SEMANAS - Semantic Support for Grant Application Processes

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Abstract. This paper introduces the concept of the SEMANAS project, which integrates flexible workflow management with semantic technologies and knowledge-based document management. The aim is to support users in grant application processes, which are knowledge-intensive and data-flow-driven. On the basis of an ontology, information coming from documents or process participants will be analyzed automatically and connected semantically. Inference mechanisms operating on this knowledge base influence further workflow control and offer flexibility. User support is further increased through adaptive information visualization.

1 Introduction

Grants and subsidies are an integral part of corporate and project finance in many industries. In agriculture mostly no economic viability can be achieved without subsidies. The importance of funding is reflected by the amount of the subsidy volume. The European Agricultural Fund for Rural Development (EAFRD) [6] has provided a subsidy volume of € 17.6 billion for the 2014-2020 funding period.

An application process for funding is usually drawn up over several weeks with the contribution of various individuals. Processes are complex and an extensive amount of manifold documents and forms is required. Thus, it is a knowledge-intensive process, which includes the processing of existing documents, the execution of complex technical tasks as well as the creation of new documents including the actual application. In addition to the applicant, other specialists participate, e.g. a consultant or an architect. The process of creating an application therefore goes through several phases during which documents must be accessed and the interaction of several persons must be coordinated. As diverse frame conditions have to be considered and complex procedures have to be dealt with, the support of an intelligent application system is essential.

The SEMANAS[3] project aims at developing concepts for supporting application processes in funding programs. As application scenario we focus on agri-

[3] SEMANAS is funded by the Federal Ministry of Education and Research (BMBF), grant no. 13FH013IX6, duration: 2017-2021

cultural grants, but nevertheless aim at creating generally applicable concepts. We will investigate whether knowledge management methods are suitable for supporting flexible processes that primarily contain knowledge-intensive tasks. An ontology will be used for storing and deriving knowledge in order to ideally support the user during process execution. In addition, it will be investigated how correlations of processes and data can be visualized comprehensibly.

In this paper we present the idea of the recently started SEMANAS project. First, existing approaches for support in application processes are sketched. Next, the difficulty in handling such application processes is explained, followed by the introduction of our concept combining semantic technologies, such as knowledge-based document management, with flexible workflow execution, which is further enhanced by process visualization.

2 Related Work

Support systems for applications play an important role today, especially in eGovernment. The scope of functions as well as intended users vary significantly. The simplest variant of such a system provides the user with the necessary forms based on the entered data [1]. More extensive functionality, i.e. electronic completion of forms, is provided by software solutions from several federal states [3, 2]. Through involving different participants, a workflow component is realized by systems like GovOS [4] and also FORMCYCLE [5]. All communication during the application process is technically supported, but no flexible deviations from the predefined process are allowed and support for individual tasks is limited to completing single forms. In this knowledge-intensive context, the user is not supported by providing relevant information, which may lead to erroneous application documents. In the VESUV project [7], semantic support in service-oriented eGoverment environments was already suggested.

3 Analysis of Grant Application Processes

Grant application processes are extremely knowledge-intensive and include the processing and use of existing documents, the execution of complex technical tasks as well as the creation of new documents including the application itself. Additionally, the necessary participation of different people requires a high coordination effort. Creating a complete and error-free application with increased opportunities for funding requires a variety of information, some of which are provided by the documents and partly by the participants.

In cooperation with our partners from agricultural consulting, we created a schematic representation of a grant application procedure (see Fig. 1), where the importance of data is pointed out. Vertices denote documents respectively data objects, whereas edges indicate data-flow and dependencies. Tasks are not explicitly shown, but for every document a corresponding task exists, which is responsible for its completion. Dashed lines indicate optionality. Blue-coloured nodes represent finished or existing documents, whereas unavailable documents

are coloured in gray. Green colour specifies possible progress, as all necessary input data is available. Thus, the enactment of tasks and accordingly the completion of documents depends on the availability of information. Due to manifold connections and dependencies between the various documents, a possible or even optimal way of handling such an application is not directly apparent. Additionally, different collaborating individuals have to be coordinated, as can be seen in Fig. 1.

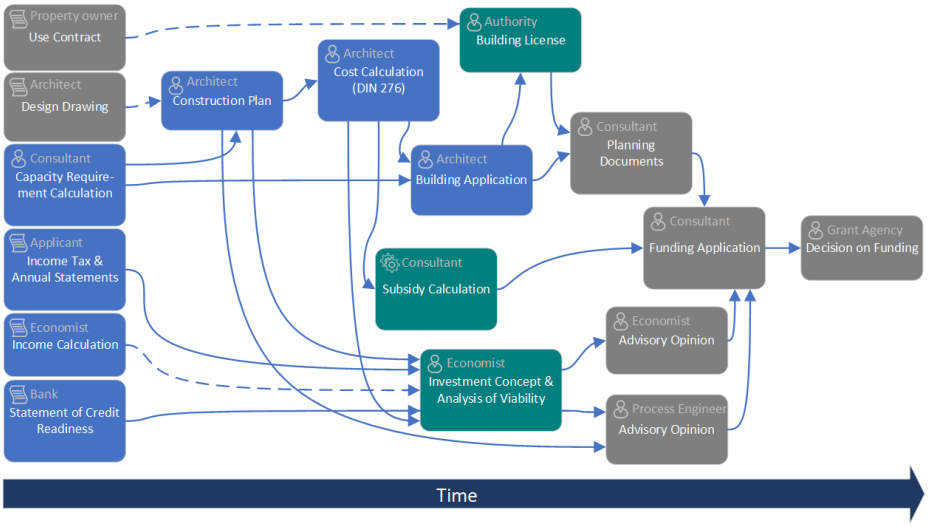

Fig. 1. Schematic representation of documents and data-flow of a grant application

Our intention is to develop procedures that can identify and exploit cross-relationships to detect or initiate necessary or helpful deviations in an application process. The most straightforward method is the detection of executable tasks on the basis of available information. Considering Fig. 1, the creation of the investment concept and analysis of viability can be proposed as next task, as all necessary information is existent, even if the subsidy calculation is a precedent step, considering temporal aspects. A more complex method, which requires inference mechanisms on ontological concepts, is as follows. If, in the case of a building application, the applicant for a subsidy is not the owner of the property to be built, a proof of a lease or use contract may become necessary in the further application process. But if it is the same person, such proof is obsolete and the entire process branch can be skipped. Such optional or conditional sections create significant complexity in many grant applications, which we want to decrease through the application of knowledge-based approaches involving semantics.

4 The SEMANAS Approach

In this section the single individual concepts of the SEMANAS project and its combined approach will be explained.

4.1 Semantic Technologies

The aim of SEMANAS is to investigate the extent to which information from documents can be connected semantically and extracted automatically by means of classification and extraction methods. Thus, semantic technologies will be used to influence the process control.

Generalized as well as specialized associations are mapped by means of an ontology. An upper ontology describes general concepts such as processes, tasks, documents, resources etc., whereas a domain ontology pictures the domain specific context, in this case for agriculture. A third ontology is responsible for depicting documents, their comprised information and interrelationships, thus semantic connections. As information from documents is often in a structured or semi-structured form, we expect that specific extraction profiles for recurring document types, such as ID cards, can be used to automatically extract and subsequently store information in the knowledge base. Thus, on the one hand, on the basis of the concepts depicted in the ontologies, the extracted data can be stored and on the other hand the ontology can be used to improve the information extraction methods, since existing relationships can eliminate uncertainties. For the classification of documents we will rely on standard methods, e.g. layout- or structure-based ones. Subsequently, rule-based information extraction methods based on declarative extraction models will be applied [10].

Furthermore, we aim at supporting the process control with applied inference mechanisms. The current state of knowledge significantly influences the progress of the process. Through the semantic integration of document and process data a knowledge base will be created which includes both general information and case-specific knowledge that is constantly being enriched during operation. Methods will be developed to systematically derive new knowledge through certain inference rules. Thereby, the process state can be derived based on existing information and missing information for a progression of the process can be complemented systematically. Efficient access to both data and relationships will be enabled to substantially assist the application process. On the basis of this semantic integration, further concepts such as process execution and mining as well as information visualization will be developed and are explained subsequently.

4.2 Flexible Data-Driven Workflow Management

Workflow management systems usually are control-flow-driven. Progress in knowledge-intensive processes essentially depends on the availability of information. Thus, the common control-flow-driven principle is not suitable for grant application processes. With SEMANAS, we want to focus on the data flow-driven nature of the application process. The aim is to design a concept that exploits

semantic integration to allow for a flexible process enactment. Deviations will be detected and utilized for further process control.

An approach for flexible workflow management will developed that allows for a separate representation of modeled (de jure) and actual (de facto) workflow instance. The actual workflow represents an execution of the activities derived from the incoming information exploiting the knowledge base. For this purpose, a novel workflow engine will be designed, which implicitly allows flexibility. Previously developed methods [8] will be extended and adapted.

Modeling languages usually base on complex definitions and require expert knowledge. As we want to support inexperienced users and manual remodeling should be superfluous, we intend to automatically optimize the modeled workflows. By modeling a single application process, a template will be created, which is valid for the respective application type. This template can then be used for subsequent application processes of the same type. Extensions and customizations will gradually complement all significant aspects of the application type such that the template is growing incrementally. Therefore process mining methods will be investigated. Process discovery or enhancement approaches attempt to derive knowledge for the adaptation and optimization of workflows with the aim of approximating the de jure workflows, if appropriate and compliant, to the de facto workflows. In this case frequently occurring deviations from the de jure workflow will cause a change of the latter. Thus, future process executions of the user can be supported ideally and the proposed process corresponds to the actual executions in the best possible way. As a result, improved support for users and continuous process optimization will be achieved.

4.3 Information Visualization

To further increase the user support, we aim at visualizing information during process execution in an adaptive way, such that the amount and kind of information ideally fulfills the users needs. For the process owner, a perspective centering on the process is required in order to be able to assess the course and the state of the process. Concerning a consultant, focus on single activities, which should be handled, and relevant information would be useful. Information derived from the contributions of participants or the content of documents can easily be presented in terms of their source and impact on the application process. This becomes more complex when cross-relationships between information are mapped in an ontology and thus generate new knowledge through inferencing.

In order to capture the status of individual application processes quickly and intuitively, an efficient and adaptable user interface is to be developed based on previously introduced concepts [9]. An individual and role-specific visualization of the desired information is pursued. Furthermore, intervention will be facilitated through this interface, which enables the consultant to take corrective measures. Besides, we aim at enabling flexible processes and detecting deviations while visualizing the impacts of the process, but still presenting comprehensible information to the users.

The forms of presentation will exploit the semantic relationships that are depicted in the ontology in order to provide case- and application-relevant knowledge. The semantic integration of application and process knowledge creates new challenges, for example through implicit constraints between activities and the information layer. As a result, the cause of the executability of an activity might not be apparent. The visualization concepts will consider this aspect and allow the traceability of missing and existing information, including the corresponding relations in the ontology. Additionally, the different requirements due to the respective context, e.g. process status, user group and role, current usage intension, should be taken into account for selecting a suitable presentation.

5 Conclusion

In this paper we presented the idea of the SEMANAS project, which aims at realizing a semantic support for grant application processes. Individual concepts, concerning knowledge-based document management, semantic technologies, flexible workflow management and information visualization will be elaborated and combined to one single approach. We intend to develop a concept and a prototypical software system, which is generally applicable for any kind of application scenario, but we focus on use cases from agriculture to evaluate the approach.

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