COMPARATIVE ANALYSIS OF BUSINESS RULES AND BUSINESS PROCESS MODELING LANGUAGES

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Abstract. During developing an information system is important to create clear models and choose suitable modeling languages. The article analyzes the SRML, SBVR, PRR, SWRL, OCL rules specifying language and UML, DFD, CPN, EPC and IDEF3 BPMN business process modeling language. The article presents business rules and business process modeling languages theoretical comparison. The article according to selected modeling aspects of the comparison between different business process modeling languages and business rules representation languages sets. Also, it is selected the best fit of language set for three layer framework for business rule based software modeling.

Key words: business process, business rule, UML, SRML, BPMN, business process modeling, business rule representation.

Introduction

Business modelling, design and analysis process has been understood as information systems developers and business representatives, because for modelling different business areas are using graphical modelling language. Graphical modelling advantages is the standard mark, a single terminology, intuitive understanding. The Unified Modeling Language (UML) – is most-used specification and graphical notation for modeling. UML can be model many things at the business layer and information system layer. However, UML is not always flexible and do not allow to model the entire required subject at the level of business. Therefore addition development of information systems with the UML models used in other languages to create models. Although UML allows model a business process using Activity Diagram, but it is other standards for modeling business process. One of the following is the Business Process Modeling Notation (BPMN). BPMN is a graphical notation and a language for modeling business processes (Business Process Model…, 2011).

In the Article (Vasilecas and Smaizys, 2007) presented the framework for business rule based software modelling. The framework is based on three layers - business system, information system and software system. In each layer is created models for a layer. In the business system layer is created models for business system, business rules, business processes, data and object models. In the information system layer is created information system models, which is related to the corresponding business models of the business system layer. Later from information system layer models is developed software system

structures, it usually is the program code or DLL scheme, and so on. In each layer it is necessary to create appropriate models. For the creation models are needed an appropriate representation or modeling language, which represents the maximum possible modeling aspects. For different layers of framework are may require different modeling and representing languages. Such as business systems layer models must be well understood by businesses people, but at the same time sufficiently clear information systems developers. The article examines how language is best suited to represent the business rules and business process modeling. It is selected the best combination that fits the business rules and business process modeling languages to support three layer framework. The paper examines which languages for business rule and business process modeling is best suited for using together in the business system layer.

The rest of the paper is structured as follows. In the next section, it is analyzed related works and process modeling languages and business rules representation languages. The Section 2 introduces to analyses procedure and the section 3 to analysis results. In the last section we present conclusions.

1. Related works

Recently appeared a lot of language for business rules representation. In previous work, we used SRML (Simple Rule Markup Language), which is a generic rule language consisting of the subset of language common to construct the popular forward-Chaining Rule engines (SRML (Simple Rule..., 2001). However, it is important to compare the rules and other representation languages.

Semantics of Business Vocabulary and Business Rules (SBVR) established Object management Group (OMG). SBVR defines the vocabulary and rules for documenting the semantics of business vocabularies, business facts, and business rules (Semantics of Business..., 2008).

Other rules notation language is the Production Rule Representation (PRR) as well as the development and OMG. It provides a vendor-neutral rule-model representation in UML for production rules as used in Forward-Chaining Rule Engine. A production rules "is a statement of programming logic that specifies the execution of one or more actions in the case that its conditions are satisfied" (Production Rule Representation ..., 2009). .

Semantic Web Rule Language (SWRL) combining languages OWL Web Ontology Language (OWL DL and Lite) with the Rule Markup Language (RuleML) (SWRL: A Semantic..., 2004).

Object Constraint Language (OCL) is a declarative language for describing rules that apply to Unified Modeling Language (UML) models (UML 2.0 OCL Specification).

Business process modeling techniques is a problem for business process management. Many authors analyzing business process modeling languages and try to find best solution for all purpose. In paper Muehlen, Indulska (2010) are analyzed business rule and process modeling languages based on Bunge–Wand–Weber (BWW) representation theory. In (Vasko and Dustdar, 2006) are analyzed different approaches of emerging workflow modeling language. Authors analyzed BPEL, YAWL, BPMN from functional, behavioural, informational aspects. The purpose of article Recker et al. (2006) has established that the

process modeling languages has lack represent capability in BPMN and has found that organizations often add business rules in textual form to BPMN process models.

Recently there is a lot of modeling language for different purposes. Trying to combine different language into one (Milanović et al., 2008) for example trying to merge with BPMN with R2ML. However, does not create models with all existing modeling languages when developing the information system and it would be not appropriate. Therefore it is only need to select the appropriate language.

The Unified Modeling Language was originally conceived as a general-purpose language for representing software systems. UML models are widely using in information system development. UML is very flexible modeling language; it is an attempt to adapt a number of areas. In the paper de Cesare and Serrano (2006) has presented a framework for mapping business process simulation models to UML models. Authors for business process simulation models using use case and activity diagrams. UML activity diagrams are often used to model business processes.

A data flow diagram (DFD) is a graphical representation of the "flow" of data through an information system. DFD can be used for business process modeling as described in the paper Shen et al., (2004).

Colored Petri Nets (CPN) is a graphical oriented language for design, specification, simulation and verification of systems (Ratzer et al., 2003). It is in particular well-suited for systems that consist of a number of processes which communicate and synchronize. But they are not directly intended to for modeling a business process, but several projects already showed that timed CPN can model business processes (Jansen-Vullers and Reijers, 2005, Wynn et al., 2007, Makajic-Nikolic et al., 2004).

The Event-driven Process Chain (EPC) is a business process modeling language for representing temporal and logical dependencies of activities in a business process. EPCs are inspired from Petri nets. EPC have function type elements to capture activities of a process and event type elements describing pre- and post-conditions. Also has connectors including AND (symbol ^), OR (symbol _), and XOR (symbol £) for the definition of routing rules (Mendling and Aalst, 2008).

IDEF3 can be used to capture detailed characteristics of information systems that support business processes. IDEF3 was a technique for producing a dynamic model of the system. How to model business process with IDEF3 is showed in article Shen et al., (2004).

We review business process modeling languages and the languages for representation business rules. The following analysis of the languages that is most suitable for level three layer framework.

2. Analysis procedure

In the paper (zur Muehlen and Indulska, 2010) for representation capability authors are using Bunge-Wand-Weber representation theory. We expanded the table in the article zur Muehlen and Indulska (2010) of with additional aspects process of information, structure and resource modeling. We added one rules presentation languages OCL and business process modeling language UML. And we use three layer frameworks (SRML (Simple Rule..., 2001) modeling aspects.

Lot of analysis criteria and modeling aspects definitions are defined (Dussart et al., 2002). They are suitable for our purpose and of which we will use. Process is defined as the series of activities needed to achieve a specific goal. Process can be action (process) and sequence. Information (object) can be thing and kind. Structure can be property and class. An event is something that happens during the course of a business process. We distinguish the following events: conceivable event space (can be observed on the state machine of a thing by looking at all transitions triggers (Dussart et al., 2002), lawful event space, external event, internal event, well-defined event, poorly defined event, transformation, lawful transformation, coupling, acts on. We distinguish such states: state, conceivable state space, state law, lawful state space, stable state, unstable state, history. Conceivable State Space is defined as all the states that a thing may ever assume (Dussart et al., 2002). A resource is an agent that is required to perform the tasks associated with an activity. People, equipment, vehicles, money, and space can be modeled as resources. We distinguish this type of resource: system, system composition, system environment, system structure, system decomposition, level structure, sub-system.

Figure 1 shows method for models transformation through the framework layers. We have BPMN business process model in business system layer. The model can be transform to UML activity and UML Class diagram in the information system layer. Next these models can be transforming in the data definition language (DDL) structure, some program (function) code and the class diagram. Some of transformation can be done automatically and other manually. SRML rule set model in the business layer can be transform in decision table on the information system layer. Next from decision table can be transform to PRR rule. Some of transformation can be automated and other only manually or semi-automatically. Because SRML language is XML based, so we can for transformation use XSLT transformation schemas for transformation automation.
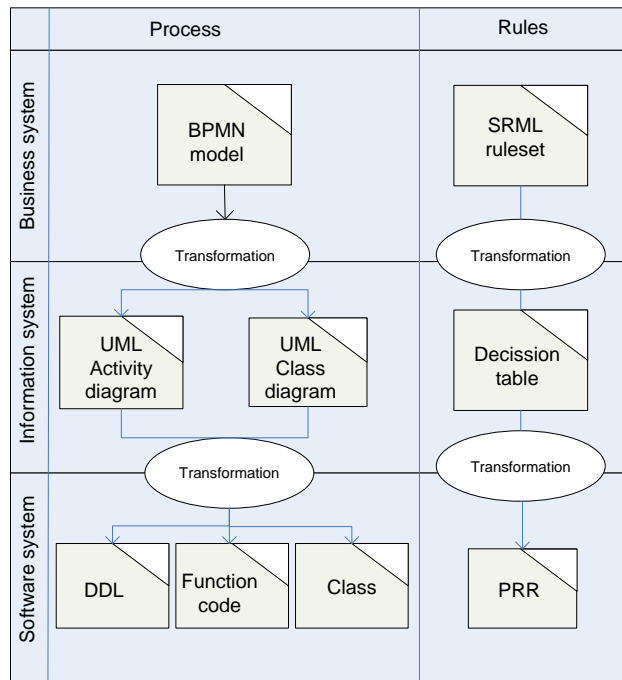

Figure 1. Method for models transformation through the framework layers.

Method show how models can be transformed form business layer to models in the other layers of framework. This method show that different layers use different modeling languages. We deal only with rules and process columns. We chose modeling aspects for this three flayers framework. The next section performs language analysis.

3. Analysis results

Results of language analysis it is show in Table 1. First, we examined languages representational capabilities for support three level frameworks. We found that there is no language to express all aspects.

Table 1. Analysis results.

Language	Rule specification (language)					Process specification (language)					
	SRML	SBVR	PRR	SWRL	OCL	UML	DFD	CPN	EPC	IDEF3	BPMN
Year/version	2001	2006	2007 v1.0	2006 v0.6	2008 v2.0	2005 v2.0	1968	1981	1992	1995	2004 v1.0
Process											
Action (process)	X			X	X	X	X	X		X	X
Sequence						X	X	X		X	X
Information (Object)											
Thing	X	X		X	X	X	X	X		X	X
Kind						X					X
Structure											
Property	X	X	X	X	X	X		X	X	X	X
Class		X	X	X	X	X		X			X
Events											
Event	X	X			X	X		X	X	X	X
Conceivable event space											
Lawful event space											
External event						X					X
Internal event						X					X
Well-defined event											X
Poorly defined event											X
Transformation	X			X						X	X
Lawful transformation	X		X	X							X
Coupling										X	X
Acts on	X			X	X			X			X
States											
State	X				X	X		X	X	X	
Conceivable state space	X				X						
State law	X	X	X	X				X	X		
Lawful state space	X		X					X			
Stable state								X			
Unstable state								X			
History											
Resources											
System	X	X	X		X	X				X	X
System Composition		X	X			X				X	X
System environment											X
System structure					X	X	X			X	
System decomposition		X								X	X
Level structure									X	X	X
Sub-system						X	X				X

SRML expresses maximum number of aspects 12, SBVR – 8, PPR – 7, SWRL – 8, OCL – 10. We use SRML language in previous works (Vasilecas and Smaizys, 2007) and SRML language has XML notation and we can use XSLT schemes for transformation rules between levels.

BPMN from business process modeling languages expresses the maximum number of aspects 21, the other languages UML – 14, DFD – 5, CPN – 11, EPC – 6, IDEF3 – 13. BPMN language best suited for modeling a business process in the business system level and BPMN is popular and adopted by a wide range of process modeling tool vendors and organizations. However, the UML can model the processes in the information system level. UML activity diagram is suitable for process modeling. An activity specifies the coordination of executions of subordinate behaviours, using a control and data flow model.

Business rules cannot be separated from business processes. Therefore, when designing information system needs to create business process models and write down the existing business rules. Therefore, we consider the possibility of language to convey aspects together.

Next we examined how many different modeling aspects and business rules representation language can express together with business process modeling language. Numbers of aspects are shown in Table 2.

Table 2. Different aspects.

	UML	DFD	CPN	EPC	IDEF3	BPMN
SRML	15	12	5	6	11	17
SBVR	9	11	8	8	9	14
PRR	13	12	8	7	14	18
SWRL	14	9	7	9	13	14
OCL	8	9	5	9	8	17

Most of the different elements together convey the BPMN and PRR. However, PRR is designed to represent more production rules, rather than business rules. Language pairs SRML-BPMN and OCL-BPMN have the same number of different aspects (Makajic-Nikolic et al., 2004). SRML language has an XML notation, which is most easily understood and the resulting XML documents are normally transformed into other structures.

Next we be examined which combination of representation business rules language and business process modeling languages has most united aspects. Results are shown in Table 3.

Table 3. Combined aspects.

∩	UML	DFD	CPN	EPC	IDEF3	BPMN
SRML	6	2	8	4	7	8
SBVR	4	1	5	3	6	7
PRR	4	0	3	2	3	5
SWRL	4	2	6	2	4	7
OCL	8	3	7	3	7	7

The study showed that most united aspects can convey SRML with BPMN.

It is important to mention that studied languages are used for modeling at the business system layer. Our study showed that SRML and BPMN languages combination is most flexible and it useful in the business system layer.

Conclusions

- The article presented the business process and business rules modeling language theoretical analysis. We found that the most flexible combination is a pair of BPMN and SRML languages. SRML and BPMN combination has most modeling aspects. SRML and BPMN language pair represent most overlapped aspects and different aspects.
- Modeling languages cannot provide all modeling aspects. It is missing some modeling aspects. BPMN present most modeling aspects of investigate business process modeling languages.
- SRML and BPMN combination is most useful for modeling in the business system level of the three layer framework.
- UML language is more universal than BPMN, but BPMN represent more aspects in business layer. With UML can be modeled in business system layer and in information system layer. But with UML notation need to use one of business rules representation languages.

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VERSLO TAISYKLIŲ IR VERSLO PROCESŲ MODELIAVIMO KALBŲ LYGINAMOJI ANALIZĖ

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Summary

Kuriant informacinę sistemą svarbu sukurti aiškius modelius ir pasirinkti tinkamas modeliavimo kalbas. Šiuo metu daugelyje literatūros šaltiniu nagrinėjamas verslo procesų modeliavimas. Siūloma daug įvairų kalbų ir įrankių modeliuoti verslo procesams. Modeliuojant verslo sistemą verslo taisyklių užrašymas taip pat yra labai svarbus. Nagrinėjamos SRML, SBVR, PRR, SWRL, OCL taisyklių specifikavimo kalbos ir UML, DFD, CPN, EPC, IDEF3 ir BPMN verslo procesų modeliavimo kalbos. Straipsnyje atliekama teorinis verslo taisyklių ir verslo proceso modeliavimo

kalbų teorinis palyginimas pagal parinktus aspektus. Parinkti proceso, informacijos, struktūros, įvykių, būsenų, resursų modeliavimo aspektai. Šiuos aspektus turėtų perteikti modeliavimo kalba. Straipsnyje parenkamas tinkamiausias trijų lygmenų karkasui verslo sistemos lygmens verslo procesų ir verslo taisyklių modeliavimo kalbų rinkinys.

Pagrindiniai žodžiai: verslo procesas, verslo taisyklė, UML, SRML, BPMN, verslo proceso modeliavimas.