Chapter 2.11
Agent-Based Dynamic Route Selection for Multilayer Electronic Supply Network

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ABSTRACT

The authors develop an intelligent information system in a multilayer electronic supply network. Using the internet for supply chain management (SCM) is a key interest for contemporary managers and researchers. It has been realized that the internet can facilitate SCM by making real time information available and enabling collaboration between trading partners. Here, the authors propose a multi-agent system to analyze the performance of the elements of a supply network based on the attributes of the information flow. Each layer consists of elements which are differentiated by their performance throughout the supply network. The proposed agents measure and record the performance flow of elements considering their web interactions for a dynamic route selection. A dynamic programming approach is applied to determine the optimal route for a customer in the end-user layer.

INTRODUCTION

Business environment is becoming increasingly complex, uncertain, unpredictable, and as a result, more and more competitive. As competition being intensified, flexibility-based supply chain management (SCM) is emerging as an increasingly important issue for companies. The challenge of flexibility in SCM is to identify and implement strategies to minimize cost while enhancing flexibility in an increasingly competitive and complex market (Browne et al., 1997; Wadhwa and Saxena, 2005). Flexibility stands out as a

prominent applicable element in manufacturing and supply chains (SCs) (Browne et al., 1995; Chan et al., 2006; Stecke and Solberg, 1981). Sushil (2000), while deliberating upon the concept of systematic flexibility, has essentially stressed the multiplicity of connotations of flexibility in response to diversity of situations. Wadhwa and Rao (2000) defined flexibility as the ability to deal with change by judiciously providing and exploiting controllable options dynamically. The potential of certain types of flexibility to enhance the overall performance of manufacturing and supply chain system has attracted the attention of many researchers (for examples, see (Browne et al., 1984; Chan et al., 2004; Wadhwa et al., 2005). The effects of flexibility on the performance of an SC need to be more closely studied as scholars are having diverse interpretations.

Enhanced competitiveness requires that companies ceaselessly integrate within a network of organizations. Firms ignoring this challenge are destined to fall behind their rivals. The integration of companies within a network demands a new look at the supply chain management (SCM). "SCM is the management of upstream and downstream relationships in order to deliver superior customer value at less cost to the supply chain as a whole" (Christopher, 1998). The integral value of the SCM philosophy is that the total performance of the entire supply chain is enhanced when we simultaneously optimize all the links in the chain as compared to the resulting total performance when each individual link is separately optimized (Burke and Vakkaria, 2002).

Recent technological developments in information systems and information technologies have the potential to facilitate the coordination, and this, in turn, allows the virtual integration of the entire supply chain. The focus of this integration in the context of internet-enabled activities is generally referred to as electronic SCM (e-SCM). Merging SCM and the internet is a key area of concern for contemporary managers and scholars. Managers realize that the internet can enhance SCM decision making by providing real-time information and enabling collaboration between trading partners. Many companies have implemented point-of-sales scanners, which read, in real time, what is being sold. These companies not only collect information in real-time to make decisions about what to order or how to replenish the stores, but they also send the information, through the internet, to their suppliers to help them synchronize their productions to actual sales.

Following the definition of SCM in (Cooper et al., 1997), we define e-SCM as the impact of the internet on the integration of key business processes from end-user through original suppliers providing products, services and information that add value for customers and other stakeholders. The main objective of our work here is first to identify the major issues concerning the impact of the internet on SCM, while focusing on supply chain processes, and then offer an integrated supply network associated with the corresponding layers and elements to provide an optimal route.

The internet can have three main impacts on the supply chain. Most interest in the literature is on the impact of e-commerce, referring mainly to how companies can respond to the challenges posed by the internet in fulfilling the goods sold through the net. Another impact refers to information sharing, that is, how the internet can be used as a medium to access and transmit information among supply chain partners. However, the internet enables supply chain partners not only to access and share information, but also to access data analysis and modeling in order to make a better planning and decision making. The joint planning and decision making is the third impact of the internet on SCM and we refer to it as knowledge sharing. A configuration of e-SCM is shown in Figure 1.

As pointed out in (Croom, 2005), there is some debate about the scope of SCM. For example, in (Houlihan, 1984; Oliver and Webber, 1992) the authors used the term SCM for the internal supply chain integrating business functions involved in

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