Chapter 2.19
Semantic Annotation of Process Models for Facilitating Process Knowledge Management

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ABSTRACT

Enterprise/business process models that represent knowledge of business processes are generally designed for particular applications in a range of different enterprises. It is a considerable challenge to manage the knowledge of processes that are distributed throughout many different information systems, due to the heterogeneity of the process models used. In this paper, the authors present a framework for semantic annotation that tackles the problem of the heterogeneity of distributed process models to facilitate management of process knowledge. The feasibility of the approach is demonstrated by means of exemplar studies, and a comprehensive empirical evaluation is used to validate the authors' approach.

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INTRODUCTION

Increasing numbers of enterprises are choosing to integrate their business processes with each other in order to facilitate collaboration between them, e.g., through workflow integration and Web Services orchestration. The use of models of integrated business processes can provide a common platform for process integration and Web Services orchestration. The process models of enterprises that are currently in use (legacy models) can be treated as reusable assets, from which knowledge of the processes used by those enterprises can be extracted, thereby facilitating the building of integrated process models. Knowledge of these processes provides a guide for finding common ground between the processes used by the different organizations, and thus provides a

framework for optimizing the integration of the existing processes. However, there is significant heterogeneity in the process models that are used in individual enterprises: often, diverse business jargon and different modeling languages are used. This heterogeneity can lead to problems with respect to the extraction of process knowledge and its use in building an integrated process model. The reconciliation of semantic heterogeneity has been identified as a very laborious task in integration projects (Doan, Noy, & Halevy, 2004). In this paper, we focus on the semantic interoperability of business process models.

Ontology-based semantic annotation is generally considered to be an appropriate technique for achieving semantic interoperability, and is achieved by introducing common means of understanding and standardization. Most semantic annotation work has been developed on and applied to unstructured (e.g., MnM (Vargas-Vera, Motta, Domingue, Lanzoni, Stutt, & Ciravegna, 2002), KIM (Popov, Kiryakov, Kirilov, Manov, Ognyanoff, & Goranov, 2004), AeroDAML (Kogut & Holmes, 2001) and OntoMat-Annotizer (Handschuh, Staab, & Maedche, 2001) for textual resources) and structured (e.g., METEROR-S (Patil, Oundhakar, Sheth, & Verma, 2004), WSMO (Bruijn, Bussler, Domingue, Fensel et al., 2005), OWL-S (Martin, Burstein, Hobbs, Lassila, McDermott, Mcllraith et al., 2004), SAWSDL (Kopecky, Vitvar, Bourne, & Farrell, 2007) and WSDL-S (Akkiraju, Farrell, Miller, Nagarajan et al., 2005) for Web services) artifacts to improve interoperability at different levels. A few semantic approaches (including our own) that use semi-structured artifacts (usually enterprise models) have been developed in recent years, such as those reported in INTEROP (Interoperability Research for Networked Enterprises Applications and Software; Panetto, Scannapieco, & Zelm, 2004) and ATHENA (Advanced Technologies for Interoperability of Heterogeneous Enterprise Networks and their Applications; Ruggaber, 2006). For the semantic annotation of unstructured and structured artifacts, semantic reconciliation focuses on one level only, that of the data in the text or in the schema. For semi-structured artifacts, semantic heterogeneities are taken into account on more than one level. These are usually either the meta-model (i.e., modeling language) or model levels (i.e., model content), or even the intention level (i.e., goal modeling).

The objects of our research, namely business process models, are examples of semi-structured artifacts. Early accounts of ontology-based semantic annotation frameworks of business process models have been presented elsewhere (Lin, Strasunskas, Hakkarainen, Krogstie, & Sølvberg, 2006; Lin & Sølvberg, 2007). Within this framework, semantic heterogeneity at the meta-model level is reconciled by means of mapping the process modeling constructs to the proposed process ontology, which consists of the most essential concepts of the process modeling languages. For the model level, annotations are made by building semantic relationships between model contents and domain ontologies. The domain ontology is a reference model that standardizes the representation of the conceptualization of a certain domain. The reference model is usually selected from the industrial standards within a particular domain that are agreed by the enterprises concerned. For the intentional level, goal annotations are included within our framework to identify the intended use of process models. In goal annotation, goals are represented as an ontology and linked to fragments of the process model. In this study, OWL (Web Ontology Language; McGuinness & Harmelen, 2004) DL (Description Logic) was chosen for the ontology building language because of its combined semantic expressiveness and power for enabling inferences to be made.

Compared with the contemporary projects INTEROP and ATHENA, we focus mainly on the business process models defined as the CIM (Computation Independent Model), rather than the PIM (Platform Independent Model) and PSM (Platform Specific Model)[1] of enterprise models.