

Chapter 19

Genetic Algorithm to Solve Multi-Period, Multi-Product, Bi-Echelon Supply Chain Network Design Problem

R. Dhanalakshmi

IBM India Pvt. Ltd, Bangalore, India

P. Parthiban

National Institute of Technology, India

K. Ganesh

Tata Consultancy Services Limited, India

T. Arunkumar

Vellore Institute of Technology, India

ABSTRACT

In many multi-stage manufacturing supply chains, transportation related costs are a significant portion of final product costs. It is often crucial for successful decision making approaches in multi-stage manufacturing supply chains to explicitly account for non-linear transportation costs. In this article, we have explored this problem by considering a Two-Stage Production-Transportation (TSPT). A two-stage supply chain that faces a deterministic stream of external demands for a single product is considered. A finite supply of raw materials, and finite production at stage one has been assumed. Items are manufactured at stage one and transported to stage two, where the storage capacity of the warehouses is limited. Packaging is completed at stage two (that is, value is added to each item, but no new items are created), and the finished goods inventories are stored which is used to meet the final demand of customers. During each period, the optimized production levels in stage one, as well as transportation levels between stage one and stage two and routing structure from the production plant to warehouses and then to customers, must be determined. The authors consider “different cost structures,” for both manufacturing and transportation. This TSPT model with capacity constraint at both stages is optimized

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using Genetic Algorithms (GA) and the results obtained are compared with the results of other optimization techniques of complete enumeration, LINDO, and CPLEX.

INTRODUCTION

To exploit economies of scale and order in large lots, the important issue in supply chain is to optimize the inventory level by considering various costs in maintaining a high service level towards the customer. Since, the cost of capital tied up in inventory is more, the inventory decision in the supply chain should be coordinated without disturbing the service level. The coordination of inventory decision within an entity is viable, but not between the entities. So the integration of the entities to centralize the inventory control is needed.

Several factors influence inventory policy and practice for the firm includes distribution savings demand seasonality in production and purchasing economies with the desired level of customer service. Transportation is the spatial linkage for the physical flows of a supply chain. Today supply chain has to examine the effective use of supply chain with value added processes in distribution center with minimum inventory levels for delivering the product in time. The gateway of the supply chain is to know our customer and serve the needs by considering the aspects of speed and reliable service with the value propositions. The effective supply chain management needs to improve customer service, reduction of costs across the supply chain, optimal management of existing inventory with optimized manufacturing schedules. The impact of distribution inventory will enhance the customer value in the form of lower costs across the supply chain.

This project presents the Genetic Algorithm Distribution Inventory Model (GADIM) approach for optimizing the inventory levels of supply chain entities with the consideration of two-echelon plant to warehouse and warehouse to customers. This model is especially suitable for inventory control

and cost reduction by unlocking the hidden profits through the genetic algorithm optimization. The generalized GADIM evaluate the transportation link between the two entities and finding the best route for transporting the product from plant to warehouse and then to customer. The demand of the customer is known in advance, so that the production rate and the inventory levels can be adjusted in the plant and warehouse. Since the logistics plays an important role in the supply chain that the two important sectors transportation and distribution inventory has taken into consideration for redesigning the allocation and routing through optimization. This approach is based on genetic algorithm. It searches the population of solutions of an optimization problem towards the improvement by simulating the natural search and selection process associated with natural genetics.

The model comprises the genetic algorithm optimization where the inventory level at the plant and warehouse are optimized according to the production capacity of the same. The distribution cost plays an important role in optimizing the inventory level, so that the total cost for the entire supply chain is minimized. The GADIM approach assure in minimizing the total cost of the supply chain by optimizing the inventory levels in accordance with production capacity of plant and warehouse.

LITERATURE SURVEY

The literature review in aspect of distribution inventory management of supply chain, states clearly that no optimal inventory policy has been developed for a serial Supply Chain in view of the complexity of the problem. Hence the objective of the study is to optimize the inventory level for a two-echelon single product serial supply chain

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