ONTOSSN: Scientific Social Network ONTOlogy

Eya Ben Ahmed
ISG, Tunisia
eya.benahmed@gmail.com

ABSTRACT: *During the past decade, the advent of the social* network has offered several platforms that promote communication *among users on common spaces. Several efforts were devoted to unify the social network domain, particularly the scientific domain through introducing ontology-based modeling of scientific social network. However, the measurement of the researchers standings within the scientific community is generally absent. To overcome this drawback, we propose, in this paper, a scientific social network ontology which includes definitions of main entities and describes main attributes of : Scientific social network concepts aiming to share common understanding of this domain and to reflect the academic career paths.*

Keywords: Knowledge Engineering, Ontology, Social Network, Scientific Social Network.nowledge Engineering, Ontology, Social Network, Scientific Social Network

Received: 14 June 2014, Revised 18 July 2014, Accepted 22 July 2014

1. Introduction

Recently, social network research has spread swiftly with the popularity of the online social websites [9]. As a matter of fact, a social network is a social structure made of individuals who are connected to each other through their particular interdependencies. These social networks are typically characterized by complex network structures and abundant interaction information. Thus, researchers are rousingly interested in addressing a broad spectrum of challenges in efficient social networks modeling to extract thereafter useful knowledge, including recognizing common static structures and dynamic evolutions of social networks.

Parallel to this, ontologies emerge in numerous domains like system engineering, software engineering, multidimensional databases [1], biomedical area, semantic web, etc. The most known definition of ontology is given by Gruber [3]. An ontology is a formal, explicit specification of a shared conceptualization. Conceptualization relates to a summary model of given domain knowledge. The key feature indicates that ontology has to be common in related domain [11]. Thus, we argue that ontologies leverage conceptual models. This aforementioned feature has been investigated by researchers to represent social network systems. Two main trends of researches have emerged: (i) those using ontology to enrich the social network analysis, and (ii) those representing the social network through an ontological form. In this context, we, exclusively, concentrate on the second pool of approaches. In addition, we focus particularly on scientific social network. The literature witnesses a determined effort the researchers. Indeed, any recommendation of domain references, namely, book, journal paper, or conference paper closely depends of the researcher reputation.

To tackle the above-mentioned limitation, we propose to build a new ontology in the scientific social network domain. Several motivations are behind our proposal : (i) analyzing the Scientific social network knowledge, (ii) sharing the common understanding of the structure of scientific social network; (iii) enabling the reuse of scientists domain knowledge and (iv) clearly separating such a domain knowledge from the operational knowledge. Usually, an ontology development regularly encompasses several steps. Diverse methodologies order them differently. In our work, we opt for the most used methodology, namely the Noy and Mcguinness' method [8].

The paper is organized as follows. Section 2 scrutinizes the related work that focused on ontological modeling for social network. Section 3 describes our new designed ontology. Section 4 presents our experimental study validating our proposal. Section 5 concludes the paper by summarizing the key results and suggesting future work.

2. Related Work: Ontological Modeling For Social Network

Basically, an ontology 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 [7]. Indeed, the ontology is used as tool that produces a comprehensible conceptual structure to a specific domain of interest [10]. Currently, ontology has started to become more widespread within the context of the social web. There are a number of papers in the literature that use ontology in social network to create constructive insights. Some well-known ontologies, such as FOAF [4], Flink [6], are used to extract and analyze social network.

Exclusively, in this context, we concentrate on ontology-based scientific social network analysis. Chen et *al*. [2] introduce a building and analyzing process of semantic-based social network. First, they identify the research aims. Then, they define nodes and edges in social network. After that, they build the social network ontology. Indeed, distinguished concepts are outlined to both of node concepts and attribute concepts which are drawn to depict the node. Regarding relations of the ontology, they encompass relations between nodes and between nodes and attributes. Such a created ontology can be used to build semantic based social network.

It is noteworthy that all above cited proposals were not interested in integrating the academic impact of researchers in modeling ontology-based scientific social networks. They were only limited to describe the existing researchers without any rating dimension.

In this paper, our main thrust is to model the scientific social network through incorporating the leveraging of researchers.

3. Scientific Social Network Ontology

The design of our ontology is guided by the Noy and Mcguinness' method [8]. It includes the following seven steps:
(1) Identify the domain and scope of the ontology; (2) Consider reusing existing ontologies; (3) Identify the important terms of the ontology; (4) Define the classes and the hierarchy of classes; (5) Define the properties of the classes (the attributes); (6) Define the facets of the attributes and (7) Create instances of the classes.

Step1: Determination of the Ontology Scope
During this first step, a range of questions should be will cover? For what we are going to use the ontology? For what types of questions the information in the ontology should provide answers? and Who will use and maintain the ontology? Indeed, we start by defining our ontology domain and scope. Indeed, our ontology will cover the scientific social network. It will be used for complex social rules discovery and may answer several questions, such as what researcher? what topic ? what institute ? etc.

Step2: Consideration of reusing existing ontologies
Aiming to save the effort and interact with the tools that use other ontologies, it is possible to reuse existing ontologies. However, in our context, we opt for building our ontology from scratch.

Step 3: Identification of the important terms in the ontology
During this stage, it is primordial to address a list of all terms related to domain of interest. What are the terms we would like to talk about? What properties do those terms have? What would we like to say about those terms? For example, our important terms will include: researchers, profiles, publications, journals, conferences, book chapters, ...etc.

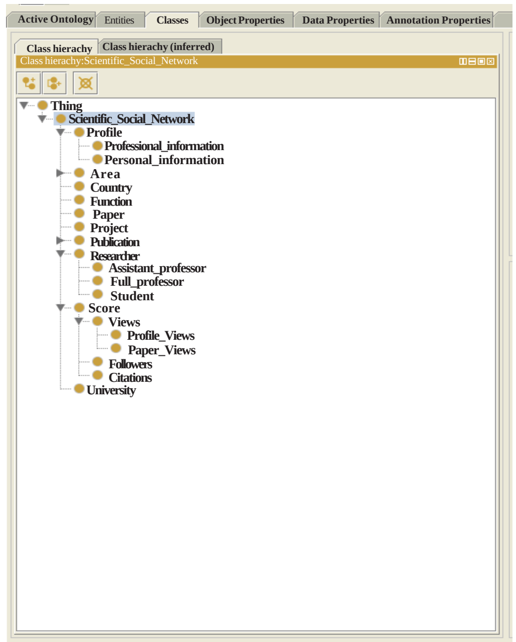

Figure 1. Structure of our SSN ontology

Step 4: Definition of the classes and the class hierarchy

It is necessary to identify classes through selecting the terms that express the objects and we arrange these classes in a hierarchical taxonomy. Figure 1 illustrates our ONTOSSN: Scientific Social Network ONTOlogy structure. Several probable approaches in developing a class hierarchy exist. We opt for a top-down development process which begins with the designation of the most general concepts in the domain and consequent specialization of the concepts (c.f. figure 2). For example, in our context, we define Researcher, Publication and Score as general concepts. Then we categorize the Researcher class by defining some of its subclasses: Student, Assistant professor and Full professor as shown in figure 3 and so on (c.f. figure 4 and figure 5).

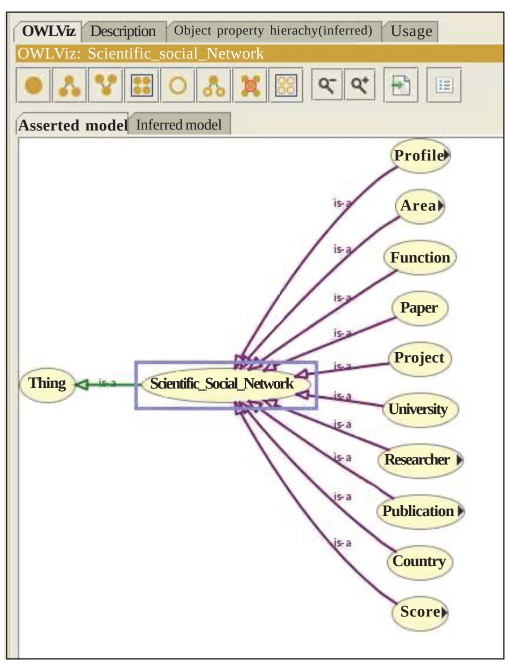

Figure 2. The class hierarchy of our *SSN* ontology

Step 5: Definition of the properties of the classes
Once, we have defined the classes, it is notable to describe the internal structure of concepts. For example, the paper class has the following properties: title, abstract and keywords.

Step 6: Definition of the facets of the attributes
In this step, we define the value type of the attributes: the types of value capable to be affected to an attribute such as: number, string, character, Boolean, etc.

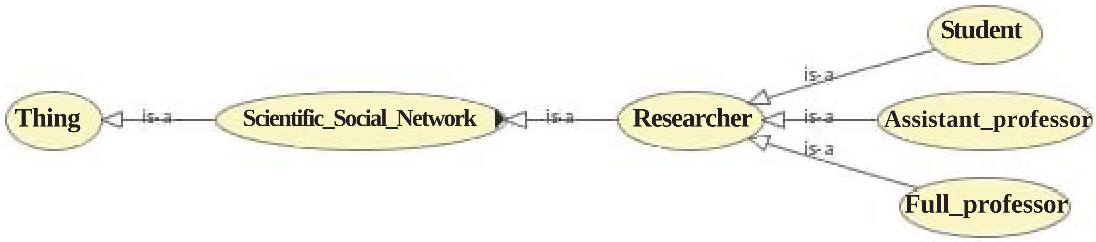

Figure 3. Part of our *SSN* ontology related to researches

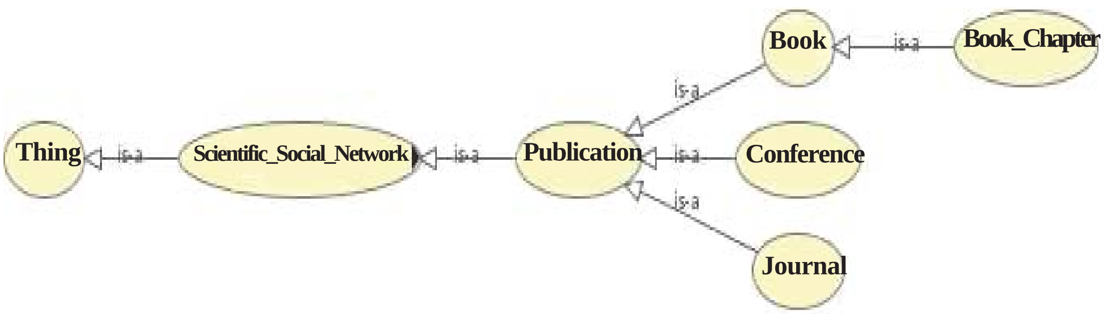

Figure 4. Part of our *SSN* ontology related to publications

Step 7: Creation of the instances of classes
The last step is to create individual instances of classes and assign their attributes. The tab "*Individuals*" of protg allows the creation of real entities. For example, the *Research Gate* is an illustration of individual scientific social network as presented in figure 7.

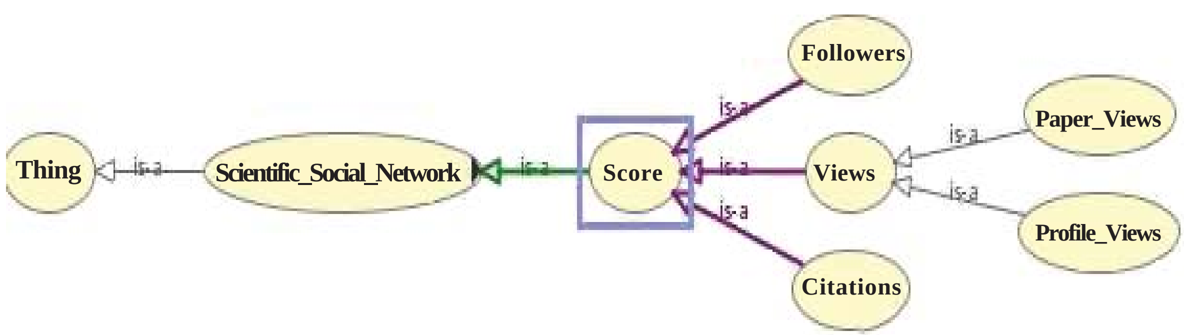

Figure 5. Part of our *SSN* ontology related to score

4. Experimental Study

In this section, we try to evaluate our ontology through our extensive experiments. The latter were carried out on a PC equipped with an Intel processor having as clock frequency 1.73GHz and 4 GB of main memory. We tested the coherence of our ontology model using the Furst criteria by the reasoner Fact ++ to validate the consistency of our model as sketched in figure 8. The obtained results point out the following assertions: (i) clarity of definitions; (ii) no redundancy of concepts and relationships and (iii) scalability of our introduced ontology.

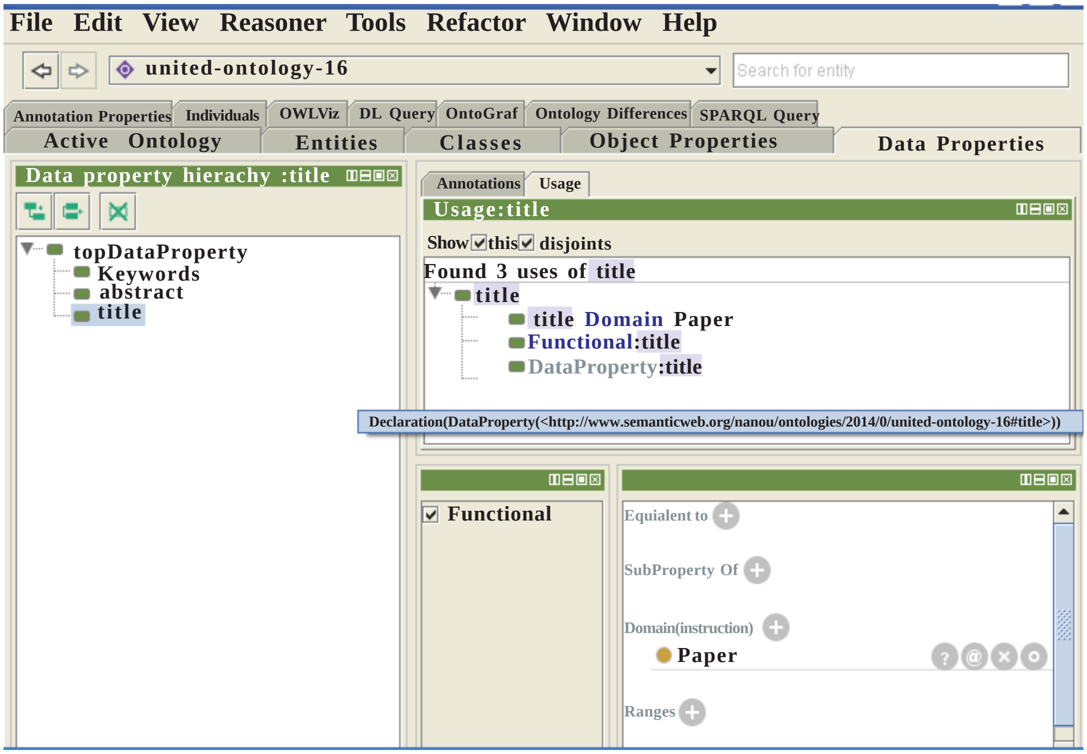

Figure 6. The paper class properties

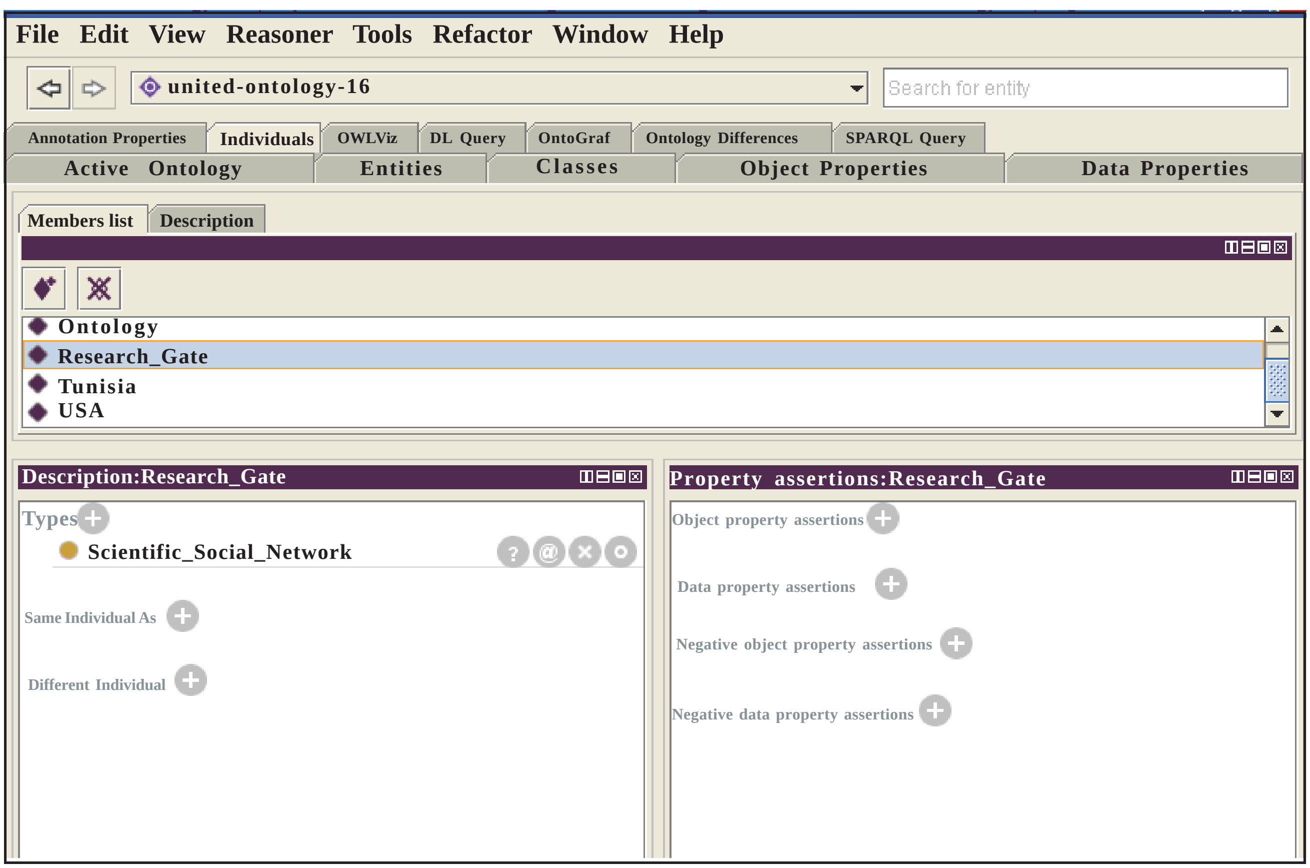

Figure 7. The "*Research Gate*" an individual illustration

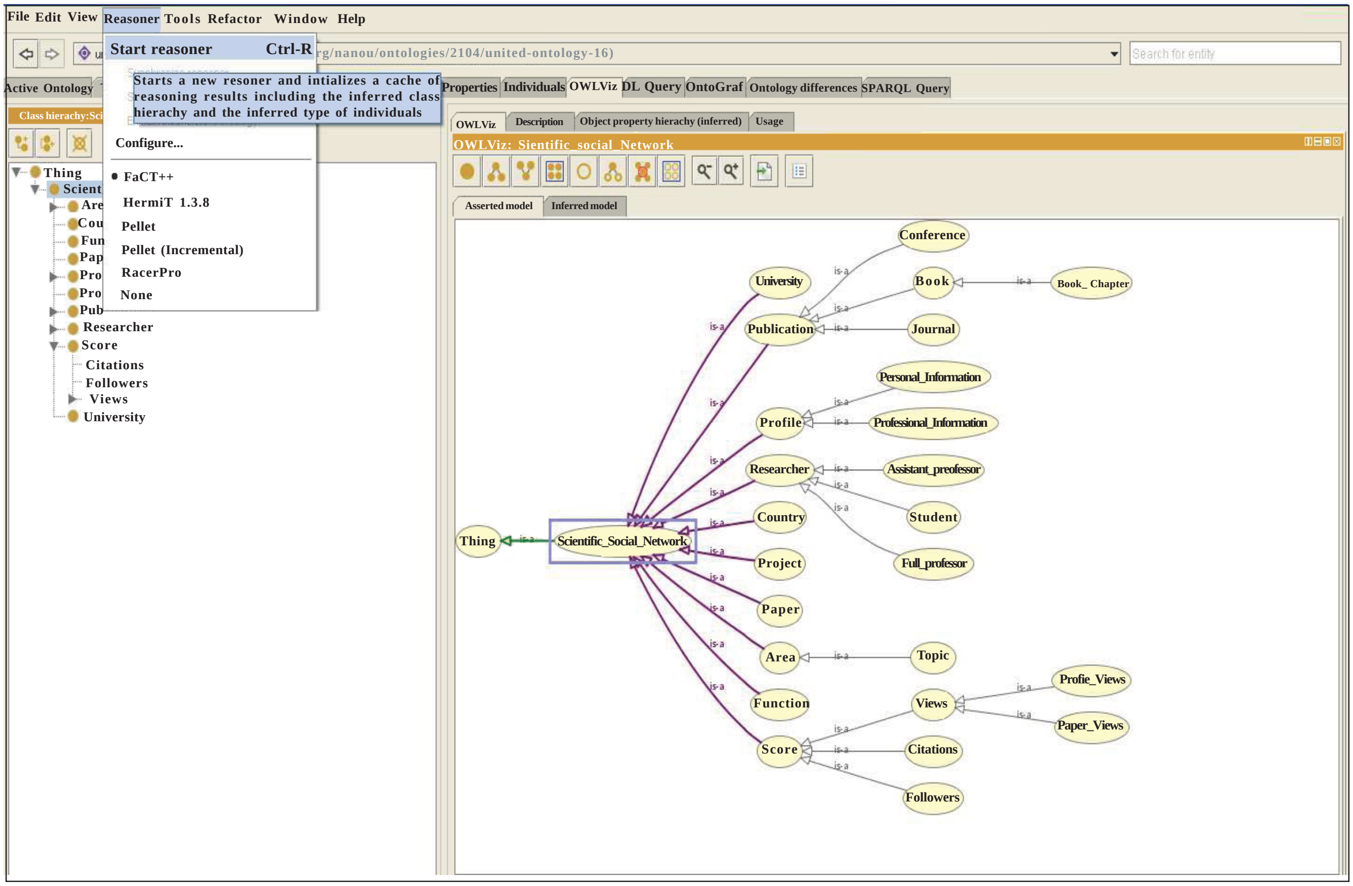

Figure 8. Validation of our *SSN* ontology using Fact ++

5. Conclusion

Social network data currently increasingly emerges everywhere. Particularly, scientific social network which describes the scientific interaction between researchers. After a deep study of ontological modeling of scientific social network, we introduce a new ontology for an enhanced scientific social network representation. Currently, we are studying two main issues: (1) the scrutinize of the impact of the social network evolution on our proposal [5] and (2) the consideration of uncertainty on handling advanced social network mining.

References

[1] Ben Ahmed, E., Nabli, A., Gargouri, F. (2012). Building Conflict-Aware Profiling Ontology from Data Warehouses, *International Journal of Computer Applications*, 48, p. 18-24.

[2] Chen, L.,Wei, S., Qingpu, Z. (2010). Semantic Description of Social Network Based on Ontology, International Conference on E-Business and EGovernment (ICEE), p. 1936-1939.

[3] Gruber, T. R. (1993). A translation approach to portable ontology specifications. *In*: Knowledge Acquisition, 5, p. 199-220.

[4] Golbeck, J., Rothstein, M. (2007). Linking Social Networks on the Web with FOAF: A Semantic Web Case Study. Proceedings of the Twenty- Second AAAI Conference on Artificial Intelligence. Vancouver, p. 1138-1143.

[5] Leskovec, J., Backstrom, L., Kumar, R., Tomkins, A. (2008). Microscopic Evolution of Social Networks, *In*: Proceedings of the 14th ACM SIGKDD International Conference on Knowledge Discovery and Data Mining, p. 462-470.

[6] Flink Mika, P. (2005). Semantic Web Technology for the Extraction and Analysis of Social Networks. *Journal of Web Semantics*, 3, p. 211-223.

[7] Neches, R., Fikes, R., Finin, T., Gruber, T., Patil, R., Senator, T., Swartout, W. R. (1991). Enabling Technology for Knowledge Sharing, *Artificial Intelligence Magazine*. p. 36-56.

[8] Noy, N. F., Mcguinness, D. L. (2002). Ontology Development 101: A Guide to Creating Your First Ontology. University of Stanford, Stanford, CA, 94305.

[9] Scott, J. (2000). Social network analysis: a hand book. Sage Publications Ltd.

[10] Spyns, P., Meersman, R., Jarrar, M. (2002). Data modelling versus ontology engineering. *SIGMOD Record*, 31(4), p. 12-17.

[11] Guarino, N., Giaretta, P. (1995). Ontologies and knowledge bases, towards a terminological clarification. Towards very large knowledge bases: knowledge building and knowledge sharing, IOS Presse, p. 25-32.