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Process-oriented Knowledge Structuring

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Abstract: Within a business environment, where the fast and reliable access to knowledge is a key success factor, an efficient handling of the organizational knowledge is crucial. Therefore the need for methods and techniques, which allow to structure and maintain complex knowledge bases according to the requirements emerging from the daily work have a high priority. This article provides a business process oriented approach to structure organizational knowledge and information bases. The approach was developed within applied research in the industrial, service and administrative sector. Following this approach, three different types of knowledge structures and their visualization have been developed by the Fraunhofer IPK and are currently applied and tested in organizations. Beside the approach itself, these three types of knowledge structure and the cases of application shall be introduced here.

Key Words: knowledge management, knowledge structure, visualization, process context, browsing, business process, knowledge base, knowledge bearer, knowledge carrier, knowledge domain, knowledge map, knowledge navigator, post-structuring, pre-structuring, process assistant, process modeling tool, key word based search, topic map engine
Categories: D.2, D.4.1, E.1, H.1, H.3.1, H.5, K.6

1 Introduction

The knowledge and information environment nowadays is increasingly dominated through information overload and uncertainty about validity, reliability and news of available knowledge. To lessen this effect organizations more and more call for methods and techniques, which allow them to structure their existing knowledge base and to enable adequate access to it. Considering the architecture of knowledge management systems frequently used nowadays, one can find that they offer various functionalities for an appropriate infrastructure or components for the controlling of organizational procedures. A knowledge management system, however, consists of technology, organizational processes and the knowledge content with its inner

knowledge structure. Only an analysis of all components together lead to KM solutions that respond in an optimal way to the circumstances of concrete organizations. The knowledge structure, in this context, represents the transition between knowledge content and all kinds of technical support. Through the way of knowledge structuring, the possibilities of visualization and therefore the interface between IT-system and user are being widely influenced. By this, the potential benefit for the user as well as the effort needed for the installation, the initial feeding and updating of the system are being anticipated. For that reason, it is necessary to take account of this important aspect at an early stage when dealing with KM, especially when a technical solution is planned. But to structure organizational knowledge offers further advantages which are of importance for a comprehensive consideration of knowledge management. Common knowledge structures, once made explicit and being communicated, allow for greater transparency but also influence the language for the exchange of knowledge and therefore have far-reaching, cultural side-effects within the whole organization. For all this reasons it is of essential importance to find an appropriate procedure to develop and implement knowledge structures in organizational environments. Business process oriented KM approaches take these consideration into account. Therefore it is nearby to combine these approaches with methods of structuring and visualizing knowledge and information.

2 Knowledge Structure

The most approaches focus the challenge of structuring knowledge spaces by using results from computer science and its technical possibilities. This, however, is only one aspect of knowledge structuring. IT tools and their various functionalities can support the structuring of knowledge and information, e.g. through procedures of information retrieval, data and text mining, procedures for content analysis, automatic clustering etc. An essential aspect of knowledge structures is, however, that they are based on experiences made by experts and create a mutual understanding between persons and therefore support the knowledge communication. Computer-generated structuring is only one part of this, yet it should not substitute the entire process of achieving a consensus between employees, experts and the executive personnel, a process which also promotes acceptance. Therefore it is the aim of IPK´s approach on knowledge structuring to put the organizational knowledge base into an action-based, *accepted* context by means of the connection, the modeling and the visualization of relations between the elements of the knowledge base. In this regard, knowledge structure can be defined as the explicit representation of verifiable, action-based relations within the knowledge base.

3 Process models for the structuring of knowledge and information

One of the aims of knowledge structuring is to place the knowledge at the employee's disposal in the right quality, at the exact point of time when it is needed to carry out a given activity. Therefore, the employment of processes can be regarded as an adequate basis for the structuring of knowledge and information. A process model

highlights and describes those connections between single activities which are relevant for the change of a given state. These process descriptions represent an important and explicit component of knowledge, the 'know-how'. Beside this mere process description the Fraunhofer IEM (Integrated Enterprise Modeling) [c.f. Spur, G., Mertins, K., Jochem, R. 93] approach offers the possibility to describe knowledge as an object *and* as an activity within the process model [Mertins et. al. 01].

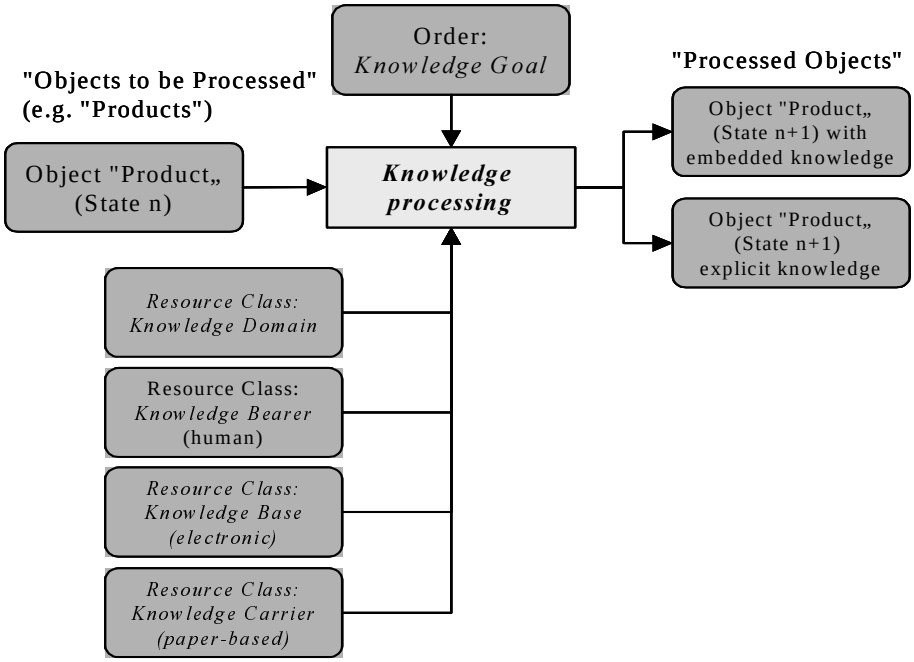

Figure 1: IEM Generic Activity Model for Knowledge Management [Heisig, P. 03]

Knowledge, therefore, is basically divided into two categories by way of a fundamental act of structuring, namely the knowledge about a process, the 'know-how'- represented in the IEM as knowledge processing task - and the knowledge within a process, the 'know-what' - represented in the IEM as knowledge resources and products. In Figure 1 the IEM Generic Activity Model for KM is shown. The resource class "knowledge domain" represents the knowledge content required to carry out the knowledge processing action. "Knowledge bearer" describes the human expert and therefore the tacit part of the necessary knowledge. And the "Knowledge base" means the electronically available knowledge. The importance of other explicit knowledge elements is recognized with the sub-class "knowledge carrier [Heisig, P. 03]. By using this method, business process models are created, which have a strong focus on knowledge and information objects. Therefore the resulting business process model represents the action-based knowledge structure of the organization. This structure can be used as the context to analyse other structures applied in the daily

work and finally to create an adequate knowledge structure, which really contributes to the given needs of the knowledge workers.

3.1 Procedure model of business process oriented knowledge structuring

There are five main steps in the procedure of business process oriented knowledge structuring:

- modelling the selected business process with the necessary knowledge domains, bearers, carriers and bases including the existing knowledge structures,
- ascertain the users' requirements for the knowledge structure derived from the business process,
- pre-structuring the relevant knowledge as to the main knowledge objects and their relevant metadata; the themes in the evaluated knowledge domain and the connections between all these elements,
- defining and specifying the structure in consensus with leaders, stakeholders and experts,
- implementing the knowledge structure through the definition of roles and processes of maintenance.

Starting with the business process modelling, both the structures employed by the organization in documents and IT systems as well as mental models of the employees are being gathered with interview and workshop techniques. If business process models are already existing, it is possible to start with them. From the users' requirements and the structure analysis an initial knowledge structure emerges which comprises relevant knowledge objects with their main characteristics as well as organizational concepts and connections between these elements. The consensus about the final knowledge structure is achieved in an iterative way using workshop methods and involving users, experts and management (cf. Figure 2). To put the structure on a broad bases a short questionnaire allows its validation within the whole personal staff.

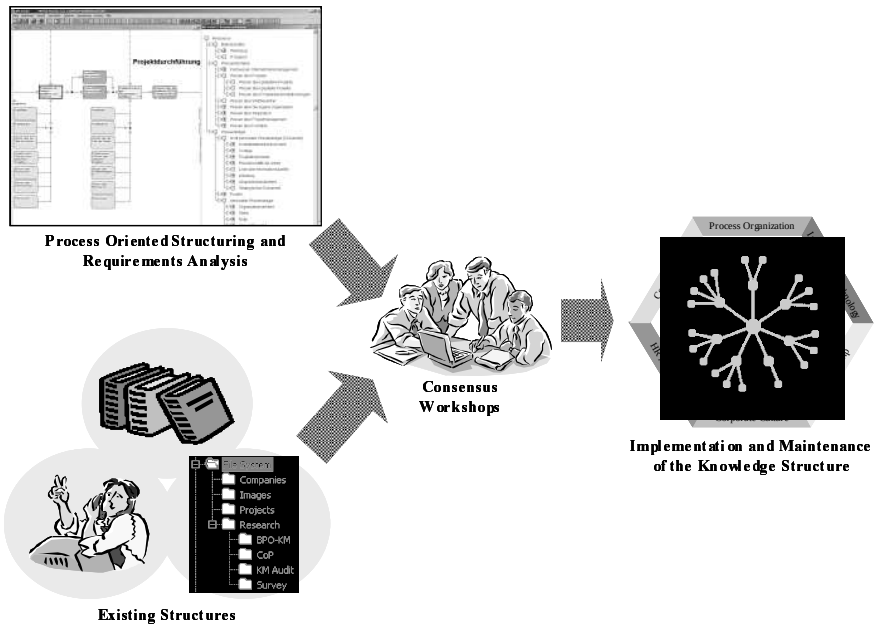

Figure 2: The Principle of process-oriented Development of a Knowledge Structure

In order to visualize the developed knowledge structure, different methods of knowledge mapping can be employed.

3.2 Visualization of the developed knowledge structures

Although the psychological findings about the cognitive effect of visual forms of presentation are still incomplete, it is relatively certain that visual information is easier to memorize than pure text, series of numbers or acoustical signals [Issing 88], [Fischer 98]. In accordance to these insights, knowledge visualization should provide an opportunity for users to use their natural competence in this area. The visualization should support the user in finding relevant information and in making inferences, interpretations, and decisions [Bair, O'Connor 98]. Following this approach, three different types of knowledge structures and their visualization have been developed by the Fraunhofer IPK and are currently applied and tested in organizations.

Topic Map Engine (TME): The Fraunhofer IPK Topic Map Engine serves as a tool for search and navigation within the knowledge base (cf. Figure 3). The TME is based on XML according to the XTM specification 1.0 [Park, J. 02] and allows to directly access connected knowledge and information sources.

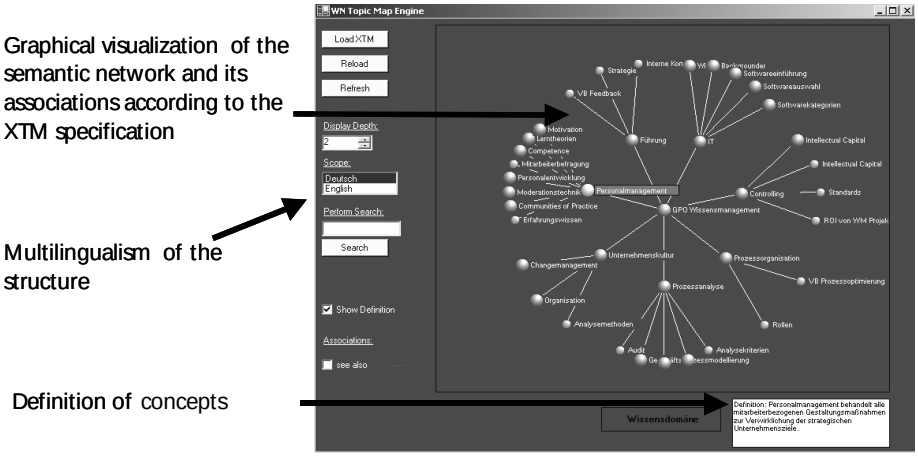

Figure 3: The IPK Topic Map Engine

The Topic Map Engine visualizes the semantic network of relevant concepts of an organization. It allows to navigate from concept to concept in an associative way. Therefore different types of associations are visualized in different ways. To take into consideration the most common requirement of users – to enable an easy overview on organizational concepts - it offers the possibility to visualize and navigate poly-hierarchical structures and provide short definitions to each concept. The TME is currently applied and tested within a KM-Project of a Fraunhofer Institute. Herein it is integrated as a module in the full KM-suite "Knowledge Navigator". Within the KM-suite the TME serve as the component which allows to visualize and browse the organizational competences and themes.

The web-based Process Assistant: The Process Assistant is a KM application which represents knowledge and information according to the organizational business processes (cf. Figure 4).

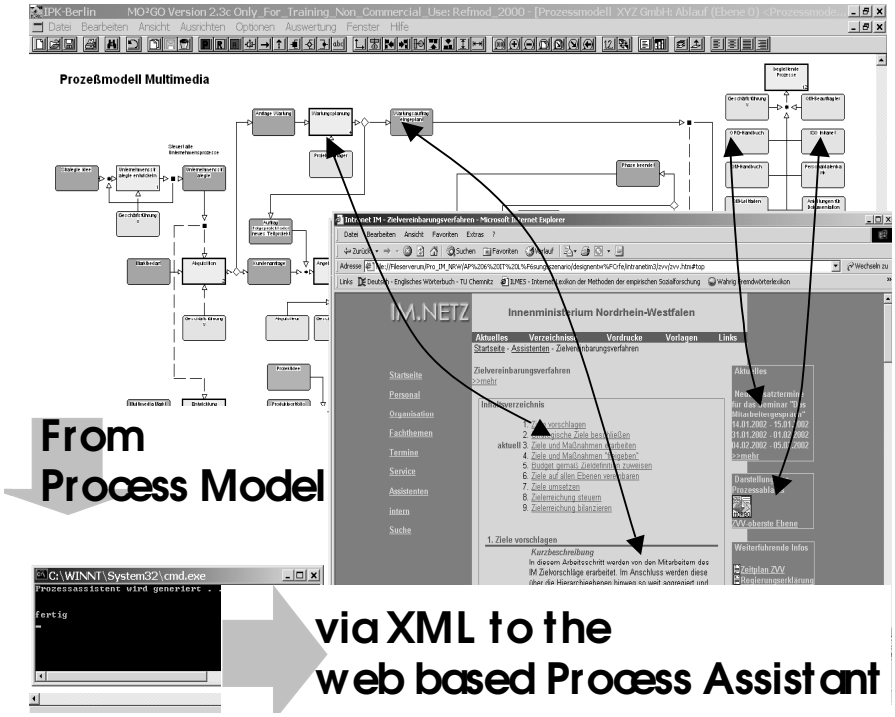

Figure 4: The web-based Process Assistant

The Knowledge Navigator: The Knowledge Navigator is a complete KM-suite, which allows the handling and organization of complex knowledge structures according to requirements of the business processes [Hoffmann, I. 01]. The tool uses several intuitively comprehensible visualization for representing and browsing the relevant knowledge. The Knowledge Navigator aims to give an overview of the entire knowledge base at one glance with direct access to the knowledge objects. The structure and visualization is used to avoid information glut by selecting and presenting knowledge within the business process context. Further it is used to enhance the awareness of new knowledge, the possibility to discover and connect elements within the knowledge base and to motivate employees by using a playful form of visualization. The Knowledge Navigator was developed for the handling of complex knowledge spaces. It is currently applied and tested e.g. within the German Air Traffic Control and a Fraunhofer Institute.

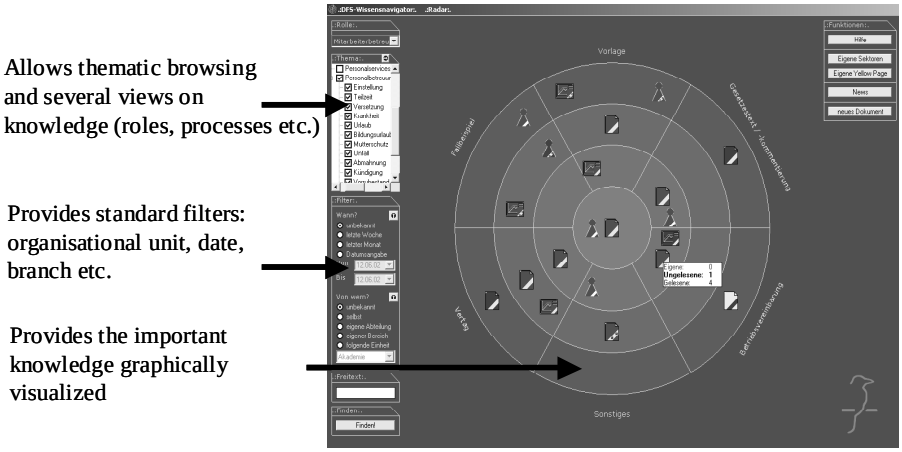

Figure 5: The Knowledge Navigator

4 Summary

Modelling knowledge structures without knowing the exact context of application is difficult. Every case in which knowledge is applied is embedded in a concrete situation and its action-based context. To define and model relevant knowledge structures, it is necessary to know about the typical, continual situations the employees are confronted with. Business processes provide such an organizational context. Therefore it is self-evident to use this business context for the structuring of knowledge. This does not mean that all knowledge structures (except of the Process Assistant) are necessarily visualized according to business process tasks. But to guarantee the relevance of the knowledge structure for the employees daily work it is inevitable to take the process context into consideration.

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