Chapter 23
Supporting Semantic Verification of Process Models

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ABSTRACT
This chapter presents an ontology-driven approach that aims at supporting semantic verification of semi-formal process models. The ontology-driven approach suggested consists of two steps. The first step is the development of a model for ontology-based representation of process models. This representation allows enriching process models by annotating them with semantics specified in a formal ontology. In the second step, the authors use this model to support an ontology-based semantic verification possible with this representation and in conjunction with machine reasoning. To implement the approach, the authors use the standardized Web Ontology Language (OWL) and the SPARQL query language. They demonstrate the approach using real-life administrative process models taken from a capital city.

INTRODUCTION
Models are important to manage complexity. They serve for optimization, reengineering, and implementation of supporting IT systems. Hence, the correctness of process models is a fundamental requirement in business process management. Aspects of correctness encompass the terminology and labels used in the process models, their structure and execution semantics as well as compliance to laws, regulations and best practices. The latter aspect focuses on the meaning of the model elements which in semi-formal modeling typically is specified using the natural language. Using natural language introduces terminological problems such as ambiguity (homonyms, synonyms) and other linguistic phenomena. Model creators and readers do not necessarily share the same understanding as the concepts they use are usually not documented and mix both discipline-specific terminology and
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informal, ordinary language. Therefore it is hard for humans to judge if a model is semantically correct and almost impossible for machines (apart from using heuristics) because the model element labels are not backed with machine processable semantics. The result is that the machine cannot interpret the contents of model elements and hence checking the semantic correctness is hard to automate. Our solution approach is to encode the model element semantics in a precise, machine readable form using ontologies. Further, we then use SPARQL (Prud’hommeaux & Seaborne 2008) queries to encode constraints used for ontology-based semantic verification.

With the term “ontology-based semantic verification” we refer to the procedure of ensuring the absence of (semantically annotated) model constructs violating constraints specified with respect to the knowledge represented in a formal ontology. In more detail, with the term “ontology-based semantics” we refer to the semantics of individual model elements which are enriched and formalized by the annotation with instances of a formal ontology. With the term “verification”, we denote criteria targeting the internal, syntactic and semantic constitution of a model. In contrast to that, validation means the eligibility of a model in respect to its intended use (Desel 2002, p. 24) – in other words: if the criteria is something outside the model (Chapurlat & Braesch 2008; Mendling 2009, p. 2).

The proposed approach of ontology-based semantic verification allows performing additional checks on process models complementary to checking that the model is syntactically correct and that its execution does not suffer from anomalies such as deadlocks or livelocks. Such checks are possible by leveraging the terminological knowledge of the domain under consideration formalized in an ontology. The merit of applying these checks is to increase the semantic validity of a process model. Semantic validity is composed of validity and completeness where “validity [...] means that all statements in the model are correct and relevant to the problem, while completeness means that the model contains all statements that would be correct” (Krogstie, Sindre & Jørgensen 2006, p. 93). With our approach, we target mainly on the validity aspect of semantic quality as we check that the model does not contain statements which are incorrect. Also, the completeness can be checked since our approach uses queries over an ontology-based model representation which support negation and consequently the detection of missing or absent information.

An important benefit thereby is that the ontology-based semantic verification constraints can be formalized on a more abstract and generic level and the inference engine interprets them with the help of both explicitly encoded and inferred knowledge from the ontology. A simple example of this would be a guideline that after order acceptance or order rejection, the customer has to be notified. A process model where a gold customer is notified by phone conforms to this guideline which can be automatically detected since a gold customer is a customer and a phone call is a sort of notification. Therefore, it is possible to formulate semantic verification constraints in a more natural and understandable way that accommodates to the nature of generic constraints such as guidelines, best practices, recommendations or laws.

The chapter is organized as follows. In the related work section, we provide an overview of approaches and tools in the state-of-the-art of model verification. In the next section “Ontology-driven Approach for Semantic Verification” we introduce our approach of semantic verification. In the section “Case Study”, we demonstrate the application of our approach to real-world problems. In the section “Tool Support”, we give a brief overview on the tools we developed to implement our approach. In the section “Conclusion and Future Research”, we describe the limitations of semantic verification and an outlook on future work.