

Centralize vs. Decentralize Supply Chain Analysis



Eftychia Kostarelou
University of Thessaly, Greece

Georgios K. D. Saharidis
University of Thessaly, Greece

INTRODUCTION

In supply chain systems the aim is to optimize some performance measure, which typically comprises revenue from sales less the costs of inventory. These measures concern either different partners in a supply chain or a combination of supply chains. Supply chain management can be defined as the efficient integration of suppliers, manufactures, warehouses, and stores, so that a production and a distribution planning are determined. Production planning, in supply chain management, is a complex process and defines which products should be produced and which products should be consumed in each time instant over a given time horizon.

For manufacturers worldwide, the business environment is complex and increasingly competitive, mainly due to outsourcing the manufacturing part and the diversification of customers' demand. Consequently, extended and complex supply chains emerge very often. In a new age of big data and ever-evolving environment, managers and researchers need access to the most current information about the trends in Supply chain management. Powerful data analytics are needed in Supply chain management to provide the business intelligence and strategic insights for the supply chain network.

Business analytics and optimization are a group of approaches that help organizations understand and develop new insights of business performance, based on different methods and data. They make extensive use of data, statistical and qualitative

analysis, and fact-based management to drive decision making. They have been increasingly recognized by organizations as an important tool for Supply chain management.

In practice, each company tends to optimize its own production unit with no attention to the whole chain. It has been more difficult the last decades to achieve a minimization of the total costs in terms of reduction in chain-wide inventory, as the environment becomes more competitive and the massive data between work-areas may be difficult to share. For these reasons, organizations will need to transfer the control of planning and management to local system levels. For example, if a factory of a supply chain purchases raw items regularly from another supply chain participant, then, during stockout periods, the company which owns that factory may occasionally find it more profitable to purchase a quantity immediately from some subcontractor outside the supply chain, rather than wait for the delivery of the same quantity from its regular supplier. Policies of this kind, namely decentralized, can be individually optimal at each stage of the supply chain, but not necessarily optimal for the entire supply chain. On the other hand, there are policies where the suppliers cooperate and coordinate to obtain optimal strategy for the entire system, whereas it may be more profitable for some of them to act individually. It has been demonstrated that under these policies, namely centralized, the maximum profit the whole supply chain could make can be much higher than the sum of the profits collected individually.

One of the best practices in order to optimize business analytics is the collaboration between partners and the application of profit sharing strategies. The aim of this chapter is to analyze and compare the two types of optimization: centralized and decentralized, in order to provide important qualitative results. The aim is to identify the gains made by the supply chain through the analysis of the differences between decentralized and the centralized optimization. In the real-life problems, the decisions must be taken promptly in order to anticipate changes of the environment and to meet the demands at the minimum cost. Moreover, the individual enterprises typically make decisions that affect the other enterprises and the entire supply chain as well. With qualitative analysis, obtained by the comparison of the two optimizations, we gain some insight into the system under study. This system is composed of two factories that work in parallel at same stage of the supply chain and supply every factory of the next stage of the chain. Because of the competitive environment and the need for Big Data sharing, the global strategy cannot be applied in most cases. Thus, there is a need for a good result using local policy. Moreover, the pure local policy is difficult to be applied in complex systems, and the use of bi-level programming formulation in decentralized policy helps to overcome difficulties. The qualitative results, obtained by the analysis, provide information about the variations between the two cases and determine the conditions under which the two cases yield the same results. Thus, at the age of Big Data, using the qualitative results we can identify the best strategy for each partner in a supply chain and analyze what is more profitable for the entire supply chain. Finally, there exist some interesting real life applications with centralized versus decentralized analysis in literature (e.g in the automotive industry, in the refineries, in the aluminum window production, in chemical and pharmaceutical industry).

In the next section, the related literature on the comparison between the two policies in supply chains is summarized and the rest of the chapter

is structured as follows: after the background information, we analyze the reasons why the two strategies are not applicable, in a complex supply chain system, as well as how these difficulties can be overcome. Finally, conclusions and future research are given at the end of the chapter.

BACKGROUND

As it is shown in (Saharidis, Dallery, & Karaesmen, 2006), decentralized planning yields less efficient results compared to centralized planning. It is, however, difficult to quantify the difference between the two approaches within the context of production planning, production scheduling and control policies. During the last years, there have been a few papers that have addressed planning and scheduling problems providing both a centralized and decentralized analyses.

In (Abdul-Jalbar, Gutiérrez, Puerto, & Sicilia, 2003), a multi-echelon inventory/distribution system is examined that considers one warehouse and N -retailers connected to it. In (Chen & Chen, 2005), a two-echelon supply chain is studied, the authors examine the two control policies minimizing the total and individual operating costs, which include inventory holding, transportation, order processing, and production setup costs. In (Kim, Jun, Baek, Smith, & Kim, 2005), authors deal with the inventory-control problem of a two-echelon supply-chain system. Two models are proposed for a supply chain consisting of one supplier and multiple retailers; a centralized and a decentralized model. The objective of the two models is to satisfy a target service level that has been predefined for each retailer. In (Ray, Li, & Song, 2005), the authors examine a serial two-echelon supply chain selling a procure-to-stock product in a price-sensitive market. The decisions are made in the presence of stochastic demand and random delivery times and the authors observe how these decisions are affected by each optimization strategy.

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