

Adaptive and Smart e-Government Workflows: Experience Report from the Projects FIT and LD-CAST

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Abstract: Increasing efficiency, flexibility and transparency of public administrations and improving usability and adaptability of systems at the same time can be reached by combining state-of-the-art semantic technologies and existing business process management approaches within the domain e-Government. This experience report presents ontology-based approaches to enable adaptive and smart workflows as they were implemented as prototypes within the EU-funded projects FIT and LD-CAST. The project FIT addresses this challenge by implementing the business rules approach to increase transparency, efficiency and flexibility of the back-office system. The project LD-CAST on the other hand provides semantic service discovery and binding for public services by linking business episode modelling with ontologies. Methodologies, technologies and integration aspects as used in the projects will be presented. Both projects show how semantic technologies can be used and integrated within e-Government approaches and that non-technical domain expert can be involved in the process of designing adaptive and smart e-Government workflows.

Keywords: Business Process Management, Business Rules, e-Government, Ontologies, Public Administration, Semantic Service Discovery

1. Introduction

Following the current challenges when implementing e-Government and due to the currently running modernisation initiatives (e.g. i2010 [1]) of public administration, business process management and reorganization in general are seen as key criteria to successfully implement e-Government, which is currently summarized under the term “New Public Management” [2]. Business process modelling and reorganization have many advantages for e-Government: The purposes of process models range from a knowledge management perspective to facilitate human understanding, communication, organisational learning and transfer of know-how [3] to the management perspective for supporting process improvement and implementing process monitoring and controlling. The derivation of variants and the comparison and testing of alternatives in a test environment become feasible before implementation. This may then directly lead to savings in time and money in the long run [4].

Despite the aforementioned benefits, current solutions still lack the necessary transparency, flexibility and efficiency to be adaptive to different scenarios. This stems from the fact that business processes in today’s administrations are highly complex, involve many different participants and spawn multiple information systems [5]. The domain expert therefore needs to become a process expert to cope with the highly complex scenarios.

The combination of semantic technologies and business process management aims to overcome these drawbacks (e.g. [6]). Semantic technologies are integrated within

e-Government systems and therefore provide this field with an application scenario showing the flexibility of the usage. The two EU-projects presented in the following (FIT [7] and LD-CAST [8]) use different ontology-based approaches to address these challenges. Both projects are co-funded by the European Commission under the “Information Society Technologies (IST)” Sixth Framework Programme (2002-2006). FIT is defined to “develop, test and validate a self-adaptive e-Government framework based on semantic technologies that will ensure that the quality of public services is proactively and continually fit to the changing preferences and increasing expectations of e-citizens” whereas LD-CAST “aims to specify, develop and evaluate an integrated network of seamless interoperable public services to businesses in the context of Enlarged Europe”.

The structure of the paper is as follows: After this introductory section, a short overview of the usage of BPM in the e-Government based on ADOeGov[®] will be outlined including identified challenges. Third chapter presents objectives and methodologies used to tackle specific tasks within the projects utilizing enhanced ADOeGov[®] modelling method. This is followed by the description of the technologies used and the actual implementation in the particular projects. Finally, a conclusion and outlook on future work is presented.

2. Business Process Management for the e-Government

Complexity and management issues in e-Government rise from the fact that for the most applications and scenarios in this area a number of actors (e.g. authorities, citizens, clerks), multi-organisational business processes and heterogeneous technologies have to be integrated [9]. The approach adopted in the LD-CAST and FIT project proposed semantic enrichment of the traditional BPM in the e-Government in order to provide it with “adaptive” and “smart” capabilities.

The modelling method used to execute the modelling of the e-Government processes in above mentioned projects was ADOeGov[®] [9] [10]. This modelling method, which was developed by BOC [11] as a comprehensive business process management method for public administration by extending the general business process management approach implemented in ADONIS[®] [12], includes aspects of service orientation through a top-down based life-event approach, process monitoring through the integration of key performance indicators into the process flow as well as a monitoring cockpit and aspects of security modelling on a technical level in order to provide the means for effective implementation of e-Government.

Within the projects ADOeGov[®] was extended to the specifics of e-Government towards agile business process management using business rules and automatic ontology development, providing the end-user with the necessary flexibility within business process management.

3. Adaptive and Smart e-Government Workflows

Within the two projects introduced different approaches were implemented to enable adaptive and smart workflows in e-Government. The two different approaches and their objectives are described in the following.

FIT follows the Business Rule Approach, addressing the challenge that processes in e-Government are often quite complex and therefore quite difficult to change. Here the Business Rules Approach can provide a powerful improvement by making business rules that are implicit in the process explicit. One benefit is that it is not always necessary to change business rules and processes due to requirement changes. New regulations or business strategies may affect the business rules without the necessity of changing the business processes. The ability of business rules to support dynamic changes, allows the modification of a business process implementation without changing and redeploying it. On

the other hand new applications or procedures might change the business process. Such arguments led to a composite approach to business rules and processes, as also mentioned in [13] or [14].

LD-Cast follows the Semantic Service Discovery and Binding Approach. Here the objective of the integration of semantic concepts and approaches is to enable non technical users, from the business layer, which are the domain experts in creating business episodes, to manage the executable workflows by changing their business processes and concrete services, thus involving them in the creation of a highly complex IT system. This enables the system to react in a timely manner upon changes in law or market situations allowing easy workflow governance by the business users and assuring that knowledge of the domain experts in case of LD-CAST the Chambers of Commerce (business layer) is available within the IT layer of the service delivery processes.

To configure adaptive and smart e-Government workflows different approaches are followed as the FIT project addresses the challenge by introducing the business rules approach whereas LD-CAST introduces the concept of semantic service discovery and binding.

3.1 - The Adaptive Workflows Methodology

In FIT Business Rules Management is integrated into the ADOeGov[®] method providing the ability to model business rules on different abstraction layers to serve different user groups from the business view to the technical level. Each of the three abstraction layers of the business rules are integrated with the according abstraction layer of the business processes. An organizational framework and methodology supports the designer to formalize the “verbal” rule definition from an abstract level to an executable level (see [15] for details).

The input for the semi-formal representation of business processes and rules of the business modelling level are document sources (e.g. laws, regulations etc.), existing process models or interviews/workshops with domain experts, as business rules and processes are often stored in the mind of the domain experts. Other sources could be database analyses or actual workflows in the form of program code. When business rules are defined they are grouped to rule-sets and assigned to the corresponding activities, decisions or processes. The added value of the semi-formal representation is that it can be modelled and understood by business people as well as by IT people as it is clearly structured.

Using the semi-formal business processes and rules, as input a transformation into an executable representation is necessary. For the execution of workflows in the back-office BPEL (Business Process Execution Language) [16] and for business rules a transformation into an open accessible format using OWL (Web Ontology Language) [17] and SWRL (Semantic Web Rule Language) [18] to ensure formality has been chosen.

3.2 - The Smart Workflows Methodology

The goal of providing Semantic Service Discovery and Binding to enable smart workflows for service delivery demanded introduction of the OWL and BPEL notation to the ADOeGov[®] modelling method in order to apply the LD-CAST four-phases-methodology. In the case of LD-CAST a methodology that covered many requirements demanded by the system having to take account of co-existence of different service delivery systems, different end user and provider legislative requirements, etc., was chosen. In order to provide sufficient and productive answers to the requirements in LD-CAST the following four phase methodology was introduced:

First, Business Episodes and Abstract Workflows are generated. This is a complex task aggravated by the fact that it is based on an everyday work of different actors which have to comply with different legal and market requirements, and even more the process of the service delivery and the delivered results were diverse for each actor. Teams consisting of

experienced modellers and business experts carried out this task. The work done was realised in different phases: Initially all information was gathered and the models were enriched to contain all attribute descriptions of the single activities – such as IT systems used, roles involved, etc. The next step was to analyse and align models in order to create reference business processes needed to create the abstract workflows, which were designed using BPEL notation. At this stage the workflows created were marked as abstract as up to this point in time they do not have any services bound to their activities.

Second, the ontology had to be generated. This task was facilitated by generating an initial ontology out of the previously created models.

Third, the services provided by Chambers of Commerce and other trusted 3rd party service providers had to be registered with the LD-CAST System through provision of specific information (parameters such as URL, Cost, Time, etc.) and made available to the system to be used for generation of executable workflows. Finally, the goal of the LD-CAST system, to provide the end user with a dynamic service delivery (not pre-defined executable workflows) at the runtime was achieved by creating the semantic bridge between the components (Business Episodes, Abstract Workflows and Concrete Services) using the LD-CAST Ontology.

4. Technology and Implementation of Adaptive and Smart Workflows

The technical framework concerning business rules as modelling concepts has been implemented using the concepts of the meta-modelling platform ADONIS[®] [19]. This gives the method engineer the necessary flexibility and efficiency in the customisation of the application. Details on the meta-modelling approach can be found in [20], [21] and [22]. The modelling language *ADOeGov*[®] was enhanced within the projects to allow the representation of business rules and processes on all levels from the semi-formal to the formal and thus interchangeable and executable representation using the OWL, SWRL and BPEL (see [23]) standards. Business rules are assigned to the business process model or to the workflow model corresponding to the BPEL standard on a technical level.

Figure 1 provides an overview of how adaptive and smart workflows are positioned within the applications area of e-Government. Adaptive workflows are created out of combination of the layers 1 (traditional BPM) and 2 (business rules), using ontology approach in defining business rules, and smart workflows are combination of the layers 1 and 3 (semantics, using ontologies for annotation).

Within the two EU-Projects the ontology is the basis for the implementation of the Business Rule Approach in FIT [24] as well as for Semantic Service Discovery and Binding in LD-CAST.

In order to capture the business rules and to model them declaratively and adequately, ontologies are used to capture the domain knowledge by introducing and relating the terms of the domain. To execute adaptive processes the integration of the workflow engine and the business rule engine was necessary, thus resulting in an adaptive workflow engine. The business rule engine is integrated as a service. The service architecture is a common approach for business rule engines as it can be easily realized ([14]). The business rule engine is called by the workflow engine (Active Bpel Engine [25]) every time a decision has to be taken. The business rule engine receives the context relevant data as well as the ruleset to be executed and has to access the ontology (in OWL format) in order to execute SWRL rules. The results of rule execution are provided in an appropriate format to the workflow engine. To make the workflow engine adaptive a rule enactor has been developed, which transforms the application data provided by the workflow engine into an appropriate format for rule execution. The benefit of this implementation is that using the rule enactor it is possible to combine other workflow engines (using different workflow languages) with the Business Rule Engine just by configuring the enactor.

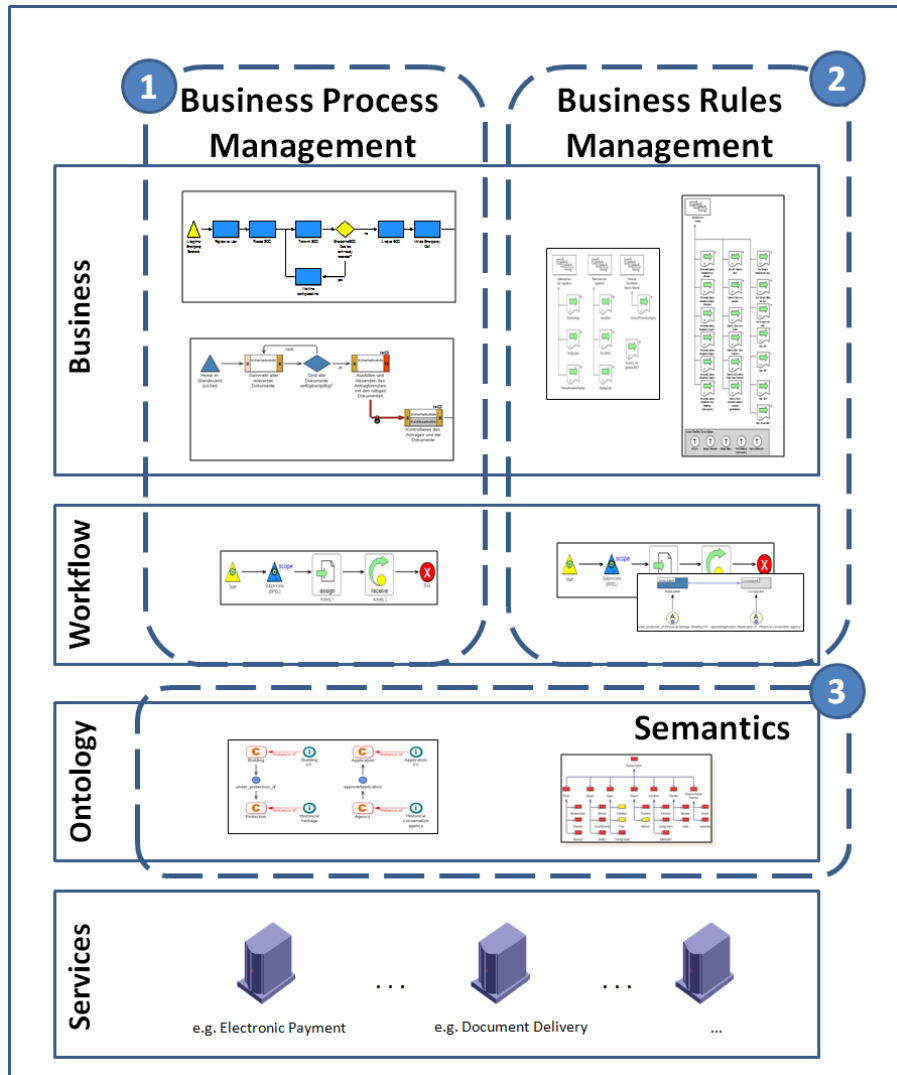


Figure 1: Positioning of the adaptive and smart workflows

The generation of ontologies is in general seen as a highly complex, costly and time-consuming task [26]. In the case of LD-CAST this task was facilitated by the fact that more than 200 business process models modelled during the project, were created using the ADOeGov[®] modelling language which allowed the seamless export of the terms and concepts available within the models in OWL format. Exported OWL files were then imported in the ATHOS ontology management system [27] creating the initial ontology. In the next step the ontology concepts were further enriched and aligned in order to create a consistent and coherent LD-CAST ontology. ATHOS is based on OPAL [28], an ontology framework for modelling business domain ontologies. Using this ontology, business processes (composing the Business Episodes) and abstract workflows could be mapped to each other by annotating the corresponding activities (composing the business process and abstract workflow) with the concepts from the LD-CAST ontology. In the second step, registered concrete services (e.g. Electronic Payment Service), which could be used to carry out one of the activities, were annotated using the same concept from the LD-CAST Ontology.

Once all required items have been annotated, registered, and published (made available on the LD-CAST portal) the end user is allowed to create executable workflows based on

their selection of the potential configurations (based on parameters such as cost and time) in the run time portal. Execution of the workflows is handled by utilising the Active Bpel Engine, which, based on the parameters set by end users, dynamically creates possible configurations of available services that can be bound to the abstract workflows and then finally executed. The results of the executed workflows are presented and delivered to the end users using the JBoss portal [29].

5. Application Scenarios of Adaptive and Smart Workflows

The FIT project uses the business rules approach for the following application areas:

- Variable Process Execution to determine activities and processes to be executed during process runtime,
- Intelligent Resource Allocation at run time to select employees based on special skills, to present information depending on user categories or to select a particular Web-Service,
- Intelligent Branching and Decision Making at runtime to control the process flow accordingly and
- Constraint Checking at runtime to evaluate mandatory constraints or guidelines.

Within the FIT project the “Building Permission” service of the Austrian end user “Municipality of Vöcklabruck” was selected as a pilot service to show the feasibility of this approach. This pilot process starts with a citizen filling out a form to apply for a building on the web-page, thus triggering a workflow. During workflow execution the Business Rules Engine has to be called every time a decision has to be taken. Using the results of rule execution provided by the rule engine the process ends with the building project registration or rejection. A prototype of this implementation can be found in [30].

The main benefit is the ability of business rules to support dynamic changes, by enabling the user to modify a business process implementation without changing and redeploying it, simply by changing the business rules. Because of the semi-formal representation of the business rules it is possible to involve domain experts right from the start.

Application scenarios for the smart workflows in the LD-CAST Project included:

- Semantic service discovery to populate abstract workflows with best-fit available services
- Service delivery to the end users at the runtime according to their demands
- Workflow Governance to allow business experts to take control over the whole process of service delivery

The integration approach used in LD-CAST allowed end users to have the possibility to choose from variety of different service providers for each of the performed tasks and to create their own executable workflows based on their preferences.

On the other hand this technology allowed business experts (e.g. Chambers of Commerce) to directly influence the whole path of the service delivery to the end customers as they, mostly not that technical savvy but extremely knowledgeable in their domain of expertise – business, could influence the creation of the executable workflows by applying changes not deeply within the IT layer, but on their own home ground – the business layer, by changing the business episodes. Involvement of the actors from business layer into the IT layer is very important in order to react promptly to changes in the law and market environments.

6. Conclusions and Outlook

The results presented in this paper provide an overview on the current stage of development and research within the area of adaptive and smart workflows from the perspective of the e-Government projects FIT and LD-CAST. The two approaches are a step in the direction towards making administrative procedures transparent, flexible and efficient by using semantic technologies. Furthermore the paper presented how domain experts are involved in the design of adaptive workflows in the FIT project. The challenges described within this paper provide valuable input on how some of the issues that arise in the field of e-Government workflows utilization could be solved by on one hand involving end users and service providers even more in the service delivery process by providing them such tools as the integration approach in the LD-CAST project. The two approaches presented can be applied to increase the efficiency and transparency of existing applications. Whenever existing business processes are weakly structured or are subject to frequent changes, smart and adaptive workflows can improve the maintainability of the system.

The drawback of the two approaches is that major effort has to be put into the creation of the ontology and rules, but in the long run the effort pays off because of the above-mentioned benefits. The ontology creation process can be supported and improved by the approach for automatic ontology development out of existing models developed in LD-CAST.

The applicability of the introduced approaches is currently evaluated in the projects by proof-of-concept trials at the FIT end users the Austrian “City of Vöcklabruck” and the Greek “Ministry of Interior - Citizens Service Centres”, as well as the integration potential into other domains and scenarios is investigated.

In case of LD-CAST system, a validation test with more than 100 users from Bulgaria, Italy, Poland and Romania including both private and public owned companies has been conducted providing valuable input for the future work on adaptive and smart workflows [31].

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