

Active Documents Supporting Knowledge Sharing in Knowledge-intensive Cooperation

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Abstract: As the knowledge perspective has become more important and knowledge has been accepted as a resource with ever increasing importance for an organization's success, it has also changed the views on cooperation. Working in partnerships focused on supporting each other in creating and sharing knowledge seems to be an efficient way to reduce costs and enable synergistic effects. This has given rise to the knowledge-intensive cooperation as a special kind of cooperation. A huge amount of transferred knowledge in this kind of cooperation are shared, e.g., by transferring electronic documents. Today, organizations have the choice of a considerable number of knowledge management instruments to support humans to overcome time- or spatial-based barriers concerning knowledge transfer. These instruments can be bundled into complex enterprise knowledge infrastructure (EKI)¹ suites. However, these have an organizational focus and are rarely prepared for knowledge that crosses organizational boundaries. Taking into account the considerable efforts for establishing EKIs, start up of an EKI specifically for knowledge-intensive cooperation is expensive, takes a lot of time and, in case of a network of multiple and changing partners, often is infeasible. The goal of this article is offering the concept of active documents as a way to overcome restrictions of EKI in knowledge sharing between organizational boundaries in knowledge-intensive cooperation. Using active documents makes it easy to start document-based knowledge sharing based on a more client perspective. Additionally it offers comfortable possibilities for automatic integration of those documents into a server based EKI in the future.

¹ A detailed discussion of the term and several aspects of enterprise knowledge infrastructures can be looked up in [MaHP09].

1 Introduction

The daily business in a globalized world can be characterized by requirements like flexibility regarding changing environment variables, the need to give fast answers to the customers' wishes and powerful cultural changes. These demand for pronounced capabilities in order to adapt to shifting knowledge environments [HoRo10]. As a consequence of this, there is a need for companies to be highly innovative as a counterpoint to shorter market presence times and development periods as well as more complex products which require different pieces of knowledge to create. [Bron93]; [Schw94] Through focusing on core capabilities, parallelization of development and cooperating with partners offering complementary competencies [Teec86], [StHe07] this challenge can be mastered. [Sieb99]; [Roye00] One basic requirement for an efficient cooperation in the way described above is the focus on the main goal: creating and sharing knowledge as basis to develop new products and services.

This paper discusses this special kind of cooperation which will be setup to create and share knowledge. In addition it describes the concept of active documents as an easy and fast way to integrate knowledge management systems and thus offer knowledge sharing support without the need of establishing a complex enterprise knowledge infrastructure (EKI) between the partners of such cooperation.

2 Knowledge-intensive cooperation

Knowledge is related to the concepts of data and information. While data can be seen as symbols which are connected using certain syntax, information will be data with a certain semantic. [LeHM95, 173]; [Krcm05, 16] Based on this knowledge will be often described as information with context that enables people to interpret the information. Consequently, knowledge transfer between organizations participating in a knowledge-intensive cooperation involves not only data, but also context describing the data and thus easing interpretation (information) which then is used in order to reconstruct knowledge at the receiving end of the knowledge transfer. In this article, knowledge will be seen as the result of an interpretation of information by a specific person. Knowledge can only be created in an individual's mind. [Maie07]

Similar to usage of knowledge, the term cooperation is an often discussed concept which offers several perspectives. The basic approach can be ascribed to the latin word "cooperare" which has the meaning working together to solve a problem. Different interpretations of this simple approach are based on several concrete use cases which build the background in the cooperation research process. The analysis of the different definitions offer the following set of properties which are used in a number of definitions [Auli99, 94]; [Paus89, 623]; [Rote93, 40f.]; [Stau92, 3f.]; [Sydo92, 79]:

- Legal and economical autonomy of the partners of a cooperation,
- Verbal or written declaration of enforcement and coordination of tasks,

- Partial limitation of the own freedom of making decisions to reach the collective goal,
- Two-way spin-off of the coordination of several functionalities of the organization.

The usage of these properties leads to the following definition of a cooperation: A cooperation will be a kind of voluntary collaboration of two or more partners which limit partially their own freedom of making decisions and spin-off the coordination of several organizational functionalities to overcome bottlenecks and reach a collective goal.[Trög07, 16]

The specific goal to transfer and develop knowledge gets more and more important since the beginning of the 1980s. Activator for this development was the cognition that knowledge became a crucial resource [Bada91, 23ff.]; [Druc69, 358ff.]; [Mach80] and that an increasing part of work can be characterized as knowledge work. [Wolf05] Due to this, cooperation will be often founded to transfer or develop a specific kind of knowledge. Such cooperative work between several organizations makes research processes more efficient. It helps to reduce time to market and development costs of new products and services. [Font96, 139f.]; [Schw94, 98f.] Additionally, the failure risk or risk of commercial flop will be divided. [Roye00, 13] There exist a great number of approaches in the scientific community (e.g. Knowledge Work, Knowledge Intensive Enterprises, Knowledge Cooperation, Cooperative organizations for creating and transferring knowledge)² which can be used to give a definition of the organizational form of a knowledge-intensive cooperation.

Combining the main properties of these concepts leads to the following definition of knowledge-intensive cooperation: Knowledge-intensive cooperation is a kind of cooperation which will be founded to overcome knowledge limitations and pursue the common goal to create new applicable knowledge by transferring and combining existing or collaboratively researching for new knowledge. [Trög07, 39]

3 Active Documents approach

This chapter illustrates the active documents approach based on an argumentation chain starting at the term document, describing the motivation to develop and finally characterizing active documents.

² For an illustration and a more detailed discussion of these basis approaches of a knowledge-intensive cooperation please have a look into [Trög07, 32f.].

3.1 The term document

The basic approach for discussing active documents are documents in general. The term document is deduced by the latin word “documentum” which means something which is conductive to attest facts. Due to this, the word document is often used similar to certificate. Using the point of view of the information and communication technologies, the term will be described in a wider way as “recorded information or object which has to be handled as unit” [ISO01] In consideration of aspects of law, a document can be defined as “... a legally sanctioned record ... or a transitory record ... of a business transaction or decision that can be viewed as a single organized unit. It is composed of a grouping of formatted information objects that can be accessed and used by a person and are usually stored on media such as paper ..., microfiche or electronic.” [MaHP09] Basis for the development of the active documents approach is the usage of the term electronic documents referring to the named document definition of MaHP09.

3.2 Motivation for the active documents approach

Knowledge work as the typical kind of work in knowledge-intensive cooperation is characterized by complex and high dynamically problems which have to be solved. This leads to a specialization of knowledge workers and based on this to a fragmentation of knowledge. As described in the section above, frequently knowledge transfer and collaborative knowledge creation is needed to fulfill the daily tasks in knowledge-intensive cooperation. Documents are often used as an instrument to support knowledge sharing. A condition of the knowledge sharing process³ is the need of knowledge de-contextualisation by the sender which translates knowledge into information and a re-contextualization by the recipient which translates information back into knowledge. These are non-trivial processes which have to be supported due to the problem that a failure in this process leads to wrong knowledge. Additionally it shows that knowledge sharing won't be possible without the usage of context describing the knowledge regarding a situation, a person, an organization, etc. Simple electronic documents on one side are not able to store context in a comfortable and easy to use way. The only way to store context in an electronic documents is as unstructured data (e.g. author, his organization and position stored in the headline of an article or concept) between the de-contextualized information. On the other knowledge management instruments [AIlLe01] supporting the knowledge sharing process as a whole are often bundled as EKI. [MaHP09] Such systems make it possible to handle semi- or unstructured data in a similar way while data Warehouses do this for structured data. Thereby, EKI are often central server based solutions. They give the possibility to store additional context in form of metadata linked to the corresponding de-contextualized information. Furthermore, they offer some additional features (e.g., communication functionalities) which will support the knowledge worker in the knowledge sharing process. [AIlLe01], [Hols03], [Maie07]; [Chen09]

³ A more detailed description of the concept of knowledge sharing and the knowledge sharing process can be found in [Pein06].

As Figure 1 shows, such EKI can be effectively used (1) if the knowledge sharing process takes place within such a bordered environment. (2) If there is a need to transfer the information between two EKI environments it is typically not possible to transfer corresponding context information (metadata, semantics). This offers a problem for the re-contextualization process to transfer information into knowledge. Additionally, the setup of a complex EKI environment specifically for the knowledge-intensive cooperation is mostly economically not feasible. [Trög07, S. 74ff.]

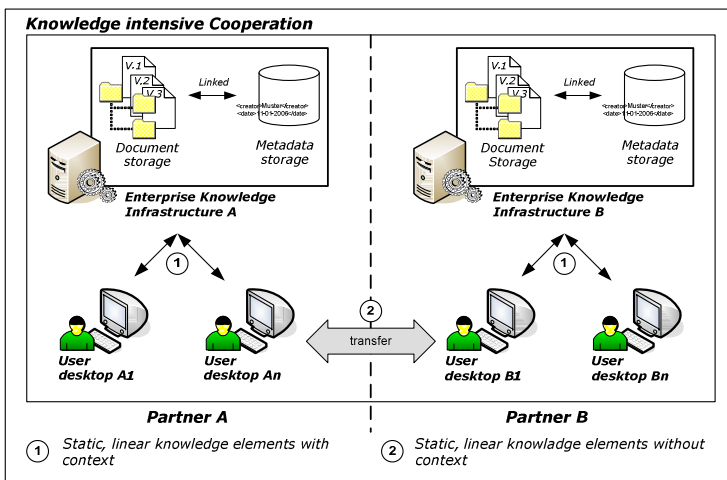


Figure 1: Active documents motivation [Trög07, 76]

Following this argumentation, efficient support of a knowledge-intensive cooperation on the one hand would make it necessary to setup a unique EKI platform to support the knowledge sharing process between all partners. On the other hand, this reduces the advantages in reference to time and money a knowledge-intensive cooperation offers.

3.3 Characterization of active documents

The research for a solution which makes it possible to overcome the weaknesses of centralized EKI systems, but offers also a solution to integrate developed knowledge in an EKI infrastructure after the end of the knowledge-intensive cooperation brings us to a deeper view in document based technologies. As the Table 1 shows several theoretical and practical approaches exist to expand classic electronic documents and make them more “intelligent”.

Abstracting the named approaches of Table 1 there can be identified several stages of activation of documents (see Figure 2). Through the integration of metadata a passiv document became an enriched document. Adding additional metadata or application logic in combination with a system environment which is able to interpret these metadata and application logic leads to reactive or active documents (depending on it’s possibility to react or initiate and control functions). The most complex stage, proactive documents, can be reached using a system environment which has autoactivation enabled.

This shows that the grade of activation is not only depending on the additional metadata the document offers. It goes hand in hand with the environment the user needs to interpret this additional information.

Concept	Description	Source
Adaptive Hypermedia	Adaptive Hypermedia is a theoretical approach with the goal of the adjustment of digital content to the user's need. Based on information about a user's interaction, a hypermedia system offers only the kind of information a user needs.	[Brus01]; [CLHS03]; [StVX06]
Self-carrying documents	A practical approach which focuses possibilities to overcome the loss of metadata while transferring documents between document management systems (DMS) through exporting metadata as XML. No standard could be established.	[KaMe97]; [GSSZ02]
Placeless Documents	Theoretical driven approach where the document will be expanded by descriptive as well as system-based (e.g., storage place) metadata. A specific and complex system environment is necessary for usage.	[LEDL99]; [DELL00]
Living Documents	A theoretical approach which expands documents with metadata and intelligent agents. A specific and complex system environment is necessary for usage.	[Schi03]
Intelligent Documents	A practical approach which expands documents with XML-based metadata (XMP). The metadata will be written in the header information of each file. Appropriate applications can use these metadata while others will ignore them.	[Körn04]; [Adob06b]
Smart Documents	A practical approach which also expands documents with XML-based metadata. The metadata can be used in MS Office for descriptive and automation reasons.	[LeML04]; [Maue04]; [GoWa04];

Table 1: Document enrichment approaches

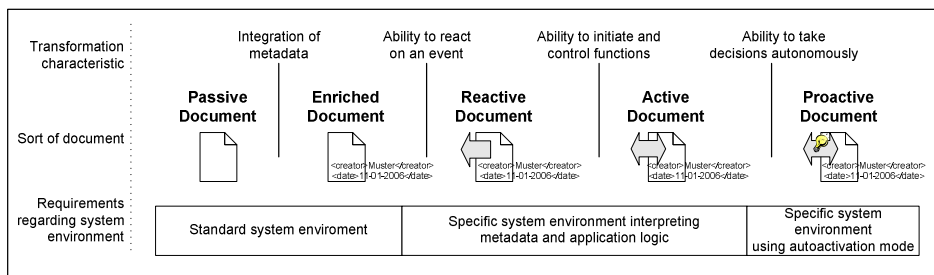


Figure 2: Activation grades of documents [Trög07, S.111]

Combining the illustrated approaches leads to the concept of active documents which will be defined as an electronic document which includes data as well as metadata and application logic. Alternatively, an active document can be directly connected with the application logic. Both elements are a fix part of the active document and can be divided from it only with substantial loss of meaning. Metadata and application logic will be transferred with the active document and be able to activate, control and execute functionalities. [Trög07, 112]

4. Towards Realization

After a general description of the possibilities the concept of active documents offers (discussed on a more theoretical basis) this chapter illustrates a short exemplary use case to give the reader a deeper understanding of the practical relevance of the discussed approach.

4.1 Theoretical perspective

Using the active documents approach offers a wide range of possible arrangements for effective knowledge sharing support in knowledge intensive cooperation. The simplest support is the usage of an **enriched document** where a metadata viewer offers the recipient an easy access to the context stored in the document's metadata. Through operating system (OS) functionalities like search engines and intelligent folders (metadata based folders) there exists an additional possibility for fast knowledge access and context-based custom view on the basis of usage of these metadata. The existence of an import filter corresponding to active documents is the only condition which has to be fulfilled to do this.

A higher level of using the possibilities the active documents approach offer can be seen in an interpretation of integrated metadata (**reactive and/or active documents**). This can be done through a scripting engine like the application Automator which is a part of Mac OS X. But it is also possible to insert a script into an active document and offer a system environment which is able to execute this script. A much higher level of automation and offering additional functionalities can be reached through the usage of a workflow engine. Easy to use and effective desktop workflow engines like the PDF workflow engine Switch⁴ offer the user an intuitive way to work with drag & drop interface so there is no need for expensive training sessions.

The usage of an intelligent agents framework to extend active documents or it's system environment can be used to reach the highest level illustrated in the active documents approach (the **proactive document**).

A main advantage of active documents is that the user no longer needs set-up times. He only has to select a way of realizing the active documents approach (e.g., using the XMP-Standard of Adobe), specify and configure the metadata and functionalities he needs and to configure a system environment. The most positive effect thereby is that the user must do a lot of conceptual work to define metadata and functionalities. This helps if he wants to insert active documents into a complex EKI in the future. To do this he needs an import filter for metadata. Additionally he has to configure an EKI workflow engine in the same way he did it for his desktop workflow engine.

⁴ For more details about the workflow engine Switch of Enfocus N.V. have a look on <http://www.enfocus.com/product.php?id=871>.

4.2 Exemplary use case

The goal of the following use case is to illustrate the general possibilities and purposes the concept of active documents offers. It's not the intention to display an example which can be directly transferred into each real world scenario.

An exemplary use case can be seen in a knowledge-intensive cooperation between a scientific research organization (SRO) and an enterprise which is an airport carrier. Goal of such a cooperation could be the development of more efficient logistic processes for the approach of airplanes. While the scientific organization uses several open source knowledge management tools the enterprise uses a complex EKI. The researches of the SRO use a web interface to upload electronic documents. All those will be stored into the file system while the corresponding metadata, which can be tagged, will be stored in a database referring to the document. The EKI of the enterprise offers a MS Office integration which makes it possible to store electronic documents directly from the office application into the EKI. During the storing process the user has to fill a form with mandatory metadata. Additionally metadata will be automatically added to the document using an implemented classification tree and a workflow process. The documents will be stored into an archive server which is a part of the EKI. The corresponding metadata will be stored in the database of the EKI.

The only possible way of document exchange is a transfer via Email or FTP due to missing interfaces between both EKI. Also the usage of only one those EKI isn't possible due to aspects of law and security. Based on this there is a loss of context which complicates the re-contextualization of information to get knowledge. As a solution both partners decide to use active documents for document based knowledge sharing. Technological basis for this are the software products Adobe Acrobat which every user has already installed on his desktop and the workflow engine Enfocus Switch which will be installed on a separate VMWare based server at the SRO and also at the enterprise. Following the displayed steps a simple document based knowledge transfer could be implemented between both partners:

1. Implementation of a metadata template using the Adobe XMP standard
2. Roll-out of the metadata template to each user which is a member of this knowledge-intensive cooperation
3. Implementation of several workflow steps using Enfocus Switch

After document creation using MS Office the document has to be rendered into PDF as the agreed exchange format for documents. During this process each user has to fill some mandatory metadata fields of a form to describe the corresponding context. Afterwards the PDF document can be transferred via Email to a central mailbox. Each document in such a mailbox will be automatically routed by the Switch workflow engine to the inbox of a corresponding user. The context metadata stored in the PDF's metadata header (based on XMP) will be used to get the correct routing information. If the user gets such a PDF document in his inbox he can open it and get information and additional metadata representing the corresponding context.

5. Conclusion

Knowledge is increasingly fragmented and distributed not only between individuals, but also between organizations who increasingly rely on knowledge-intensive cooperation in value networks that helps them to benefit from complementary competencies needed for jointly creating new processes, products, services and business models. While many organizations nowadays support knowledge handling with the help of an EKI, this type of effective support regularly does not exist when documented knowledge should be ferried across organizational boundaries. Typically, knowledge, that is information plus context [AlLe01], loses context in this procedure. The paper has presented various sorts of active documents with increasing context and functionality that help to overcome this problem. The paper is not limited to conceptual considerations, but also points towards already available standard solutions that help implementing the concept of active document. Future work can put the artifacts created in this paper to a test and thus investigate what factors aid organizations in harvesting the benefits of this promising approach.

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