Chapter 8.14
Toward an Organization: Oriented Design Methodology for Agent Societies

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ABSTRACT

In this chapter, we present a framework for the design of agent societies that considers the influence of social organizational aspects on the functionality and objectives of the agent society and specifies the development steps for the design and development of an agent-based system for a particular domain. Our approach will provide a generic frame that directly relates to the organizational perception of the problem.

The framework specifies the development steps of the design and development of an agent-based system for a particular domain. Based on the coordination characteristics of a domain, the methodology provides three frameworks for societies (market, hierarchy, and network). These frameworks relate to the organizational perception of a problem and allows for existing methodologies to be used for the development, modeling, and formalization of each step. The methodology supports the development of increasingly detailed models of the society and its components.

INTRODUCTION

In an increasing number of domains, organizations need to work together in transactions, tasks, or missions. Work relationships between people and enterprises are shifting from the "job-for-life" paradigm to project-based virtual enterprises in which people and organizations become independent contractors. These considerations lead to an increasing need for a transparent representation and implementation of work processes. In such settings, the ability to organize and maintain business processes, the support of communication and collaboration, and the management of knowledge are issues that are increasingly more important to insure the survival and sustainable advantage of organizations.

The fact that business processes are highly dynamic and unpredictable makes it difficult to give a complete a priori specification of all activities that need to be performed, which are their knowledge needs, and how they should be ordered. In organizations, there is often a decentralized ownership of data, expertise, control, and resources involved in business processes. Different groups within organizations are relatively autonomous, in the sense that they control how their resources are created, managed, or consumed, and by whom, at what cost, and in what time frame. Often, multiple, physically distributed organizations (or parts hereof) are involved in one business process. Each organization, or part of an organization, attempts to maximize its own profit within the overall activity. There is a high degree of natural concurrency (many interrelated tasks and actors are working simultaneously at any given point of the business process), which makes it imperative to be able to monitor and manage the overall business process (e.g., total time, total budget, etc.).

Software agents, characterized as autonomous entities with reasoning and communicative capabilities, are utmost suitable to implement, simulate, or represent autonomous real-life entities and, therefore, are an ideal means to model organizations. It is commonly accepted that agents are an effective solution in situations where the domain involves a number of distinct problem-solving entities, data sources, and other resources that are physically or logically distributed and that need to interact to solve a problem. Therefore, because of the proactive and autonomous behavior of agents, it is natural to design organizational support systems using agent societies that mimic the behavior and structure of human organizations (Zambonelli et al., 2001).

In order to make agent technology widely accepted and used in industry, it is necessary to clearly specify the types of problems suitable for an agent approach and the benefits of agents above other technologies. Furthermore, it is necessary to develop engineering methodologies that focus not only on the internal organization of each of the intervening agents but also on the social aspects of the domain (Omicini, 2001). However, as yet, there is no well-established and all-encompassing agent-oriented methodology that covers the whole development process of agent systems from requirement acquisition to implementation and testing. Most existing methodologies concentrate on just one part of the total picture or are too formal to be applicable in practice. A methodology for designing multiagent systems must be specific enough to allow engineers to design the system and generic enough to allow the acceptance and implementation of multiagent systems within an organization, allowing for the involvement of users, managers, and project teams.

Objectives

We propose a framework that describes all the stages of development of a multiagent system, takes an organizational perspective on systems design, and specifies all the development steps for the design and development of an agent-based system for a particular domain. Specific agent-oriented methodologies can be used for the development and modeling of each of the development steps. We believe that such a generic framework, based on the organizational view, will contribute to the acceptance of multiagent technology by organizations. Following the development criteria proposed by Sycara (1998), we define a social framework for agent communities based on organizational coordination models that "implement" the generic interaction, cooperation, and communication mechanisms that occur in the problem domain. The proposed methodology allows a generic coordination model to be tailored to a given application and its specific agent roles and interactions to be determined.