Semantically rich description of e-CF based job profiles

I. Kaloudi, A. Kameas

Educational Content, Methodology and Technology Laboratory, Hellenic Open University
Patron-Clauss 278, GR-26335, Patras, Greece
ioanna.kaloudi@windowslive.com; kameas@eap.gr

Abstract: In this paper we present an ontology we developed that can be used to store eJob profiles based on the European eCompetence Framework (e-CF). We outline the methodology we used, and then we present the ontology itself, together with instance job profiles. We demonstrate the use of the ontology with the help of competence queries.

Keywords: Job profiles, Ontologies, e-CF, EQF

1 Introduction

A job profile is a description of a set of knowledge, skills, competences that a person should have in order to perform the respective job. A similar description can be used to characterize training courses and content. The use of XML-based meta-data decouples the job profile description from the course description, because the meta-data plays the role of a semantic mediator. The added-value of creating machine readable semantically rich descriptions of job profiles (for example, using an ontology) is that these files can be used by any software application in order to extract the information contained in the job profiles and thus can facilitate the process of developing training course descriptions. Moreover, the production of XML-based machine-readable versions of the jobs profiles will greatly facilitate Europe-wide standardization of the core competence descriptions and at the same time will enable localization to adopt nation-specific particularities, without loss of compatibility among descriptions.
In this paper, we are proposing a semantically rich description of e-CF based job profiles using ontologies; these profiles have been developed in the context of various EU projects (such as PIN (www.prointernet-project.eu) and CompAAL (www.compaal.eu)) and can be downloaded from the e-Jobs Observatory (www.e-jobs-observatory.eu). An ontology is usually defined as “a formal, explicit specification of a shared conceptualization” (Gruber, 1993). A

"conceptualization" refers to an abstract model of some phenomenon in the world, which identifies the relevant concepts of that phenomenon. "Explicit" means that the type of concepts used and the constraints on their use are explicitly defined. "Formal" refers to the fact that the ontology should be machine readable. "Shared" reflects the notion that an ontology captures consensual knowledge, that is, it is not private of some individual, but accepted by a group. Thus, an ontology is a structure of knowledge, used as a means of knowledge sharing within a community of heterogeneous entities. It defines the basic terms and relations comprising the vocabulary of a topic area, as well as the rules for combining terms and relations, to define extensions to the vocabulary (Neches et al, 1991). Ontologies describe domain knowledge in a generic way and provide agreed understanding of a domain. They are means of knowledge sharing and reuse. Sharing means that different applications use the same resources. Reuse means to build new applications, by assembling already built components.
In section 2 of this paper we outline the methodology we used to develop the ontologies. Then we present two phases of ontology development. In section 3 we present the ontology we used to represent e-CF job profiles, while in section 4, we add specific job profiles to it. Section 5 concludes the paper and presentsfuture research directions.

2 Ontology engineering methodology

The aim of the proposed ontology is to connect Job Profiles, e-Competences, e-CF levels and EQF levels in order to describe specific job profiles, serving as a reference point not only for the Human Resources (HR) departments of companies searching for employees but also for people interested in working or studying in those specific fields.
The software used for the development of the ontology was Protégé 4.1 Ontology Editor and Knowledge Acquisition System (OWL DL language). The construction was based on the iterative methodology "Ontology Development 101: A Guide to Creating Your First Ontology" (Noy and McGuiness, 2001). Initially, a main structure was developed and the objects and properties were inserted gradually. The basic steps followed for the comprehension and construction of the ontology are listed below:

Step 1: Determine the domain and scope of the ontology
Step 2: Consider reusing existing ontologies
Step 3: Enumerate important terms in the ontology

Step 4: Define the classes and the class hierarchy
Step 5: Define the properties of classes
Step 6: Define the data properties of the classes
Step 7: Create instances
Step 8: Evaluate the ontology by implementing DL Queries

3 Using an ontology to represent e-CF

The scope of the ontology (step 1) at this stage is related to the European e-Competence Framework (http://www.ecompetences.eu/) and is mainly focused in connecting the three (d1: e-Competence areas, d2: e-Competences, d3: e-Competence Proficiency Levels) out of four dimensions of which e-CF consists (d4: knowledge and skills was not included, as we plan to use an ontology based on the Bloom's taxonomy). At the time of research, no existing ontology that would satisfy the specific requirements of the project was located (step 2).
For the main structure the terms introduced are: E-cf Proficiency Level, Eqf ProficiencyLevel, eCompetences. The connections developed between the European Qualification Framework (European Qualification Framework for lifelong Learning, 2008) or e-CF levels correspond to the values that levels return to the competences (step 3). The classes and subclasses developed at this part of the ontology (step 4) are the following:

- The Class **ProficiencyLevel:** Represents the third dimension of the e-CF (d3: e-Competence Proficiency level), which describes the level to which a competence is assigned according to the e-CF. Subclasses of this class: E-cfProficiencyLevel, EqfProficiencyLevel
- The Class **eCompetences:** This class represents electronic competences mentioned at e-CF. These competences are classified in five categories: Enable Run, Build, Plan and Manage. As a result, there are five subclasses for this class: Enable_eCompetences, Manage_eCompetences, Build_eCompetences, Plan_eCompetences and Run_eCompetences.

In the OWL language, object properties are used to represent special class features. For the classes above, the object properties (step 5) developed are mentioned below:

Object properties	***Classes***
hasProficiencyLevel	eCompetences (domain) -> e-CFlevel (range)
isRrelatedTo	e-CFProficiencyLevel(domain) -> EqfProficiencyLevel (range)

Inverse object properties	***Classes***
relatesTo	EqfProficiencyLevel (domain) -> e-CFProficiencyLevel (range)
isProficiencyLevelFor	e-CFProficiencyLevel (domain) -> eCompetences (range)

For the subclasses mentioned, the instances (step 7) introduced are listed below:

- **ProficiencyLevel**
  - **E-cfProficiencyLevel:** e-1, e-2, e-3, e-4, e-5
  - **EqfProficiencyLevel:** EQF_3, EQF_4, EQF_5, EQF_6, EQF_7, EQF_8
- **ECompetences: all 36 e-CF competences grouped in five groups:**
  - **Enable_eCompetences** (i.e. Sales_Management, etc.)
  - **Manage_eCompetences** (i.e. Business_Change_Management, etc.)
  - **Plan_eCompetences** (i.e. Service_Level_Management, etc.)
  - **Run_eCompetences** (i.e. User_Support, Change_Support, etc.)
  - **Build_e Competences** (i.e. Design_and_Development, etc.)

Figure 1 represents the main structure of the competence ontology with all the classes, subclasses, instances and object properties.

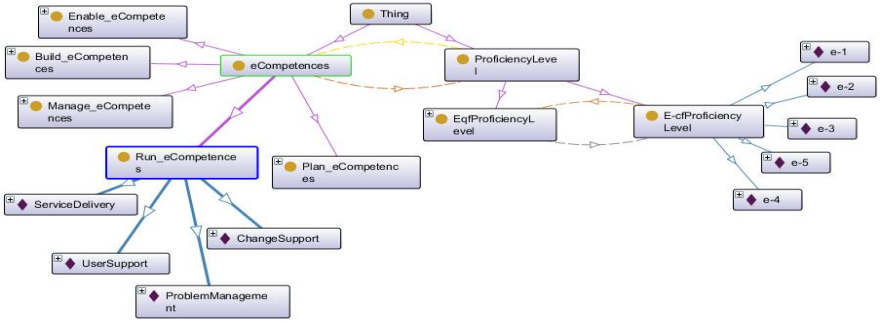

Figure 1. Graphical representation of the ontology

In order to verify if the ontology is developed properly, a series of DL Queries was implemented. These queries follow the Manchester Owl Syntax. For example, the query "Which competences from the ones that belong to the subclasses

Build_eCompetences and Run_eCompetences have level e1?" is answered by the system as in Figure 2.

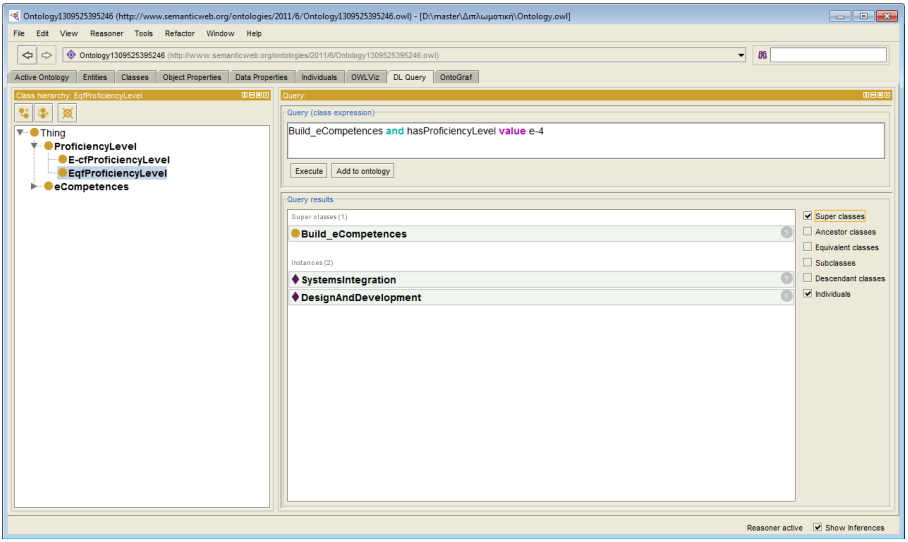

Figure 2. Example competence query and query result

4 Introducing job profiles in the ontology

At this stage, the aim is to relate the term "Job Profiles" with concepts that already exist in the ontology, e.g. "levels" and "competences". Particularly, there has to be a distinct connection (new object property) between the levels and competences, as for every Job Profile there are specific competences –combined with specific levels- required. To illustrate the above, the Job Profile Digital Animator (developed during the PIN project) is used; the job profile is connected with the competence Product or Project Planning, required at the level 3 (Figure 3).

After the description of the topic at this stage (Step 1), the new term "Job Profile" will be represented by the class **JobProfiles** (Step 4). This class includes instances like (Step 7): Digital Animator, Webmaster and Web Designer but not any subclasses (Figure 4).

A. PLAN		
A.4. Product/Project Planning		
Dimension 2: e-Competences: Title + generic description	In analysing and defining the current and target status of the animation project, the digital animator acts systematically in estimating cost effectiveness and decision templates. He maintains a project diary and exploits specialist knowledge in the specification development to create and maintain standard and complex documents of the animation project (such as structure plans, timescales, milestone descriptions).	
Dimension 3: e-Competence proficiency levels	Level 1	
	Level 2	
	Level 3	Exploits specialist knowledge in specification development to create and maintain complex 2D and 3D animations.
	Level 4	
	Level 5	
Dimension 4: Knowledge and Skills	✓ B03 Is precise and aware of details ✓ B04 Is customer oriented	

Figure 3. Excerpt from the Job Profile "Digital Animator"

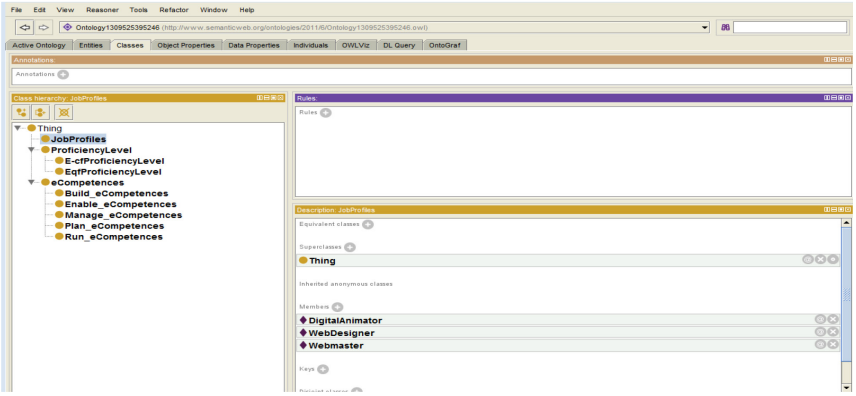

Figure 4. Introducing the class "Job Profiles"

However, to achieve the aim of the ontology at this stage we also need to create new object properties (Step 5), which will connect the classes **ProficiencyLevel**, **eCompetences** and **JobProfiles**. Of course, the previous object properties and inverse object properties are maintained. The present set of object properties is listed below:

Object properties	***Classes***
hasProficiencyLevel	eCompetences (domain)-> e-CFlevel (range)
isRrelatedTo	E-cfProficiencyLevel(domain)-> EqfProficiencyLevel (range)

haseCompetences	JobProfile (domain)-> eCompetences (range)
hasLevel	eCompetences (domain)->ProficiencyLevel(range)
Inverse object properties	***Classes***
relatesTo	EqfProficiencyLevel (domain)-> E-cfProficiencyLevel (range)
isProficiencyLevelFor	e-cfProficiencyLevel (domain) ->eCompetences (range)
belongsToJobProfile	eCompetences (domain) -> JobProfile (range)
isLevelFor	ProficiencyLevel (domain)-> eCompetences (range)

Then we associate every Job Profile with its specific competences, which require specific levels as well. After finishing the construction at this stage, a new series of DL Queries has been implemented to evaluate that the ontology runs properly (Step 8). For example, the query "Which job profiles require the Technology Watching competence?" is answered by the system as in Figure 5.

5. Conclusions and Future Work

In this paper we presented the first edition of a job profiles ontology based on the European eCompetence Framework (e-CF). To evaluate the ontology, we added job profile decsriptions developed in the context of European projects PIN and CompAAL. The ontology has managed to accommodate these profiles successfully; it was also used to answer queries regarding these profiles, proving the usefulness of the approach.

In the next phases of our research, we plan to add more profiles in the ontology, as well as to translate the ontology (and the profiles) in different languages, thus providing a tool with European added value in looking for job profiles. Moreover, we plan to add an ontology for the representation of learning outcomes based on the Bloom's taxonomy (Bloom, 1956-64). This will allow us to match profile descriptions with course outline descriptions and learning objects metadata.

Acknowledgements

Part of this research has been financed by projects PIN (504025-LLP-1-2009-1-ES-LEONARDO-LNW) and CompAAL (518218-LLP-1-2011-1-DE-LEONARDO-LMP). The authors wish to thank fellow researchers for fruitful collaboration.

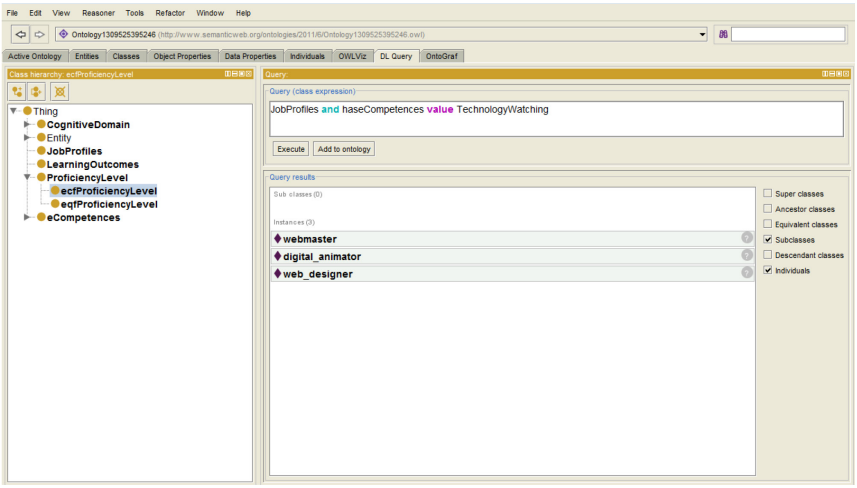

Figure 5. Example competence query and query result

References

Bloom, B. (1956-1964). Taxonomy of Educational Objectives: The classification of educational objectives (Vol. Handbook I: The Cognitive Domain). New York: McKay.

European Qualification Framework for lifelong Learning. (2008, April). Retrieved January 2012, from http://ec.europa.eu/education/pub/pdf/general/eqf/broch_en.pdf

Gruber, T. (1993). A translation approach to portable ontologies. Knowledge Acquisition, Vol. 5, No. 2, pp. 199-220.

Mager, R. (1984). Preparing Instructional Objectives. Belmont,California: Pitman Learning.

Neches, R, Fikes, R, Finin, T, Gruber, T, Patil, R, Senator, T, and Swartout, W. R. (1991). Enabling Technology for Knowledge Sharing. AI Magazine, pp. 36-56.

Noy and McGuiness. (2001). Ontology Development 101: A Guide to Creating Your First Ontology. Standford Medical Informatics Technical Report SMi-2001-0880 and Standford Knowledge Systems Laboratory Technical Report KSL-01-05.