Chapter 2.24
A Multi-Agent System for Optimal Supply Chain Management

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ABSTRACT

Supply chain management recently has been developing into a dynamic environment that has to accept the changes in the formation of the supply chain. In other words, the supply chain is not static but varies dynamically according to the environmental changes. Therefore, under this dynamic supply chain environment, the priority is given not to the management of the existing supply chain but to the selection of new suppliers and outsourcing companies in order to organize an optimal supply chain. The objective of this research is to develop a multi-agent system that enables the effective formation and management of an optimal supply chain. The multi agent system for optimal supply chain management developed in this research is a multi agent system based on the scheduling algorithm, a cooperative scheduling methodology, which enables the formation of an optimal supply chain and its management. By means of active communications among internal agents, a multi-agent system for optimal supply chain management makes it possible to quickly respond to the production environment changes such as the machine failure or outage of outsourcing companies and the delivery delay of suppliers.

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This research has tried to suggest a new direction and new approach to the optimal supply chain management by means of a multi-agent system in dynamic supply chain environment

INTRODUCTION

Many companies have tried to introduce SCM (supply chain management) in an effort to enhance competitiveness amid severe competition caused by market globalization. Now, the participating companies in the supply chain are not fixed but rather are dynamically being changed in response to the environmental changes. Under such a dynamic SCM, it is very important to determine with whom to cooperate in order to solve these problems coming from environmental changes. Instead of seeking to optimize the existing supply chains, this study has focused on optimizing the supply chain itself. The optimization of an existing supply chain can be efficient to a fixed supply chain, but it is difficult for a dynamic supply chain to respond flexibly under the environment that its member is always changing. When a company joins an existing optimal supply chain, or when a company, which is currently joining a supply chain, has to transfer to another supply chain, they have to change their systems or processes in order to join in the new supply chain. However, this is not an easy job. The optimization of a supply chain is not made only once. Rather, it is to be made continually in response to diverse environmental changes. That is, it needs to be made on a real-time basis.

By the way, the supply chain, which consists of a lot of companies, is likely to meet with various complex problems for entire optimization, and these problems bring a significant influence on making the optimal supply chain. For example, machine failure of one participating company affects not only its related member companies but also the whole supply chain that the company belongs to. Therefore, this problem must be coordinated or adjusted not as a problem of one company, but as a problem of whole supply chain. To this end, each member of the supply chain has to cooperate and exchange information between members on a real-time basis. A multi-agent system can provide a useful tool for this purpose. Many preceding studies have emphasized that the multi-agent system is the best way in solving many complicated problems under diverse environmental changes (Bussmann, 1999; Choi, Kim, Park, & Park, 2004; Fox, Barbuceanu, & Teigen, 2000; Julka, Karimi, & Srinivasan, 2002; Shen & Norrie, 1998; Shen, Norrie, & Kremer, 1999). Also, this is an efficient way of exchanging and sharing information without integration of its applications among companies. That is to say, it enables relevant companies to move smoothly to another supply chain without changing their systems and processes. Accordingly, only by the transfer of the agent alone, which represents the relevant company, cooperation, and information exchange among members within the supply chain can this be made possible.

In this study, we developed an integrated scheduling method in order to organize and manage an optimal supply chain and a multi-agent system in order to solve the various problems occurring on a real-time basis in the optimal supply chain. The integrated scheduling method enables the scheduling for the entire supply chain in cooperation with related members in a supply chain, thus it is possible for a manufacturing company to make scheduling by taking into consideration the production environments of outsourcing companies and the delivery status of suppliers. And the multi-agent system shares the information on production environment and supply capacity of both outsourcing companies and suppliers, making it possible to respond to the dynamic environmental changes such as a delay in supplying parts or raw materials, power stoppage, or machine failure of the outsourcing companies for an optimal supply chain management.

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