A Knowledge Management Framework for Knowledge-Intensive SMEs

Thang Le Dinh[1], Thai Ho Van[1] and Éliane Moreau[2]

[1]*Laboratory for Enterprise Development in Developing Countries, Université du Québec à Trois-Rivières,
Trois-Rivières, Canada*
[2]*Institut de recherche sur les PME, Université du Québec à Trois-Rivières, Trois-Rivières, Canada*

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Abstract: Nowadays knowledge-intensive enterprises, which offer knowledge-based products and services to the market, play a vital role in the knowledge-based economy. Effective knowledge management has become a key success factor for those enterprises in particular and the whole economy in general. Knowledge management is important for both large and small and medium knowledge-intensive enterprises; however, there is still a little focus on this topic in knowledge-intensive small and medium enterprises (SMEs). In this study, the authors propose an integrated framework as a foundation for designing an appropriate knowledge management solution for knowledge-intensive SMEs. The paper begins with a theoretical background and the research design and then continues with the characteristics of the framework. Accordingly, the principal components of the framework corresponding to design science research such as the constructs, model, method and instantiations are illustrated. The paper ends with the conclusions and future work.

1 INTRODUCTION

Knowledge-intensive enterprises (KIE) play an important role in the knowledge-based economy (OECD, 2007). Knowledge-intensive enterprises can be loosely and preliminary defined as organizations that offer to the market the use of fairly sophisticated knowledge or knowledge-based products and services (Doloreux and Shearmur, 2011). Knowledge management is important for both large enterprises and small and medium-size enterprises (SME). As a matter of fact, many topics related to knowledge management in SMEs have not been well studied yet (Durst and Edvardsson, 2012). Given the importance of effective knowledge management in knowledge-intensive SMEs (KI-SME), there is a special need for more research on this topic. An appropriate knowledge management framework for KI-SMEs may help them to manage their business activities effectively, to improve their performance and innovation capacity, and also contribute to the development of the economy as a whole.

This paper is organized as follows. Following the introduction, the paper begins with theoretical background and research design, and then continues with the characteristics of the proposed framework.

Accordingly, the principal components of the framework for KI-SMEs are presented. The paper ends with a short discussion and conclusion, including implications for research and practice.

2 THEORETICAL BACKGROUND

Knowledge-intensive enterprises are organizations that assist others in solving problems and making business decisions that require external sources of knowledge (Miles, 2005). KIEs often provide products and services that get involved in activities to create the values of knowledge collection, enhancement, and dissemination (Miles et al., 1995). The two groups of KIEs are technology KIEs and professional KIEs (Shearmur and Doloreux, 2008). Technology KIEs perform activities related to information technology, research and development, architecture and engineering activities and related consultancy, testing and technical activity's analysis. In professional KIEs, the following activities are included: legal sectors, accounting, bookkeeping and auditing activities, tax consultancy, market research, as well as the entire advertising industry. Moreover, there are three characteristics of KIEs (Miles et al.,

1995). Firstly, activities of KIEs are mainly based on professional knowledge. Secondly, KIEs either use their own sources of information and knowledge in their activities or external knowledge sourcing in services for their clients or suppliers (Clausen, 2013). Finally, the competitive edge of KIEs is that they are the primary knowledge suppliers for their clients when they expect to perform and innovate (Harris et al., 2013).

Knowledge and intellectual capital are increasingly recognized as the main sources of competitive advantages in the knowledge-based economy (Nonaka and Takeuchi, 1995; Steinmueller, 2002; Daud and Yusoff, 2010). For this reason, knowledge is one of the key elements in the success of KIEs (Muller and Doloreux, 2007). The main focus of KIEs is on knowledge creation, transfer and development (Miles, 2005). Therefore, effective knowledge management is a question of survival for KIEs (Scarso and Bolitani, 2010). Organizations realize that they need to pay more attention to knowledge management and social capital (Daud and Yusoff, 2010). Knowledge management influences social capital; social capital affects organizational performance, and the integration of knowledge management and social capital can improve organizational performance and innovation capacity (Daud and Yusoff, 2010; Harris et al., 2013).

For SMEs, knowledge management is recognized as the key strategy to deal with the complexities and changes in the modern economy (Beijerse, 2000; Jetter et al., 2006). Applying knowledge management activities may bring various benefits to SMEs such as staff development, innovation enhancement, improved customer satisfaction and external relationships, increased sales growth and decreased losses (Edvardsson and Durst, 2013). Although both large and SMEs recognize the role of knowledge management as a vital competitive edge, research on knowledge management in SMEs has been received a little focus. Since SMEs only apply knowledge management at the operational level, systematic knowledge management practices need to be adopted in these enterprises (Beijerse, 2000). Indeed, SMEs face major challenges in the implementation of knowledge management projects such as the lack of human and financial resources (Durst and Edvardsson, 2012).

3 RESEARCH DESIGN

This paper seeks to answer the following research question: "*What is the appropriate knowledge management framework for KI-SMEs?*"

In order to explore this research question, we used a design science research framework, which is particularly useful for creating and evaluating IT artefacts for solving identified organizational problems. The framework includes fundamental components such as a set of constructs, a model, a method and a set of instantiations (March and Smith, 1995; Vaishnavi and Kuechler, 2004).

The main purpose of this study is to propose a conceptual framework for building a knowledge management solution for various types of KI-SMEs that need to overcome the key challenges related to human and financial resources. Consequently, the characteristics of the proposed framework, called NIFO, can be represented by its four attributes: *Natural*, *Incremental*, *Focal*, and *Open*. The *natural attribute* of the framework can assist KI-SMEs in convincing their employees to participate actively in the knowledge management process in an informal and appropriate way corresponding to their habits and culture in order to transform the business information produced and used in daily activities into organizational knowledge. The *incremental attribute* can help enterprises implement the knowledge management project step-by-step and in an evolutionary way depending on their organizational growth level. The *focal attribute* supports enterprises to focus on knowledge management for core products and services according to their business priority. The *open attribute* allows enterprises to manage actively their projects and to overcome the challenges related to human and financial resources by co-operating and innovating together as well as by using open source solutions.

The NIFO framework has two levels: design and implementation. At the design level, enterprises can understand extensively the values of knowledge to design the appropriate knowledge management solution, starting with core activities (focal attribute) and then applying the knowledge management system step-by-step (incremental attribute). At the implementation level, the model helps enterprises to implement the system effectively to motivate employees to create explicit knowledge from tacit knowledge in a natural way (natural attribute) at the lowest costs (open attribute).

4 KNOWLEDGE MANAGEMENT FRAMEWORK FOR KI-SMEs

4.1 Constructs of the Framework

The constructs of the NIFO framework are different types of concepts related to the business information and knowledge produced and used in daily business activities. For this reason, the constructs need to represent the characteristics of knowledge such as the structure, transition, possession and coherence of knowledge.

The *structure of knowledge* is represented by the "know-what" that describes knowledge that relates to a phenomenon of interest (Garud, 1997). Know-what is often generated through 'learning-by-using'. Know-what in a KI-SME focuses on products, services or intellectual capital of the organizations. This construct describes what types of information exist, their structures, as well as their interrelations. The key concept of this construct is the classes. A class is defined as an object type and a set of objects of this type. An attribute of a class is a function corresponding to every object of this class and to a set of objects of other classes.

The *transition of knowledge* is represented by the "know-how" that describes the understanding of the generative processes that constitute phenomena (Garud, 1997). Know-how is generated through 'learning-by-doing', which has been represented by the concept of processes. A process is a feedback of the organization to the occurrence of an event or a situation. A process may perform a transformation of a set of dynamic states.

The *possession of knowledge* is represented by the "know-who" that describes groups or individuals who may provide resources related to domain knowledge. One way to obtain know-who is 'learning-by-working-together' that aims at participating and co-operating with others. This construct describes who may be knowledgeable about a specific knowledge. Its key concept is the concept of zone of responsibilities (ZoR). In KIEs, this construct often includes the knowledge about who-know-what and who-know-how.

The *coherence of knowledge* is represented by the "know-why" that describes the understanding of the principles underlying phenomena. This construct is represented by the rule aspect that concerns the coherence of information. Its key concept is the concept of business rules (BR). Scopes of a BR represent the business context that covers a set of classes. Risks of a BR are the possibilities of

suffering the incoherence of information that relates to a set of processes.

4.2 Model of the Framework

The model of the NIFO framework aims at expressing the relationships among the concepts that can be specified using simplified *Unified Modeling Language* (UML) notation (Rumbaugh et al., 1999). KI-SMEs can use this model to represent the conceptual specification of their knowledge base. In Figure 1, each class of UML represents a key concept of our framework. The structure of knowledge is represented by concepts such as classes and their attributes. A method of a class performs a specific function. The transition of knowledge is represented by processes and dynamic states. A process performs a transformation of information that invokes a set of methods and changes a set of dynamic states. The possession of knowledge is represented by a zone of responsibilities that describes the relation between know-who with know-what or know-how. The coherence of knowledge is represented by business rules. The scope of a rule represents a set of classes as a semantic context within which it operates. The risks of a rule relate to a potential incoherence in the information that concerns a set of attributes and involves a set of methods.
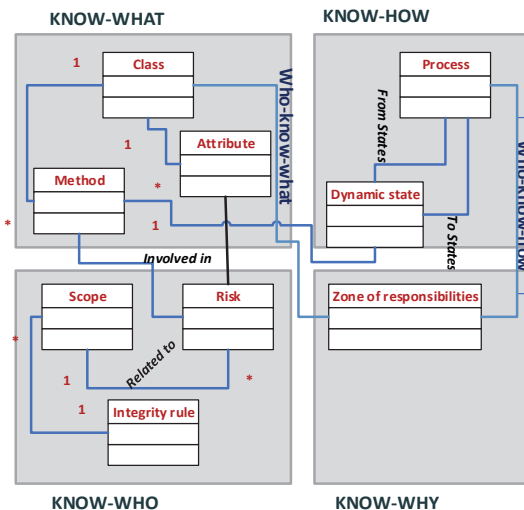

Figure 1: Model of the NIFO framework.

4.3 Method of the Framework

The method of the NIFO framework is a set of activities supporting the process of knowledge management. We adopted four knowledge conversions (combination, internalization,

externalization and socialization) and five knowledge enablers (vision, strategy, staff, structure, and system) proposed by Nonaka and Takeuchi (1995) as a foundation for our method.

Figure 2 presents the overall architecture of the knowledge management system (Alavi and Leidner, 2001). We consider a knowledge management solution in a KIE as a service system that needs to take into account the three dimensions of service science: Management, Science and Engineering (Le Dinh and Pham Thi, 2012).
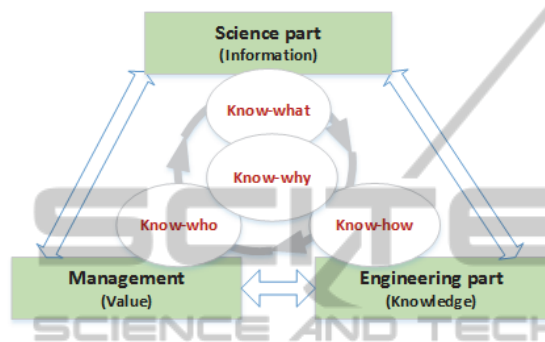

Figure 2: Method of the NIFO framework.

The *management part* is related to the effectiveness of enterprises with the objective of enhancing effectiveness and coordination with partners. This part concerns the value creation chain of the enterprise and corresponds to three knowledge enablers: Vision, Strategy and Staff. Firstly, KI-SMEs must determine their knowledge vision and strategy, which must be conformed to business strategy and priority. Secondly, they also need to pay attention to working with staff for promoting knowledge sharing and for a cross-levelling of knowledge.

The *science part* is related to business information, especially to the process of collecting data and transforming data into information. The focus of this part is on determining which good and innovative products and services they can supply to clients and how to supply them. In other words, this part focuses on knowledge about business activities of enterprises. The science part corresponds to the structure knowledge enabler that redefines the organizational structure to promote and facilitate the knowledge management and conversions. Additionally, this part is also necessary to customize the framework and to build the knowledge hierarchy model of the organization.

The *engineering part* is related to knowledge that is defined as the use of business information to create added values. This part focuses on knowledge about the processes of performing tasks in

organizations. The engineering part corresponds to the system knowledge enabler that aims at implementing networking communities of knowledge.

4.4 Instantiations of the Framework

The instantiations related to the experimentation of the framework are the focal point of our present and future work. The instantiation presented hereafter is related to a KI-SME that offers IT services and resources in a developing country. This SME has about 30 employees who are mostly team leaders and software developers. The demand for IT professionals in this developing country is rather high; therefore, employees often leave the SME to work for large enterprises. Knowledge management, especially training and knowledge transferring to new employees, is a survival factor for this SME.

Concerning the method, the business priority of the SME is to provide better knowledge-intensive services to its customers. Therefore, the knowledge management solution needs to promote both innovation in services and innovation in service processes. Accordingly, all of the four knowledge conversions have been used to promote the learning process and intellectual capital (Nonaka and Takeuchi, 1995). The SME has used an open-source platform, which supports the reconciliation of e-collaboration and knowledge management systems (Le Dinh *et al.*, 2013). The taxonomy system has been organized based on the concepts of the NIFO framework. Each content is associated to one or several tags of the taxonomy (i.e. types of knowledge components). At the group level, the SME organized several teams. Each team has 3 to 8 persons, who work on a same project and use a common working space in the platform. Related to the *socialization conversion*, tacit knowledge can be shared through forum discussion, chat and video conference functions. Related to the externalization *conversion*, all written documents, Q&A, and presentations have been classified and shared within and between teams. Related to the *combination conversion*, a wiki system has been used at the organizational level. All of the content is being collected and classified in order to form the new content as wiki pages. Those wiki pages are linked based on their tags. Related to the *internalization conversion*, the SME motivates its employees to consult the wiki system when doing their tasks and also to give comments on the wiki pages.

Concerning the model, the SME has decided to begin with the concepts such as class, attribute,

process, rule, scope, risk and zone of responsibilities. The other concepts such as method and dynamic state have been foreseen for the next step.

Concerning the construct, the *structure of knowledge* concerns the knowledge related to its services, represented by the "Service" class. The "Service" class may have attributes such as "Start date", "End date", "Contact person", "Estimated cost", and "Actual cost". Related to the *transition of knowledge* inside the KI-SME, there are process concepts that relate to the "Service" class concept such as "Service proposal", "Service design", "Service implement", and "Service operation". Related to the *possession of knowledge*, there are a ZoR, related to the "Service" class as a who-know-what, and several ZoRs related to the processes of "Service proposal", "Service design", "Service implement", and "service operation" processes as who-know-how. Finally, the *coherence of knowledge* must correspond to the goal of the SME, which aims at improving the satisfaction of its customers by controlling effectively project schedule and budget. Accordingly, there is a business rule about the relationship between "Estimated cost" and "Actual cost". The management of the KI-SME has decided that the difference between those two costs should be less than 10% of the estimated cost. The scope of this rule is the "Service" class. The risks concern the processes such as "Service proposal", "Service design", "Service implement", and "Service operation".
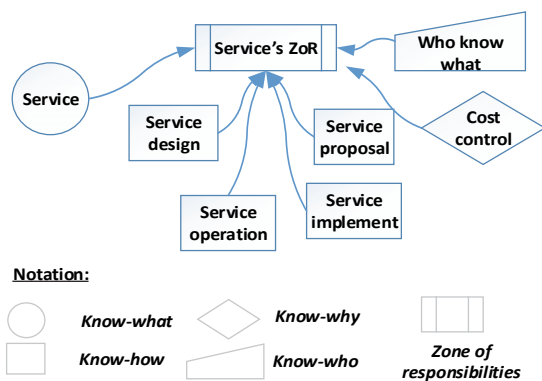

Figure 3: Excerpt of the constructs.

5 CONCLUSIONS

In this paper, we have presented an appropriate knowledge management framework for knowledge-intensive enterprises (KIE) with a focus on the particularities of knowledge-intensive small and medium enterprises (KI-SME). Accordingly, the framework, called NIFO framework, has four main attributes: Natural, Incremental, Focal, and Open.

We believe that our work is one of the first approaches that focuses on building a knowledge management solution for KI-SMEs based on the perspective of knowledge components. To answer our research question, we proposed a framework for knowledge management and conversions that consists of different artefacts with different levels of abstraction: constructs, model, method, and instantiations. With regard to practical implications, when a KI-SME intends to build its knowledge management solution, the NIFO framework provides a starting point to determine and organize knowledge according to their knowledge components such as know-what, know-how, know-who and know-why.

Concerning the related work, there are approaches that suggested the concept of knowledge audit as the initial process in knowledge management (Choy *et al.*, 2004; Perez-Soltero *et al.*, 2009). Our approach shares the common strategy of those approaches serving as an integrated approach for knowledge management. Compared to Choy *et al.* (2004), the NIFO framework includes the constructs, model, method and instantiations; however, the approach of Choy *et al.* (2004) focuses more on the method, including different phases in a systematic manner. Compared to Perez-Soltero *et al.* (2009), the NIFO framework also has more dimensions at different levels. The approach proposed by Perez-Soltero *et al.* (2009) is based on ontology that corresponds essentially to the structure of knowledge. Furthermore, our framework is not only useful for collecting, storing, and analysing knowledge, but also for developing new knowledge to support different types of innovation related to products, services and business processes in KI-SMEs.

Currently, we are working on building an intranet-based knowledge management system based on an open-source content management platform so that SMEs could reuse and enhance this system as their solution at lower costs.

Concerning the future work, we intend to experiment our framework with some specific knowledge-intensive industries in the fields of business, research and development, educational and health-care services.

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