Mapping Fundamental Business Process Modelling Language to OWL-S

Gayathri Nadarajan[1] and Yun-Heh Chen-Burger[2]

[1] CISA, School of Informatics, University of Edinburgh, UK
[2] Artificial Intelligence Applications Institute, University of Edinburgh, UK

Abstract. This paper presents a conceptual mapping framework between a formal and visual process modelling language, Fundamental Business Process Modelling Language (FBPML), and the Web Services Ontology (OWL-S), aiming to bridge the gap between Enterprise Modelling methods and Semantic Web services. The framework is divided into a data model and a process model component. An implementation and an evaluation of the process model mapping are demonstrated.

1 Introduction

The need for more sophisticated Web based support tools has become apparent with the fast advancement of the Web and the Semantic Web vision. Business-to-Business (B2B) Electronic Commerce is fast becoming the most important application area of Semantic Web technology in terms of market volume [1]. Enterprise Modelling (EM) methods, on the other hand, are mature methods used as analysis tools for describing and redesigning businesses. They have been recognised for their value in providing a more organised way to describe complex, informal domain. For virtual organisations with business goals, the automation of business processes as Web services is increasingly important. Thus, traditional EM methods, such as Business Process Modelling (BPM) methods could be exploited by emerging technologies such as Semantic Web services to provide a more mature framework incorporating both business- and Web application-specific technologies. In a wider context this aims to bring business- and technical-oriented communities closer in order to achieve common organisational goals.

FBPML [2] is an inherited, specialised and combined version of several standard modelling languages that seeks to provide distributed knowledge- and semantic-based manipulation and collaboration. It provides graphical notation for describing business processes and has two sections to provide theories and formal representations for describing data and processes. OWL-S [3] is a Web service ontology that aims to describe Web services in machine-processable forms to facilitate the automation of Web service tasks, including automated Web service discovery, execution, composition and interoperation. Both languages have separate models to describe data and processes and are therefore structurally similar. Furthermore, OWL-S is also fast becoming the de facto standard for describing Web services, thus it is the most appropriate Semantic Web based language for FBPML to be mapped with.

2 The Conceptual Mapping Framework

A conceptual mapping framework was devised to map the two languages, motivated by the fact that both languages have a clear separation between their data and process schemas. FBPML's data model is described in the FBPML Data Language (FBPML DL) while OWL-S is described in the Web Ontology Language, OWL [4]. FBPML's process model is described by the FBPML Process Language (FBPML PL), while OWL-S contains its own classes to describe its process model. Thus the mapping framework was divided into a data model component and a process model component. Figure 1 illustrates this distinction and the general approach undertaken for this work.

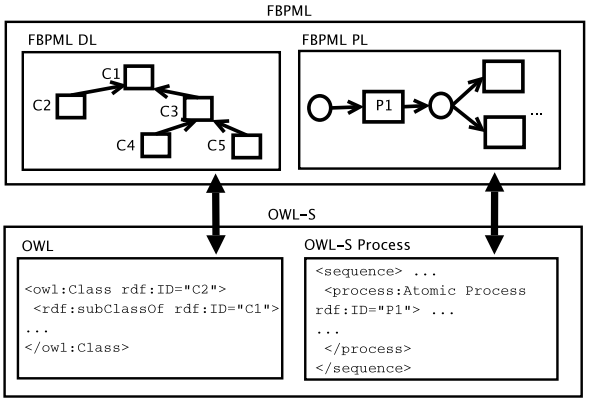

Fig. 1. The FBPML to OWL-S Conceptual Mapping Framework

The mapping of data models between FBPML and OWL-S involves the translation of representations of concepts (or classes), instances (of the concepts) and the relationships between the concepts and instances from FBPML DL to OWL. It also entails the translation of representations of properties and restrictions between the two data model languages. The process model mapping entails the mapping between FBPML PL and OWL-S. The primitives in FBPML were mapped to the primitives in OWL and OWL-S, resulting in Table 1.

3 Mapping, Implementation and Evaluation

Following the primitive mapping exercise, an exhaustive decomposition methodology was devised as an attempt to translate a FBPML process model into its OWL-S equivalent using worked examples on the data and process models. The worked examples are not shown here due to space limitation. Based on this methodology, a process model translator was developed using SICStus Prolog

3.10.1 on (Red Hat) Linux 9, that parses first-order logic (Horn) clauses into hierarchical OWL and RDF tree-like tags [5]. A data model translator was not developed due to time limitation. The main aim of the process model translator was to cater for any process model described in FBPML PL to be converted into OWL syntax. As pointed out in Table 1, the process model mapping does not encompass all the possible primitives and process constructs, and is thus limited. Hence the system was implemented to perform the translation as closely, accurately and directly as possible, taking into account some viable assumptions and interpretations. The mapping exercise using worked examples demonstrated

Table 1. Summary of mapping between FBPML and OWL-S primitives

Model Type	Primitive	FBPML	OWL/OWL-S
Data	Classes	Concrete Class	Class
		Abstract Class	Class
	Instances	Instance of Class	Instance of Class
Data	Relations	Class Relationship	Class Property
		Instance Relationship	Object Property
		Instance Attribute	Datatype Property
Process	Main Nodes	Activity	Composite Process
		Primitive Activity	Atomic Process
		Role	Participant
		Time Point	See *Note*
Process	Links	Precedence Link	(part of) Sequence
		Synchronisation Bar	See *Note*
Process	Junctions	Start	See *Note*
		Finish	See *Note*
		And-Joint	Split-Join
		Or-Joint	See *Note*
		And-Split	Split
		Or-Split	Repeat-While, Repeat-Until
		Xor-Junction	Choice
Process	Annotations	Idea Note	See *Note*
		Navigation Note	See *Note*
Process	Process Components	Precondition	Precondition
		Trigger	See *Note*
		Postcondition	Effect
		Precondition, Trigger and Postcondition	Input/Output
		Action	Atomic Process
		Conditional Action	If-Then-Else

Note: Limited (or no) equivalent convention provided by OWL-S.

that most of the data model components could be mapped directly, while not

all the process model components, in particular the junctions, could be fully mapped. The implementation of the process model translator, although limited, decomposes the sequences and combination junctions in a methodical manner. A constituent of a FBPML process model that could not be translated is recorded in the comment construct. The problem will arise if loops, which may cause partly overlapped processes, are added to the process model. When this happens, the process model may not be decomposed, thus causing mapping problems. Thus, we can conclude that the formal mapping between FBPML and OWL-S is very challenging and will require more insight and exploration before a reasonable mapping framework could be formulated. The essence of the analysis is that a much thorough understanding for both languages has been gained and this can work as the groundwork towards future directions.

4 Conclusion and Extensions

We have demonstrated a conceptual mapping framework between two formal languages, FBPML and OWL-S. The former is traditionally used in the context of business process modelling and the latter in the domain of Semantic Web services. We have also attempted to automate the translation of the process modelling aspect between the two languages. The conceptual mapping exercise and implementation have brought to light some vital differences between the constructions of the two languages which suggest that the mapping between them is partial. Furthermore, the specifications of some aspects of OWL-S are still in progress and, hence, the mapping is not complete. A complete formalism for rules and conditions within OWL would allow for some of the gaps between FBPML and OWL-S to be filled. The framework could also be further strengthened by incorporating ontologies to represent the data and process models together with sound mapping principles. As the future of OWL-S remains unclear, current effort towards converging OWL-S with Web Services Modelling Ontology (WSMO) could be a positive step towards the development of a stronger and more stable global standard for Semantic Web services.

References

1. Antoniou, G. and van Harmelen, F.: A Semantic Web Primer. MIT Press, Cambridge, MA, USA. (2004)
2. Chen-Burger, Y.-H., Tate, A., and Robertson, D.: Enterprise Modelling: A Declarative Approach for FBPML. In Proceedings European Conference of Artificial Intelligence, Knowledge Management and Organisational Memories Workshop. (2002)
3. Martin, D. et al.: OWL-S Semantic Markup for Web Services, Release 1.1.. World Wide Web Consortium (W3C), http://www.daml.org/services/owl-s/1.1/ (2003)
4. McGuinness, D. and van Harmelen, F.: OWL Web Ontology Language. World Wide Web Consortium (W3C), http://www.w3.org/TR/owl-features/ (2004)
5. Nadarajan, G.: Mapping Fundamental Business Process Modelling Language to a Semantic Web Based Language. MSc. Dissertation, School of Informatics, University of Edinburgh, UK. (2005) (unpublished)