Chapter 2.6
Framework of Agent-Based Intelligent System for Distributed Virtual Enterprise Project Control

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ABSTRACT

Virtual enterprise-oriented projects need the support of a distributed project management system, which concerns the collaboration of different departments and enterprises. In this chapter, we propose a multi-agent system with negotiation strategies for project schedule control—a collaborative system framework wherein a distributed project can be scheduled dynamically by agents in the virtual enterprise environment. A prototype of the multi-agent systems with the negotiation strategies is implemented by Java, JADE, FIPA-ACL, and the negotiation strategies are experimentally validated. It successfully demonstrates on the online coordination and resolution of scheduling dynamically while encountering unexpected events to meet each project participant's requirements.

INTRODUCTION

Recent developments on environments for computer supported collaborative work, distributed knowledge management and software agents for sharing resources and computational services have lead to an increased interest in what has been termed virtual enterprises. The companies engaged in a virtual enterprise share their knowledge, their competencies and business relationships in order to perform the virtual enterprise's task. This combination of forces is to enable the companies to reach global markets

with products and solutions that each of them could not have accomplished on its own. The increasing globalization and flexibility required by companies generated new issues relating to the management of large-scale projects and the cooperation between enterprises within geographically distributed virtual enterprises. Virtual enterprises are established in order to be able to flexibly react to the opportunities of highly dynamic global markets. The globalization of markets leads to the formation of spatially distributed production and logistics services. In a distributed global enterprise project, as the project participants have the characteristics of independence, specialty and distribution by nature, and are always situated at different locations. In contrast, the traditional control mechanism of the project by the general contractor seems to be more often centralized. In current, highly competitive and changeable environments, the traditionally centralized mechanism of the project scheduling control technique for a distributed global enterprise project can easily encounter various difficulties. The major one is that the centralized control mechanism of the general contractor may lose efficacy (Kim, 2001). Although a general contractor conventionally takes the majority of the responsibility of coordinating all of project participants, due to the project participants' characteristics of independence, specialty and distribution, and some of them may not have directly contractual relationships with the general contractor. Accordingly, most project participants still have to monitor schedule progress and to solve difficulties on their own as much as possible (Kim, Paulson, Levitt, Fischer, & Petrie, 2003). Also, various interface problems can occur during a project execution stage because of the general contractor's lack of specialized expertise, shortage of manpower and slow responses (Al-Hammad, 2000; Hinze & Tracey, 1994).

Software agents provide the technology necessary to dynamically negotiate, select and utilize the appropriate services required in today's highly dynamic virtual enterprise. With the emergence and rapid development of multi-agent systems (MAS), these problems then become solvable in timely manner, and have been the focus of active research in recent years. Multi-agent systems represent an appropriate approach to take unexpected event into account in distributed virtual enterprise project control. Therefore, if project participants were offered an assistance of distributed and real-time multi-agent system that can automatically coordinate activities and resources, while also encouraging intraproject cooperation without the intervention of a general contractor during the project execution phase, then some potential difficulties such as resource discrepancies, interface problems, inarticulate communications and delays could be predicted and resolved earlier by the project participants involved. Such assistance could be important for the success of a distributed virtual enterprise project control.

Virtual enterprises enable the deployment of distributed business processes among different partners in order to shorten development and manufacturing cycles, reduce time to market and operational costs, increase customer satisfaction and operate on global scale. The dynamic property is the most outstanding characteristic of virtual enterprise. It is usually organized according to the demand of the market, and it exists with the emergence of the project begins and disappears with the end of the project. Therefore, the success of a virtual enterprise depends on whether the virtual enterprise project is completed perfectly or not. Virtual enterprise oriented projects need the support of distributed project management system which concerns the collaboration of different departments and enterprises. Many scholars have studied the distributed project management system and some valuable and practical implementation schemes were proposed. For example: Bourgault et al. (2002) proposed project management system supporting distributed product development**,** and Lin et al. (2003) suggested a distributed project management model based on ASP**.** Many enterprises developed their own