Involving Domain Experts in Ontology Construction: A Template Based Approach

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1 Introduction

The availability of knowledge encoded in computer-readable forms, and expressed according to precise conceptual models and formal languages such as the ones provided by ontology languages, is an important pillar for the provision of flexible and better integrated ways of handling content, production processes, and knowledge capital of organisations and enterprises.

In spite of the efforts and progresses made in the area of knowledge elicitation and modelling, methodologies and tools available nowadays are mainly tailored to Knowledge Engineers [1], that is, people who know how to create formal conceptualisations of a domain, but do not know the domain to be modelled. These tools are instead scarcely usable by Domain Experts, that is, the people who know the organisation's capital, but often do not have any skills in formal model creation. As a result the interaction between Knowledge Engineers and Domain Experts is regulated by rigid iterative waterfall paradigms which make the process of producing and revising good quality ontologies too complex and expensive for the needs of business enterprises.

The work of the MoKi [2] project¹ aims at producing a Web2.0 tool able to support an active and agile collaboration between Knowledge Engineers and Domain Experts, as well as the mining of the organisation's content, to facilitate the production of good quality formal models. The work of this thesis aims at improving MoKi in supporting a more agile construction of good quality ontologies by encouraging Domain Experts to actively participate in the construction of the formal part of the model. More in detail it aims at exploring: (i) how templates, based on precise characterisations provided by Top Level or specific Domain ontologies, can be used to describe knowledge at a (semi-)formal level, and (ii) how Ontology Design Patterns (ODPs) can be used to reuse existing knowledge without having to know the details of the underlying languages nor the ODPs in all their detail. We explore and apply our ideas to the construction of Enterprise Models [3], which provide the use case for this thesis.

2 Previous and Related Work

Our work touches upon different areas of research. We focus here on Enterprise modelling and ontology engineering.

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¹ moki.fbk.eu

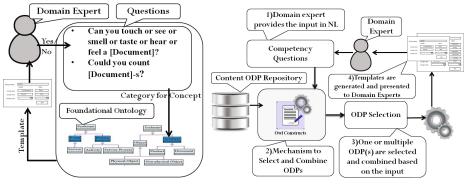
E. Simperl et al. (Eds.): ESWC 2012, LNCS 7295, pp. 864-869, 2012.

Enterprise Modelling Approaches: The work in [4] presents a methodology called Enterprise Knowledge Development Method (EKD); a participative approach to enterprise modelling. In this approach stakeholders meet in modelling sessions to create models collaboratively and document them on large plastic sheets using paper cards. It requires an extra effort of transferring the models from plastic walls to computer based models by modelling technicians. The work in [2] proposed a collaborative framework and a tool called MoKi, that supports the the creation of articulated enterprise models through structured wiki pages. Moki enables heterogeneous teams of experts, with different knowledge engineering skills, to actively collaborate in a modelling process. A comparison of MoKi and some other wiki-based tools is contained in [2] and due to lack of space we do not elaborate further on the comparison.

Ontology Engineering Approaches: There has been some work done on capturing organisational aspects through the use of an enterprise ontology. In [5], a preliminary proposal of an ontology of organisations based on DOLCE ontology [6] was presented. They propose that the ontological analysis of an organisation is the first fundamental step to build a precise and rigorous enterprise model. DOLCE is a top level ontology describing very general concepts which are independent of a particular problem or domain. So it is required to provide some support for Domain Experts to work with them, which is missing in [5]. A tutoring methodology called TMEO, based on ontological distinction embedded in owl-lite version of DOLCE was proposed in [7] to guide humans in elicitation of ontological knowledge. In [8], a controlled natural language based approach was introduced to involve Domain Experts in the ontology construction process. This approach requires that the Domain Experts learn the controlled language before starting to model and it works with certain languages (e.g., English). An approach that attempts to enrich ontologies by finding partial instantiations of Content ODPs and refining ontology using axiomatised knowledge contained in ODPs, is found in [9]. This approach assumes the availability extended kind of ODPs which contain additional lexical information, and it is more focused toward Ontology Engineers.

3 Supporting Domain Experts in Conceptual Modelling with Moki

State of the art methodologies and tools for ontology construction usually ask Domain Experts to provide / revise knowledge (sources), and Knowledge Engineers to formally encode that knowledge, but lack suitable guidance and support to ensure their active involvement in the construction of the formal part of the model (as they often do not have required skilled in conceptual modelling methodologies and tools). Nevertheless, as argued in [8] involving the Domain Experts in authoring (rather than only providing knowledge for) ontologies is an important task for improving the process of ontology construction and making it more agile. To facilitate the involvement of Domain Experts, we have implemented a collaborative (enterprise) modelling tool called MoKi, that supports access to the enterprise model at different levels of formality (informal, semi-formal, and formal) and encourages Domain Experts to actively participate in the construction of the formal part of the model by providing not only access to the knowledge inserted by Knowledge Engineers, but also comment or directly modify part of it. In this thesis we aim at involving Domain Experts in the construction of ontologies by



- (a) Foundational ontology based Template generation
- (b) ODP based Template generation.

Fig. 1. An overview of our approach

using "templates" for helping them in describing knowledge at a (semi-)formal level, and Ontology Design Patterns, for helping them in reusing existing knowledge. So the idea is to start from the initial version of Moki and further develop it in order to guide and facilitate Domain Experts in entering *rich* and *good quality* knowledge, even if they do not have a deep understanding of knowledge engineering techniques and concepts. We illustrate these ideas in the following.

Helping Domain Experts via Templates: Top level ontologies can be considered as a set of formal guidelines for domain modelling. They can serve as a starting point for building new ontologies as they answer the question what things are there in the domain to be modelled. We are starting with the Descriptive Ontology for Linguistic and Cognitive Engineering (DOLCE) [6] and analyse which of its ontological categories can be used in Moki to facilitate the modelling activities of Domain Experts by providing a precise characterisation of the main "types" of entities in their domain. The intention is to select the DOLCE categories which are easy to grasp and to work with for Domain Experts. Through this approach, we intend to answer the following questions:

- 1. How can a top level ontology be used to guide the overall process of model construction by Domain Experts, in particular through generating templates from it?
- 2. How can users be guided to select the appropriate template?

Concerning the first question, template generation has been done to some extent for ODPs but it is more focused toward knowledge engineers. Moreover, it needs to be extended, as usability aspects have not been studied and it has not been used for top level ontologies. A template has a predefined information with placeholders and parameters for capturing required information. This means, it will help Domain Experts to know what information to fill in according to its position within the template, which is missing in the controlled natural language based methods. As shown in Figure 1a, the main idea is to provide "templates", based on foundational ontology, for the Domain Experts in order to perform the characterisation of entities in a "guided" manner. These categories are selected after reviewing the material available in DOLCE and different extensions of DOLCE, which will act as a starting point of the modelling activity. The idea is to

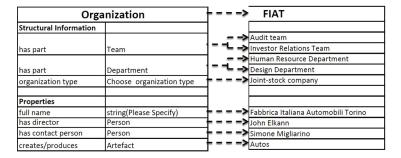


Fig. 2. Organization template and its Instantiation

characterise the main entities with DL axioms, provide a mechanism that transform the logical characterisation in templates (for the specification of sub-concepts or individuals) and guiding user through the different fields of the templates by providing list of possible entities suitable to fill in the different fields of the templates. Here we present a portion of organization template and its instantiation in Figure 2 to show that how these templates can be used to model real world entities. As shown in Figure 2, the arrows represent the instantiation of Organization template to a particular organization "FIAT" along with all the structural information and properties, such as "Audit Team" is one of a Team in "FIAT" and the director of the organization is "John Elkann".

Concerning the second question, we plan to use a Natural Language Question Answering (QA) system like TMEO [7] to help the user in selecting the correct category (and therefore template) to which the entity belongs. As shown in Figure 1a, the Domain Experts ask for assistance from the system to select the right template for the concept. The QA system will ask the Domain Expert a list of question and depending on the answers (Yes/No) given by the Domain Expert, the system will purpose the template.

Helping Domain Experts via Ontology Design Patterns: Our goal in this part is to discover whether some piece of knowledge that the Domain Expert needs to model can be efficiently modelled through the use of ontology design patterns (ODPs). ODPs provide repositories of already formalised knowledge and can be used as building blocks in ontology design, as shown in [10]. The initial line of research will be to explore if ODPs can be detected directly from competency questions. Through this approach, we intend to answer the following questions:

1. How can Content ODPs help Domain Experts to model complex distinctions in an ontology?

We aim at answering this question by providing a mechanism for Domain Experts to specify the requirements as competency questions and select the content ontology design patterns covering competency questions. In this direction, we have conducted a small experiment in [11] about detection of patterns in ontologies. However, this approach was fairly naive considering only concepts in the matching process. The concepts in patterns are abstract enough to match multiple competency questions, so the matching process will require more than matching concepts. It will also match relations

because they are the major indicators of pattern instantiation. As shown in Figure 1b, the process of identifying ODPs starts by taking input from Domain experts in the form of competency questions and then matching it against the Content Ontology Design patterns repository to see if there exist a complete match against this input or if it partially instantiates some ODP. If it partially instantiates some ODP then a recommendation will be given to the user suggesting to add the missing concepts and properties.

4 Results and Future Work

The result we have so far is based on a deep analysis of material related to the DOLCE ontology and its extensions, to extract a model to facilitate Domain Experts in their modelling task. We analysed all these extensions of the DOLCE ontology and taken out most common ontological categories that are easy to grasp for Domain Experts along with the relation existing between them and built an initial draft of the templates.

This work is done in the context of moki but the approach is general enough to be easily tailored and implemented for other tools. Currently we are working on the pre-evaluation of the templates with the Domain Experts, to verify the acceptability and usability of these templates before proceeding to implement them in MoKi. In future, we plan to provide an implementation of these templates in MoKi and incorporate a QA support system in MoKi to help the Domain Experts in selecting correct category. The next step will be to provide a mechanism for pattern selection on the basis of competency questions and generating templates from them. Once these changes are implemented we will perform an post-evaluation of updated moki in some use cases and also to conduct experiments with different types of users, e.g., ontology engineers as well as Domain Experts to verify the usability and effectiveness of the tool.

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