

Ontology to Multi-Dimensional Separation of Concerns in Requirement Engineering

Miguel Bento Alves
Instituto Politécnico de Viana do
Castelo

mba@estg.ipv.pt

ABSTRACT

Ontologies are defined as the representation of the semantics of terms and their relationships. They consist of concepts, concepts properties and relationships between concepts, all express in linguistic terms. In this work we propose an ontology to Multi-Dimensional Separation of Concerns in Requirements Engineering. We also presented rules to inference over the ontology proposed.

Keywords: Ontologies, Early aspects, Separation of Concerns.

1. INTRODUCTION

The reason why ontologies are becoming popular is largely due to what they promise: a shared and common understanding of a domain that can be communicated between people and application systems. As such, the use of ontologies and supporting tools offers an opportunity to significantly improve knowledge management capabilities in large organizations. In [1] is described the importance of ontologies in requirements engineering. There are clear overlaps between what an Ontology Engineer aims to achieve in the modelling of a domain and the modelling that a Requirements Engineer will perform during the requirements process. All formalisms for Requirements Engineering embody a particular conceptualisation, and many (probably most) are reducible to first order logic. Therefore, even these other formalisms have much in common with ontologies. Ontologies allow the representation of the requirements model itself, imposing and enabling a particular paradigmatic way of structuring requirements. Besides, ontologies makes it easier to interrelate knowledge between different areas and offers a unified, underlying conceptualization to the requirements process. In this work we propose ontology to modelling requirement engineering approach to separation of concerns. This approach is presented in [2] and [3].

2. MULTI-DIMENSIONAL SEPARATION OF CONCERNS IN REQUIREMENTS ENGINEERING

In [2] and [3] is presented a model that decomposes requirements in a uniform fashion regardless of their functional or non-functional nature. This makes it possible to *project* any particular set of requirements on a range of other requirements, hence supporting a multi-dimensional separation. A projection specifies the influence of a given concern on other concerns and is

achieved through composition rules employing informal, often concern-specific, actions and operators. The rules specify the projection of a particular concern onto other concern relates to. The various projections make it possible to compose a range of *reflected projections* contributing to an individual concern. The approach supports establishment of early trade-offs among crosscutting and overlapping requirements. This, in turn, facilitates negotiation and decision-making among stakeholders. The uniform nature of the decomposition also makes it possible to deal with situations where an initially non-crosscutting set of requirements evolves to have a wider influence in the system. In this approach, concerns imply any coherent collection of requirements, functional and non-functional requirements.

3. MOTIVATION

The domain model represents the understanding of the domain under consideration, i.e. in the form of concepts, their relations and business rules. In its simplest form, a glossary may serve as a basis for a domain model. However, it can be formalized using a conceptual modelling language such as the UML. Moreover, the problem domain can be described using an ontology language, with varying degrees formalization and expressiveness [4]. Ontologies in requirements engineering, representing the requirements model itself, imposing and enabling a particular paradigmatic way of structuring requirements [5].

The motivation for constructing an ontology to Multi-Dimensional Separation of Concerns in Requirements Engineering was the standardization and unification of this approach, representing the concepts and the rules. Besides, if we have the knowledge representation of a given analyse methodology or tool, it is possible sharing information among different systems even if a system do not know that methodology or tool. With an ontology it is also possible reasoning about the information.

4. CONSTRUCTION OF AN ONTOLOGY

We modelled the proposed ontology in OWL, either because its expressiveness either because allows the definition of restrictions. A restriction describes the classes of all instances that fulfil a specific condition on a property. These restrictions allow the definition of the rules of the Multi-Dimensional Separation of Concerns in Requirements Engineering approach. As example, lets extract the following description of the Multi-Dimensional Separation of Concerns in Requirements Engineering approach from [2]: *Once the requirements have been derived from*

desirable system features, they are categorizing them into concerns from the meta concern space. Notice that a requirement can have sub-requirements. A requirement is characterized by an identification code, in a univocal way, and by a description. Let's begin by modeling the concept of *requirement*. In figure 1 we show a graphical representation of the modeling.

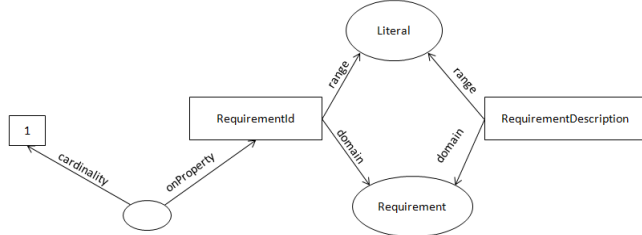


Fig. 1 – Graphical modelling of *requirement*.

The `<owl:Restriction>` definition guarantees the uniqueness of *concerned* property. Let's now consider that a requirement can have sub-requirements. In other words, a sub-requirement is a sub class of requirement. Besides, a sub-requirement must be associated with a requirement. The modeling of this description is represented in figure 2.

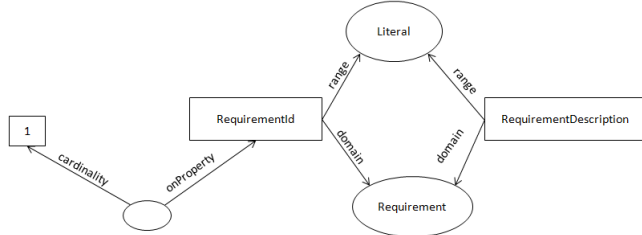


Fig. 2 – Graphical modelling of a *sub-requirement*.

We want to guarantee that a sub-requirement only can be associated with one requirement. One sub-requirement cannot belong more than one requirement. To implement this restriction, *subRequirementOf* property is stated as *FunctionalProperty* to guarantee a unique value. If a property is a *FunctionalProperty*, then it has no more than one value for each individual. Let's now model that a requirement is categorized into concerns. In figure 3 we show a graphical representation of the modeling.

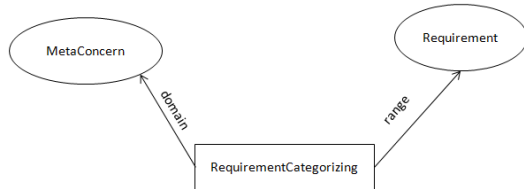


Fig. 3 – Graphical modelling of *categorizing requirements*.

Modeling the “domain model” in OWL, we can introduce some reasoning. As example, in Multi-Dimensional Separation of Concerns in Requirements Engineering approach, one the steps is to identify coarse-grained relationships among concerns by relating concerns to each other through a matrix. If a given requirement is categorizing in more than one concern then that

concern is candidate to a coarse-grained relationship. We can inference this candidate concerns by the follow rule:

```
RequirementCategorizing(?c1, ?r1) ∧
RequirementCategorizing(?c2, ?r1) →
coarse_grainedRelationshipCandidate(?c1, ?c2)
```

5. CONCLUSIONS AND FUTURE WORK

In this work we proposed an ontology to *Multi-Dimensional Separation of Concerns in Requirements Engineering* approach presented in [2] and [3]. We showed the guidelines that drove our implementation supported by simple examples. We also present rules to reasoning in presented ontology. All presented OWL statements were validated in W3C RDF validation service¹. Also, were imported to PROTÉGÉ² tool to a redundant validation. As future work, the first task that must be done is a validation of this ontology with specialists in *Multi-Dimensional Separation of Concerns in Requirements Engineering* approach. We believe that there are some aspects where are necessary a better understood. This leads to a refinement of the ontology. When we modeled our ontology we do not care if the model was in OWL DL or in OWL full. Therefore, we must assume that our ontology is in OWL full, therefore, with no computational guarantees. In future, we should evaluate if an OWL full modelling carry problems to computation and if we need, or not, modelling in OWL DL.

6. REFERENCES

- [1] Dobson, G. and P. Sawyer, *Revisiting ontology-based requirements engineering in the age of the semantic web*, in *Proceedings of the International Seminar on Dependable Requirements Engineering of Computerised Systems at NPPs*. 2006: Halden, Norway.
- [2] Moreira, A., A. Rashid, and J. Araujo, *A Concern-Oriented Requirements Engineering Model*, in *17th Conference on Advanced Information Systems Engineering (CAiSE 2005)*. 2005, Springer Berlin / Heidelberg: Porto, Portugal. p. 293-308.
- [3] Moreira, A., A. Rashid, and J. Araujo, *Multi-Dimensional Separation of Concerns in Requirements Engineering*, in *Proceedings of the 13th IEEE International Conference on Requirements Engineering*. 2005, IEEE Computer Society: Paris, France.
- [4] Happel, H.-J. and S. Seedorf, *Applications of Ontologies in Software Engineering*, in *2nd Int. Workshop on Semantic Web Enabled Software Engineering (SWESE 2006)*. 2006, Athens, GA, U.S.A.
- [5] Dobson, G. and P. Sawyer, *Revisiting Ontology-Based Requirements Engineering in the age of the Semantic Web*, in *International Seminar on "Dependable Requirements Engineering of Computerised Systems at NPPs"*. 2006, Halden.

¹ <http://www.w3.org/RDF/Validator/>

² <http://protege.stanford.edu/>