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Defining an Infrastructure for Knowledge Intensive Business Processes

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Abstract: Business processes can be modelled and analysed extensively with well known and established methods. The simple signs of static knowledge do not fulfil the requirements of a comprehensive and integrated approach of process-oriented knowledge management. The Knowledge Modelling Description Language KMDL is able to represent the creation, use and necessity of knowledge along common business processes. Therefore KMDL can be used to formalise knowledge-intensive processes with a focus on certain knowledge-specific characteristics and to identify weak points in these processes. The tool K-Modeller is introduced for a computer-aided modelling and analysing.

1 Introduction

Knowledge management has gained importance since the 1990s. Companies hope for an improvement of innovation capability and an increase in process efficiency. Among other developments globalisation, emerging competition, increasing market dynamics and shorter product development and life cycle times require an increased adaptability of companies to a dynamic environment (Probst et al., 1998). These requirements cause an adaptation and consequent aligning of business processes to existing and future market demands.

A business process is a set of organisation-specific activities. These activities have a logical and temporal relation to each other in order to produce an output. This is achieved by combination of information, machines, material, methods and human resources. (Gausmeier and Fahrwinkel, 1994)

The procurement of the needed material inputs or information objects is often fulfilled by other well defined processes. Those objects can easily be specified because the type and characteristic of the required objects will remain nearly unchanged for different process flows. Whereas the demand of knowledge as process input cannot be predetermined easily. It depends on the acting employee and the dynamic environmental situation the process is embedded in. The objective knowledge need always differs from the subjective knowledge need and offer. Therefore variations or divergence from a reference business process, inadequate or impractical process rules or the missing of a well structured process model

can only be overcome by the employee's knowledge of keeping the process flow going on. These activities of knowledge exchange have to find their own way and cannot be completely captured by common business process models. Thus undesigned and unscheduled activities of knowledge conversion are running in parallel to common business processes. Therefore the long-term objective of a comprehensive process oriented knowledge management approach must be to discover these processes, model, analyse and optimise them.

The above mentioned problems and challenges have been the trigger for the development of the Knowledge Modelling Description Language KMDL and a software tool basing on KMDL for modelling knowledge intensive business processes (Working Group Knowledge Management, 2004). Different manifestations of knowledge conversion can be modelled, so that the flow of knowledge between persons can be visualised by KMDL. Knowledge flows in a process and the different kinds of knowledge conversion can be used in the model to retrieve information about the generation of new knowledge and possible weak spots.

2   Knowledge conversion and knowledge intensity

Nonaka/Takeuchi argue that knowledge can not 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 termed explicit knowledge following a term coined by Polanyi as opposed to person bound knowledge named tacit knowledge (Nonaka and Takeuchi, 1995)(Neuweg, 1999).

New objects of knowledge or information are created by transformation of objects already existing in the process. This transformation is performed by an interaction of knowledge and information objects. As an analogy to Nonaka and Takeuchi four types of knowledge conversion are distinguished by KMDL. Explicit or rather externalised knowledge and information are modelled as information object, while tacit or non-externalised knowledge is represented as knowledge object. This ensures a strict separation of knowledge bound to persons from knowledge not related to persons and from information.

– **Internalisation** means the conversion of information in tacit knowledge.

– **Externalisation** is understood as the transformation of tacit knowledge in information objects.

– The transmission of tacit knowledge from person to person is called **socialisation**. This is handled normally by means of direct personal communication. Socialisation is represented in KMDL by the interaction of knowledge objects.

– During a **combination** one or more information objects are used to create new information.

A process is knowledge intensive if it can only create added value through fulfilment of the knowledge requirements of the process participants. Further evidences 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 organisation (Hoffmann, 2002), many process participants with different expert's reports, the use of creativity, a high degree of innovation and a wide decision range.

Common business processes are characterised by a predefined process structure and repeated tasks that are fulfilled based on the underlying process model, which contains information, tasks and user roles.

Knowledge-intensive business processes are only partially mapped by the process model due to unpredictable decisions or tasks guided by creativity. Typically knowledge flows and knowledge transfers between media and persons are necessary to achieve a successful process completion.

So if there is a view on a knowledge-intensive process, the set of relevant activities defining the process has to be extended by activities describing the use, the demand and the creation of knowledge, that is necessary for the organisation-specific activities.

3   KMDL - the Knowledge Modelling Description Language

The occurrence of knowledge and its flow and transfer between media and persons is not sufficiently modelled in common business process management tools (Gronau et al., 2003, p. 316f). The comparison of some recent approaches has shown that nearly no language or tool separates tacit knowledge from explicit information. This lack was one of the main reasons for the development of KMDL, which was designed to fulfil the following requirements:

– knowledge is bound to persons (knowledge bearer)

– knowledge itself cannot be codified (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 modelled 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 offer)

- explicit knowledge is not bound to persons (information object)

- knowledge can be externalised, internalised, socialised or combined (knowledge flow)

KMDL provides an object library containing information, task, position, position requirements, person, knowledge object and knowledge descriptor.

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

Tasks: Tasks are the basic framework for business process models. The sequence 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 are fulfilled by positions. Positions are manned by persons and have the knowledge objects of all persons assigned to them. By relating employees and tasks to a position, the functional and organisational structure of a company can be represented.

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

Task requirements: Performing tasks poses requirements on the positions that are modelled 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.

Knowledge descriptor: A knowledge descriptor describes the borders and content 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 notes, which part of a knowledge domain in which quality is required.

Knowledge object: A knowledge object describes the knowledge of persons. Each knowledge object must have a reference to a knowledge descriptor for describing which part of a knowledge domain it covers in which quality.

Conversion: The conversion is represented as a node All participants - knowledge or information objects are linked to this node. These links 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.

In the following an editorial process is taken as example for modelling with KMDL: 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 organisation. 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 1 it is shown how the use of knowledge and knowledge conversions in a concrete editorial process could be represented by KMDL. (The visualisation of knowledge descriptors and requirements has been neglected in the example.) In this case knowledge of scientific writing includes
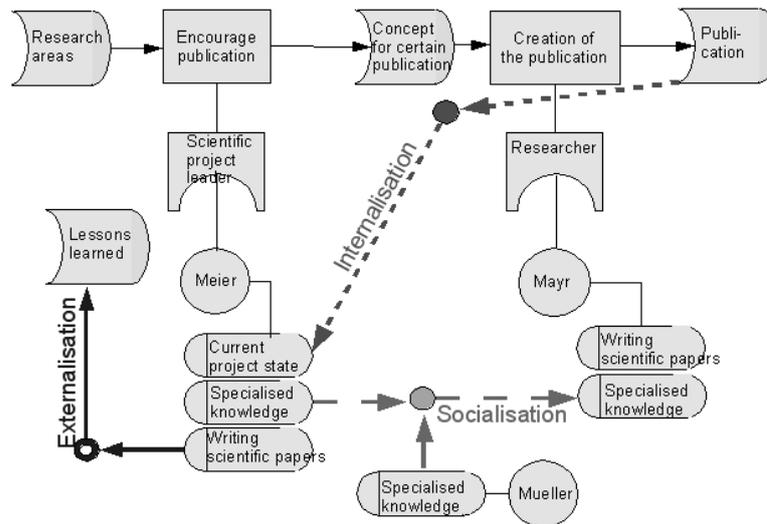

Figure 1: Process modelled with KMDL

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 recognise the necessity for selecting a certain topic. He needs specialised knowledge about the selected topic and because of his responsibility for the publication he needs to know the current

state of the publication. The researcher needs skills in writing and specialised knowledge about the considered topic, too.

In this example the required knowledge of the project leader and the researcher was insufficient for doing their job. Therefore the researcher was taught in several sessions by the project leader and a further person. (Of course there might be some more external information objects as sources, too.) These sessions (maybe a weekly personal meeting) are represented as a knowledge conversion, that transfers knowledge from one person to another by socialisation.

Although the reference process has not proposed it, the project leader always watches the arising publication. This is an internalisation 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 (externalisation). In this case the researcher knew how to write using a scientific style. If there will be another one without this knowledge he could use the externalised knowledge for teaching himself.

This example is too small for analysing complicate coherence. But even if this reference process for writing a paper is reused for some times, some special concurrence activities may be identified. If there are the same informal sessions for knowledge socialisation in every writing process, these meetings should be integrated formally in the reference process or at least be supported technically or organisationally. So an expensive reorganisation for each new writing process would not be necessary.

4   K-Modeller - the modelling tool for knowledge intensive business processes

Based on the concept of KMDL a tool is under development that allows to store the modelled knowledge-intensive business processes in a database and to analyse them (Working Group Knowledge Management, 2004). The software is completely developed in JAVA, while the data is stored in a RDBMS. For interactive modelling a modelling 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 modelling 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 recognise errors in the model.

Additionally the K-Modeller tool offers functions to analyse the modelled processes. With these functions it is possible to recognise weak points in knowledge-intensive business processes. Examples for weak spots that can be recognised automatically with K-Modeller are knowledge monopolies, unsuitable knowledge

profiles of employees, dissatisfied demand for knowledge objects, acquisition and generation of unnecessary knowledge, multiple generation of similar knowledge, barriers against knowledge transfer, media breaks and missing actualisation of knowledge

The analyses are not only basing on the actual modelled 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-Modeller 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 mentors for specific skills can be found and connected with these employees easily.

Knowledge monopolies exist if only a few people have the knowledge about a certain domain. This could be intentionally because it is classified knowledge, but it could also become a problem if the knowledge owner quits his job and so this knowledge gets lost for the company. For preventing organisational knowledge leakage by employee turnover K-Modeller could detect upcoming knowledge shortages or monopolies at an early stage.

The usage of information technology used in companies can be analysed with K-Modeller, 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 ease the search for experts. K-Modeller judges by using the attributes of knowledge and information objects, whether the knowledge management system really participates in the distribution of these objects or not.

Especially after a restructuring of a process, for example by laying off personal, the ensemble acting between information and tacit knowledge can be disturbed. With the dispensing tacit knowledge is withdrawn from the process. If a former model with K-Modeller 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-Modeller. It is expected that information that is no longer used, become antiquated because it can no longer participating in the knowledge flow.

5 Summary and outlook

The description language KMDL and the K-Modeller tool were developed to model and analyse knowledge-intensive business processes especially considering the aspects of flow and conversion of knowledge bound to persons.

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 modelling can be reached also with K-Modeller. A methodology 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 prototypical interactive graphical tool. The conceptually 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-Modeller for skill management is planned.

References

Gausmeier, J. and Fahrwinkel, U. (1994). Strategiekonforme geschäftsprozesse und cim-maSSnahmen. *CIM-Management*, 10(2):56–61.

Gronau, N., Palmer, U., Schulte, K., and Winkler, T. (2003). Modeling of knowledge-intensive business processes with the declaration language KMDL. In Reimer, U., Abecker, A., Staab, S., and Stumme, G., editors, *Professional knowledge management - Experiences and visions*, pages 315–322. Bonn.

Hoffmann, M. (2002). Analyse und Unterstützung von Wissensprozessen als Voraussetzung für erfolgreiches Wissensmanagement. In Abecker, A., editor, *Geschäftsprozessorientiertes Wissensmanagement*. Heidelberg.

Neuweg, H. G. (1999). Könnerschaft und implizites Wissen. Zur lehrlerntheoretischen Bedeutung der Erkenntnis- und Wissenstheorie Michael Polanyis.

Nonaka, I. and Takeuchi, H. (1995). *The Knowledge-Creating Company. How Japanese Companies Create the Dynamics of Innovation.* Oxford University Press, New York.

Probst, G., Raub, S., and Romhardt, K. (1998). *Wissen managen, wie Unternehmen ihre wertvollste Ressource optimal nutzen.* Frankfurter Allgemeine, Gabler, Frankfurt a. M., 2. edition.

Working Group Knowledge Management (2004). K-Modeler. http://www.k-modeler.de (Last accessed: January 2004).