Fact-Based Web Service Ontologies

Peter Bollen

Department of Organization & Strategy
School of Business and Economics
Maastricht University

1 Introduction

The service-oriented architecture paradigm has gained attention in the past years, because it promised to lay the foundation for agility, in the sense that it would enable companies to deliver new and more flexible business processes to improve customer satisfaction [1, 2, 3]. In the *service-oriented architecture* (SOA) paradigm, a *service requesting organization* (SRO) basically outsources one or more organizational activities or even complete business processes to one or more *service delivering organizations* (SDOs). The way this is done in a traditional way, is that the SRO 'outsources' a given business service to a 'third-party' SDO for a relative long period of time (3 months, a year). In an agile environment, the reconfigurable resources might face a life-span of a few days or even a few hours, in principle reconfiguration of business services can take place on a run-time time-scale, in the sense that for each new transaction a possibly different SDO must be configured into the value chain. The application of the service-oriented paradigm, therefore, allows the dynamic composition of business functionality by using the world-wide web [3, 4].

The problem with current approaches is that they cannot handle the semantic and ontological complexities caused by flexible participants having flexible cooperation processes.

In most business organizations the function that is responsible for information and knowledge management will have some kind of repository, schema or knowledge map that (ideally) defines the information objects (business repository or business ontology) and the semantic relationships between these business concepts (conceptual schema or a data description language (DDL) of some sort). At best (large) companies have a business glossary in which business concepts are defined precisely. When it comes to processes we must conclude that at best descriptions of procedural knowledge might be documented in some type of data flow diagram (DFD) or other process description logic (e.g. BPMN [5]). In most practical situations, however, the process logic is embedded in software code, and an explicit semantic description is lacking.

We will extend the current modeling capabilities of the fact-based approach with modeling constructs for the modeling of business services in the context of the service-oriented paradigm by extending the concepts definitions and derivation/ exchange rule modeling constructs [6] to cater for 'business services' that can be provided by either the SRO itself or by one or more (external) SDO(s).

P. Herrero et al. (Eds.): OTM 2012 Workshops, LNCS 7567, pp. 290–293, 2012.

2 Business Ontology I: Concept Definitions

We will now take this set of 'explicit' verbalizations and abstract them into a set of concept definitions and fact type readings in a fact type diagram. This list of structured concept definitions (see table 1), should facilitate the comprehension of knowledge domain sentences and comprise the business domain ontology [7].

Table 1. List of concept definitions for SDO

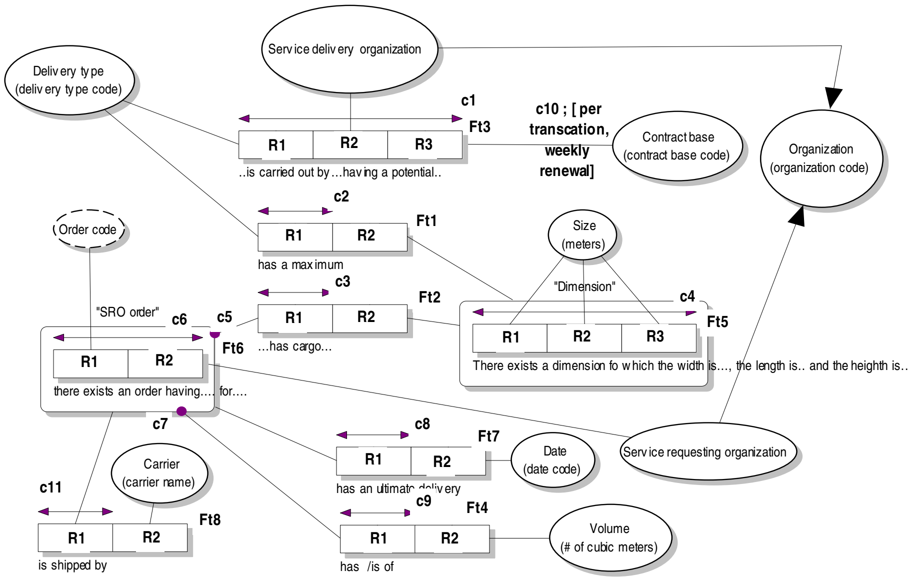
Concept	Definition
Carrier	A third party logistics organization that ships packages for an [order] from a [SRO] to a client of the [SRO]
Carrier name	A name from the *carrier name* name class that can be used to identify a [carrier] among the set of [carriers]s that exist in the world.
Local delivery type	A label to refer to a specific type of service provided by a specific [carrier]
Carrier delivery type	A [local delivery type] that is offered by a [carrier]
Period length in days	A period or slice in time having a duration
Natural number	A name from the *natural number* name class that can be used to identify a [period length in days] among the set of [period length in days].
Money amount	A specific quantity of money
Dollars	A name from the *dollar* name class that can be used to identify a [money amount] among the set of [money amount]s.
Promotional price	A price that is charged per kg for a delivery service during a number of [week]s in a promotional period
Standard price	A price that is charged in a [week] for which no [promotional price] is charged
Maximum dimension	The maximum [size] for length * the maximum [size] for width * the maximum [size] for height of an [order] for which a given [delivery type] is still valid

3 Business Ontology II: Fact Types and Fact Type Readings

The domain sentences from the former sections can be abstracted and will lead to fact types and associated fact type readings. In figure 1 an example is given of the fact types and fact readings that have been abstracted from these example domain sentences for the example communication UoD for the SRO.

4 Business Rules I

The fact type diagram can be used as a starting point for a further explicitation and encoding of business rules in terms of constraints on the allowed populations of the fact type diagram as for example is given in figure 1.



Define Order has Volume (cubic meters)
As Order has cargo Dimension **and** There exist a dimension for which the width is $Size_1$ and the length is $Size_2$ and the heighth is $Size_3$ **and** Volume= $Size_1 * Size_2 * Size_3$

Fig. 1. Complete conceptual schema for SRO (in combination with table 1) using ORM (I) notational conventions

5 Business Rules II: Exchange- and Event Rules

Adding the semantic definition of a (business) process to the list of concept definitions, is a pragmatic extension of the current definition of the list of definitions, which normally contains definitions for concepts in the ontology. From a theoretically point of view, however, if we consider a process base [8] as part of our UoD, then a semantic definition of a process type, should per definition be contained in the list of concept definitions.

Process: Calculate Volume	A process that has a a result: a rough indicator of the cubic [volume] of a package which is determined by multiplying its width, heighth and lenghth. **<Create(s) instance(s) of Ft4>**
Process: Add order	A transaction in which the [order] and the [dimension] and [delivery date] of the [order] are added to the information system.**<Create(s) instance(s) of Ft2 and Ft7>**
Process: Determine carrier for order	This process leads to the selection of a specific [SDO] for the shipment of an [order] under the best possible conditions for [delivery time] and [shipment price]**<Create(s) instance(s) of Ft8>**

6 Conclusions

In this article we have given additional modeling concepts in fact-based modeling (FBM) to cater for the explicit modeling of a application domain's ontology. The new modeling constructs allow us to capture the definitions of the fact-generating business processes. The practical relevance of the list of concept definitions is in the 'networked' society and business-world in which a traditional conceptual schema has to be 'upgraded' to cater for communication of the definition of business processes with potential external agents, e.g. customers, suppliers, web-service brokers, whose identity is not yet known to us at design time.

In line with semantic web developments, the conceptual schema needs a communication part that contains 'definition' instances to be shared with the potential agents in order for them to be able to communicate effectively and efficiently with a ('web-based') business application in which the 'traditional' allowed communication patterns and their state (transition) constraints will not be violated. This will significantly increase the perceived quality and ease-of-use of such a (web-based) application, since it has established a semantic bridge with the potential external users, allowing them to communicate in a direct way with the business application, by preventing semantic ambiguities from occurring in the first place.

References

1. Yusef, Y., Sarhadi, M., Gunasekaran, A.: Agile manufacturing: The drivers, concepts and attributes. International Journal of Production Economics 62(1-2), 33–43 (1999)
2. Demirkan, S., et al.: Service-oriented technology and management: Perspectives on research and practice for the coming decade. Electronic Commerce Research and Applications 7, 356–376 (2008)
3. Choy, L., et al.: Leveraging the supply chain flexibility of third party logistics – Hybrid knowledge-based system approach. Expert Systems with Applications 35, 1998–2016 (2008)
4. Grefen, P., et al.: Dynamic business network process management in instant virtual enterprises. Computers in Industry 60, 86–103 (2009)
5. OMG, Business process modelling notation (BPMN) specification, OMG (2007)
6. Bollen, P.: Fact-based modeling in the data-, process- and event perspectives. In: OTM 2007, ORM 2007. Springer, Vilamoura (2007)
7. Bollen, P.: Extending the ORM conceptual schema design procedure with the capturing of the domain ontology. In: EMMSAD 2007. Tapir Academic Press, Trondheim (2007)
8. Nijssen, G.: An axiom and architecture for information systems. In: Information Systems Concepts: An In-Depth Analysis (1989)