

A Business Process oriented Approach for the Identification and Support of organizational Knowledge Processes

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***Abstract:** Process orientation is a widely recognized concept of organizing companies. With the emergence of knowledge management, new and challenging questions arise: How can knowledge management build on existing process management efforts? How can these two approaches effectively be integrated? How can organizational knowledge flows adequately be identified and supported by analyzing business processes? This contribution proposes a methodology and an according framework that address these questions and suggest appropriate solutions. Based on business processes, relevant organizational knowledge flows are identified and visualized in a promising way. The introduced concept of knowledge processes aids in analyzing organizational knowledge work as well as in deducing supportive knowledge management interventions. By anchoring all deduced knowledge management interventions in business processes, the concepts of this contribution take the integrated nature of business and knowledge processes into account.*

1. Introduction and Motivation

Business process management is a widely accepted and implemented way of organizing companies [iso01]. Also, business process management already represents a big step towards the management of organizational knowledge by managing the knowledge *about* directly or indirectly value-generating processes. The focus here is on identifying, improving and supporting best-of-breed flows of work and furthermore making the knowledge about these workflows visible to all employees of a company.

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With the emergence of knowledge management, new and challenging questions arose: How can knowledge *within or across* business processes be identified? How can the identified flows of knowledge be supported? [RL00] acknowledge the need for a comprehensive investigation of knowledge flows, by stressing that a successful improvement of knowledge intensive business processes stronger relates to knowledge flows than to workflows.

Knowledge flows are considered to run within, in parallel and/or orthogonally to business processes [DHMS00], and in that sense, are not fully captured by traditional business process modelling techniques.

To give an example: In an acquisition process, a sales agent talks to a customer and thereby generates knowledge about him. Now, the knowledge generated in that process potentially can be useful in a series of other processes (e.g. Customer Support, Customer Relationship Management, etc). So what we have here is 1) an undocumented flow of knowledge that 2) crosses the boundaries of multiple modelled business processes and 3) represents an unsupported flow of knowledge in that sense, that there is no agent (a human being or a system) which is responsible for supporting that flow.

So why is the *identification and support* of knowledge flows of utmost importance for organizational improvement? Knowledge processes, as a representation of complex knowledge flows, depict the generation, storage, transfer and application of knowledge that is necessary to create products or services. Thus they describe the most important resources of knowledge-intensive [ESR99] business processes, and that resources are only partially integrated in today's (workflow-oriented) process modelling techniques. They are, if at all, included in interfaces between multiple business processes, but they are not *identified and supported* as important additional processes.

Having motivated the problem domain, this paper introduces a methodology and a according framework that *support the comprehensive identification of knowledge processes based on business processes*. By doing that, a profound basis for deducing knowledge management interventions for supporting organizational knowledge processes on an operational level is laid.

2. Business process oriented Knowledge Management

The integration of process and knowledge management is a current topic in research and industry and promises a wide range of opportunities. A commonly used term to describe such integration is "business process oriented Knowledge Management (bpoKM)" which itself is a rather new term and includes a variety of concepts and approaches. The following list of approaches which promise to combine process and knowledge management gives an idea on how diverse the field of bpoKM is; A comprehensive overview of current bpoKM approaches can be found in [Rem02].

- bpoKM provides knowledge to process agents that is relevant for certain business process instances [DHMS00]
- bpoKM aids in the design of knowledge portals based on business processes [Har02, BsV00]
- bpoKM uses processes as a navigational support for providing task-relevant knowledge to knowledge workers [RL00]
- bpoKM leverages communities for business process improvement [ADK+02].
- bpoKM extends WFMS² to meet knowledge management requirements [Goe02]
- bpoKM analyzes business processes by means of specific knowledge processes [Hei01]
- bpoKM integrates knowledge management aspects in current business process modelling techniques [PMA02]

Regardless of the varying aspects, the above mentioned approaches share one important common property: by orienting all considered knowledge management activities, methods or techniques to business processes, undertaken knowledge management efforts visibly contribute to value chains of organizations. Another established approach of implementing knowledge management activities in organizations is to align them to business goals [LSF+02]. Because business goals often represent abstract organizational views and directions, a causal relationship between them and knowledge management activities is hard to determine. By aligning knowledge management activities to business processes which implement business goals on a more concrete level, the contribution of knowledge management activities to organizational development efforts gains visibility.

² WFMS... WorkFlow Management System

3. Definitions

The following definitions are necessary to clarify the semantics of terms that are used throughout this paper:

Business Processes: According to [ISO00, p. 23] a process is a *"set of interrelated or interacting activities which transforms inputs into outputs."* Additionally, business processes contribute to organizational value chains.

Specific Knowledge Processes: A distinction between specific knowledge processes and knowledge management processes has been made by [PRR98] and has been stressed by [RL00]. Specific knowledge processes, in this contribution, are thus (similar to [Hei01]): *"Basic knowledge activities that focus on the generation, storage, transfer or application of knowledge"*.

Knowledge Domains: *"(Organizational) Knowledge domains represent fields of knowledge which are relevant for undertaking certain (business) actions"*. Knowledge domains can be combined to so called knowledge structure diagrams which represent knowledge domains at various abstraction levels in a, mostly hierarchically, organized way (similar to [Noh00]).

Knowledge Processes: Knowledge processes represent an approach of visualizing organizational knowledge flows. In this contribution, knowledge processes represent knowledge domains which are related to one or several business processes and also span multiple specific knowledge processes. Thus, *"Knowledge processes represent the generation, storage, transfer and application of certain knowledge domains across or within business processes"*.

4. A Methodology for supporting organizational Knowledge Processes

The cycle in figure 1 depicts necessary activities and results in order to identify and support organizational knowledge processes and thereby improve organizational effectiveness. By analyzing business processes in terms of their contribution to specific knowledge processes, relevant knowledge processes can be deduced. In order to do so, so called knowledge structure diagrams [Noh00] need to be created to structure organizational knowledge domains and relationships between them. This is an important aspect for identifying knowledge processes, since knowledge processes are related to certain knowledge domains and thus share the relationships between those domains. By analyzing knowledge processes, a set of knowledge management interventions can be deduced that provides

support on an operational level. These interventions can be of technological (e.g. providing communication technologies), cultural (e.g. workshops) or organizational (e.g. establishing organizational roles like knowledge brokers) nature. Because knowledge processes are considered to be integrated in business processes [PMA02], all supportive interventions have an effect on and need to be anchored in business processes. *By implementing such interventions, knowledge management becomes an integral part of organizational processes, guidelines, instructions and infrastructures.*

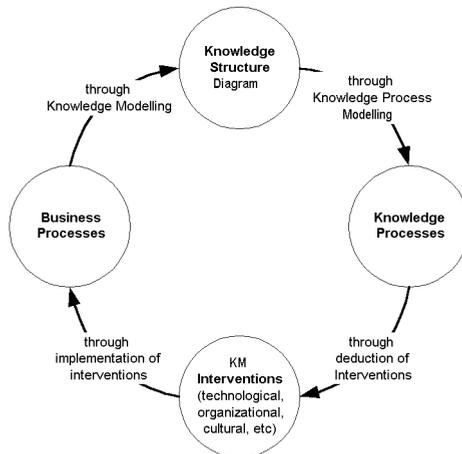


Figure 1: A Methodology for supporting organizational Knowledge Processes

While the development of knowledge structure diagrams (knowledge modelling) and the deduction of knowledge management interventions is covered in current literature (e.g. [Noh00],[Rol03]), a comprehensive concept for modelling knowledge processes based on business processes is not available. The framework below now introduces a new and promising concept to identify and model these knowledge processes. By representing knowledge flows as knowledge processes, the complex nature of knowledge flows is taken into account.

5. A Framework for modelling organizational Knowledge Processes

In order to be able to identify and support organizational knowledge processes, a model on the basis of business processes has been developed. Figure 2 depicts the developed framework.

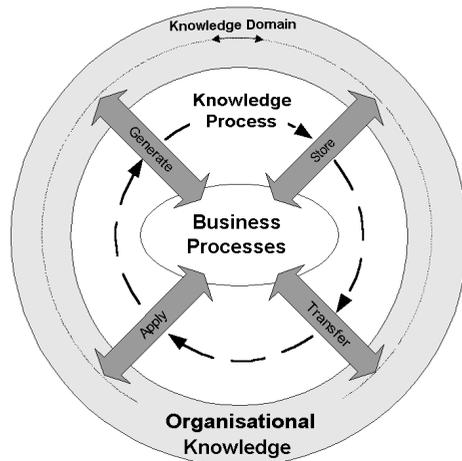


Figure 2: A Framework for modelling Knowledge Processes based on Business Processes

At the heart of this framework are organizational business processes which can be modelled with arbitrary, workflow-oriented, modelling techniques. Through structured interviews with business process agents and their supervisors as well as through analysis of documented business process models, a relationship between business processes and organizational knowledge domains (which are organized in knowledge structure diagrams) can be achieved. Now these relationships can be investigated in terms of their contribution to various specific knowledge processes (knowledge generation, storage, transfer or application), that were considered as "important" and "a must" ([Hei01]) from knowledge management practitioners. The basic elements of this framework are widely established and accepted ([Hei01], [AHMM02, p.123], [Sch00], [PMA02]) and thus, serve as a profound starting point for the effective combination of these existing approaches. The value of the introduced approach depicted in figure 2 lies in the powerful visualization of organizational knowledge processes based on business processes.

An Example of implementing the introduced Framework

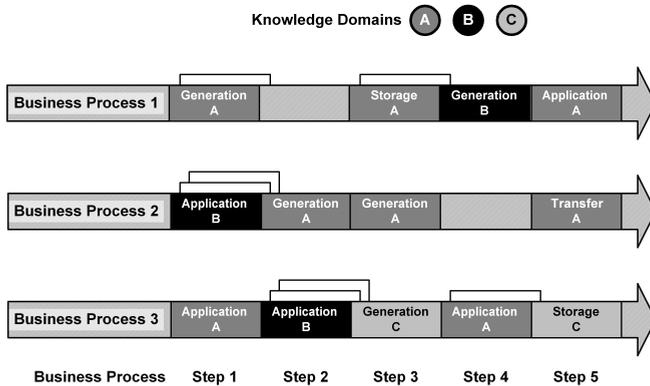


Figure 3: An Example of analyzed Business Processes

Figure 3 depicts the knowledge work of three exemplary business processes regarding three knowledge domains. A relation between business processes and knowledge domains can be achieved through: 1) Analysis of existing business process models and 2) process-oriented interviews with process agents and their supervisors. After establishing such relations, business processes can be analyzed in terms of their contribution to the four specific knowledge processes. Because the visualization in figure 3 is not appropriate for comprehensively analyzing knowledge processes, an adequate visualization now is being introduced.

Resulting identified Knowledge Processes

By applying the framework and the according methodology, hidden knowledge processes that are executed and/or are only partially documented in organizational business processes now become visible in a way, that is illustrated in figure 4. Per knowledge domain, related business process steps (in figure 4 represented as e.g. BP1S2 - Business Process 5 Step 2) are illustrated to give an idea, where (during the course of which business processes) that knowledge domain is being generated, stored, transferred and/or applied. Thus redundancies, gaps, relationships and/or interactions can be identified and analyzed on top of these representations of knowledge processes. Although the arrows in figure 4 imply a sequential execution of the considered specific knowledge processes, these activities do not necessarily have to be in that order.

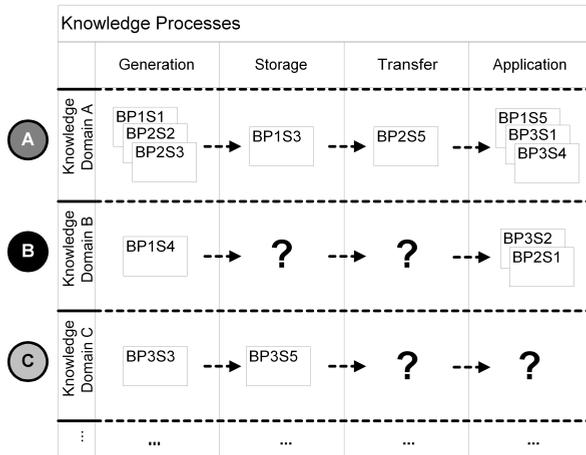


Figure 4: Illustration of potential Knowledge Processes.

While knowledge flows often are visualized by oversimplified flows of information, the suggested visualization takes the complex nature of knowledge flows into account and thus, aids in gaining a deeper understanding of organizational knowledge work and related business process dependencies. To further point out the advantages of such visualization, the following scenarios exemplarily describe potentially elicited knowledge processes and according interpretations that provide a basis for onward analyses and the subsequent deduction of knowledge management interventions.

Scenario A: Knowledge process A (row 1) in figure 4 visualizes a managed organizational knowledge process. Managed in that sense, that all specific knowledge processes are considered in related business processes. The fact, that the knowledge domain in that knowledge process is generated and applied in a set of different business processes raises the need for an effective coordination of these efforts. Whereas the distributed generation of knowledge could be supported by knowledge management interventions like e.g. CSCW³ systems, the distributed application of that knowledge domain could be supported as well by means of e.g. workshops or meetings with the according process agents.

Scenario B: Knowledge process B (row 2) demonstrates an unorganized knowledge process in an organization in that way that knowledge storage and transfer is not defined (and thereby not supported) in any considered

³ CSCW...Computer Supported Collaborative Work

business process. This could point to potential flaws in current business process management efforts. While the storage of that knowledge domain may not be an organizational goal or may not even be possible ("tacit knowledge"), the transfer of knowledge could be supported by establishing an organizational role (e.g. a knowledge broker) that is responsible for transferring knowledge between a company's employees.

Scenario C: Knowledge process C (row 3) identifies a potential waste of organizational resources by pointing out that no business process profits from the generation and storage of that knowledge domain. Another possible interpretation is, that the knowledge being generated and stored could be useful in a set of other business processes, but the potentially affected process agents are not aware of the existence of that knowledge. Through focussed interviews with process agents such gaps could be analyzed and resolved.

Given that, the chosen visualization tackles the identified challenges concerning organizational knowledge processes. They:

- identify currently hidden organizational knowledge processes
- enable the profound analysis of knowledge processes
- provide the basis for supporting knowledge processes by implementing knowledge management interventions

A more detailed Design Description

To underpin the introduced principle, an UML-diagram representing the main relationships of the concept was developed. Figure 5 describes the structure of that concept. The three main elements of this framework are:

- business process models
- hierarchical organizational models (consisting of organizational roles)
- knowledge structure models (consisting of knowledge domains).

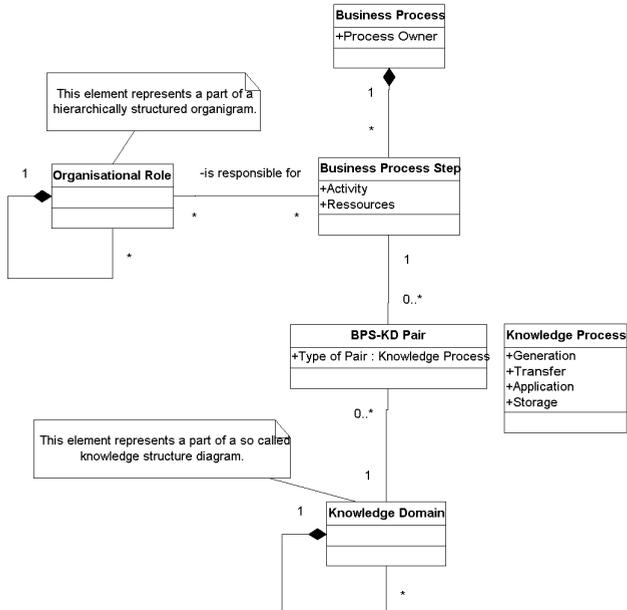


Figure 5: The Structure of the Framework visualized in UML

By defining classified relationships between business process steps and knowledge domains (UML-element: BPS-KD Pair in figure 5), the basis for identifying knowledge processes is laid. Additionally, the hierarchical structuring of the models enables extended evaluation of the undertaken investigations, for example: Which organizational unit generates which knowledge? Which organizational unit mostly contributes to the transfer of certain knowledge domains? Which employees of a company deal with similar knowledge domains? This enables, beneath the analysis of knowledge processes, the analysis of knowledge work of organizational units and areas.

6. Application in a Case Study

Although the concept of identifying and supporting organizational knowledge processes represents a promising approach for organizational development, evidence is needed in order to assess the usefulness of the introduced concepts. Because in this context, a mathematical proof of the usefulness can hardly be achieved, a case study is instrumentalized in order to provide empirical evidence. Since a case study can never completely

verify such concepts, it can, at the best and only to some extent, corroborate the introduced approaches. The following sections now describe the conditions under which the case study took place, details concerning the approach and preliminary results of applying the framework and the according methodology to a 200 employee software developing company. After that, a summarization aggregates the main results of performing this case study.

Conditions

In a software development company, the methodology and the framework introduced in this paper are used to identify and support organizational knowledge processes based on modelled business processes. The main focus of this case study is to deduce technological interventions that can be implemented in the corporate knowledge management system to support organizational knowledge processes. The case study takes place in the R&D division of a company, which is certified according to the process-oriented ISO9001:2000 standard and consists of ~80 employees. About 30 coarse business processes are modelled to describe the core work of this division.

The case study performed deviated from the concepts introduced in this contribution in two main points:

Firstly, regarding the introduced methodology, no detailed knowledge structure diagram was created before knowledge processes were identified. Instead, the knowledge structure diagram building was a constant process, which was performed in parallel to identifying knowledge processes. This approach was necessary because of imposed time restrictions by the case study company. After taking this approach, the author even promotes that kind of approach since such developed knowledge structure diagrams more precisely are aligned to business processes which are under investigation.

Secondly, because of the amount of involved business processes, the undertaken investigations didn't take place on a business process step level, but on a more abstract business process level. Since the differentiation between business processes and business process steps can happen on arbitrary abstraction levels, this deviation poses no restrictions regarding the applicability of this case study.

Detailed Approach

After coarsly analyzing the company's business processes, eight process agents (from management & top management) were selected for business process oriented interviews. All of the selected agents were confided with

their according business processes and a minimum of two agents per organizational role was selected. A pilot interview provided valuable feedback for performing subsequent interviews. Each of the subsequent interviews was accomplished in less than two hours. The interviews focussed on concrete, past instantiations of business processes and instrumentalized request-respond patterns of process agents to identify knowledge flows.

Preliminary Results

The preliminary results of this case study first and foremost corroborate the implicit assumption of this paper - the existence of knowledge processes that run within or across multiple business processes. The undertaken investigations elicited about 20 knowledge processes that are of varying relevance for organizational improvements. Nevertheless, all of them are related to business processes and thus, directly or indirectly contribute to organizational value chains.

Secondly, the case study provides strong evidence that such existing organizational knowledge processes can well be identified and illustrated by applying the introduced concepts. While not all elicited knowledge processes are of utmost importance to organizational development, for a certain subset of these knowledge processes appropriate organizational support is crucial.

An Example:

Knowledge Process - Knowledge About Design Decisions					
Knowl.-Domain	Generation	Storage	Transfer	Application	Description
Knowledge about Design Decisions	<div style="border: 1px solid black; padding: 2px; display: inline-block;"> SD5.2 Planning & Design </div> <div style="border: 1px solid black; padding: 2px; display: inline-block; margin-left: 10px;"> PM </div>			<div style="border: 1px solid black; padding: 2px; display: inline-block;"> SD5.4 Implement- ation </div> <div style="border: 1px solid black; padding: 2px; display: inline-block; margin-left: 10px;"> TL MD </div>	Design decisions that led to specific SRD & ADD are of interest for the employees that need to implement the requirements. (suggestion by the interviewpartners: meeting minutes, e-mail archives, TWSs)

Figure 6: An elicited Knowledge Process – “Knowledge about Design Decisions”

The knowledge process “Knowledge about Software Design Decisions” in Fig. 6 has shown to be of highest relevance for module developers (MD) of the case study company. They are in need for that kind of knowledge (including reasons for design changes, history of decisions, etc) while executing their “Implementation” business process. Project managers (PM) generate the knowledge in question during the process “Planning &

Design". Currently, no information concerning that knowledge domain is documented and the transfer of that knowledge domain takes place in an informal way (informal talks). In the future, this knowledge process can be supported by the following knowledge management interventions: By integrating the transfer of this knowledge into business processes (by performing formal meetings) and by documenting the results (through meeting minutes) and storing them in the corporate knowledge management system, the knowledge domain of that knowledge process gets treated in an appropriate way. Module designers in the future will be able to access knowledge about design decisions which is critical to their business process of implementing software more easily.

Thirdly, in the case of knowledge processes that are very poorly supported by business processes, the introduced visualisation only partly aids in selecting supportive KM interventions (the problem of "empty" knowledge process diagrams). Therefore, the author promotes two main extensions to the established concepts: A) Activities, that contribute to certain knowledge processes (e.g. informal activities like informal meetings, workshops or e-mails, etc), but are not modelled in business processes should be integrated in the visualisation of knowledge processes and B) Organizational roles, that take part in knowledge processes, but whose detailed activities and/or whose purpose remain unclear at the time of modelling (e.g. partners, customers, etc) , should be integrated in the visualisations as well.

This fuzzy modelling further enhances the descriptive power of knowledge processes and aids in selecting supportive KM interventions (see Fig. 7).

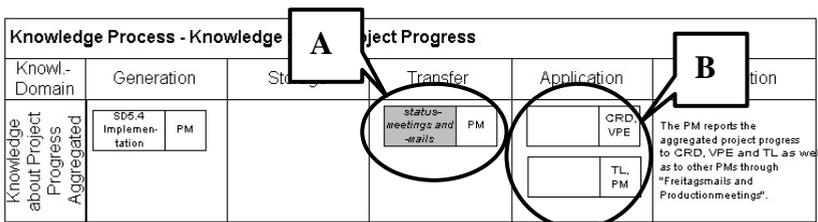


Figure 7: Two Extensions to the introduced Concepts of visualizing Knowledge Processes

Fourthly, analyzing knowledge processes on the basis of the introduced concepts is possible, but takes place differently than expected. First analyses already take place during the interviews directly by the process agents; They use the interviews and business processes to channel and generate

improvement suggestions that would lower their work burden. Onward analysis, performed by the analyst, include scrutinizing knowledge process gaps and improvement suggestions made so far. Thereby, the introduced visualization of knowledge processes act as an “object to think with” rather than a “KM interventions generator”. The analyst always has to take the business context of the investigated knowledge processes into account. Still, the introduced visualization aids in focusing on *relevant* problem domains and narrows the space of reasonable KM interventions.

Summarization

The concepts introduced in this paper could mainly be corroborated by the case study at hand. The identification of knowledge processes is well supported by the introduced concepts. To remedy deficiencies that may occur when knowledge processes are very poorly supported by business processes, the author suggests adaptations to the current concepts. Beneath that, the case study provides evidence that the analyses of knowledge processes and the selection of KM interventions that support *relevant* organizational knowledge domains are well aided by applying the concepts of this paper. Also, the case study could be performed in a reasonable amount of time and process agents felt comfortable with the confronted process oriented interviews.

7. Conclusions

The most important prerequisite for supporting organizational knowledge flows is to identify and visualize them adequately. Knowledge processes, as a business process oriented approach of visualizing knowledge flows, represent a profound concept for visualizing complex, inter business process, dependencies and influences beyond currently available approaches (e.g. [Hei01], [AHMM02, p. 123], [PMA02]). Knowledge processes thereby act as a capable starting point for the deduction of knowledge management interventions that support organizational knowledge work. A performed case study mainly corroborated the concepts introduced in this contribution.

By anchoring all deduced knowledge management interventions in business processes, the execution of knowledge management becomes an integral part of organizational business efforts. *Process management thereby provides the basis and the means for a sustainable and focused implementation of business-critical knowledge management interventions in organizations.*

8. Future Work

By analyzing identified knowledge processes (as in figure 4), various subsequent evaluations can potentially be performed:

- evaluating interactions and dependencies between business processes
- evaluating knowledge work of organizational roles and units
- evaluating the degree of organizational management concerning knowledge processes
- evaluating the degree of implementing organizational knowledge goals and strategies in business processes
- identifying members of knowledge communities on the basis of knowledge processes

The potential value and the necessary effort concerning these investigations will be considered and tested in subsequent case studies. Also, a software tool that supports knowledge process identification and analysis is about to be developed. This tool aims to support KM consultants in performing organizational assessments and in deducing appropriate KM interventions.

9. Acknowledgements

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