Chapter 4.25
Applications of Agent-Based Technologies in Smart Organizations

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ABSTRACT

This chapter introduces agent technology as a means of creating dynamic software systems for the changing needs of smart organizations. The notion of agency is introduced, and individual and collective agent architectures are described. Agent interaction methods and agent system design techniques are discussed. Application areas of agent technology are overviewed. The chapter argues that the autonomous and proactive nature of agent systems make them suitable as the new information infrastructure for the networked components of dynamically changing smart organizations.

INTRODUCTION

Nowadays the whole world is networked into the Internet and if an organization is not connected to the Internet, then it has serious competitive drawbacks. Private persons are using the Internet more and more as well, so organizations keep contact with their clients through e-mail and give them information on their products and services on information portals. Customers can do the shopping in electronic shops and get all the information they want from the portal server; they can even configure the product they want to order. In order to satisfy individual needs, smart organizations must feed online information from the Internet into their internal information system and then further to their internal production control, accounting, design, resource planning, and several other components. The organization can adapt to these requirements only if it requires the same type of information management from its suppliers, so the interorganizational com-

munication must become part of this networked environment as well.

In this environment, we can less and less talk about individual software products, because software components are interconnected and sooner or later almost every software component must be capable to interoperate with other software systems. This way, the information system of smart organizations becomes part of the worldwide Internet, so individual solutions cannot be applied. The software technology of smart organizations means less and less the design and implementation of individual software systems; rather, we can talk about the development of the design and implementation of a single distributed worldwide information system. In this context, the designers of subsystems cannot apply individual solutions, they have to adapt to global practice and standards. At the time of the design of such a global information system, the designer does not have enough information and resources to make a complete solution, so the designed system must integrate into the worldwide system with the ability to adapt to unforeseen changes and requirements using incomplete information at run-time.

Satisfying these requirements is among the goals of several technologies, including the Web services technology characterized by SOAP[1], WSDL[2], UDDI[3] abbreviations (Web Services, 2004; UDDI, 2004), the semantic Web technology (Berners-Lee, Hendler, & Lassila, 2001), the grid (Foster & Kesselman, 1999) and maybe the most complete approach, which is agent-based computing (Wooldridge, 2002).

This chapter presents the most important elements of agent technology and how they can be applied in smart organizations. First, we define what agents and agent systems are, then we overview the history of agent developments. We discuss the internal structures of agents, then how these agents can form smart organizations, then the methods of agent system analysis and design. Finally, we discuss the applications of agent systems and the conditions of their wide adoption.

THE AGENT METAPHOR

The word "agent" has different meanings in different contexts, so computer scientists working in the agent field may have somewhat different definitions of agency. There is agreement on the main characteristics, but some researchers consider other characteristics important as well, while some researchers think that these are not important, depending on their background.

Intelligent Agents

The notion of agent emerged from many different fields, including economics, game theory, philosophy, logic, ecology, social sciences, computer science, artificial intelligence, and later distributed artificial intelligence. In all these fields, an agent is an active component that behaves intelligently in a complex environment to achieve some kind of goal. Artificial intelligence is the branch of computer science which investigates how to implement in computer systems intelligence comparable to human intelligence. While the goal of artificial intelligence focuses mainly on intelligent performance comparable to an individual person, distributed artificial intelligence investigates how a group of software components called agents can achieve intelligent behavior comparable to a group of persons.

From a software technology point of view, agent technology promises to enable system designers to handle more complex systems than before. As systems become more and more complex, software development processes need higher and higher abstractions. In the beginning, functional and modular programming techniques provided enough level of abstraction, then object-oriented systems became the most commonly

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