

Chapter 78

Supply and Production/ Distribution Planning in Supply Chain with Genetic Algorithm

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ABSTRACT

The present study, using genetic algorithm, tries to improve material flow management in supply chain. Consequently, in this paper, an integrated supply-production and distribution planning (SPDP) is considered despite the fact that in most of the Iranian industrial firms, SPDP is done independently. The effective use of integrated SPDP not only enhances the performance rather decreases inventory cost, holding cost, shortage cost and overall supply chain costs. A quantitative mathematical model is used to the problem articulation, and then it is solved by applying heuristic genetic algorithm (GA) method. The proposed model with genetic algorithm could provide the best satisfactory result with the minimum cost. The reliability test was carried by comparing the model results with that of the amount of variables.

1. INTRODUCTION

Supply chain management (SCM) is the process of planning, implementing, and controlling the operations of the supply chain as efficiently as possible. Contrary to the uncoordinated and inefficient production management of previous years, a uniform supply chain is being preferred these days in order to manage properly the material flow,

commodity, information and finance. However, for better performance, some old or new means like mathematical programming, simulation, meta-heuristic procedures are applied. Since the design and management of supply chain flows (materials, information and finance) as well as their success are closely linked to each other; failures of electronic commerce are often attributed to problems arising from poor design and management of supply chain flows (Chopra et al., 2004). By this way, the SCM is a collection of methods used for

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the effective coordination of suppliers, producers, storage and stores. It also makes the needful products available to customers, at a significant time and place. Further, this method minimizes the total cost of chain and satisfies customers' needs with a high level service (Simchi-Levi & Kaminsky, 2000). Since, the failure or the success of SCM depends on its inventory role; the level of coordination is much needed phenomenon. As a matter of fact, while the shortage of source adversely delays the production flow, extra inventories could also increase the needless costs. Additionally, there is an inventory shortage in this supply chain sections, but at another places, there unusually exists surplus inventory, which are unsatisfactory (Stevenson, 2004).

In the Middle Eastern region, most of the manufacturing units have the same traditional planning, with each supply chain units concerns optimizing its benefits alone. Hence, it often leads to raise the actual price level and considerably decreases the firms' competitiveness. The rest of the paper is organized as follow: The subsequent sections two and three deal with literature review and experimental study. Section 4 covers the mathematical modeling of the supply chain. Section 5 explains the proposed GA, with brief description about the heuristic approaches used in the computational experiment. Section 6 gives model validation followed by conclusion in Section 7.

2. LITERATURE REVIEW

Previous researchers came up with different models on supply chains, to which we came across during the course of literature review. These models can be categorized as:

- Coordinated model of buyer-seller
- Coordinated planning model of production-distribution
- Coordinated planning model of production-invention

- Model of location-allocation
- Coordinated model of purchase-production-distribution

Chandra and Fisher (1994) proposed a coordinated planning model of production and distribution, in which products from a single production unit are transported to retailers directly from the plant. Significance of this model is the demand of retailers for each product in the specific period, however; this also minimizes the total costs consisting manufacturing, transportation and the inventories. Jayaraman and Pirkul (1998) presented yet another coordinated model of mixed zero-one programming. In this model, the input of the production plant are varied i.e., raw materials are supplied from different dealers and the output of finished goods are carried to different storages or distributed to markets based on customers' demands. This model also aims to minimize the total costs including deployment, operation and storage, production and distribution. In a separate research, Jayaraman and Pirkul (2001) also proposed the PLANWAR model, showing the location of plants and storages with capacity constraints.

Cohen and Moon (1991) illustrated a mixed zero-one programming aimed at optimizing the flow of materials and products as well as combining the output in a supply chain network with stable structure. This model significantly emphasizes on sellers, manufacturing units, their capacities and distribution centers. It intends to minimize the overall material, production and transportation costs; and as such it concerns much about demand, supply and chain structure.

Considering different source constraints, Lee *et al.* (2002) determined the system structure based on multi-plant, multi-product and multi-periodic production and distribution. Kiahara and Toshiba (2003) highlighted the P.P.P model, which is about the problems of suppliers to the final assembling plants. It consists of a two-level BOM to allocate manufacturing and distributing plans. In this model, the transportation time was considered later.

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