

Chapter 7

Decision–Making Coordination within Three– Echelon Supply Chains

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ABSTRACT

Supply chain performance is highly influenced by the coordination level between its members, which needs information sharing. In this paper we consider a three-echelon direct sell supply chain model and focus on the problem of coordinated decision-making between its members. Our contribution is a first approach that measures the impact of the degree of coordination between the members. Demand behavior is modeled using a geometric Brownian process. Simulation models are run in order to analyze various cooperation scenarios. Our results show a direct relation between the degree of coordination within the supply chain and the total system cost. Although this result is intuitive, our simulations allowed us to quantify such a relation and in which measure these costs are whether or not associated to imperfect coordination.

INTRODUCTION

In today's globalized context, enterprise management becomes more and more difficult to master. Market evolution has driven the enterprises to create strategic alliances with both their suppliers and their clients. Since more than a decade ago, it has been widely accepted that market competition is not anymore between the enterprises themselves, but between the supply chains they belong to

(Lee and Billington, 1995; Núñez-Muñoz and Montoya-Torres, 2009). The management of such supply chains is concerned with the management of material, information and financial flows, in which coordination and integration of these flows within and across companies are critical (Breiter et al., 2009). Coordination is hence a core requirement in supply chain management.

According to Simatupang et al. (2002), cited by Breiter et al. (2009), the state of coordination in a supply chain can be understood as “an act of properly combining (relating, harmonizing, adjusting,

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aligning) a number of objects (actions, objectives, decisions, information knowledge, funds) for the achievement of the chain goal". According to Cachon (2003), coordination in a supply chain is present if the set of supply chain optimal actions is a Nash equilibrium, which means that if no firm has a profitable unilateral deviation from the set of supply chain optimal actions. Since the determination of a global supply chain optimum is not always possible or intended, a less restrictive understanding of the term coordination can be considered for supply chain performance analysis, as the one considered by Böhle et al. (2009): a supply chain is coordinated if the behavior of all involved partners results in an improved plan for the overall supply chain compared with an initial or default situation (Stadtler, 2007).

The study of logistic chains may be done from two points of view (Huang et al., 2003). The first one corresponds to the study of supply, manufacturing and distribution activities within one on the members of the supply chain. The second analysis point of view corresponds to the study of coordination mechanism of product, information and economic flows between the members of the supply chain. Models and analysis in this paper are given from the second point of view. Although the first approach may be considered as a part of the second, seminal works in the literature related to the first approach have not very often considered the interaction or coordination between the members of the supply chain (Núñez-Muñoz and Montoya-Torres, 2009).

In this paper, we investigate what is the actual impact of coordination in a (simple) three-echelon supply chain and how this coordination can be achieved by analysis various cooperation (information sharing) scenarios. We consider the same supply chain model presented by Sepulveda and Frein (2004a): a direct sell supply chain model. As these authors state, this model structure is very common by Internet computer vendors like Dell and HP. Production is based on demand (make-to-order environment) and intermediate

stock (i.e. inventory between the members of the supply chain) is considered as infinite. Instead of being interested by individual performance measures for each member of the chain, we intend to analyze global performance measures under different coordination scenarios. Hence, the work presented in this paper focuses on the problem of coordinated decision-making between the members in a supply chain. For this configuration, little work has been presented in the literature, at least to the best of our knowledge. A similar work was presented by Toptal and Cetinkaya (2008) focused on the analysis of costs structures for a two-echelon (buyer-vendor) model. Our contribution however is a first approach that measures the degree of coordination between the members of a three-echelon supply chain. Demand behavior is modeled using a geometric Brownian process which allows us to consider uncertainty when a decision has to be made by one of the members of the chain. Our study also quantifies the benefits that can be obtained under a coordinated decision-making behavior.

The rest of this paper is organized as follows. We first describe the problem under study and review relevant literature. The conceptual model of the supply chain under study is presented next, as well as the key performance metrics employed in our analysis. Computational experiments are performed and results are analyzed. Finally, some concluding remarks are given.

PROBLEM STATEMENT AND LITERATURE REVIEW

Since several years ago, demand uncertainty is one of the most important characteristics of any market (Cleaves and Masche, 1996; Fisher, 1997). At the production planning level, market evolutions have added great challenges to enterprises concerning data management and maintenance. Coordination within the supply chain has become one of the strategies considered by enterprises

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