

# Workflow Management in the Light of Emerging Collaborative Applications

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**Abstract.** The authors' intention is to revisit workflow management (as an academic field and a practical tool) and to consider different integration paths with advanced collaborative information systems, e.g. knowledge management, shared workspaces, distance learning, and synchronous solutions.

The focus of installed workflow management solutions is generally on well structured processes in corporate environments. Advances in the supporting technology as well as in related collaborative applications open up opportunities to extend workflow management into less structured processes and to leverage the benefits of both the workflow management system and the related collaborative system.

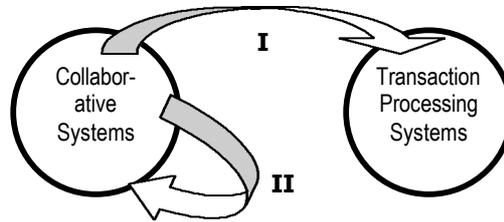
The discussion of these topics cannot be isolated from technical aspects. Nevertheless does this paper focus on the strategic level.

## 1 Introduction

Workflow management has evolved from an experimental field of computer science to a productivity tool used in many companies. Workflow functionality for the most heavily used and well structured business processes has become an integral part of ERP systems and major transaction processing systems (arrow I in fig. 1). There are also special workflow management systems in the market that support less frequent or weaker structured processes as well. Most of them are designed as extensions or enhancements of other systems, e.g. groupware, office suites, or document management systems.

While there is no generally accepted common standard for workflow management the individual systems do not cooperate with their counterparts in other organizations, and often they even leave a lot to be desired when linking into the IT-environment of their own organization.

The most promising approach for a general-purpose workflow management system seems to be based on a groupware infrastructure. Since this is also the ideal platform for other forms of collaboration it is worth while examining the similarities, common



**Fig. 1.** Workflow Management in Transaction Processing and Collaborative Systems

requirements and ties of workflow management to some of the emerging advanced collaborative applications.

This paper is organized in 7 chapters. Chapter 2 summarizes the evolution and the state of the art of workflow management. In chapter 3 we explain the relevant emerging technologies (systems and applications). Chapters 4 and 5 put workflow management in perspective with the advanced collaborative applications. The following chapter 6 focuses on major research topics, and the final chapter provides an outlook.

## 2 Evolution and State of the Art of Workflow Management

Workflow management is an approach to using computer networks for implementing/supporting business processes that are typically involving multiple persons in an organization.

In the early days of data processing the computing power helped speed up the execution of algorithms and relieve the individual of the tedious repetition of tasks. With the introduction of powerful operating systems and teleprocessing systems it became possible to support more than one workplace with the same application system. A modern application system will support a business process as a whole or at least the major part of it.

But this is true in general only for the most important - will say: most often executed - processes. In most information systems the logic of collaboration is represented as part of the application code. The development is costly, maintenance is difficult. Therefore only the major business processes can be automated. A large number of less often invoked procedures however have to be controlled manually. Individuals will frequently use computers to execute partial tasks (processing and communication), but the process as a whole is not represented in the application system. This results in high costs for the individual process because human labor is tied into administrative and control tasks rather than being used for problem solving. It can also lead to more error prone and less reliable processes.

Workflow management systems have been designed to overcome this unsatisfactory situation. They provide a process modeling tool and a process engine that allow to include a variety of processes in an integrated environment. The types of processes are not limited to the highly repetitive but can also include the less often invoked processes. This is achieved by an infrastructure for modeling and running processes that relieves the application code from the workflow logic.

While workflow management systems have made their way into most every major company's information systems portfolio, they are still far from being mature as they are often not fully integrated with the other application systems and in most cases not integrated across the companies' boundaries. This in turn seems to have limited the broader adoption of workflow that many workflow vendors had anticipated. Recent developments in information and communication systems technology can potentially help advance workflow management significantly.

### **3 Relevant Collaborative Applications and Information System Technologies**

Workflow management is but one aspect of using computers and networks to support collaboration among clerical workers. Computer Supported Cooperative Work (CSCW) is the term used to describe all aspects of collaboration, including synchronous and asynchronous forms of supporting a team by information and communication technology. Recently some innovations have found their way into the business world that bear a potential for synergies with workflow management (arrow II in fig. 1). Among others, the most relevant solutions are knowledge management, platforms for integration of the World Wide Web, new approaches to distance learning, and enhancing collaboration by synchronous solutions.

#### **3.1 Knowledge Management**

Managing the corporate knowledge is the strategic focal point of information and communication technology and is therefore a critical success factor for IT and the whole enterprise. Knowledge management includes several building blocks as depicted e.g. in [14] with emphasis on implicit and intangible knowledge. The collection and representation of these and other forms of knowledge, however, cannot be left to manual processes, but must be automated in order to be effective in a real world environment. "Traditional Organization Theory and Groupware [...] do not provide any cooperative knowledge processing technology" [6, pp. 11 f.].

Only recently have some development projects addressed this deficit, like Raven which was the name of a development project that has a focus on automatic discovery of knowledge in an organization [8]. The first product to emerge from the project now called the Knowledge Discovery System is the Lotus K-Station [9].

#### **3.2 Shared Workspaces**

Sharing of workspaces as platform for collaboration usually means a web-based solution. The workspace is – in contrast to its name – an active component that offers different services for supporting teamwork.

QuickPlace [15] is an example of a self-service web tool for *team collaboration*. It enables the creation of a team workspace on the web – instantly. Teams use Quick-

Place to share and organize ideas, content and tasks around any project or ad hoc initiative. Only simple workflow components are incorporated.

### 3.3 Distance Learning

Advances in relevant technologies have put a lot of attention to learning in business. Some authors even define knowledge management as the management of organizational learning. Planned (and effective) learning should make use of a workflow approach to help learners and teachers, but in practice there is no integration between the tools.

LearningSpace [10] may serve as an example of a web based team support tool.

### 3.4 Synchronous Solutions

The approaches mentioned so far are primarily made for asynchronous collaboration. However, as the example of semi-structured and collaborative processes shows (cf. fig. 2), synchronous interactions can play an important role in business processes. Mechanisms like chatrooms or desktop videoconferences are readily available but usually not integrated into business solutions. The combination of workflow management and synchronous communication solutions, like Lotus Sametime [16] or Microsoft Netmeeting [19].

## 4 Workflow Functionality in Advanced Collaborative Applications

Workflow management targets at improving the collaboration of clerical workers to fulfill a certain business task. Improvements can be achieved in different areas, like quality of service, reliability, turnaround time, cost of labor, auditability, etc. The contributions of workflow management to achieving these goals are well recognized in basic administrative/operational application systems, with a focus on highly struc-

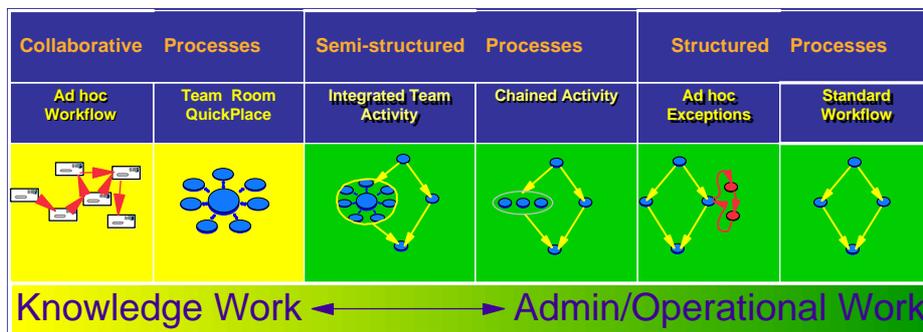


Fig. 2. Workflow Continuum

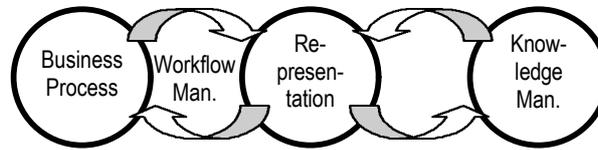


Fig. 3. Representation as mediator

tured processes (cf. fig. 2 - the right end of the workflow continuum). There is no reason, however, to limit the use of workflow management to the mainstream applications. On the one hand, some of the managerial tasks can be structured as well. On the other hand, workflow management can be applied to processes that are not structured originally - the structure can in fact be generated or implemented by use of the workflow idea, as depicted in fig. 2 by the *ad hoc* workflow on the left end.

Knowledge management is a key factor for competitiveness at the beginning of the 21st century. A successful firm applies information technology to make the know how and the experience of individuals and teams available to others, to learn from previous projects, and to identify and spread knowledge systematically. Workflow management can obviously help to distribute knowledge in an organization in a more consistent, repeatable and reliable fashion. But it can also help in identifying knowledge, namely process knowledge. Kouloloulos calls workflow software "the 'how' of knowledge management [7]. Whenever a workflow management system is used for the execution of collaborative tasks, the processes can be revisited and analyzed.

Knowledge management aims at finding specific information about people, places or things. A prerequisite for finding something is a form of representation that allows a search. Any business process that has been executed using a workflow management system has produced some specific form of representation that is suitable for subsequent knowledge management processes (fig. 3).

Workflow and knowledge management can be thought of as being symbiotically related to each other: Workflow management can support knowledge management to turn knowledge into action(able business processes), while knowledge management can leverage workflow management to gather information of past action and turn it into knowledge. Staab and Schnurr [17] give some sample scenarios of the integration of knowledge and business processes.

Workflow management can also help disperse the knowledge in an organization if a *push*-approach is used. The distribution of knowledge can be implemented in a workflow management system just like any other business process (fig. 4).

A third aspect of how workflow management can enrich knowledge management is based on the organization model that is necessary for either one of the approaches.

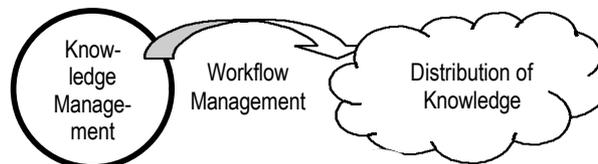
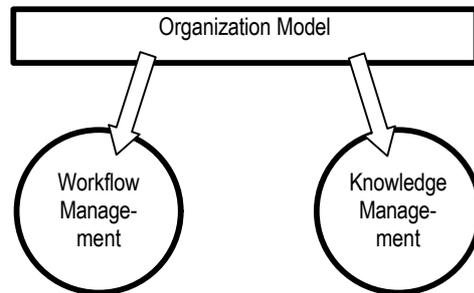


Fig. 4. Workflow Management for the Distribution of Knowledge



**Fig. 5.** Common organization model

Building the workflow definitions on an abstract organization model rather than on concrete names of actors is a prerequisite for a flexible and realistic system. Just about the same organization model is useful in identifying existing process knowledge in an organization (fig. 5).

A more theoretical approach to combining workflow management and knowledge management is based on Nonaka's spiral model of knowledge creation: organizational knowledge reaches higher levels by spiral movements between explicit and tacit knowledge as well as between socialisation, internalization, combination and externalization [13]. If this frequently cited model is relevant then a workflow approach to the spiral process should be considered.

A practical example for the combination of process support and knowledge management is given by Bach et al. [2, pp. 136 f.]. They describe a computer aided selling system of an investment group which starts out with a browser based knowledge base that is extended by transaction capabilities and leads to broad support of marketing and service processes.

In this chapter we have so far seen that workflow management has a potential for enhancing knowledge management. Yet there are more possible benefits, namely by adding workflow functionality to new shared workspaces. A system like QuickPlace (Lotus), BSCW (GMD) or SharePoint (Microsoft) provides a problem-solving platform for teams, with a focus on a team-room metaphor. Processes involving several team-members can be improved by workflow functionality provided by the system. Of course, the philosophy of a shared workspace is to provide a simple, easy-to-use interface which might conflict with sophisticated workflow functions.

**Recommendations to:**

*(1) Development:* Simplify the user interface / create user interface that allows integration of workflow solutions in other collaborative applications. Scale up / scale down the workflow functionality to the expectations of other systems (e.g. adaptive workflow for knowledge workers with a simple representation of parallelism, simple conditions). Check applications like K-station and QuickPlace for opportunities to make use of workflow functionality (disperse knowledge, implement simple workflows for team work).

(2) *Customers (IT-management)*: Plan a portfolio of collaborative tools, decide on the prevailing user interface (portal).

(3) *Management (LoB)*: Incorporate workflow elements in collaborative applications, where appropriate.

## 5 Enhancing Workflows by Advanced Collaborative Applications

In the previous chapter we have shown how workflow management can augment advanced collaborative applications. We now take the reverse point of view and study the potential of new collaborative approaches to enhance workflow management systems (fig. 6).

At first glance, the structured workflow seems to be self-contained, with no need for additional input from other applications. While this may be true for the standard workflow (to the far right of fig. 2) it is certainly questionable for the structured workflow with *ad hoc* exceptions. It is the *ad hoc* nature of the exceptions that they cannot be defined in all respects in advance, therefore giving the human actor a chance to decide on the spot how to handle an exceptional situation. The potential benefits of additional collaborative applications at this point are evident: knowledge management can e.g. help to find a similar situation in the past, or a synchronous solution can be employed to have a spontaneous discussion on the pros and cons of a specific idea for dealing with the exception. This kind of benefits applies even more in the management of semi-structured and ad hoc types of workflow where flexible collaboration is part of the definition of the workflow type.

One may question, however, the relative importance of each of the workflow types. The standard workflow is the easiest to implement and the easiest to justify in terms of a cost-benefit-analysis. Therefore it is found in every workflow management installation. But experience shows that especially in knowledge driven work environments the occurrence of exceptions has to be assumed as normal in the execution of business processes. A well defined workflow will incorporate the most frequent exceptions, making them part of the standard procedure, yet there is still plenty of room for unplanned situations calling for a creative solution on the spot. Moreover, the true bene-

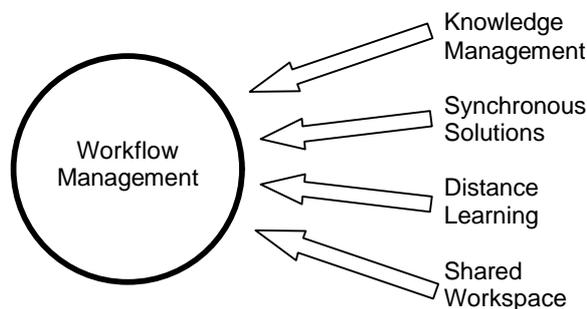


Fig. 6. Workflow Management and Emerging Collaborative Applications

fits of a workflow management system in an organization will be achieved only if the majority of business processes is run within the system and not just the mainstream processes. So there is an urge for enhancing the workflow management functionality by other collaborative techniques.

We have already mentioned knowledge management and synchronous communication solutions as examples. If a distance learning system is readily available to the office worker it can also be very useful in this context. The more processes are incorporated into a workflow management system, the more it becomes likely that some of the modeled processes are executed very rarely. As a consequence the office worker will not be familiar with all of the processes offered by the system. The incorporation of a system like LearningSpace can improve the usability of the workflow management system. Finally, adding web application platforms to the integrated environment around a workflow management system greatly widens the scope of the system. Not only the co-workers in the own organization can participate in the workflow, but also anybody on the internet can be included to play some role in the execution of the workflow.

#### **Recommendations to:**

(1) *Development*: Identify the similarities between different collaborative applications, find synergies (e.g. organization model, incorporate distance learning techniques into help system, utilize web application platform for web based user interface of workflow management system, etc.).

(2) *Customers (IT-management)*: Select a workflow management tool that can be combined with other collaborative tools.

(3) *Management (LoB)*: Model workflows in view of other collaborative applications.

## **6 Major Research Topics**

The analysis has shown that there are some topics common to workflow management and other forms of collaborative tools that need further research.

### **6.1 Organization Model**

As we have mentioned in different portions of this study, a sophisticated model of the organization is necessary for workflow management as well as for knowledge management. While the focus of the two areas may be somewhat different, the basic needs are the same. For a flexible workflow management system, it is necessary to model the organization (structural and processual) independent from individual persons. It is also necessary to take the dynamic aspect of any organization into account. Since many instances of the same workflow type may be active in different states of execu-

tion, it is not suitable to use a simple database functionality for modeling the organization, but the model must provide for reproducing former states at any time.

The same functionality is needed for knowledge management: independence of individual persons, mastering dynamic changes of the organization, and ability to refer to previous states of the organization.

A lot of research effort has been put into the modeling of organizations in this sense, yet still there is no simple solution. The task is so difficult that it does not make sense to develop a model for the purpose of either workflow management or knowledge management alone, but rather a common model.

## **6.2 User Interface**

Supporting the office worker in her or his daily work is not just a matter of functionality. Equally important is the user interface. For an office environment it is advisable to have only one major interface that will allow access to any of the tools. Depending on the type of office worker the portal could for example be workflow oriented or knowledge oriented, providing access to other collaborative systems.

Experience shows that the user interface must be adaptive to different types of office workplaces and to different levels of expertise. In order to integrate most every process in a collaborative system it must provide for easy definition of ad hoc processes as well as for changes to predefined processes during the course of execution.

## **6.3 Standardization**

The discussion of workflow standardization has up to now focused on workflows across different enterprises which means in general also the interaction of different workflow engines. The efforts of different interest groups, mainly the Workflow Management Coalition, has lead to some theoretical models and a reference framework. It is far from a general solution, however. Meanwhile, the situation has become more complicated, as now workflow system have to interact not only with their counterparts in other organizations (and possibly with systems made by competing suppliers), but also with other collaborative solutions like knowledge management, distance learning, and web application platforms.

Workflow management is a key enabler for turning an organization into an e-business. This creates a necessity for observing electronic data interchange (EDI) standards in workflow management (e.g. Extensible Markup Language, XML).

## **7 Summary and Outlook**

The study has shown that there are strong ties between workflow management and other forms of collaborative applications. This is especially true for the relationship of knowledge management and workflow management, with influences in either direction. The more a technical platform for collaboration becomes a utility in a firm, the more synergies can be derived from combining different applications.

The technical approach for joining the collaborative applications should be based on an embeddable (as opposed to an intrusive) architecture that independent developers can easily include in their solutions.

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