Challenges for Business Process and Task Management

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Abstract: Knowledge-intensive work goes beyond classical workflow with respect to flexibility and integration into the personal task management. The necessity of such integration is demonstrated considering the example of Engineering Change Requests (ECR), handled by an integrated workflow as provided by SAP's Product Lifecycle Management (PLM). This solution is discussed with respect to additional requirements that occur in ECR processes. This is compared to current approaches as provided by projects at the DFKI and others. An approach is presented that carries on the existing ideas on a more flexible basis, making more extensive use of knowledge management methods.

Keywords: Knowledge Work, Workflow, Task Management
Categories: H.1, H.4

1 Introduction

Although it is generally accepted that Workflow Management Systems (WfMS) have made a significant contribution to the increase of work efficiency, it is also known that their rigidity restricts their applicability. This has motivated research for more flexible approaches for a couple of years [Aalst et al. 00]. Research in this area has been further motivated by the growing importance of knowledge work with its complexity and larger requirement of expertise and swiftness [Wiig 04]. Moreover, process conformance has become more important than ever. Reasons are multifaceted, e.g., the Sarbanes-Oxley Act of 2002, which establishes new standards for corporate management, or higher workforce fluctuation. Finally, the increasing competition between companies coerces these into streamlining their processes to reduce costs.

These endeavours have lead to various adaptive workflow research projects that extended the structured automated workflow by different ad hoc capabilities [Aalst et al. 00]. However, these more flexible model-based workflows require explicit model adaptations causing considerable costs. An alternative approach, which is pursued by Computer-Supported Cooperative Work (CSCW), is mainly unstructured with respect to processes and focuses on information exchange. Consequently CSCW approaches are characterized by lacking process transparency, which can lead to redundancies, and therefore do not solve the fundamental problem.

In [Section 2] we outline the theoretical frame for a task management for knowledge-intensive work that goes beyond these restrictions. Such an approach reverts to knowledge management (KM) methods to replace classical workflow. In [Section 3] the example of Engineering Chance Requests (ECR) handling by means of SAP NetWeaver Business Process Management (BPM) is considered [Rickayzen 04]. This solution combines business workflow and ad hoc workflow. On the basis of this example the problematic aspects will be discussed and related to the points discussed in [Section 2]. [Section 4] compiles existing approaches and discusses their efficacy. [Section 5] concludes with a summary of the discussion on task-oriented process management.

2 Theoretical Framework – Action Theory and Personal KM

Classical WfMS are too restrictive for weakly-structured processes that characterize knowledge-intensive work [Schwarz et al. 01], although the workflow paradigm is very attractive in terms of provided functionalities such as modelling and coordinating processes (in teams), supporting environments for executing activities, monitoring the current state of affairs, and providing rich workflow context [Maus 01], as well as logging mechanisms providing a process history for later access. However, a tool that is to meet the needs of knowledge work must support structured and unstructured process parts in a uniform way. Precondition for an appropriate solution is the recognition of task patterns based on detailed task descriptions.

Regarding tasks as actions motivated by external triggers allows us to consult action theory for the analysis of task management. Such an approach suggests concentrating on the constituents of action like agent, goal, context, and execution as well as hypothetical and operational knowledge [Riss 05]. The central idea is to completely record these aspects of tasks, in contrast to classical WfMS that take a good deal of this information as constant and treat it implicitly. This allows for the fact that knowledge-intensive work is characterized by high variability of all constituents. Agents are candidate for experts, goals are required to identify tasks regarding their purpose, contexts comprise all factors that can influence an action, and execution descriptions report the efficiency of the chosen plan. However, some of these constituents can be replaced without changing the main character of the process. An extended task management must enable effectual reuse of existing cases even if these are not identical.

Existing cases represent reusable knowledge. Reuse of task patterns, however, requires separating domain knowledge, e.g., concrete customer data, from proper process knowledge, e.g., how to file a patent. The former is related to specifics of the object whereas the latter describes examples to be followed. Process knowledge represented by patterns is to be collected in a repository containing completed and ongoing cases. Variability is realized by offering similar task patterns that provide templates for new tasks. These replace the process models that are used in WfMS. The result is a modularized task concept. After all, the central challenge consists in the development of appropriate pattern identification and retrieval algorithms. Here the application of KM methods will be decisive.

Another central aspect concerns the integration in the user's "personal" knowledge management. This is motivated by users' avoidance of additional work for KM-initiatives without immediate benefit. The topic has been recently addressed in the project EPOS[1] that provides a so called *personal knowledge space* (PKS) which is fed by the user's native structures found in file directories, bookmarks, email folders as well as task structures (ToDo-lists, worklists from WfMS) together with stored resp. attached documents. These structures reflect the user's subjective view, e.g., the meaning of a user's mail folder is expressed by the set of contained emails. Furthermore, the user also takes part in the organization which is reflected by the used organizational structure, project workspaces, processes, and domain ontologies which also influence the user's view and work behavior. Using this environment, EPOS-services are able to support knowledge workers in their activities considering their own subjective views. For instance, an assistant bar provides relevant structures, information (documents, emails, notes), colleagues, and workflow tasks to support the assumed user goal which is derived from user observation within the PKS [Schwarz and Roth-Berghofer 03]. The more users elaborate their personal knowledge space, the more they contribute to an organizational knowledge space which is leveraged from the collection of individual knowledge spaces [Elst and Kiesel 04], thus providing a bottom-up approach to organizational memories.

The EPOS approach consequently allows to learn more about a single (workflow) task fulfilment. This will support users to explicitly structure their work. So far a main drawback of agile workflow approaches, such as the weakly-structured workflows in [Elst et al. 03], is the demand of modelling efforts of users during their work. Capturing domain and process know-how does not only aim at immediate user support but also at later reuse in similar cases. Undue efforts only inhibit users from modelling their work in detail. The approach taken in EPOS is to additionally observe the user's desktop activities, interaction with applications (email, browser, text editor, document repository), as well as information items and try to figure out the generic task the user is executing. Such a generic task or *task pattern*, is part of an ontology of task patterns containing part-of and is-a hierarchies, and relations to task and workflow models as well as current instances realizing one or more generic tasks [Schwarz 03]. In contrast to the top-down approach of weakly-structured workflows – from the abstract task definition to a refined task – this describes a bottom-up approach by observing user activities. A similar approach is reported in [Fenstermacher 05] to realize a process-oriented support for knowledge workers in agile processes. Once having identified such task patterns, this can be used for supporting users without requiring detailed workflows. However, it will also semi-automatically enrich workflows with observed task patterns in order to refine workflow tasks without (much) user interaction.

The integration aspect in the PKS becomes especially important since a task management has to compete with email as today's most favourite structuring tool for collaborative tasks. Compared to phone calls, email brings the advantage of asynchronous communication, i.e., questions can be issued when they occur, replies can play the role of reminders, and questions and answers persist and can be accessed also later. However, if we look at the disadvantages of emails (cf. [Whittaker and Snider 96]) we observe that they are too unstructured. For example, they can get lost, stay (unawarely) unanswered, or the relation between different emails and their topic can get lost. Another problem is that email is inappropriate to structure personal work since it is designed as communication tool and if it is mixed up with task management

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[1] Evolving Personal to Organizational Knowledge Spaces; `http://www.dfki.de/epos`.

it definitely looses its lightweight character. A successful task management that shall compete with email must decisively reduce effort and complexity of task handling to convince users. Simplicity is one of the major causes for the success of email.

In this regard, research on personal task management is an important complement to task pattern management. It helps to understand how knowledge workers manage their personal work (see [Bellotti et al. 04]) in order to realize a convenient user environment keeping users in their personal knowledge (work-) space as the basis for the acquisition of process knowledge, instead of using, e.g., paper notes to manage their tasks that are out of the reach of automatic analysis.

3 Use Case – Engineering Chance Request (ECR)

Today's production processes are characterized by the fact that about 25% of the working time consists in waiting for decisions and searching for information [Goltz 00]. This holds especially if multiple partners are involved and a high amount of coordination is required. Changes are all along part of today's business in modern manufacturing enterprises. They result from changing markets, customer requirements, technical innovations, or legal issues. The management of change requests involves various specific activities. The process is initiated by creating a change notification that is routed by workflow to the responsible agents. These check the issue and decide on appropriate follow-up activities. If a decision is made that an engineering change is necessary, an ECR is created on the basis of the change notification.

The management of ECRs is also part of SAP's PLM solution that includes an engineering workflow for ECRs. It comprises a model-based structured workflow as well as ad-hoc unstructured activities (collaborative tasks) to allow for process flexibility. From a user's point of view both are offered as tasks in the Universal Worklist (UWL) that is part of the SAP Enterprise Portal. The model-based tasks concern standard processes, e.g. initial checks or classification of changes, whereas parts that are not standard, e.g. the soliciting of particular expertise, are treated by collaborative tasks. The different nature of both types of tasks is concealed from the user who only sees items in the UWL as her central inbox for task request.

An example for difficulties that can appear during the handling of ECRs is the treatment of scrapping costs, e.g., for spare parts or remaining stock that is no longer needed resulting from the change of the engineering process. Since these costs can be extremely high today, the decision whether an ECR is accepted can decisively depend on this detail. As long as standard parts are involved the treatment can be processed in a structured way. In this case estimates for the scrapping costs can easily be calculated. If, however, precarious chemicals are involved, which require special disposal procedures, the procedure can become rather complicated and it can be necessary to consult various experts who must work closely together.

The integration of structured and unstructured tasks in the UWL already brings about several advantages. First, compared to expert consultation by email or phone, the transparency of the process is increased since it is clear who is in charge to deal a certain problem due to the corresponding task in the UWL. This also holds for the accountability which is clearly assigned as well. If a problem is assigned to several experts and one of them solves it, the work item disappears from the UWLs of the other experts. Thus the process remains up-to-date and double work is avoided. If questions are assigned to experts via collaborative tasks, it can happen that the same chemicals appear in different components, which are processed by different employees. These might then ask the same expert the identical question or, even worse, they ask different experts and get different answers. Obviously this leads to additional coordination costs. This example also shows the limits of transparency, accountability, and actuality of the current solution. Transparency is only given for task owners not for general users. In this manner a continuous evolution of a supportive process library can be realized. Examples for the need of process transparency are indeed manifold.

However, if the treatment of a specific class of chemical becomes routine, it would be very useful to make the corresponding task pattern generally available. If such a chemical is mostly treated by the same expert who has proven her expertise in previous cases, this information should be made available to all users who have to deal with similar cases. The same holds for resources since there is no model as basis for a resource planning. Let us assume that there is only one expert for the disposal of a certain chemical but that by a legal change the procedure has become decisively more complex than before. Whereas previously one person was sufficient now the demand has multiplied. The problem must be made apparent to all affected employees as soon as possible. At best the system would even propose alternative experts or report the lack of appropriate experts. However, this information can only be determined by analysis of already executed cases that are identified as similar.

4 Existing Approaches

Support for knowledge workers by the workflow paradigm has been in the center of interest for quite a time. Therefore the present approach can revert to a variety of existing approaches to the support of knowledge-intensive work processes. Ever since the advent of workflow management, the deficiency of available workflow solutions regarding knowledge work has been a hot topic. Researchers used methodologies such as speechact theory, activity theory, and constraints, applied a simplified user-oriented process language or enabled collaborative process modeling (for a recent overview see, e.g., [Jørgensen 04]). The main approaches are compiled in [Table 1] with their specifics and will be discussed in the following. Many valuable features of these approaches can be adopted.

The KnowMore approach is applicable for well structured processes where knowledge-intensive tasks and their contents are known in advance, thus, allow for modelling information needs during buildtime. However, as mentioned, knowledge work bears characteristics that make classical workflows inappropriate here. The PRIME-system is similar to the previous approach but more flexible due to the separation of tasks and information needs which allow defining an information need and relevant information for a broader range of tasks resp. situations. Therefore, such an approach is also applicable if users are already able to adapt workflows to their needs. Given that flexibility, the question arises how to support users in determining appropriate changes.

CBRFlow introduces the additional feature that a user can enter a dialogue and state facts about the current situation. On this basis similar cases are retrieved from the associated case base. The dialogue is continued until the user finds an appropriate process step which she can introduce in the existing workflow. The system learns new cases (situation/process step combinations) by explicit annotation when the user adapts an existing or creates a new process step.

Approach	**Characteristics**	**Reference**
KnowMore	Predefined information needs for tasks; context-specific information support during runtime	[Abecker et al. 00]
PRIME	Repository with information needs & support and characterization when applicable; information support during runtime based on user and task characteristics	[Holz 03]
CBRFlow	Context-specific selection and application of process steps from a case base via conversational CBR	[Weber and Wild 05]
FRODO	agile knowledge workflows for knowledge work; context dependent change suggestions and provision of information and similar tasks / workflows	[Elst et al. 03]

Table 1: Approaches to knowledge-intensive work processes

In FRODO, workflow changes are retained and offered to users in similar situations based on the current workflow context. The system is first of all designed for a knowledge worker accomplishing her personal work who is, however, still embedded in a team's workflow. Thus, a workflow could start from scratch as a personal ToDo-list, be refined and attached with information such as memos or documents. It can also be extended to colleagues using task delegation and in the end it represents the work accomplished and the knowledge items used and produced. In this way the workflow integrates previously hidden process know-how. Since the workflows are embedded in an organizational memory, various services can be provided such as proactive and context-specific information support, support in planning work by providing appropriate task instances from colleagues or task templates from a model repository, capture and disseminate process know-how, and finally allow for process-oriented knowledge organization.

5 Conclusions

Although the approaches presented in the previous section try to support knowledge work by increasing flexibility they are still based on static models that have to be adapted manually if the standard behavior is to be changed. Generally the development of models is expensive and models developed from the scratch are often far from reality when applied. Often companies develop core processes by activating information that is available from their Enterprise Resource Planning systems. However, it seems to be more promising to acquire relevant process information on the basis of execution experience.

Therefore, a pattern based approach built on executed cases is preferable. It allows for a continuous adaptation of processes to external changes and offers more variability for individual needs. Even if we have to face the problem that the offered process templates might become fluctuant due to the developing case base this should not be problematic if we turn to really individual task handling. Task patterns require repositories containing descriptions of cases, which have been executed, including all relevant task constituents. Context, goal, and planning information must be stored and can be used to identify appropriate task patterns. Repeated successful execution of related tasks allows identifying expertise in specific domains. Therefore, the assignment of agents can be seen as source for expert identification.

A case repository, however, can also suit other purposes than pattern and expert recognition. Case repositories provide the opportunity to precisely monitor the execution of task. The state of every task, even if it is separated into a full hierarchy of subtasks, becomes transparent. They also allow for the identification of negative patterns, i.e., patterns that did not lead to the planned goal. Therefore, representations of cases must provide enough information to support other users in planning, coordinating, and executing processes. Moreover, a task recording is the ideal basis for archiving cases by tracking the complete executions. This includes ex post documentation of failures, which is often neglected otherwise. Thus, problems, which results from decisions in previous tasks, can be identified to avoid further failures.

Some of these features might be known from project management. This particularly concerns the planning of tasks and their dependencies. However, the focus of project management is the planning of a process in its individual complexity, while the present approach concentrates on repetitive aspects of processes. The tracking of process *experience* is not an additional external but an internal aspect. This makes motivation of users, who have to record tasks, a crucial issue. Central motivation is the offering of direct benefits. One benefit is that processes become fully transparent. However, this only works if the users do not feel harassed by task recording, i.e., recording must not become too complex. Here we need a seamless integration of tasks in the personal task management as developed in the EPOS approach. This is a fundamental precondition for treating this kind of knowledge-intensive and weakly-structured processes. Only a task management based on consequential user centricity will be successful. Consequently, KM technology has to play a predominant part in such a system reflecting the close relation between knowledge and user action [Wiig 04]. For example, case knowledge must be represented and made available to users, existing cases must be analysed for process knowledge, processes include collaboration and expert identification, and efficient pattern mining is mandatory.

Following this idea, the middle and long term strategy of SAP BPM will aim at a full integration of structured core processes and unstructured collaborative tasks. The primary target is a consistent handling of both task types and the avoidance of errant processes. A consistent workflow environment (UWL) will allow users to survey the entire process related to a workflow item, in which they are involved. Transitions from ad hoc processes to core processes must be smooth. Process mining will become mandatory. The most challenging step will be the implementation of a fully pattern based workflow, which will be the focus of our future research.

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