Chapter XI

An Agent-Based Collaborative Negotiation System for Global Manufacturing Supply Chain Management

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Abstract

This chapter applies the multi-agent system paradigm to collaborative negotiation in a global manufacturing supply chain network. Multi-agent computational environments are suitable for dealing with a broad class of coordination and negotiation issues involving multiple autonomous or semi-autonomous problem-solving agents. An agent-based multi-contract negotiation system is proposed for global manufacturing

supply chain coordination. Also reported is a case study of mobile phone global manufacturing supply chain management.

Introduction

Economic and industrial communities worldwide are confronted with the increasing impact of competitive pressures resulting from the globalization of markets and supply chains for product fulfillment. More and more manufacturing enterprises are being driven to pursue a global manufacturing strategy that aims to transcend national boundaries in order to leverage capabilities and resources worldwide (Pontrandolfo & Okogbaa, 1999). Next generation manufacturing calls for new forms of manufacturing strategies, which are based on global networks of self-organizing, autonomous units (Anderson & Bunce, 2000). These units may be part of a single company located globally or several companies cooperating together to address customers' requirements coherently within extended and virtual enterprises (Bullinger et al., 2000). Since global manufacturing activities might be dispersed and carried out in diverse locations, coordination decisions have been identified as crucial for the successful implementation of global manufacturing strategies (Fawcett, 1992).

A global manufacturing supply chain is a network of suppliers, factories, subcontractors, warehouses, distribution centers, and retailers, through which raw materials are acquired, transformed, produced, and delivered to end customers (Fox et al., 2000; Ho et al., 2000). In a global manufacturing supply chain, a number of autonomous or semi-autonomous business entities are collectively responsible for procurement, manufacturing, and distribution activities associated with one or more families of related products (Pontrandolfo et al., 2002). Performance of any entity in a supply chain depends on the performance of others and their willingness and ability to coordinate and negotiate activities within the supply chain of product fulfillment (Swaminathan, 1996). A global manufacturing supply chain usually involves heterogeneous environments (Tso et al., 2000). Such a supply chain network is much more complex than that for the procurement, production, and delivery of a simple commodity, not only for the volume and complexity of transactions but also due to its dynamic and heterogeneous manufacturing environments (Gaonkar & Viswanadham, 2001).

The rapidly expanding Internet provides a promising networking medium, while the agent technology lends itself to the management of global supply chain networks within a distributed environment. An agent is a computer system situated in a certain kind of environment and is capable of autonomous action in order to meet its designed objectives (Jennings & Wooldidge, 1998). Moreover, a multi-agent system is a loosely coupled network of software agents that interact to solve problems that are beyond the individual capacities or knowledge of each problem solver (Barbuceanu & Fox, 1996). Agent-based technology has emerged as a new paradigm for conceptualizing, designing, and implementing software systems. Multi-agent systems (MAS) enhance overall system performance; in particular, along such dimensions as computational efficiency, reliability, extensibility, responsiveness, reuse, maintainability, and flexibility. They also are ca-

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