

Semantic Formulations in SBVR

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An Object Management Group proposal called *Semantics of Business Vocabulary and Business Rules (SBVR)* offers a vocabulary for describing meaning. A part of SBVR called Logical Formulation of Semantics focuses on the structure of meaning.

Business rules are generally expressed in natural language, although some rules are at times illustrated graphically. SBVR is not a logic language for restating business rules in some other language that business people don't use. Rather, SBVR provides a means for describing the structure of the meaning of rules expressed in the natural language that business people use. SBVR calls this "semantic formulation". Semantic formulations are not expressions or statements. They are structures that make up meaning. SBVR provides a vocabulary for describing them. Using SBVR, the meaning of a definition or statement is communicated as facts about the semantic formulation of the meaning, not as a restatement of the meaning in a formal language.

Semantic formulations are described below with examples. Readers are referred to the SBVR document (currently available to OMG members) for the full Logical Formulation of Semantics Vocabulary. Several points about semantic formulations are covered below:

- Communication of semantics of vocabularies and rules using XML
- Involving concepts from other kinds of models such as OWL
- Basis in first order logic
- Extension to intentional logics

SBVR draws from ORM/NIAM and from ISO terminology work (particularly ISO 1087-1). SBVR takes a fact-orientation from ORM/NIAM and incorporates the concept of fact type.

SBVR does not attempt to address the needs of inference engines. It focuses on meaning independently of any possibilities for automating business rules completely or partially. However, semantics of business rules can be used as input to construct production rules for rule engines. Efforts at automating such transformations are already underway.

Example

Here is an example of a very simple business rule taken from rules for a car rental company. The rule is stated in different ways but is one rule having one meaning. Many other statements are possible.

A barred driver must not be a driver of a rental.

It is prohibited that a barred driver be a driver of a rental.

It is obligatory that no barred driver is a driver of a rental.

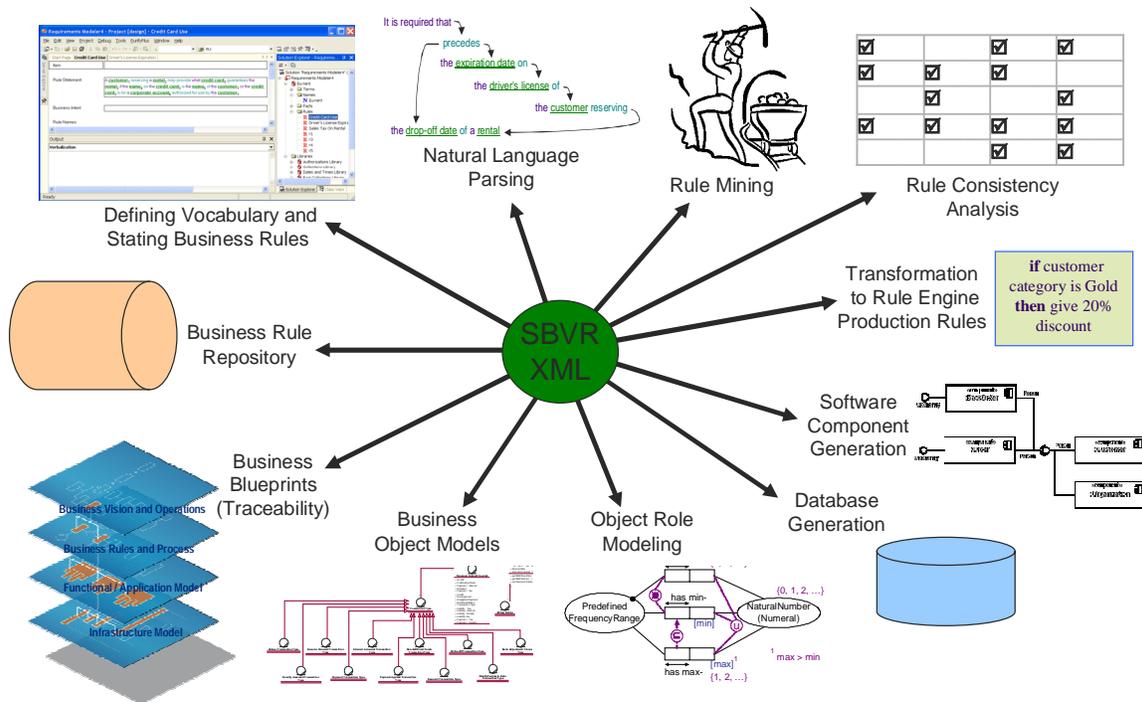
Below is a description of the semantic formulation of the rule above expressed in terms of the SBVR Logical Formulations of Semantics Vocabulary. It is easily seen that SBVR is not meant to provide a concise formal language, but rather, to provide for detailed communication about meaning. The description is verbose, when separated into simple sentences. But it captures the full structure of the rule as a collection of facts about it.

The rule is meant by an obligation claim.
That obligation claim embeds a logical negation.
The negand of the logical negation is an existential quantification.
The existential quantification introduces a first variable.
The first variable ranges over the concept 'barred driver'.
The existential quantification scopes over a second existential quantification.
That second existential quantification introduces a second variable.
The second variable ranges over the concept 'rental'.
The second existential quantification scopes over an atomic formulation.
The atomic formulation is based on the fact type 'rental has driver'.
The atomic formulation has a role binding.
The role binding is of the fact type role 'rental' of the fact type.
The role binding binds to the second variable.
The atomic formulation has a second role binding.
The second role binding is of the fact type role 'driver' of the fact type.
The second role binding binds to the first variable.

Note that designations like 'rental' and 'driver' are used above to refer to concepts. The semantic formulations involve the concepts themselves, so identifying the concept 'driver' by another designation (such as from another language) does not change the formulation.

XML

SBVR provides an XML Schema that is generated from the SBVR vocabulary. Facts, such as those listed in the example above, are serialized into XML based on that schema. Each fact is serialized as an individual XML element. A variety of tools will use such XML documents for semantic interchange, as shown in the diagram below.



Semantic Formulations with Ontologies and Other Models

Concepts can be identified by their designations (e.g. ‘rental’, ‘driver’) or by the semantic formulation of their definitions. A designation is itself identified not merely by a signifier, but by a signifier and a namespace. A namespace is then identified by another designation or finally, by a URI.

The scheme for referring to concepts via designations in namespaces allows semantic formulations to involve concepts named in OWL ontologies or in other kinds of models that have namespaces, such as in UML models, especially in UML business object models. The same reference scheme works for referring to concepts in standardized glossaries, such as in ISO specifications. But most importantly, the scheme lends itself to referring to ordinary business vocabularies.

First order logic

Semantic formulations are founded on first order logic. Semantic formulations include quantifications and logical operations, as shown in the example above. Note that SBVR does not include quantifiers or logical operators, which are symbols, but has the concepts of quantification and conjunction. Variables are typed. Atomic formulations are based on fact types whose roles are bound by the atomic formulations to variables, constants or individual concepts.

Intensional logic

Business rules often use semantic structures that go beyond first order logic. These are briefly explained below.

Modal Logics

SBVR includes model formulations for the following modalities from Deontic and Alethic logics:

- Obligation
- Permission
- Logical necessity
- Logical possibility

Distinguishing between guidance (rules that people break) and structural rules (rules about meaning) is very important in understanding business rules. Consider the following two rules.

- It is obligatory that each person on a bus has a ticket.
- It is logically necessary that each person on a bus has a ticket.

Based on the first rule, a person on a bus either has a ticket or is breaking the rule. Based on the second rule, being on a bus implies that there is a ticket.

Discourse about Discourse

Semantic formulations make distinctions between expression, representation, meaning and extension. Note how “San Francisco has an airport” is interpreted differently in each example below.

1. Expression (literal text)
John did a Google search for “San Francisco has an airport.”
2. Representation (quoting a statement)
Ron said, “San Francisco has an airport.”
3. Meaning (nominalization of a proposition)
Ron said that San Francisco has an airport.
4. Extension (objectification of a proposition)
A cause of pollution in San Francisco is that San Francisco has an airport.

SBVR provides a kind of formulation for nominalization of propositions, which makes a proposition to be an object of discourse as in 3 above. SBVR also supports nominalization of questions and interrogatives (“what”, “whether”, etc.). A separate kind of formulation accomplishes objectification, which makes the actuality or state of affairs that corresponds with a proposition to be an object of discourse as in 4 above. Number 2 above involves a quoted statement, so its formulation identifies the statement as a combination of its text and its meaning (using nominalization).

Nominalized or objectified propositions can include free variables, as shown below.

In each facility located in a nonsmoking region, a rule that it is prohibited that an employee smoke in the facility must be displayed in each language commonly used at that facility.

Time and Change

SBVR does not attempt to define tenses or the variety of ways propositions can relate to each other with respect to time or can be related to times, periods and durations. But nominalization supports formulations of all of these. The specific relations of interest can be defined as fact types. Here is an example of a rule involving time.

A rental car assigned to a rental must be available before the scheduled pick-up time of the rental.

The example above uses a fact type 'proposition [is true] before time'. A careful analysis reveals there is a free variable in the nominalized proposition (the rental), so the nominalization produces a proposition for each referent of the variable (each rental).

Rules about change often involve concept formulations, which are special formulations that support intensional roles. Consider the following condition:

If a rental car's odometer reading increases by more than 1000 kilometers during a rental period then

The subject of "increases" in the condition above is not a distance, but an individual concept of a distance. The condition uses the fact type 'individual quantity concept increases by quantity during period', which does not involve a particular distance, but an individual concept denoting one particular distance at any single point in time. An example instance of that fact type would not have "25 kilometers" as its subject because 25 kilometers is always 25 kilometers and cannot increase. Rather, an example subject would be the individual concept defined by "the odometer reading of rental car 66". Concept formulations are needed for many common verbs such as "includes", "changes" and "becomes".

Conclusion

Semantic formulations are structures of meaning. SBVR provides a vocabulary for describing semantic formulations and a corresponding XML schema for communicating semantics. Semantic formulations can involve concepts from ontologies and other kinds of models. Examples demonstrate the challenges of modeling business meaning. Intensional logic extensions are added to first order logic in order to formulate the structure of real business rules.