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HSM: a hierarchical spiral model for knowledge management

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Publication Details

This article was originally published as Sun, Z and Hao, G, HSM: A Hierarchical Spiral Model for Knowledge Management, in Proceedings of the 2nd International Conference on Information Management and Business (IMB2006), Sydney, Australia 13-16 February 2006, 542-551.

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Disciplines
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The 2nd International Conference on
Information Management and Business,
13 – 16 February 2006, Sydney Australia

Paper Submission Cover Page

Paper Title	HSM: A Hierarchical Spiral Model for Knowledge Management
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Paper Topic	Knowledge management
Submission Category	**X. Full Paper Submission**
	□ Doctoral Consortium Submission

HSM: A Hierarchical Spiral Model for Knowledge Management

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Knowledge is the most important asset for organisations today. Knowledge management (KM) has become one of the most moving research and development fields in information systems (IS), business management and commerce development. There are many researches in the technical and strategic aspect of KM. However, how to model KM is still a big issue. This paper will fill this gap by providing a hierarchical spiral model (HSM) for KM. The proposed model will facilitate the research and development of KM and IS.

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INTRODUCTION

The flourishing interests on knowledge management (KM) have recently led to a rush pursue on organizational knowledge in the business world (Coakes, 2003). For example, there are already a large number of KM initiatives implemented in organizations. Typical approaches of these initiatives were using information technologies (IT) for managing organization-wide knowledge resources. Building a KM system with internet technologies or creating a knowledge repository system with database technologies is very common (Radding, 1998). In order to better use IT in KM, it is necessary to model the KM process in a more systematic way. Process orientation (Ahn & Chang, 2004) is a perspective widely accepted in organization science. Recently, there have been a number of attempts to integrate KM and process orientation (Liebowitz, 1999). However, there are few KM process models that are based on system development methodology. Whereas, KM software must be embedded in stage model, in order to attain a seamless design, regarding the special qualities and requirements of knowledge work, detailed studies of the existing processes and analysis of the used knowledge are necessary. Therefore, this paper will propose a hierarchical spiral model (HSM) for KM in organisations, based on the waterfall model and the spiral model for KM.

The rest of the paper is structured as follows: Section 2 discusses KM as a process. Section 3 reviews three kinds of process models for KM. Section 4 proposes a new hierarchical and spiral model for KM: HSM, and discusses the processes in the HSM and their relationships. Section 5 concludes the paper with some concluding remarks.

KNOWLEDGE MANAGEMENT AS A PROCESS

Knowledge management (KM) implies that knowledge can be managed. KM is a set of processes directed at "creating, capturing, storing, sharing, applying, reusing" knowledge (Wiig, 1997). This definition is criticized for making KM to involve somewhat mechanistic and sequential process steps and for focusing attention on explicit knowledge artefacts as opposed to tacit knowledge, although knowledge engineering (KE) reflects this view of KM. There are also other definitions of KM. For example, KM is the systemic and organizationally specified process for acquiring, organizing, and communicating knowledge of employees so that other employees may make use of it to be more effective and productive in their work (Davenport, et al, 1998). KM provides the perspectives and approaches to put investments made in data and information to better use where it is needed most. KM is the science of collecting organizational knowledge and, by recognizing and understanding relationships and patterns, turning it into usable, accessible information and valuable knowledge (Loshin, 2001). KM can be also considered the process of "delivering the right knowledge to the right persons at the right time" (Coakes, 2003), although it is criticised to be applied to an outdated business model (Hildebrand, 1999). Alternative definitions have been attempted to better capture the complexities of knowledge and KM. The effective KM is the creation of management processes and infrastructure to bring together knowledge and communities in a common ecology that will sustain the creation, utilization and retention of knowledge. Nonaka (1994) recognises that KM must address both explicit and tacit knowledge, as well as the interaction between the two, and begins to address some of the mechanism for doing this. It does not, however, capture all aspects of KM, nor does it address how knowledge will be used or how a

knowledge-based enterprise will ultimately function. More specifically, KM is developing and managing integrated, well-configured knowledge systems with embedding work systems (Barth, 2000). It is clear that both knowledge systems and their embedding work systems can be managed. Finally, this definition is broad enough to capture all aspects of KM but is not overly vague – one can define, with some precision, what a knowledge system is. One can also articulate how work systems can become embedded within knowledge systems.

It should be noted that there are two main motivations for an organisation to implement KM. The first one is to generate, communicate, preserve and share knowledge internally and externally. This means that the organisation can prevent knowledge loss and develop asset. Furthermore, good KM enables organization to retain critical expertise and prevent critical knowledge loss resulting from retirement, downsizing, employee departures and changes by building an organizational economy (Liebowitz, 1999). It also improves the organization's ability to capitalize on legal protection for intellectual property. The second one is to ensure a vital workforce and promote human capital. The basic benefits of KM are to improve productivity and gain competitive advantage through embedding KM processes into daily work activities. By capturing, sharing, and generating knowledge to stimulate innovation and achieve success, KM enables the organization to fully understand its customers, prospects, the market, and the competition (Yildizoglu, 2001). Effective KM also helps to keep good relationships with clients by increasing customer knowledge, expediting response to customer queries, suggestions, and complaints. It also ensures improved consistency and quality when serving customers.

PROCESS MODELS FOR KNOWLEDGE MANAGEMENT

As IT and Information system (IS) play an increasing important role in KM, it is necessary to deploy IT and IS to develop KM. During the development of KM, there have been many models for KM (Chua, 2004). Blumentritt and Johnston (1999) propose a cyclic model for KM, while Sun (2004) proposes a waterfall model for KM. Nonaka (1994) proposes a spiral model of KM. In what follows, this section will review these three kinds of process models.

A Cyclic Model of Knowledge Management

Blumentritt and Johnston (1999) attempt to draw together key thinking in the area of KM to enable a distinction to be drawn between information and knowledge, and provide a framework encapsulating the various strands of thinking about knowledge into an overarching structure. They believe that KM has been concerned with knowledge creation, acquisition and flow, and develop their own framework to categorise knowledge. Within this framework there is an increasing level of difficulty associated with transforming knowledge into information. They challenge the contention that IS may be used interchangeably with KM systems. Instead, they argue that knowledge can only exist within the mind of the individual. By creating a clear distinction between knowledge and information they attempt to develop a model which shows the links between knowledge and information. One of the models that they have developed bears great similarity to Nonaka's knowledge spiral model (Nonaka, 1994), showing it within the context of the transformation of knowledge into information and back through the cycle to knowledge.

Nissen, et al (2000) has developed another life cycle model which makes flow time explicit and supports a multidimensional framework that enables a new approach to analysis and visualization of diverse knowledge-flow patterns in the organisation. This model describes "a continuous cycle with six phases of knowledge flowing through the organisation: 1) creation, 2) organization, 3) formalization, 4) distribution, 5) application, and 6) evolution" (Nissen & Levitt, 2002). Briefly, the creation phase begins the life cycle, as new knowledge is generated within an organisation, similar terms from other models include capture and acquisition. The second phase pertains to the organization, mapping or bundling of knowledge, often employing systems such as taxonomies, ontology and repositories. The third phase addresses mechanisms for making knowledge formal or explicit; similar terms from other models include store and codify. The fourth phase concerns the ability to share or distribute knowledge in the enterprise; this also includes terms such as transfer and access in other models. Knowledge use and application for problem solving or decision making in the organization constitutes Phase 5, and 6 and covers knowledge refinement and evolution, which reflects organizational learning, and thus a return to knowledge creation through time. It should be noted that the above models are generally iterative and involve feedback loops between stages.

A Waterfall Model of Knowledge Management

One of the concerns of KM should be the management of the KM process itself, which has been ignored in the existing models to some extent. In order to resolve this issue, Sun (2004) divides the main stages of KM into more

specific processes. KM goes far beyond the storage and manipulation of the data, or even of information. KM is a discipline that focuses on knowledge processing and corresponding management which permeates each of following processing stages:

- Understand and use knowledge
- Discover and expand knowledge
- Capture, and acquire knowledge from a variety of sources
- Select, filter and classify the existing knowledge
- Define storage structures for saving knowledge
- Design ontology of knowledge
- Generate, adapt and/create new knowledge
- Measure and/or evaluate knowledge
- Visualized knowledge
- Distribute and/or transfer knowledge to other organization or individuals
- Recommend, share, utilize/apply and sell knowledge
- Retain and maintain knowledge as an asset

The management of knowledge processing for each processing stage includes analysis, planning, support, collaboration, coordination and all management functions. Based on all these aspects of KM, Sun (2004) states a waterfall model to explain the function of KM. From this model, it is easy to see the processing stages in KM, while each processing stage can be regarded as each component in the KM. The sequence of the processing stages is also pragmatic rather than precise; the processing stages may also not be executed sequentially, because some later processing stages sometimes are a basis for some former process stages. For example, knowledge ontology is the basis for further processing knowledge including storage, generation, creation, and classification. Knowledge creation sometimes can be the result of knowledge sharing, while knowledge sharing also could lead to new knowledge creation. Therefore, these processing stages in this model are interrelated logically and systematically. This model can help to overview the overall functions of KM and understand the interrelationship between each process step. However, this waterfall model can only cover some aspects of KM, an iterative or spiral processing models of KM is needed to reflect the interrelationship between the processing stages in the waterfall model.

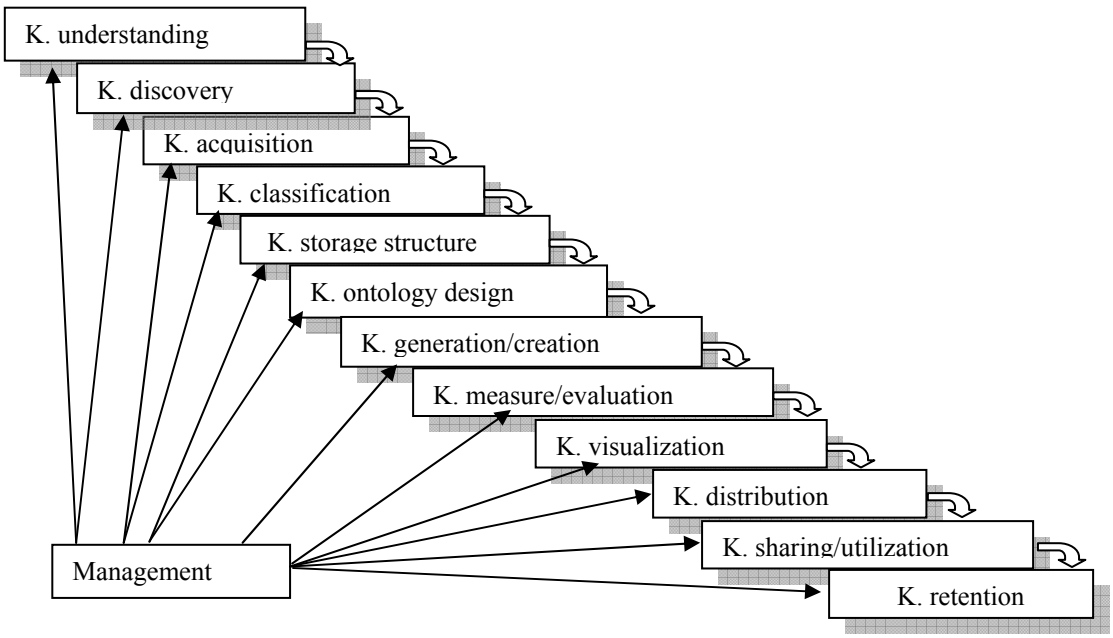

Fig. 1. A waterfall model of knowledge management (Sun, 2004)

A Spiral Model of Knowledge Management

Nissen (2002) and Nonaka (2004) propose a spiral model of dynamic interaction between tacit and explicit knowledge and characterize four processes (socialization, externalization, combination and integration) that enable individual knowledge to be amplified and effect organizational knowledge crystallization. Nissen and Levitt (2002) adapt Nonaka's spiral model to a dynamic model of knowledge flow. This model intends to describe how knowledge flow through the modern organisation, and what kinds of managerial interventions can be made to enhance the flow of knowledge. The model embeds the knowledge flow to organisation's everyday work flow to distribute knowledge through the organization. Nissen and Levitt (2002) believe that KM is unlikely conducted effectively before the phenomenon of knowledge flow can be understood. Comparing with Nonaka's work (Nonaka et al, 1996), Nissen and Levitt (2002) introduce dynamic representation of knowledge flow dynamics taking into account computational organization theory so that their model provides much greater fidelity and insight into knowledge flow dynamics, and enables the execution and performance of diverse knowledge-work processes to be simulated for analysis and comparison. This dynamic model illustrates how to enhance the flow of knowledge through the modern enterprise, as shown in Fig. 2.

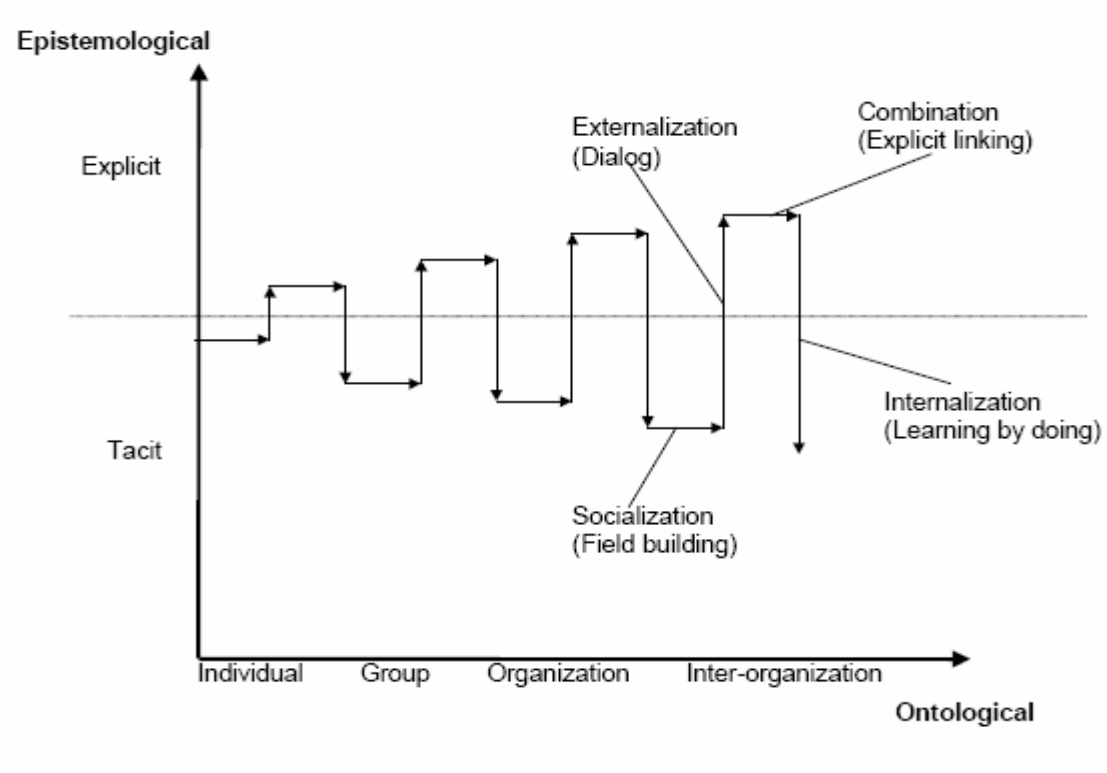

Fig 2. A spiral model of KM (Nonaka, 2004)

This model describes continuous and routine flows that comprise the bulk of organizational knowledge work. It delineates the interaction between epistemological and ontological dimensions used by Nonaka as the principal means for describing knowledge as it flows through the enterprise (Nissen & Levitt, 2002). As noted above, this flow is characterized by four enterprise processes: socialization (tacit to tacit), externalization (tacit to explicit), combination (explicit to explicit), and internalization (explicit to tacit). The related trigger concept (Nonaka, et al, 1996) is also integrated into the figure to show where each knowledge conversion process is induced by one of four triggers: field building, dialog, linking explicit knowledge, and learning by doing. Briefly, socialization denotes members of a team sharing experiences and perspectives, much as one anticipates through tightly connecting workgroups and communities of practice. Externalization denotes the use of metaphors through dialog that leads to articulation of tacit knowledge and its subsequent formalization to make it concrete and explicit; such dialog or what Nonaka refers to as collective reflection is described as inducing externalization. Combination denotes coordination between different groups in the organization, along with documentation of existing knowledge to link and combine new intra-team concepts with other explicit knowledge in the organisation. Internalization means that diverse

members in the organization apply the combined knowledge from above, often through trial and error, and in turn translate such knowledge into tacit form at the organization level. As suggested by the repeating pattern delineated in the figure, such interaction between "triggers" and conversions enables a continuous "spiral" development of knowledge.

The above examination of related work on process models of KM shows that there is no single existing model that addresses all the important processes of knowledge. Further, the components or stages in KM have not been classified in such categories that they can be treated in a hierarchical way, which is useful and practical in organisational practice. For example, in the waterfall model of Sun (2004), the knowledge processes have the same importance from a KM viewpoint without taking into account hierarchy of the knowledge processes. Spiral development of KM has also not examined in detail in that model. In what follows, we will propose a new process model for KM in order to resolve these issues.

HSM: A HIERARCHICAL SPIRAL MODEL FOR KNOWLEDGE MANAGEMENT

There are some indispensable processes of knowledge management (KM). These processes have appeared in a number of existing process models in KM. Different models have different emphases on certain amount of the process stages of KM. For convenience of research, the hierarchical spiral model (HSM) proposed here is mainly based on Sun's waterfall model (Sun, 2004) and Nonaka's spiral model of KM (Nonaka, 1994). The major process stages of the HSM are extracted from the waterfall model. The processes are divided and categorized to five main processes and eleven sub-processes from a hierarchical viewpoint, which form a spiral within three main processes. The proposed HSM provides the guidance between the different phases of KM activities. The main processes present the operational process stages carrying out in real KM activities such as knowledge selection, sharing, update, etc. The sub-processes demonstrate how these main processes been done in detail and show the relationship between each other. Fig. 3 shows the proposed model by illustrating its processes and their basic relationships. The main operational processes consist of knowledge selection, knowledge creation, knowledge sharing, knowledge preservation and retention, and knowledge update (Chua 2004). Three of the main processes consist of several sub-processes. The arrows connecting the processes denote the interaction of knowledge flows. In what follows, we will examine the main processes and the sub-processes in the model respectively in some detail.

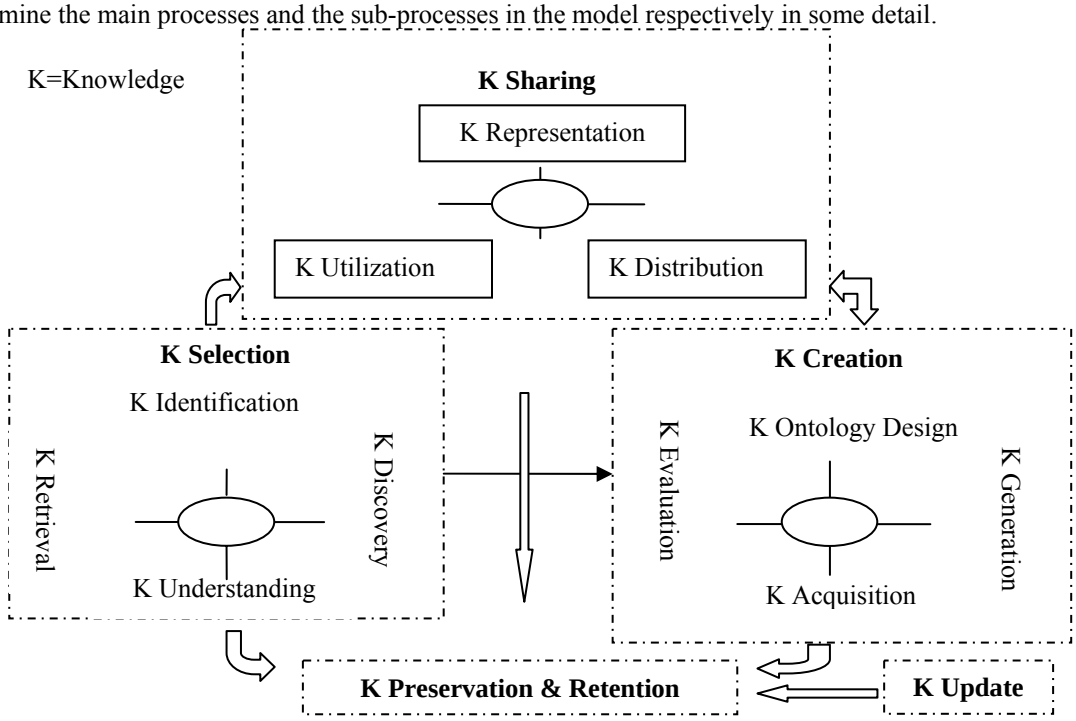

Fig. 3. A hierarchical spiral model for knowledge management

Main Knowledge Processes in HSM

As the first main process of KM, *knowledge selection* identifies knowledge needs by understanding, and select useful knowledge from the existing repository. This process supports to make knowledge reachable, and filtrate the useful knowledge from an organization's existing knowledge and make it easy to search and find. The right knowledge has to be found, retrieved and absorbed. Searching is a significant issue if there is a large amount of knowledge available and the right knowledge becomes difficult to find. Identifying potentially valuable knowledge is of importance, since a huge amount of knowledge stored will eventually lack trust of people (Blumentritt & Johnston, 1999). Knowledge selection involves several sub-processes, which refer to as knowledge identifying, understanding, discovering, and retrieving. These four sub-processes are not necessarily followed in a strict sequence, but rather there can be overlaps and iterations.

If the identified knowledge needs can not be satisfied with the existing knowledge or when the required knowledge is unavailable in an organization, then the knowledge flow goes to another main process of KM: *Knowledge creation*, as shown in Fig. 3. This process supports generation and creation of knowledge. Development of new knowledge in an organization focuses on creating new products, better ideas, more efficient services or new skills. The knowledge creation is desirable if the existing knowledge does not fit needs or is basically too expensive. New knowledge is usually generated in the research department in this process. If the identified knowledge is reachable outside the organization, then the knowledge will be acquired from other organisations. These two ways of creating knowledge are described as knowledge generation and acquisition. Before generating and acquiring new knowledge, the frame of knowledge should be established by ontology design, which is another sub-process supporting knowledge creation. The importance of knowledge creation depends on organization culture, organization objectives and innovation/research efforts (Davenport & Prusak, 2000). Approaches to knowledge creation are techniques and tools of data mining, knowledge discovery, knowledge-based systems, and machine learning (Becerra-Fernandez et al, 2004).

The third main process in HSM is *knowledge sharing*, which is fulfilled after existing knowledge has been identified or the new knowledge has been created. This main process is regarded as the core process of KM, because one of the primary objectives of KM research and practice is to foster the flow of knowledge among organization members (Chua, 2004; Shin, 2004). Knowledge sharing is performed by distribution and utilization of the knowledge that has been selected or generated from the organisation and acquired outside. When sharing knowledge, new knowledge is often created by combining the shared knowledge and existing knowledge (Davenport & Prusak, 2000). The purpose of the first two main processes is to provide useful knowledge for sharing knowledge. They contribute to knowledge sharing by selecting existing knowledge and creating new knowledge.

The new knowledge has to be stored in the fourth main process: Knowledge preservation and retention. Knowledge preservation aims at retention of knowledge assets. The new valuable knowledge has to be stored from time to come. This has to be accomplished by efficient storage media to access knowledge, to prevent valuable expertise from disappearing. The importance of knowledge preservation depends on the viscosity of knowledge to store, amount of knowledge accruing, organisation objective, infrastructure and culture (Huber, 1991). Finally, the knowledge needs to be updated frequently because the knowledge becomes obsolete rapidly in the knowledge society. Nowadays, the transformation of the world and technology forces the organization to renew and update knowledge in time. Otherwise, the use of obsolete knowledge would mislead and cause negative influence on organization.

Sub-Processes of Knowledge Management in HSM

There are four sub-processes in the main process of knowledge selection; that is, knowledge identification, knowledge discovery, knowledge understanding and knowledge retrieval.

Knowledge identification is the first sub-process of knowledge selection. This sub-process identifies the need for knowledge, and determines it. Before knowledge can be created or shared, the need for knowledge has to be identified. Further requirements have to be determined to find the right knowledge in the case of sharing and to enable the creation of the right knowledge in the case of creation (Radding, 1998). The importance of knowledge identification in an organisation depends on organisation objectives, infrastructure and organisation culture (Davenport & Prusak, 2000). Knowledge identification also refers to recognize and realize the needs of knowledge within an organisation. When a knowledge seeker with a clearly formulated request pulls knowledge selection, knowledge identification primarily involves locating the resources from which the knowledge is to be captured (Coakes, 2003). As knowledge identification progresses the undesired resources, knowledge is filtered.

Knowledge discovery refers to finding valuable knowledge existing in the organization. After the needs are identified, it should first find the needed knowledge within organisation. There is much useful knowledge that is immerged within the organization. Knowledge discovery is to mine this valuable intellectual capital from documentation, database and mind of experts. Some tools and techniques like data mining and interview are useful for knowledge discovery. Data mining can help knowledge seeker to discover desired knowledge or maybe some unexpected useful knowledge from the huge databases of the organization. Interview with incentive encourages knowledge and experience holders to express the knowledge they possess.

Knowledge understanding refers to comprehending the discovered knowledge. People cannot use knowledge well if they do not understand what the knowledge is. The more employees know the knowledge well the better the knowledge can be used for the organisation. Understanding knowledge comes from a number of attributes, both of the knowledge itself and the format in which it is used, and the previous experience of the user. When accumulating knowledge there is a conscious choice to learn or discard the knowledge of others. Very often, you choose what you agree with and what does not challenge your own assumptions. This is a form of self-prejudice (Ahn & Chang, 2004). In fact, the mind always follows a certain pattern – knowledge can therefore gradually become formulaic.

Knowledge retrieval refers to extracting knowledge from the existing knowledge resources such as a document, database, a data warehouse, a computer system or an employee. In cases where knowledge to be selected resides in multiple identified resources, knowledge retrieval involves coordinated collection or gathering from a variety of resources such as databases or data warehouses. The sequencing and timing of retrievals within a collection effort can have a significant effect on what knowledge is captured. It is important that the correct knowledge be retrieved completely.

It should be noted knowledge recommendation is also involved in knowledge selection. Knowledge recommendation usually occurs after knowledge retrieval and before knowledge is accepted. Just as product recommendation plays an important role in business management, knowledge recommendation will become an important part of KM, although no such study has been found so far, to the knowledge of the author.

The main process of knowledge creation consists of the following sub-processes: Knowledge ontology design, knowledge generation, knowledge acquisition, and knowledge evaluation.

Knowledge ontology design is to formalize the existing knowledge and offer a format for adding new knowledge. Ontology is an explicit specification of conceptualization. In Artificial Intelligence (AI), it refers to providing definitions for the vocabulary used to represent knowledge in a given domain. Knowledge ontology design formalizes the semantics of objects and relations in a knowledge universe of discourse and provides a set of terms, which can be used to examine these objects and their relationships (Coakes, 2003). This set of objects, and the describable relationships among them, are reflected in the representational vocabulary with which a knowledge-based program represents the knowledge in the knowledge universe of discourse such as business negotiation.

Knowledge generation is concerned with producing new knowledge. According to Nonaka (1994), in a strict sense knowledge can only be generated in people's minds. Knowledge generation can and should also take place in an uncontrolled manner. After the need for knowledge has been identified and it cannot be discovered internally, this represents the possibilities of acquiring or generating the desired knowledge. Knowledge generation also occurs when the knowledge cannot be acquired from outside organization. There are several ways of knowledge generation, for example, by sending people to training, have them read books or assigning a consultant that provides knowledge. Data mining and machine learning are intelligent techniques for knowledge generation. Knowledge sharing can also generate new knowledge by combining shared knowledge with the user's existing knowledge (Huber, 1991).

Knowledge acquisition supports to obtain knowledge. No organisation is able to produce all needed knowledge itself. So the knowledge that an organisation can not develop itself has to be acquired. Acquiring knowledge can be accomplished by acquiring innovative organisations, recruiting experts, buying documents from outside sources, hiring consultants, buying patents, and retrieving the Web using search engines such as google.com, and so forth. Relationships with customers, suppliers, competitors and partners do also serve potential external sources for knowledge. The importance of knowledge acquisition depends on organisation culture and objectives. Methods to implement knowledge acquisition are i.e. data bases containing indices of external sources potentially valuable for the organisation.

Knowledge evaluation needs to be conducted after the knowledge has been generated internally or acquired from outside. The new knowledge that has been generated or acquired needs to be evaluated to make sure that the new knowledge is correct and valuable before it can be shared in the next main process. Usually the acquired knowledge

is often correct, because it is the knowledge used in other organisations. However, this does not mean it is unnecessary to be evaluated, because knowledge good for other organisation may not fit the acquired organization. For the generated new knowledge, it is often the immature knowledge with many mistakes, the evaluation should be conducted to identify whether this new knowledge is worth further development.

The main process of "Knowledge Sharing" contains the following sub-processes: knowledge representation, knowledge distribution and knowledge utilization.

Knowledge representation (KR) means to represent the knowledge in a more clear and storable way. KR includes activities such as documentation, conversion and exhibition. A willingness of documentation helps those unknowns who follow later. According to Tsoukas (2002), explicit knowledge is most easily documented as writings, or in electronically, in digitalized form. Tacit knowledge, on the other hand, remains in the minds of the holder and must be exchanged live with another person via a dialog. KR is an important research field in AI (Nilsson, 1998). Semantic network, frames, concept mapping, and predicate logic, to name a few, are KR techniques for representing knowledge in intelligent systems.

Knowledge distribution supports the spread of knowledge. Knowledge has to be made available throughout the organisation. That is spreading and sharing know-how which is already presented within the organization. This function goes hand-in-hand with knowledge representation. A distribution process may incorporate a variety of techniques ranging from books, reports, visual identity, correspondence, and electronic communications (Kikoshi & Kikoshi, 2004). No matter what techniques are used for spreading the knowledge, distribution process should make sure that the message is received by the knowledge seeker, but it does not guarantee the spreading knowledge is well understood, which is done by knowledge understanding in the main process of knowledge selection.

Knowledge utilization supports knowledge application. Simple availability does not guarantee that present knowledge is indeed used. Knowledge representation and distribution is a precondition to successfully apply knowledge. This still does not ensure utilization, but the chance of usage of highly available and distributed knowledge does increase. Moreover, utilization means to assist knowledge workers to apply implemented knowledge. The importance of knowledge utilization depends on the complexity of problems, organisation culture, trust of knowledge sources and organisation infrastructure. Furthermore, the design of system interfaces may greatly affect utilization.

Knowledge Flowing in HSM

In the previous sections, the main processes, sub processes and their functions have been discussed. This subsection will examine the relationships among the processes by looking at the knowledge flowing among the processes in HSM. First of all, it will look at the knowledge flowing among the main processes.

The knowledge management (KM) flow starts with *knowledge selection*. In this process, the knowledge needs is identified and the useful knowledge is understood and retrieved within organization. If the needs of knowledge can be satisfied by the discovered and retrieved knowledge in the organization, then the management process can go to the next step: knowledge sharing. Otherwise, the knowledge flow goes to the process: knowledge creation. In this process, new knowledge is created by generation within the organization or acquired from outside. The created knowledge is also evaluated in the process. After that, the new knowledge can be shared in the knowledge sharing process. In the sharing process, the selected or created knowledge is firstly represented to let people know. Consequently, knowledge is distributed by various ways. Finally, the distributed knowledge can be utilized by the knowledge seekers. The processes of knowledge selection, creation and sharing are all linked to knowledge preservation and retention. All the retrieved and generated knowledge is stored and maintained in this process. Knowledge is then updated and saved again, because it has to be adapted to the needs and context of the organisation.

The sub-processes in the main process of knowledge selection are knowledge identification, knowledge discovery, knowledge understanding and knowledge retrieval. The knowledge flowing starts with knowledge identification. After the needs are identified, the required knowledge needs to be found in the organization. This is called knowledge discovery. The discovered knowledge cannot be used if it can not be understood by employees. So the next sub-process is to understand the discovered knowledge. At the end of this main process, useful knowledge is retrieved and organized for sharing and preserving. In practice, these four sub-processes are interrelated. For example, when retrieving identified knowledge, some related knowledge needs to be discovered. Then the process goes back to the knowledge discovery to find the important knowledge.

Knowledge creation has also four sub-processes: Knowledge ontology design, knowledge generation, knowledge acquisition and knowledge evaluation. Knowledge ontology design can be considered as a bridge between knowledge selection and knowledge creation, because it formalizes the existing knowledge and establishes a format for adding new knowledge. As the format is set, it is ready for knowledge generation. This means to encourage employees to produce new knowledge for the knowledge needs. If the required knowledge cannot be generated within the organization or cost too much, then the knowledge flow goes to the knowledge acquisition. However, the sub-process of knowledge acquisition does not have to be followed by knowledge generation. It may follow the ontology design process. Actually, the relationship between knowledge generation and knowledge acquisition process is parallel. These two sub-processes are linked to knowledge evaluation. The new knowledge is evaluated in this process for the next main process: knowledge sharing.

There are three sub-processes in knowledge sharing. As the first sub-process of this main process, knowledge representation is to reveal and demonstrate selected and/or created knowledge. This makes the knowledge seeker find the required knowledge easier. The knowledge distribution process continues to deliver knowledge to the employees that need it. Finally, knowledge can be used in the knowledge utilization process.

CONCLUSIONS

The compelling knowledge needs require the organization to pursue knowledge as much as possible. However, the problems of generating and transferring knowledge between individuals, across organisations and from each generation to the next are substantial and complex. Pursuing knowledge without effective management may lead to overlap in work and assignments, taking into account the fact that it requires similar processes for knowledge creation, documentation, storage, and dissemination. This paper reviewed three different types of process models: a cyclic model, a waterfall model and a spiral model. Then this paper proposed the HSM: a hierarchical spiral process model based on the waterfall model and the spiral model for KM. The HSM provides an approach to managing knowledge processes in a hierarchical and spiral way so that the importance of each knowledge process in the KM can be emphasised in a different way. Future research could be related to integration of management as a process into the HSM and the economical analysis based on the proposed model. We will also validate and verify the proposed model in real business practice, and apply the proposed model to organizational learning. This could help the understanding of process modeling of KM.

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