Chapter 1

Introduction

1.1 Overview and Preface to Supply Chain Management

India ranks 56th out of 142 countries in the Global Competitiveness Index as a result of survey for overall competitiveness. This has a reference to the Global Competitiveness Report 2011-12 by World Economic Forum. India displays competitive strengths in areas of business sophistication, innovation and financial market sophistication. The country can also rely on fairly well-functioning institutions. On the other hand, there is considerable room for improvement in several of the basic drivers of competitiveness in particular infrastructure viz. industry, health and primary education. It is Universal fact that today; Supply Chain Management (SCM) is one of the basic drivers of competitiveness for industry.

Evidences show that Supply Chains were present from the time when mankind understood the need of merchandising and distribution. There are several examples of success achieved in battles and wars of ancient history due to Supply Chain Management. During World War II, military forces made effective use of Supply Chain Management to ensure that the required was at the right place at right time. A war could be lost if the weapons food and supplies did not reach to the soldiers in time. Strategically, supply lines were cut off in order to cause havoc in enemy campus. The Supply Chain ever could be traced down to ancient times when barter system was used. In this system, one product was traded for another product of equal value. Later in 300 BC, Caesar made trading posts in East Asia in order to promote trade. This was the first Retailer-Supplier relationship establishment of the silk route to India as mentioned by Johnson and Pyke (2006)[1].

The era from the mid-20th century to the present can be roughly broken down into three phases. The first phase from 1960 to 1975 witnessed the development of contemporary go-to-market strategy. The phase was an inventory push environment in which the stock was pushed out to the distribution centers from
the central supply that focused primarily on physical distribution of finished goods. The production output was cascaded down to finish goods locations and management’s task was to balance production output with customer requirements. The companies managed manufacturing, work-in-progress and raw materials as separate parts of the business.

The second phase was from 1975 to 1990. In this phase business leadership began to recognize the importance of integrating operation within the enterprise. During this period, companies harnessed increasing amounts of computer horsepower to the material output process. Management Information Systems priorities shifted from a focus on the financials to material management techniques like Material Requirement Planning and Manufacturing Resource Planning. The management priorities shifted to balancing raw material, work-in-progress, finished goods inventory, and multiple customer service measures. Some progressive industries started shifting from an inventory push to a customer pull channel as power began to move downstream to the customer. The customer demand triggered the pulling of product from the central supply.

The third phase started in late 1980s and has accelerated into this decade. In 1981, IBM outsourced almost all of its activities and built a full computer. Wal-Mart introduced the concept of cross docking and replaced K-mart as the leader in retail stores in 1985. Effective use of computers revolutionized the business process in 1990. Internet revolutionized the information pathway and the distribution system of the business in 1996. This latest evolution is based on the realization that the significant increase in productivity can only come from managing Relationships, Information and Material Flow across enterprise borders. This is Supply Chain Management (SCM). It is defined as the set of approaches to efficiently integrate Suppliers, Manufactures, Warehouses, and Stores, so that merchandise is produced and distributed in right quantities, to the right locations, and at the right time, in order to minimize system-wide costs while satisfying service level requirements as stated by David et. al. (2000) [2].

A
coordinated Supply Chain integrates Procurement, Production, and Distribution and links together Suppliers, Manufacturers, Distributors, Customers and Carriers in a network system that allows for effective planning, information exchange, transaction execution, and performance reporting.

Supply Chain Management (SCM) has emerged over the past few years as the key to success in the Global economy, regardless of industry or company size. Its premise is simple: operational strategies should be designed and managed around customer needs. In the near future only those Enterprises will survive which can provide goods and services to its customers in Timely & Cost Effective manner. Application of Supply Chain Management in effective way to Indian Context will definitely upgrade India's present position. Pressures from low-cost and the new Global competitive environment require companies to be more productive, react faster to market changes, and maintain smaller inventories.

This Project examines the types of activities involved in Supply Chain Management Decisions; the Dynamics of the traditional Supply Chain Management, and proposes the complementarities of technology in achieving effective management of operations.

Supply Chain Management involves the movement of products, services, and information between and within businesses, the creation of value, and support of enterprises in the pursuance of a competitive advantage in the market place. It involves the cooperation and coordination of activities of all parties for the production and distribution of products to the final consumer with mechanism in place to optimize inventories across the entire supply chain as quoted by Haan, et. al. (2005) [3], Viswanathan and Piplani (2001) [4], with effective management of products to create added value in financial analysis of shares.

The upstream and downstream coordination endangered by Supply Chain Management with the Goal of minimizing uncertainty and variations along the
Supply Chain shows that businesses can no longer expect that the objective of business can be met just by becoming efficient in itself. As indicated by Hameri and Palsson (2003) [5], process rationalization in psychology and measurement system would need to be implemented to improve the operational efficiency inside a company by reducing lead times and by partnering with upstream and downstream players of the Supply Chain. The situation requires that for value to reach the customers, efficiency must be evident even in the suppliers, the distribution channel, and all associated activities and partners. Competition is no longer between individual businesses, but between groups of companies that are linked together in a Supply Chain for delivering customer value as stated by Chandra (2000) [6]. Christopher (1994) [7], defined Supply Chain as “A Supply Chain is a set of entities that collectively manufactures a product and sells it to an endpoint” The definition of a Supply Chain is in many cases very wide and not always easy to narrow down. Furthermore the definition often tends to vary from one person to another. In fact the view should differ from one company to another depending on different situations because the activities that make one company successful will not work for another as depicted by Ayers (2000) [8]. All organizations have Supply Chains of varying degrees, depending upon the size of the organization and the type of product manufactured. These networks obtain supplies and components; transform the raw material into finished products and distribute the finished products to the customers as stated by Mark Stevenson (2007) [9].

Supply Chain (SC), which involves the configuration, coordination, and improvement of sequentially related set of operations in establishments, integrates technology and human resource capacity for optimal management of operations to reduce inventory requirements and provide support to enterprises in pursuance of a competitive advantage in the market place in accordance with; in prosecution or fulfillment of customer requirements....satisfaction....delight as quoted by Kilty (2000) [10]. The developments in the operation of businesses entail significant changes in the traditional ways of manufacturing system Park (1995) [11].
With this understanding of the Supply Chain (SC) and Supply Chain Management (SCM), in this research, critical issues causing bottlenecks in the operational efficiency of Supply Chains are identified for the Supply Chains of Fast Moving Consumer Goods (FMCG) / Fast Moving Engineering Goods (FMEG). Here, a three echelon Supply Chain network is considered under Stochastic Demand during lead time and which includes Production, Distribution and Transportation functions.

![A Three echelon Supply Chain](image)

**Figure 1.1: A Three echelon Supply Chain**

- Effective strategies to resolve these issues are proposed which make use of scientific tools and techniques viz. Analytical Hierarchy Process, Relative Reliability Risk Evaluation, Fuzzy approach.
- MATLAB version 7.0 is used for optimization of the cost function of the integrated Supply Chain.
- A simulation model is developed using PROMODEL version 7.0 to mimic the Dynamically variable Supply Chain.
- Supply Chain phenomenon / activity can be splitted into three fundamental blocks, Inputs, System and Outputs. Nobody has yet tried to obtain Mathematical Relationship among the various parameters governing these three fundamental blocks. This is a drawback of existing research. To overcome this drawback, in this research, Mathematical
Relations are established among Supply Chain parameters. You can decide the magnitude of the input required to get a desired output, only when you have established a Mathematical Relationship. Therefore the aim of this research is also to establish Mathematical Model for the Supply Chain activity of given configuration and to optimize its operation.

- MATLAB version 7.0 is also used for Artificial Neural Network (ANN) simulation for comparative study and to show the applicability and efficiency of Artificial Neural Network (ANN) simulation for this type of problem.
- An Innovative Cross-Boundary performance measurement method is proposed to benchmark the Supply Chains under study. This method uses Fuzzy approach to evaluate various performance metrics.
- By evaluating the output data, the Supply Chain Network for this case is designed, and the optimal product quantities between the Factory, Warehouse and Retailer are calculated. Also it is proved that Artificial Neural Network (ANN) simulation can be used instead of analytical computations because of ensuring a simplified representation for this method and for time saving.

1.2 Need of Decision Support Systems for Supply Chain Drivers

Clearly, like many complex business systems, Supply Chain Management problems are not so rigid and well defined that they can be delegated entirely to computers. Instead, in almost every case, the flexibility, intuition and wisdom that are unique characteristics of the humans are essentials to manage the system effectively. A Decision Support System (DSS) is a system under the control of one or more Decision Makers that assists in the activity of decision making by providing an organized set of tools intended to impose structure on portions of the decision-making situation and to improve the ultimate effectiveness of the decision outcome. The DSS clearly offers management a powerful tool and is rapidly becoming an integral component of managerial work.
The speed at which today's information becomes yesterday's news, continues to increase at a staggering rate. Tomorrow's manager will confront an ever-narrowing window of opportunity within which effective decision will need to be made. Deadlines will measured in days, hours, and minutes rather than in quarters, months, and years. The leveraging of technology that will allow tomorrow's effective decisions in such high-speed environment is what decision support is all about.

To meet the demands of managerial work, a DSS must be able to provide the Decision Maker with certain key elements vital to his or her success. It's effectiveness depends on the degree of fit between the Decision Maker, the context of the decision, and the DSS itself. The potential benefits of DSS are as follows:

- Extends the Decision Maker's ability to process information and knowledge.
- Extends the Decision Maker's ability to tackle large-scale, time-consuming, complex problems.
- Shortens the time associated with making a decision.
- Improves the reliability of a decision process or outcome.
- Encourages exploration and discovery on the part of Decision Maker.
- Reveals new approaches to thinking about a problem space or decision context.
- Generates new evidence in support of a decision or confirmation of existing assumptions.
- Creates a strategic or competitive advantage over competing organizations.

The DSS is expected to extend the Decision Maker's capacity in processing the mountain of information involved in making a decision. Further, many components of a decision situation, although structured, are highly complex and time-consuming. The DSS can solve those portion of the problem, and save on cognitive resources and more importantly, large blocks of precious time for the
Decision Maker. As a result, using a DSS can be expected to decrease the overall time involved in reaching a complex, structured decision. Additional benefits can be found in the area of innovation and creativity. Simply using the DSS can provide the Decision Maker with potential alternatives that might otherwise go unnoticed or appear too complex and difficult to pursue. The tools within the DSS can stimulate the problem solver to reach innovative insights regarding solutions and their associated outcomes. In addition, the output of DSS may often justify the position of the Decision Maker(s), thus facilitating consensus among stakeholders. Finally, given the shrinking window of opportunity associated with the pace of business, the DSS must provide competitive advantage to organizations. To achieve some or all of this potential benefits, however, the manager must understand not only the appropriate application of a particular decision support tools but also its limits.

Decision Support System for Supply Chain Management (SCM) is a fast growing sector of logistics software industry as quoted by Ballou (2000) \(^{[12]}\). In 1993, Procter and gamble (P & G) started a programme of redesigning its entire Supply Chain, which would lead to lower costs as depicted by Kuei, C.H., Madu, C.N. Lin, C. (2001) \(^{[13]}\). Working with faculty from University of Cincinnati, P & G engineers developed a DSS to aid the teams involved in decision making. Amoco Chemical Corporation was confronted with a set of common inventory management challenges: identifying appropriate inventory levels at different locations in the Supply Chain, dealing with capacity constraints of capital, equipment and people, and conflicting organizational objectives among sales, production and inventory. The objectives of the corporation include: relocate working capital to fund growth, maintain or improve customer service levels and improve operational efficiency. Mercer Management Consulting Inc. and Amoco developed a customer DSS to address these issues as stated by Wen-Chyuan Chiang (2004) \(^{[14]}\).

It is now obvious that Supply Chain manager has to take many decisions along the Supply Chain and the success of SCM depends upon their drivers i.e.
Facilities, Transportation, Information and Inventory as stated by Chopra and Meindl (2003) [15]. For any particular problem or issue of the driver, managers have to apply analysis or the decision support tools for decision making. The Supply Chain drivers play a significant role in Supply Chain Management’s ability to support a firm / organization’s competitive strategy to maintain the competitive advantage.