On the Relativity of Ontological Domains and Their Specifications

E. Kapetanios
Semantic Technologies, Switzerland

INTRODUCTION

Business knowledge is considered the most valuable resource of organizations. The exchange of business knowledge within an organization as well as among different cooperating organizations is considered a major promotion of know-how and better coordination of various organization units, as well as an increase of the value of an organization itself.

In the era of "information overload" and an ever increasing "networked world," however, where the premium of business and IT is placed on communications and distributed computing and networks, semantics play a crucial role. To this extent, the usage of *semantic technology* should encourage not only *information globalism*, but also *information particularism*, in which:

- individuals or groups define, generate, and access information in ways that make sense to them,
- information is accessible across the business by integrating different and, very often, controversial points of view, and
- semantic heterogeneity is not treated as a "necessary evil," but also encouraged by the technology and solutions.

Meeting these challenges is considered a key issue in order to enable real knowledge exchange and cope with inherited diversities such as cultural differences, vaguely formulated or uncertain specifications, relativity of concept validity, and so forth. This goal becomes more crucial when, for example, advanced scientific (biology, physics, chemistry, etc.) or engineering application domains in large business settings and environments are concerned.

BACKGROUND

Knowledge models, or *ontologies*, are a necessary precondition to any semantic application (Bresciani & Fontana, 2002; Kapetanios, 2002; Kapetanios, Baer, & Groenewoud, 2003; Kapetanios, Baer, Groenewoud, Mueller, Novosad, 2004; Sugumaran & Storey, 2002). Ontologies have emerged over the last 10 years as a core technology and fundamental data model for knowledge systems.

They enable various advanced functions, for example, smart search (Andreasen, Motro, Christiansen, & Larsen, 2002), and are the foundation of the (emerging) semantic Web (Berners-Lee, Hendler, & Lassila, 2001; Davis, Fensel, D., Hendler A. J, Lieberman H., Wahlster W., & Harmelen, 2002; Fensel, Hendler, Lieberman, & Wahlster, 2002). Ontology-enabled semantic technologies show great promise for the next generation of more capable information technology solutions because they can solve some problems much more simply than before and make it possible to provide certain capabilities that have otherwise been very difficult to support.

The current state of the art, however, on representing and using ontologies has grown out of several efforts that started in the 1980s. Back then, KL-ONE was the most influential of the frame-based representation languages; it allowed for the representation of categories and instances, with inheritance of category properties, and a formal logic (Baader, Calvanese, McGuinness, Nardi, & Patel-Schneider, 2003) for expressing the meaning of properties and categories. At about the same time, rule-based systems were a promising technology. The NASA-sponsored C-Language Integrated Production System (CLIPS) became a de facto standard for building and deploying rule-based systems.

The Knowledge Interchange Format (KIF) and its accompanying translation tool Ontolingua were developed to allow knowledge to be shared among these different efforts, and provided the capability to translate knowledge bases in one representation language to another. These languages were ahead of their time. As a result, they have remained largely within academia, gaining little commercial support.

With the advent of the World Wide Web and the acceptance of XML (extended markup language) as a de facto standard for the representation of information on the Web, ontology efforts joined in. An early project at the University of Maryland produced SHOE (simple HTML [hypertext markup language] ontology extension), a system for expressing ontologies in XML and marking up Web pages with ontology-based annotations. Many of the ideas from this work made it into the World Wide Web Consortium (W3C; http://www.w3c.org) proposal for the Resource Description Framework (RDF) language (http:/

/www.w3c.org/RDF). Moreover, languages such as DAML (Defense Advanced Research Projects Agency - DARPA - or agent markup language), DAML+OIL (Ontology Inference Layer), and OWL (Web ontology language; http://www.w3c.org/2001/sw/WebOnt), which became a foundation for the W3C Web ontology language, are built on RDF.

However, the major assumption underlying all currently available ontology description formalisms and languages has been the "common view" of a conceptualization of an application domain (Berners-Lee et al., 2001; Davis et al., 2002; Fensel, Hendler, Lieberman, & Wahlster, 2002). This is also reflected in currently available ontology development tools, which are a key factor in adoption of semantic technology. Many tools are still offered as research prototypes, but many others have begun to be commercialized (they are often commercial versions of their direct research counterparts). Standard compliance and support for RDF and OWL is growing. Due to the different forms of RDF, ontology tools still do not interoperate well.

It turns out that the assumption of a common view is an unrealistic one given the ever increasing networked world, which results in a wide range of user perspectives and points of view of the same concepts within, for example, different organizational units or cultural and social environments. Information and knowledge exchange should pay tribute to these diversities in order to increase information quality and interpretability, as well as to strengthen collaboration among various user communities or organizational units and processes.

PRESENTING ONTOCONTEXT

The most outstanding difference between OntoContext and other ontology description languages and editors is twofold.

- The support of concept relativity in terms of diverse perspectives, viewpoints, natural languages, and so forth, which are reflected in both the ontology description language and the tool itself.
- Functioning as a collaborative platform and a database-driven approach reflecting concept relativity such that large-scale ontologies are enabled and shared by a wide range of end users.

Conceptulization According to Relativism

OntoContext addresses relativity and perspectiveness within an ontology in a twofold manner:

1) an ontology *external context*, such as bounding the representation of concepts to particular user environments such as natural language, roles of organization units, and so forth, and
2) an ontology *internal context*, enabling the expression of holding conditions or constraints under which concepts, business rules, and their definition, even in an agreed-upon ontology, become relevant.

Examples of an ontology internal context are given by

- the consideration of the validity of properties, value domains, or classification hierarchies under specific conditions,
- the definition of the membership of instances to classes according to the distinction between *necessary* and *sufficient* conditions,
- the definition of percentages for the membership of instances to classes,
- the definition of classes according to the distinction between prototypes and well-established properties, and
- the naming of concepts by using more than once the same name within the same ontology description name space (no unique name assumption).

As far as the database-driven availability and management of large-scale ontologies is concerned, this strengthens their practicability and usage in multiuser environments, and enables the implementation and coordination of authoring or editing facilities among various user communities, in addition to querying and sharing of business knowledge.

As far as the human-computer interaction facilities are concerned, they are addressed by a graphical user interface, which

- is free of knowledge-based formalisms and concepts,
- enables interaction with the business knowledge in more than one natural language,
- enables adaptation to particular user environments with respect to ontology external context, and
- enables the presentation of the ontology internal context issues, as stated above.

Tool Description and Architecture

The concept-relativity issues as described above are reflected in the OntoContext tool, which is an ontology development tool. However, the outstanding difference between OntoContext as an ontology development tool and other ones is

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