Life Cycle: The Knowledge Management Cycle (KMC) Model

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Abstract: As more companies implement knowledge management (KM), they require a practical and coherent strategy and practice anchored in a valid and comprehensive KM life cycle model or framework. Using a knowledge-based view, this paper aims to improve how firms conceptualize, strategize, and manage organizational knowledge. The paper opens with an analysis of organizational knowledge and knowledge assets. Appropriate conceptualization and partitioning of knowledge is required since the cost, benefit, and imitability of knowledge assets largely depend on their form. Subsequently, the paper provides a historical and chronological overview of some of the most influential KM life cycle models, based on their scholarly adoption and frequency of use by practitioners. Each represents an advance in the thinking concerning the KM life cycle and introduces valuable new elements to be considered in understanding how organizational knowledge is processed throughout its useful lifespan. Life cycle models examined include Wiig (1993), Meyer and Zack (1999), Bukowitz and Williams (1999), and McElroy (2003). Dalkir's (2005) integrated life cycle model and Heisig's (2009) examination of 160 KM frameworks are also reviewed for their contribution. Building on these models and prior work by Evans and Ali (2013), the Knowledge Management Cycle (KMC) model is proposed. Finally, sample KM initiatives, activities, and technologies are mapped to the seven non-sequential KMC model phases (i.e., *identify*, *store*, *share*, *use*, *learn*, *improve*, and *create*) to illustrate its practical use. The main contribution of the KMC model is that it provides a holistic view of the knowledge life cycle, by building on previous life cycles models and Heisig's (2009) analysis of KM frameworks. It further extends previous models by including different knowledge forms, integrating the notion of second order or double loop learning, and associating some facilitating initiatives and technologies for each of its phases.

Keywords: Knowledge management, KM life cycle, KM framework, initiatives, technology, knowledge, knowledge assets, tacit, codified, encapsulated

1. Introduction

There is no doubt that knowledge workers have dominated the North America workforce since the early 1980s (Earl, 1997). In fact, knowledge workers have been estimated to outnumber all other workers in North America by a factor of more than 4-to-1 (Zuckerman, 1994; Haag et al, 2006). Executives have acknowledged this by recognizing that the most important strategic asset in their organizations is the knowledge possessed by their employees (Wiig, 1993). However, many admit that it is not clear how to manage this asset (Wiig, 1993). Nonaka and Takeuchi (1995) and Drucker (1991) see raising the productivity of knowledge workers as the single greatest challenge that managers face, which will ultimately determine the competitive performance of organizations.

Knowledge Management (KM) consists of the systematic processes for acquiring, organizing, sustaining, applying, sharing, and renewing all forms of knowledge, to enhance the organizational performance and create value (Davenport and Prusak, 1998; Allee, 1997; Alavi and Leidner, 2001; Al-Hawamdeh, 2003; Choo, 2006). KM is about acting to build and leverage knowledge through an understanding of how it is created, acquired, processed, distributed, used, harnessed, controlled, etc. (Wiig, 1993). Therefore, KM aims to facilitate the access, use, and reuse of valuable knowledge resources (Dieng-Kunz and Matta, 2002). Effective knowledge management involves learning to manage knowledge as both an object and as a process (van den Berg, 2013; Choo, 2006), which requires executives to develop a general understanding of what knowledge is, as well as efficient and systematic methods for managing it within the organization.

More than two decades ago, Wiig (1993: 9) called for 'coherent and practical' frameworks for KM. 'The lack of [a] framework for managing knowledge on a broad and relevant basis has been a problem for managers [as] they have not had ways of "thinking about thinking" with practical directions for how to deal with all the required knowledge-related aspects and supported by practical methods' (Wiig, 1993: 11). Wiig (1993) argued that if such practical guidelines existed there would be far more adoption of KM practices, as well as more organizational resources devoted to KM.

Using a knowledge-based view, this paper is driven by a desire to improve how firms conceptualize and manage organizational knowledge. A knowledge-based view presupposes that knowledge is the most basic and valuable strategic and economic asset of the organization (Drucker, 1993; Wiig, 1993; Earl, 1997), as well as the foundation of

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all functions and facets of the enterprise (Wiig, 1993). According to Boisot (1998), knowledge minimizes the amount of effort needed for information (and physical) processes. Knowledge also enables the development and improvement of products and services (Choo, 2006; Nonaka and Takeuchi, 1995; Boisot, 1998). Argote and Ingram (2000) and Wiig (1993) purport that effective knowledge processing forms the basis of competitive advantage in organizations and is critical to the survival of the firm. Employees cannot leverage current or past understandings to make more effective and innovative decisions, unless knowledge is accessed and shared.

2. Knowledge and Knowledge Assets

Answering the problematic question of 'what is organizational knowledge' seems like a logical starting point for developing a knowledge management framework. However, epistemologists and philosophers have been plagued with defining this concept for thousands of years. As Wiig (1993: 71) points out, knowledge is 'one of the most nebulous and difficult concepts encountered in our pragmatic efforts to conduct business'. Following van den Berg (2013), this paper does not seek to resolve these debates, rather to suggest some operational notions of organizational knowledge and knowledge assets.

Some researchers (Bollinger and Smith, 2001; Goh, 2002; Boisot, 1998) have come to view organizational knowledge as a strategic asset. Through this perspective, knowledge is 'an asset in its own right and not simply […] an enhancement of other kinds of assets' (Boisot, 1998: 2). Building on Grant (1996), van den Berg (2013: 160) further elaborates, by suggesting that knowledge is more of a meta-resource, since it 'transcends basic resources and is the unique source of economic growth and value'.

Organizational knowledge assets are defined as 'stocks of knowledge' Boisot, 1998: 3) through which a variety of value added services flow. Knowledge assets may also be referred to as intellectual assets (Dalkir, 2011; Stewart, 1994), which may be thought of as what is known by the organization and its employees. In theory, these assets could have a long lasting, open-ended value since there is a nonlinear relationship between the effort used in creating them and the value they yield for the organization (Boisot, 1998). Boisot (1998) classifies knowledge assets along two important dimensions, which comprise the founding concepts for their analysis. The first is the degree to which knowledge assets may be abstracted, where abstract principles have more widespread application and larger scope than specific principles. The second dimension focuses on the extent to which a knowledge asset can be given form (often referred to as *codification*).

2.1 Forms (shapes) of Knowledge

Boisot (1998) and van den Berg (2013) suggest that the cost, benefit, and imitability of knowledge assets largely depend on their form. Therefore, to manage organizational knowledge as a strategic asset, some conceptualization and partitioning is required. Most KM theorists recognize knowledge as having several forms or shapes, with the most popular perspective being the dichotomy of tacit vs. explicit knowledge.

Explicit knowledge is commonly defined as knowledge that can be formally expressed using a system of symbols (e.g., words, formulae) (Choo, 2006; Polanyi, 1966; Nonaka and Takeuchi, 1995; van den Berg, 2013). Wiig (1993: 71) expounds explicit knowledge as being 'describable and tangible'. Choo (1998) further separates explicit knowledge into rule-based and object-based. The former is 'codified into rules, instructions, specifications, standards, methodologies, classification systems, formulas' (Choo, 1998: 112). The latter is further divided into knowledge that is represented as 'strings or symbols (words, numbers, formulas) or is embodied [i.e., made tangible] in physical entities (equipment, models, substances)' (Choo, 1998: 112). Making this distinction between forms of explicit knowledge (i.e., whether the knowledge can be codified using a system of symbols, or embedded or encapsulated as an artifact) is imperative to managing knowledge effectively (van den Berg, 2013; Wiig, 1993; Choo, 2006).

Codified knowledge or 'knowledge that can be stored or put down in writing without incurring undo losses of information' (Choo, 1998: 110) allows for greater fluency, especially in its dissemination (Boisot, 1998). This form of knowledge is highly refined (Wiig, 1993) and formalized, which allows it to be disseminated, more easily, more rapidly, and more extensively in the organization than other forms (Grant, 2002; Choo, 2006; van den Berg, 2013). Codification also has an economic advantage for the organization, as the easier it is to codify a knowledge asset, the less expensive is to create (Boisot, 1998), replicate, and share it since it is commonly held within the organization (van den Berg, 2013). However, the characteristics of this type of knowledge also increase the likelihood for it to be misappropriated (van den Berg, 2013).

Van den Berg (2013: 164) argues that 'it may be constructive to consider knowledge organized in an encapsulated configuration as a classification of knowledge distinct from codified knowledge'. Encapsulated (or embedded)

knowledge is an object-based explicit knowledge (Choo, 2006), where the codification takes place in the design and functionality of artifacts (van den Berg, 2013; Wiig, 1993; Gorga, 2007; Boisot, 1998). Some common examples include patents, products, tools, prototypes, software code, models, technical drawings, etc. (Choo, 2006; van den Berg, 2013; Wiig, 1993; Kogut and Zander, 1992). Encapsulated knowledge is not fully codified, since the substantive knowledge that went into the design and development of artifacts remains partially hidden from its users (van den Berg, 2013). 'Encapsulation consists of the transformation of substantive knowledge into a product that requires only functional knowledge for its utility' (van den Berg, 2013: 163-164). Extracting and codifying encapsulated forms of knowledge requires further unpacking using methods similar to reverse engineering or compositional analysis (van den Berg, 2013; Choo, 2006).

Encapsulated knowledge has value to the organization because it permits users to gain utility from its functional use, without having to possess substantive knowledge (van den Berg, 2013; Gorga, 2007). In addition, 'knowledge encapsulated in artifacts design and functionality minimizes the cognitive load on users' (van den Berg, 2013: 165). However, encapsulated knowledge may be more expensive to create, replicate, and share than codified knowledge. This is because encapsulated knowledge is more concrete (Boisot, 1998) and most users only gain functional benefits from it (e.g., using a dashboard reporting tool without needing to understand how it compiles and visualizes information). Although, like codified knowledge, encapsulated knowledge is commonly held in the organization and may also be subject to a misappropriation (i.e., if it can be unpacked properly).

The third form of knowledge is tacit knowledge, which simply put, is uncodified knowledge (Choo, 2006; Polanyi, 1966; Nonaka and Takeuchi, 1995; van den Berg, 2013). This form of knowledge is commonly referred to as being: complex, unrefined, difficult to articulate, implicit, automated, internalized, abstract, and idiosyncratic (Spender, 1996; Choo, 2006; Wiig, 1993; Boisot, 1998; van den Berg, 2013). Tacit knowledge is personal and action oriented (Choo, 2006; Polanyi, 1966). It must be acquired and accumulated in the minds of employees (where it resides), through experience and over time (Wiig, 1993, van den Berg, 2013; Choo, 2006; Nelson and Winter, 1982; Winter, 1987). Wiig (1993: 161) refers to it as non-conscious or 'so internalized that we have lost conscious access to it'. It is utilized in employee problem solving and decision making and evidenced in the way in which relationships are utilized and how information and other resources are used. (Polanyi, 1962; 1966; Polanyi and Prosch, 1975; Tsoukas, 2005b; Evans and Ali, 2013). Since this form of knowledge is not fully consciously available to the individual, any attempt to capture or store such knowledge will ultimately result in the loss of its essential elements (Choo, 2006; Wittgenstein, 1953; Polanyi, 1966; Tsoukas, 2005a).

Tacit knowledge is likely to have the most value to an organization because of how it is unique in nature (Earl, 1997). Organizations learn and innovate by leveraging tacit knowledge (Choo, 2006); however, its transference is slow and expensive (Grant, 2002; van den Berg, 2013; Kogut and Zander, 1992; Choo, 2006; Boisot, 1998; Heiman and Nickerson, 2004). As previously mentioned, the more complex and abstract knowledge is, the more costly is for the organization to create, replicate, and share it (Boisot, 1998; van den Berg, 2013). Tacit knowledge is costly and difficult to use for leveraging because it is difficult to communicate to others and cannot be reduced to a set of rules, systems, or elements (Choo, 2006; van den Berg, 2013; Teece, 1998). Organizations may consider tacit forms of knowledge assets as intangible assets (Evans and Ali, 2013).

The three forms of organizational knowledge are interdependent (Choo, 2006) and 'codified and encapsulated knowledge ultimately originate from tacit knowledge' (van den Berg, 2013: 167). Tsoukas (2005b: 158) refers to explicit and tacit forms of knowledge as 'two sides of the same coin'. Essentially, codified and encapsulated knowledge provide the grounding of meaning and the basis for the interpretation to a tacit activity. 'Uncodified knowledge provides background context and warrants for assessing the codified' (Duguid, 2005: 112). Further, in attempting to codify or encapsulate tacit knowledge, it is important to understand that some remnants remain in the human mind (Choo, 2002; Spender, 1996; van den Berg, 2013; Tsoukas, 2005ab; Evans and Ali, 2013). For instance, certain patterns of thinking or intuitions used in solving complex problems may only exist in the individual's memory and seldom be elicited, codified, and stored for reuse (Tsoukas, 2005ab; Boisot, 1998; Evans and Ali, 2013). This may be 'because they are inarticulable or because they are too idiosyncratic to justify the effort involved in articulating them' (Boisot, 1998: 13).

The next section provides a historical and chronological overview of some of the most influential KM life cycle models. Each represents an advance in the thinking of the KM life cycle. Each life cycle introduced valuable new elements to be considered in understanding how organizational knowledge is processed throughout its useful lifespan. Early life cycle models include Wiig (1993), Meyer and Zack (1999), Bukowitz and Williams, 1999, and McElroy (2003). Dalkir's (2005) integrated life cycle model and Heisig's (2009) examination of 160 KM frameworks are also reviewed for their contribution. Based on these existing life cycle models and frameworks, a new integrated model is proposed.

3. Historical Overview of KM Life cycles, Frameworks, and Activities

As previously mentioned, Wiig (1993: 9) was among the first to address the need for a 'coherent and practical framework for KM', which he attempted to create by identifying a set of organizational knowledge processing phases. His approach was based on the principle that knowledge must be organized, to be useful and valuable (Dalkir, 2011). In addition, any model used to depict how knowledge is built and used 'must be both flexible and quite specific as to how different needs can be met' (Wiig, 1993: 55). Wiig's (1993) model is characterized by the use of colloquial terms to describe each of the four major phases (stages) namely: *build*, *hold*, *pool*, and *apply* knowledge.

In the first phase of the model, *build*, the author references major functions and activities that knowledge workers engage in, to make products and provide services. These activities include obtaining, analyzing, reconstructing (synthesizing), codifying, and organizing knowledge. Building knowledge starts with its acquisition through a variety of means, such as personal experience (experiential learning), formal education or training, and sources such as books, peers, etc. This is a form of learning, but knowledge acquisition also extends to analyzing the knowledge that is obtained, reconstructing it in different ways (e.g., as an executive summary report), codifying and modeling the knowledge (e.g., as in a conceptual map), and organizing the acquired knowledge (e.g., as a taxonomy). Analyzing knowledge often involves extracting meaning and value, such as abstracting, identifying patterns, discovering causal relations, and also verifying that the content is correct and valid. Some examples of the knowledge building phase are conducting market research, competitive intelligence studies, synthesizing lessons learned, or documenting frequently asked questions (FAQs) in order to post them on a website. At an organizational level, knowledge acquisition can be done, for example, by hiring people or through research and development projects.

The second phase of Wiig's (1993) model, *hold*, involves remembering, accumulating and embedding knowledge in repositories, and archiving knowledge. In other words, knowledge is internalized in the employees' minds or held in more tangible forms, such as documents and archives. Computer-based repositories or scientific libraries can also be used to accumulate new and archive old knowledge.

The third phase, *pool*, relates to the collective or group level of the organization and refers to coordinating, assembling, accessing, and retrieving knowledge. Forming collaborative teams or expert networks represent ways of pooling the knowledge. Other approaches involve the use of technological systems, such as portals or intranets. Knowledge can also be pooled through social interactions, such as apprenticeships, brainstorming sessions, and consulting with coworkers. Expertise locator systems, a form of corporate yellow pages, can help employees find out 'who knows how to do what', by searching the database. Some other examples of approaches to pooling knowledge include digital libraries or knowledge base systems.

Finally, the fourth phase, *apply*, refers to knowledge being used in order to generate benefits. Wiig (1993) mentions the use of refined knowledge for routine tasks and more general knowledge to survey exception situations. Knowledge can be used in the work context to describe various scenarios and determine the scope of the problem at hand, either as encapsulated knowledge or as knowledge that is applied to successfully complete the task. In other words, knowledge is used to support observation, characterization, and analysis of a situation. In addition, knowledge is used to support the synthesis and evaluation of potential alternatives, make a decision as to what to do, and finally to implement a solution by executing the appropriate tasks.

One of the advantages of Wiig's (1993) model is that knowledge processing is considered at three levels: the individual, the group, and the organization. The four phases in Wiig's (1993) life cycle are discrete, but they need not necessarily be carried out in order. Often, phases can be conducted in parallel and repeated as needed. Another strength of this model is that it provides a more nuanced approach to the classification of knowledge to be managed. This, in turn, enables practitioners to take a more pragmatic and refined approach to maintaining knowledge, beyond the simple tacit vs. explicit dichotomy (Dalkir, 2011).

Meyer and Zack's (1999) KM life cycle focused more on the architecture of information products, where they used the term information to include knowledge content. In their broad definition of information products, Meyer and Zack (1999) include information circulated both internally and externally, in electronic (i.e., information systems) or printed form. Information products are not as directly observable as physical products, yet they exhibit similar characteristics: they are 'part of product families, product and process platforms, and derivative products' (Meyer and Zack, 1999: 46). The authors' model is based on an information-processing perspective. Their assertion is that 'the product platform of an information products business is best viewed as a repository comprising information content and structure' (Meyer and Zack, 1999: 47) and the content is what ultimately forms the substance of the information products. The five information (knowledge content) stages of the Meyer and Zack (1999) life cycle include: *acquisition*,

refinement, *storage/retrieval*, *distribution*, and *presentation/use*. These stages are not always followed sequentially and there can be feedback loops among them.

The *acquisition* phase refers to the gathering of information, with the caveat that the source data should be of high quality, so that the downstream integrity of the life cycle is not compromised. The authors refer to the adage 'garbage in, garbage out' (Meyer and Zack, 1999: 48) as a guiding principle of this phase.

The *refinement* phase, may it be in a physical (e.g., translation of information between various media) or logical form (e.g., labeling or indexing the information), is the primary source of value added and can also include a process of cleaning and standardizing the information (Meyer and Zack, 1999). This phase creates value not only through producing usable information, but also through allowing the information to be stored flexibly, in different formats and on different media. Some of the specific processes in this phase involve the analysis, interpretation, integration, synthesis, and standardization of information. However, the caveat of this phase is that, in creating flexibility, the information previously acquired may have to be converted into a more meaningful or useful format.

The authors see the next phase, *storage/retrieval*, as a 'bridge between the upstream acquisition and refinement stages that feed the repository (product platform) and the downstream stages of product generation' (Meyer and Zack, 1999: 48).

The next phase in the model is *distribution*, which entails the delivery of information and the timing and frequency of this delivery. The medium used for delivery can vary and may take electronic (e.g., email, radio, television, etc.) and/or print formats. The caveat of this phase is that medium and content are interrelated. For example 'audio data must have a way to deliver audio signals' (Meyer and Zack, 1999: 48), which may impede on the flexibility of storage.

The final stage of the model is the *presentation/use*, which, among other issues, addresses the characteristic of establishing the value of information (i.e., the value added) through the context of its use. Meyer and Zack (1999) assert that the ease of use (i.e., the quality of the presentation interface) is as important as the usefulness of information (i.e., the content being presented).

The Meyer and Zack (1999) model, while overlapping the Wiig (1993) model in terms of its *acquisition* and *storage/retrieval* phases, brings a significant contribution to the landscape of KM frameworks, through the *refinement* phase. The authors were the first to introduce the notion of critically assessing knowledge before allowing it to pass on to the next processing phase. *Refinement* also describes a process of breaking down knowledge into its component parts. An example would be to highlight and hyperlink only the relevant portions of a document, rather than the entire electronic resource. The Meyer and Zack (1999) model also places a greater emphasis on the distribution of knowledge primarily through technological means, rather than simply referring to pooling or aggregating content.

In examining the above models, it is noted that they typically involve sequential performance of the stages that they identify, with a prescribed sequence that is followed, and an implied beginning and end. Among the first to introduce the notion of a cyclical sequence of knowledge processing steps, were Bukowitz and Williams (1999). In their model, there are phases that are similar, if not identical, to those found in the both the Wiig (1993) and Meyer and Zack (1999) models (e.g., *get*, which is the same as *build* and *acquire*; *assess* is similar to *refine*; *build/sustain* is similar to *hold* and *storage/retrieval*; and *contribute* is similar to *use/apply* and *distribution*). Furthermore, the *get* step in Bukowitz and Williams' (1999) model discusses a similar guiding principle as Meyer and Zack's (1999) garbage in, garbage out – quality over quantity. 'Knowledge repositories […] are not dumping grounds for every thought anyone in the organization has ever had. They should be containers for knowledge that the organization […] considers important and potentially useful to others' (Bukowitz and Williams, 1999: 76). However, Bukowitz and Williams (1999) take this principle a step further in the *use* phase, by asserting that, in using the information available, its effectiveness and efficiency are no longer adequate enough. Innovation and out-of-the box thinking now become key elements in the process of applying the knowledge to specific situations. Ideas must flow in and out of the environment ('permeability'), crossing organizational boundaries and exposing knowledge workers to different perspectives and possibilities (Bukowitz and Williams, 1999). The organization can provide tools (e.g., processes and systems) that encourage collaboration and allow information to become an open resource that moves fluidly and dynamically throughout the organization. Furthermore, the *build and sustain* phase is distinguished by the addition of the term 'sustain' to highlight the importance of not only acquiring knowledge, but also making sure it remains valid, up to date, and usable.

One of the main contributions of the Bukowitz and Williams (1999) model is the *learn* phase, in which individuals learn from their experiences and organizations create an organizational memory. The authors also use the term *contribute* to describe the phase in which knowledge is acquired, in contrast to the *get* or *acquire*. The advantage is that the word

'contribute' better describes the voluntary nature of knowledge management, namely that employees must be motivated and encouraged to post (share) what they have learned to a knowledge repository or organizational memory. Valuable knowledge, that can serve to help coworkers, needs to be encapsulated. Perhaps more importantly, it is critical that knowledge not be completely separated from the people knowledgeable about that content, as there will always be added value in having someone advise, coach, or simply help others apply the content in the right context. However, learning from both successes and failures, improving the outcome of future projects by understanding how actions affect the outcomes of current projects, and encapsulating the added value gained through learning may not be easy to capture in a knowledge repository. To further stimulate the voluntary sharing of knowledge, the organization can employ various systems and structures that support contribution, remove potential sharing barriers, and motivate and allow employees the necessary time to contribute their best work (Bukowitz and Williams, 1999).

Another important contribution of the model is that it introduces novel steps. In particular, the addition of *divest* is significant, as knowledge processing should not duplicate the efforts of warehousing or backing up content. Therefore, the *build and sustain* or *divest* phases become a decision point whereby the knowledge unit may be retired or completely removed from the life cycle. Divesting could take the form of outsourcing or spinning-off a company, for example, determined by the understanding of the knowledge base parts that will be unnecessary, moving forward, for maintaining a competitive advantage (Bukowitz and Williams, 1999). The authors assert that a strategy of discriminating between 'forms of knowledge that can be leveraged and those that are limited [and] finding alternatives to direct acquisition' (Bukowitz and Williams, 1999: 323) can result in unnecessary knowledge not being acquired in the first place. While this idea of forbearance – self-controlling what knowledge is to be acquired and not simply following what other organizations are doing – may seem strange, the authors, however, argue that it should be part of the organizational strategy. Adopting a more contemplative and nuanced approach and not blindly acquiring knowledge in the first place, pushes organizations into finding new and innovative ways to achieve their strategic objectives (Bukowitz and Williams, 1999).

McElroy's (2003) approach to creating a KM life cycle model was quite different than the previous models. The model starts with a phase called *knowledge claim*, which immediately requires a validation action, the *knowledge claim evaluation*. In other words, to be processed, all knowledge must first be deemed worthy, before proceeding further. It is this validation process, in the form of procedural or declarative rules, that results in the formal acceptance and adoption of new organizational knowledge (McElroy, 2003). A claim must be formulated and evaluated through the individual and group learning and acquisition processes. If the claim is found to be valid, the knowledge is then codified and circulated throughout the organization. If it is not valid, the knowledge is discarded. However, there is a third possible outcome – the claim is undecided. Much like the Scottish justice system, this is a 'not proven' outcome, which typically occurs where there is insufficient information to make a decision. In this case, additional steps must be taken to further assess the usefulness of the content, and this process is repeated until a decision can be made.

The second phase of the model, *knowledge integration*, relates to sharing and disseminating the newly validated knowledge. Knowledge is viewed as being held by both individuals and, collectively, by groups. Furthermore, this phase recognizes that knowledge will either meet the business expectations, or fail to do so. If there is a match, reuse will occur. Any mismatches will result in adjustments in the individual and/or the organizational behaviour, which, in turn, result in more learning. However, it must be noted that these adjustments call for 'acts of willful transformation, both by the sponsor of the new [knowledge], as well as by the workforce that the changes affect' (McElroy, 2003: 76). Therefore, the integration of new knowledge implies 'the deliberate abandonment of one set of operating rules in the favor of another' (McElroy, 2003: 76).

Recognizing the capacity to learn, innovate, adapt to change, and not mechanically apply knowledge in practice is one of the main characteristics of the second-generation KM (McElroy, 2003). In double-loop learning (Argyris and Schon, 1996; McElroy, 2003; Evans and Ali, 2013), knowledge is no longer just a collection of reference rules that can be applied in response to a situation, rather it is 'challenged', resulting in 'alternative scenarios in which we play out likely outcomes' (McElroy, 2003: 70). The main purpose of this challenge (e.g., a knowledge claim evaluation) is to test innovative ideas and potentially choose a different response path (which in itself may evolve through time) that provides the best knowledge for the situation at hand. There is also a need to constantly question existing knowledge. Along with incorporating the idea of double-loop learning, the major contribution of this model is the inclusion of a phase in which a conscious decision must be made as to whether knowledge should be processed through the life cycle, until it is eventually incorporated into the organizational memory.

Dalkir (2005) investigated the above four life cycle models (Wiig, 1993; Meyer and Zack, 1999; Bukowitz and Williams, 1999; and McElroy, 2003) with respect to their scholarly adoption and frequency of use by practitioners. Dalkir (2005)

further set out to formulate an integrated life cycle model that incorporated most of the elements of the above models. The intent was to simplify the KM life cycle as much as possible by combining phases where possible and by identifying key activities before linking them to major phases. The author's integrated life cycle included the following phases: *create/capture*, *assess*, *share/disseminate*, *contextualize*, *apply/use*, *update*. In this model, tacit knowledge must be 'created' or codified, while explicit knowledge must be 'captured' or identified. To be more widely disseminated, knowledge must then be assessed with respect to its degree of generalizability, interest and relevance to specific target audiences, and general suitability. The next phase is about sharing (between people) and disseminating (typically using a technological platform). In order to optimize sharing and maximize reuse, knowledge must be contextualized. This will usually involve documenting metadata and providing supporting materials – anything from simple annotations to fully developed 'user manuals' – so that others may better understand how to make use of the knowledge. In the final stage, the knowledge is applied or reused in a work context. As this is a cycle, and not a sequence, it is important to ensure that the knowledge is sustained, which typically involves updating it and feeding it back into the cycle. The major contribution of Dalkir's (2005) integrated model is to highlight the similarities between the earlier life cycle models.

In 2009, Heisig took a more empirical approach to identifying KM activities used to manage organizational knowledge, which can be used to inform the construction of a new integrated KM life cycle model. Using a mixed methods approach, the author conducted a content analysis of 160 KM frameworks that have been proposed. Frameworks were identified through the scholarly literature, academic and practitioner conference publications (1998-2003), corporate KM initiatives, and Internet searchers. The author also conducted a 'call for frameworks', using a direct survey targeted at KM professionals. The collected frameworks were published from 1995 to 2003, with more than half being published after 2001. In total, more than 165 unique terms were identified as KM activities in the frameworks. However, Heisig (2009) judged many of these terms to be essentially synonymous, and concluded that KM activities fell into six broad categories. Of these, the six most frequently mentioned activities included: *use*, *identify*, *create*, *acquire*, *share* and *store*. Notably, 73 percent of the KM framework activities examined were explicitly designed to manage knowledge (74 percent of frameworks mentioned different dimensions of knowledge and 52 percent adopted different knowledge dichotomies – e.g., tacit vs. explicit).

Clearly, the main strength and contribution of Heisig's (2009) comprehensive review of existing frameworks, is the breadth of analysis. More interestingly though, Heisig was the first researcher to solicit and involve users (organizations and KM practitioners) in the identification of KM frameworks and activities associated with KM. This research makes a contribution to the life cycle literature, since Heisig's (2009) broad categories of KM activities represent the most popular, practical, and coherent activities used, from a practitioner perspective. The main limitation of Heisig's (2009) research was that there was no distinct conversion of these activities into a KM life cycle, either cyclical or sequential.

4. The Knowledge Management Cycle (KMC) Model

By integrating the KM life cycles reviewed thus far with Heisig's (2009) findings can result in the construction of a simple, practical, and comprehensive KM life cycle model. Building on Evans and Ali's (2013) model, the Knowledge Management Cycle (KMC) model advanced in this paper contains seven phases: *identify*, *store*, *share*, *use*, *learn*, *improve*, and *create* (Figure 1).

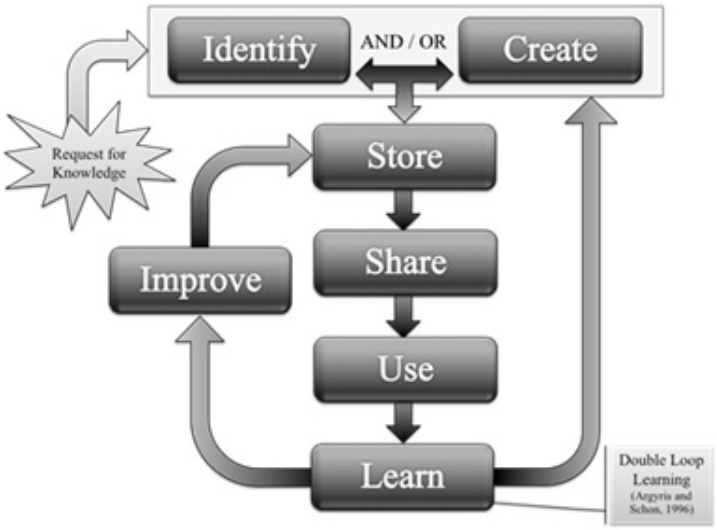

Figure 1 The Knowledge Management Cycle (KMC) Model

4.1 Identify and/or Create

A knowledge request may be triggered for numerous reasons, some of which include strategic and/or operational problem solving, decision making, knowledge gap analysis, or innovation. When a request for knowledge is made, the searcher must *identify* if appropriate knowledge exists in-house, or if appropriate knowledge assets need to be *created* or acquired.. This is one of the reasons why these phases are interrelated and grouped together in the KMC model. In some cases, the searcher may find that they will both identify existing appropriate knowledge assets and also have a need to create new knowledge assets. This is another reason why these two phases are shown together in the KMC model. Even though there is clear overlap, for the purpose of clarity these phases need to be addressed separately.

4.1.1 Identify

The *identify* stage involves eliciting codified and encapsulated knowledge assets (e.g., documents in electronic and print format stored in a knowledge repository and/or live demonstrations and observations of artifacts). In addition, this stage identifies subjectively held tacit knowledge (McElroy, 2003; Dalkir, 2011) through methods such as network analysis or brainstorming sessions. Inevitably, this will be interrelated with the *store* phase. Along with effectively searching for knowledge assets, the *identify* stage subsequently involves analyzing and assessing the assets based on specific organizational rules, cultures, and evaluation criteria. According to Wiig (1993), analysis involves reviewing and extracting what appears to be value in the asset and abstracting it further to find potential underlying knowledge. Other models (Meyer and Zack, 1999; Bukowitz and Williams, 1999; Dalkir, 2011) include an assessment, which is meant to identify and extract patterns and relations, and then evaluate the value of the asset as a feasible solution to the problem or decision at hand. It is critical that, throughout the analysis and assessment, emphasis is placed on the quality (Meyer and Zack, 1999; Bukowitz and Williams, 1999) and relevance of the information extracted from the knowledge asset. Some general metrics include accuracy, currency, credibility, and value to the organization. The *identify* stage of the KMC model is most similar to *build* (Wiig, 1993), *acquisition* (Meyer and Zack, 1999), *get* (Bukowitz and Williams, 1999), *claim* (McElroy, 2003), *capture* (Dalkir, 2005), and *identify* (Evans and Ali, 2013).

4.1.2 Create

A knowledge request may trigger the need for new knowledge assets to be created, if none are found through searching during the *identify* stage. New knowledge assets may also need to be created if existing knowledge assets only partially satisfy knowledge needs. Some common organizational initiatives that assist in the creation of new knowledge assets include expert interviewing, prototyping, information and workflow analysis, and competence and process mapping. An example of technology that can be used in this phase is idea management software. The creation of new knowledge assets should follow the same guiding principles as those relating to analyzing and assessing

knowledge assets, as outlined in the *identify* stage. The *create* stage of the KMC model is most similar to the *create* stage in Evans and Ali (2013) and both *contextualize* and *create* in Dalkir (2005).

4.2 Store

Once the knowledge has been deemed valuable to the organization, based on the analysis and assessment in the *identify* and *create* phases, it is stored as an active component of the organizational memory. This may entail retaining more codified forms of knowledge into corporate portals and encapsulating knowledge artifacts and tools through prototyping. More tacit forms of knowledge may be stored in the form of knowledge audits, maps, models, and taxonomies. However, the repository cannot be a random collection of knowledge assets, regardless of their individual and collective value. Beyond their intrinsic value, knowledge assets must be stored in a structured way that allows them to be efficiently manipulated, retrieved, and eventually shared. Common related activities include metatagging, templating, annotating, classifying, archiving, linking, and optimizing search and retrieval. These activities extend Meyer and Zack's (1999) labelling, indexing, and cross-referencing. The *store* stage of the KMC model is similar to *hold* (Wiig, 1993), *storage/retrieval* (Meyer and Zack, 1999), *build and sustain* (Bukowitz and Williams, 1999), *assess* (Dalkir, 2005), and *organize and store* (Evans and Ali, 2013).

4.3 Share

Knowledge assets are retrieved from the organizational memory, to be shared (disseminated/communicated) both internally and externally. The timing and frequency of sharing can be either pre-established (e.g., immediately after the new/updated knowledge asset has been stored – similar to a 'push' approach) or in an ad-hoc fashion, based on immediate need (similar to a 'pull' approach). The process through which knowledge is shared is important, as employees are seldom aware of its existence, particularly when new knowledge is created and stored. As Bukowitz and Williams (1999) assert, it is not uncommon for organizations to seek knowledge outside their boundaries, when in fact that knowledge may already exist. Having an explicit, dynamic, and flexible (Wiig, 1993; Meyer and Zack, 1999) network of expertise (e.g., community of practice) fosters collaboration and can greatly assist in the sharing of organizational knowledge assets. The sharing of more tacit forms of knowledge may be encouraged through coaching, mentoring, and apprenticeships programs as well as through storytelling, narratives, and anecdotes (Swap et al, 2001; Peroune, 2007). It is also important to choose the optimum mix of technologies and dissemination channels, as various communication media have their own strengths and weaknesses (Dalkir, 2011). The choice of medium is not only a function of specific professional tasks (Dalkir, 2011), but also dependent on the KM maturity of the organization. The more mature the organization, the more efficient the medium, and the more timely the sharing of knowledge. Some of the more common technologies used to share knowledge assets include communication and collaboration technologies and many current customer relationship, supply chain management, and decision support systems. It should also be noted that the *share* phase of the KMC model can be seen as a bridge between the upstream knowledge 'hunting and gathering' and the downstream putting knowledge into practice (exploitation and exploration). The *share* stage of the KMC model is most similar to *pool* (Wiig, 1993), *distribution* (Meyer and Zack, 1999), *contribute* (Bukowitz and Williams, 1999), *integration* (McElroy, 2003), *share/disseminate* (Dalkir, 2005), and *share* (Evans and Ali, 2013).

4.4 Use

Once shared, knowledge assets can be activated (put to use) – their value can be extracted and applied throughout the organization, to solve problems, make decisions, improve efficiency, or promote innovative thinking. Knowledge assets can be used in encapsulated form (Wiig, 1993), but there will always be some degree of tacit knowledge that is applied. As Dalkir (2011) posits, codified forms of knowledge may not, by themselves, translate into understanding. For example, there may be some contextual information that has not been encoded or tacit knowledge that has not been encapsulated. In addition, the larger or more complex a knowledge asset is, the more difficult it may be for value to be extracted from it. Therefore, the intervention of an expert may be required to apply the knowledge correctly and efficiently. An example of such intervention would be taking a general document and making it specific for the problem that needs to be solved, which is referred to as 'recontextualization of knowledge' (Dalkir, 2011: 211). The *use* stage is also key to internalizing tacit forms of knowledge. Yuasa (1987: 25) called this 'learning with the body' and Boisot (2002: 73) 'learning-by-doing'. This is usually done by assimilating and dwelling in the activity or with the artifact (Polanyi, 1962; 1966; Polanyi and Prosch, 1975; Tsoukas, 2005b). Some of the more common activities that assist in the *use* stage include developing communities of practice, workshops, and tutorials. The technologies employed in these activities include, for example, incident and help desk systems, expert systems, and communication and collaboration technologies. It is important to note that unless this phase is accomplished successfully, 'all of the

KM efforts have been in vain, for KM can only succeed if the knowledge is used' (Dalkir, 2011: 183). The *use* stage of the KMC model is most similar to *apply* (Wiig, 1993), *presentation/use* (Meyer and Zack, 1999), *contribute* (Bukowitz and Williams, 1999), *integration* (McElroy, 2003), *apply/use* (Dalkir, 2005), and *apply* (Evans and Ali, 2013).

4.5 Learn

The knowledge assets that have been shared and used in previous phases can also be used as the foundation for creating new and refining existing knowledge assets. The use of knowledge, particularly in situations where experts provide contextual understanding, leads to employees gaining experience, as they interpret the impact of knowledge on their work environment (Evans and Ali, 2013). This phase involves deconstructing the knowledge blocks, integrating, connecting, combining, and internalizing knowledge. If knowledge assets are found to be valuable, based on the previously mentioned analysis and assessment criteria, they proceed to the *improve* stage in the KMC model, where further refinement and/or codification/encapsulation activities take place. However, if knowledge assets are judged insufficient (or incomplete), the searcher returns to the *identify* and/or *create* phase where additional knowledge assets are identified or created based on the gaps found. This iterative process of reflecting on the value and applicability of knowledge assets constitutes double-loop learning (Argyris and Schon, 1996; McElroy, 2003) in the KMC model. Existing rules are challenged and new knowledge assets are created, thus triggering the life cycle to begin all over again. Some of the more common activities that assist in the *learn* stage include benchmarking, best practices and lessons learned, and knowledge gap analyses. The technologies employed in these activities include, for example, learning management and help desk systems. The *learn* stage of the KMC model is most similar to *apply* (Wiig, 1993), *integration* (Meyer and Zack, 1999), *contextualize* (Dalkir, 2005), and *evaluate and learn* (Evans and Ali, 2013).

4.6 Improve

The learning that takes place in the previous phase leads to further refinement of the knowledge assets. New value is either identified or created from them and additions or updates are made to keep them current in the organizational memory and applicable to the organizational context. The knowledge assets are repackaged to be stored or referenced (in the case of more tacit forms) so that their value may be effectively leveraged in the future. Bukowitz and Williams' (1999) may view this stage as a cleansing or sanitizing of sorts, which they refer to as divesting. In the KMC model, *improve* is the decision point for knowledge assets to be archived, retired, or transferred outside the organization for further use. Some of the more common activities that assist in the *improve* stage include after action reviews, reflection time, and adapting lessons learned. Technologies that assist in these activities include, for example, learning management and workflow technologies. The *improve* stage of the KMC model is most similar to *refinement* (Meyer and Zack, 1999), *assess and divest* (Bukowitz and Williams, 1999), and *update* (Dalkir, 2005).

Following a similar depiction of life cycle phases as Evans and Ali's (2013) summary table, a cross-reference chart is presented in Figure 2.

5. Sample Initiative and Technologies

The initiatives, activities and technologies are organized according to the KMC model in order to add clarity to the model and highlight its practical application. The table is adapted from earlier work (Evans and Ali, 2013) that identified the initiatives, activities and technologies through several KM resources (Dalkir, 2011; Terra, 2005; Barnes, 2011; Garfield, 2012). Additions and revisions were made based on discussions with KM academics and practitioners. An earlier version (Evans and Ali, 2013) was presented for feedback at an academic KM conference and based on this feedback and additional discussions with KM scholars, it was revised to fit the KMC model. As with the earlier version, Figure 3 'is not inclusive of all KM initiatives and technologies. Further, these initiatives and technologies are not necessarily exclusive to the life cycle stages they are indicated in […] and may be subject to reclassification based on organizational context' (Evans and Ali, 2013: 162). It must also be noted that KM initiatives and technologies cannot be considered universally applicable across all KM life cycles, as each stage may require unique tools (Birkinshaw and Sheehan, 2002; Evans and Ali, 2013).

CYCLE	CROSS-REFERENCE OF LIFECYCLE PHASES					
KMC Model	**Identify/Create**	**Store**	**Share**	**Use**	**Learn**	**Improve**
Wiig, 1993	Build	Hold	Pool	Apply		--
Meyer & Zack, 1999	Acquisition	Storage / Retrieval	Distribution	Presentation / Use	--	Refinement
Bukowitz & Williams, 1999	Get	Build / Sustain	Contribute		--	Assess and Divest
McElroy, 2003	Claim	--	Integration			--
Dalkir, 2005	Create / Capture Contextualize	Assess	Share / Disseminate	Apply / Use	Contextualize	Update
Evans & Ali, 2013	Identify	Organize and Store	Share	Apply	Evaluate and Learn	--

Figure 2 Cross-reference of Knowledge Life Cycle Phases

6. Conclusion

The main contribution of the KMC model is that it provides a holistic view of the knowledge life cycle, by building on previous life cycles and Heisig's (2009) analysis of KM frameworks. It further extends previous models by including different knowledge forms, integrating the notion of second order or double loop learning, and associating some facilitating initiatives and technologies for each of its phases. The addition of the *learn* and *improve* phases ties in the value creation aspect of the knowledge life cycle more closely and provides more flexibility, allowing for feedback and reuse of different phases. The addition of the double loop learning highlights the learning and improving aspects and shows how the KMC model can lead to a cycle of continuous improvement. One of the major reasons to process knowledge is for individuals, groups and the organization itself to learn, to remember what it has learned and to leverage the collective expertise in order to perform more efficiently and more effectively.

Figure 3 presents a sample list of key initiatives, activities and technologies used in the management of organizational knowledge assets.

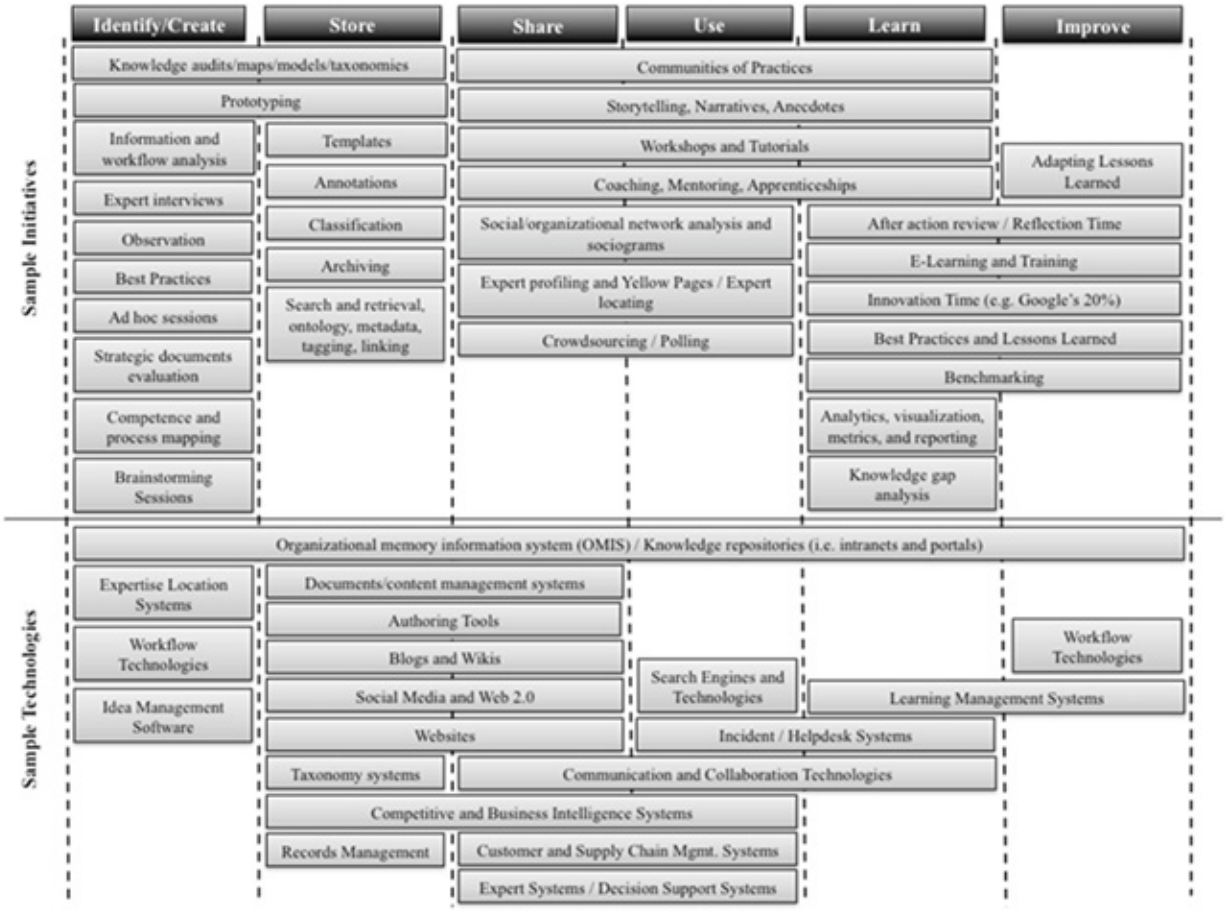

Figure 3 Sample KMC Model Initiatives and Technologies (adapted from Evans and Ali, 2013)

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