

Ontologies for Collaborative Networked Organizations

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INTRODUCTION

It is commonly agreed that networking, as a new way of collaboration, brings benefit to its members (Camarinha-Matos & Afsarmanesh, 2005). Collaboration implies communication and sharing of knowledge between network participants. However, as the participants may be from different fields or may follow a different problem solving philosophy, it is necessary to introduce a mechanism to share common understanding of the information and to agree on a controlled vocabulary used for communication. An ontology provides a representation of knowledge, which can be used and re-used, in order to facilitate the comprehension of concepts and relationships in a given domain, and the communication between different domain actors, by making the domain assumptions explicit. These actors can be either software agents or people that need to access or share a piece of information (Gruber, 1993).

A collaborative network is an association of a set of participants (profit organizations, non-profit organizations, individuals, etc.) and may include organized and non-organized collaborations. In this chapter we focus on collaborative networked organizations (CNOs) which represents only organized and intentional collaborations. CNOs can be roughly characterized as long-term or short-term associations. A long-term association of organizations is called a virtual organization breeding environment (VBE) and its main purpose is to enable fast creation of virtual organizations (VOs) (Camarinha-Matos & Afsarmanesh, 2003). A VO is a short-term alliance created in order to fulfil a common business goal. In the case of individuals, a

professional virtual community (PVC) is a long-term alliance, with the aim to enable dynamic creation of virtual teams (VTs).

An introductory and learning phase for organizations joining a VBE should be as short as possible. Ontologies have proven to be an unambiguous and compact way of knowledge representation enabling mutual understanding, as they provide a basis for sharing information not only among people but also among software agents. If several organizations or individuals, joining a CNO, share the same underlying concepts (for example on the Web or on their intranet), then software agents are able to extract and aggregate information and use it to gather the data and to answer some queries. Such agents can also support a process of VO and VT creation by proposing more or less optimal VOs and VTs based on competencies of their participants. In order to share the same terminology, the participants of the VBE need to agree on the terms that they intend to use for collaboration.

This chapter introduces business ontologies and illustrates the notions on a CNO ontology, implemented in the Protégé ontology development tool (Protégé, 2000). This chapter does not aim at giving an exhaustive overview of the state of the art in ontology research and development, as this is a research area on its own. Instead, the goal is to outline existing business ontologies and to present an ontology development approach applicable in CNOs.

The chapter first gives a brief outline of ontologies, their definitions, different types, possible encodings and structure, focusing on existing ontologies related to the business domain. It then presents a sample,

manually developed CNO ontology implemented in Protégé. Its purpose is to establish the vocabulary used in the domain of CNOs and to identify the main CNO actors and their roles. The ontology can be re-used in different CNOs, and can be further elaborated given the specificities of each type of network.

BACKGROUND: BUSINESS ONTOLOGIES

The most basic type of ontology is a set of terms representing a controlled vocabulary (e.g., a glossary), which are the terms that people agree to use when dealing with a common domain. By providing definitions, an ontology helps people and machines to use the same terminology which enables better mutual understanding. The role of an ontology is not limited to providing information; complex ontologies can also constrain the usage of knowledge by giving axioms or micro-theories and show the relations between the different components.

The content of an ontology depends both on the amount of information and on the degree of formality that is used to express it. Generally, we distinguish two main types of ontologies: lightweight and heavyweight (Gomez-Perez, Fernandez-Lopez, & Corcho, 2004). A lightweight ontology is a structured representation of knowledge, which ranges from a simple enumeration of terms to a graph or taxonomy where the concepts are arranged in a hierarchy with a simple (specialization, is-a) relationship between them. A heavyweight ontology adds more meaning to this structure by providing axioms and broader descriptions of knowledge. As a word can have several senses, knowledge can be also interpreted in different ways, which creates ambiguity in the knowledge base. Axioms and constraints tend to reduce the ambiguity by restricting and constraining the usage of information, for instance by specifying what is possible to do with it and what is not.

The degree of complexity of knowledge expressed in an ontology can vary from one ontology to another. This is also true for the spectrum of knowledge. An ontology may cover one or several domains or even focus on a specific aspect. In all cases, the construction of an ontology involves the choice of appropriate concepts that will best describe the knowledge represented in the ontology. These choices are called “ontological commitments” and are described by the ontology. “We

say that an agent commits to an ontology if its observable actions are consistent with the definitions in the ontology.” (Gruber, 1993).

Many ontologies have been developed, covering different domains (medicine, tourism, common-sense knowledge, etc.). The most important ontologies concerning the business domain and enterprise modeling are outlined in the following.

The AIAI Enterprise Ontology

The AIAI enterprise ontology (Uschold, King, Moralee, & Zorgios, 1998) was developed in the scope of the enterprise project whose goal was to provide a set of tools for enterprise modeling. The available enterprise tool set contains a procedure builder, for capturing process models, an agent toolkit for supporting agent development, and a task manager for integration and visualization. The ontology was used in order to ensure a consistent communication between agents (human or software agents). The enterprise ontology built within the enterprise project is not meant to be a complete ontology describing the enterprise domain. It only presents the most frequent terms used in this field. Thus the ontology has to be enriched for each specific business case.

The enterprise ontology is divided into five top-level concepts: activities and processes, organization, strategy, marketing, and time. The organization part contains the terms representing the actors that play a role in an enterprise. They can have legal responsibilities or not, be a human or a machine. These terms are then used to model activities and processes. The activity part includes the concept of resources and skills that are needed and the effects of the activity (i.e., the concept of input-output). The central concept of the strategy part is purpose. Purpose captures the idea either of something which a plan can help achieve, or what an organization unit can be responsible for. Finally, the marketing part describes sales. Sale is an agreement between two legal entities for the exchange of a product for a sale price.

The Toronto Virtual Enterprise's Ontology (TOVE)

The TOVE enterprise ontology was developed in the scope of the TOVE project (Fox, 1992). The TOVE ontology is a formal representation of the enterprise

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