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The KMDL Knowledge Management Approach: Integrating Knowledge Conversions and Business Process Modeling

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Abstract. This paper shows the KMDL Knowledge Management Approach which is based on the SECI and *ba* model by Nonaka and Takeuchi and the KMDL Knowledge modeling language. The approach illustrates the creation of knowledge with the focus on the knowledge conversions by Nonaka and Takeuchi. Furthermore, it emphasizes the quality of knowledge being embodied in persons and creates a personalization and socialization strategy which integrates business process modeling, skill management and the selection of knowledge management systems. The paper describes the theoretical foundations of the approach and practical effects which have been seen in the use of this approach.

1 Introduction

Knowledge management clearly has become more and more important since the beginning of the early nineties. Companies expect an improvement of the innovation capability and a significant increase in process efficiency. Globalization, increasing competition, more dynamic markets and shorter cycles in product development and innovation increase the need for a better adaptation to those environmental factors. These factors establish the need for a consequent adaptation of all business processes to existing and future market needs.

Knowledge processes are executed parallel but also linked to normal business processes in a ladder like structure. The knowledge processes are only slightly structured. Detecting, modeling, analyzing and finally optimizing those processes should be the long-term aim of a process-oriented knowledge management approach.

Knowledge and business processes are integrated and should be evaluated as a whole [1]. Business processes can be modeled and analyzed via the existing business process modeling methods. Furthermore, there are numerous approaches which take into consideration the knowledge within the company or the organization [21, 22]. Mapping static, explicit knowledge can only contribute little to a broad and integrated process-oriented knowledge management approach. Modeling the business processes and the processes of knowledge creation can ensure an effective and reasonable process-spanning knowledge flow.

The described problems and challenges have been the motivation to develop the knowledge modeling language KMDL (Knowledge Modeling Description Language) [2] in order to model knowledge-intensive business processes with the KMDL-based software tool K-Modeler. The tool implementing the language in an early version has been integrated into an approach which is based on the knowledge management philosophies of Nonaka, Takeuchi and Konno. The definition of the term knowledge is based on the very ideas of Nonaka and Takeuchi [18]. The knowledge is bound to a person, it is indeed personal knowledge. This so called tacit knowledge cannot be expressed by formal methods. It is based in the employee's occupation, the proficiencies of each employee and his ideals, values and experiences. It is possible to analyze and model this knowledge through KMDL even if it is not directly used in the operational business process.

2 Theoretical Foundation of the Approach

2.1 Definition of Knowledge, the SECI Model and *ba*

Nonaka and Takeuchi's thoughts and ideas are not only influenced by Japanese tradition but strongly by Michael Polanyi. Polanyi [20] defined the idea of a tacit knowledge embodied as personal knowledge. Therefore, Nonaka and Takeuchi distinguish between two types of knowledge: the tacit and the explicit knowledge. Tacit knowledge is personal knowledge which consists of mental models, beliefs and perspectives which cannot be easily articulated or shared. Explicit knowledge is formal, codified, systematic, articulated in writing/numbers, easy to communicate and shared; it is transmittable in a formal language and can be stored in databases or libraries [12].

The tacit knowledge is the more interesting knowledge when looking at knowledge-intensive business processes as we will see later. But yet, there are ways and possibilities to convert and combine tacit and explicit knowledge. Nonaka and Takeuchi mention four types of knowledge-conversions in the so called SECI model, the socialization, the externalization, the combination and the internalization.

The socialization is a conversion from tacit knowledge to tacit knowledge. Often it is done by sharing experience, just like apprentices of a craftsman learn their skills by

watching a knowledge-worker can learn his needed abilities through on-the-job training. Even if possible, the socialization can be done without speaking or writing a single word.

The externalization is a conversion from tacit to explicit knowledge. By using metaphors, analogies or models one can express his tacit knowledge in a manner which can be understood by others. It is the essence of tacit knowledge which can then be handed over in a written form, yet it can be very difficult to externalize tacit knowledge, often it is simply impossible.

The combination is the conversion from explicit to explicit knowledge. Different kinds of explicit knowledge can be combined through media like telephone, mail, word processing by reconfiguring, categorizing and adding new information and context to the knowledge.

The internalization is the conversion from explicit to tacit knowledge. It is very close related to learning-by-doing. Experiences made through socialization, externalization or combination are internalized and put into one's own knowledge framework, they can become know-how or mental models and according to this, very important knowledge assets. It is very helpful if the explicit knowledge is in a written form like documents, handbooks or stories.

Those conversions are done regularly in everybody's daily life. Yet the idea is often neglected, because the conversions are bound to a place and depend on certain conditions and requirements. The idea has been adopted by Takeuchi and Konno [19]. The concept of *ba* creates the idea of this place. The *ba* is a shared location or place where relations can evolve. The place can be either physical (including bureau, shared workroom, mall) or virtual (email or teleconferences) or even mental (shared values, ideas, or ideals). The *ba* restrains itself from the ordinary human interaction by being a place of knowledge creation. Knowledge is bound to the *ba*, if it is dislodged from the *ba*, it simply becomes information. The *ba* is the framework where knowledge becomes the resource for creativity.

The model by Nonaka, Takeuchi and Konno establishes a logical framework which can be used to take a look at tacit and explicit knowledge, the conversions between those kinds of knowledge and therefore the creation of knowledge and the conditions and requirements for conversion to happen (the *ba*). It will serve as the basic framework for modeling a dynamic process of knowledge creation within the author's approach.

2.2 Definition of Knowledge-Intensive Business Processes

Several definitions of knowledge-intensive business processes have evolved. Remus first of all distinguishes four types of knowledge-oriented processes. A knowledge-intensive process is super-ordinate to the other processes in order to distinguish them from normal business processes [3]. The knowledge-intensive

business process is a process which relies very much on knowledge like research and development processes. Remus defines two more processes which rely on knowledge [22]. The knowledge-process which is a process combining different knowledge activities like creating and distributing knowledge, for example the content management process and finally the knowledge-management process which tries to improve knowledge processes. The knowledge-intensive business process is subject to the definition of knowledge-intensive processes within this paper.

The literature defines several factors which are fundamental to knowledge-intensive business processes. In knowledge-intensive processes, knowledge contributes significantly to the values added within the process. The process has got many innovative and creative parts [5]. People within the process have a large scope of decision freedom, they can decide autonomous. The event flow of knowledge-intensive business processes is not clear from the very beginning, it can evolve during the process [3]. Many participants of the process have got different knowledge from different domains at different levels [11]. Like the flow, even the tasks within the process do not have to be clearly defined. A high level of communication between individuals is often part of the knowledge-intensive process. Knowledge which is part of the process has often a very short life-time [5], it is outdated very often, even though, it is more often very time-intensive to build up this knowledge [23]. Knowledge-intensive business processes often do not cover structured working rules and often lack metrics for evaluating the success of the process [4]. The IT-support for knowledge-intensive business processes is often not very sophisticated because it heavily relies on socialization and informal exchange [14]. A knowledge-intensive process should be a core process of the company and it should produce or add new knowledge to the organization's knowledge base [15]. A last criterion focuses on the very high costs which are often generated by knowledge-intensive processes.

Looking at these criteria, we can classify many processes, for example software development processes [17] or public administration processes as knowledge-intensive processes. The very vague and unstructured flows of knowledge cannot be modeled by conventional modeling tools. Important elements like the representation of tacit knowledge or the creation of knowledge through conversions cannot be modeled [7].

2.3 Knowledge Strategy

Hansen et al. have established the idea of the knowledge strategy [13]. They distinguish between two main strategies which are often combined but are in general two poles for knowledge management approaches. The *codification strategy* tries to track the knowledge of the employees or other stakeholders with interviews or analogue techniques and to save this knowledge by electronic means and measures within databases. By retrieving from those databases, knowledge can be used again and again within new processes and situations. According to the definition by Nonaka and Takeuchi, this so called "knowledge" is indeed just information. This approach is

far more an information management approach than a real knowledge management approach. The focus is on documenting situational knowledge from projects in order to reuse this knowledge like lessons-learned or best-practice documents over and over again (the so called people-to-documents approach).

The second strategy is the *personalization strategy*, which focuses on tacit knowledge. This knowledge is bound to several experts within the process or company. The strategy tries to identify the experts and to connect or visualize them through methods like yellow pages or knowledge maps. The communication between experts should be improved. The codification strategy does not seem to be appropriate for knowledge-intensive processes; the personalization strategy can be suitable if it is expanded by some more elements which is sometimes called *socialization strategy* [6].

This strategy focuses on the exchange and creation of knowledge within groups. Knowledge is a social product made within an environment [24]. The settings of the environment and the organization are within the focus of this strategy. A successful strategy for knowledge management of knowledge-intensive processes should focus on a combined personalization and socialization strategy.

Looking at the previous paragraph, we can see that knowledge-intensive business processes deal very much with creating and using tacit knowledge from many participants. An integrated approach should focus first of all on the *ba*-concept of places or processes where knowledge is created, the difference between tacit and explicit knowledge and focus on the factors of knowledge-intensive processes which are very much driven and fulfilled by the SECI knowledge conversions. Furthermore, the general strategy should be a combination of personalization and socialization, we should be able to identify tacit knowledge bound to persons as well as identifying processes within the organization creating knowledge and supporting the creation by appropriate (knowledge management) solutions or practices. The three types of knowledge processes according to Remus should be supported, if it is possible to model and support knowledge-intensive processes, the subordinate processes can be modeled, too. Our approach to fulfill those requirements is the KMDL.

3 The Knowledge Modeling Description Language

The elements and mechanisms have been discussed in several other publications and the literature [9, 10]; we will therefore only discuss the core elements which are basis to the mentioned practical benefits in the third section of this paper.

3.1 Objects

The actual implementation of the KMDL consists of six objects: information, task, role, role requirement, knowledge object and person. The relation of those objects can be seen in Figure 1.

The information object is used in a process like any other information or explicit knowledge. Information can be externalized easily. It can be saved to disk or written down in documents.

The task object is the core element of the process model. A task is defined in this context as an object within the business process having input and output and being a single step within the whole superior process. Knowledge-intensive processes often process a lot of information, the input and outputs of the task therefore are information objects.

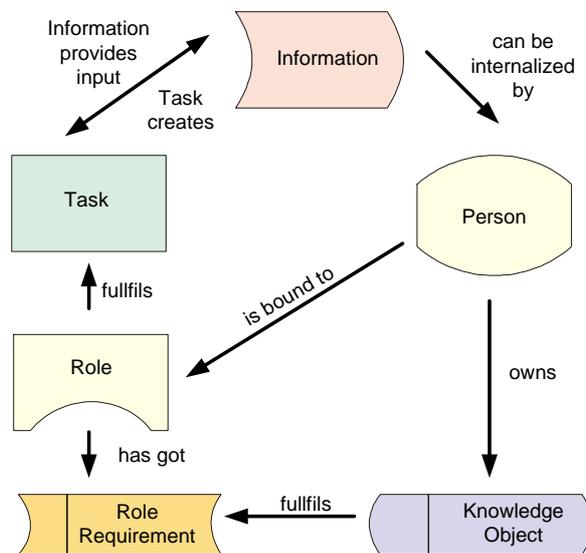


Fig. 1. Objects of KMDL

The role object is bound to tasks and roles execute the tasks. Roles can be taken and assigned to several persons. This provides the possibility to model the whole functional and personal company structure.

The role requirements are mainly used for skill management. Tasks require certain skills to be solved; those skills have to be provided by the persons taken the certain role. The complete role requirements define the tacit knowledge which is needed to fulfill the task assigned to the role. Every requirement is a tacit knowledge object. Though it is no physical object, we still define it as kind of internalized experience knowledge object.

Persons are bound and assigned to roles and are the owners of the knowledge objects. Knowledge objects are used to track the whole process-relevant (tacit) knowledge objects of a person. They are the foundation of everyone's knowledge base.

3.2 Knowledge Conversions and Relations

The four knowledge conversions according to the SECI model are represented within the notation as relations between the objects. It is possible to model several of the conversions properties, the most important we identified are frequency, completeness, number of participants, and conversions direction.

The frequency is an attribute how often people contact each other to share their knowledge. This can happen once, daily, twice a week or whatever. We can identify the necessity to support this process by looking at the frequency. We expect higher use when supporting frequent processes.

The completeness focuses on the level of socialized knowledge you can learn complementary knowledge from different persons to add to your knowledge base. Still, it is possible to externalize and socialize most of the knowledge.

The number of participants can vary within a conversion. When listening to a speech, multiple people can gain new knowledge.

The direction of the conversion can vary from the process or *ba*. A discussion, brainstorming, personal evaluation implicate different types of knowledge flows. Every recipient can be sender or receptor.

These properties have been taken into account when modeling; the relations can be seen in figure two.

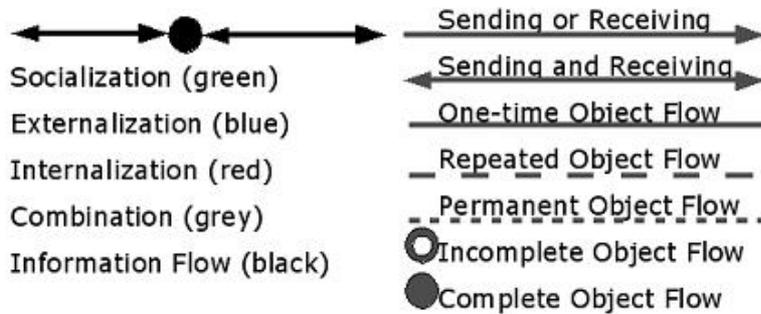


Fig. 2. Object relations and conversions

3.3 Views of the KMDL

Using those objects and relations, we can distinguish and model several views which show different aspects of business processes or the organization.

The task view shows an EPC-like view to the tasks which are involved in the whole process without any further information. We can use this view as an overview to identify all core tasks within the process.

The simple process view includes the tasks and the information coming in and out of the task. This is the level where it can be possible to import EPC models and include more information into the further views which better meets the requirements of modeling knowledge-intensive business processes.

The extended process view consists of the elements provided by the simple process view which have been enriched by the roles. It provides the advantage that we can view the roles associated with the tasks. Improper allocation and multi-allocations can be recognized.

The tacit process view shows the roles, the assigned persons and their knowledge objects which are subject to the role requirements. We therefore can get a view about all requirements within the process or a view about all the knowledge objects provided by the matching employees.

The general view contains all the elements from the other views and integrates the whole views to a general view of the process which contains all the knowledge conversions and knowledge involved within the process.

4 Practical Aspects of the Approach

Normally, we must always consider the practical aspects of the approach. We have done several projects with the KMDL and developed several introduction models and features which provide the advantage for the whole approach. The following paragraph will summarize those benefits and provide an overview of non-striking benefits for the integrated approach for modeling knowledge-intensive business processes with the KMDL.

4.1 Procedural Model

We have already introduced several aspects which covered different domains of knowledge-intensive business processes like public administration, software development, IT-infrastructure, information systems in logistics business and corporate academies. The procedural model ensures the correct elicitation of all data needed and can be strongly adapted to the customers' processes and workers council requirements.

The model consists of several steps which can then again be subdivided. First of all, it is necessary to identify the knowledge-intensive processes. They can be defined by the customer but can also easily be identified using our criteria catalogue consisting of thirty factors. Having found the processes, we must do an analysis of the

actual process executed. This is the most important point. We identify the tasks, assign the information objects to them, then identify the person and roles executing the task, specify their requirements and assign the person's knowledge objects to the role requirements. Afterwards, the process is modeled with our JAVA-based tool, the so called K-Modeler. The modeled processes are discussed afterwards with all partners, and then they are analyzed and hopefully optimized with the tool and the modelers' domain knowledge. Then the optimization can be directly executed within the company afterwards.

4.2 The K-Modeler Tool

The JAVA-based tool provides the possibility to model direct and via drag and drop on a canvas like design surface. The object can have attributes assigned to them which can be freely defined. A syntax check has been implemented to ensure that only formal correct models can be stored within the tools database. The processes tracked can be justified whether they include known anti-patterns which could be found in knowledge-intensive processes. We could identify knowledge monopolies, media breaches, not suitable knowledge objects which do not fit the role requirements, unsupported knowledge flow processes, unused knowledge, insufficiently used knowledge and so on.

4.3 Skill Management

The information about the person knowledge objects and the requirements of their roles can be used within skill management systems. It is possible to examine gaps between the requirements and the actual knowledge levels. This information can be used to start learning processes within the company to enhance the knowledge levels of the process-involved employees. The standard for the data used is HR-XML which provides a general format not only suitable for skill management systems but also for human resources information systems. The data tracked via the process modeling approach can support processes outside the knowledge-intensive domain. For example, an overview over the knowledge objects mostly used within the company can provide knowledge maps but also lead to finding core competences and processes with the corporation which can support a general business strategy [8].

4.4 Hyperlink structure of modeled processes

It is possible to export all objects into a structured documentation in HTML or XML which provides an overview of all relevant data for a certain task. The task is shown with all information objects processed, all people linked with their role requirements in a hypertext-structure which can be browsed via normal internet browsers. It is a kind of process handbook which can easily be navigated. Linking resources like documents from DMS or CMS directly within these hypertext-documents ensures fast access to the relevant process information objects.

An export in XML format can be used to configure structures within those systems. Using this data in an electronic handbook furthermore ensures the topicality and validity of the data because it can easily be updated from the process tracked there is no need to reprint large documents over and over again.

4.5 Pre-Configuration of Workflow or Document Management Systems

The process models can be exported to provide a pre-configuration of workflow management systems in order to reuse the modeled processes and to transmit the improved processes to the execution level. Document management systems can track the information documents created and used within the processes and link them via hypertext directly from the process model which can ensure a fast access to the relevant information for all employees or stakeholder within the business process.

4.6 Choosing Knowledge Management Systems

The knowledge conversions within the processes and the knowledge creation should be consequently supported by knowledge management systems. We have done a survey of knowledge management systems and tools [16] which ensures that we have a taxonomy which supports what type of knowledge creation and distribution is especially supported by which system.

4.7 Modeling Reference Processes without Personal Data

Even when it is not possible to track all data due to workers council reasons and data protection, the approach still can contribute with modeled reference processes which show in an anonymous way how best practice processes can create knowledge and where conversions should appear. Furthermore, the skill catalogue for skill management systems can be created because all role requirements are needed skills which should be included in the catalogue.

5 Conclusion

The KMDL approach can be used as a very pragmatic and suitable platform for knowledge-intensive business processes. It covers various quick wins and factors which provide benefits for the business modeling approach and the companies analyzing their processes. It is possible to improve the processes and knowledge creation via various tools. The approach itself has been evaluated and improved in several projects and companies and should be established as one very suitable method to manage knowledge-intensive processes.

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