A Negotiation-to-Coordinate (N2C) Mechanism for Modeling Buyer-Supplier Relationship in Dynamic Environment

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ABSTRACT

In this article, a novel Negotiation-to-Coordinate (N2C) mechanism is proposed to explore the interactive nature of the buyer-supplier relationships for dynamic environments. The proposed N2C mechanism uses prioritized fuzzy constraints to represent trade-offs among the different probable values associated with the negotiation issues and to signify how agents should make concessions. Supervisor agent in the N2C mechanism takes into account the conflicts of interest of buyer’s agent and supplier’s agent and the proposal and plan generated by supervisor agents helps in resolving the true and potential conflicts of interests for buyer’s agent and supplier’s agent. The proposed computational framework based on fuzzy constraints is suited for capturing the dynamics by modeling trade-offs between different attributes of a product leading to a fair and equitable deal for both suppliers and buyers. The efficacy of the proposed approach is demonstrated through an illustrative example.

Keywords: buyer–supplier relationship; coordination; negotiation; supply chain dynamics

INTRODUCTION

An interesting development in the field of supply chain management (SCM) is the ability to gainfully exploit the benefits offered by the Internet in effectively deploying SCM strategies. Several studies predicted electronic markets to play a significant role in redefining buyer-supplier relationships (Ford et al., 1998; Tang, Shee, & Tang, 2001). Electronic marketplaces create value for participants by playing three roles: connector, value-added service provider, and spend aggregator. To become a value-added service provider, Business-to-Business (B2B) marketplaces must provide access to services ranging from baseline interoperability and directory services to specialty services, such as
online payment, logistics, and dynamic trade. Many marketplaces also take on the role of spend aggregator, negotiating lower prices for buyers by leveraging collective volume. Most of previous studies have neglected significant impacts of integration issues because of the modeling complexity required. Therefore, past models may be confined in their capability and applicability to analyze real supply chain process. An integrated quantitative model, addressing the above-mentioned issues, becomes an imperative.

Every market, whether online or not, represents a complex assembly of buyers and suppliers united by intricate lines of power and dependency. Although forces of supply and demand control the flow of business, each market carries a built-in measure of inefficiency (Mahadevan, 2000, 2002). It is suggested that explicit modeling of the flow of entities such as material, resources, decisions, and information in the dynamic system is important for both manufacturing and supply chains (Wadhwa & Rao 2003, 2004). The B2B marketplaces minimize that inefficiency by tightening the relationship between supplier and buyer, promoting price discovery and spend aggregation, slashing supply chain costs, and increasing the reach of suppliers. The agents operate in multiagent systems, and situations often arise in which their plans conflict with the plans of other agents. For achieving an effective multiagent coordination, conflict resolution is crucial. Negotiation is a predominant tool for resolving conflict of interests. A higher level coordination mechanism with respect to distributed modeling of supply chains is generally not specified in the reported literature (Chan & Chan, 2004; Chan, Chung, & Wadhwa, 2004).

In this article, we explore the interactive nature of the buyer-supplier relationship in the dynamic supply chain environment. First, a prioritized fuzzy constraint based model is developed for bilateral multiissue negotiation in dynamic supply chain environments. A novel Negotiation to Coordinate (N2C) approach is proposed, which utilizes prioritized fuzzy constraints to represent trade-offs between the different possible values of the negotiation issues with a corresponding coordination mechanisms dedicated to dynamic supply chain networks.

The proposed N2C approach has the following benefits:

- It enables the negotiation to be carried out over fuzzy constraints of multiple issues of a product. That is more efficient than negotiation that is carried out over single point solutions. The proposed model uses prioritized fuzzy constraints to represent trade-offs among the different probable values of the negotiation issues and to signify how agents should make concessions.
- The supervisor agent in the proposed mechanism takes into account the conflicts of interest of buyer’s agent and supplier’s agent, and the proposal/plan generated by supervisor agents helps in resolving the true and potential conflicts of interests for buyer’s agent and supplier’s agent. The supervisor agent maintains dynamic updates of resource requirements.
- It is generic and can be used for a wide range of domains, such as negotiation of supply contracts for flexible production networks. The model ensures a high degree of flexibility; it avoids deadlocks and enhances chances of willingness to a compromise. It guarantees that the outcome of the negotiation is Pareto optimal for both parties (if such a solution exists), yet the participating agents reveal minimal information about their preferences and constraints.

The article is organized as follows: First we discuss in detail the prioritized fuzzy constraint satisfaction problem for supply chain networks. The next section provides the details of the proposed N2C mechanism along with a numerical example. Finally, we present concluding remarks and the scope for future work.
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