Integration Method of Business Vocabularies and Business Rules Specifications (Models)

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1 STAGE OF THE RESEARCH

The stage of the research is in implementation of merging algorithm of business vocabularies and rules that will allow to merge several business vocabularies and find conflicts that will be listed for the user for further actions.

Online storage prototype for business process vocabularies and business rules are implemented for their management. Types of conflicts were identified that could occur during vocabularies merging.

2 RESEARCH PROBLEM

Information system development starts from defining business vocabulary and rules. There are some cases when several business vocabularies and rules from the same domain must be used. Therefore there is a need to merge those business vocabularies and rules to make one and use it for development of a system.

The research problem is that there is a need to use merged information from several business vocabularies and rules. Merging them could cause to occur conflicts between the elements from different sources. To our knowledge, the problem yet is not solved nor in the scientific literature nor in practical applications.

3 OUTLINE OF OBJECTIVES

The goal of this research is to allow forming sets of business rules, develop business vocabularies and rules, configure and merge vocabularies and to maintain interfaces with software models. In order to do so, we have to develop an online access and business process and business rules prototype based on SBVR (Semantics of Business Vocabulary and Rules) metamodel, ensuring the complete life cycle of business vocabularies and rules.

The outline objectives are:

1. To identify business vocabularies and business rules ensuring criteria that allows possibilities to manipulate the elements of the vocabularies.
2. To estimate SBVR metamodel possibilities that are needed for managing business vocabularies and business rules.
3. To create vocabularies merging method and carry out an experiment.
4. To prepare the management of architectural framework for business vocabularies and business rules storing.
5. To develop online access prototype that would ensure the storage of business vocabularies and business rules.

4 STATE OF THE ART

Analysis of related works showed that merging whether it would be vocabularies, databases, web services, etc., requires dealing with conflicts that could occur due to different sources even if the problem domain is the same. The method for merging databases based on conflict solving is presented by Parent et al. (Parent et al., 1998). Semantic conflicts were solved during the exchange of information through web services (Al-Baltah et al., 2013). Furthermore, detailed semantic classification was presented in the article. A spreading activation model is proposed for the purpose of automatically merging databases with heterogeneous indexing systems by Lee (Lee, 1999). Taxonomy of conflict problems in integrating information resources using XML schema was proposed (Lee et al., 2002). Term mapping process is explained, but this method does not use conflict solving because the information retrieval requires term mappings. Ontologies merging problems by means of definitions and terms were presented (Kotis et al., 2006). Model-driven conflict specification mechanism was presented, a conflict metamodel has been proposed to specify conflict patterns between different elements (Cicchetti et al., 2008). The HCONE-merge approach was analysed

Sinkevicius E. and Butleris R..
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along with the other approaches to find the approach that would allow merging with the minimum user interaction. However, the results showed that human interaction is necessary to produce valid mappings between the ontologies. Merge algorithm was presented which preserves context-free correctness and detects context-free conflicts (Westfechtel, 1991). Formal approach to three-way merging of models in the EMF framework which produces a valid model, handles move operations, detects and resolves context-free and context-sensitive conflicts were presented by Westfechtel (Westfechtel, 2010) Later, by the same author, formal and detail merging techniques are presented (Westfechtel, 2014) listing the conflicts and describing their solving solutions. Method for three-way merging of XML was presented, also, investigations were made for number of cases on XML merging from which high-level merge rules were derived (Lindholm, 2004). An approach for computing differences between UML models encoded as XMI files was presented (Kelter et al., 2005), but the tests were performed with not realistic examples, so they are not fully comprehensive. Requirements for algorithms and tools for differencing and merging of software diagrams were defined (Förtsch et al., 2007). Also, they have explored several crucial design decisions which tool developers have to perform. Two different kinds of conflicts in model versioning were defined based on the notion of graph modifications: operation-based and state-based conflicts (Taentzer et al, 2010). An operation-based conflict detection algorithm to detect conflicts in operations and models was presented (Koegel et al., 2010) resulting with operation-based conflict detection results in less conflicts and requires fewer merges.

In many literature sources that explain merging various technologies, solutions are missing for new technologies or standards that should be used in merging methods. Currently there are proposed various new standards, as SBVR that allows defining business vocabularies and rules that are used in early stages of system development. SBVR (Semantics of Business Vocabulary and Rules) (OMG, 2008; OMG, 2013) allows to define business process and business rules using Structured English. As SBVR attracts more and more attention and it is continually updated, this OMG (Object Management Group) standard was selected for this research.

Online storage prototype for business vocabularies and business rules was created on the basis of VeTIS tool (Nemuraite et al., 2010; Sukys et al., 2012) as an editor for business vocabulary and rules.

5 METHODOLOGY

The current research is based on methodology of finding all classified conflicts due to the different sources of the same domain and using transformation from SBVR vocabularies to OWL 2 (Web Ontology Language) ontologies in order to detect inconsistencies. All the conflicts must be listed to the user for further actions.

Semantic conflicts will be solved using transformation from SBVR to OWL ontologies (Karpovic et al., 2011; Karpovic et al., 2012). All the other conflicts will be solved using primary sources. To find inconsistencies in OWL 2 ontologies will be performed using Protégé Hermit OWL Reasoner (ISG, 2012) or Protégé Pellet Reasoner (Clarkparsia, 2013).

6 EXPECTED OUTCOME

The expected outcome of this research is to implement a method that would allow performing merging of several different vocabularies from the same domain and finding all the conflicts that could occur. For business vocabularies and rules management online storage prototype must be implemented.

7 APPROACH OF MERGING SBVR VOCABULARIES OF THE SAME DOMAIN

In this section we present the approach of merging SBVR vocabularies of the same domain dealing with several kinds of conflicts. Furthermore, online storage prototype of SBVR vocabularies and rules is presented.

7.1 SBVR Business Vocabularies and Rules Management Method under Implementation

While implementing business vocabulary and business rules, several steps must be made. These steps define all required actions in order to create business vocabulary and rules for the examined domain. Figure 1 presents those steps in an activity diagram. In this diagram the activity “merge vocabularies” is the activity which is examined in detail (section 7.3) in order to create an algorithm

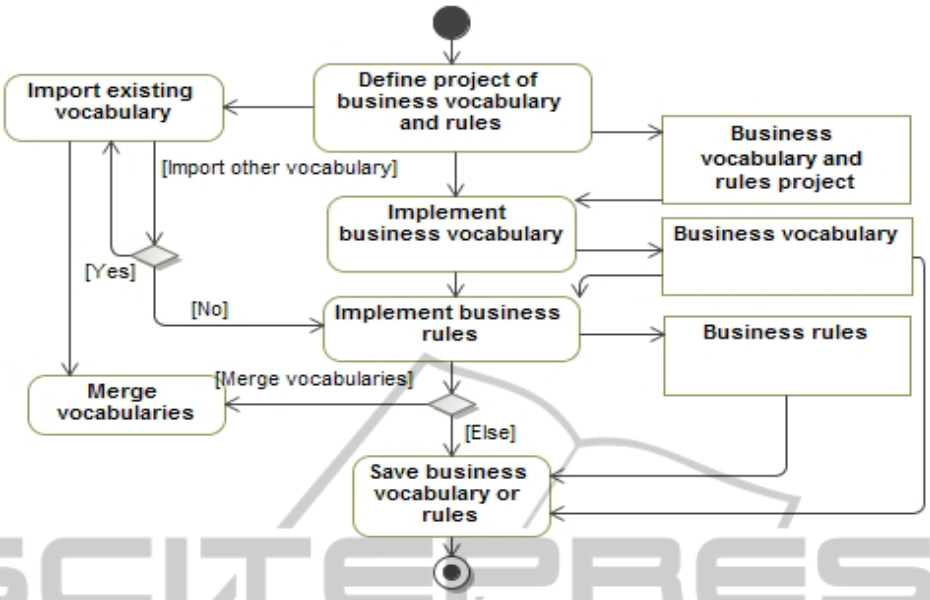

Figure 1: Method of implementing business vocabularies and rules.

and the method for the possibility to merge several vocabularies and rules and find conflicts that would be presented to the user for further actions.

Needs for vocabularies merging could occur for a variety reasons: due to several experts working on the same project, due to the upgrade of the system, due to automatic model transformations (Mickeviciute et al., 2014) and etc.

7.2 Types of Conflicts While Merging SBVR Vocabularies

While merging several business vocabularies and business rules four types of conflicts could occur:

1. Structural conflicts
   This type of conflicts could occur in two different ways:
   - When examined vocabularies are correct and full, all the rules are defined:
     e.g. vocabulary 1: It is necessary that house *has* at_most_1 color
     e.g. vocabulary 2: It is necessary that house *has* at_most_2 color
   - When examined vocabularies are not full, then we have to consider to the general rules:
     e.g. when a person has just one date or birth.
2. Value conflicts
   e.g. house *has* color
   It is necessary that color *is* green or blue or...
   It is necessary that house *has* at_most_1 color
   The solution could be made that both rules are left as they are and the additional rule is written:
   e.g. It is necessary that house *is* green or house *is* blue
   This solution makes the given information fuzzy and inaccurate.
3. Semantic conflicts
   The word may have a meaning in the specific context, e.g. roles, when a person is a driver if a person drives a car:
   e.g. person
   General concept: noun concept
   driver
   Concept type: role
   General concept: person
   One of the methods to define a conflict is to perform transformation from vocabularies to ontologies to check their consistency.
4. Naming conflicts
   In the one vocabulary there will be a person, in another vocabulary the same person may be called client and etc. In this case their properties overlap:
   e.g. person
   client
   In such cases synonymous forms should be used:
   e.g. person
   Synonym: client

7.3 Algorithm of Merging Vocabularies

This section of the paper explains the algorithm of SBVR vocabularies merging. In order to do this, there should be selected SBVR business vocabularies from the same domain. All the other steps are listed in the Figure 2.

As the Figure 2 shows, merging vocabularies are

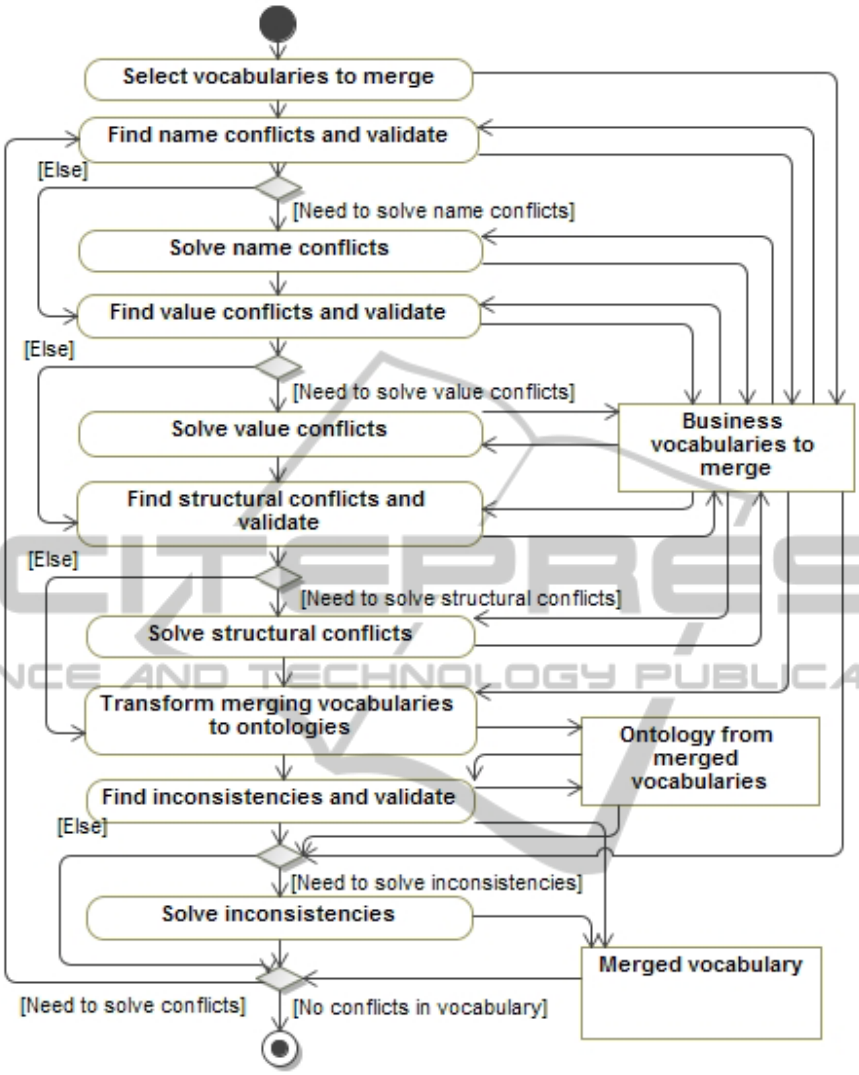

Figure 2: Algorithm of SBVR vocabularies merging.

transformed (Karpovic et al., 2011; Karpovic et al., 2012) to OWL ontologies (W3C, 2012) to check for their consistency. Located inconsistencies are solved in the main merged vocabulary. If after the transformation structural, value or naming conflicts are still found, the whole sequence could be repeated from the beginning using the main merged vocabulary. In this algorithm are used three methods of vocabularies merging: transforming to ontologies, automated with presentation of results to the user for validation and created by expert manually.

7.4 Online Storage Prototype for Business Vocabularies and Rules

The online storage prototype for business vocabularies and rules were implemented to create and maintain business vocabularies. Use case diagram of the implemented prototype is presented in Figure 3. The vocabularies merging activity is hidden under “Manage vocabularies, sets of rules and projects” use case.

Interface of implemented tool is presented in Figure 4. Project and file browser is on the left side and concept tree is given on the right side of the tool. Other main functions are explained in the grey blocs. Example of two vocabularies merging is given in Figure 5. Different colours show different conflicts: the same in different name (orange), added concept (green), deleted concept (red). Vocabulary A and Vocabulary B are from the same domain.

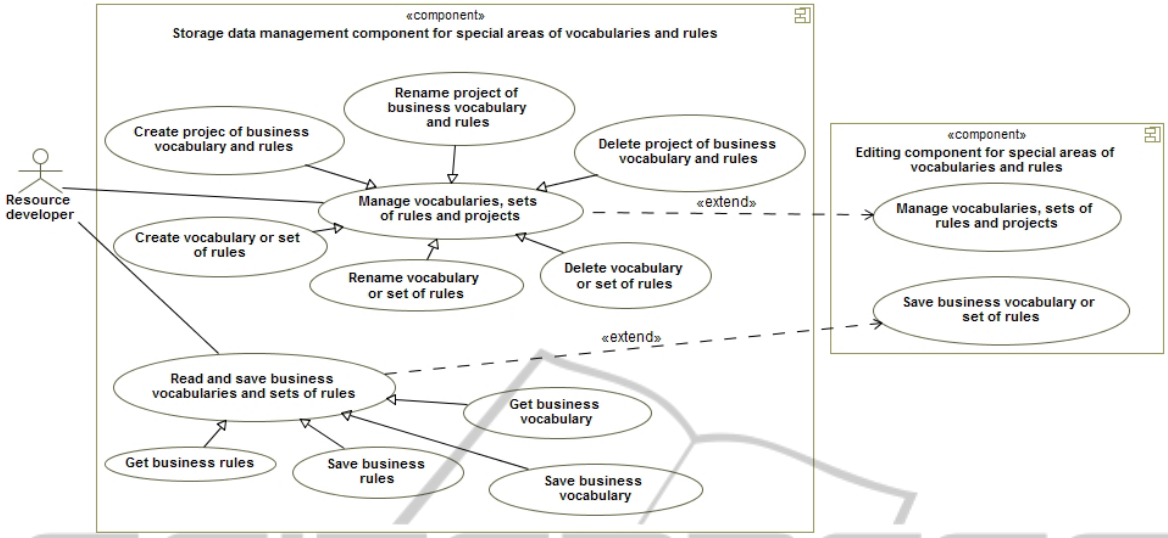

Figure 3: Use case diagram of online storage prototype for business vocabularies and rules.

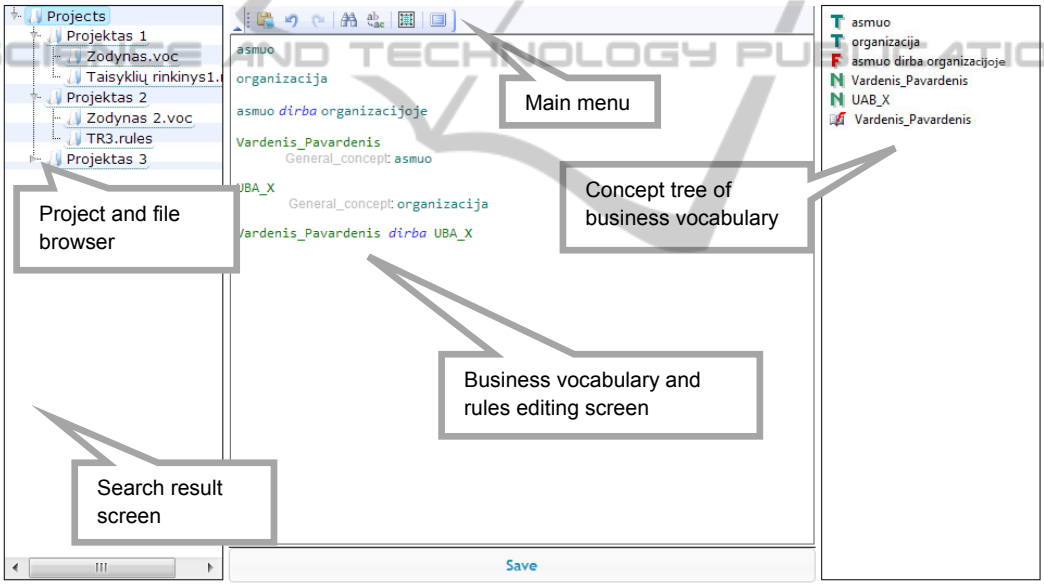

Figure 4: User interface of implemented tool for business vocabularies and business rules management.

8 CONCLUSIONS AND FUTURE WORKS

According to the analysis of related works about SBVR metamodel and other possible model storage ways the decision was made that the best storage way of SBVR model is with structured natural language. Merging problems of vocabularies were defined and SBVR vocabularies merging rules were created. Four main vocabularies merging conflicts were defined: structural, value, semantic and naming. Three methods of vocabularies merging were identified: transforming to ontologies, automated with presentation of results to the user for validation and created by expert manually. All of these methods are included in new proposed method. Management of architectural frame for business vocabularies and business rules storing was prepared and online access ensuring business vocabularies and business rules storage prototype was developed.

	Vocabulary A		Vovabulary B
1	car	1	vechicle
2	General_concept: object	2	General_concept: object
3		3	
4	contract	4	contract
5	General_concept: object	5	General_concept: object
6		6	
		7	accepted_rental
		8	General_concept: rental
		9	
7	rental	10	rental
8	General_concept: contract	11	General_concept: contract
9			
10	rejected_rental		
11	General_concept: rental		
12			
13	rental_contract_document		

Figure 5: Two vocabularies after merging: colours show difference.

The future work of this research is devoted for implementing merging method of business vocabularies. Further, the will be carried out an experiment to test the new method.

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