Ontoprocess – a prototype for semantic business process verification using SWRL rules

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ABSTRACT

In this paper, we describe Ontoprocess, a prototype implementation for semantic business process management (sBPM)[1] consisting of a simple rule editor and a process modelling workbench. Our focus is to provide means for automatically checking the compliance of business processes with business rules. Therefore we combine semantically described business processes with SWRL rules by a set of shared ontologies, capturing knowledge about a business domain. These formal specifications enable us to automatically verify if a process description satisfies the consistency constraints defined by business rules.

1. MOTIVATION

In today's business world, the management and flexibility of services are key success factors for an IT-enabled enterprise. Companies have to assure that their business processes comply with new regulations like the *Sarbanes-Oxley Act* or *Basel II*. Additionally, the possibility for a flexible reconfiguration of services is required for quickly reacting to market changes and customer demands.

These two fundamental requirements – compliance with regulations and flexibly changeable processes – are a big challenge for business process management. In the case of new regulations, all processes have to be revisited in order to assure their compliance. In the case of changing a process, it has to be verified against all regulations. A powerful business process management environment should assist those activities by providing means for automatically verifying the consistency of business processes and guide the process engineer to implement the required changes.

2. SOLUTION APPROACH

In order to automate the verification of business processes, regulations and business processes must exist in a formal, machine-understandable representation. In the following we present a combination of semantic web technologies with process modelling and business rules to tackle this issue.

Our concept involves a two level architecture of process modelling (see Figure 1). The upper layer includes domain information, capturing central business concepts of an organization in ontologies, and business rules in a formal rule representation. The second layer consists of semantic-based process models, describing the organizations' business processes.

Both layers can be maintained by appropriate experts. The process activities are annotated with the domain concepts, thus providing a propagation link in case of changes.

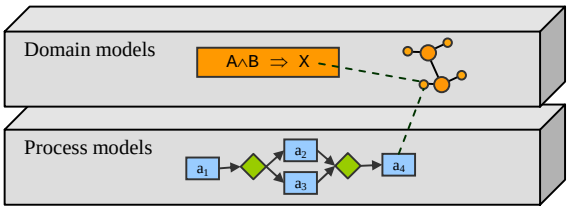

Figure 1: Layers of semantic web-enabled business process modelling

In order to employ formal methods for checking the consistency of business processes, both, the process models describing the actual system behaviour and the correctness requirements need to be specified in a formal language. Thus, we use OWL ontologies for process description and DL-safe rules (a decidable subset of SWRL rules [1]) to express correctness requirements. The process description ontologies are based on an extension of OWL-S[2]. Since the KAON2 inference engine[3] is capable of processing both formalisms, we use it to check if process models satisfy the consistency constraints defined by the rules.

3. EXAMPLE

Our motivating example comes from the area of veterinary regulation. We combine fictitious business processes of a meat processing company with data inspired by an EU regulation that specifies "rules for the organisation of official controls on products of animal origin intended for human consumption"[4].

Therefore we modelled some business processes (such as a procurement process for chicken) and created domain-specific ontologies (e.g. about animals or veterinary regulation) to annotate them. We show how our framework guides the maintenance of business processes in case of adding new or changing existing rules.

[1] http://km.aifb.uni-karlsruhe.de/ws/sbpm2006, http://www.sbpm.org/

[2] http://www.daml.org/services/owl-s/

[3] http://kaon2.semanticweb.org/

[4] http://europa.eu.int/eur-lex/lex/LexUriServ/LexUriServ.do?uri=OJ:L:2004:139:0206:0319:EN:PDF

Our scenario is to demonstrate the change of a business rule and its subsequent propagation and implementation into the process layer. This change shall pertain to an existing rule (see Figure 2). It demands that every process that is annotated to operate within a *Procurement* Context dealing with *Chicken* has also to include a *Visual-check*. In our scenario, we assume a regulatory change that demands a higher-level *Ante-mortem inspection* instead.

$$\texttt{Process(p)} \wedge \texttt{ProcurementContext(x)} \wedge \texttt{Chicken(c)} \wedge \texttt{hasContext(p,x)} \wedge \texttt{hasSubject(p,c)} \wedge \neg\texttt{R(p)} \Rightarrow \texttt{Error(p)}$$

$$\texttt{coversRegulation(p,v)} \wedge \texttt{Visual-check(v)} \Rightarrow \texttt{R(p)}$$

Figure 2: Example rule

When verifying the business processes in the process modelling workbench, a process *procureChicken* is highlighted. It has become invalid, because the annotated *Visual-check* is no more sufficient in order to comply with the business rules. Changing this to an *Ante-mortem inspection* makes the process valid again. Similarly, consistency checking can highlight invalid activities when adding a new business rule to the rule set.

4. IMPLEMENTATION

A meta-process ontology on top of the domain model and the process model layer provides some basic concepts that are specialized in each layer (see Figure 3). It contains entities used for ontology-based process modelling such as *Activity*, *Regulation* or *Context* and a set of relations among them, namely *hasContext*, *hasSubject* and *coversRegulation*.

The domain model layer includes domain ontologies, refining concepts from the meta-process ontology in order to have domain-specific data needed for process description. In our scenario this is a *Veterinary* ontology, defining concepts of veterinary regulation, an *Animal* ontology and a *Business Context* ontology containing categories for business processes such as *procurement*.

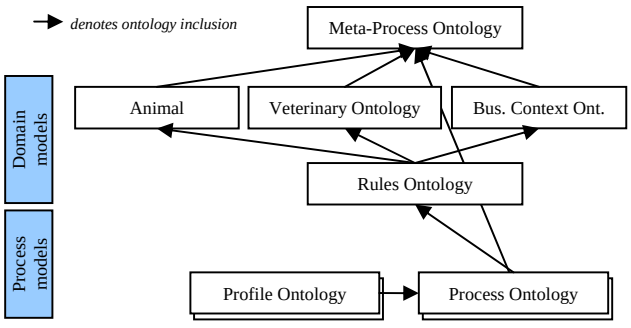

Figure 3: Ontologies in the scenario

Furthermore, a set of rules is part of the domain model layer. It contains business rules (see Figure 2 for an example), relating concepts from the domain-specific ontologies to process activities by the relations defined in the meta-process ontology. We implemented a GUI ("RulEd") appropriate for end-users to model a simple kind of IF/THEN rules. The rules are internally created using the KAON2 API and saved in an OWL file.

The process layer of our framework is based on the process modelling workbench [2] developed in the OntoGov project[5]. It allows to visually model business processes and to annotate them with entities from ontologies. This information is leveraged for ontology-based change management – i.e. propagating changes from domain ontologies to depending processes. Process descriptions are saved in a profile and a process ontology for each process (see Figure 3). Within the process modelling workbench, there is the possibility to verify processes against the previously defined rules by invoking the inference component.

5. CONCLUSION

In this paper, we presented the Ontoprocess architecture for semantic business process management. It is implemented by a simple rule editor and a process modelling workbench that uses formal methods to verify process models against business rules. Using example data from the domain of veterinary regulation we have shown how our framework can assist process engineers by automatically identifying inconsistencies in process models.

We see two major benefits in this approach. First, the speed and efficiency of change management rises. While process engineers have to check every process in order to be sure of its compliance in standard environments, Ontoprocess helps to highlight processes that become inconsistent in the case of rule or ontology changes. Secondly, the rules can guarantee the compliance of business processes, given that they are correctly annotated. Domain and process models can be maintained by appropriate experts, thus allowing a separation of concerns. Domain models and rules may be centrally created or even "bought" from third parties, while business engineers can concentrate in managing their process models.

As a drawback, one might consider the costs for creating and maintaining the domain ontologies, rules and the annotation of services. While we think that the above mentioned advantages already compensate these costs, the usage of annotations is not limited to this scenario. The same domain models and annotations may be used for reusing and analyzing processes in the process modelling workbench and for discovery and matching of semantic web services at process runtime.

6. ACKNOWLEDGMENTS

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7. REFERENCES

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[5] http://www.ontogov.com