Business Rules in the Semantic Web, are there any or are they different?

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Abstract. The semantic web community and the business rules community have common roots. However the communities do not share resources, conferences, research, and seem to be not very aware of each other. There are some signs that this is going to change. This article explores the differences and similarities between the two fields.

1 Introduction

Research analysts are reporting more and more on the semantic web community (including the ontology research field and reasoning on the web) this last year. Their interest in this topic is triggered by the standardization efforts of the semantic web community at the W3C and the OMG. My visits of several workgroups and conferences in the semantic web community, given my background as a practitioner in the business rules community, has let me to make the following observation: "*the business rules community and semantic web community talk about the same things, but by people with a different background; the business rules community is driven by the practical experiences of business people and business consultants while the semantic web community is a vision of scientists driven by (mostly) scientific publications*".

If this observation is correct, it is important that there is more understanding of each other's work so that we can end up with a 'semantic business' that supports a practical approach to business problems and is supported by a long-term vision.

If this observation is not correct, and the business rules community and the semantic web community do talk about different things, then we need to get a better understanding of the border between the two communities so that we can develop standard transformations or processes to cross these borders.

The aim of this article is to get a better understanding of the differences and similarities that exist between the semantic web and business rules community. Since these communities consists of individuals with private opinions, the choice for particular quotes and definitions influences the resulting conclusion in this article. Hopefully these form a basis for further, fruitful, discussions.

1.1 Organization

This article is organized as follows:
- Paragraph 2 gives a short overview of the semantic web, describing these topics that are needed for a comparison to business rules.
- Paragraph 3 gives a short overview of business rules, describing these topics that are needed for a comparison to semantic web.
- Paragraph 4 makes a comparison between similarities and differences of the ideas in the semantic web and business rules communities
- Paragraph 5 makes some final conclusions.

2 Semantic Web

A business oriented description of the Semantic Web is: " … an extension of the current Web in which information is given well-defined meaning, better enabling computers and people to work in cooperation" [3]. A more technical description of the Semantic Web emphasizes the need to have interoperability between software programs on a semantic level, and not just at a precompiled-syntax level. When we look at the literature on and uses of the Semantic Web the support of the interaction between machines/software is very dominant as a goal. On a second place we find interactions between machines/software and humans.
The focus of the semantic web community on machine-machine interaction makes it a candidate to solve long existing integration problems in enterprise architecture. The semantic web should help in making more 'sense' out of software application data to improve interoperability between applications in an enterprise. Software analysts are already picking up this new trend by writing business oriented executive reports on this topic. See for example[1], [2]

The Semantic Web defines the semantics of data in an ontology. The word ontology has very distinct meanings. In the context of the semantic web an ontology structures data in a predefined way so that the semantics of the data can be derived from the relations between the data. An ontology description for a particular domain is referred to as an ontology model. An ontology model consists of concepts (also called classes) and relations between classes.

Typical relations in an ontology language are "sub class of", "class has property", "class is equivalent with". The semantics of the relations are defined in the ontology language specification and the expression power of the language is determined by the expression power of the pre-defined relations and, eventually, the other knowledge representation forms allowed by the language.

Software applications that share an ontology model can exchange information, even if they are not aware of each other's existence at compile time. These software applications are also called 'intelligent agents'. To model the behavior of intelligent agents they may have rules that are defined using the ontology model or in the ontology model (when the ontology language includes a rule language). Since a rule is always expressed in domain terms, any rule language needs to have a model of the domain and this model can be an ontology model.

The question whether the Semantic Web should be augmented to support behavior specification (with rules) is subject to debate (see debate "where are the rules" [4]). Question is if we should augment ontology languages with rules and what type of rules we would need. Current developments seem to point in the direction of augmenting ontology languages with rules. The first steps in this direction seem to restrict the expression power of the rule languages to particular rule types [5].

3 Business Rules

Business rules describe strategies that restrict or guide the behavior of enterprises [6]. Business rules are described in a language that is natural to business people that are also responsible for the formulation and enforcement of the business rules.

Enforcement of business rules by software programs is a natural phenomenon in enterprises but is not the main goal of formulating and managing business rules. Business rules may be used directly in software programs if the business vocabulary can be mapped to an enterprise data model and a machine using the vocabulary can interpret the business rule expressions.

Rules should be unambiguous. There are several sources that give practitioners guidelines to write non-ambiguous business rules [7, 8]. They all share that all terms used in rules should be defined in a business vocabulary. The business vocabulary defines all the concepts and lists signifiers for those concepts (terms) relevant to describe the business rules of a domain (read: particular business area of interest) in a particular language. Besides the definitions of concepts a business vocabulary defines all the relations between concepts (needed for expression of all business rules). A structural definition defines a concept in terms of it's relations to other concepts (similar to the way concepts are defined in an ontology model)

One or more concepts that are related are called 'fact types' and they form the basis for business rule expressions. Different type of relations may be predefined so that relations have consistent semantics in different vocabularies. Examples of those predefined relations are "is assorted to", "is a generalization of", "is a category of". There is an obvious overlap when we compare these relations with the relations we typical find in an ontology-model.

The examples in table 1 show that the synonyms 'car' and 'automobile' are not defined with a relation between the concepts 'car' and 'automobile', but that they are in fact different signifiers for the same concept in a particular language. The definition of the concept is considered part of the vocabulary, while such descriptions are not a required element of an ontology model. The simple relations between concepts (Fact Type 1 and 5) are defined in a similar way as in an ontology-model. Expression of the derived fact types (Fact type 2 and 3) and the rule may be very different in an ontology model, depending on the ontology language in use.

Current standardization efforts at the OMG are standardizing the semantics for business rules [9]

Table 1. Example of what you can find in a business vocabulary including business rules.

Concept	Concept with definition 'a motorized vehicle' has signifier 'car' and 'automobile' for the English lanuage
Fact type 1	A car has wheels
Fact type 2	A normal car is a category of an automobile where the car has exactly four wheels
Fact type 3	A car drives with a speed
Fact	A mercedes is a 'normal car'
Rule	It is forbidden to drive with a speed greater than 100 km. per hour with a three-wheeled-car

4 Comparison Business Rules and Semantic Web

Common Roots

The semantic web and the business rules communities have their roots in Artificial Intelligence. However, the players in both communities like to decouple themselves from this ancestor. This seems to be due to the failure of AI technologies to deliver when the pioneers set high expectations. The idea to formalize and reason with domain knowledge using logic and logical inference is known in the field of AI as the study of knowledge representation. The offspring of this research are expert systems. Product vendors in this area are now positioning themselves as business rule management systems. Product vendors in the area of the semantic web position themselves more in the field of knowledge management where the challenge is to present the right information on the right time and in the right place.

Different Target Audience

Improvement of communication between humans is a goal of the business rules approach while improvement of the communication between machines is the goal of the semantic web. Both emphasize that improvement of the communication between humans and machines can be a happy side effect.

Given this difference in target audience the two approaches are also positioned differently in the Model Driven Architecture (MDA) of the Object Management Group [10]. An ontology-model is used in a run-time environment and should therefore be positioned at the PSM-level, while a vocabulary is used at the CIM level to improve human communication about a domain.

A survey under ontology tool builders [11, 12] shows a different trend. There focus is to decrease the complexity of building full-blown and full proof ontology's, especially for domain experts (business people without a training in formal logics or computer programming) rather than professionals trained in formal logic and ontology design.

Same Goal

Both the business rules and semantic web techniques are supposed to capture semantics about real world domains (independent of a particular application or task). This distinguishes them (ontology models and vocabularies) from conceptual modeling approaches (like UML and ORM) that are both intended to describe the domain knowledge for one specific application.

The idea to be more independent of a particular application or task should encourage the reuse of business vocabularies and ontology models. There is an interesting friction here that is recognized in the business rules community [13] and the semantic web community [14] in that rules are affected by the nature of the problem (or business strategy) that they support and the inference strategy to be applied to the problem. Therefore the resulting rules that are captured in the context of a particular task will be less reusable and more specific to a particular (class of similar) task(s).

Similar Form

A business vocabulary and ontology both consist of interrelated concepts and rules (e.g. identity, cardinality, taxonomy etc.) that constrain and specify the intended meaning of concepts.

In an ontology-model only the structural relations between concepts define the semantics. In a business vocabulary the semantics can also be described by giving a definition for a concept. This definition may be informal and every concept needs to have a definition. In an ontology-model, concepts do not have a definition. You can just stop somewhere at the border of your domain with connecting a concept with other concepts.

The business rules approach focuses more on natural language / human readable descriptions, for example the expression of definitions and business rules is not restricted to a specific formal specification language. In the Semantic Web every element that is part of the ontology model should be compliant with a formal language because otherwise it cannot be used in a run-time environment.

Different Expression Power

The formal specification languages used by the semantic web and the business rules communities differ in expression power and assumption. The expression power that is requested in the business rules community is high, including the notion of higher order logic, deontic logic and predicate logic. The initiatives of rules in the Semantic Web are mostly based on horn clause logic or other descriptive logics and the expressiveness of these languages is questioned (see also the discussion in [4]). Another difference is that the business rules languages work under a 'closed world assumption' while the semantic web languages uses an 'open-world assumption'.

5 Conclusion

The similarities between the two approaches should encourage researchers and practitioners to work more closely together to explore fundamental issues at the level of

capturing the semantics of real world domains. This collaboration is already started, for example with a W3C workshop on business rules (see http://www.w3.org/2004/12/rules-ws/cfp). Tool builders that want to serve both communities to broaden their market drive these collaborations. Given the differences between the expression power and target audience of business rules and semantic web rules, they will need clearly defined transformations between business rules standards and semantic web standards. I see the most important challenge and research topic as the mapping from business rules that should be automated, written in a non technical language under a 'closed world assumption', to technical executable rules that can be used by IT systems with semantic web technology and an 'open world assumption'.

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