Applying Rules to an Ontology for Project Management

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Abstract. In this article we work with ontologies in the area of project management. There is an increasing interest in using ontologies in the area of project and process management and different approaches are being used for representing knowledge in this field. Based upon previous works on project representations we have developed a basic ontology and we apply rules on it. The ontology is represented in OWL and the rules are constructed in SWRL. SWRL is the language used for reasoning with rules in an ontology, as proposed by the W3C. The article shows an example of different types of rules that can be applied on our specific ontology. In this way, we see how further knowledge can be derived and, thus, decision-making for managing projects can be improved.

Keywords: project management, software engineering, ontologies

1 Ontologies for Project Management

Within the growing interest in the field of project management there is a need to find ways for conceptually managing the semantic content created in a project [1] [2] [3]. Different ideas have been proposed in the last decades, ranging from petri nets and many variations of them, different variations of semantic nets, etc. One of the last trends is the use of ontologies [4] [5]. An ontology is a conceptualization of a part of the world that is of interest to the modeller. The concept of ontology has a long tradition in philosophy and the concept is now very popular in the field of informatics.

Although the idea of ontology is not yet fully mature for its practical and widespread use, the W3C consortium has proposed a language for reasoning with the concepts of an ontology, which is the SWRL. This allows the information analyst to model ontologies and to reason about them [6].

2 Two basic ontologies

Based on other authors' published ideas and on our previous works on project representations [7] we have built a basic ontology for the project management.

The ontology has a core of concepts and other extensions such as the core-extension and the organizational ontology. As there is not a unique way to represent the concepts under the manager's viewpoint, different alternatives to ontological modelling may coexist.

A growing area of research is the interaction and combination of different ontologies for the same field or area of interest, but those issues are beyond the scope of our current research. We simply model our concepts of interest according to our perspective of the representations of project management. Thus, we have developed the Core ontology (Figure 1) and the Organization ontology. These ontologies were built with the idea of our specific conceptualization as the main goal. For the sake of clarity we have added a section to the core ontology to see how SWRL rules can be applied. We have called this part the Core-extension ontology, which explicitly deals with problems in project management (see Figure 2). The SWRL rules are applied to this part as it is explained in section 3.

The extension to the Core ontology is based on the multiple underlying applications that the concept of *activity* has. In this case we model some of the generic problems or issues that activities can deal with within the context of a project. The ontology of Figure 2 can be read, in a concise manner, as follows: in every project there are problems, interruptions or issues, which are represented as `Management Issues`. Each `Management Issue` can be managed by an `Activity`, that in our case is modeled as `Activity` ***`Manages Issue`*** `Management Issue`. Each `Management Issue` can be classified in different types `Type Issue`, and there is a subset of problems that can be effectively managed `Type of Issue Managed` in one way or another. `Management Issue` is related to the `Type Issue` with ***`hasIssue`*** and it is also related to `Type of Issue Managed` with ***`hasIssueManaged`***. In summary we see that this part conceptually may assign managerial problems to activities, and that there is a subset that can be effectively managed.

3 Semantic Web Rule Language (SWRL)

The language SWRL has been proposed for adding rules in the process of reasoning about an ontology developed in OWL [8] [6]. SWRL allows reasoning about OWL individuals. As defined by the W3C, the SWRL extends the set of OWL axioms with Horn-like rules. It combines the sublanguages of OWL DL, OWL Lite and RuleML. rules are of the form of an implication between an antecedent (body) and consequent (head). The intended meaning can be read as: whenever the conditions specified in the antecedent hold, then the conditions specified in the consequent must also hold.

The classic simple example of the basic use is the expression `hasParent(?x1,?x2)` $\wedge$ `hasBrother(?x2,?x3)` $\Rightarrow$ `hasUncle(?x1,?x3)`, which has the obvious meaning that if an individual `?x1` has a parent `?x2` and `?x2` has a brother `?x3`, then `?x1` has an uncle `?x3`.

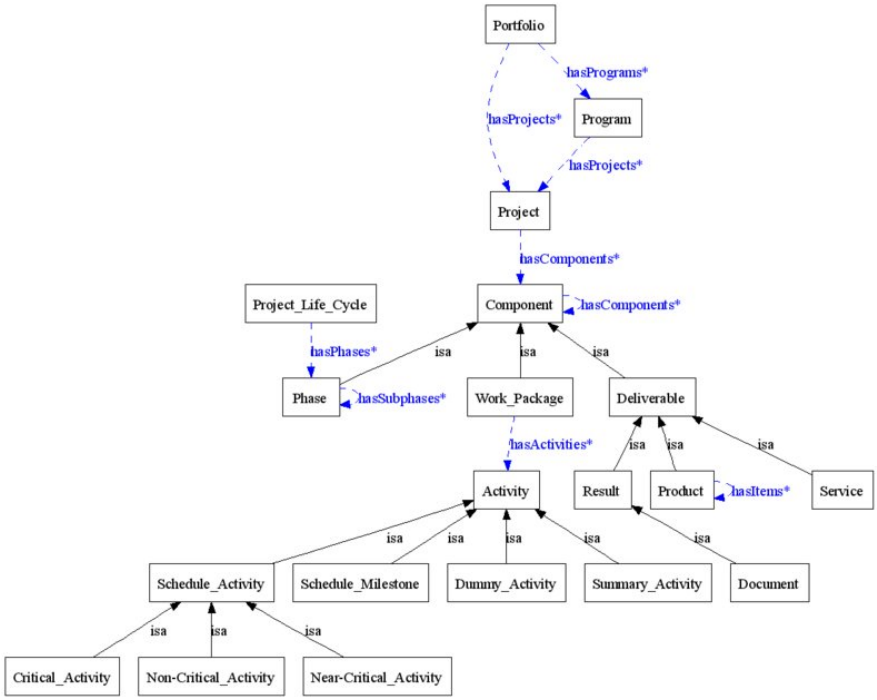

Fig. 1. The Main ontology. The concept `Activity` will be refined.

In our current setting the rules are executed using the Jess rule engine in the Protégé environment. Other alternative could use the Pellet reasoning engine but it does not add more value to our development.

4 Applying rules to the ontology

We propose some rules for deriving knowledge from the ontology, and we select the portion that is amenable to reasoning, that is the generation of issues reporting, changes or events management. We have defined some basic SWRL rules on the Extension to the Core ontology and this allows us to represent management constraints and to add new knowledge to the ontology. Another set of SWRL rules are those that are queries to the ontology for recovering specific sets of values. These Queries and Rules show how it is possible to build a reasoning subsystem on the concepts previously defined. Below we describe part of the rules built in our ontology which can be classified as query rules and management-reasoning rules.

Examples of Query rules are:

– A simple query is: `organization:Project_Team_Member(?p)` ⇒ `sqwrl:select(?p)`. This rule extracts all team members of a specific project.

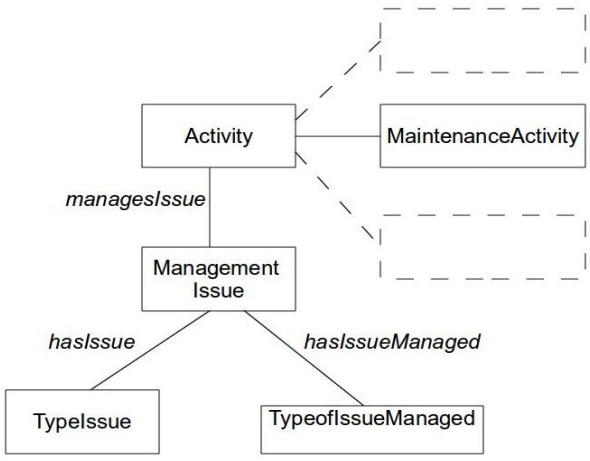

Fig. 2. Extension to the Core ontology with Management Issues.

– In this second query rule the system extracts all change requests that have been initiated by a specific team member (JaneDoe)
`pmo:Approved_Change_Request(?r)` ∧ `pmo:change_request_initiator(?r, p1:JaneDoe)` ⇒ `sqwrl:select(?r)`

Examples of Reasoning rules are:

– Rule 1
`pmo:ManagementIssue(pmo:problemaSerio)` ∧ `pmo:MaintenanceActivity(?a)` ⇒ `pmo:hasIssue(pmo:problemaSerio, pmo:revisionGeneralProyecto)` ∧ `pmo:hasIssueManaged(pmo:problemaSerio, pmo:reactivo)` ∧ `pmo:managesIssue(?a, pmo:problemaSerio)`

This rule makes some operations if there is a `problemaSerio` and there is a `MaintenanceActivity ?a`, which basically translates in managing the issue through `managesIssue`.

– Rule 2
`pmo:ManagementIssue(pmo:problemaNimio)` ∧ `pmo:hasIssueManaged(?i, pmo:reactivo)` ∧ `pmo:MaintenanceActivity(?a)` ⇒ `pmo:managesIssue(?a, ?i)`

The second rule reads that if there is a problem named `problemaNimio` and the problem is also of type `reactivo` (that it also can be managed because `hasIssueManaged`) and there is a `MaintenanceActivity` then the activity `?a` manages the issue `?i` (`managesIssue`)

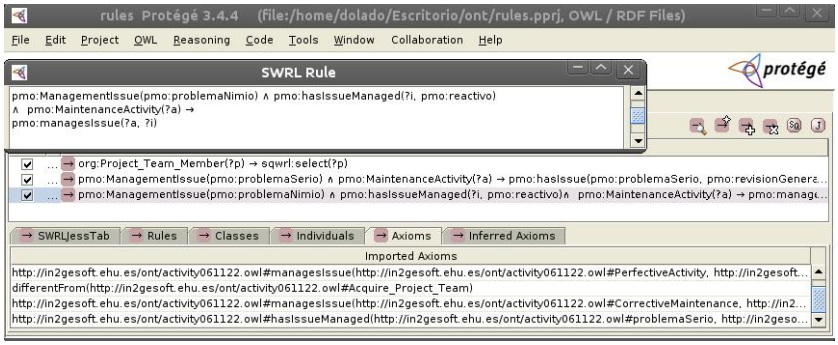

Fig. 3. A complex rule for the ontology

– Similarly, the third rule works in a similar way to the previous one, but it uses the instances `personnelProblem` and `internal`.
`pmo:ManagementIssue(pmo:personnelProblem)` ∧ `pmo:hasIssueManaged(?i, pmo:internal)` ∧ `pmo:ManagementActivity(?a)` ⇒ `pmo:managesIssue(?a, ?i)`

We see in Figure 3 the execution of management rules in the Jess-Protégé environment.

5 Conclusion and future work

In this article we have shown, through different example rules, how it is possible to make some type of reasoning and how to derive information about the project by using the conceptual model already developed. One of the problems in project management, and more specifically in software projects, is the constant need for information at different levels of management. The concept of *ontology* allows to define ideas and concepts at different levels.
By using an ontology developed in OWL and Protégé and using the SWRL language we can derive more knowledge about project management. We have developed two classes of rules: one for querying and the other for reasoning. Queries cannot strictly be considered rules, since they do not derive additional behaviour. Further work is needed to organise and/or to formalise the reasoning rules, specifically for project management. While the conceptual structure of project management has been studied in the last decade, few effort has been employed to understand the different ways of reasoning in management. Its formalization through SWRL may provide a route to help the managers' endeavours, but there is a lot of work to do for organising all the rules used by managers.

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