Ontologies in the Context of Knowledge Organization and Interoperability in e-Government Services

José Angel Martínez Usero
Universidad Complutense de Madrid
Information Science Lecturer
Tel: 34-913946675
Fax: 91 3946669
e-mail: joseangel@caelo.eubd.ucm.es

Maria Pilar Beltrán Orenes
Universidad Complutense de Madrid
Information Science Lecturer
Tel. +34 913947142
Fax: +34 913942281
e-mail: mpbeltran@ccinf.ucm.es

Abstract: A philosophical and technical approach of the concept of ontology is introduced and the importance of ontologies to structure, manage and retrieve the knowledge of different scientific fields and various political and social contexts is enhanced. The tools related to ontology management and the languages used for ontology creation are revised. In particular, an identification of the web-based ontology mark-up languages that contribute to knowledge representation and organization in this electronic and hypertextual environment, such as DAML+OIL, OWL and OML, is carried out. Finally, ontologies are presented as the basis for semantic web development and as a tool to guarantee information interoperability in e-government services. In this sense, some examples of initiatives for ontology application in electronic public services are provided.

Keywords: ontologies, knowledge management, knowledge representation, semantic web, e-government

Introduction

The origin of ontologies comes from Metaphysics where an ontology is considered a completely generic concept. The term ontology implies the creation of a formal structure in a specific domain and each ontology includes the interaction rules with other entities in the domain as well as their characteristics. With the ICT revolution, a wide range of technical applications of ontologies in diferent fields (for example Artificial Inteligence, Information Science and Knowledge Management) have come into sight.

Nowadays, a set of different ontology creation languages for web applications are being developed to facilitate knowledge representation of web resources. Therefore,

ontologies are considered as a way to structure electronic information and improve human and machine information retrieval (Daddieco, 2004). Having into consideration existing standard technologies for ontology creation, Governments around the world have started ambitious projects for ontology application in e-government services knowledge management (Hovy, 2003).

The concept, objective and structure of knowledge ontologies

Several approaches to the ontology concept have been made from diverse and heterogeneus disciplines which work in the application of ontologies to knowledge structuring from various points of view. Acoording to Vossen, the main approaches have been made in the field of Philosophy, Cognitive Sciences, Artificial Inteligence and Information Science, and each discipline has developed specific tools for ontology creation and management.

In the field of Information Science, San Segundo and Beltrán define ontology as "the instruments or structures with a technological translation that can be used for knowledge representation in web catalogs, databases, subject heading lists, glossaries, thesauri and other vocabulary control devices".

The main objective of an ontology consists of improving information representation and information retrieval. More specifically (Noy and MacGuinnes, 2001) the main objectives of an ontology are: to make possible the knowledge analysis in a field, establishing terms and relations, to separate the knowledge among domains, to allow knowledge re-utilization, and to share the common understanding of information structure among humans or software agents. This last item facilitates the web content extraction and retrieval and it is considered a key element for the future semantic web (Berners-Lee et al., 2001). So, ontologies provide meaning to information units (contents) and add some value to information management due to they contribute to "deliver the correct information to the correct user, in the correct moment and in the correct way" (Topquadrant, 2003).

Refering to structure, an ontology represents a way for describing the knowledge of a domain and it is composed by four main parts (García Jiménez, 2004): classes and subclasses (the concepts); slots (also called roles or properties), that limit the characteristics of each concept; facets (or role restrictions), that describes the possible characteristics for an slot; and instances, considered the objects of a class.

Web-based ontology mark-up languagues for electronic knowledge organization: DAML+OIL, OWL and OML

From a technical perspective, an ontology is a tool defined by the following traits: it is a finite vocabulary, controlable and extensible; it establishes without ambiguity the classes, terms and their relations; it presents a strict hierarchy among classes and sub-classes; it can specify the particular properties of a class; and it can decide the inclusion of a unique item or not.

There are many different methods for ontology creation, most of them proposed and experimented in the context of research projects. There are also a variety of tools (Ding, 2001 and Corcho et al., 2003) for ontology building and management. However, in this research the languages for ontology creation are enhaced because of their contribution to electronic knowledge representation.

The Web represents a very extense and dinamic knowledge base, so the implementation of a specific ontology definition language and the subsequent consistency of the resulting ontologies are a complicated challenge, mainly due to the disorganized nature of semantic web. Ontologies are framed in the set of technologies responsible for the transition from the traditional web to the semantic web. In this sense, Hodgson establishes that semantic interoperability in a web environment can be achieved through the application of three complementary technologies based on XML: the metadata language RDF, the ontology languages (DAML+OIL, OWL, OML), and the topic maps.

The ontology language called OIL (Ontology Inference Layer) was developed in the framework of two research projects: On-To-Knowledge and IBROW. It is the first ontology representation language based on W3C standards, including a XML sintaxis. Combining American and European efforts oriented to develop standarised ontology languages, a new ontology language, called DAML+OIL, is created (KM.Gov, 2005).

DAML+OIL is an ontology language proposal created by the co-operation of two work teams: the above mentioned OIL work team in Europe, and DARPA in USA, that formely had developed the language called DAML (DARPA's Agent Markup Language). Therefore, DAML+OIL is a new and more advanced standard language.

The ontology language OWL (Web Ontology Language) appears in July 2002 as a product of the work team WebOnt (Web-Ontology) of the W3C, that publishes the first draft. OWL is based on XML technology, derived from DAML-OIL and able to interoperate with RDF schemes. On Febrary 10th 2004 OWL obtains the status of W3C recommendation and it is widely used to describe classes and relations of web resources.

The last language analysed, called OML (Ontology Markup Language) is the translation of SHOE (Simple HTML Ontology Extensions) into XML . However OML is much more advanced than SHOE and compatible with RDF scheme.

In the context of this standarization process is very important the work carried out by ISO 46 Technical Committee, as the creator of a reference ontology for cultural information interchange (Cover Pages, 2002). As a result, the Committee Draft ISO/CD 21127 was published in Agusth 8th 2002. In the drat a formal ontology in the cultural information field is described. This ontology tries to cover all relevant concepts for cultural and historical information, foremost these linked to data interchange among public organisations, such as libraries, museums and archives.

The application of ontology languages in e-government services

In the e-government technological, political and cultural field, semantic web technologies generate new opportunities for information interoperability. In this way, ontologies, as a key technology for semantic web development, are considered essential to guarantee data and content interoperability in such a heterogeneous and multilevel knowledge field (Klischewski, 2003). Ontologies provide a common vocabulary to understand information and knowledge contained in web resources. Therefore, machines can add automatic meaning to web resources, discover relations among resources, and limit searches only to relevant resources for a specific query.

W3C standard technologies foster semantic interoperability as a whole. In this sense, ontologies are important for e-government service integration. Public services are developed through several organizations participation and ontologies contribute to create a common vocabulary to facilitate web resources access and retrieval. If Goverments carry out the integration of different levels of e-goverment services without a common vocabulary, the integration of heterogenious resources from different administrative level and the adequate retrieval of relevant resources would not be possible.

From a technlogical approach, Daconta, Obrst y Smith propose a tridimensional model about standard technologies related to web content interoperability evolution (Figure 1).

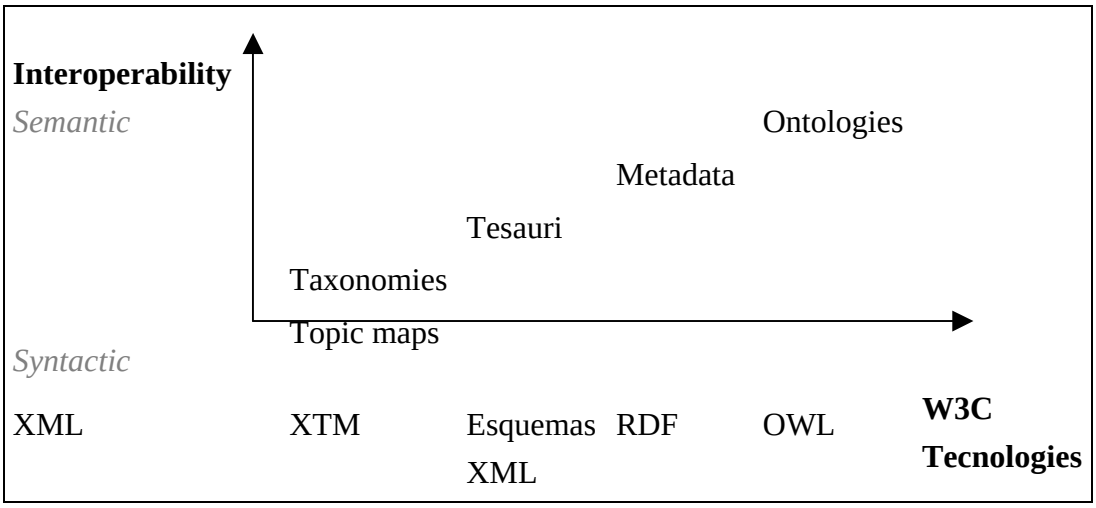

Figure.1. Dimensions of semantic technologies vs. interoperability
Source: Daconta, Obrst y Smith, 2003

Some Governments around the world are using semantic web technologies for e-goverment services development. In this context, the projects related to ontology application for web knowledge management are normally concentrated on specific services (Fraser, 2003). In the European Union level, two IST projects propose the use of ontologies for electronic knowledge management in e-government services. The Webocracy project (Paralic and Sabol, 2003) is oriented to the usage of ontologies for structuring organizational information in order to improve information representation and retrieval capabilities. The OntoGov project (Tambouris et al., 2004) aims to develop, test and validate an e-government platform semantically enriched through the use of ontologies. Apart from the above mentioned projects and initiatives, a considerable proportion of the applications of ontologies in e-government services are oriented to electronic document management (Klischewski, 2003) and workflow change management (Ae Chun and Atluri, 2003).

Conclusions

Public Administrations manage huge amounts of data, information and knowledge. In order to manage electronic contents of e-government services ontologies are proved to be an adequate tool to improve resource integration an retrieval.

There are several standard ontology languages to create ontologies. However, the ontology applications in e-government services are linked to very specific projects with specific needs and there is not an exhaustive analysis of international application needs. Therefore, when an application needs to be used in a different administrative level or specific services some adaptions and changes have to be made.

All administrative levels (local, regional, national, European, Groups of countries and International) should agree a standard ontology to identify electronic resources and use it appropiately in order to foster interoperability and improve the access to public information resources as a way to attenuate digital divide and fight for equal opportunities.

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