INTEGRATING AD HOC PROCESSES AND STANDARD PROCESSES IN PUBLIC ADMINISTRATIONS[1]

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In a world of dynamic and discontinuous change, public administrations are constantly requested to adapt themselves to new conditions so that they are prepared to survive and flourish in an increasingly competitive environment. In such a dynamic landscape, public administrations are re-examining the ways they treat their knowledge assets and they are identifying new and reorganising existing processes in which they can exploit them more effectively in the future. Therefore, efficient management of knowledge intensive processes has attracted increasing attention. Semantic technologies qualify as enabling technology to handle structured as well as unstructured parts and data of knowledge intensive processes, thus supporting two crucial roles a knowledge worker has to fill in a business process oriented environment: Support for process executers in the efficient, standardized but still flexible execution of business processes and support for process engineers in the definition of such standardized processes based on existing work practice. The goal of our approach is to resolve the dilemma of flexibility for knowledge workers versus organizational needs for standardization and control by supporting the grass roots development and evolution of workflows.

1. Introduction

The amount of data available world-wide and its network-based linkage will continue its rapid growth in the foreseeable future: According to a study [1] conducted by P. Lyman and H.R. Varian at the University of California, Berkeley, in 2003, an amount of 800 Megabytes of new data is currently created per year and per capita, based on an assumed world population of 6.3 billion. The same study estimates that of a total amount of 5 Exabytes of information available world-wide, about 92% exists in electronic form, with a 170 Terabyte share being available on the Internet.

This development has already reached organizations of any type; including public administrations where it is about to significantly change the type of work. The new type of work is very much coined by the amount of knowledge which necessary to successfully get the knowledge intensive work and tasks within business processes accomplished. But the increasing amount of knowledge also raises the following problems for the employees, particularly in public administrations:

- Finding the information which is required to perform a specific task becomes more and more time-consuming;

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- The more knowledge is available within a public administration the less knows each individual (knowledge paradox);
- Each individual requires more and more knowledge to successfully get his/her task accomplished;
- The more "knowledge delivery" systems exist the more difficult it becomes for the individual to find the system with exactly the knowledge he/she needs.

Research in the field of knowledge management and business process management has revealed that the integration of both fields generates enormous synergies. The integration of these two fields is often referred to as business process-oriented knowledge management which has attracted increasingly attention in the past years [2, 3].

"Knowledge work", "knowledge worker" and "knowledge processes" are important concepts in business process-oriented knowledge management and should therefore be explained in further detail: Knowledge work is work with a large amount of creative activities (as opposed to routine work). Knowledge processes describe distributed, organizational knowledge work. They are regarded to run within or across a set of business processes. With the term knowledge worker we refer to an employee of an organisation whose essential operational and value creating tasks rely on knowledge as their critical work resource. Knowledge workers activities lie in searching, analysing, and synthesising information, and in collaborating with others to generate new knowledge. Knowledge Workers are primarily controlled by goals instead of tasks, and they have significant freedom in structuring their activities themselves (such as timing and procedures). This freedom calls for new types of processes, processes which resolve the dilemma of flexibility for knowledge workers versus organizational needs for standardization [4]. We refer to such processes as ad hoc processes [5]. They consist of defined in- and outputs, but leave the way to accomplish the defined outputs up to the knowledge workers and their specific context. They also allow for the agile but uniform handling of structured and unstructured process parts.

This process dilemma, weakly defined ad hoc processes versus well defined business processes, in knowledge intensive organisations raises the question about the underlying technologies used today. The organizational perspective has manifested itself in the field of work flow management systems which boosts productivity by increasing the degree of standardization and transparency, enabling traceability of past process executions, allowing effective controlling and monitoring mechanisms, and permitting easier synchronization and coordination of networked and interdependent activities. Here the process is in focus and dictates the way of execution down to the smallest detail. The individual perspective on the other hand is represented by the field of Computer Supported Cooperative Work (CSCW) which supports knowledge workers in coordinating and negotiating work tasks, in the exchange of information within a specific work context, and collaboratively coming up with solutions to common problems. This approach is mainly unstructured with respect to processes and focuses on information exchange and collaborative sense making. Consequently CSCW approaches are characterized by lacking process transparency, traceability, standardization and control. Both technical approaches, workflow management and CSCW, can be improved to allow the efficient definition of ad hoc processes, their automatic analysis and mapping to standard processes, and the automatic adaptation of workflows.

This leads us to the objective of this paper, which is based upon the research project DYONIPOS (DYnamic ONtology based Integrated Process OptimiSation). DYONIPOS strives to develop sophisticated agile semantic technologies which have the power to deal

with the multitude of technological challenges involved in the simultaneous handling of ad hoc processes and standardized business processes. DYONIPOS will develop new technical approaches based on automatic and semiautomatic knowledge management methods and technologies such as knowledge discovery, semantic systems, and knowledge flow analysis. DYONIPOS will build on existing semantic technology standards such as RDF [6] and OWL [7] but extend them to deal with agile environments. In addition, DYONIPOS will develop new techniques for supporting process executors and process engineers. DYONIPOS supports the role of the process executor by developing new methods for proactive context sensitive information delivery and metadata extraction, inductive definition of ad hoc processes, and for dynamically proposing workflow changes. Furthermore, the process engineer is assisted by semantically enhanced optimization and knowledge mining methods for integrating ad hoc into standardized business processes.

The paper is structured as follows: Section 2 summarizes the objective of the DYONIPOS project. The following section highlights the functionalities which are required to achieve the project objectives. After this description form a user perspective, Section 4 briefly illustrates the most important scientific aspects of DYONIPOS. The paper closes with an overview of the current project state and the list of references.

2. Objectives

The main objective of DYONIPOS is that it will provide integrated support for two roles a knowledge worker has to fill within a knowledge-intensive organization – the role of the knowledge executer and the role of the process engineer.

Process Executer Support: DYONIPOS provides process executers with support to find, perform, and record ad hoc processes (variations on a standardized process). This is done within their work environment such that ad hoc process retrieval, application, and definition take place within the executer's current work context.

Process Engineer Support: DYONIPOS acknowledges the organization's perspective by enabling process engineers to review and analyze recorded ad hoc processes, compare them to the standardized processes and automatically enhance them.

It is important to note that within public administrations often knowledge workers will have to perform both roles: most times working as a process executer trying to cope with always changing situations but periodically serving as a process engineer (responsible for certain processes) judging the different process variations and combining them to one standard process. Instead of researching each of these two roles and perspectives individually (as is done within workflow management systems and CSCW research) it is the DYONIPOS integration of both within one methodology, one architecture, and one environment all based on semantic technologies. This semantic-based integration enables knowledge workers to execute and engineer their own work processes seamlessly.

2.1 Research Approach

DYONIPOS introduces the concept of two different roles a modern knowledge intensive public administration has to intertwine closely in order to account for continuous process changes: the role of the process executer with the perspective of the individual knowledge worker and the role of the process engineer with the organizational perspective. Their

activities build two cycles which are interlinked by ad hoc processes (see Figure 1): Process executers execute standard processes, define or record ad hoc processes, and (re)use them together with previously compiled information or decisions (if available). Process engineers analyze ad hoc processes, extract process patterns, and map these to standard processes.

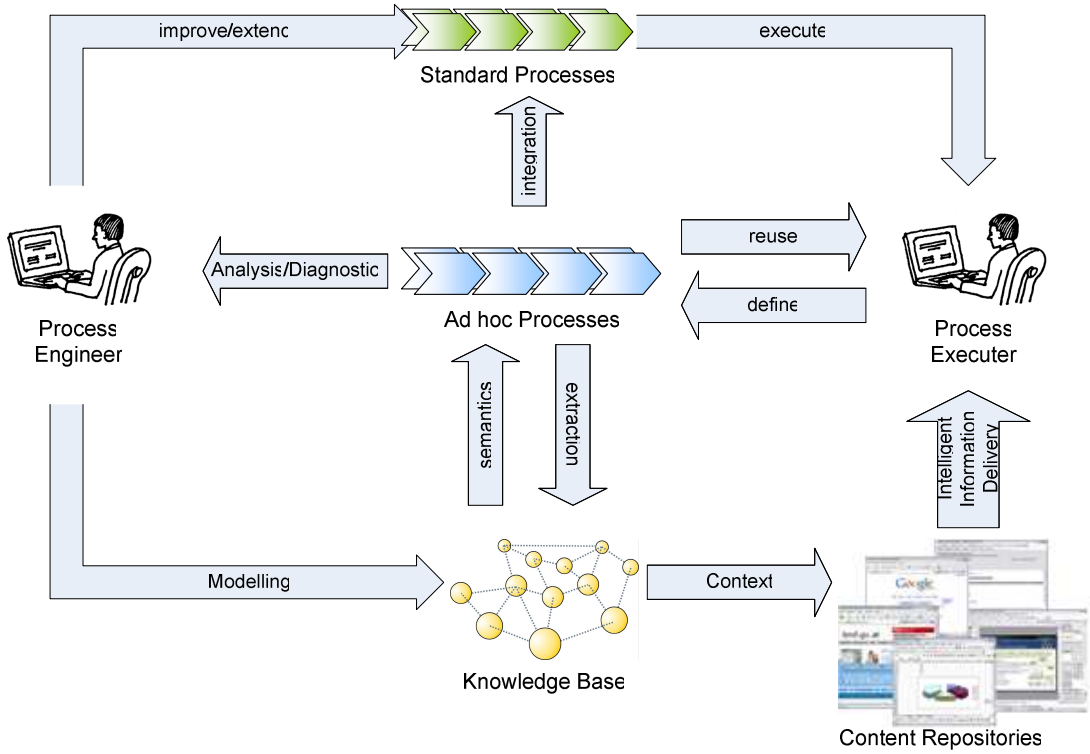

Figure 1: Sketch of the DYONIPOS components and the most important relations between them.

This workflow will use a knowledge base containing rules, constraints and background knowledge for a process as well as semantic descriptions for the content (e.g. documents) used in a process. The knowledge base will determine the context of processes and therefore allow intelligent information delivery to the process executor. Furthermore, the knowledge base will be created semi automatically by mining ad hoc and standard processes to reduce the manual efforts in DYONIPOS.

Ad hoc Processes: They represent the view of the business process executer. DYONIPOS stores process histories which are kept within the process repository of the knowledge base; it serves as a case base for the entire system. If the process executer deviates from the standard process DYONIPOS automatically derives ad hoc process descriptions using newly developed, semantically enhanced mining techniques. This allows for easy adaptation to exceptional situations on the side of the process executer while at the same time complying with the requirements of the traditional business process definitions. The previously created knowledge base resolves contradictions and ambiguities and supports the seamless integration of ad hoc processes into the standard processes. Also, the knowledge base is updated (semi)automatically on a regular basis by analysing the newly defined ad hoc processes and the corresponding content.

Standard Processes: These represent the view of the business process engineer. In order to ensure the compliance of standard as well as ad hoc processes to organizational and regulatory rules a knowledge base is maintained. It contains for instance the dependencies

between processes, the different roles and resources in a process as well as constraints regarding the workflow (e.g. constraints by law, organizational constraints). DYONIPOS relies on semi-automatic creation of the knowledge base by analysing the structure of different processes, resources involved or data manipulated in a process (all kept within the process repository). For discovering such rules DYONIPOS will adapt classification and clustering techniques [8] as well as the extraction of association rules to the domain of knowledge intensive business processes [9].

Integration of Processes: DYONIPOS focuses on the integration of ad hoc processes into traditional models of business processes based on the formal definitions within the knowledge base. Similarities between ad hoc processes will be developed to serve the purpose of finding groups of similar ad hoc processes. Thereby, similarity relies on one side on the similarity of knowledge entities handled in an ad hoc process and on the other side on the formal definitions in the knowledge base. For doing so DYONIPOS will combine content based statistical methods with semantic based methods based on description logic and inference.

Information and Decision Reuse: This provides additional support to the process executer. It has been shown that information overload worsens decision making performance. Thus, besides suggesting applicable ad hoc processes (the structure on how to execute); DYONIPOS also suggests information, people and decisions needed within business processes. DYONIPOS focuses on contextual retrieval methods based on content analysis methods as well as on metadata and formal descriptions of knowledge entities.

3. User Services and Functionalities

To create a system for business process execution with traditional business processes as well as ad hoc processes and to support the executor's dynamic information needs in various process steps, two different groups of services have to be considered.

The first group of services supports the execution of process instances performed by a knowledge worker by (1) dynamically adapting the process workflow, (2) supporting the maintenance of metadata for documents/process instances with respect to the process context, and (3) supporting the decision making process by delivering context-dependent information.

The second group of services supports process engineers in (1) validating and improving existing standard processes, (2) creating new standard processes based on different ad hoc processes, and (3) analyzing processes based on different criterion such as the knowledge flow between processes.

3.1 Functionalities for Executing Process Instances

The following functionalities for the execution of process instances are required to offer the above mentioned user services:

Dynamic workflow: The goal is to dynamically propose succeeding sub-processes depending on the current status and content of the project instance for the purpose of dynamically handling exceptions and special control flows.

Contextual information delivery/retrieval: The goal is to provide the necessary information for the decision making process of a knowledge worker within a specific process context.

Metadata extraction from process instance documents: The goal is to automatically extract metadata from documents used/created in a process instance. A direct benefit lies in reducing the time users need for managing metadata and in ensuring a higher level of consistence between different user groups.

3.2 Functionalities for Process Engineers

The following functionalities for supporting process engineers are required:

Functionalities for analyzing traditional processes: As mentioned before, traditional processes are well-defined and complete. Usually, these processes are modelled by process engineers. To support the modelling of these processes, DYONIPOS envisages the following functionalities:

- *Suggestion for workflow changes*: Standard processes are continuously analysed by using indicators. Deviations will be recognized and reported to suggest changes in the workflow.
- *Validation and analysis of workflow changes*: Changes within traditional processes will be captured and analysed. This will be based again on the evaluation of indicators.
- *Simulation of workflow changes*: Changes will be simulated based on the previously executed process instances. Simulation of changes will help identifying bottlenecks and dependencies between processes.
- *Visualisation and analysis of workflow changes over time*: In order to facilitate the work of process engineers, information and knowledge visualisation techniques will be used to display the changes within workflows over time.
- *Suggestions for the integration of ad hoc processes into standard processes*: Based on different optimization criteria and performance indices, suggestions for the integration of ad hoc process into traditional processes will be provided.

Services for analysing ad hoc processes: Unlike traditional processes, ad hoc processes are a convenient way to dynamically create new processes in order to handle exceptional states and special processes. Loosely coupled ad hoc processes bear the risk of having many different processes not necessarily contributing to the overall process goal. Also, some ad hoc processes may be inefficient, since experience about optimizing processes is not shared among different organizational units. Within this context, DYONIPOS envisages the following services:

- *Simple definition of ad hoc processes*: Knowledge workers will be provided with simple modelling tools which allow them to define ad hoc processes on their own.
- *Consolidation and evaluation of ad hoc processes*: The decentralised definition of processes may lead to a large number of different (but not necessarily consistent) process definitions. This service supports knowledge workers in finding patterns in ad hoc processes and in ordering similar processes.
- *Detection of inefficiency*: By analysing finished process instances and ad hoc processes, indicators for efficiency, knowledge transfer etc. will be evaluated. By comparing process chains of similar processes, this service will identify inefficient process chains and inefficient ad hoc process.

4. Scientific Impact

DYONIPOS will have very different impacts in various scientific domains. In general, developing an integrated system for business process engineering and business execution based on semantic technologies contributed to the field of business process oriented management in providing an integrated framework for intelligent business process engineering and intelligent business process executions by the use of new technology.

Semantic technologies applied and developed in DYONIPOS will lead to a new generation of tools for business process-oriented knowledge management. In particular, the scientific impact of DYONIPOS will include:

- New contextual information delivery methods in the context of business processes.
- New methods for semi-automatically defining ad hoc processes.
- The semi-automatic integration of ad hoc processes into traditional business processes to increase the agility and dynamic of business processes passed on pattern matching.
- Agile and dynamic workflow optimization based on semantically enhanced case based reasoning approaches.
- Semi-automatic analysis of business processes and knowledge flows between business processes.
- New algorithms for automatically extracting semantics and semantic based business rules from business processes.
- Contextual information extraction and contextual knowledge discovery based on the current process context.

4. Current Project State

The DYONIPOS project is a two year project (March 2006- February 2008) which just started three months ago (March 2006). The project follows two orthogonal strands: In the scientific strand, we are currently investigating semantic technologies which match best with our requirements. We are also analysing technological synergies with other similar research projects such as AVALON (http://www.iwm.tugraz.at/research/projects/Avalon) and MISTRAL (http://www.mistral-project.at). In the use case strand, we are developing usage scenarios and are identifying user requirements in public administrations.

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