Chapter 22
Mathematical Modeling of Supply Chain Management Systems

C. Elango
Cardamom Planters' Association College, India

N. Anbazhagan
Alagappa University, India

ABSTRACT

Supply Chain Management (SCM) is the practice of coordinating the flow of goods, services, information and finances as they move from raw materials to parts supplier to manufacturer to wholesaler to retailer to consumer. Different supply chains have been designed for a variety of firms and this chapter discusses some issues in this regard. This chapter attempts to find why we require different supply chain for different companies. In this chapter we discuss the role of stochastic models in supply chain management system, and also discuss other mathematical models for SCM.

INTRODUCTION

Our growing global economy has caused a dramatic shift in inventory management in recent years. Now, as never before, the inventory of many manufacturers is scattered throughout the world. Even the inventory of an individual product may be dispersed globally.

Most of the MNCs implemented an ERP strategy to solve production and inventory management problems arise in the industry. Hindustan Oil Corporation (HOC) is an example from Inidia on ERP based system management. The (ERP) selection was based on the data and process integration that can be provided by the ERP package, rich functionality are features of the ERP, productsupport and services. Indian presence of ERP vendor and recommendations by leading management consultants, track a record of the vendor company in India and abroad. This is basis for supply chain managemnet system. The major modules which facilitated the supply Chain efficiency include demand planning (forecasting accuracy), data warehouse(reduce maldistribution and lost sales), vendor management of inventory (to improve response time).

A manufacturer's inventory may be stored initially at the point or points of manufacture (one echelon of the inventory system), then at national

DOI: 10.4018/978-1-61520-625-4.ch022

or regional warehouses (a second echelon) then at field distribution centers (a third echelon), and so on, thus each stage at which inventory is held in progression through a multistage inventory system is called multi-echelon inventory system. In the case of a fully integrated corporation that both manufactures its products and sells them at the retail level, its echelons will extend all the way to its retail outlets.

Some co-ordination is needed between the inventories of any particular or the different echelons. Since the inventory at each echelon(except the last one)is used to replenish the inventory at the next echelon as needed, the inventory level currently needed at an echelon is affected by how soon replenishment will be needed at the various locations for the next echelon.

The analysis of multi-echelon inventory system is a major challenge. However, considerable innovative research (tracing back to the middle of the 20th century) has been conducted to develop tractable multi-echelon inventory models. With the growing prominence of multi-echelon inventory systems, this undoubtedly will continue to be an active area of research.

Another key concept that has emerged in the global economy is that of supply chain management. This concept pushes the management of multi-echelon inventory system one step further by also considering what need to happen to bring a product into inventory system in the first place. However, as with inventory management, the main purpose still is to win the competitive battle against other companies in bringing the product to the customers as promptly as possible.

A supply chain is a network of facilities that procure raw materials, transform them into intermediate goods and then final products, and finally deliver the products to customers through a distribution system that includes (probably multi-echelon) inventory system. Thus Supply Chain consists of all parties involved directely in fulfilling a customer request. The supply chain includes manufacturers, suppliers, transporters, warehouses, retailers and customers themselves. Whithin each organization such as manufacturers the Supply Chain includes all functions involved in receiving and filling the customer request. These functions includes but are not limited to new product developmnet marketing, operations, distribution, finance and customer service.

A supply chain spans procurement, manufacturing, and distribution. Since inventories are needed at all these stages, effective inventory management is one key element in managing supply chain. To fill orders efficiently, it is necessary to understand the linkages and inter-relationship of all the key elements of supply chain. Therefore, integrated management of the supply chain has become a key success factor for some of today's leading companies.

The Hewlett-Packard was one of the early pioneers in using operation research to help implement effective supply chain management throughout the corporation. Wal-Mart, Dell computers are other major players in the field of Supply Chain Management Systems

A typical supply chain may have variety of stages. The different stages of SC (Supply Chain) are:

- Customers
- Retailers
- Wholesalers/ Distributors
- Manufacturers
- Compnents/ Raw material suppliers

THE OBJECTIVE OF A SUPPLY CHAIN

The objective of every supply chain is to maximize the overall value generated. The value a supply chain generate is the difference between what the final product worth and the effort the supply chain expends in filling the customer request.

In most of the Commercial Supply chains the value will be strongly correlated with the supply