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Web Ontologies and Philosophical Aspects of Knowledge Management

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ABSTRACT

This paper is a brief assessment of the interaction between the philosophical aspects of Web Ontologies and their role in the cutting edge development in information management – the Semantic Web. The term ontology has been traditionally used as a component of the standard philosophical vocabulary. Recently, the study of ontologies developed into a multidisciplinary undertaking. We analyze the key aspects of the developing field of Web Ontologies and show how different dimensions of ontology research contributed to the newly found interaction between the variety of disciplines such as philosophy, sociology, anthropology, and computer science. Ontology recapitulates technology.

INTRODUCTION

The astonishing growth of Internet shifted the focus of academic and industrial community from the purely technical challenges to the semantics of knowledge representation on the Web. The term Semantic Web is a reflection of this change, whereby the Web is viewed as a complex infrastructure involving (empirically) multiple communities and (conceptually) multiple semantic domains or ontologies.

In this context, the Web Ontologies are often defined as conceptualizations which "provide a shared and common understanding of a domain that can be communicated between people and heterogeneous and widely spread application systems." (Fensel, 2003). The study of ontologies is recognized as a multidisciplinary undertaking: researchers from a variety of fields are investigating the ways in which meaning can be transparently represented on the Web and shared by Web communities, thus creating the more *humane* Web structure. Moreover, due to the continuing *globalization* trend increasingly involving communities from the developing countries, the ongoing Semantic Web project requires cooperation between the parties belonging to different social and economic environments. Consequently, the interaction between philosophical and technical aspects of the information management process became an intrinsic element of the recent revolutionary changes in information technology.

ONTOLOGY IN PHILOSOPHICAL DISCOURSE

The term ontology – 'study of being' - assumes a strong philosophical association and typically attributed to metaphysics.

Within the positivist tradition the issue of ontological commitment is considered in a seemingly neutral framework with an explicit stress on logical/linguistic analysis, while avoiding the term metaphysics as archaic. This approach goes back at least to Spencer's project of unified science, where he developed in a systematic manner such concepts as system, organization, negative and positive feedback, control, dynamic equilibrium etc. Spencer was among the first to recognize that phenomena ostensibly belonging to different 'ontological' domains have important invariant characteristics. Considering biological and social phenomena, Spencer emphasizes that they represent "*analogies between the systems, or methods of organization: there is in both a mutual dependence of parts*" (Spencer, 1981). Consequently, he indicates, biological and social growth is accompanied by the "continually increasing complexity of structure" when "parts gradually acquire a mutual dependence." He further specifies this dependence as a development and "maintenance of … positively regulative and negatively regulative" systems of control. Spencer's conceptual framework was a precursor of the General Systems Theory and Cybernetics. Among the later notable developments of positivism is Mach's theory of 'neutral elements of experience', which inspired both the early Russell's version of logical atomism and logical positivism of the Vienna Circle (Carnap, 1959). At the same time, Quine construes an ontological commitment as a choice of a conceptual framework dependant on logic and language, thus undermining the thesis of ontologically 'neutral' experience (Quine, 1969).

Within the continental tradition the influential phenomenological school also claimed to study ontologies by the rigorous scientific methods, though based on the 'conventional' methodology going back to Descartes and Kant. For Husserl, an ontology represents a conceptual unity revealed in the process of eidetic phenomenological reduction. Such a reduction was intended to discover invariant structural properties of different ontological realms, thus laying the ontological foundation for empirical sciences (Husserl, 1980). In this context ontologies represent patterns or a collections of patterns related to particular knowledge domains. Such patterns could be described by a variety of mathematical methods – the idea not foreign to phenomenology, if we consider mathematical practice as a form of eidetic intuition. Especially interesting in this respect is *mereology* clearly traceable to the ideas of Franz Brentano and Husserl (Simons, 1987). Mereology and the related *catastrophe theory* can be also linked to Spencer's 'systemic' approach (Thom, 1975). However, the crisis of the 'rigorous' phenomenological approach forced Husserl to introduce the concept of Life-World (Husserl, 1970). The notion of Life-World reinforces the importance of cultural dimensions for the assumingly 'pure' study of ontologies. Thus, seemingly diverse philosophical developments prepared ontological studies as an interdisciplinary area.

ONTOLOGIES IN INTERDISCIPLINARY CONTEXT

What is exciting is the truly interdisciplinary and *global* character of research efforts needed to develop and implement the emerging Web project. The global nature of this undertaking is rooted, first, in the increasingly global nature of modern economy and, second, in the strong connotation between the content of knowledge and its formal representation in culturally diverse environments. Interestingly enough, we've come to the point in history when the practical fields of business and politics find it important to team up with philosophy previously often treated as impractical or useless! This tendency towards the integration of philosophical and moral studies with business, politics, and technology brings hope to those of us who are looking to advance not only material prosperity but also human values and intercultural understanding.

The applied multifaceted study of Web Ontologies involves philosophy, social sciences as well as computer science and mathematics. Overall, it includes but not limited to:

- Philosophical study of ontologies in a spirit of both Anglo-American *analytic* as well as *continental* tradition, including phenomenological and any other approach.

- Empirical study of ontologies, including sociological and psychological analysis of the Web communities.
- Ontologies in a context of computer science and mathematics including the study of formal structure of ontologies and Web communities, the 'mappings' between ontologies, ontology languages, intelligent data search.

What seems to be at the core of this diverse field is an issue of *knowledge representation*. The *Semantic Web* concept assumes that explicit representation of *knowledge* (*metadata*) is the answer to information explosion we face on the Web. In this context, the Semantic Web project is focused on reshaping the Web into the multifaceted *semantic* infrastructure where philosophical, social, moral, and technical aspects of knowledge management are equally important.

KNOWLEDGE REPRESENTATION ON THE WEB AND DISTRIBUTED COMPUTING

The practical implementation of the Semantic Web is aimed at reshaping the Web as a hierarchy of ontologies representing different knowledge domains such as e-commerce, travel, art etc. The leading candidates for the future linguistic skeleton of the *Semantic Web* are modifications of XML, with OWL emerging as a language of choice for the long awaited framework of the Semantic Web. The new forms of knowledge representation require new forms of distributed computing, with emphasis on *agent-oriented* paradigm. The intelligent agents are autonomous computer programs empowered to assist or even to substitute humans in the decision making process. The heterogeneous Web Ontology environment could enhance availability of agent-to-agent Web interactions, leading eventually to the development of multiagent systems distributed over the global network. As a result, the agents could be eventually entrusted with all or most of the details of typical Web interactions.

Considering that an agent may be required to make critical decisions in real time, we have to consider the correlation between the ability to make a decision and the corresponding measure of moral responsibility. Is a decision making ability in a socially rich environment sufficient to turn an *intelligent software agent* into a *moral agent*? Does passing the Turing test qualify an intelligent agent as also a moral agent?

MORAL ASPECTS OF DISTRIBUTED KNOWLEDGE MANAGEMENT

Some researchers maintain that it's sensible to recognize an artificial intelligent *agent* as at least a moral *patient* (Floridi, in press). Independent of weather the last point is correct *in principle*; it's clear that mobile intelligent technology represents a significant challenge, further erasing the boundaries between the 'computers and humanities.' Hence, the importance of the essentially philosophical conceptual framework for the design and development of information management systems. Once social and moral considerations are incorporated into standard software design procedures, becoming an integral component of the software engineering culture, they would be able to reshape information management environment, including software development practice.

From moral and social perspectives we should always consider the possible damage a particular intelligent technology can cause and the consequent moral constraints to be imposed on its design and use. In this context, the cooperation between philosophers and computer scientists in design and development of information systems in general and intelligent technologies in particular is not only desirable but even mandatory. We should keep in mind that the benefits and the side effects of intelligent Web technologies are closely interrelated. For example, some Web protocols can be excessively intrusive. The current business practice in the 'consumer society' is often aimed at engineering the artificial needs and consequently creating the products to 'satisfy' them. Too often humans and human rights are redefined by the corporations and politicians as consumers and consumer rights. This point carries on to the Semantic Web project and in particular to Web-based technologies enabled and often intended to amplify the potentially abusive impact of intrusive business practices. The developers of such technologies should be able to distinguish between a support tool design and a 'social engineering' tool design. It would be reasonable to expect IEEE software engineering standards to address social concerns related to security, privacy and the overall behavior of intelligent technologies by mandating some sort of security mechanism as an integral part of overall system architecture in general and of software architecture in particular.1

CODA

We would like to finish with methodological remarks. The rapid development of information technology is transforming all aspects of social life – from entertainment industry to business, politics, and art. We have been experiencing the ever-deepening penetration of information technology into the very fabric of our society. An important question is whether design principles for advanced information management tools should be based on the *a priori rational* foundation or to be *empirically* shaped by the changing design environment. The answer to this question is closely linked to the status of an educator: Who is the most appropriate candidate to teach in the field of knowledge management – a philosopher or a software engineer? Let us answer with a motto – *moral ontology recapitulates technology*. Consequently, both the practitioners and the educators must be proficient in philosophical aspects of information technology in general and ontology design in particular (Kats, 2003).

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ENDNOTE

[1] The candidates for such requirements: IEEE Std. 1229-1998, 830-1998, 1012-1998.

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