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Modeling of Knowledge Intensive Business Processes with the Declaration Language KMDL

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ABSTRACT

The Knowledge Modeler Description Language KMDL is able to represent the creation, use and necessity of knowledge along common business processes. So KMDL can be used to formalize knowledge-intensive processes with a focus on certain knowledge-specific characteristics and to identify weak points in these processes. For a computer-aided modeling and analyzing the tool K-Modeler is introduced.

INTRODUCTION

Knowledge management has gained importance since the 1990s. Companies hope for an improvement of innovation capability and an increase of process efficiency. Not at last globalization, emerging competition, increasing market dynamics and shorter product development and life cycle times require an increased adaptability of companies to a dynamic environment [PrRo98]. These requirements cause an adaptation and consequent aligning of business processes to existing and future market demands.

Low structured knowledge processes are running in parallel to common business processes. The long time aim of a comprehensive process oriented knowledge management approach must be to discover these processes, to model, analyze and optimize them.

Therefore knowledge processes and business processes are linked together and should be regarded together. Business processes can be modeled and analyzed extensively with well known and established methods. Some more approaches exist that consider knowledge as a component of a company or an organization [Go02, Re01]. The simple mapping of static knowledge (typically in an explicit manner as information) does not fulfill the requirements of a comprehensive and integrated approach of process-oriented knowledge management. Only the coordination of business processes with the processes of knowledge processing guarantees an efficient general knowledge flow [Re02, p. 2].

The above mentioned problems and challenges have been the trigger for the development of the Knowledge Modeler Description Language KMDL and a software tool basing on KMDL to model knowledge-intensive business processes [WKM03]. Within KMDL the term knowledge is understood as bound to persons. This kind of knowledge named from Nonaka/Takeuchi as tacit knowledge is personally and cannot be transferred to a formal notation. It is anchored in the activities and skills of the knowledge bearer and additionally in her/his ideals, values and experiences [NoTa95]. Therefore also knowledge can be modeled and analyzed that is not necessary for the fulfillment of an operative business task in a business process. Furthermore with KMDL the different possibilities of knowledge conversion can be modeled, so that the flow of knowledge between persons can be visualized. Knowledge flows in a process and the different kinds of knowledge conversion can be used in the model to retrieve information on the generation of new knowledge and possible weak spots.

DEFINITION OF KNOWLEDGE INTENSIVE BUSINESS PROCESSES

Some authors accentuate the ability to plan the knowledge requirement and determine the knowledge intensity on the basis of variability and exceptional conditions [He02]. Other sources name processes as knowledge intensive if an improvement with conventional methods of business reengineering is not or only partially possible [Re02]. Davenport recognizes the knowledge intensity by the diversity and uncertainty of process input and output [Da95].

A process is knowledge intensive if its value can only be created through the fulfillment of the knowledge requirements of the process participants. Clues for a knowledge intensive process are apart from the above mentioned criteria:

- Diversity of information sources and media types
- Variance and dynamic development of process organization [Ho02]
- Many process participants with different expert's reports
- Use of creativity
- High degree of innovation
- An available degree of decision scope.

KNOWLEDGE AND KNOWLEDGE CONVERSION

KMDL uses the understanding of tacit knowledge according to Nonaka/Takeuchi. They argue that knowledge cannot exist on information media like documents or database entries, because this media is not bound to persons. Knowledge that can be expressed on handbooks, papers, patents or software is named as explicit knowledge following a term coined by Polany [NoTa95, Neu99].

New objects of knowledge or information are created by transformation of objects existing in the process. This transformation is performed by an interaction of knowledge and information objects. As an analogy to Nonaka/Takeuchi KMDL distinguishes between four types of knowledge conversion. Explicit knowledge and information are modeled as information object, while tacit knowledge is represented as knowledge object. So a strict separation of knowledge bound to persons from knowledge not related to persons and from information can be achieved. It can be distinguished between the following types of knowledge conversion:

- *Internalization* means the conversion of information in tacit knowledge. A knowledge object is generated with the help of one or more information objects.
- *Externalization* is understood as the transformation of tacit knowledge in information objects. Other information objects do not participate in this conversion.
- The transmission of tacit knowledge from person to person is called *socialization*. This is handled normally by means of direct personal communication. In the K-Modeler description language socialization is represented by interaction of knowledge objects.

- During a *combination* one or more information objects are used to create new information. Knowledge objects can be participate in the combination, but have only a coordinating role and are not created by the information to be combined.

KMDL - THE KNOWLEDGE MODELER DESCRIPTION LANGUAGE

The result of the modeling process should be an idealistic, simplified and similar mapping of a subject, system or other part of the world. The main aim is to study some characteristics of the original system using the model [HBB+94]. To guarantee the completeness of the modeling method, certain elements, relations and their qualities have to be considered to be able to grasp the knowledge intensity of a process and the usage of knowledge. In actual modeling methods these requirements are only partially fulfilled [Gro03, p. 5-10].

Requirements for Describing Knowledge Intensive Processes

The mapping of following aspects has to be demanded from a description language:

- Knowledge is bound to persons (knowledge bearer).
- Knowledge itself cannot be coded. Therefore a paraphrase of the knowledge or a description of the knowledge domain is necessary (knowledge descriptor).
- The required or available knowledge of a person can cover an arbitrary set of an arbitrary common defined knowledge domain (class of competency).
- The knowledge of a person can only be modeled as a reference to a section of a domain (knowledge object)
- The usage of knowledge depends on its context (pragmatic aspect)
- Knowledge can be inquired or offered (knowledge demand and knowledge offer).
- Knowledge can be externalized, internalized, socialized or com bined (knowledge flow).

Elements of KMDL

KMDL provides an object library containing information, task, position, position requirements, person, knowledge object and knowledge descriptor (see fig. 1).

Information

Information is next to existing knowledge a base for the creation of new knowledge. Information can be externalized in an easy manner. It is stored on data media or written down in documents. The creation of new information is done by externalization or combination.

Tasks

Tasks are the basic framework for models of business processes. The order of the tasks determines the temporal structure of the process. A task is defined as an atomic transfer from input to output, represented as information objects.

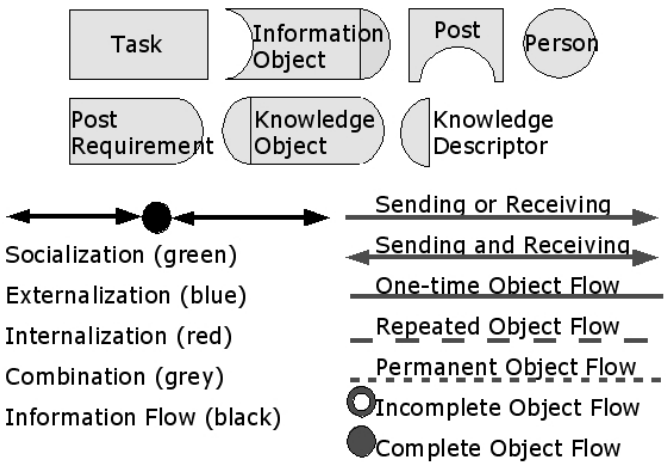
Positions

Tasks are related to and be fulfilled by positions. Positions are manned by persons and have the necessary knowledge objects of all persons assigned to them. Relating employees and tasks to a position the functional and organizational structure of a company can be represented.

Task requirements

Performing tasks makes demands on the positions, that are modeled as task requirements. The totality of task requirements defines the tacit knowledge that is necessary for a position working on a concrete task. Every needed tacit ability is represented by a knowledge object. More than one task requirement can be associated to a position, because normally more than one ability is necessary to accomplish the task.

Figure 1: Elements of KMDL



Person

Persons are the owners of knowledge objects that are necessary to fulfill tasks. The totality of knowledge objects of a person should be equal to the requirements of the task the person has to do.

Knowledge object

A knowledge object contains tacit knowledge of persons. Knowledge objects can be available or asked. Available knowledge objects can be used for task fulfillment immediately. Asked knowledge objects are necessary for the task fulfillment, but must generated by the person responsible for the task. This can be done by internalization or socialization.

Knowledge descriptor

A knowledge descriptor describes the borders of a knowledge domain and defines partial domains, if necessary. It is no codification of knowledge. Task requirements and knowledge objects refer to a certain knowledge descriptor. The attributes of the task requirement document, which domain part in which quality is required. The knowledge object says, which domain part it covers in which quality.

Knowledge Conversion

KMDL supports all four expressions of knowledge conversion. A socialization occurs, when people exchange tacit knowledge directly. This can be done during a personal talk, on a conference, during exchange of experiences or by imitation. These examples show that a knowledge conversion can have varying appearances. Depending on the intention of the model it can be sufficient to represent a socialization as a directed relation between knowledge objects of two persons. KMDL also offers extended representation possibilities to grasp further characteristics. These can be transferred to other expressions of knowledge conversion.

Frequency

The contact between two persons for the exchange of knowledge is possible once, often or permanent. The last possibility occurs especially during an imitation. The other cases can be explained with single or multiple telephone calls.

Completeness

The completeness of the socialized knowledge has to be considered. Different or supplementary contents can be given in different contacts. In addition a complete transfer of the actual knowledge is possible in every contact.

Number of participants

A conversion can take place with multiple participants. A talk given to three people is a single act of socialization. If this is modeled as three different relations between speaker and listener, it is meant that three different contacts with three different acts of socialization exist.

Direction of conversion

A discussion, a brainstorming meeting or a personal suggestion of one of the participants implicates a multitude of knowledge flows. These are not directed. Every participant can be either sender or receiver. Otherwise the acts of socialization had to be represented on the level of single sentences. Such a degree of detail is not efficient and no real gain of information. Therefore a representation of expressions of knowledge flows is necessary, where the participants can be sender, receiver or both.

The graphical representation of these qualities in KMDL is shown in Fig. 1. The conversion is represented as a node, with that all participants (knowledge or information objects) are linked. These relations are directed and show the status of the element as sender or receiver. The line style shows the frequency of participation while the completeness of the conversion is represented by the shape of the node symbol.

Scaling and Comparability

The coverage of a knowledge domain is coded in an interval from 0 to 100. 100 means that be described knowledge domain is totally covered. A value of zero means that no knowledge from this domain is available. A knowledge descriptor always describes an ideal status of 100. Within the attributes of a knowledge descriptor are divided in different subclasses. Possible names of the intervals are

- no knowledge available
- basic knowledge
- working knowledge
- management knowledge and
- expert knowledge

With a position requirement it has to be mentioned, which competency class is required. The position requirement can also use an own classification or a numeric scale. The expressed accuracy is in this case lower than the exact number feigns. The accuracy of the model is the higher, the more detailed the knowledge domain is split up. It has to be mentioned that all these classifications and categories depend on subjective assessments or from hidden objective information. Competency classes are also assigned to the knowledge objects. By comparison with the position requirements of a task, filled with a person, it is possible to recognize over or under qualifications. Learning measures or personal reassignments can be derived from these results.

The main function of the knowledge descriptor is the preservation of the semantic correctness of a model and for internal comparisons. The knowledge descriptor delivers an ideal requirement satisfaction for a part of a knowledge domain. Knowledge objects and position requirements need a content alignment from a link to a knowledge descriptor. They are not allowed to define or categorize knowledge by themselves. In combination with the competency classes a semantic comparison is possible, that can automated without problems.

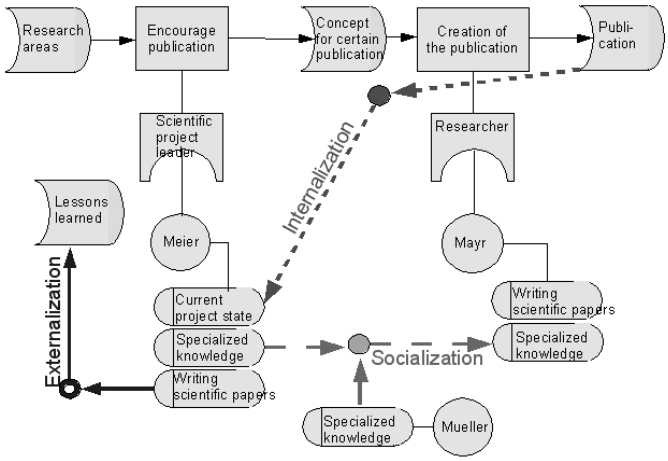
Example

As an example we take an editorial process. There is a set of research areas. A topic of one of these areas has to be selected and a concept for a publication has to be written for it by a scientific project leader. Based on this concept another person has to do further research and write the final scientific paper.

It is a very simple example and a process like this could very easily be reused as a reference process by any organization. But there are also a lot of implicit assumptions and concurrent activities for serving those two tasks of encouraging and creating a publication. In figure 2 it is shown how the knowledge requirements and knowledge processes of a concrete editorial process could be represented by KMDL. The visualization of knowledge descriptors and requirements has been neglected in the example.

In this case knowledge of scientific writing includes the writing itself as well as the review of scientific literature. If it should not be a random or cyclic topic selection for the publication, the project leader needs an overview over the existing literature and has to recognize the necessity for selecting a concrete topic. He needs specialized knowledge about the selected topic and because of his responsibility for the publication he should know the current state of the publication. The researcher needs skills in writing and specialized knowledge about the considered topic, too.

Figure 2: Process modeled with KMDL



The knowledge of the project leader and the researcher was insufficient for doing their job. Therefore the researcher was taught in several sessions. These sessions (maybe a weekly and personally meeting) are represented as a knowledge conversion.

Although the reference process does not proposed it, the project leader took a permanent view on the arising publication. This is an internalization to acquire knowledge of the qualitative and quantitative state of the paper.

After all the project leader took a moment and wrote down some lessons learned about writing a scientific paper (externalization). In this case the researcher knew how to write in a scientific style. If there will be another one without this knowledge he could use the externalized knowledge for teaching himself.

This example is too small for analyzing complicate coherence. But even if this reference process for writing a paper is reused for some times, concrete concurrence activities may be identified. If there are in every writing process the same informal sessions for knowledge socialization, these meetings should be integrated formally in the reference process or at least be supported technically or organizationally. So there has not to be an expensive reorganization of those informal activities for each new writing process.

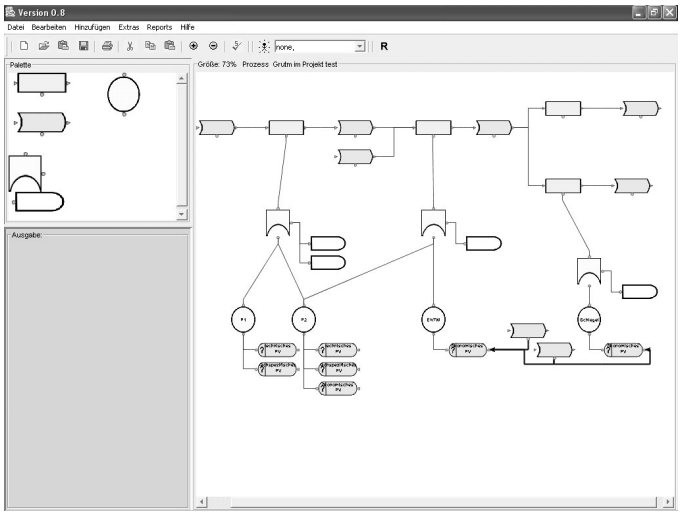
K-MODELER – THE MODELLING TOOL FOR KNOWLEDGE INTENSIVE BUSINESS PROCESSES

Basing on the concept of KMDL a tool is under development that allows to store the modeled knowledge-intensive business processes in a database and to analyze them [WKM03]. The software is completely developed in JAVA, while the data is stored in an relational database management system. For interactive modeling a modeling pane is available. Needed objects can be placed on the work pane with drag and drop. Afterwards the edges between the objects are drawn with the mouse to create logical connections. The modeling process is watched by an intelligent agent. Objects can only be placed agreeing with the defined syntactical rules. Furthermore a function „Syntax check“ exists, that is able to recognize errors in the model. Fig. 3 shows the graphical user interface and the model of a process example.

Additionally the K-Modeler tool offers functions to analyze the modeled processes. With these functions it is possible to recognize weak points in knowledge-intensive business processes. Examples for weak spots that can be recognized automatically with K-Modeler are:

- Knowledge monopolies
- Unsuitable knowledge profiles of employees
- Dissatisfied demand for knowledge objects

Figure 3: User interface and example process of the K-Modeler tool



- Acquisition and generation of unnecessary knowledge
- Multiple generation of similar knowledge
- Barriers against knowledge transfer
- Media breaks
- Missing actualization of knowledge

The analyzes are not only basing on the actual modeled process but on the process database. Information on all existing and on former processes and process elements are taken into consideration. In the meaning of a process warehouse the variety of possible evaluation and reports is unlimited.

If K-Modeler is used with person-related data, a well-directed comparison is possible between the qualification of employees and the process requirements. So employees can be supported, because matching teachers for specific abilities can be found and connected with these employees easily.

The usage of information technology used in companies can be analyzed with K-Modeler, too. This is especially related to information technology used in the field of knowledge management. The main aim of knowledge management is to provide employees with information and to simplify the finding of experts. K-Modeler judges using the attributes of knowledge and information objects, whether the knowledge management system really participates in the distribution of these objects or not.

The separation between information and tacit knowledge is another important benefit of K-Modeler. Information are at the disposal of the whole organization. They incorporate the intellectual assets and are available in different manners like patents, organization diagrams, handbooks and so on. They exist independently form the persons in an organization and are therefore often named as „organizational memory“ [BoPa98]. In contrary knowledge can only be created by individuals. Organizations should foster create persons [NoTa95]. Fostering can be the availability of information or the connection of people for knowledge exchange.

This idea was realized with K-Modeler. The organization, with processes running in it, puts information and infrastructure for the administration of information at the disposal of the members of the organization. Persons enrich the information pool of the organization by creating new information. The information (and also new tacit knowledge objects) is created by combination with tacit knowledge objects.

Especially after a restructurization of a process the ensemble acting between information and tacit knowledge can be disturbed. As an example it is mentioned the attempt to cut cost by laying off personnel. With the dispensing tacit knowledge is withdrawn from the process. If a former model with K-Modeler exists, it is possible to predict, whether relevant knowledge was withdrawn from the process or not and which knowledge and information cannot be generated furthermore. The information and knowledge objects remaining in the process will be used in another way. Which way can also be predicted with K-Modeler. It is expected that information that is no longer used, becomes antiquated because it can no longer participating in the knowledge flow.

OUTLOOK

First experiences in practice, for instance during the concept of a new large governmental Intranet or during the creation of a corporate university show, that typical advantages of business process modeling can be reached also with K-Modeler. A certain proceeding model assures the efficient collection of additional qualities and attributes, that are necessary to generate statements concerning the quality of the knowledge management in the investigated process.

One of the next steps will be the reimplementation of the interactive graphical tool, which is actually in the status of a prototype. The conceptual defined automated weak spot analysis will be implemented then. Another step is the usage of all collected process elements for the documentation of the process and for a navigation through all participated elements, perhaps with a knowledge map. Furthermore the usage of KMDL and K-Modeler for skill management is actually in preparation.

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