Chapter 117
Ontology

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Category: Technologies for Knowledge Management

INTRODUCTION

An ontology comprises the explicitly articulated and shared concepts of a knowledge community or domain. These concepts, arranged formally in a taxonomy, are governed by specifically defined rules and axioms. Ontologies often play an important role in Knowledge Management Information Technology (KMIT). An enterprise Knowledge Management IT system, for example, may use an ontology "to facilitate communication, search, storage, and [knowledge] representation" (O'Leary, 1998, p. 58). A general survey of the literature suggests that ontologies are capable of improving performance in a large variety of Knowledge Management IT functions, especially relative to knowledgebases for best practices, lessons learned, human resource skills, Help Desks, FAQs, document collections, standards and regulations, products, services, proposals, and the like. In addition, as we look to the future, ontologies will function centrally in Agent Mediated Knowledge Management (AMKM), Distributed Knowledge Management (DKM), and the Semantic Web as these technologies become pervasive in a global economy that distributes KM knowledgebases across companies and cultures (Borgo & Lesmo, 2008; Cardoso, Hepp, & Miltiadis, 2008; Chira, Chira, Roche, Tormey, & Brennan, 2006; Daconta, Obrst, & Smith, 2003; Davies, Studer, & Warren,

DOI: 10.4018/978-1-59904-931-1.ch119

2006; Fensel, 2001; Gruber, in press; Heflin, Volz, & Dale, 2002; Lopez, Motta, Uren, & Sabou, 2007; McGuinness, 2002; Mentzas, Kafentzis, & Georgolios, 2007; Taniar & Rahayu, 2006).

The term *ontology* has its origins in philosophy, and to this day informs a vital approach to philosophical inquiry. Philosophical *ontology* deals with metaphysical aspects of the nature of existence, touching upon the various meanings, relationships and instances of the abstract, the concrete, the general, and the specific. It could be said that historically much of philosophy has been devoted to constructing a high-level ontology, an abstract model of reality, its primary constituents, their essential/accidental characteristics, and the various relationships that pertain among them. To provide a deeper understanding of the term *ontology*, and to offer a general sense of the ontological aspect of IT in KM, this article defines the history, purpose, scope, and function of *ontology*.

Historically, ontological philosophers have examined existence by delineating its parts categorically in accordance with an explicit theory. Aristotle's categories, syllogisms, definitions, and axioms, for example, form the basis of identifying, classifying, and theorizing about existence in just this way. So too have modern philosophers such as Kant, Peirce, Husserl, Whitehead, and Heidegger attempted to understand reality through categorization and logic (Sowa, 2000, pp. 56-77). Much of their philosophical groundwork, in fact, forms the basis of *ontology* as presently understood in practical applications for computerized systems of information. Additionally, the mathematician and logician Stanislaw Lesniewski supplied a key component of the computerized sense of *ontology* when he used "an artificial formal language to represent his formal theory of parts (mereology)." He thereby "inaugurated philosophy's use of artificial languages and formal logic in expressing ontologies" (Mayhew & Siebert, 2004, pp. 1-2). Thus, the philosophical sense of the word *ontology*, with its long and rich history, forms much of the theoretical and logical base of the computer science sense of the word. The relatively modern use of *ontology*, as applied to computerized information systems, appears first in 1967 in G. H. Mealy's "Another Look at Data," a paper dealing with "the foundations of data modeling" (Smith, 2004, p. 22).

Today's computerized ontologies attempt to capture some aspect of the explicit knowledge of a specific domain, such as biology, medicine, genetics, pharmaceuticals, accounting, finance, human resources, procurement, supply chain management, process management, manufacturing, law, architecture, publishing, scientific research, Web services, and engineering, to name a few. With this knowledge, the ontology helps a computer agent or program function in some practical way to operationalize the key concepts made explicit and constrained by highly specified rules and axioms. An agent operating on the Semantic Web, for example, could theoretically consult various ontologies distributed on the Web to gather the meaning of key terms, assertions, processes, and actions that would allow the agent to shop for your dinner, buy your favorite wine, get the best price available for both, make sure that everything is delivered at a specified time, charge your credit card, and have your garage door open when you arrive home for dinner. Only an agent with a brain could perform all these activities. But computerized agents don't have brains. They have ontologies—ontologies to consult in carrying out your instructions for dinner. Computers cannot understand as humans do; but ontologies help to create the illusion that they can.

Within the last forty years, *ontology* has become a central component in computerized information processing, especially in constructing large databases (sometimes termed knowledgebases). Ontologies have also figured predominantly in software application development, Artificial Intelligence (AI) initiatives, Web services, business and commerce, information and document retrieval, decision-support, medical informatics, the Semantic Web technologies, and, of course,