Improving the Plan of a Manufacturing Network with Non-Integrated Business Units

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ABSTRACT

Despite the independency of companies in a supply chain as a network of separated business units which produce altogether the value for final customers, companies are dependent on resources and information of other members of the supply chains. To manage the use of resources and information, supply chain management plays a major role to coordinate independent companies by using the coordination mechanisms. According to the literature of supply chain management, some mechanisms largely use the information shared by members to achieve an optimal solution and some others are based on minimum level of information sharing. Planning based on minimum level of information sharing could increase the complexity of supply chain management and the complexity is ever higher when number of independent members in a supply network augments. This research addresses the problem coordination in a supply chain with more than two partners, while the information in a private element, which is not exchanged with other partners.

Keywords: Coordination, Linear Programming, Logistics, Lot-Sizing, Manufacturing Network, Operations Planning, Operations Research, Supply Chain Management

1. INTRODUCTION

Supply networks are complex systems which compose of numerous independent facilities connected through upstream and downstream linkages to produce value for clients by procuring raw materials, transforming raw materials into products, and distributing the final products to customers. The complexity of these networks may vary from industry to industry. The complexity also depends on the numbers of members in a network as well as the mode of information exchanged between these members.

The goal of supply network management is the coordination of interdependent plans.

The objective of supply chain management is to contribute into the complexity of supply chains by proposing the different coordination mechanisms. According to Simchi-Levi and Kaminsky (2000) supply chain management is the integration of key business processes among networks of interdependent suppliers, manufacturers, distribution centers, and retailers in order to improve the flow of goods, services, and information from original suppliers to final customers, with the objectives of reducing system-wide costs while maintaining required service levels.

The integration of supply chain can be categorized into three levels (Lee, 2000). The

DOI: 10.4018/ijal.2014040101
first level is information integration, when some essential information is shared between partners. As an example, sharing inventory status, capacity limits, production plans, financial results, demand forecasts, and transportation plans. The second level is the integration by sharing not only the information, but also resources to achieve an optimal solution for all members of supply chain. Finally, third level of integration is organisational linkage by defining common performance indicators as well as common incentive system. In all of these three integration levels partners could achieve an optimal solution because they have access to essential information necessity to optimize the mutual plans.

Despite producing the optimal solution to all partners, these types are integrations are not practical when different companies are independents and they do not want to share their critical information like inventory status, capacity limits, production plans, financial results, demand forecasts, and transportation plans. But not sharing the critical information can give rise to another problem. According to Lee et al. (1997) lack of systematic exchange of critical information can give birth to the phenomenon of bullwhip effect, which is the amplification of demand variability as one moves upstream a supply chain.

The question, which is raised, is how operations in a supply chain can be coordinated when the partners decide not to integrate in none of above integration levels without having the problem of bullwhip effect.

In order to answer this main question non-integrated approaches of coordination are designed which respect the independent nature of each company and try to provide the near optimal solution to all partners of a supply chain. This research addresses the above question by introducing a contribution in the decentralized approaches of coordination, which is based on limited exchange of information. Our objective is to coordinate a network of manufacturing units without any integration and just based on minimum level of information sharing. We want to show that our approach can improve the result of upstream planning as a basic hierarchical approach of coordination based on one way of information exchange. To propose a network coordination approach we extend our approach (Taghipour and Frayret, 2012), which coordinates two partners of a supply chain, to consider simple form of a divergent supply network including one supplier and several manufacturers.

The reminder of this paper is organized as follow. A literature review is presented in Section 2. Then, Sections 3 through 5 introduce the planning mechanism, our models and the test results to demonstrate the performance of the proposed approach. Finally, Section 6 concludes and presents directions for future research.

2. LITERATURE REVIEW

In order to review the literature of supply chain management we begin by analysis of supply chain structures introduced in the literature and in the second phase we focus on the particular case of divergent supply chain and the coordination approaches that concern this particular type of supply network.

The literature of supply network can be categorized into five forms of structure (Huang et al., 2003). The simplest form of supply chain is a dyadic structure which consist of two or ganizations, normally a seller and a buyer or a supplier and a manufacturer (Yu et al., 2001; Tsung, 2000; Cachon and Lariviere, 2001; Cheung & Lee, 2002; Swaminathan et al., 1997; Taghipour & Frayret, 2012).

Dyadic structure can be developed to form a serial structure in which more partners are added to the left or the right of a dyadic structure. For example: a supplier, a manufacturer and a distributor or a supplier of supplier, a manufacturer and a retailer (Fleisch & Powell, 2001; Fu et al., 2000; Kimbrough et al., 2001; Gibert & Ballou, 1999; Minegishi & Thiel, 2000). The next three forms are the more complex structures of supply network. In the third form which is called divergent supply network, one business unit is connected onto some other business units. For
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