Chapter 1

Enabling Workflow-Embedded OM Access With the DECOR Toolkit

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Abstract: The DECOR project (Delivery of context-sensitive organisational knowledge) project develops, tests, and consolidates methods and tools for business-process oriented knowledge management (BPOKM). DECOR builds upon the KnowMore framework (see (Abecker et al., 2000)) for organizational memories (OM), but tries to overcome some of its limitations. In DECOR, three end-user environments serve as test-beds for validation and iterative improvement of innovative approaches to build: (1) knowledge archives organised around formal representations of business processes; (2) active information delivery services which offer to the user in a context-sensitive manner helpful information from the knowledge archive, and (3) methods for an organisation analysis from the knowledge perspective, required as supporting methods to design and introduce the former two systems.

Key words: organizational memory, ontology, workflow

1. MOTIVATION & OVERVIEW

Organisational Knowledge is mainly created, used, distributed and reused in business processes. Business processes can be understood as the company's knowledge platform. Since Business Process Management (BPM) and

Business Process Reengineering (BPR, (Malhotra, 1998) became important business trends and academic disciplines in the recent years, it seems promising to systematically investigate synergy potentials and innovation opportunities coming from the fusion of BPM and Knowledge Management (KM, (Davenport & Prusak, 2000)), one of today's most powerful trends in research and practice. In (Abecker et al., 2002) we distinguish phases of the lifecycle of a BPOKM project where synergy potential can be identified:

1. System Design: Both KM and BPM initiatives require elaborated analysis, planning, and introduction steps. These can be shared to some extent between BPM and KM projects. Further, BPM methodology can "drive" and encompass the KM specific work (cp. (Karagiannis & Telesko, 2000), (Mertins et al., 2000)).

2. System Use: If process support and KM infrastructure interoperate, a higher level of system services can be achieved. The following integration approaches exist:

- **Process-Oriented Knowledge Archive**: business process models are used for organizing knowledge archives, e.g., representing one view in a company or community knowledge portal. Further, an information system can be coupled with the actual workflow enactment such that for a given process activity the associated knowledge and information objects can be accessed easily (cp. (Goesmann & Herrmann, 2000)).
- **Active Knowledge Delivery**: a workflow engine enacts a business process instance and, when starting a specific activity, can automatically pose a query to the knowledge archive according to a previoulsy attached task-specific information need.
- **Dynamic Process Context**: the approach above is extended in such a way that not only fixed, predefined information needs are attached to tasks, but information needs are parameterised by variables to be filled by the running workflow instance. This makes possible a context-specific information retrieval which takes into account instance-specific information (cp. (Abecker et al., 2000); (Staab & Schnurr, 2000)).
- **Contextualized Information Storage**: the workflow creation context (in terms of details of the actual business process instance) can be archived together with a newly created document. This information can be used for a better retrieval in other, similar situations, or it can be used for assessing the quality of the knowledge contained (Who created it? Was the creating project successful? Is there other important background information related with this process instance? etc.).

– **Context-Embedded Discussions**: context-dependent information delivery actively providing background information for a running process instance can also stimulate discussions about content and quality of the information objects retrieved. The users may have possibilities to make comments, attach discussions, send e-mails to authors or knowledge managers, etc., if a running activity gives rise to criticize some information object.

3. System Evolution: One should try to continuously feed back experience and change requests coming from new insights / requirements or a changed environment to the process design unit in the organization, thus steadily keeping up-to-date the formalized process models with the best practice about how to enact them. This continuous improvement process is a KM process itself (cp. (Wargitsch et al., 1998)) which affects both process knowledge and function knowledge.

In the European R&D project DECOR (Delivery of Context-Sensitive Organisational Knowledge) we focus on System Design and provide technology for Process-Oriented Archives with Active Knowledge Delivery using Dynamic Process Context. In Section 2, we show an overall scenario with these components playing together at runtime. The set of integrated methods and tools for building the respective software systems is briefly discussed in Section 3. In Sections 4 and 5 we summarize and discuss some related work.

2. DECOR USAGE SCENARIO

Normally the explicit knowledge in a company (documents, databases, etc.) is spread over many different sources, forms, media etc. Further, links and relationships between documents are often not represented. ***Ontology-based information systems*** (cp. (Benjamins et al., 1998)) acquire from the community of system users the commonly agreed upon domain structures (concepts and definitions, relationships, constraints, axioms) which *logically* organise a certain domain of expertise or area of work. A formal representation of these generally accepted domain knowledge structures, the *ontology*, is the basis for homogeneous, concept-based content description of knowledge sources. Having a document archive organized around ontological structures, the ontologies can be used to design knowledge portals for manual browsing, or they can be used by information retrieval algorithms in order to improve precision or recall when evaluating queries (see, e.g., (McGuiness, 1998)). In DECOR we employ *business process models* as one ontology which can be used to specify the *creation*, or the potential *usage context*, for a given knowledge item. So we have a ***process-oriented structured archive***,

a meta information system providing conceptual structures to access the underlying already existing information systems (see Figure 1).

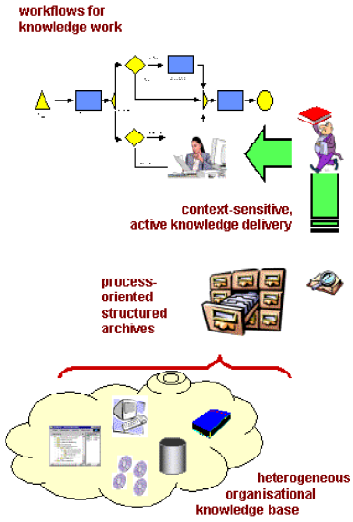

Figure 1. DECOR Overall Scenario: Active Knowledge Delivery at Workflow Runtime

On the other hand, users are engaged in their daily work routines; they don't want to spend much time in searching for information or storing expertise. What they need is an ***active, context-sensitive knowledge delivery*** service which "knows" what he or she user is actually doing, and exploits this information for autonomous information management services at the desktop. To achieve this goal, DECOR employs a workflow management system as the host which is aware of the specific tasks to be performed by the user at a given point in time. We consider *weakly-structured workflow models for representing knowledge-intensive work routines* which are usually not so strict and predetermined as, e.g., administrative workflows. *Enriched workflow models* describe information flow between and information needs of specific tasks. An ***information assistant*** observes the running workflow and interprets modelled information needs to offer active support from the process-oriented structured archive; further it maintains a notion of information *retrieval context* using additionally modelled information flow variables which allows for more precise queries to the archive.

Altogether, existing knowledge sources are used and extended in a more efficient and more consistent way throughout the company. Figure 1 illustrates the several system parts playing together at system usage time.

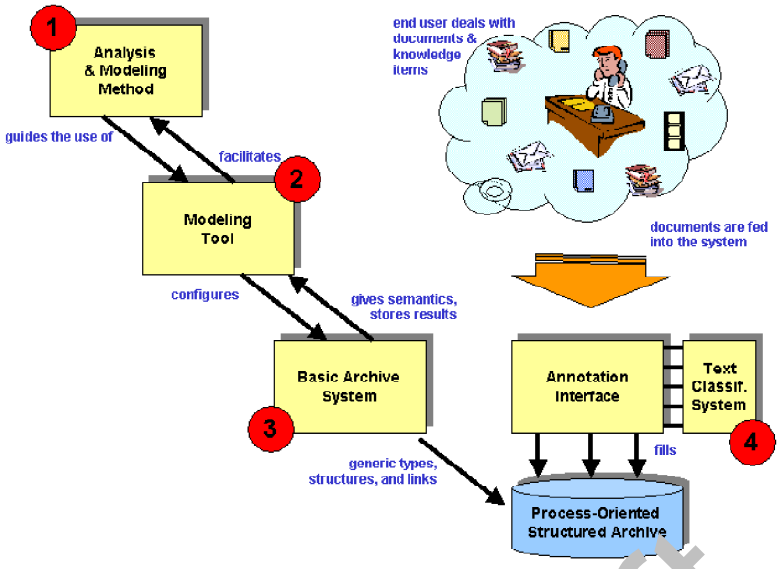

Figure 2. DECOR Modules Used at System Build Time

However, the above scenario is based upon a number of analysis and modelling steps: (1) domain ontologies for knowledge organisation and content description; (2) workflows for knowledge-intensive business processes; and (3) information flow and information needs for workflow enrichment. All modelling activities must be carried out by consultants at reasonable costs and with a predictable result. Hence, we need a structured approach for running BPOKM projects which supports the consultant with appropriate methodological guidance and modelling tools. Figure 2 shows the modules of the DECOR toolbox which shall help achieving this goal. We briefly discuss the several complementing modules in the following section.

3. THE DECOR TOOLBOX FOR WORKFLOW-EMBEDDED OM ACCESS

Module 1: DECOR Business Knowledge Method

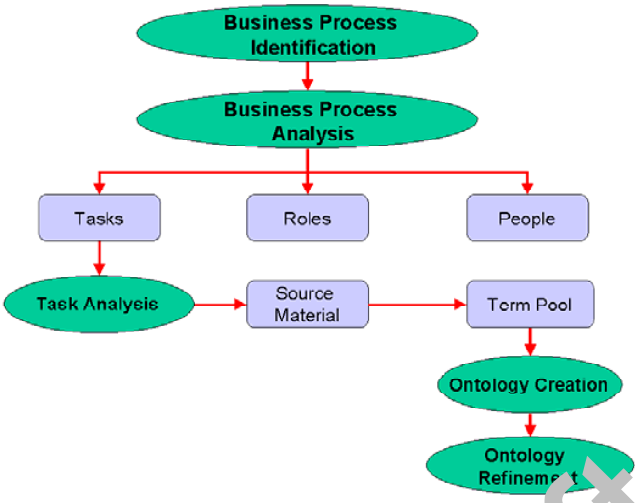

Figure 3. Amalgamating CommonKADS and IDEF5 in the DECOR Business Knowledge Method

The DECOR Business Knowledge Method provides an approach for systematically running BPOKM projects. Its main elements are shown in Figure 3. The method slightly extends the CommonKADS process analysis (Schreiber et al., 1999), and adds a task-analysis driven domain ontology construction according to the IDEF5 approach (see http://www.idef.com).

Module 2: Business Knowledge Modelling Tool

The DECOR Modelling Tool supports all modelling activities related to the method described above: business processes, task-specific information needs, domain ontologies, and process-specific context variables. It primarily addresses users without a specific AI background and is oriented towards existing BPM tools. It is realized as a set of related modelling methods for the MS VISIO® 2000 graphical modelling tool. This ensures a wide usability of the software basis and a good familiarity of non-expert users with the

overall look-and-feel. The VISIO® interface actions are coupled via a dynamic link to the DECOR Basic Archive System (see below). So, all graphical modelling steps in VISIO directly lead to the respective effects in the configuration of the underlying knowledge networks: new concepts or links are inserted in the ontologies, business process models are extended, or indexing concepts added to document models. This dynamic link to the Basic Archive System allows to equip the graphical modelling interface with a better semantic foundation: e.g., only reasonable links are possible, whereas links which do not respect the value restrictions of the represented relationship can directly be rejected, etc.

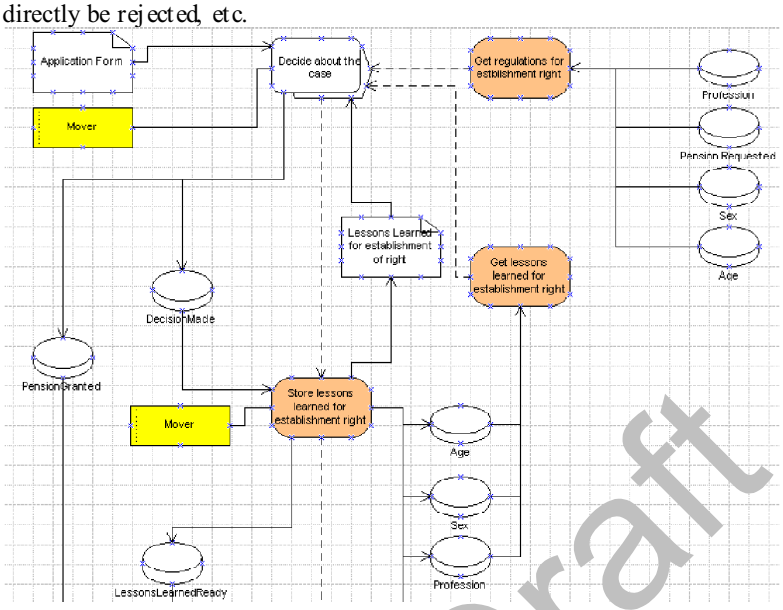

Figure 4. Example for Modelling Tasks and KM Tasks

Figure 4 shows part of a sample business process from one of our case studies, modelled using the DECOR modelling method for VISIO. Here, as part of a decision process regarding the granting of full old age pension in a social insurance institution, we see "Decide about the case" as the central knowledge-intensive task. This task is supported by two (coloured boxes) automatically started KM tasks, namely "Get lessons learned …" and "Get regulations …" which shall provide interesting background information for the clerk. The retrieval process uses some context variables in order to find the best knowledge items applicable for the given case, like "Profession" or "Age" of the applicant. Further, there is a KM task "Store lessons learned

…" as optional part of the normal control flow which allows to extend the OM when new, interesting cases are considered.

Module 3: DECOR Basic Archive System

The Basic Archive System stores *knowledge items plus metadata as well as links between knowledge items*. *Knowledge items* are documents (or links to documents), or links to tacit knowledge (e.g., a homepage for each employee in a yellow page system as a summary of his/her skills and experience). *Metadata* are expressed in terms of underlying ontologies designed with modules (1) & (2). Business process models are some of many possible ontologies providing archive structuring criteria. The basic archive system can be accessed via XML retrieval messages which combine retrieval constraints formulated over links and metadata. Another access path is manual navigation in hierarchical indices which can be extracted from the index ontologies.

Software basis for the DECOR Basic Archive System is the CognoVision® product offered by DHC GmbH (Abecker & Müller, 2001). CognoVision® allows to represent arbitrary semantic networks built from attributed concepts and attributed links. Information objects are attached to concepts such that navigation through the concept network leads to concrete documents stored in information objects. In detail, information objects encapsulate (i) logical content entitities like the set of all documents with the same content, but in a different language; plus (ii) the respective metadata (author, version, language, etc. Metadata attributes can be freely defined for each type of information object). These mechanisms allow to express arbitrary indexing ontologies and the related document models plus the link to the original (multimedia) document.

Module 4: Annotation Interface

In order to fill our archive system, we need a software tool for easily attaching semantic categories (in terms of modelled ontologies) to knowledge items to feed them into the process-oriented structured archive, index them, and establish the required links. Since indexing is a well-known bottleneck for ontology-based KM systems, we have built a generic interface of the annotation tool to an automatic text classification software. For this purpose we use the MindAccess® SDK (see http://www.im-insiders.de). MindAccess® is an extensible multi-paradigm tool which employs a number of state-of-the-art classification algorithms.

So far, we characterised the DECOR modules required for designing and installing a process-oriented structured archive and for filling it with annota-

ted knowledge items. In order to realize the services described Section 2, we need the following additional DECOR solution modules 5 & 6.

Module 5: Weakly-structured workflow tool

Having a deeper look at the characteristics of knowledge work (see, e.g., (Buckingham Shum, 1998)), one can see that knowledge-intensive processes tend to be determined by dynamic changes of goals, information environment, and constraints, also by highly individual and ad-hoc communication and collaboration patterns; this makes it difficult to plan in detail the work on a knowledge-intensive task in advance.

The easy way to deal with this observation (which preserves most benefits of the KM-workflow integration) is to model the related business process just quite roughly and embed the knowledge-intensive subtasks in black boxes without further details. Nevertheless, we aim at a more fine-grained description in order to achieve more of the usual workflow benefits like process documentation, automated document routing, planning support, etc. To this end, a promising way was shown by (Wargitsch et al., 1998): (i) below the level of granularity which can be fixed in advance, compose case specific workflows from archived skeletons or process fragments at runtime; (ii) enact and adapt the so-configured workflow at runtime; and (iii) evolve the skeleton repository by reflection-in-action, discussing the pros and cons of certain fragments when using them.

The DECOR Weakly-Structured Workflow (WWF) support shall provide modelling support and enactment machinery for flexible and adaptive workflow in this sense. In (Schwarz et al., 2001) we describe some design decisions for this system:

- A process archive contains process templates which later are converted to process instances;
- Task specifications (arranged in a task ontology) and process logic are defined separately;
- Task specifications are hierarchically decomposed into sub-tasks;
- Sub-tasks may contain "black boxes"; and
- Black boxes may be refined at runtime (late modelling).

The prototypical implementation is based on the JADE agent platform (see http://sharon.cselt.it/projects/jade). It will be described in more detail elsewhere.

Module 6: Context-aware knowledge agents

The purpose of the DECOR Context-aware Knowledge Agents is to cooperate with workflow engine and modelled information needs, thus proacti-

vely offering information from the process-oriented structured archive to the user in charge of a certain task. Here, the same holds true as for the WWF engine: The feasibility of the principal idea has been shown in KnowMore; the current prototype is implemented is in JADE. Further experimentation with the concept, its user acceptance, and the measurable effects of workflow context on information retrieval quality must follow.

4. RELATED WORK

The idea of ***knowledge-oriented organization analysis*** is grounded in existing work. However, most existing approaches (cp., e.g. (Goesmann & Herrmann, 2000); (Mertins et al., 2000)) focus on analysis and do not lead to far-reaching IT innovations. BPOKM is also a main topic of the EU project PROMOTE (Karagiannis & Telesko, 2000) which has similar analysis goals and methods, but relies on a conventional strongly-structured workflow paradigm. For other ongoing work about ontology engineering methods, ontology editors and ontology-based document annotation, see, e.g., (Schnurr et al., 2000), (Kim, 2000), (Grosso et al., 1999), or http://www.ontoprise.com). For practical solutions, we consider the deep integration of method and tool and the grounding on widespread technology as crucial.

Context-aware information retrieval is sometimes interpreted in a not workflow-related way: Often, highly knowledge-intensive processes are not formally modeled because they are too complex or because they are too much ad-hoc. *Attentive systems*, e.g. personal information agents like WATSON (Budzik & Hammond, 2000), try to detect the task a user is actually performing, and use this knowledge to retrieve context-oriented information. In contrast to our process-embedded scenario, only the *local work context* can be obtained in this way (e.g., the application a user utilizes). Thus, relevant knowledge from preceding tasks is hardly available to better specify the information need. In the long-term, a combination of both interpretations of work context could be promising.

5. SUMMARY

The main distinctive feature of the DECOR project is the idea of a ***total solution*** to context-aware, workflow-embedded information retrieval for knowledge-intensive tasks. So, the main advantage above research prototypes like KnowMore or work at AIFB (Staab & Schnurr, 2000) which were mainly concentrated on intelligent techniques in the centre of information retrieval, ontology-based document representation, or context representation,

is the completion of this technology-focussed scenario by appropriate analysis methods, modelling support, and introduction and maintenance advice. The description of the overall system design and the play-together of different toolkit elements was the main concern with this paper.

Another focus of DECOR is the ***technical consolidation*** of academic research results using (de facto) standards (like RDF/S, CommonKADS, IDEF), commercial software and widespread tools (CognoVision®,Visio®, JADE) wherever possible.

Currently, the described method and software modules are ***tested in three pilot applications*** in the medical and social security sector.

Altogether, the DECOR project develops (and continuously tests in the three pilot sites) a practice-driven, total solution for business-process oriented knowledge management. Long-term goals for extending the scenario concern the *storage* of documents enriched with their creation context, and the evolution of process knowledge as a knowledge management process intertwined with workflow execution.

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