

Chapter 11

e-Supply Network: The Design of Intelligent Agents for Buyer-Supplier-Supplier Coordination

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ABSTRACT

The automation of negotiation among buyer-supplier-supplier triad is an important policy in e-supply network coordination (e-SNC). In addition to the buyer-supplier coordination advantages, a further coordination among suppliers is also highly important in order to maximize the network supply capacity utilization especially when the suppliers are geographically decentralized. This chapter focuses on the impact of suppliers' coordination in a network where the coordination among buyers and suppliers is in place. The proposed agent-based model is composed of two negotiator agents, one monitor agent, and one coordinator agent. The model begins with buyer-supplier negotiation and coordination mechanism adopted from the approach developed by Mohebbi and Shafaei (2010). Then, the suppliers' coordination mechanism is developed to investigate the interaction among suppliers and evaluate the subsequent benefit obtained in the global network. The efficiency of the proposed approach is evaluated using a simulation model. The results demonstrate that in a network where the coordination among buyers and suppliers is in place, a further coordination among suppliers leads to the reduction of total network cost.

INTRODUCTION

E-Supply Network (e-SN) can be defined as a new structure which is being enhanced due to the trend of market globalization, information technology, and automation of different echelons' behavior (Mohebbi and Shafaei, 2009). It emphasizes on the cooperation among supply echelons, and realizes the

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dynamic nature of information, capital, and materials flows with the assistance of electronic commerce and intermediary services. In e-SN, the flexibility of network structure in terms of the relations among the nodes can be obtained by making a possibility of cooperation among the suppliers and buyers as needed. In other word, one key feature of the e-SN is the dynamic alteration of interaction structure, and the nature of network attributes/criteria as represented by informational flow.

In addition to the dynamic nature of an e-SN, there are a couple of key factors affecting the performance of an e-SN. This includes coordination among the network members and negotiation among those partners whose inter-relation has been established but needs to be enhanced.

Regarding the supply network coordination (SNC), some existing approaches have focused on the design of coordination mechanisms for a two-echelon supply chain: buyers on the one side and suppliers on the other side. A buyer and a supplier together constitute a simple two stage supply chain. The idea of joint optimization for buyer and vendor was initiated by Goyal (1977) and later reinforced by Bannerjee (1986). Afterwards, Weng (1999) demonstrated that when both parties are coordinated, the order quantity and joint profit will increase while selling price may decrease. Hoyt and Huq (2000) presented a literature review on the buyer–supplier relationship from the perspective of transaction cost theory, strategy structure theory and resource-based theory of the firm. A framework was provided for understanding how buyer–supplier relationships have evolved over past decades from transaction processes on arms-length agreement to collaborative processes based on trust and information sharing.

The coordination of a supply chain, however, requires accurate and timely information about the operational decisions and activities to be shared among all members to deal with uncertainties (Li and Wang, 2007). Cachon and Fisher (2000) presented a simulation-based comparative study, where the supply chain costs are 2.2% lower on average with full information-sharing policy than with traditional information policy and the maximum difference of these policies is 12.1%. Indeed, this results in faster and cheaper order processing that leads to shorter lead times. Such information is those which the parties are willing to share with their partners and hence does not include the member's confidential information. Chu and Leon (2009) investigated the problem of coordinating assembly inventory systems with private information system so that the objective function and cost parameters of each facility in two-echelon supplier-buyer model are regarded as private information. It can be, therefore, concluded that the main issue on SNC is to establish a suitable structure of information which should be shared among the network members (Mohebbi and Shafaei, 2010). In other word, assuming a complete information flow without adequately capturing the dynamics and uncertainties of the environments may lead to an over simplified and restricted models in SN.

As addressed before, the second factor affecting the performance of a SN is negotiation among the partners. Negotiation has long been recognized as a time-consuming process since all parties involved intend to pursue their own interests in the face of conflicting goals. Indeed, in a web-based environment, the ability to rapidly identify suitable partners and effectively coordinate them through the net is crucial to the success of SN. Hence, the sheer number of participants in the network introduces difficulties when attempting to find and negotiate with potential buyers or suppliers (Cheng et al., 2006).

The implementation of automated negotiations conducted by software agents in the e-marketplace may overcome the difficulties in human negotiations. Automated negotiation can be viewed as a search process (Choi et al., 2001; Oliver, 1997) in which negotiator agents in SN search for a mutually acceptable partner to establish/re-establish global consistency and optimality (Mohebbi and Shafaei, 2009). Among the automated negotiation studies in the literature, Buttner (2006) proposed taxonomy for classifying the automated negotiations based on the type of process (automation level, orientation type,

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