



Rural Management Rural Supply Chain Management

First Edition



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Editorial Board

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About the Book

Supply chain management is an integrated approach adopted by the firms to gain competitive advantage. Supply chain is process by which all business partners / entities are seamlessly integrated. SCM includes suppliers, manufacturers, distributors, retailers and end users. In a supply chain there are three important flows that are going to take place, namely, physical flow of goods and services, from upstream, money flows from downstream and information flows across. SCM has three important stages, i.e integration, collaboration and adoption. Total value can be optimized through adoption. In a supply chain, demand and supply are matched through managing inventories. Different techniques are used to manage the inventory optimally. Supply chain management has larger scope in rural business management. Rural businesses are still in the primitive stage of implementing SCM philosophies. Supply chain and value mapping are important.

This book consists of five chapters. Chapter 1 outlines the introduction to supply chain management. It includes definition, evolution of operations and SCM. Impact of globalization, productivity and competitiveness has been covered. Chapter 2 details the process of supply chain management. In this chapter, flow in supply chain, inventory management and control system, bullwhip effect, supply chain network design decisions, logistics management & its functions. This chapter is concluded with the integration of processes in supply chain.

Chapter 3 focuses on tools used in implementation of rural supply chain management. In this chapter, importance tools in SCM, shipping status tools & order processing tools, lean inventory and warehouse management tools are covered. Further, greater emphasis was given to supplier management, demand forecasting tools, supply chain analytics and reports. Of course, supply chain analytics is one of the emerging areas in SCM. Lot of space is available for job opportunities. Chapter 4 describes the rural supply chain mapping and its importance, supply chain mapping methodologies, and supply chain mapping using value stream mapping. This chapter is culminated with case studies. Chapter 5 elaborates the current opportunities in SCM, impact of GST on rural supply chain, impact of FDI on rural supply chain, and scope for rural managers in rural supply chain management. Case studies were also included in the chapter.

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Dr W G Prasanna Kumar
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Contents

Chapter1 Introduction to Supply Chain Management	1-20
1.1 Defining Supply Chain Management	
1.2 Evolution of Operations and Supply Chain Management	
1.3 Impact of globalization	
1.4 Productivity	
1.5 Competitiveness	
Chapter2 Process of Supply Chain Management	21-49
2.1 Flow in supply chain	
2.2 Inventory management and areas of inventory control system	
2.3 Bullwhip effect	
2.4 Designing the distribution network in a supply chain	
2.5 Logistics Management and Integration of processes in supply chain	
Chapter 3 Tools used in Implementing Rural Supply Chain Management	50-77
3.1 Importance of tools in SCM	
3.2 Shipping status tools and Order processing tools	
3.3 Lean Inventory and warehouse management tools	
3.4 Supplier management and demand forecasting tools	
3.5 Supply chain analytics and reports	
Chapter 4 Mapping Supply Chain in Rural Markets	78-98
4.1 Defining rural supply chain mapping	
4.2 Importance of rural supply chain management	
4.3 Supply chain mapping methodologies	
4.4 Supply chain mapping using Value Stream Mapping	
4.5 Case Studies	
Chapter 5 Scope of Rural Supply Chain Management in India	99-125
5.1 Current opportunities in SCM	
5.2 Impact of Goods and Services Tax (GST) on rural supply chain	
5.3 Impact of foreign direct investment on rural supply chain	
5.4 Scope of rural managers in rural supply chain management	
5.5 Case Studies	

List of Tables

1.1 Notable definitions of SCM	3
1.2 Evolution of Operations and Supply Chain Management	5
1.3 Top 10 Countries Gross Domestic Product (GDP) and Population	10
1.4 ITC framework to understand firm competitiveness	16
2.1 Inventory Control Techniques	26
2.2 Bullwhip Effect in a supply chain-Pickle	30
2.3 Summary of obstacles to coordination in a supply chain	34
2.4 Summary of factors affecting the distribution network	37
2.5 Summary of distribution channels in supply chain	38
3.1 Important tools used in supply chain management	51
3.2 Summary of Wastes in Operations (Mudas)	61
3.3 Summary of lean approaches used in lean inventory	63
3.4 Major activities in a warehouse	65
3.5 Summary of Time Horizons for Forecasting	70
3.6 Summary of types of demand forecasting	71
3.7 Types of demand forecasting methods	71
4.1 Strategic Supply Chain Mapping versus Process Mapping	79
4.2 Value added through time	81
4.3 Supply Chain Mapping- an example	81
5.1 GST Implementation by various Countries	105
5.2 Category of Items and GST Rates	106
5.3 M&A Investments	110
5.4 Top five recipients due to M&A	110

List of Figures

1.1 Elements of Supply Chain Management System	2
1.2 Supply chain entities	9
1.3 Five Dimensions of Competitiveness	17
2.1 Flows in Supply Chain	22
2.2 Inventory System Components	25
2.3 Economic Order Quantity Model	27
2.4 Bullwhip effect	29
2.5 Major causes or contributing factors to the bullwhip	31

2.6 Major obstacles to coordination in supply chain	33
2.7 Hierarchy of supply chain decisions	36
2.8 Supply chain network	37
2.9 Integrated Logistics System	46
2.8 Integrated supply chain	47
3.1 Electronic Data Interchange	52
3.3 Global Positioning System (GPS)	53
3.4 Photo of a Scanner	54
3.5 Enterprise Resource System (ERP)	54
3.6 Speed Post Booked Receipt	56
3.7 Tracking chart of Speed post parcel	59
3.8 Layout of warehouse	64
3.9 Strategic Sourcing Plan Stages	66
3.10 Ways to source new suppliers	67
3.11 Schematic diagram of Box-Jenkins Model	73
4.1 Rural Supply Chain Stakeholders	80
4.2 Rural Supply Chain Network	83
4.3 Integrated Rural Supply Chain Network	85
4.4 Supply chain mapping existing position	86
4.5 Impact of supply chain integration / optimization	88
4.6 Value Chain	90
4.7 Value Enhancement	91
4.8 Value stream mapping	92
4.9 Supply Chain Mapping Icons	93
5.1 Prime Models of GST	105
5.2 Tax System followed prior to GST	106

Chapter 1 Introduction to Supply Chain Management

Introduction

The key business challenges faced by companies are fierce competition; customers' expectations increasingly high, less supply time, customization, more varieties and low cost. For this companies have started doing lot many things internally. For example, internal integration, adoption of technology, implementation of quality controls tools and productivity improvement methods. They could not meet the business challenges beyond some levels. So, companies have started adopting supply chain methodologies as part of their business integrating with suppliers and customers. In other words, networking with their suppliers and customers, is known as supply chain networks. This integrated approach has given huge benefits to the companies. Through implementation of supply chain management process and tools, companies have gained competitive advantage. So, supply chain management practices are used for gaining competitive advantage. The objective of Supply Chain Management (SCM) is to achieve operational excellence throughout the enterprise by maximizing revenue, minimizing expenses and making full use of all the assets.

The term supply chain management (SCM) was introduced by consultants in the early 1980s. It has its origins in the literature and logistics has continued to have a significant impact on the concept. This chapter outlines definition of supply chain management, evolution of operations and supply chain management, impact of globalization, productivity and competitiveness.

Learning Objectives

After reading this chapter you will be able to:

- i. Gain insights on the supply chain management concepts.
- ii. Discuss the operations management objectives and scope.
- iii. Explain the globalization and its impact on business.
- iv. Describe about productivity and measures of productivity
- v. Appreciate what is competitiveness and its importance

Chapter Structure

1.1 Defining Supply Chain Management	
1.2 Evolution of Operations and Supply Chain Management	
1.3 Impact of globalization	
1.4 Productivity	
1.5 Competitiveness	

1.1 Defining Supply Chain Management

Supply chain management (SCM) is an integration of all activities, i.e sourcing, procurement, operations, distribution and retailing including product recalls. Supply chain management means planning, organizing and controlling of supply chain activities. Supply chain management can be seen as the process of strategically managing the procurement, movement and storage of materials, parts, finished inventory through the organization and its marketing channels in such a way that current and future profitability are maximized through the cost effective fulfillment of orders. Supply chain is understood as a bridge between demand and supply. It conveys the demand to the supply point and delivers the supply to the demand point. Thus, most supply chains are actually networks. Figure 1.1 describes the elements of supply chain management system.

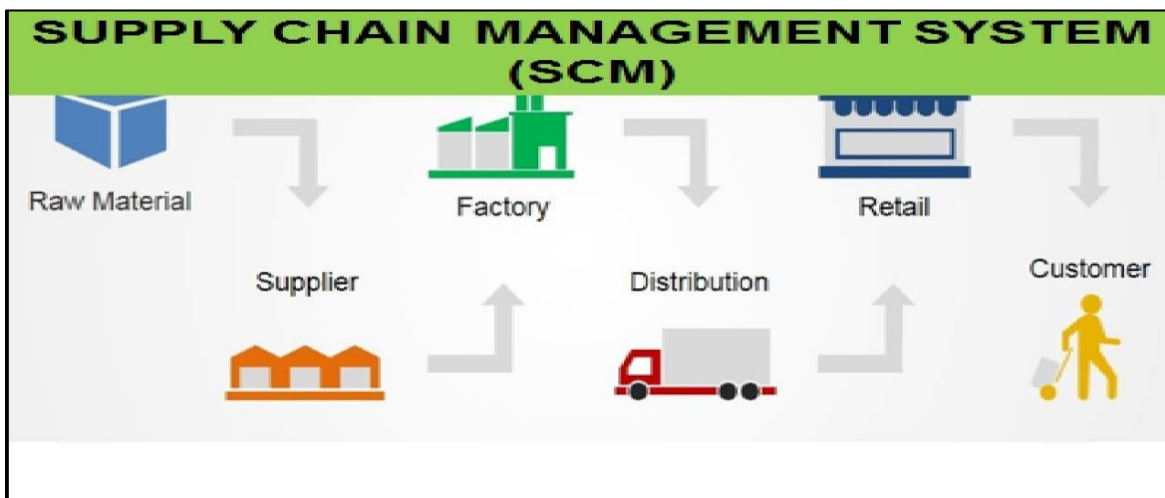


Figure 1.1: Elements of Supply Chain Management System (Dinesh, 2017)

A typical supply chain involves a variety of stages. These supply chain stages include: Component /raw material suppliers, manufacturers, wholesalers / distributors, retailers and end customers. Each stage in a supply chain is connected through the flow of products /services, information and funds/ money. Supply chains exist in both manufacturing and service organizations, although the complexity of the chain may vary greatly from industry to industry and firm to firm. Rural supply chain management is in a primitive stage and fragmented as well.

Supply chain is understood as the process starting from the procurement of raw materials to the ultimate consumption of the finished product linking across supplier-user companies, or the functions inside and outside a company that enable the value chain to make products and provide services to the customer.

Supplier → Manufacturer → Wholesaler / Dealer / Distributor → Retailer → End customer

Various Definitions of Supply Chain Management

Some of the notable definitions for supply chain management are represented below in Table 1.1.

Table 1.1: Notable definitions of SCM

Sl. No	Definition	Organization
1	SCM is the integration of key business processes from end user through original suppliers what provides products, services and information that add value for customers and other stakeholders	The Global Supply Chain Forum, 2004.
2	'Integrated SCM is a process oriented, integrated approach to procure, produce and deliver products and services to customers. Integrated supply chain management has broad scope that includes sub- suppliers, suppliers, internal operations, trade customers, retail customers and end users. It covers the management of materials, information and fund flow.	MIT official definition, 1998.
3	' The integration of business process from end user through original suppliers, that provide products, services and information that add value for customers'	Ohio State University.
4	A 'Supply Chain' consists of all of the entities necessary to transform ideas into delivered products and services. The SM directs and transforms a firm's resources in order to design, purchase, produce and deliver high quality goods and services. As goods and services flow from supplier to producer to customer to final user, SCM is particularly concerned with the interfaces between organizations. One way to view supply chain management is as the management of linkages between organizations.	Arizona State University.
5	Supply chain management as ' the process of planning, implementing and controlling efficient and cost-effective flow of materials, in-process inventory, finished goods and related information from point-of-order to point-of-consumption, for the purpose of conforming to customer, for the purpose of conforming to customers requirements	The Council of Logistics Management.
6	SCM means planning, organizing and controlling of supply chain activities. Supply chain is understood as the process starting from the procurement of raw materials to the ultimate consumption of the finished product linking across supplier user companies, or the functions inside and outside a company that enable the value chain to make products and provide services to the customer.	American Production and Inventory Control Society (APICS) Dictionary.
7	Supply chain management process components include: Plan, Source, Make, Deliver and Return.	IFPSM SCOR Model

The Various Connotations of SCM

Thomas and Griffin (1996): Management of material and information flows both in and between facilities such as vendors, manufacturers and assembly plants and distribution centres.

Beamon (1999): An integrated process, where raw materials are transformed into final products then delivered to customers.

Hicks (1999) : Systematic effort to provide integrated management to meet customers' needs and expectation from the suppliers of raw materials through manufacturing to end customers.

Lee and Billington (1992): A supply chain is a network of facilities that procure raw materials, transform them into intermediate goods and then final products and deliver the finished products to customers through a distribution system.

Ganeshan and Harrison (1995): A supply chain is a network of facilities and distribution options that perform the functions of procurement of materials, transformation of these materials into intermediate and finished products and the distribution of these products to customers.

Jayasankar, Smith and Sadeh (1996): A network of autonomous or semi-autonomous business entities collectively responsible for procurement, manufacturing, and distribution activities associated with one or more families of related products.

The SCM aims to increase sales, reduce cost and make full use of assets by streamlining the interaction and communication of all participants along the supply chain. According to Performance Measurement Group (PMG) studies, it is mentioned that the supply chain improvements lower costs as much as 25 percent in one year.

To Do Activity

Visit a Pot making unit nearby your place. Study the supply chain of Pot making and identify the various elements in that supply chain. Prepare a report.

1.2 Evolution of Operations and Supply Chain Management

World is full of amazing man made creatures like the pyramids of Egypt, the Great Wall of China, Taj Mahal in India, and Eifel towers in France. The industrial Revolution was started in the 1700s. So, operations management began after this only. Prior to that time, skilled crafts persons and their apprentices fashioned goods for individual customers from studios in their own homes. So, the evolution of operations management has many milestones and facets. It started with craft production, division of labor, interchangeable parts, scientific management, mass production, emphasis on quality, lean production and supply chain management. Table 1.2 describes the details of evolution of operations management (Roberta S. Russell, 2009).

Table 1.2: Evolution of Operations and Supply Chain Management

Milestones	Details
Craft production	The process of handcrafting products or services for individual customers. Every part in a product is very unique, hand fitted and made entirely by one person. Examples, sculptures, statues, tools, ornaments etc. The revolution first took hold in textile mills, grain mills, metalworking, and machine making facilities. This was the practice prior to Industrial revolution in the 1700s.
Division of labor	Dividing a job into a series of small tasks each performed by a different worker. Adam Smith's Wealth of Nations (1776) proposed the division of labor. In division of labor, the production process was broken into a series of small tasks, each performed by a different worker. Job specialization has started and further encouraged the development specialized machineries.
Interchangeable parts	The introduction of interchangeable parts by Eli Whitney (1790s) allowed the manufacture of firearms, clocks, watches, sewing machines, and other goods to shift from customized one at a time production to volume production of standardized parts. This meant the factory needed a system of measurements, and inspection, a standard method of production and supervisors to check the quality of the worker's production.
Scientific Management	The systematic analysis of work methods. F. W. Taylor is called 'Father of Scientific Management'. Taylor's philosophy (1900s) became known as Scientific management. He has given importance for measurements, methods, observations, incentive system, etc. His ideas were embraced by efficiency experts Frank and Lillian Gilbreth, Henry Gantt, Henry Ford etc. Henry Ford applied scientific management to the production of the Model T in 1913. They have adopted integration strategies (backward and forward) and also moving parts by conveyor system. They are able to produce high volume or 'en masse' yielding the name mass production.
Mass Production	The high volume production of a standardized product for a mass market. American manufacturers became adept at mass production over the next 50 years and easily dominated manufacturing worldwide. Later on human relations movement Elton Mayo (1930s), Frederick Herzberg, Maslow, Douglas McGregor and others have contributed towards mass production.
Emphasis on quality	An emphasis on quality and the strategic role of operations. This was started by the Japanese firms by adopting 'quality is the way of life' philosophy. Earlier to this, American manufacturers were focusing on managerial effectiveness and technical expertise. Japanese companies such as Matsushita, Toyota, and Honda started producing high quality and low cost products. This was a great challenge to American firms. Mass production can produce large volumes of goods quickly, but it cannot adapt very well to changes in demand.
Supply chain management	Managing the flow of information, products, and services across a network of suppliers, manufacturers, enterprises and customers.

Operations Management

Operations management is that activity whereby resources, flowing within a defined system, are combined and transformed in a controlled manner to add value in accordance with policies communicated by management.

Operations management is the design, operation and improvement of productive systems. Operations are a function or system that transforms inputs into outputs of greater value.

Need for Operations Management

- i. Why to produce..... Customer demand
- ii. What to produce..... Products / Services
- iii. When to produce..... Time / delivery
- iv. Where to produce..... Facility / Plant location
- v. Who has to produce..... In-house / Outsourcing
- vi. How to produce..... Process

5P's of Operations Management are:

- i. Product
- ii. Plant
- iii. Processes
- iv. Programmes
- v. People

Scope of Operations Management

- i. Location of facilities
- ii. Plant layout and job design
- iii. Material handling
- iv. Product design
- v. Process design
- vi. Production Planning & Control (PPC)
- vii. Quality Control
- viii. Inventory Management
- ix. Maintenance Management
- x. Automation

Objectives of Production and Operations Management

The main objectives are:

- i. To attain maximum output with given set of resources
- ii. To produce maximum with lowest cost
- iii. To control pollution and wastages
- iv. To ensure optimum capacity utilization
- v. To exercise inventory control
- vi. To control and reduce cost of production
- vii. To ensure optimum utilization of resources
- viii. To ensure timely delivery of output
- ix. To ensure quality products
- x. To suggest changes in machineries and equipments

Operations as a Transformation Process: Input-Output Production System Model

Input – Output model describes the inputs like resources, men, machines, materials, money, methods/process technology, time (minutes) and space (square meters). Then, the next element is process- conversion process. After this, the next system element is output like goods and services. All these elements are interlinked with a feedback system to meet the set standards. In a production system inputs like men, materials, methods, money, machines, time and space in square meters are used / converted into useful / value added outputs i.e. goods / services.

Example 1

Fruit juice extraction production system is taken as example to identify the inputs, process, outputs and feedback control. In this case, the key inputs are: fruits, machineries, workmen, power, and consumables the conversion process includes fruits feeding system, juice extraction, filtering and packaging / bottling and the output includes juice, fruit residues, and wastes. Production system concept is applicable to both manufacturing and service domain also. In the case of manufacturing system, the outputs are goods and services, whereas in the case of service production system, the outputs are 'service delivery'.

Example 2

In hospital healthcare system, the inputs are doctors, nurses, staffs, equipments, beds, other facilities etc, the conversion process is treatment, and procedure and the outputs are cured patients, and wellness. The medical care adds value (and enhanced existence) to the patients 'lives'.

Operations Management as a Competitive Weapon

Business and government leaders are recognizing the importance of involving the whole organization in making strategic decisions in order to compete globally. Because the organization usually commits the bulk of its human and financial assets to operations, operations is an important function in meeting global competition.

Wickham Skinner (1969) suggested that the production system could be either a competitive weapon or a milestone. He concluded that operations policies covering inventory levels, schedules, and capacity planning should be focused on achieving strategic goals of the company. The importance of operations and supply chain management issues are realized during these pandemic times, i.e. supply of Covid vaccines, oxygen support systems, and life saving respiratory systems. It is seen that mismatch between supply and demand besides wastage of inventory.

Supply Chain Management

The concept of supply chain existed right from the evolution of trade and could be traced back up to 5000 years BC in India. India was a trade leader in those periods and dealt with Egyptian and Romanian cultures along with huge domestic operations. After the First Industrial Revolution (1700s) the corporate were following system which was efficient at that time but with fragmented supply chain approach. Every department was functioning in silos. The scenario started changing after the Second Industrial happened as Toyota Production System (TPS) in Japan. The same was accelerated by advent of MRP systems, MRP-II systems and finally ERP systems. Through ERP all functions were tightly integrated. The relationships between the trading organizations were improving which was referred as partnership. The

evolution ultimately resulted into supply chain management. Thus the concept of supply chain did exist long back but the concept of supply chain management is new (Roberta S. Russell, 2009).

Therefore, SCM function is the outgrowth of the unified evolution of manufacturing management and logistics management functions. The concept of logistics management itself evolved from unified evolution of materials management and sales and distribution management (V.Altekar, 2005). The term 'supply chain management,' was coined in the late 1980s and became very popular in the 1990s. Before that, firms had used terms such as 'logistic' and 'operations management' instead of SCM. Michael Hugos (2006) has defined 'supply chain is the co-ordination of the production, inventory, location, and transportation among the participants in a supply chain to achieve the best mix of responsiveness and efficiency for the market being served.

Concept of SCM

According to Martin Christopher (2003), SCM is defined as 'the management of upstream and downstream relationships with suppliers and customer to deliver superior customer value at least cost'. Upstream of supply chain is move towards the suppliers and downstream moves towards customers.

Objectives of SCM

- i. To solve suppliers problems
- ii. To improve customer's service performance
- iii. To reduce pre and post production inventory
- iv. To minimize total cost of operations and procurement
- v. To achieve maximum efficiency in utilization of labor, capital and plant

Supply Chain Performance Drivers

The purpose of supply chain strategy is to make trade-off between responsiveness and efficiency. So, the key drivers are: production, inventory, location, transportation, pricing, sourcing and information. The combined effect of these five drivers determines the required level of responsiveness and efficiency of the entire supply chain. Combination determines how well the supply chain services its market and how possible it is for the participants in that supply chain.

SCM Approach

There are two approaches of managing supply chain namely, traditional approach and modern approach. In traditional approach, customers and suppliers were treated as external entities and most of the time ignored for any strategic decisions. So the first level of integration happened through Material Requirement Planning (MRP). Examples are production planning and production control, material planning and procurement. In the second level, planning, purchase, outsourcing and stores were integrated through MRP-II. In the third level, suppliers, internal and customers are integrated via ERP. In the modern approach, typically it integrates all of its internal supply chain operations as well as the external supply chain operations to deliver value to the end customers. Through Collaborative Planning Forecasting Replenishment (CPFR), all the organized players are seen as one entity, i.e suppliers, manufacturing plants, distributors / dealers, Retail Outlets and end customers. Figure 1.2 exhibits the supply chain entities.

Supplier	→	Manufacturer	→	Distributor	→	Retail Outlet	→	End Customer
Raw material, parts, components, systems / units, Stockiest		Machining, Sub-Assembly, Assembly, Testing and packing		Distributors / dealers/ sub-dealers		Kirana stores, hyper malls, provision stores, shops		Customer / Consumer
-----→ Physical flow of goods								
<-----Fund / Money flow								
<----- Information ----->								

Figure 1.2: Supply chain entities

Elements in SCM

SCM consists of two major elements namely, SCM planning and SCM execution. The efficiency of supply chain is the result of both the planning and execution decisions. SCM planning is based on the optimization theory and the use of highly sophisticated systems. It is imperative to prepare at the most efficient production schedules, distribution plans, transportation plans and also fulfillment plans. The SCM planning process will recommend various activities, their schedules being based on the overall requirements and resource loading factors. These plans will ensure that the operating costs are minimal with all the services being offered as per expectations. SCM execution typically starts from the date of schedule. Due to various practical reasons and limitations deviations from the plans are generated. To handle these fluctuations and still meet the targets as per plans, SCM execution systems will help users with various alternatives. Typical execution level decisions include re-planning of the material flows, loading factors and also margins.

To Do Activity

Study a potato chips production system. Identify the inputs, process, outputs and feedback system. Suggest some improvements in the existing process.

1.3 Impact of Globalization

Globalization means to integrate the economy of one country with the global economy. During globalization the main focus is on foreign trade & private and institutional foreign investment. It is the last policy of liberalization, privatization to be implemented. The main aim is to transform the world towards independence and integration of the world as whole by setting various strategic policies. Globalization is attempting to create a borderless world, wherein the need of one country can be driven from across the globe and turning into one large economy.

Two thirds of today's businesses operate globally through global markets, global operations, global financing and global supply chains. Globalization can take the form of selling in foreign markets, producing in foreign lands, purchasing from foreign suppliers, or partnering with foreign firms. Companies 'go global' to take advantage of favorable costs, to gain access to international markets, to be more responsive to changes in demand, to build reliable sources of supply, and to keep abreast of the latest trends and technologies.

The Internet and falling trade barriers have paved the way for globalization. The World Trade Organization (WTO) has opened up the heavily protected industries of agriculture, textiles, and telecommunications and extended the scope of international trade rules to cover services, as well as goods. The European Union (EU) requires that strict quality and environmental standards be met before companies can do business with member countries. Strategic alliances, joint ventures, licensing arrangements, research consortia, supplier partnerships and direct marketing agreements among global partners have proliferated.

India has an enormous resource of highly skilled engineers, scientists and technically trained workers available at less than half the cost of those located in developed countries. In 2005, India exported USD 17.7 billion in IT services, compared to USD 3.6 billion for China, and USD billion for Russia. Indian companies, such as Infosys, WIPRO, TCS and HCL are world leaders in software development and business processes, with plenty of room to expand. Competition from other low-cost countries such as the Philippines, Vietnam, Malaysia, Brazil and Eastern Europe is just beginning.

Top 10 Economies Countries and Population

GDP and population are based on 2019 data. United States and China ranks 1st and 2nd position respectively. India stands at 5th position. Other countries like India, France, South Korea and Taiwan are growing economy countries. India stands at 5th position in the top 10 economies countries table. In terms of population China ranks first and India stands second. Table 1.3 shows the top 10 countries economies and Population

Table 1.3: Top 10 Countries Gross Domestic Product (GDP) and Population

Sl. No	Country	GDP (Crs. In USD)	Population (In crores)
1	USA	21,43,00,000	32.82
2	China	14,34,00,000	139.77
3	Japan	5,08,00,000	12.63
4	Germany	3,86,00,000	8.30
5	India	2,87,00,000	136.64
6	United Kingdom	2,83,00,000	6.60
7	France	2,72,00,000	6.71
8	Italy	2,00,00,000	6.04
9	Brazil	1,84,00,000	21.1
10	Canada	1,74,00,000	3.76

China Factor

The country China is known as ‘global factory’. More than 70 percent of American companies are depending for parts, raw materials, components etc from China. India’s imports on electrical and electronic items are coming from China. Worldwide countries are heavily depending on China for various inputs. Most of the Fortune 500 companies are having their shops / facilities in China. So, China’s dominance will continue for some for years.

The most important outcome of the globalization process is outsourcing. During the outsourcing model, a company of a country hires a professional from some other country to get their work done, which was earlier conducted by their internal resource of their own country. Various Business Process Outsourcing

(BPO) companies or call centres, which have their model of a voice based business process, have developed in India. Activities like accounting and book-keeping services, clinical advice, medical transcription, banking services or even education are been outsourced from developed countries to India.

Example

Sourcing parts /components from Detroit, USA, moving those inputs to Chennai, India to build the final product (may be a car) and then move that final product to European market, this is nothing but globalization. Globalization facilitates the companies source the raw materials from one country, and the move those inputs to another country, where their facility is located. They use all the inputs sourced from different countries to build the final product, that product will be moved to another region/ country, where market is available for those products.

Impact of Globalization

Globalization has impacted heavily on the economic development front. The main impacts are:

- i. The most important advantage is outsourcing. Through outsourcing big multi-national corporate or even small enterprises can avail good services at a cheaper rate as compared to their country's standards. Examples: steel items, capital equipments, and medical services to foreign patients.
- ii. The skill set in India is considered the most dynamic and effective across the world. Indian professionals are best at their work. Examples: software related work, and system design.
- iii. The low wage rate and specialized personnel with high skills have made India the most favorable for global outsourcing in the later stage of reformation. Examples: electronic equipments, mobile handsets, etc.
- iv. GDP of countries are improving.
- v. Infrastructures development such as roads, airports, seaports, etc can be built.
- vi. Improvement in Quality of living conditions and standards.

To Do Activity

India is aiming to reach USD 5.0 trillion economy by 2026. Is it possible, if yes, how? If no, why not? Concentrate on rural economy of India.

1.4 Productivity

A general definition is that productivity is that productivity is the relationship between the output generated by a production or service system and the input provided to create this output. Thus, productivity is defined as the efficient use of resources- capital, labor, land materials, energy, and information in the production of various goods and services.

Productivity can also be defined as the relationship between results and the time it takes to accomplish them. Time is often a good denominator since it is a universal measurement, and it is beyond human control. Higher productivity means accomplishing more with the same amount of resources or achieving higher output in terms of volume and quality for the same input. This is usually stated as:

Productivity = Output / Input

Productivity is a measure of the effectiveness of the use of resources to produce goods and services.

Productivity = Value of outputs / Cost of inputs

Productivity can be improved in many ways, i.e. Increasing output without changing the input, by reducing the input increase the output, increase both input & output and increase the input marginally and increase the output significantly. The essence of productivity improvement is working more intelligently, not harder.

Productivity is a comparative tool for managers, industrial engineers, economists and politicians. It compares production at different levels of the economic system (individual and shop-floor, organizational, sectoral and national) with resources consumed. The International Labor Organization (ILO) has for many years promoted an advanced view of productivity which refers to the effective and efficient utilization of all resources, capital, land, materials, energy, information and time, in addition to labor. In promoting such views, one must combat some common misunderstandings about productivity.

First, productivity is not only labor efficiency or 'labor productivity' – although labor productivity is still useful policy –making data. The false conclusions which may be drawn from analyses of single factor productivity are demonstrated by a major British productivity success story: agriculture. Because of improvements in fertilizers, breeding and sprays, land and technology, labor productivity in agriculture rose 60 percent between 1976 and 1982 as did yield per hectare. But one unit of energy (which includes fertilizers) grew less wheat in 1983 than in 1963. A more appropriate yardstick of efficiency is, then, the yield produced for each monetary unit spent. Hence the emerging importance of multi-factor or total factor productivity not single factor productivity measure alone.

The second misconception is that it is possible to judge performance simply by output. The latter may be increasingly without an increase in productivity if, for instance, input costs have risen disproportionately. The third problem is confusion between productivity and profitability. In real life profit can be obtained through price recovery even though productivity may have gone down. Conversely, high productivity does not always go with high profit since goods which are produced efficiently are not necessarily in demand. Hence there is one more misunderstanding –confusing with efficiency. Efficiency means producing high quality goods in the shortest possible time.

The fifth mistake is to believe that cost-cutting always improves productivity. When done indiscriminately, it can make matters worse in the long term. Another myth which causes damage is that productivity can only be applied to production. In reality, productivity is relevant to any kind of organization or system, including services, notably information. Productivity improvement methods can be applied to rural sectors also.

The concept of productivity is also increasingly linked with quality – of output, input and the process itself. An element of key importance is the quality of the workforce, its management and its working conditions, and it has been generally recognized that rising productivity and improving quality of working life do tend to go hand in hand. In this context, the managers' roles in rural sectors are expected to be high. Generally speaking, productivity could be considered as a comprehensive measure of how organizations satisfy the following criteria:

Objectives: the degree to which they are achieved.

Efficiency: how effectively resources are used to generate useful output.

Effectiveness: what is achieved compared with what is possible.

Comparability: how productivity performance is recorded over time.

Measures of Productivity

Productivity growth is a continuing concern for all countries not only for one country. Generally, two important productivity measures are practiced by the managers and policy makers. They are: i. Single factor measure and ii. Multifactor or total factor productivity measure.

Single Factor Productivity

In this measure, only a single input was considered. Examples, labor hours or capital employed. It is also called as partial factor measure of productivity. Managers generally utilize partial factor productivity measures because the data is readily available. Other partial factor measure options could appear as output in units / machine hrs used kilograms of rice produced / acres of land used, number of bricks output / energy units consumed, liters of oil produced / kilograms of coconuts crushed.

Multi- Factor Productivity

A multifactor productivity measure means more than a single factor is considered. Examples, both labor and capital employed. Hence multifactor productivity or total factor productivity is the ratio of total output to total inputs consumed. Examples of liters of sugarcane juice produced divided by the labor hours plus Kilograms of sugarcane crushed plus overheads. Obviously the input factors must be input factors must be measured in the same units. Both output and inputs are considered in Rupees.

Example

Total Factor Productivity (TFC) growth for the manufacturing sector over this was about 12 percent higher in China than in India.

Numerical Examples on Single Factor Productivity

- i. For example, if a toy manufacturer produces in an hour output of 2 units, whose price is Rs.100 each, and then his productivity is Rs.200.
- ii. An agricultural products packaging firm generates services valued at Rs.80, 000/= per day and has total costs of Rs.50, 000/= per day. What is a single measure of productivity?

Solution:

Productivity = Value of outputs / Cost of inputs = 80,000 / 50,000 = 1.6 Answer.

Numerical Problems on Multifactor Productivity

Worked Out Example 1

A wrapping paper company produced 2000 rolls of paper in one day. Standard price is Rs. 1 per roll. Labor cost was Rs.160; material cost was Rs.50 and overhead was Rs.320. Determine the multifactor productivity.

Solution:

Multifactor productivity = Quantity produced at Std. Price / Labor cost +Material cost + Overhead
= 2000 x 1 / (160+50+320) = 3.77 rolls output per Rupee value.

Worked Out Example 2

A toy shop produces 30,000 teddy bears per month with a selling price of Rs.24 per piece. It spends Rs.12, 000 per day for a 26 day production month on raw material. They pay 25 workers a wage of Rs. 5,500 per month. Calculate the multi factor productivity and briefly comment on it.

Solution:

Productivity = Value of Outputs / Cost of Inputs

Multi-factor productivity = Number of teddy bears per month produced X Selling price per piece

$$\frac{\text{Number of teddy bears per month produced} \times \text{Selling price per piece}}{\text{(Material cost per month)} + \text{(Labor cost per month)}} \\ = \frac{30,000 \times 26}{(12000 \times 26) + (5500 \times 25)} \\ = 1.601 \text{ Answer}$$

Comments: The productivity on the basis of multi-factor method works out to 1.601, which means that the value of output produced is greater than (1.6 times) the cost of inputs.

Principal Factors Influencing Productivity Changes

Some of the principal factors influencing productivity changes are:

- i. Investment (capital / labor ratio)
- ii. Resource availability
- iii. Educational and skill level of people
- iv. Innovation and technology
- v. Regulatory and bargaining effects
- vi. Mix of goods versus Services produced
- vii. Propensity to save versus Spend
- viii. Quality and global competitiveness

Productivity Improvement Methods

Some of the productivity improvement methods suggested to rural industries is:

- i. Training of Employees
- ii. Motivation
- iii. Technology upgrading
- iv. Automation
- v. Waste reduction
- vi. Resources utilization
- vii. Cost reduction
- viii. Fringe benefits & Medical insurance
- ix. Incentives and bonuses

Different Types of Productivity

Four different types of productivity are used. They are:

- i. Labor productivity: It is the ratio output per person. Labor productivity measures the efficiency of the labor in the transformation of something into a product of higher value. Example, if a person is able to peel 20 Kilograms of Onion per hour. It represents the efficiency of that person.
- ii. Capital productivity: It is the ratio of output (goods or services) to the input of physical capital. Example, a pot maker is able to produce the value of pots Rs.10,000/= with a capital investment of Rs.20,000/=.
- iii. Material productivity: It is the ratio of output to the input of material (also known as natural resources). Example, a coir manufacturer is able to 50 Kilograms coir by consuming 80 Kilograms of raw coir fiber.
- iv. Total Factor Productivity (TFP): It is not simple ratio of output to input, but rather it is a measure that captures everything that is not captured as labor, capital or material.

Benefits of Productivity

Some of the key benefits are:

- i. It helps cut down cost per unit and thereby improve profit (Profit = Total revenue- Total cost). This benefit can be transferred to customers.
- ii. Gains can be shared with employees by paying higher rate, incentives, bonus etc.
- iii. Export market opportunities can be explored for handicrafts, toys, fancy items etc.
- iv. Generate more employment, opportunities in rural sectors.
- v. Better quality of life standard and living conditions.
- vi. Increase in Gross National Product (GNP).

To Do Activity

Visit a Kalamkari unit nearby your place, study the coloring / dyeing process. Calculate the productivity of that unit. Suggest productivity improvement methods to the manager.

1.5 Competitiveness

Competencies are the specific abilities in organization have that give it a competitive advantage. The International Trade Centre (ITC) provides a holistic view of enterprise competitiveness in the following definition: “Competitiveness is the demonstrated ability to design produce and commercialize an offer that fully, uniquely and continuously fulfills the needs of targeted market segments, while connecting with and drawing resources from the business environment and achieving a sustainable return on the resources employed.”

The importance of competitiveness is driving firm survival, growth and trade made it key elements in economic development. For this reason ITC has developed an analytical framework to understand firm competitiveness and how it can be improved over time. It s comprised of three pillars that drive the capacity to be competitive across three levels of the economy. Table 1.4 describes the ITC framework to understand firm competitiveness.

Table 1.4: ITC framework to understand firm competitiveness

Pillars	Theme	Levels
Compete	<ul style="list-style-type: none"> • Quality requirements • Time requirements • Quantity requirements 	<ul style="list-style-type: none"> • Firm capabilities • Business Ecosystem • Natural environment
Connect	<ul style="list-style-type: none"> • Connecting to buyers • Connecting to suppliers • Connecting to Institutions 	
Change	<ul style="list-style-type: none"> • Financial requirements • Skills requirements • Innovation and Intellectual Property (IP) requirements 	

ITC has prescribed three pillars i.e competes, connect and change. Under each pillar there are three themes, i.e requirements, so nine themes are quality requirements, quantity requirements, time requirements, connecting to buyers, connecting to suppliers, connecting to Institutions, financial requirements, skills requirements and Innovation & IP requirements. All themes are connected with levels, i.e, firm capabilities, business ecosystem and natural environment.

The World Economic Forum (WEF) defines the competitiveness as ‘the set of institution, policies and factors that determine the level of productivity of a country. Another way to think about what makes a country competitive is to consider how it actually promotes over well-being. The world Economic Forum has divided competitiveness into 12 distinct areas or pillars. These are ‘basic requirements’ which comprise institutions, infrastructure, macroeconomic environment, and health and primary education. Next comes ‘efficiency enhancers’, sub-index includes higher education & training, Goods market efficiency, labor market efficiency, technology readiness, financial requirements and market developments. Last pillar includes innovation and sophistication. According to the World Economic Forum survey 2017, the top 10 most competitive economics are Switzerland, Singapore, USA, Netherlands, Germany, Sweden, United Kingdom, Japan, Hong Kong SAR and Finland.

Enterprise Competitiveness and the Operations Function

There are five dimensions of competitiveness that measure the effectiveness of the operations function:

- i. Cost
- ii. Quality
- iii. Delivery
- iv. Flexibility / service
- v. Dependability as a supplier

It is often referred as competitive priorities. Indian rural industries should focus more on these priority factors.

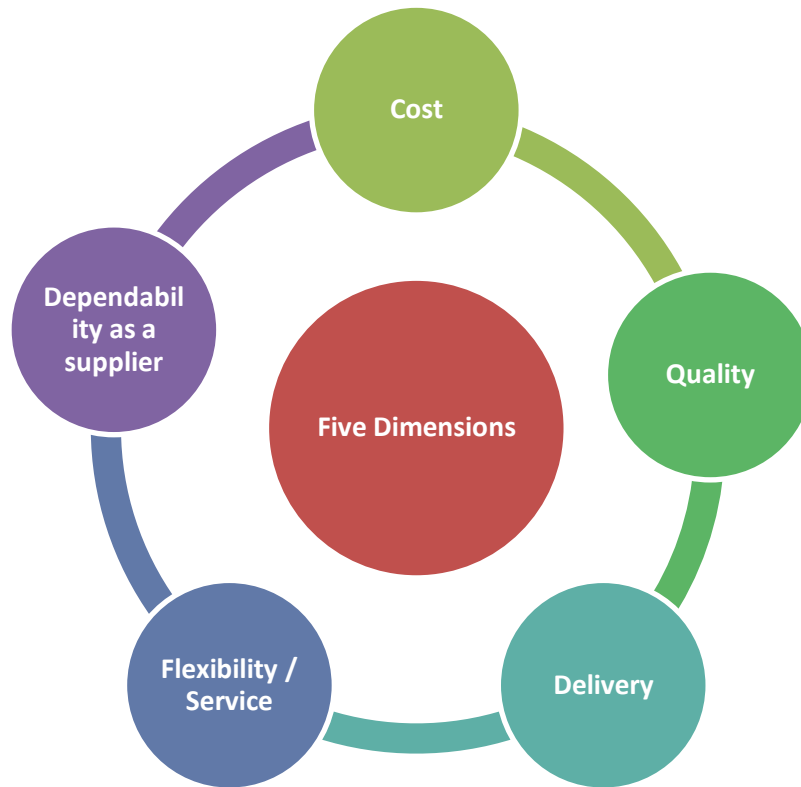


Fig 1.3: Five Dimensions of Competitiveness

i. Cost

Although price is the competitive weapon used in the market place, profitability related to the difference between price and cost. Cost is the variable that can allow lower prices that may be profitable. To compete on the basis of price requires an operations function capable of producing at low cost. Therefore, the effects of facility location, product / service design, equipment use and replacement, labor productivity, good inventory management, employment of process technology and so on all contribute to the reducing costs. Examples, Chinese handicrafts / toys are cheaper than Indian products. This is because of economic scale of production, automation, plant location, plant layout and learning curve. Each product, they design and manufacture in millions only. More over their learning levels are faster and high. This will have an effect on cost of the product.

A survey was conducted during the 1970s on companies' closure. These companies are listed in Fortune 500 companies. 171 out 1000 plants were closed due to various reasons. The six common reasons are: Inefficient or outdated process technology, lack of sales volume, price competition due to better process technology, higher labor costs, price competition due to higher labor costs, and superior product performance and features. Although all the dimensions of production performance are important in competitiveness, the cost factor is one that is particularly crucial for survival. These reasons are related to the cost, effectiveness of operations strategy in dealing with costs and product quality.

ii. Quality

The effectiveness of this factor has been highlighted by Japanese market dominance in

consumer electronics, steel, automobile and machine tools, where product quality has been cited as a reason for preferring the products purchased. Customers and clients are often willing to pay more for or wait for delivery of superior products.

iii. Delivery

Delivery is another competitive priority factor. Customers are expecting shorter or quick delivery. Even cost some times overruled by the customers, but on delivery no compromise. So, companies started adopting E-Commerce models by embracing technology. Examples are e-retail giants like Wall-Mart, Amazon, Flipkart, Myntra, and Big Basket. In food e-retail chain, Swiggy, Zomato, and Dunzo are good examples for quick delivery. In vegetables and fruits segment, companies like Ninjacart, and Viswa Farm Products are successful in the delivery side.

iv. Flexibility / Service

Flexibility means that the ability to be flexible will depend a great deal on the design of the productive system and the process technology employed. Examples are, if a fish vendor sells only fish, but he is not providing the cleaning, and cutting, then customer may find service variations with regard to their competitors. Another example is car servicing centre, if they stock spare parts, oil, and consumables, then the customer may prefer only those service centres. So, flexibility and service are important elements in an enterprise strategy that is provided by the production function.

v. Dependability as a Supplier

Dependability is an important element for competitiveness. Customers may compromise on cost or even quality some extent to obtain on-time delivery when they need an item. The scheduling and coordination of all elements of the productive system determines its ability to produce on time.

Examples

Timely supply of vegetables to the hotels, timely delivery of laundry clothes, and timely supply of sweets during festival season

In the past the ground rules for marketing success were obvious; strong brands, backed up by large advertising budgets and aggressive selling. This formula now appears to have lost its power. Instead, the argument is that companies must recognize that increasingly it is through their capabilities and competencies that they compete. Some companies compete with their products; examples are Sony products, Honda, and Haldirams eatable items. Some companies are competing processes; examples are Motorola, 3M, packaged drinks, dry fruits, and nuts. Other examples, Dabbawallas of Mumbai and TVS group of companies have already practicing six sigma process standards. These are not just sufficient to gain competitive advantage; now companies are going beyond these two, i.e., cost, quality, innovation, up-gradation, sustainability, and environment impacts. Therefore, companies are adopting more than one factor as their competitive priority.

To Do Activity

Conduct a study on competitiveness index of India during last year's. Analyze the trend and identify the improvement areas to improve India's competitiveness.

Summary of the Chapter

In this chapter, the supply chain components along with various connotations and notable definitions are presented. Supply chain concepts along with examples are discussed. The importance of supply chain managements is also explained. Under evolution of Operations and SCM unit, the evolution of operations management from craft production till supply chain management has been highlighted. The contributions of various authors are also mentioned. SCM evolution and its major branches such as manufacturing, & logistics, under logistics marketing and distribution are also highlighted. 5Ps of operations management, scope and objectives of operations management are highlighted. In this unit, the production system input-output model in respect of manufacturing and service productive system are detailed with examples. The importance of competitiveness has been discussed. Further, the objectives of SCM, performance drivers such as production, inventory, information, transportation, pricing and sourcing are explained. The impact of globalization has been explained with an illustration of top 10 countries and populations are compared. In this context, China factor is also highlighted. Productivity and measures of productivity like single factor productivity measure and multi-factor productivity measure are well explained with numerical examples. Further, productivity improvement methods, different types of productivity and benefits are also explained. Under the subunit competitiveness, definition of competitiveness, ITC framework to understand firm competitiveness, enterprise competitiveness and operation function have been explained. In this context, the competitive priorities such as quality, cost, delivery, flexibility, dependability and customer service are discussed in detailed manner. At the end of each subunit, 'To Do Activity' has been included to enhance the students learning process.

Model Questions

1. What is supply chain?
2. Discuss the objectives and types of supply chain. Give examples.
3. Identify the inputs, process and outputs in an oil extraction production system.
4. Define productivity.
5. Enumerate the productivity measures. Cite examples.
6. How to measure the productivity in a palm sugar manufacturing plant?
7. Determine the multifactor productivity for the combined input of the labor and banana peeling machine time using the following: labor Rs.1000, materials = Rs.520, Overheads = Rs.2000, production is 1760 units (Banana's peeled)
8. What is globalization?
9. Mahesh wants to start a fruits juice extracting plant. Explain with a sketch of supply chain and identify the upstream and downstream of that supply chain
10. What is competitiveness?

Reading Materials

1. M.L. (1997). What Is the Right Supply Chain for Your Product? *Harvard Business Review*, 83-93.

References

1. Roberta S. Russell, W.B. (2012). *Operations Management Along the Supply Chain, Sixth Edition*. New Delhi: Wiley India.
2. V. Altekar, .R. (2005). *Supply Chain Management: Concepts and Cases*. New Delhi: Prentice –Hall of India Private Limited.

Chapter 2- Process of Supply Chain Management

Introduction

Supply chain management is an integrated process through which suppliers, manufacturers' distributors, retail outlets and end users are seamlessly connected. In any supply chain, there are three important flows namely, physical flow of goods, information flow and money flow. Inventory plays an important role balancing the demand and supply. Different techniques are used to manage the inventories better. Integration of processes is important in the supply chain. Tools such as ERP, ECR, VMI and CFPR are used to integrate the suppliers and customers.

This chapter describes flow in supply chain, inventory management & areas of inventory control system, bullwhip effect, supply chain network design decisions, logistics management and integration of processes in supply chain.

Learning Objectives

After reading this chapter you will:

- i. Understand the flows in supply chain
- ii. Explain the inventory control measures and tools
- iii. Describe the bullwhip effect in the supply chain and its counter measures
- iv. Apply the supply chain network design tools to locate a new facility
- v. Understand the functions of logistics management and stages of integration processes in supply chain

Chapter Structure

2.1 Flow in supply chain	
2.2 Inventory Management and areas of Inventory Control	
2.3 Bullwhip Effect	
2.4 Designing the distribution network in a supply chain	
2.5 Logistics management and Integration of processes in supply chain	

2.1 Flow in Supply Chain

Supply chain management is a set of approaches utilized to efficiently integrate suppliers, manufacturers, warehouses, and stores, so that merchandise is produced and distributed at the right quantities, to the right locations, and at the right time, in order to minimize system wide costs while satisfying service level requirements. Supply chain management involves planning, design and control of flow of material, information and finance along the supply chain to deliver superior value to the end customer in an effective and efficient manner. In typical supply chain, suppliers, manufacturers,

distributors, transporters, warehouse operators and end customers. The supply chain encompasses all activities involved in the transformation of goods from the raw material stage to the final stage, when the goods and services reach the end customer.

In a typical supply chain, raw materials are procured and items are procured at one or more facilities shipped to warehouse for intermediate storage / distribution centres and then shipped to retailers or customers. Consequently, to reduce cost and improve service levels, effective supply chain strategies must take into account the interactions at the various levels in the supply chain.

Traditionally, firms have focused their efforts on three main functions: planning, manufacturing and distribution. Transport and storage activities within individual functions and across functions have not received adequate attention and have usually been handled by the department managing the logistical aspects of the company. Initially, supply chain managers focused on the internal integration of activities in these three functional areas with the logistics function. Gradually, firms realized that these activities have to be coordinated and, not just within a firm, but across the entire supply chain, keeping in mind the material / product flow right from the vendor to the end customer. To integrate material flow across the chain, information and financial flow across the chain also have to be integrated. As shown in figure 2.1, a typical supply chain involves managing all five flows in the chain. Example, coir manufacturing units or edible oil producing firms uses material flow, information flow, money flow, value flow and risk flow within the departments and also across the company.

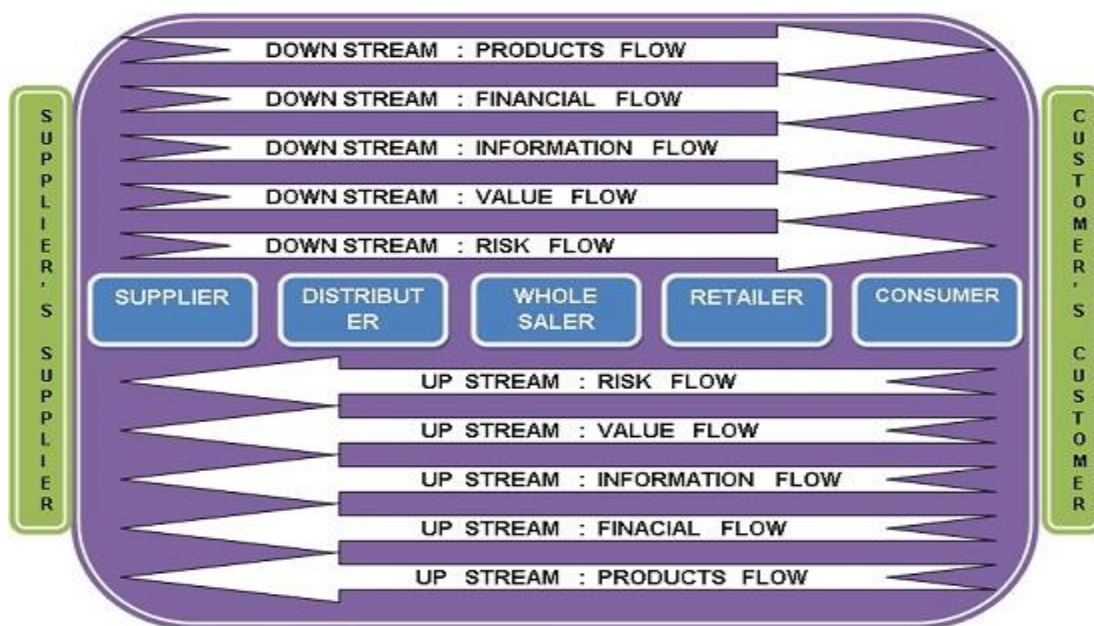


Figure 2.1: Flows in Supply Chain (Saikrishna, 2016)

There are five major flows in any supply chain: product flow, financial flow, information flow, value flow and risk flow (Saikrishna, 2016).

- i. **Product flow:** This the flow of the physical product from the suppliers all the way down to the customer. This flow is usually unidirectional, that is, it only flow one direction from suppliers to customer, i.e, product flow from suppliers to customers (downstream). A typical flow of materials usually begins with the raw material suppliers to manufacturers to warehouses and distribution centres to the end customer. Example, in a brick manufacturing supply chain, clay, water, wood/

oil & moulds flows from the suppliers to manufacturers and then to stockiest / customers (usually house construction people & civil contractors. Sometimes, product flow also involves returns/ rejections (reverse flow).

- ii. **Information flow:** Information is the flow of information from suppliers to customers and from customers back to suppliers. This flow is bi-directional. The type of information that flows between customers and suppliers include quotations, purchase orders, delivery status, invoice, customer complaints and so on.
- iii. **Money flow:** Thirdly money flow involves the moment of money from the customer to the distributors / dealers, then to manufacturer and then to suppliers. Sometimes, the money flow the other direction (from suppliers to manufacturers and then to customers in the form of debt).
- iv. **The Value flow:** As supply chain has a series of value creating processes spanning over entire chain in order to provide added value to the end customer. In chain at each such activity these are costs, revenue and asset values are assigned. Either through controlling / regulating cost drivers better than before or better than competitors or by reconfiguring the value chain, sustainable competitive advantage is achieved.
- v. **The flow of Risk:** Risks in supply chain are due to various uncertain elements broadly covered under demand, supply price, lead time and delayed payments. Risk factors also include cash flow, constraints, inventory financing, and delayed cash payments. Risk can be external or internal and more either way with product or financial or information or value.

For an efficient and effective supply chain, it is important that all the five flows are managed properly with minimal effort. Therefore, integration of flows in supply chain is essential.

Integration of Flows in Supply Chain

SCM integrates key business processes from end customer through suppliers, manufacturers, traders /stockiest and third-party logistics service (3 PLs) providers in a supply chain. Integration is crucial success factor to achieve superior performance in the supply chain. To achieve superior supply chain performance (cost, quality, flexibility and time performance) require multi-lateral integration. Internal / external integration: Functional integration, geographical integration; integration in chains and networks, and integration through Information Technology (IT). The integration even goes beyond to include supplier's supplier and customer's customer to leverage the power of the 'network'.

To Do Activity

Visit a poultry farm nearby your place. Study the different of types of flows in their supply chain. Suggest methods to integration of flows in their supply chain.

2.2 Inventory Management and Areas of Inventory Control System

Inventory concept: Inventory may be defined as usable but idle resource'. Inventory management is the job basically done for maintaining the stock. The objective of inventory management has been to keep enough inventories to meet customer demand and also be cost effective. Traditionally, companies maintained 'generous' inventory levels to meet long-term demand because there were fewer competitors and products in a protected market environment. In the current global business environment , with more competitors, more new products and products with better features, the cost of inventory has increased due to in part to quicker product obsolescence (short life cycle).

The main objective of inventory management is to balance the demand and supply. The demand and

supply are managed through inventory management. But the real challenges for materials management are: The decisions of how much to acquire and when follow clarification of what is required. The natural response is to say, “Buy as much as you need when you need it.

Need of Inventory

The needs of Inventory are:

- i. Dealing with uncertainty of demand
- ii. Smoothing out irregularities in supply
- iii. Buying or purchasing in batches
- iv. To meet seasonal demand
- v. To take quantity discount
- vi. To maintain continuity in production process
- vii. Stock built up for scale of economy

The main challenges for materials management department is balance the following: i. How much to buy? (Quantity) ii. When to buy? (Time) and iii. What to buy? (Item details). In the process, they have to manage the ordering cost, inventory carrying cost and purchase cost. If they buy more than the required quantities, then they will have problem of overstocking and inventory cost burdens etc. On the other hand, if the plan to buy less than the required quantities, then cost of under stocking becomes critical. Therefore, knowing the right quantity to procure at right time and right material are important. For that selective control measures such as ABC, FSN, SDE, VED, XYX, Seasonal / Non-seasonal items are used. MUSIC-3D is an integrated inventory management tool, wherein all the three dimensions are combined. In this paper, firstly, ABC, FSN and SDE analysis are carried out and secondly, MUSIC-3D also conducted (C, 2021).

Elements of Inventory Management

Inventory is a stock of items kept by an organization to meet internal or external customer demand. Throughout supply chain, inventory is held in various forms. It is ranging from raw material to finished goods via work in progress. Raw material is with the supplier; work-in-progress is with the manufacturer and finally the finished goods with the distribution and retailers. The supply chain performance is very much affected by the value of inventory in the supply chain. As we know, we are interested in improving responsiveness and efficiency; the store’s manager involved in the inventory should try to find tradeoff between the efficiency and responsiveness.

Examples: Nursery has inventories of different plants, trees, and flowers. A flour (Atta) producing company keeps inventories such as grains, machineries spare parts, and other ingredients. Many of us think of inventory as a final product waiting to be held to be sold to a retailer customer- a can of tomatoes or a bulk of palm sugar. This is certainly one of its most important uses. However, especially in manufacturing firm, inventory can take on forms besides finished goods, including: raw materials, purchased parts & components, work-in-process (WIP), Pipe line inventory, spare parts, consumables and finished goods.

Sunil Chopra (2011) has identified three basic decisions that supply chain managers must make regarding the creation and holding of inventory.

- i. **Cycle Inventory:** It is the average amount of inventory that is demanded by the customers between successive shipments. Example, 500 liters of Sun flower oil. Manufacturers tend to produce more to enjoy economies of scale. Purchasers would like to buy in bulk to avail discounts.

Both these situations will lead to holding of excessive inventory and the corresponding higher inventory carrying cost.

- ii. **Safety Inventory:** It is primarily to counter the unexpected demand or surge in demand from the customers if the forecasting has significant error that can also contribute loss of sales due to non-availability of required goods or may lead to excess holding of inventory. Safety stocks are held in the firms to meet the unexpected demand.
- iii. **Seasonal Inventory:** Certain products demand fluctuations from period to period. There will be high demand during certain period and low demand during other periods. Examples, during Deewali, Pongal and Christmas time, the demand for sweets, cloths, fire crackers and paints will be very high. Similarly, fruits, flowers and other pooja items will have high demand.

Inventory Systems

Any inventory system will have following elements or components; Figure 2.2 shows the important components of inventory system.

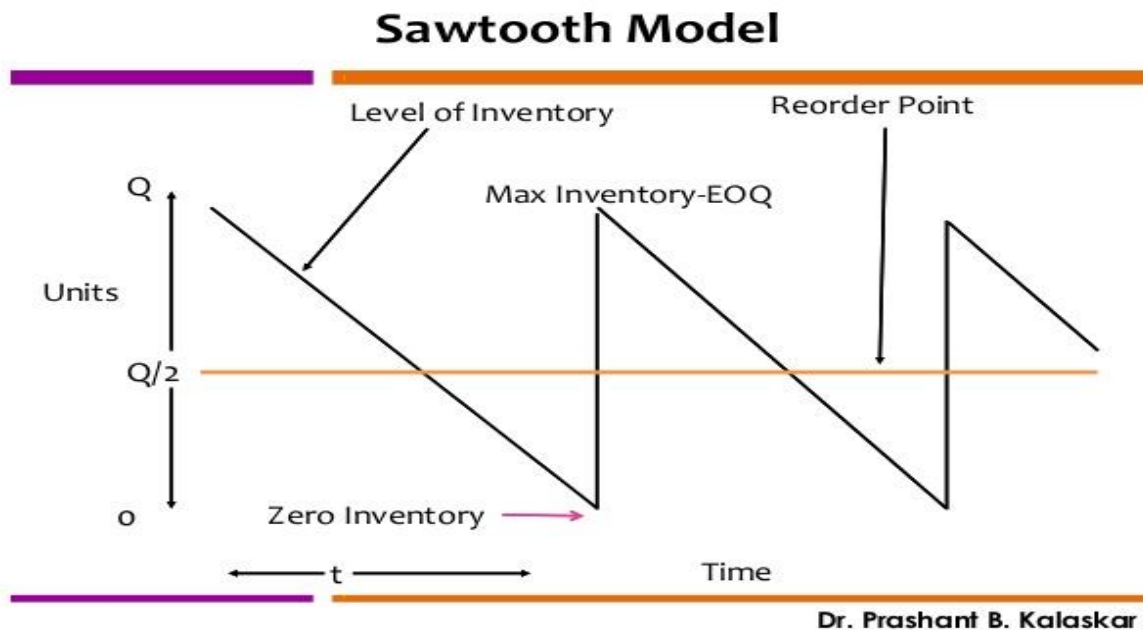


Figure 2.2: Inventory System Components (Kalaskar, 2019)

- i. **Lead time:** Lead time is an interval between placement of order and delivery of material. It is a measure of logistical performance. Variations in lead time are one of the most difficult logistical problems.
- ii. **Reorder Level (ROL) or Reorder Point (ROP):** ROL is that inventory level at which an order should be placed to replenish the inventory. $ROL = Lead\ time \times Average\ usage$. If safety stock is present then reorder level becomes: $ROL = Safety\ stock + Lead\ time\ consumption$. It is a level of inventory in stock at which a new order is placed.
- iii. **Safety Stock (SS):** SS is a component of average inventory that takes care of short-term fluctuations in lead time and consumption. It is also called as 'Buffer Stock'. Some of factors affecting level of safety stock are: value of item, criticality of item, lead time, number of suppliers,

and availability of substitutes and risk of deterioration. Safety stock is maintained to ensure the uninterrupted flow of production.

- iv. Maximum Inventory: Maximum inventory under this deterministic situation is Q and the minimum inventory level is zero.
- v. Average Inventory: The average cycle inventory is equal to $(Q + 0) / 2 = Q/2$.
- vi. Economic Order Quantity: EOQ is the quantity at which the total ordering cost and total annual inventory carrying is equal. Also, the total inventory cost is optimum. It is a fixed order quantity that minimizes total inventory costs.

Inventory Control Measures

Various control measures or techniques are applied to control inventories. Table 2.1 shows the summary of control measures (C, 2021).

Table 2.1: Inventory Control Techniques

Sl. No	Technique	Details	Applications
1	ABC	Items are classified based on annual consumption value, i.e class A items, class B items and class C items. Pareto principle is applied- vital few and trivial many. Class A items require strict control, Class B items require moderate control and Class C items require less control.	Manufacturing firms, which use 1000 of items. Inventory control manager should more focus on Class A items.
2	VED	Items are classified based on its criticality, i.e vital, essential and desirable. Vital items need more control.	Maintenance department use this technique to control spares inventory control.
3	FSN	Items are classified based on its frequency of withdrawal, i.e, fast moving, slow moving and non-moving items.	In departmental stores, warehouses and manufacturing firms.
4	SDE	Items are classified based on its availability, i.e scarce items, desirable items and essential items.	This is applied in procurement considering the lead-time. i.e long lead time, medium lead-time and short-lead-time
5	XYZ	Items are classified based on its inventory value, i.e high value items (X), moderate value items (Y) and low value items (Z)Med	It is applied in R&D / Development projects.
6	Seasonal Items	Items are classified based on seasonality, i.e, seasonal items and non-seasonal items.	Agricultural Products Marketing Committees and Food Corporation of India, they apply this technique to management inventories.

Inventory Control Systems

The Economic ordering quantity (EOQ), Continuous Review (Q) System and Periodic Review (P) System are applied whether to order large quantities frequently or to order small quantities frequently.

i. Economic Order Quantity (EOQ) System

The EOQ provides guidance for this choice by indicating the lot size that minimizes (subject to several assumptions) the sum of ordering costs and annual holding over some period of time, such as a year. EOQ is the quantity for which the ordering costs and annual holding costs are equal and also the total cost is optimum. Figure 2.3 describes the generic EOQ model.

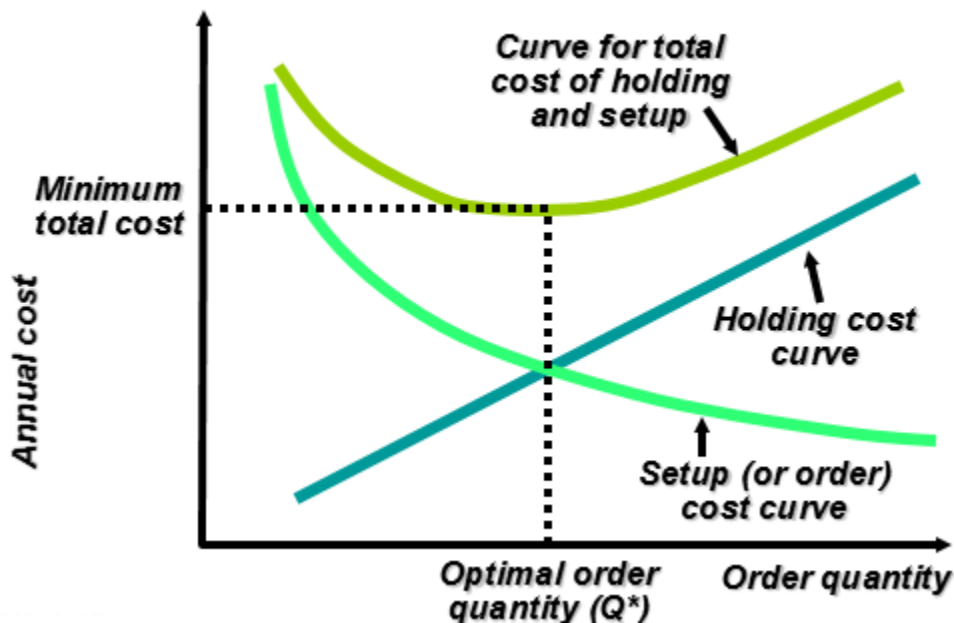


Figure 2.3: Economic Order Quantity Model

Total annual cost = Total ordering costs + Total annual holding costs + Total purchase cost

Total purchase cost is ignored, because, EOQ generic model operates on the following assumptions:

- i. Purchase unit price constant throughout.
- ii. Demand is constant
- iii. Ordering cost is constant
- iv. Holding cost is constant
- v. No shortages and back orders are allowed

In view of the above, total annual cost is equal to total ordering cost plus total annual holding cost

$$TC = (D / Q) \times CO + (Q/2) CC$$

$$EOQ = \text{Square Root of } (2 \times D \times CO) / CC$$

Where,

EOQ = Economic Order Quantity

D = Annual demand

CO = Ordering cost per order

CC = Annual inventory carrying cost

ii. Continuous Review (Q) System

In the continuous review (Q) review system, the buyer places orders of a fixed lot size of (Q), when the inventory position drops to the reorder point. It is also called a reorder point (ROP) system or fixed order quantity system.

Inventory Position (IP) = On-hand Inventory (OH) + Scheduled receipts (SR) – Backorder (BO)

The inventory position (IP) measures the item's ability to satisfy future demand. When the inventory position reaches a predetermined minimum level, called the reorder point, a fixed Q of the item is ordered. Examples, sugar cane order placed by a sugar mill. Food Corporation of India (FCI) procures food grains in bulk. Demand for chicken soup at a supermarket.

iii. Periodic Review (P) System

In this system, the inventory level is checked after a specific time period and a variable amount is ordered, depending on the inventory in stock. Sometimes, this system is also called a fixed interval reorder system or periodic reorder system, in which an item's inventory position is reviewed periodically rather than continuously.

Target inventory level (T) = Average demand during the protection interval + Safety stock

Protection interval = Time between orders + Lead time = P+L

Review Interval = Time between orders (TBO) = P

Order quantity = Target inventory level – Inventory position = T-IP

Replenishment rule = Every P time periods order – IP units

Examples: Pharma Industry, Medical stores, and even Covid 19 vaccines are placed at periodic interval basis. Hospitals order their gadgets on periodic basis only. Some of the retail stores they replenish the coconuts stock by using P system of Inventory only.

Managing Supply Chain Cycle Inventory

Inventory is an idle resource but has a useful value. When we purchase / produce a lot which is more than the requirement, inventory accumulates. Let us take an example, a fruit juice vendor needs 50 kilograms of oranges per day and if the lot size is 300 kilograms, then at the end of the first day, he will have 250 kilograms on hand. At the end of second day 200 kilograms will be on his hand. The balance stock on hand is referred as 'Inventory'. In this example, at the end of 6th day, he will be left with no stock. It means zero inventories. Assuming that the lead time is three days, then he has to place order at the end of third day itself to get oranges. Sometimes, there could be uncertainty in demand, lead time and supply also. So, safety stock is necessary.

To Do Activity

Discount Carpets manufacturers Cascade carpet, which it sells in its adjoining showroom store in the town. Estimated annual demand is 20,000 feet of carpet with an annual carrying cost of Rs.2.75 per feet. The cost of ordering is Rs.720 per order. Determine EOQ, Total inventory cost and number of orders to be placed.

2.3 Bullwhip effect

Concept and Definition

Through the numerous stages of a supply chain: key factors such as time and supply of order decisions, demand for the supply, lack of communication and disorganization can result in one of the most common problems in supply chain management. This common problem is known as the bullwhip effect; also sometimes the whiplash effect.

Increase in variability as we travel up in the supply chain is referred to as 'Bullwhip Effect'. It can also be defined as demand variability due to lack of coordination and distorted information. Small changes in demand and information can reverberate through a supply chain, causing huge swings of inventory and production levels. Bullwhip effect is a problem in forecast-driven supply chains and careful management is required to reduce the intensity of the effect is an important goal of supply chain managers.

The bullwhip effect can be explained as an occurrence detected by the supply chain where orders sent to the manufacturer and supplier create larger variance than the sales to the end customer. These irregular orders in the lower part of the supply chain develop to be more distinct higher up in the supply chain. This variance can interrupt the smoothness of the supply chain process as each link in the supply chain will over or underestimate the product demand resulting in exaggerated fluctuations. Figure 2.4 describes the bullwhip effect.

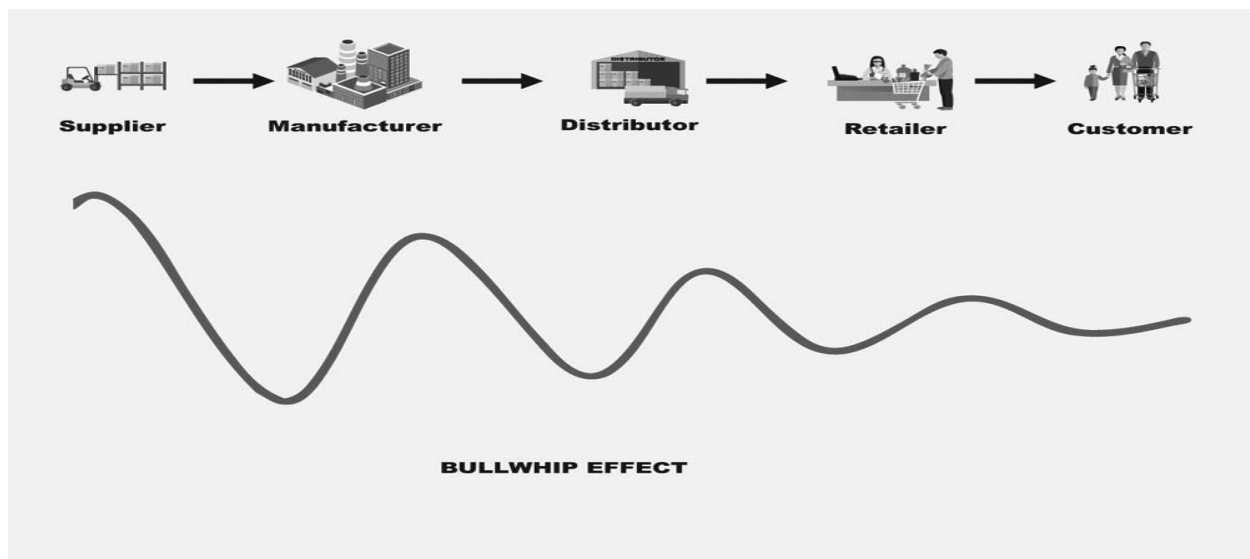


Figure 2.4: Bullwhip effect (Cazeaux .A, 2019)

Example of the Bullwhip Effect

Let us look at an example, the actual demand for a product (say pickle). The materials start at the customer, however often the actual demand for a product gets distorted going down the supply chain. Let us say that actual demand from a customer is 100 bottles of pickle, the retailer may then order 120 bottles from the distributor, an extra 20 bottles are to ensure they do not run out of stock, Because they the effect under stocking in their business.

The distributor then orders 140 bottles of pickle from the manufacturer, allowing them to buy in bulk so they have enough stock to guarantee timely shipment of goods to the retailer. Then manufacturer then receives the order and then orders from their supplier (wholesaler or mandis) ordering mangoes to make 160 bottles of pickle to ensure economy of scale in production to meet the demand or increase in demand. Now materials have been procured for 180 for a demand of 100 bottles. It is also quite possible that they may procure bulk quantities to avail the price discount benefits. So, each stage, the inventories are piled up. Table 2.2 highlights the effect of bullwhip effect.

Table 2.2: Bullwhip Effect in a supply chain- Pickle

Entities	Expected demand (according their prediction) (No. of Bottles)
Customer	100
Retailer	120
Distributor	140
Manufacturer	160
Raw material supplier	180

Although the bullwhip effect is a common problem for supply chain management understanding the causes of the bullwhip effect can help managers find strategies to alleviate the effect.

Major Causes or Contributing Factors to the Bullwhip

There are many factors said to cause or contribute to the bullwhip effect in supply chains; the following list names a few:

i. Lack of Communication

Lack of communication between each link in the supply chain makes it difficult for processes to run smoothly. Managers can perceive a product demand quite differently within different links of the supply chain and therefore order different quantities.

ii. Demand Information

Demand information relying on past demand information to estimate current demand information of a product does not take into account any fluctuations that may occur in demand over a period of time.

iii. Disorganization

Ordering larger or smaller amounts of a product than is needed. This is due to disorganization between each supply chain link. This has resulted in over or under reaction to the supply chain beforehand.

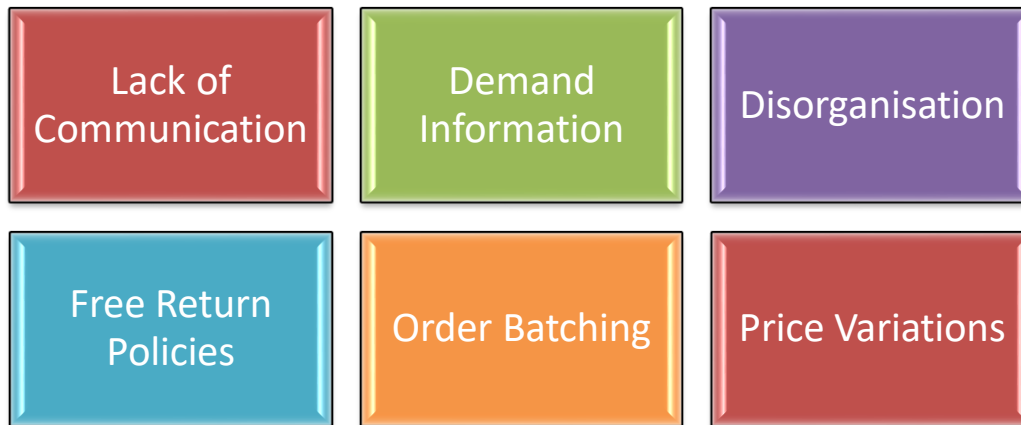


Figure 2.5: Major causes or contributing factors to the bullwhip

iv. Free Return Policies

Customers may intentionally overstate demands due to shortages and then cancel when the supply becomes adequate again, without return forfeit retailers will continue to exaggerate their needs and cancel orders, resulting in excess material.

v. Order batching

Companies may not immediately place an order with suppliers; often accumulating the demand first. Companies may order weekly or even monthly. This creates variability in the demand as there may be for instance is a surge in demand at some stage followed by no demand offer.

vi. Price variations

Special discounts and other cost changes can upset regular buying patterns; buyers want to take advantage on discounts offered during a short time period, this can cause uneven production and distorted demand information.

Counter Measures to Prevent Bullwhip Effect

The following steps should be taken for reducing the bullwhip effect for eliminating its impact on supply chain.

- i. Reducing uncertainty : By centralizing demand information, sharing POS information etc
- ii. Reducing variability: Everyday low price, efficient customer response etc.
- iii. Lead time reduction: By cross docking, Electronic Data Interchange etc
- iv. Strategic partnership: By vendor managed inventory, third party logistics,
- v. Postponement strategy: By delay differentiation, time, location & manufacturing postponement, push-pull strategy etc.

Coordination in the Supply Chain

Coordination help to ensure that each part of the supply chain takes actions that increase total supply chain profits and avoids that improve its local profits but hurt total profits. A lack of coordination results in degradation of responsiveness and also an increase in cost within a supply chain. Supply chain coordination improves if all stages of the chain take action that together increase total supply chain profits. For effective coordination, the effect of each stage has on other stages must be taken into

account. If conflicting objectives are found in different stages they lead to lack of coordination. In each stage, the stage owner tries to maximize their own profit which may lead to lack of coordination. Lack of coordination may lead to lowering of total supply chain profit. The fundamental challenge today is for supply chains to achieve coordination in spite of multiple ownership and increased product variety.

For example, Priya produces many varieties of pickles with different units. The increased variety makes it difficult for food to coordinate information exchange with hundreds of suppliers and dealers.

When products (numbers) move from retailers' stage to wholesalers it experiences bullwhip effect. Bullwhip effect is the fluctuations in orders increase as they move up the supply chain from retailers to wholesalers. Same thing happens when it moves up to manufacturers and further up as suppliers.

The Effect on Performance of Lack of Coordination

- i. **Manufacturing Cost:** The lack of coordination increases manufacturing cost in the supply chain due to increased variability in demand.
- ii. **Inventory Cost:** The lack of coordination increases inventory cost in the supply chain. To handle increased variability in demand, the firms have to keep more inventories than required level. This high level of inventory also increase the warehousing space required and thus the warehousing cost incurred.
- iii. **Replenishment Lead Time:** Lack of coordination increases replenishment lead times in the supply chain. There are times when available capacity and inventory cannot supply the orders coming in.
- iv. **Transportation Cost:** The lack of coordination increases transportation cost in the supply chain. The transportation requirements overtime at Priya pickles and its suppliers are correlated with the orders being filled. This raises transportation cost because of fluctuation in transportation requirements.
- v. **Labor Cost for Shipping and Receiving:** The lack of coordination increases labor costs associated with shipping and receiving in the supply chain. Due to fluctuation in orders, the labor requirement varies, so the labor cost increases.
- vi. **Level of Product Availability:** Lack of coordination hurts the level of product availability and results in more stock outs in the supply chain.
- vii. **Relationship across the Supply Chain:** Lack of coordination has a negative effect on performance at every stage and thus hurts the relationships between different stages of the supply chain. So, the blame game starts and leads to loss of trust between the supply chain entities.

Therefore, the lack of coordination reduces the profitability of a supply chain by making it more expensive to provide a given level of product availability.

Obstacles to Coordination in the Supply Chain

Any factor that leads to either local optimization by different stages of the supply chain, or an increase in information delay, distortion and variability within the supply chain, is an obstacle to coordination. Major obstacles are divided into five categories. Table 2.3 outlines the summary of obstacles

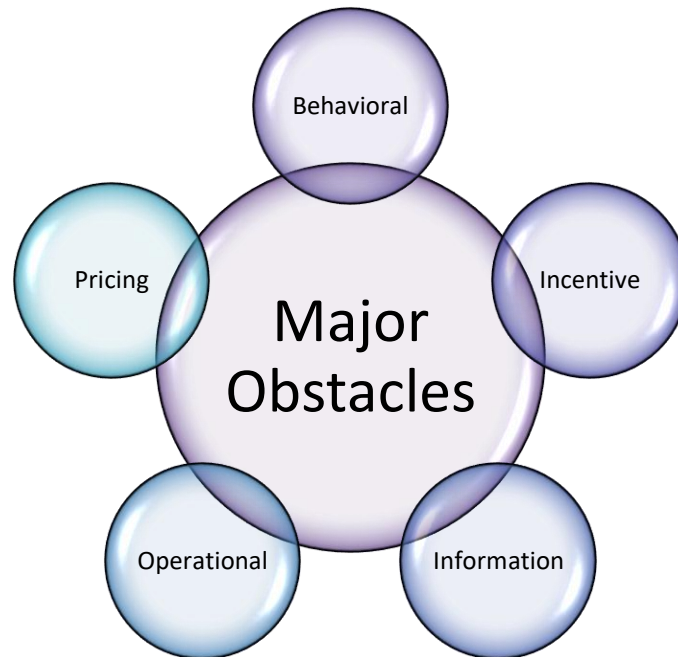


Figure 2.6: Major obstacles to coordination in supply chain

1. **Incentive obstacles:** Incentive obstacles occur in situations when incentives / trade commission offered to different stages or participants in a supply chain lead to actions that increase variability and reduce total supply chain profits.
 - i. **Local Optimization within functions or stages of a supply chain:** Incentives that focus only on the local impact of an action result in decisions that do not maximize total supply chain profits. For example, Priya’s distributors will maximize their profits through increased purchasing and inventory, not total supply chain profits.
 - ii. **Sales force incentives:** Improperly structured sales force incentives are a significant obstacle to coordination in a supply chain. Example, order size for palm cakes or palm roots from distributors may vary from 100 nos from one to the next week. A sales force incentive based on sell –in thus results in order variability being larger than customer demand variability.
2. **Information –Processing Obstacles:** Information processing obstacles occur in situations when demand information is distorted as it moves between different stages of the supply chain, leading to increased variability in orders within the supply chain.
 - i. **Forecasting Based on Orders and not Customer Demand:** The fact that each stage in a supply chain forecasts demand based on the stream of orders received from the downstream stage results in a magnification of fluctuations in orders as we move up the supply chain from the retailer to the manufacturer.
 - ii. **Lack of Information Sharing:** The lack of information sharing between stages of the supply chain magnifies the information distortion. Example, if the retail outlet or distributor is planning for promotional campaign, that information is not shared with the manufacturer, then leads to a large fluctuation in manufacturer orders.
3. **Operational Obstacles:** Operational obstacles occur when actions taken in the course of placing and filling orders lead to an increase in variability.
 - i. **Ordering in Large Quantities:** When a firm places orders in lot sizes in lot sizes that are much larger than the lot sizes in which demand arises, variability of orders is magnified up in the

supply chain. Example, placing order for 5 tons of sugarcane instead of 2 tons to save transportation cost, ordering cost, loading and unloading cost.

- ii. **Large Replenishment Lead Times:** Information distortion is magnified if the replenishment lead times between stages are long. Example, if the supply lead is two weeks, but the demand trend is calculated for one week, then may to demand variability in the supply chain.
 - iii. **Rationing and Shortage Gaming:** Rationing schemes that allocate limited production in proportion to the orders placed by retailers lead to a magnification of information distortion. This can occur when a high –demand product is in short supply. Examples, onion, tomato and vegetables. If the retailer orders for 500 Kilograms of onion, if he gets only 300 Kilograms, then, he has to inflate its order i.e. ordering for 800 Kilograms instead of 500 Kilograms.
- 4. Pricing Obstacles:** Pricing obstacles arise when the pricing policies for a product lead to an increase in variability of orders placed.
- i. **Price Fluctuations:** Trade promotions and other short-term discounts offered by a manufacturer result in forward buying, by which a wholesaler or retailer purchase large lots during the discounting period to cover demand future periods. Example: forward buying, chicken buying for biriyani during the weekends and festival seasons. Another example, ‘buy one get one free’ offers.
 - ii. **Lot Size –Based Quantity Discounts:** Lot-size based quantity discounts increase the lot size of orders placed within the supply chain. Example, Rs. 100 price per unit for a lot size of 1-100 numbers, Rs.90 per unit for a lot sized of 101- 500 numbers. Coconut Rs.100 for 5 numbers, but when we buy one number, then the cost per unit would be Rs.25-30.
- 5. Behavioral obstacles:** Actions are focused locally and not visualized the impact on other stages. A lack of trust among supply chain partners causes them to be opportunistic at the expense of overall supply chain supply performance. Based on local analysis, the partners will blame others in the supply chain. These problems are related to the way the supply chain is structured and the communications between different stages. Summary of obstacles is shown in Table 2.3.

Table 2.3: Summary of obstacles to coordination in a supply chain

Sl. No	Obstacles	Details
1	Incentive obstacle	<ul style="list-style-type: none"> i. Local optimization within functions or Stages of a supply chain ii. Sales force incentives
2	Information processing obstacles	<ul style="list-style-type: none"> i. Forecasting based on orders and not customer demand ii. Lack of information sharing
3	Operational obstacles	<ul style="list-style-type: none"> i. Ordering in large lots ii. Large replenishment lead times iii. Rationing shortage
4	Pricing obstacles	<ul style="list-style-type: none"> i. Lot size based quantity discounts ii. Price fluctuations
5	Behavioral obstacles	<ul style="list-style-type: none"> i. Actions based on local conditions ii. Lack of trust or No trust iii. Reaction to the local situations

Managerial Levers to Achieve Coordination

Supply chain managers should focus to overcome these obstacles. The below mentioned managerial actions increase total supply chain profits and moderate information distortion (Sunil Chopra, 2011).

- i. Aligning of goals and incentives
- ii. Improving information accuracy
- iii. Improving operational performance
- iv. Designing pricing strategies to stabilize orders
- v. Building strategic partnerships and trust.

To Do Activity

Visit a brick manufacturing unit nearby your place and study their supply chain coordination issues if any. Also identify whether they have faced bullwhip effect in their supply chain. If so, suggest counter measures to overcome bullwhip effect. Prepare a report on this and submit.

2.4 Designing the Distribution Network in a Supply Chain

A supply chain is a network consisting of nodes and linkages. Nodes represent conversion (manufacturing) or storage (warehousing) or demand points (retail outlet) and linkages represent transportation activities through which material flow takes place in the chain. Network design focuses on the location nodes of plants and storage point for given customer nodes. Network operations focus on identifying the optimal linkages between plants and markets. In network design where to locate the facilities is an important strategic network design decision. So, the network design decisions are most important supply chain decisions. When designing supply chain network, we need to consider the various facilities available, transportation options available, inventory portion, and information methods are in use.

Distribution means moving raw material from supplier end to manufacturing end to customer hand. Various distribution options are available in moving materials. Since the cost of transporting materials accounts major share in the item cost, distribution has to be planned efficiently and at the same time responsiveness also should be ensured (David Simchi-Levi, 2004).

Three Levels of Supply Chain Management Decisions

Supply chain management decisions are often said to belong to one of three levels, i.e the strategic, the tactical or the operational level. Figure 2.5 shows the three levels of decisions as a pyramid shaped hierarchy. The decisions on a higher level (strategic level) in the pyramid will set the conditions under which lower level decisions are made.

Strategic Level: At strategic level long term (may be more than 3 years) decisions are made. The decisions are related to location, production, inventory and transportation. Location decisions are concerned with the size, number and geographic location of the supply chain entities such as plants, inventories or distribution centres. The production decisions are meant to determine which products to produce, where to produce them, which suppliers to use them, from which plants to supply distribution centres and soon Inventory decisions are concerned with the way of managing inventories throughout the supply chain. Transportation decisions are made usually modes of transport to use.

Tactical Level: At tactical level medium term (1- 3 years) are made such as weekly demand forecasts, distribution and transportation planning, production planning and materials requirements planning.

Operational Level: The operational level of supply chain management is concerned with the very shorter decisions made from day to day (say up to 12 months).

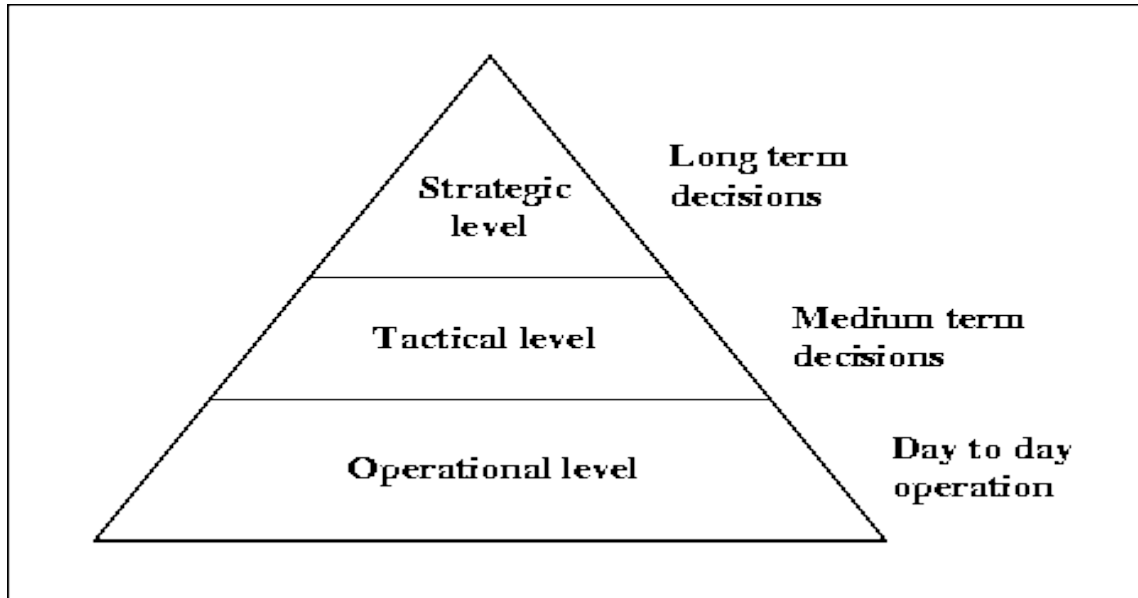


Figure 2.7: Hierarchy of supply chain decisions

The Role of Distribution in the Supply Chain

Without distribution there is no supply chain. It occurs at every stage. The cost of supply chain and customer satisfaction depends on the efficiency of the distribution in the supply chain. Distribution accounts more than 20 percent of the cost of manufacturing. Companies, which followed effective distribution system, succeeded in achieving world class competitiveness. Examples are Amul, Aavin, Nandini and other milk marketing federation companies. Distribution should provide higher level of customer responsiveness at a reasonable cost. Companies can directly deal with the customer or can contact through retailers. When they contact directly the customer, the products may move faster. On the other hand distributors who are intermediaries play a much more significant role in distributing the consumer goods. Examples furniture and house hold items supply chains. In India, distributors play a major role in distributing consumer goods. So, it is to be justified whether direct selling is profitable through distribution. A poor distribution network can hamper the level of service that customer receive while increasing the cost.

An inappropriate network in distribution can affect the profit. So, it is important to design the distribution network appropriate to the business. Figure 2.6 shows a simple supply chain network.

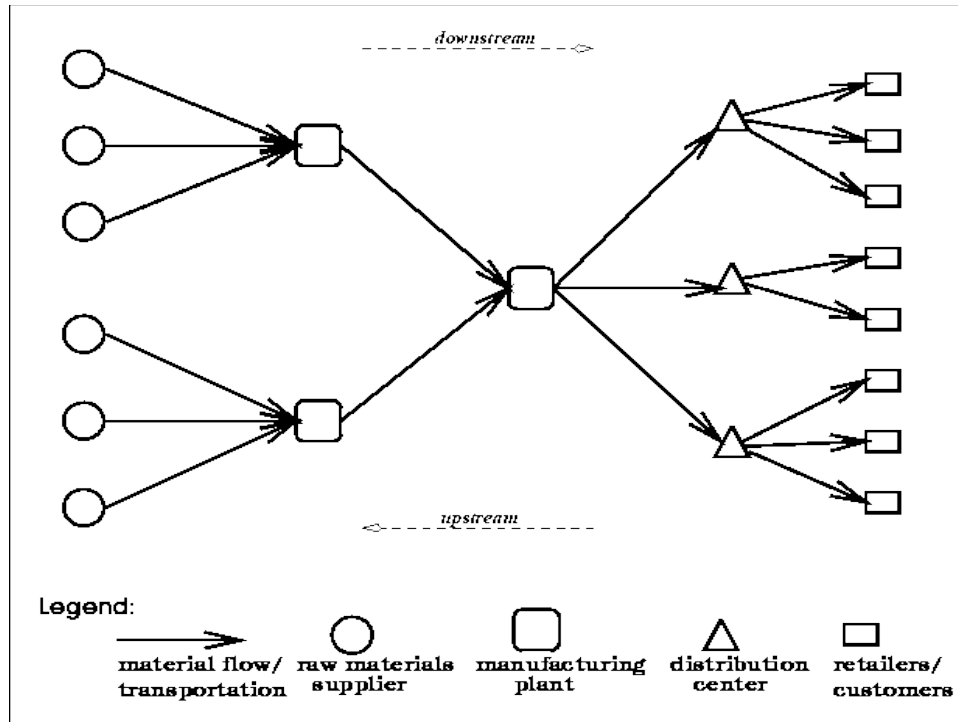


Figure 2.8: Supply chain network

Factors affecting the distribution network

The performance of the distribution network can be measured by the level of customer service provided and the associated cost of maintaining distribution network. According to Sunil Chopra et al, (2011), the factors responsible for customer services are: response time, product variety, product availability, customer experience, order visibility and return ability (in case of rejections and recalls). Table 2.4 gives the summary of factors affecting the distribution network.

Table 2.4: Summary of factors affecting the distribution network

Sl. No	Factor	Explanation
1	Response time	It is the time elapsed between order placement and receipt of the same. Customer expects lower response time to become satisfied.
2	Product availability	The ability of the firm to meet customer requirements as and when demand arises. Higher inventory but increases the inventory cost.
3	Customer experience	Customer experience leads the customer satisfaction. Good experience leads to better satisfaction, whereas bad experience in dealing with distributors / retailers in getting products leading dissatisfaction. So distributors should ensure good experience in getting their products / service.
4	Order visibility	Order visibility is nothing but transparency in dealing with the transactions.
5	Return ability / Recalls	The case with which a customer can return unsatisfactory products and the network should be sufficiently geared to handle such cases effectively.

Customer always wants higher level in all these parameters. So, there must be a tradeoff in designing distribution network and provide customer service at the highest level. A distribution network with many warehouses allows reduction in transportation cost relative to a network with a single warehouse. Total supply chain costs are the sum of inventory, transportation, and facility costs. To reduce the total cost, the cost of maintaining facilities should be minimized. So, in order to maintain good customer service at minimum cost is the objective to designing network.

Design Options for a Distribution Network

The distribution is the movement of materials from supplier end to manufacturing end and also from manufacturing end to customer end.

- i. Supply directly to the customer
- ii. Distribution through in transit to the customer
- iii. Supply through a distributor with a carrier delivery
- iv. Home deliver through a distributor
- v. Customer pick up points

Table 2.5: Summary of distribution channels in supply chain

Sl. No	Distribution mode in supply chain	Examples
1	Supply directly to the customer: In this method, supply chain cost and handling cost are minimized.	Farmer supplies the milk directly to the consumers. Nirma washing powder was supplied directly to the customers.
2	Distribution through in transit to the customer: In this system an intermediate agency is developed. Products are procured from many suppliers and distributed to the customers.	Examples: Electronic components or computer parts are purchased through this system. Food items supplied through Public distribution system (PDS).
3	Supply through a distributor with a carrier delivery: Distributors play a key role in the supply chain network. They collect finished goods from the manufacturers and stores in their place. It is best suited for medium to fast moving items.	Examples: Packaged milk supply by cooperative milk marketing federations, khadi items, eggs and soaps.
4	Home delivery through a distributor: In this option products are delivered to the customer at their home. Supermarkets they take up orders on door delivery basis.	Home delivery of rice, water and groceries are successful.
5	Customer picks up points: In this approach, products are stored at the manufacturer or distributor / retailer warehouse. Customers can place their orders either online or over phone. The pickup points are designed and located several in numbers closer to the targeted customers.	Examples: supply of medicines, bus operators and Tiffin box (Mumbai Dhabbawalas).

The value addition in the supply chain

Distributors in the supply chain play an important role. Even though e-business and online shopping business is trying to replace the distributors in the supply chain. In Indian context still 'Kirana stores' / distributors are important. So, the presence of distributors thus improves the performance of the supply chain.

Some of the value additions due to the presence of distributors in the supply chain are:

- i. Reduction in cost of transporting material from supplier to manufacturer
- ii. Reduction in cost of moving finished goods from manufacturer to customer
- iii. Reduction in inventory cost due to aggregation of requirements
- iv. Better planning of production by manufactures due to stable order
- v. Distribution can ensure better response time due to closer to customer
- vi. Customer can get product from several manufacturers

Model for Facility Location and Capacity Allocation

Supply chain network is influenced by inventory strategy, transport strategy and location strategy. Transportation and location are highly correlated. When the volume of material required is large and also available abundantly, and then better locates the plant / facility closer to the supply source. i.e Value of supply is greater than the value market. If the value of supply is less than the value of market, then locate facility / warehouse nearer to market.

Location decision involves determination of number of facilities, location and size of the facilities used. The facilities in a supply chain network must be equal to the number that minimizes total logistics costs. Maximizing profitability and improving responsiveness are the goals of a manager in locating facilities.

Example: Coir products or honey processing units, the manufacturing facility should be located nearer to the supply source, but, the warehouse or distribution centre should be located nearer to the markets.

This will enable the unit to optimize its transportation cost, i.e. transportation cost from supply to manufacturing unit and transportation cost for movement of final products from manufacturing plant to warehouse or Distribution Centres can be reduced. Location decision uses the following information's:

- i. Location of supply sources and markets
- ii. Identification of potential sites
- iii. Demand forecast for each product
- iv. Facility, labor and material costs by site
- v. Transportation costs and its implication
- vi. Selling price of each commodity at each site
- vii. Taxes and tariffs as product is moved between locations
- viii. Expected response time and service factors.

Facility could be a plant, warehouse, hospital, international airport, & seaport and distribution center. So, the facility decision has a long term implications in terms of investment, utilization of resources and time. It is important considering the strategic reasons. Therefore, models are used for network optimization.

- i. Centre of Gravity method or Grid technique is used for single facility.
- ii. Location cost-profit volume analysis
- iii. Total weighted rating point method
- iv. Network optimization models like mixed integer, goal programming, and dynamic programming are used for multi-facility location problems.

i. Center of Gravity Method or Grid Technique

Centre of gravity model is a method that determines the location of a facility that will minimize shipping cost and travel time to various destinations. Single facility location model uses center of gravity as approach in locating a single plant, terminal, warehouse or retailer service points. This technique is simple, since transportation cost between the source and the material is only considered as location factor. The material is moved from a source point to a demand point. The model is based on minimizing the total cost of transportation that is.

$$\text{Min TC} = Q \times C \times D$$

Where;

TC = Total transportation cost

Q = Quantity of material shipped per unit period 'i'

C = Cost of material transporting a unit point unit distance

D = Distance between source point and demand point

Further, we define a weight age (w), which is nothing but a weight associated with the source facility 'i'. This is the product of quantum of materials (Q) moved and the cost per unit distance between the demand point (new facility) and the supply source 'i' per unit period. The distance (D) between the source and the demand point is considered as squared. Gravity model assume both the market and the supply source can be located as grid on a plane. All distance are assumed to be squared. These models also assume that the transportation cost is linearly related to the quantity shipped.

Numerical Problem

Determine the Center of Gravity based on the Following Information.

Destination	Horizontal Axis (X) miles	Vertical Axis (Y) miles	Weekly demand in units
1	7	6	700
2	5	3	500
3	8	6	800
4	6	4	600
5	2	2	200
Total			2800

Solution: Coordinates

Horizontal Axis (X) for new facility = $(7 \times 700) + (5 \times 500) + (8 \times 800) + (6 \times 600) + (2 \times 200) = 6.36$ miles

Vertical Axis (Y) for new facility = $(6 \times 700) + (3 \times 500) + (6 \times 800) + (4 \times 600) + (2 \times 200) = 7.75$ miles

ii. Location Cost Profit Volume Analysis

Location cost volume profit volume analysis is a method for locating a distribution center that minimizes the distribution costs. Location cost- profit-volume analysis is a method of determining the volume of production where a company breaks even with costs and profits. This method takes into account both fixed costs and variable costs that influence the overall production costs. This can be used for facility location decisions in the supply chain.

Total cost = Total fixed cost + Total variable cost

Total variable cost = Variable cost per unit X Number of units produced.

Total Revenue = Number of units sold X Selling price per unit

Profit = Total revenue – Total cost
 = (Number of units sold X Selling price per unit) – (Total fixed cost + Total variable cost)

Example, if there are three locations, then for each location the total cost and profit has to be computed, based on that decisions are made.

Worked out Example

A firm is considering four alternative locations for a new unit and has collected the costs shown in table below.

Cost details	Location 1	Location 2	Location 3	Location 4
Labor cost per unit	0.55	1.10	0.80	0.45
Plant construction cost (Rs. In millions)	5.00	3.90	4.00	4.85
Materials and equipment per unit	0.43	0.60	0.40	0.30
Electricity per year	30,000	26,000	30,000	28,000
Water per year	27,000	6,000	7,000	7,000
Transportation per unit	0.02	0.10	0.10	0.05
Taxes per year	43,000	28,000	63,000	55,000

The firm will finance the new unit from bonds bearing 10 percent interest. Determine the most suitable location (economically) for output volumes in the range of 50,000 to 1,30,000 units per year.

Solution

Costs	Location 1	Location 2	Location 3	Location 4
Fixed costs per year				
10 percent of investment	5,00,000	3,90,000	4,00,000	4,85,000
Electricity	30,000	26,000	30,000	28,000
Water	27,000	6,000	7,000	7,000
Taxes	43,000	28,000	63,000	55,000
Total	6,00,000	4,50,000	5,00,000	5,75,000
Variable costs per unit				
Labor	0.55	1.10	0.80	0.45
Materials and equipment	0.43	0.60	0.40	0.30
Transportation	0.02	0.10	0.10	0.05
Total (Rs per unit)	1.00	1.80	1.30	0.80
Total costs (Rs)	6,00,000 + 1.00 per unit	4,50,000 + 1.80 per unit	5,00,000 + 1.30 per unit	5,75,000 + 0.80 per unit

At Zero Unit of Output

Location 1 : Rs.6,00,000

Location 2 : Rs.4,50,000

Location 3 : Rs.5,00,000

Location 4 : Rs. 5,75,000

Location 2 is preferred for zero units output (based on fixed cost only).

At 50,000 units

Location 1 : $6,00,000 + 50,000 \times 1.00 = \text{Rs. } 6,50,000$
 Location 2 : $4,50,000 + 50,000 \times 1.80 = \text{Rs. } 5,40,000$
 Location 3 : $5,00,000 + 50,000 \times 1.30 = \text{Rs. } 5,65,000$
 Location 4 : $5,75,000 + 50,000 \times 0.80 = \text{Rs. } 6,15,000$

Location 2 is preferred for 50,000 units output (based on total cost)

At 1, 00,000 units

Location 1 : $6,00,000 + 1,00,000 \times 1.00 = \text{Rs. } 7,00,000$
 Location 2 : $4,50,000 + 1,00,000 \times 1.80 = \text{Rs. } 6,30,000$
 Location 3 : $5,00,000 + 1,00,000 \times 1.30 = \text{Rs. } 6,30,000$
 Location 4 : $5,75,000 + 1,00,000 \times 0.80 = \text{Rs. } 6,55,000$

Location 2 or 3 preferred for 1, 00,000 units

At 1,30,000 units

Location 1 : $6,00,000 + 1,30,000 \times 1.00 = \text{Rs. } 7,30,000$
 Location 2 : $4,50,000 + 1,30,000 \times 1.80 = \text{Rs. } 6,84,000$
 Location 3 : $5,00,000 + 1,30,000 \times 1.30 = \text{Rs. } 6,69,000$
 Location 4 : $5,75,000 + 1,30,000 \times 0.80 = \text{Rs. } 6,79,000$

Location 3 preferred for 1, 30,000 units and above.

Note: This problem can be computed through MS Excel sheet and also graphs can be plotted.

iii. Total Weighted Rating Point Method

In this method, total points are calculated for each location. After that for each location weights are assigned. Then, the total point score is multiplied with weights assigned. Example, location 1, total score is 60 points, & for location 2 is 80 points. The weightage assigned is 20%, then, total weighted point score for location 1 is 12 and for location 2 are 16. In this case, location 2 is recommended.

Worked out Example

As the Head of the team for the selection of a service centre facility, you have received the following details. The scores are given in the table below: (Scale is 10 points = Best):

Factor	Weight	Location		
		A	B	C
Easy Access	0.10	86	76	94
Parking Facilities	0.20	74	84	86
Display Area	0.15	82	86	76
Window shoppers	0.10	96	78	78
Transportation costs	0.15	88	68	82
Operating costs	0.20	92	82	84
Ambience	0.10	90	90	92

- a. Using the factor ratings given above, determine which location alternative should be chosen on the basis of maximum composite score
- b. If the manager weighs the factors equally, how would the locations is ranked?

Solution:

a.Total weighted point score:

Location A:

$$= (0.10 \times 86) + (0.20 \times 74) + (0.15 \times 86) + (0.10 \times 78) + (0.15 \times 68) + (0.20 \times 82) + (0.10 \times 90)$$

$$= \mathbf{85.9 \text{ Answer}}$$

Location B:

$$= (0.10 \times 76) + (0.20 \times 84) + (0.15 \times 86) + (0.10 \times 78) + (0.15 \times 68) + (0.20 \times 82) + (0.10 \times 90)$$

$$= \mathbf{80.7 \text{ Answer}}$$

Location C:

$$= (0.10 \times 94) + (0.20 \times 86) + (0.15 \times 76) + (0.10 \times 78) + (0.15 \times 82) + (0.20 \times 82) + (0.10 \times 92)$$

$$= \mathbf{84.1 \text{ Answer}}$$

Based on total weighted point score, location A is recommended.

b.Factors equally weighed

$$\text{i.e } 1.0 / 7 = 0.14$$

Location A:

$$= (0.14 \times 86) + (0.14 \times 74) + (0.14 \times 86) + (0.14 \times 78) + (0.14 \times 68) + (0.14 \times 82) + (0.14 \times 90)$$

$$= \mathbf{85.12 \text{ Answer}}$$

Location B:

$$= (0.14 \times 76) + (0.14 \times 84) + (0.14 \times 86) + (0.14 \times 78) + (0.14 \times 68) + (0.14 \times 82) + (0.14 \times 90)$$

$$= \mathbf{78.96 \text{ Answer}}$$

Location C:

$$= (0.14 \times 94) + (0.14 \times 86) + (0.14 \times 76) + (0.14 \times 78) + (0.14 \times 82) + (0.14 \times 82) + (0.14 \times 92)$$

$$= \mathbf{82.88 \text{ Answer}}$$

If the manager weighs the factors equally, then, location A stands first, location C second and location B third.

iv. Network Optimization Techniques

Mathematical programming models are employed to get optimum solutions. Multiple –centre of gravity method can also be used to solve multi-location problems. Mixed integer linear programming is yet another method to solve the multi-facility location problems. Goal programming, tree methods and dynamic programming techniques are also used for solving this difficult problem optimally. The most promising among these techniques is mixed integer linear programming approach. In this method, fixed cost is dealt with optimally.

Impact of Uncertainty on Network Design

Supply chain design involves long-term decisions. Long term decisions are strategic in nature. Once decisions are made, alterations / modifications in the future are very difficult and prove to be costly. The important decisions involved in design of supply chain are number of plants to be established, the size of plants, number of trucks to be purchased or leased and the number of warehouses to be built or leased. All these decisions are long run in nature. Since it is difficult to modify, the decisions must be made very accurately.

However, the uncertainty in the demand, fluctuations in market price, unexpected swing in the exchange rates and turbulent competitive environment make decision making difficult. These uncertainties causes supply chain design complex. If enough care is not taken, the impact of uncertainty will make it operational to be very costly and complex. Financial uncertainty can be take care if discounted cash flow technique is followed in designing network (Sunil Chopra, 2011).

To Do Activity

Visit a cotton marketing mandi / society nearer to your town and study the supply chain network design issues. Submit a report.

2.5 Logistics Management and Integration of Processes in Supply Chain

Definition of Logistics

According to Council of Logistics Management (CLM) 'Logistics is the process of planning, implementing and controlling the efficient and effective flow of goods, services and related information from point of origin to point of consumption in order to meet customer requirements'. Logistics includes inbound logistics (IBL) and outbound logistics (OBL). The key functions of logistics management are: transportation, warehousing, distribution, 3PL logistics services and reverse logistics.

Operating Objectives of Logistics

The main objectives of logistics are:

- i. Rapid Response
- ii. Minimum Variance
- iii. Minimum Inventory
- iv. Movement / shipping consolidation
- v. Quality improvement
- vi. Life –Cycle Support

Types of Logistics

- i. **Inbound logistics:** All the activities related to the material movement till the dispatch of the products out of the factory gate are called as inbound logistics. Creation of value in the products depends upon availability of inputs on time. Making available these inputs on time at minimum cost is the essence of inbound logistics. Activities of a procurement performance cycle under the scope of inbound logistics.
- ii. **Outbound logistics:** All the activities in which the value added goods are to be made available in the market for customers are called as outbound logistics activities. Success of the firm depends upon the supply of products to the customer on time. Activities of distribution performance cycle come under the scope of outbound logistics. They are order management, transportation, warehousing, packaging and handling.
- iii. **Reverse logistics:** Reverse logistics is also known as product recall. It may be defined as a process of moving goods from their place of use, back to their place of manufacture for reprocessing, refilling, repair, and recycling or waste disposal. Examples: automobile cars recalls, collection of milk containers, empty cool drink bottles and packing boxes.
- iv. **Third Party Logistics (3PL):** In order to keep the costs of inbound and outbound logistics activities under control, an outside agency appointed to perform these logistics functions is called 'Third Party Logistics. Examples: SICAL logistics, TVS logistics, GATI, DHL and OM logistics.
- v. **Fourth-Party Logistics (4PL):** Forth Party Logistics is complete outsourcing of manufacturing and logistics functions including selection of Third Party Service Provider (3PLS)'.
vi. **Cold Chain Logistics:** Products like fish, meat, medicines, milk products, egg, fruits, and vegetables are moved by 'Reefer Vehicles' with temperature controllers. Some of the items are moved with temperature ranges from minus 4 centigrade to plus 12 degrees.

Logistics in the Globalization

Logistics functions are some domestically and globally but differ in four D's i.e. distance, documents, diversity in culture and demand of customer. In the global logistics distances are longer, documentation, is more extensive, customer demand varies to satisfy cultural differences within both, countries and regions. Developing strategies to respond to the environment is the global challenge for logistics management. There are some factors that facilitate globalization and necessitate global logistics and also some barriers that continue to impede global logistics. Logistics management must balance the cost of overcoming these barriers with the potential.

Forces Driving Globalization of Logistics

- i. Economic growth
- ii. Supply chain perspective
- iii. Regionalization / Regional Trade Blocks
- iv. Technology
- v. Transportation Deregulation

Main Functions of Logistics

- i. **Transportation:** Transportation is an essential and major sub-function of logistics that creates time and place utility in goods. Transportation management covers the area of shipment scheduling / routing, freight cost, carrier selection, shipment tracking and parcel management. It helps us to make the best use of available resources and keeps informed on all transportation process.

Functions of Transportation are: product movement, and product storage.

- ii. **Warehouses:** Warehouse is a location provided with adequate facilities, where bulk shipments are received from production centers, which are then broken into small order size for shipment to the customers as per their requirement.

Functions of Warehousing are: performing quality and quantity checks, sorting goods at specific locations, packing the products for executing customer's order, shipping goods by selected mode of transport, preparing records and documents of stock, and information transfer to management.

Types of Warehouse

- Private Warehouse- Amazon, OM logistics and GATI
- Public Warehouse- Central Warehousing Corporation (CWC)
- Contract Warehouse- TVS logistics
- Co-operative Warehouse- Agricultural Products Marketing Committees

Location of Warehouse: The primary considerations while locating the warehouse are cost and customer service.

- iii. **Packaging:** Packaging though an integral part of logistics, also affect marketing and production function. Packaging function helps in promotion of products and size, shape and material of the package affects production labor efficiency. Logistical functions of packaging are containment and protection. Stages in logistics packaging are products packaging, master cartons, unit load and containerization.

- iv. **Material Handling System (MHS):** Material handling is a process of movements of raw materials, WIP and finished goods within a facility most efficiently at the lowest possible cost. Scopes of MHS are during receipt of materials and during dispatch of finished goods. MHS adds value to the product, otherwise lot of rework / rejections would have occurred in the supply chains. MHS are classified as: Manual system, mechanical system and automated system- ASRS, Carousal, Robots, and AGVS.

Integrated Logistics System (ILS): Suppliers, customers, government agencies, society, environment and green logistics – reuse, recycle, reduce and return are integrated in the logistical systems besides the integration of its own functions. Figure 2.7 depicts the integrated logistics system,

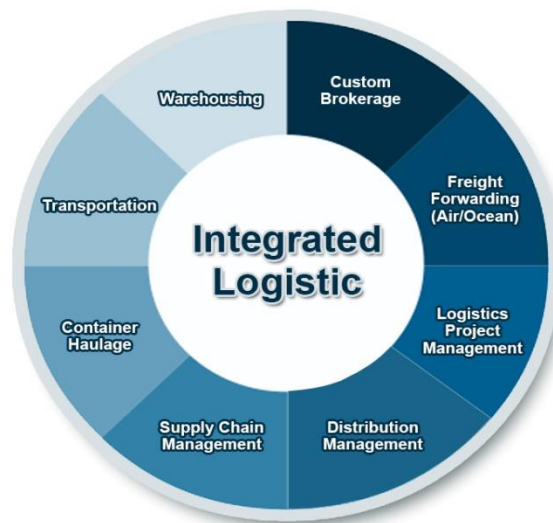


Figure 2.9: Integrated Logistics System (Harbor-link group.com)

Integration of Processes in Supply Chain

In well- managed chains material, information and finance flow seamlessly across departmental and organizational boundaries and it is the end customer pull and not internal compulsions that govern these. Individual departments and firms may be interested in performance at the local level rather than performance at the chain level, resulting in material and products waiting for a considerable period of time at both boundaries. The performance or strength of any supply chain goes with the ‘weakest link’ in that supply chain. i.e The strength of a supply chain is as strong as its weakest link. So, process integration is essential. In general, the integrations are done at three stages. i.e Islands within an organization, internal integration and external integration (Shah, 2009).

Islands within an organization: Sourcing, manufacturing and distribution are working in silos. This has to be integrated to enhance its synergy.

Internal Integration: Sourcing, Manufacturing and Distribution are integrated. Example, material planning, procurement, stores & inventory management and outsourcing are integrated and named as integrated materials management (IMM) for better control and faster decision making.

External Integration: In this stage the firm integrates itself with suppliers as well as customer and works as an integrated chain. This is done through Enterprise Resource Planning (ERP)- SAP, IFS, MS ERP, Tally ERP and Oracle platforms. Figure 2.8 describes the supply chain integration stages.

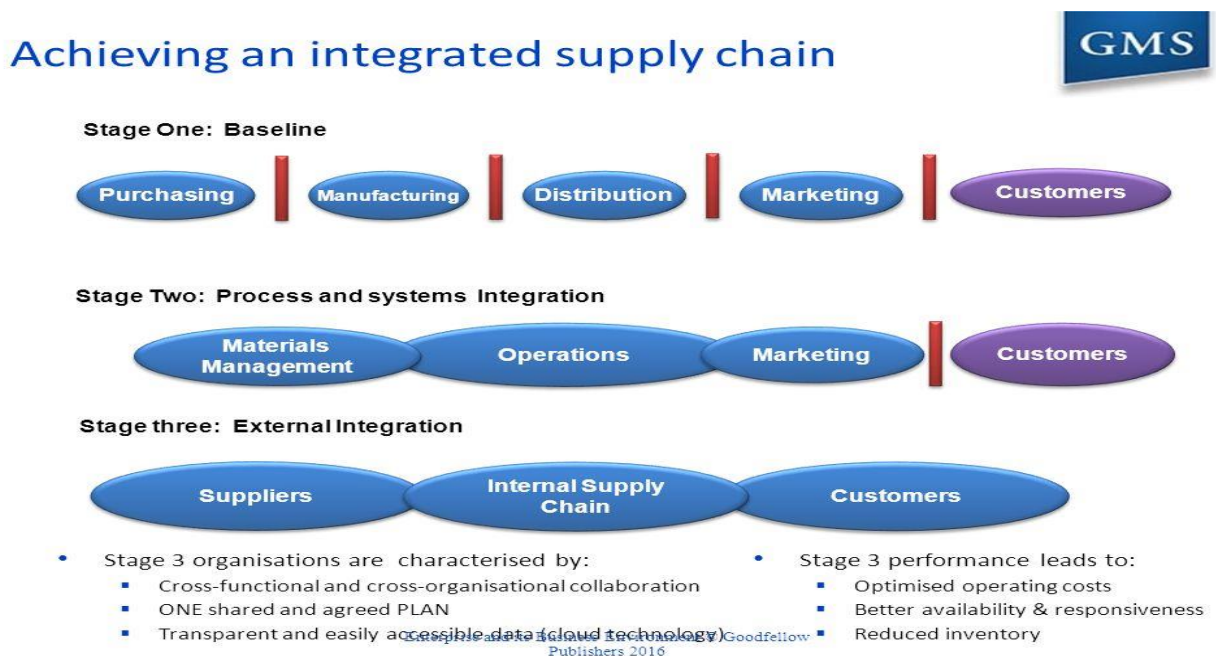


Figure 2.10: Integrated supply chain (GMS, 2018)

Indian companies namely, TaTa Motors, HAL, HUL and Godrej have already integrated their supply chains. Main benefits are better inventory control, faster decision making, closely working with suppliers and customers. Efficient Customer Response (ECR), Vendor Managed Inventory (VMI) and Collaborative planning, forecasting and replenishment (CPFR) are aimed at facilitating and improving collaboration between partners in a chain.

To Do Activity

Visit a warehouse nearby your city and study the functions of that warehouse. Distinguish between a warehouse and distribution centre. Submit a report.

Summary of the Chapter

In this chapter, five flows namely, physical flow of goods, information flow, money flow, value flow and risk flow in a supply are emphasized. Inventories are necessary assets to meet the demand fluctuations. Different type's inventories, needs of inventory, inventory control measures such as ABC, VED, FSN, SDE, XYZ and Seasonal Inventories are explained with examples. Under inventory control system, EOQ, Q-System and P-System of Inventory management and its relevance are highlighted examples. Coordination in supply chain is important. Due to lack of coordination and distorted communication, bullwhip effect occurs in supply chain. The causes, effects and counter measures are explained. Designing the distribution network in a supply chain is a strategic decision. To locate a new facility (single facility and multi-facility), techniques such as centre of gravity model, location cost volume profit analysis, total weighted rating point method; mathematical programming, integer programming and dynamic programming are discussed. The key functions of logistics management such as transportation, warehousing, packaging and material handling systems. Integrated logistics system (ILS) is an integrated approach in which all the stakeholders are integrated. Integration of processes is important to get superior performance. Integration is taking place at stages namely, islands within an organization, internal integration and external integration. Integration tools such as ERP, ECR, VMI and CFPR are also explained.

Model Questions

1. Identify the important flows in a supply chain.
2. Define inventory. Mention classification of inventories.
3. What is EOQ? State its assumptions.
4. What is bullwhip effect?
5. Explain the causes, effects and counter measures with examples
6. What is centre of gravity model?
7. You are appointed to identify a suitable location cooperative society milk collection centre. How to go about this?
8. What is logistics management?
9. What are the key functions of logistics management
10. What is material handling system? Discuss different types of MHS used in a sugar factory.

Reading Materials

1. Saikrishna. (2016, March 23). *The five major flows in supply chain*. Retrieved 12 14, 2020, from <https://brandlyzer.blog>2016/03/23>: <https://brandlyzer.blog>2016/03/23>
2. C, S. (2021). Multi-Unit Selective Inventory Control - Three Dimensional (MUSIC-3D). *Industrial Engineering Journal* , 19-25.

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1. Sunil Chopra, P.M. (2011). *Supply Chain Management Strategy, Planning and Operation, Fourth Edition*. New Delhi: Pearson Education, Inc, 509-521.
2. David Simchi-Levi, P.K-L. (2004). *Designing and Managing the Supply Chain: Concepts, Strategies and Case Studies*, Second Edition. New Delhi: Tata McGraw –Hill Publishing Company Limited.
3. Shah, J. (2009). *Supply Chain Management Text and Cases*. New Delhi: Pearson Education Inc.

Chapter 3 Tools used in Implementation Rural Supply Chain Management

Introduction

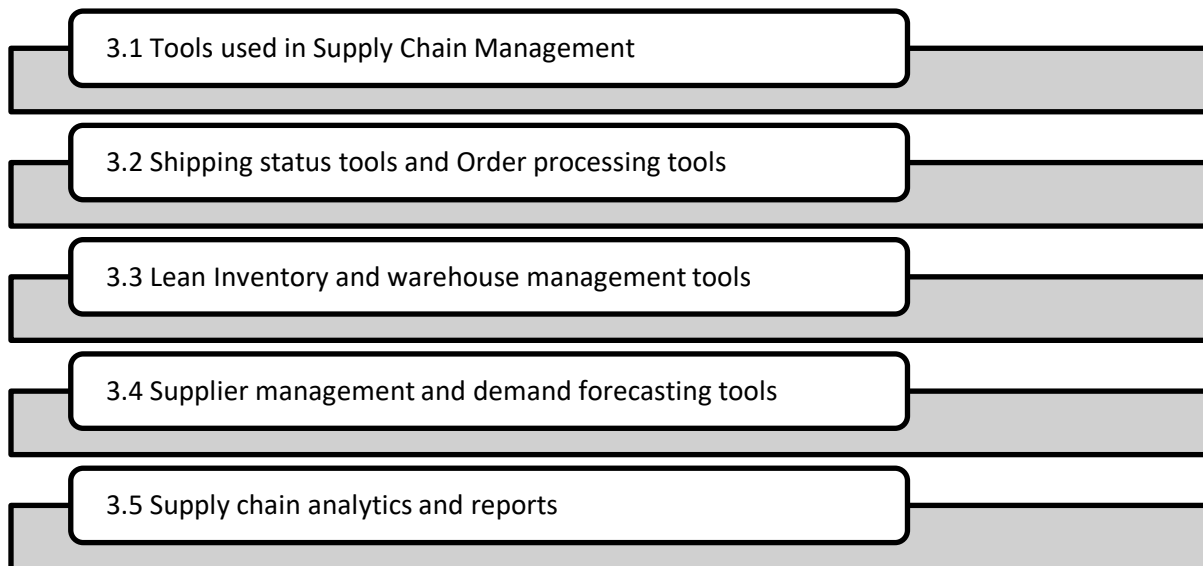
Supply chain managers use information, tools and techniques to make many important decisions related to key building blocks of the supply chain that is, inventory, transportation, and facility. Setting the inventory level requires information and tools to know about customers on demand, information about suppliers on availability and information about current inventory levels, costs, and margins. Determining transportation policies requires information on delivery and shipping locations, routes, rates, transportation time and quantities to be shipped. Warehouse / store /plant decisions require information on customer and supplier locations, information on capacities, revenues and material / operating costs. In this chapter, the various tools used in SCM, shipping and order processing tools, strategic sourcing stages & demand forecasting tools, and supply chain analytics and reports are explained.

Chapter Objectives

After learning this chapter you will:

- i. Gain insights on various tools used in SCM
- ii. Demonstrate the shipping tools and order processing tools
- iii. Explain the lean principles and warehouse operations
- iv. Describe the strategic sourcing stages and demand forecasting tools
- v. Apply supply chain analytics and reports

Chapter Structure



3.1 Tools used in Supply Chain Management

Supply chain management, enabled by advances in technology, aims to develop a technical infrastructure linking technology and people, in an effort to align advances information technology (IT) with the capability of the organization for facilitating customer satisfaction. This integration is aimed at leveraging information tools to address these business concerns: flexibility and variety, quality, responsiveness and moving toward agility. Table 3.1 summarizes the important tools used in the entire spectrum of supply chain activities.

Table 3.1: Important tools used in supply chain management

Sl. No	Supply chain activities	Important tools used
1	Sourcing and Procurement	Enterprise Resource Planning (ERP), Electronic Procurement System, Electronic Data Interchange (EDI) and Payment gateways
2	Manufacturing	ERP, Shop orders generation, work order issuance, standard hours calculation and machine utilization
3	Distribution / warehouse management system	EDI, E-Commerce tools, Radio Frequency Identification Devices (RFID), Bar coding system, scanners, Internet and Intranet
4	Logistics / Transportation	Global Position System (GPS) for tracking, and Geographical Information System (GIS)
5	Delivery to the Customer	Through online and off-line mode. Through emails and physical delivery of products through third party (E-Kart, Packaged Parcels and Mumbai Dhabbawalas)

Companies use a host of tools to bring more visibility to their supply chains. Some of the tools are: EDI, RFID, bar coding, Scanners, GPS, E-Commerce models and ERP.

- I. **Electronic Data Interchange (EDI):** EDI is defined as the inter-company computer to computer communication of standard business transactions in a standard format that permits the receiver to perform the intended transaction without human intervention. In the EDI environment, the supplier’s computer and buyer’s computer can interact directly through a program / software i.e ANSI X12 or ANSI D12 format. Through EDI the supplier / buyer is able to see the inventory, payment status and supply status without human intervention. Figure 3.1 shows the process involved in an EDI.



Figure 3.1: Electronic Data Interchange (www.automationintelligence.com)

ii. **Radio Frequency Identification Device:** RFID is a microchip –based technology. The microchip is attached to an antenna and the unit is so formed is called RFID tag. RFID tags can be read as long as they are within a particular range.

The RFID uses radio frequency electromagnetic fields to extract data from a tag attached to an item for automatic identification and tracking. The RFID hence provides benefits like automatic reading, increased coverage area, no line of sight and many more. Figure 3.2 shows the RFID functions.

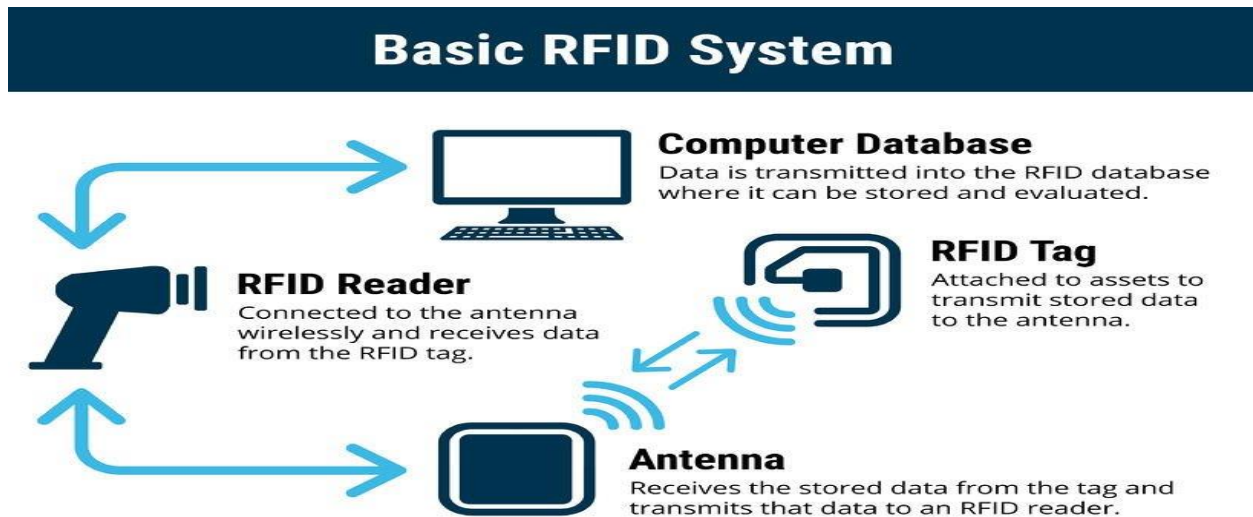


Figure 3.2: Radio Frequency Identification Device (www.researchgate.com)

Applications of RFID:

- It is used for identification of a particular product, source, year of manufacturing, batch number etc.
- It is used to prevent counterfeiting / spurious products
- It also helps in speedy clearance of goods by customs authorities
- It can also serve as the connection between the physical side and the virtual world.

- v. It has very sophisticated applications, for instance, the product availability in the refrigerators or out of stock can be ascertained intelligently.

iii. **Global Positioning System (GPS):** GPS uses Geographical Information System (GIS) . It is a computerized system for capturing the position of an object and then processing, enhancing, querying, analyzing, and storing it with spatially referred data.

The key components of a GIS are:

- a. Hardware and
- b. Software

The GPS technology enables the supply chain managers to locate the exact position of vehicles, people, or even inventory in the supply chain. GPS based vehicle tracking systems are used to optimize routes, communication, of delivery status to customers and also optimize warehousing operations. Figure 3.3 shows the GPS in tracking the trucks.



Figure 3.3: Global Positioning System (GPS) (www.researchgate.com)

Key components of GPS are:

- a. Space segment- satellites are placed in space 11000 nautical miles above the earth.
- b. User segment – consists of receivers, which can be hand held or mounted on a car
- c. Control segment- consists of five ground stations located around the world.

iii. **Bar Coding:** Bar coding is a passive system. Thick lines are printed on the product. With a help of a scanner, product related information such as product code, product description, batch number and price details can be captured on the system for billing. If the bar code is damaged, then, the scanner cannot read the product details. Different bar coding systems are used i.e 9 digits, 13 digits and Kotak bar coding system.

iv. **Scanners:** Scanner is an active device. It works on line of sight principle. From the bar code, it facilitates the product related information to transfer to the computer (Point of Sale). Figure 3.4 shows a typical scanner used in the retail outlets / hyper malls.



Figure 3.4: Photo of a Scanner (www.pavantechnology.com)

v. Enterprise Resource Planning (ERP): ERP is software that organizes and manages a company's business processes by sharing information across functional areas. ERP integrates the business processes, i.e integration of internal operations, suppliers and customers. ERP system facilitates customer satisfaction. It improves business results. ERP systems consist of a series of application modules that can be used alone or in concert. The main modules are: finance and accounting, sales and marketing, production and materials management and human resources. Figure 3.5 shows the type of information that flows between customers, suppliers and these various functional areas. ERP creates a central depository for the company's data, which enables the company to perform various business analyses. Key ERP software vendors are : SAP, Oracle, IFS, Microsoft Dynamics, Q Technologies, Oracle's PeopleSoft, PTC EDS Dassault Systems and i2 Technologies.



Figure 3.5: Enterprise Resource System (ERP) (www.researchgate.com)

- vi. **Internet and Intranet:** Internet is used to connect with suppliers, customers and other stakeholders. E-Commerce business transactions are conducted via internet. Intranet is used to communicate within organization. Examples: Local Area Network (LAN) and Wide Area Network (WAN).
- vii. **Electronic Procurement System:** Electronic procurement is part of the business to business (B2B) commerce being conducted on the Internet, in which buyers make purchases directly from suppliers through websites by using software packages. The Internet can streamline and speed up the purchase order and transaction process from companies. In SAP ERP package E-Tendering module is available, through which e- Reverse auction / e-Tendering can be conducted. The main benefits are: transparency, cost reduction, wider participation, faster ordering and delivery.
- viii. **Artificial Intelligence (AI):** AI the ability of a digital computer or computer controlled robot to perform tasks commonly associated with intelligent beings. Applications of Artificial Intelligence are: Goods traceability in supply chain management, consumer insights, branding, customer connect, authentication of products, digitization and automation of routine activities. AI along with IoT devices can be used to ascertain a product is genuine or false. Example, Kosha designs a startup in Bengaluru has developed a device by combining AI and IoT to check whether the handloom fabric is genuine or fake.
- ix. **Blockchain Technology:** Blockchain is programmable, distributed, anonymous, time stamped, unanimous, immutable, and secure system. This used for goods traceability and distribution in the supply chain management along with IoT devices. The movement of goods on real time basis can be tracked in logistics management.

Key Benefits of Various Tools Used in Supply Chain Management

- i. Improves supply chain efficiency and effectiveness
- ii. Reduced transaction costs
- iii. Optimized inventory
- iv. Increased accuracy
- v. Improved customer service
- vi. Real time feedback
- vii. Increase return on investment (ROI)
- viii. Enhance overall performance
- ix. Improved decision making
- x. Improved quality

To Do Activity

Visit one of the Khadi Craft Centre and study the various tools implemented in their supply chain. List out the key benefits of those tools.

3.2 Shipping Status Tools and Order Processing Tools

Shipping Status Tools

An increasingly popular supply chain management tools, real time alerts provide timely information on all shipping activities. Typically, large companies have high volume supply chains with many different types of cargo shipped to customers around the country or around the world. Shipping status tool automatically generates the tracking page under that domain allows customers to track their orders.

Shipping charges are calculated at the time of booking itself. Many tracking tools are available to track the consignment.

Important tools are:

- Shipstation
- Shippo
- Status and order tracking
- YITH WooCommerce
- YITH WooCommerce and
- Park Tool

When we open the tracking page / menu, it will ask 'Tracking Number' or Consignment Number or Airway Bill Number, if enter the reference number correctly, then it will show the current status of the consignment.

Example: India Post

When we book a letter or parcel, based on its weight, location and type of booking, i.e Registered Post or Speed Post, the fee is collected. In the booking receipt, we could see the booking number, booked by whom, place of booking post office, date & time and the addressee name & place with Pin Code number. After two days, we track our letter by the entering the EL Number / ER Number, within few seconds, we will be able to get the complete history like booking time, place, packed, delivered to SRO, opened, delivered to destination with time & date including the delivery confirmation. Specimen receipt is shown in Figure 3.6.

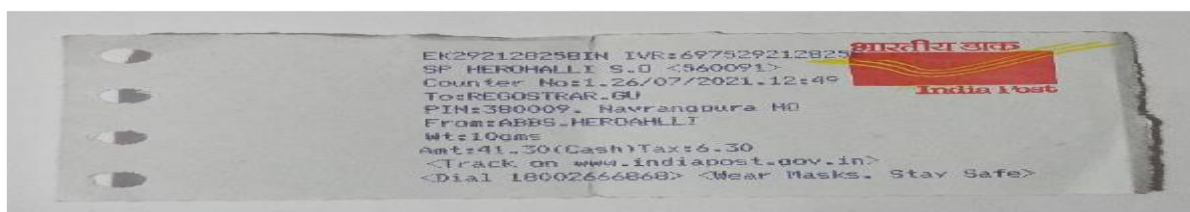


Figure 3.6: Speed Post Booked Receipt (www.indiapost.gov.in)



Sign In

Register



हिन्दी



You are here Home >> **Track Consignment**

Tools



Track Consignment

[Quick help](#)

* Indicates a required field.

* Consignment Number

Track More

Booked At:	Herohalli S.O
Booked On:	26/07/2021 12:49:20
Destination Pincode:	380009
Tariff:	41.30
Article Type:	Inland Speed Post
Delivery Location:	Navrangpura HO
Delivery Confirmed On:	29/07/2021 16:21:33

Event Details For : EK292128258IN

Current Status : Item Delivery Confirmed

Time:	08:07:24
Office:	Ahmedabad NSH
Event:	Item Received
Date:	27/07/2021
Time:	05:17:48
Office:	Bengaluru NSH
Event:	Item Dispatched
Date:	27/07/2021
Time:	01:16:05
Office:	Bengaluru NSH
Event:	Item Bagged
Date:	26/07/2021
Time:	17:46:02
Office:	Bengaluru NSH
Event:	Item Received
Date:	26/07/2021
Time:	14:14:08
Office:	Herohalli S.O
Event:	Item Dispatched
Date:	26/07/2021
Time:	14:11:50
Office:	Herohalli S.O
Event:	Item Bagged
Date:	26/07/2021
Time:	12:49:20
Office:	Herohalli S.O
Event:	Item Booked

Delivery Confirmed On: 29/07/2021 16:21:33

Event Details For : EK292128258IN

Current Status : Item Delivery Confirmed

Date:	29/07/2021
Time:	16:21:33
Office:	Navrangpura HO
Event:	Item Delivery Confirmed

Date:	29/07/2021
Time:	12:09:00
Office:	Navrangpura HO
Event:	Out for Delivery

Date:	29/07/2021
Time:	10:10:12
Office:	Navrangpura HO
Event:	Item Received

Date:	28/07/2021
Time:	15:27:41
Office:	Ahmedabad NSH
Event:	Item Dispatched

Date:	28/07/2021
Time:	14:41:20
Office:	Ahmedabad NSH
Event:	Item Bagged

Date:	28/07/2021
Time:	08:07:24
Office:	Ahmedabad NSH

Figure 3.7: Tracking chart of Speed post parcel (www.indiapost.gov.in>track)

Illustration: Speed post parcel booked from Bengaluru (PIN 560091) to Ahmedabad on 26th July 2021 and Item reached Navranpura Post Office (PIN 380009) on 29th July 2021 and delivered to the Office of the Registrar, Gujarat University on 29th July, 2021 at 16.21.33).

Logistics companies like USPS, Fedex, DTDC and GATTI they are using the consignment number for tracking. They also have bookings like: express services, priority (AK & HI only), over night services, weekend services and also day specific services.

In shipping, tracking number is important. Speed and timely delivery of the consignment is important. While these factors allow for growth, they also supply chain vulnerable to more errors. Real time updates keep everyone posted in the supply chain, so that the other stakeholders can take action before small issues become much larger. Additionally, these alerts can be sent to mobile device to inform the status of supply chain at any time, day or night.

Order Processing Tools

Order processing is very important to any supply chain. SCM software tools suggest all functions across order processing like sales order processing, order management and order fulfillment, billing and order to cash. Order processing is the process or work flow associated with the pricing, packing and delivery of the packed item. Shipping carrier is a key element of order fulfillment. In retail scenario, this is a key element of retail order fulfillment, where reliability and accuracy lead to customer satisfaction.

Order management refers to the process of receiving, tracking and fulfilling customer orders. The order management begins when an order is placed and ends when the customer receives their package. The order management cycle consisting of the following stages:

- ✓ Order placed
- ✓ Order received
- ✓ Order packed
- ✓ Order / item shipped
- ✓ Item delivered

These supply chain optimization tools can automate most activities involved in order processing using Electronic Data Interchange (EDI) and similar technology to directly capture order data. This reduces the time it would take to traditionally process an order by eliminating the need to manually generate and send Pos and invoices. It also reduces the opportunity for human error since there is no need to manually taken down order information and re-enter it in to a difference system.

Important order management software's are:

- ✓ Skubana
- ✓ Netsuite
- ✓ ShipStation
- ✓ Trade Gecko
- ✓ Bright Pearl
- ✓ Ship Bob

Some of the software tools are supporting only order processing and some of the software's provide end to end solutions including order fulfillment.

To Do Activity

Visit one of the DTDC centre in your city and identify the shipping tools and order processing tools used by that. Discuss the salient features and submit a report.

3.3 Lean Inventory and Warehouse Management Tools

Lean production means production means doing more with less – less inventory, fewer workers, less space. The term coined by James Womack and Daniel Jones to describe the Toyota Production Systems, widely recognized as the most efficient manufacturing system in the world. Lean production is an integrated management system that emphasizes the elimination of waste and continuous improvement of operations. Earlier, it was known as just in time, it emphasized minimizing inventory and smoothing the flow of materials so that material arrived just as it was needed or 'just-in-time'.

Taiichi Ohno, a former shop manager and later vice president of Toyota Motor Company, is the individually generally credited with development of lean production. In Lean's mandate is eliminating waste. These wastes are called as 'Mudas'. Muda means waste, anything other than that which adds value to the product or service. There are seven types of waste (mudas) according to lean production: Over production, waiting, Transporting, processing (unnecessary steps), inventory (in factory and warehouse), movement, non-utilized talent and defects. Table 3.2 depicts the wastes in operations.

Table 3.2: Summary of Waste in Operations (Mudas)

Sl. No	Type of Muda	Details
1	Over production	Producing items we cannot immediately use or sell
2	Waiting	For parts, machines, and downstream operations
3	Transporting	Moving items needlessly
4	Processing	Unnecessary steps that do not add value
5	Inventory	Storing, retrieving, counting, insuring, taking up space and money
6	Movement / Motions	Searching for tools, parts, instruction, approved
7	Defects	Rework and scrap
8	Non-utilized Talent	Waste of talent present in the organization

Basic Elements of Lean Production

Lean production is the result of the mandate to eliminate waste. It is composed of ten elements: flexible resources, cellular layouts, pull system, kanbans, small lots, quick setups, uniform production levels, quality at the source, total productive maintenance and supplier networks (Roberta S. Russell, 2009).

Lean Supply Model

The development of supplier –relationships does not stop at partnership. Lean supply model is post-Japanese model, also known as lean supply. It is based on the concept of lean production for the automobile industry described by Womack, Jones & Ross (1990). Competition in a lean supply

environment will be global. A tier- 1 supplier to an assembler in one country must also be able to supply the assembler in other parts of the world. This supplier must also be willing to set up transplant production units close to the customer's assembly plant or establish plant or establish joint ventures with local suppliers.

The lean supplier will contribute to product technology in collaboration with the assembler, but the requirements go even further. The lean supplier is expected to become a technology leader, developing new technologies independently of the assembler. As in the partnership model, sourcing practice will be single or dual, with long-term contracts with the suppliers to establish a stable basis for production and R&D. The suppliers become involved in development of new models in the earliest stage, and engineering teams from the suppliers will work side by side with the engineers and technical staff of the assemblers.

The level of pressure for continuous improvements will be high for both customer and supplier. In the lean supply model, the ability to provide product quality at defect levels measured in parts per million (six sigma quality) is a basic requirement. i.e six sigma means that 3.44 parts per million defects.

Lean Inventory

Lean refers to a systematic approach to enhancing value in a company's inventory by identifying and eliminating waste of materials, effort and time through continuous improvement in pursuit of perfection. Lean inventory management is the calculated approach to increasing value of a company's inventory by identifying and eliminating wastes left behind from manufacturing. This is carried out by analyzing and streamlining the effort it takes to produce a product through the continuous improvement of the production line.

Lean Inventory Principles

According to Womack and Jones (2009), there are five lean principles: Define / identify value, value stream mapping, create flow, & establish flow (pull) and pursuit perfection. In lean, processes are configured so that they include only activities that add value to the item and ultimately to the customer, termed as Value Added (VA) – with everything else seen as waste.

Eight Types of Wastes

The eight types of wastes are:

1. Defects,
2. Over production,
3. Waiting,
4. Non-utilized talent,
5. Transportation,
6. Inventory,
7. Motion and
8. Excess processing.

All these wastes are eliminated or reduced by applying the below mentioned approaches. Table 3.3 describes the summary of lean tools implemented in the lean inventory.

Table 3.3: Summary of lean approaches used in lean inventory

Sl. No	Lean Approaches	Details
1	Pull system	Rely on customer demands. In pull system, up to certain point the push system will be applied and made all the items ready for assembly. The moment customer order is received, immediately, the demand pull happens, the final product configured as per the customer order and supplied. Example: Dell computers. Standardization and modular construction helps to implement pull system.
2	Kanban	A card that corresponds to a standard quantity of production (usually a container size). A kanban contains basic information such as part number, brief description, and type of container, unit load, preceding station and subsequent station. Sometimes the kanban is color coded to indicate raw materials or other stages of manufacturing. Kanban maintains the discipline of pull production.
3	Just-in-Time (JIT)	Smoothing the flow of material to arrive just as it is needed. Example: Maruti Suzuki India Ltd., has already implemented JIT philosophies. They receive the material just few hours before only.
4	Single Minute Exchange of Die (SMED)	SMED is based on the following principles. i. Separate internal setup from external setup, ii. Convert internal setup to external setup, iii. Streamline all aspects of setup, iv. Perform setup activities in parallel or eliminate them entirely. Shingo has developed SMED approach. He reduced setup time on a 1000 ton press from 6 hours to 3 minutes. In SMED, all setups should be less than 10 minutes.
5	Vendor Managed Inventory (VMI)	VMI is an integral part of supply chain collaboration. In this system, the buyer does not maintain the required level inventory, whereas the suppliers manage the inventory. Example: Maruti Suzuki India Ltd., has already implemented the VMI methodology. All their suppliers are having their warehouses within 120 kilometers from MSIL plant. Electronic Data Interchange (EDI) is used in VMI system.
6	Software tools: Simulation games- Beer game	Simulation software like Beer Game is used to manage the inventory. Manufacturing plants, warehouses and distribution centres are studied based on its location, transportation distance and transportation cost per unit. Accordingly, managerial decisions are made to manage the inventory.
7	Risk pooling software tools	Risk pooling is another software tool used to management the inventory management related issues. In this system, the inventory is not maintained / stored at single location. Example: Amazon, they keep their inventories at different location to minimize the risk.
8	Katana software tools	It is an auto booking engine used in manufacturing, warehousing, purchasing and sales.

Warehouse Management Tools

Distribution encompasses all of the channels, processes and functions, including warehousing and transportation that a product passes through on its way to the end customer. It is the actual movement of products and materials between locations. Distribution management involves managing the handling of materials and products at receiving docks, storing products and materials, packaging and the shipment orders. Distribution and transportation are also often referred to as logistics. The most important factor in transportation and distribution is speed.

Warehouse Management System (WMS): Warehouse management system is an automated system that runs the day-to-day operations of a distribution center and keeps track of inventories. A WMS may include the following features: transportation, order management, yard management, workforce management and warehouse optimization.

The WMS places an item in storage at a specific location (a put away), locates and takes an item out of storage (a pick up), packs the item, and ships it via a carrier. The important components in warehouse management system are: order management system (OMS), workforce management, warehouse optimization, custom labeling and packaging, order tracking system, cross docking and yard management. Figure 3.8 outlines the typical layout of a warehouse.

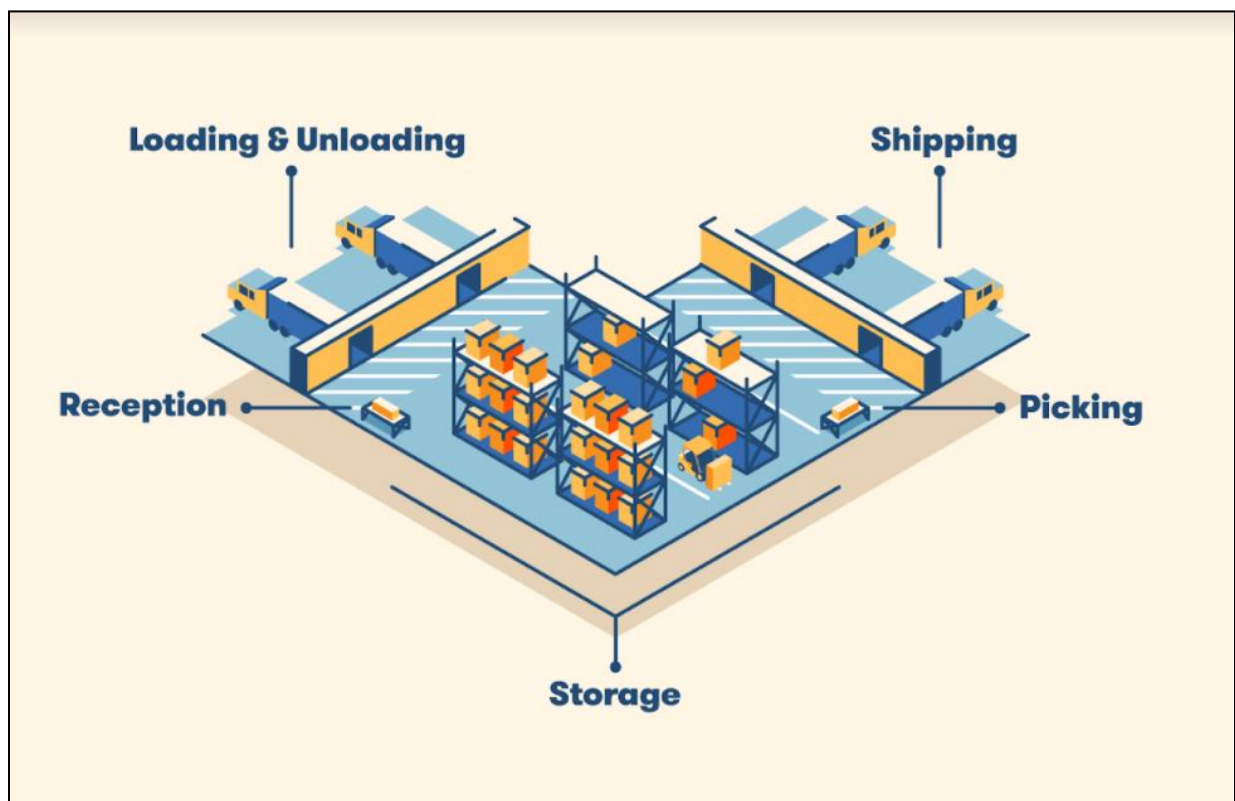


Figure 3.8: Layout of warehouse (Erhan, 2017)

The important components of warehouse system are: inbound area, outbound area, put away, picks up points, packaging and labeling area, cross docking and order processing area. Table 3.4 outlines the important activities of a warehouse.

Table 3.4: Major activities in a warehouse

Sl. No	Major Activities	Details
1	Inbound area	Key activities are material receipt, unloading and accounting for material receipts.
2	Outbound area	In this area, material issue, loading of materials on outbound trucks, preparation of gate passes and travel documents.
3	Put away	Placing of an item in a rack or shelf is known as put-away.
4	Packing and labeling	In a warehouse lot of value added activities are carried out like assortment, consolidation, bulk breaking, sorting / grading, re-packing and labeling.
5	Cross docking	Cross docking means that materials are transferred from inbound truck to outbound truck without keeping in the warehouse. Warehouse is one of the docking points besides state borders and hubs. Example : Wal-Mart is well known for cross docking as part of their WMS.
6	Order processing and order fulfillment	Orders are processed and delivered on –time in warehouses. It is the process of ensuring on-time delivery of the customer’s order.
7	Postponement	Postponement actually pulls distribution into the manufacturing process, allowing lead times to be reduced so that demand can be met more quickly. Example: Some of the generic parts like computer parts are stored in the warehouse. Once the customer order comes, immediately, the final product will be configured and supplied to the customer.
8	Transportation Management System (TMS)	TMS allows the DC/ warehouse to track inbound and outbound shipments, to consolidate and build economical loads, and to select the best carrier based on cost and service.
9	Yard Management	Yard management controls activities at the facilities dock and schedules dock appointments to reduce bottlenecks.
10	Workforce Management	Workforce management plans, manages, and reports the performance level of warehouse personnel.

Warehouse Management Software's: Several tools and systems are available to improve warehouse efficiency, reduce overhead and improve profits. The important tools are: Kechie warehouse management, Manhattan Associates warehouse management system, wireless warehouse in a Box, Honeywell Distribution Centres Simulation Softwares, 3PL warehouse manager, TECHSYS and Robocom WMS.

To Do Activity

Visit a Central Warehousing India Ltd., warehouse in Hyderabad to study the warehouse functions, WMS and Inventory management. Submit a report.

3.4 Supplier Management and Demand Forecasting Tools

Supplier Management: The Strategic Sourcing Plan

Development of a strategic sourcing plan is driven by the recognition that tactical sourcing will not succeeded in developing a supply base that will yield the benefits of collaborative relationships and alliances. According to Burt et al.(2008), the strategic sourcing plan consisting of five important stages, i.e discovery, evaluation, selection, development and management. Figure 3.9 shows the strategic sourcing plan strategies

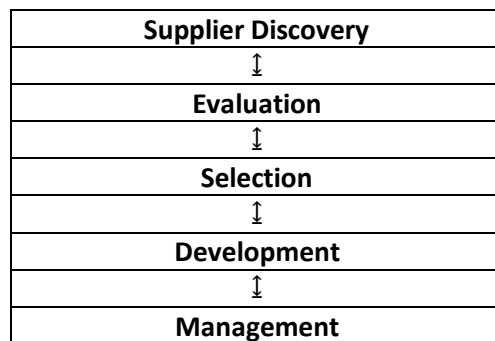


Figure 3.9: Strategic Sourcing Plan Stages ((David N.Burt, 2008)

Discovery / Supplier Discovery

The heart of procurement activity is selecting and managing relations with suppliers. Careful vendor screening and selection is critical because reliable delivery of quality vendor-produced components determines the quality and price of the final product. Prior to the information age and globalization of markets, the discovery process for potential suppliers was greatly limited. Today, suppliers throughout the globe can be found by simply typing several key words into a worldwide web search engine or letting suppliers find a company through a variety of posting methods.

There are number of ways available to source new suppliers.

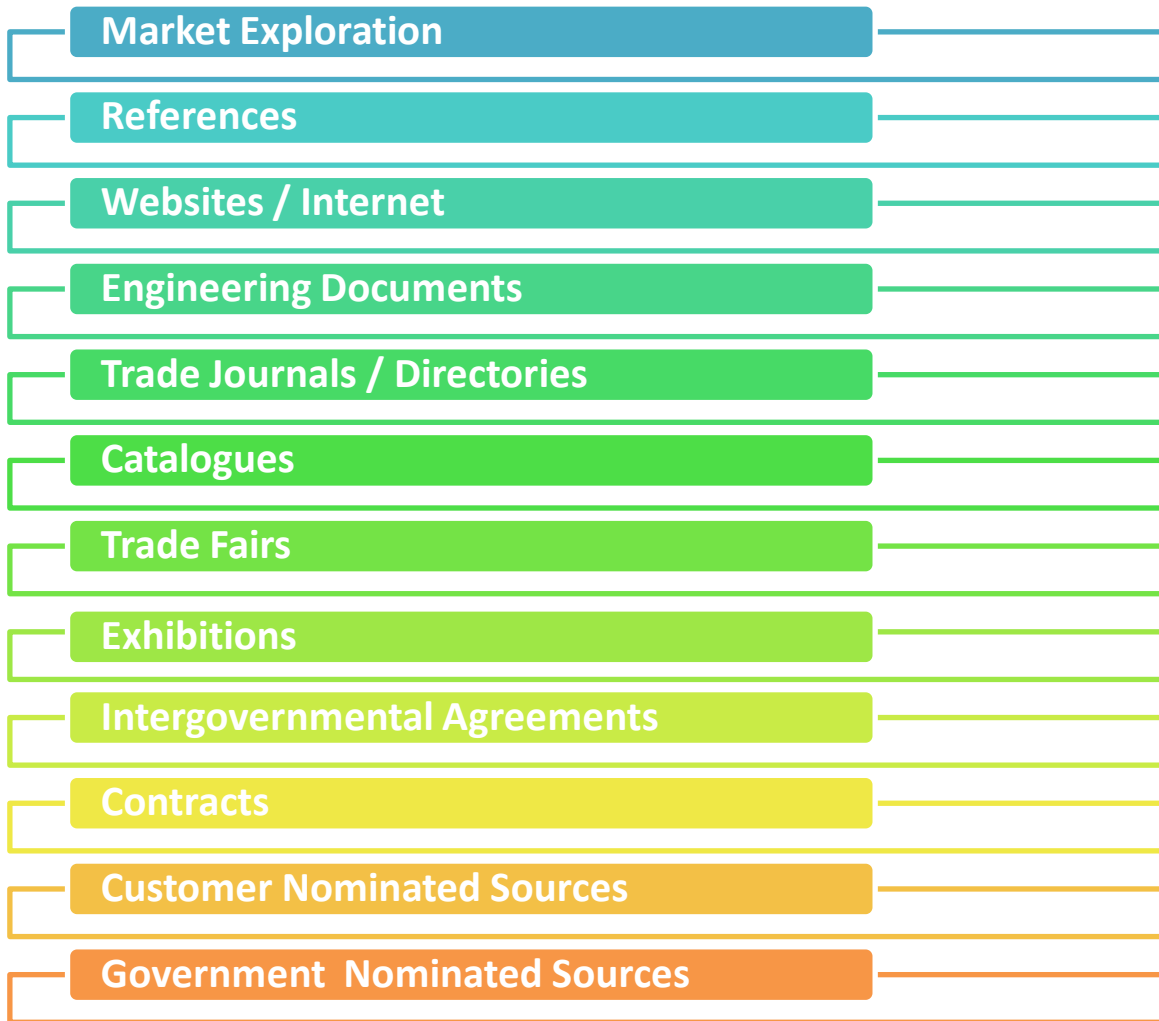


Figure 3.10: Ways to source new suppliers

a. Evaluation

After developing a comprehensive list of potential suppliers, the supply manager’s next step is to evaluate each prospective supplier individually. Supplier evaluations are carried out in two stages. They are: during the supplier registration and award of contracts or purchase orders. Supplier / vendor registration is process through the supplier is selected based on technical competence, financial soundness, customers feedback and past experience. After short listing / selecting supplier, a vendor code will be assigned and included in the vendor directory. ERP software is used for vendor code generation and inclusion in the directory. Evaluation of suppliers’ supply performance is done based on certain criterions i.e vendor rating. Vendor rating is important for assessing the supply performance. Rating is done on quarterly, half yearly and annual basis. Rating is done based on price, quality, delivery and after sales service criterions.

Vendor Rating Methods

Generally, four vendor rating methods are used. They are: categorical method, weighted point method, cost-ratio method and total acquisition cost method.

- i. **Categorical Method:** Categorical method is a qualitative method to the evaluation of supplier performance. Each supplier is assessed by a group of experts and they will assign the overall group rating and as a rule the supplier are weighted of the rating received. It is expressed in + (plus), - (minus) or 0 (zero).
- ii. **Total Weighted Point Method:** This method is a quantitative method used for assessing the supplier performance considering important factors. The key factors are: quality (40 percent), delivery (20 percent), price (20 percent) and after sales service (10 percent). Accordingly grades are assigned. If the total weighted point score is 80-and above ' A' Grade 60 -79 ' B' Grade and below 60 ' C' Grade.
- iii. **Cost-ratio Method:** The cost ratio method relating all identifiable procurement and handling costs to the value of each shipment received from individual suppliers. Example, if the procurement cost is Rs.1500 for each order placed, loading & unloading cost is Rs. 4500 and total order value is Rs.6,00,000/=. Then, cost ratio is one percent. i.e (6000/6,00,000)x100= 1). The lower the ratio of costs to shipment value, higher the rating for the supplier.

- iv.

Example: Purchase of a Diesel Generator set for captive power at Rs,10,00,000/=:, average maintenance cost is Rs.8,000 each year, average fuel cost is Rs. 10,000 per year, the operating life of the DG set is 10 years. Then, the total life cost is Rs. 11, 80,000/=(Rs.10,00,000+ 80,000+ 1, 00,000).

 cost

A. Selection of Suppliers

After one or more potential suppliers have passed the evaluation process, the selection process must begin. Selection of supplier process includes identifying potential suppliers through tendering / competitive bidding process, notice inviting tenders (NIT), preparing comparative statement to identify by loading all the factors i.e., basic price, applicable taxes, loading, transportation cost and other levies. After identifying the lowest price quoted bidder, the negotiation process starts only with that supplier. During the negotiation, both the parties negotiate for better payment clause, delivery, and other terms. After that purchase order will be placed.

B. Supplier Development / Vendor Development

Supplier development is an important process through which the suppliers are nurtured. Not all suppliers need development, but to reach the status of a world class collaborative relationship is needed. The processes of supplier development include the development of the buyer in collaborative relationships. For example, BEL and HAL, they do lot of vendor development activities. They provide technical assistance, financial support wherever needed, training and development of suppliers' personnel, providing process standards, and material support. They also help their suppliers to get ISO 9000 Quality certifications and TQM programmes. Some of the companies like TVS group of companies and Tata Motors have helped their suppliers to achieve self certification status.

C. Supply Management

Supply management must, on a periodic basis, analyze its supplier's abilities to meet the firm's long-term needs. Supply management includes the placement of order to payment to the suppliers. Supply management also includes in developing new sources, attending pending issues of suppliers, providing assistance and support to the suppliers.

Earlier supplier involvement (ESI) is an approach in supply management to bring the expertise and collaborative synergy of suppliers into design process. ESI seeks to find 'win-win' opportunities to both the buyer and supplier. Some of the companies engage their prospective suppliers in the product development stage itself.

Demand Forecasting Tools

Prediction is very difficult, especially if it's about the future- Niels Bohr

Forecasting in the supply chain context is the art and science of predicting future demand. (Demand forecasting is a process of prediction of the future demand based on past and present data and analysis of trends. Prediction is used for estimating the sales for the year. Demand forecasting means that prediction of future that future is uncertain. So no one can predict the future with absolute certainty. However, there are several demands forecasting techniques that help you make an educated guess.

Characteristics of Forecasts

We first need to understand a few characteristics of forecasting that have serious implications on the design of the forecasting system for a firm (Shah, 2009).

- i. **The Forecast is always wrong:** Whatever level of sophistication one introduces in the forecasting methodology, the actual demand will never match the forecast. Example: good rainfall which will help the high yield of crops. Sometimes, it will not happen in that way, so less supply and high price.
- ii. **The Longer the Forecast Horizon, the Worse the Forecast:** Forecast for a longer time horizon is likely to be less accurate than forecast for a shorter time horizon. Example: price of onion and gold can be forecasted better in short time horizon than longer time horizon.
- iii. **Aggregate Forecasts are more Accurate:** An aggregate demand for milk is more accurate than forecast for end items like $\frac{1}{4}$, $\frac{1}{2}$ and one litre packets.
- iv. **Forecasts are an Integral part of Decision making:** As discussed earlier, forecasting involves two important decisions: i. determining the appropriate level of aggregation and ii. Determining the appropriate forecasting horizon. The level of aggregation required by different decision makers will change from one context to another. For example, the sales manager of a firm may be interested in forecasting for the next month requirement of cashews, while the purchase manager may be interested in a 6 month horizon because of supply lead time that may be really long. So, the time horizon is very important in decision making.

Time Horizons for Forecasting

The key factor in choosing a proper forecasting approach is the time horizon for the decision requiring forecasts. Forecasts can be made for various timeframes; short, medium and long terms. Table 3.5 shows the summary of time horizons for forecasting.

Table 3.5: Summary of Time Horizons for Forecasting

Time Horizon	Period	Details
Short-term	1 to 3 months	Time series analysis is used most often for short-term forecasting. When historical data are not available, managers use judgment methods for short-term forecasts during the product launch stage. Decisions regarding production, transportation scheduling, procurement and inventory management involve short-term forecasting. Examples: fashion style and mobile phone handset.
Medium-term	3 months to 24 months	The medium term relates to aggregate planning i.e sales and operations planning. Both time series and causal models are used for medium –term forecasting. For products with long life cycles, time series models are used extensively. But for products with shorter life cycles (1- 3 years), causal models are preferred considering their product life cycle.
Long -term	More than 24 months	Long-term forecasts are used for process selection, capacity planning and location decisions. Judgment models and causal models are primarily used for long-term forecasts. Examples: new model of automobile car, refrigerators and microwave ovens.

Demand Forecasting as Planning Tool

Production planning is a projection of future business or production activity. The process of production planning contains a number of steps and forecasting is an essential step, because it requires that the company projection needs into future. Key steps followed in the forecasting are:

- i. Select the method of forecasting for production planning
- ii. Determine a time period to study
- iii. Choose reports on various company activity help with projecting future production
- iv. Pick up market trends to apply to the demand forecast

Types of Demand Forecasting: There are several different ways to do demand forecasting. The important types of demand forecasting are:

- i. Passive demand forecasting
- ii. Active demand forecasting
- iii. Short term projections
- iv. Long-term projections
- v. External macro forecasting
- vi. Internal forecasting

Table 3.6 shows the types of demand forecasting with details.

Table 3.6: Summary of types of demand forecasting

Sl. No	Type of demand forecasting	Details
1	Passive demand forecasting	In this model, past data is used to predict the future. This is applicable for seasonality items like apples, mangoes, onions and other agricultural products.
2	Active demand forecasting	Active demand forecasting model takes into consideration of market research, marketing campaigns, and expansion plans. Example: startups, they use this model, because they may not have historical data.
3	Short-term projections	This is useful for managing just-in-time supply chains. This is one for next three to 12 months. So, understanding short-term demand is important. Example: palm sugar unit is producing many product varieties like ginger, masala and pepper.
4	Long-term projections	This forecasting model focuses on shaping business growth trajectory. This is based on sales data and market research. This is done one to five years. Examples: coir products and bricks producing units.
5	External macro forecasting	This projection looks at how those trends will affect the company goals. External macro forecasting can also touch on the availability of raw materials and other factors that will directly affect the supply chain. Examples: cement blocks and blue metals crushing units.
6	Internal business forecasting	This forecasting model focuses in the business financing, cash on hand, profit margins, supply chain operations and personnel. If the customer demand for jackfruit chips doubles whether the plant capacity will meet the demand. It is a helpful tool for making realistic projections and it also prompts the focus areas for expansions.

Demand Forecasting Methods

Demand forecasting methods are classified into qualitative method and quantitative method. Table 3.7 shows different types forecasting methods.

Table 3.7: Types of demand forecasting methods

Qualitative method	Quantitative method
<ol style="list-style-type: none"> 1. Expert opinion method 2. Consumer survey method <ol style="list-style-type: none"> i. Complete Enumerate survey ii. Sample survey iii. End-use method 	<ol style="list-style-type: none"> 1. Time series 2. Causal models 3. Moving average 4. Exponential smoothing 5. Index numbers 6. Regression analysis 7. Econometric analysis 8. In-out analysis

- i. **Trend Projection:** Trend projection uses past sales data to project future sales. While using this method, the unusual factor in historical data may be examined. Example, sales would have gone up based an event say promotional campaigns or price discounts.

- ii. **Market Research:** Market research demand forecasting is based on data from customer surveys. This method can provide valuable insights, because certain details are not available from internal sales data. Market research is particularly helpful for startups that are just getting to know their customers. Example, budding entrepreneur will do market research to ascertain the market potential for their products.
- iii. **Delphi Method:** The Delphi method or Delphi technique, leverages expert opinions on market forecast. This method requires engaging outside experts and a skilled facilitator. In this method, questionnaire is send to a group of demand forecasting experts, then summarized their responses and shared with the panel. This process is repeated through successive rounds. The Delphi method is complete when the group comes to a consensus. This process is designed to allow the group to build on each other's knowledge and opinions. The end result is an informed consensus.
- iv. **Econometric Method:** This technique combines sales data with information on outside forces that affect demand. Then a mathematical formula is created to predict future customer demand. The econometric demand forecasting method accounts for relationship between econometric factors like personal debt and increased demand for home repairⁱ services or expansion levels.
- v. **Causal Models:** Causal forecasting models show the cause for demand and its relation to other variables. Usually, regression is used for modeling the cause and effect behavior. Examples: demand for soft drinks and coconut waters can be related to the average summer temperature. Demand for auto spares is a function of current demand. Long-term demand of consumer durables can be linked to the population growth and the economic growth of a region. Causal models are good for medium to long-term forecasting. Apart from regression, econometric models, input-output models and simulation models are also used.

Box-Jenkins Method

Box-Jenkins method was proposed by George Box and Gwilyn Jenkins in the year 1970. It is a univariate version of time series forecasting method. It is used to find out an appropriate formula so that the residuals are as small as possible and exhibit no pattern. It refers to a set of procedure for identifying and estimating time series models within the class of Autoregressive Integrated Moving Average (ARIMA) model and Autoregressive and Moving Average (ARMA) model. ARIMA model is a classical of statistical models for analyzing and forecasting time series data. Exponential smoothing and ARIMA are the two most widely used approaches to time series forecasting and provide contemporary approaches to the problem. ARIMA is non-stationary. ARMA is another model used for solving time series data problem. ARMA model is stationary. Figure 3.10 describes the key steps involved in Box-Jenkins model.

The model building process involves four steps:

- i. Plot series
- ii. Variance stable
- iii. Obtain Auto Correlation (ACs) and Partial Auto Correlation (PACs)
- iv. IS Mean stationary.

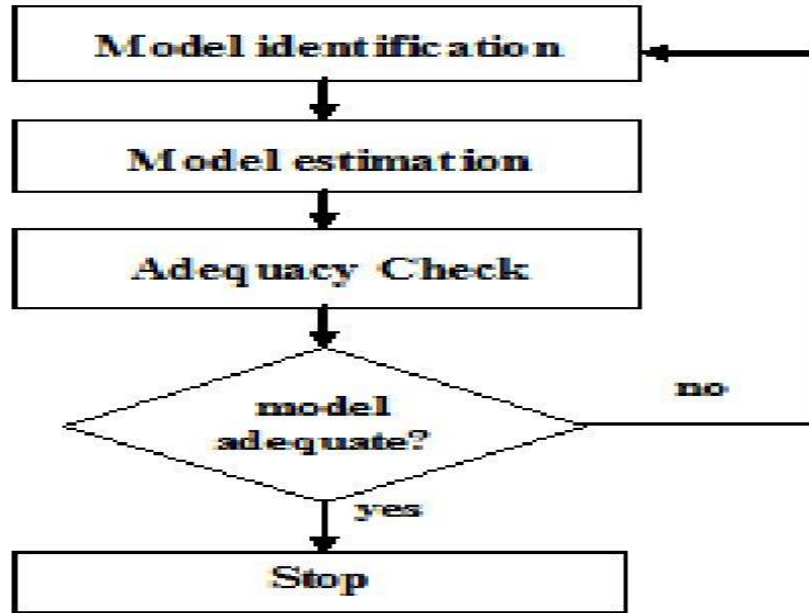


Figure 3.11: Schematic diagram of Box-Jenkins Model (Box & Jenkins, 1970)

R-Programming is used for solving time series problem of demand forecasting. E-Views and Gretel softwares are used for panel data problems in demand forecasting. MatLab is also used for time series forecasting problems.

Key Issues with Demand Forecasting

The important issues in demand forecasting are: lack of historical sales data, inadequate supply chain management and lack of inventory control. These issues can be tackled by taking a help from a third party logistics service providers (3 PLs).

Benefits of Demand Forecasting

The important benefits of demand forecasting are:

- i. Reveal seasonal trends
- ii. Rationalize cash flow
- iii. Plan the supply
- iv. Understanding outside factors and its influence on sales
- v. Prepare for the future

To Do Activity

Visit a cashew processing unit and identify the kind of seasonality they are facing. Suggest a demand forecasting method to overcome / minimize the seasonality.

3.5 Supply Chain analytics and Reports

Supply chain analytics refers to the processes organization use to gain insights and extract value from the large amounts of data (may be in terms of Tera Byte and more) associated with procurement, processing and distribution of goods. Supply chain analytics is an element of supply chain management. Supply chain analytics is used to improve forecasts and efficiency and be more responsive to customer needs. For example, the point - of- sale (POS) data stored in a demand signal repository is used in predictive analytics. This can help a business anticipate consumer demand, which in turn can lead to cost-saving adjustments to inventory and faster delivery. Supply chain analytics brings information together across the procurement of raw materials and extends through production, distribution and aftermarket services. This is also enables to view data on goods at every stage in the supply chain. This integration is also known as supply chain visibility.

ERP and SCM software vendors have begun applying complex event processing (CEP) to their platform for real-time supply chain analytics. Most ERP and SCM vendors have one-to-one integrations, but there is no standard. However, the supply chain operations reference (SCOR) model provides standard metrics for comparing supply chain performance to industry benchmarks. SCOR model has more than 200 metrics, but some of the metrics are industry specific. Examples, cycle time metrics, cost metrics, quality metrics and assets metrics.

Features of Supply Chain Analytics

Supply chain analytics software usually includes the following features:

Data Visualization: It is the ability to slice and dice data from different angles to improve insight and understanding.

Stream Processing: It is a process of deriving insights from multiple data streams generated by for example, the IoT applications, whether reports and third-party data.

Social Media Integration: using sentiment data from social feeds to improve demand planning.

Natural Language Processing: Extracting and organizing unstructured data buried in documents, new sources and data feeds.

Location Intelligence: Deriving insight from location data to understand and optimize distribution.

Digital Twin of the Supply Chain: organizing data into a comprehensive model of the supply chain that is shared across different types of users to improve predictive and prescriptive analytics.

Graph Databases: organizing information into linked elements that make it easier to find connections, identify patterns and improve traceability of product, suppliers and facilities.

Types of Supply Chain Analytics

According to Gartner's model (2015), there are four main types of supply chain analytics, i.e descriptive analytics, diagnostic analytics, predictive analytics and prescriptive analytics.

Descriptive Analytics: uses dashboards and reports to help interpret like what has happened. It often involves using a variety of statistical tools to search through summarize and organize information about operations in the supply chain. The information is useful to manage inventory level or return on capital investment (ROI).

Diagnostic Supply Chain Analytics: Diagnostic supply chain analytics is used to figure out why something happened or not working as well as it should. Example, expenditure incurred on advertisement is not giving enough sales. Why? The reasons for delayed shipments and reasons for non-performing inventory turnover compared to their competitors.

Predictive Supply Chain Analytics: Predictive supply chain analytics helps to forecast what is likely to happen in the future based on current data. For example, how will a pandemic lockdown affect the availability and cost of raw materials or goods? i.e shortage of supply, price increase and panic buying of the consumers.

Prescriptive Supply Chain Analytics: Prescriptive supply chain analytics helps prescribe or automatic the best course of action using optimization or embedded decision logic. This can help improve decision about when to launch a product, whether or not to build a factory or the best shipment strategy for each retail location.

Supply chain analytics can be looked from another angle based on the following functions:

- Workflow
- Decision support
- Collaboration
- Unstructured text mining
- Structure data management

Supply chain analysis tools allow uses full visibility not just into physical location of inventory, but also into the health and performance of the company. In addition to analyzing consumer demand and suppliers performance, SCM solutions perform analyses of data from the entire supply chain from sourcing till delivery. Analytics can provide insight into the company as a whole or into individual sectors. Demand forecasting give visibility into the popularity of certain items, whereas warehouse analysis might tell the most efficient way to store and move that product. SCM software's also allows users to analyze order processing which can uncover the source of delays and errors. Additionally, users can analyze transportation and logistical processes.

This helps decision makers understand how well carriers and performing along with patterns of delay and error. All of this visibility gives users the means to improve their processes while abandon less useful methods.

Supply Chain Analytics Applications

Supply chain analytics are used widely in the business. The main areas are:

- i. Sales and Operations Planning (SOP)
- ii. Improve risk management
- iii. Increase planning accuracy
- iv. Improve order management
- v. Streamline procurement
- vi. Increase using capital
- vii. Prepare for the future

Analytics must be conveyed in the form of report. Different solutions may offer different reporting methods including tables, charts, dashboards and more dashboards are one of the most common methods as they offer quick information as soon as a user logs into the system. Supply chain dashboards software can be configured to show the most relevant Key Performance Indicators (KPIs) as determined by the user.

Example, As Amazon continues to raise the bar, the margin of error within SCM sets thinner and thinner. Even a simple mistake could easily cost business thousand of rupees and allows competitors to get ahead. SCM tools and techniques make it possible for users to reduce errors and costs while optimizing the entire supply chain.

IBM uses supply chain analytics in their business. Lenovo uses Intelligent Business Analytics (IBA) starting supply chain insights with Watson.

Future Trends of Supply Chain Analytics

Supply chain analytics tools are already integrated with Blockchain technology, Artificial Intelligence (AI), Machine Learning (ML), Automation and other Industry 4.0 technologies. It is also predicted that lots of job opportunities emerging from these areas.

To Do Activity

Visit one of the Big Bazaar outlet or Wal-Mart store in your city to study the supply chain analytics tools used and reports generation system. Submit a report.

Summary of the Chapter

Companies use a bundle of tools to bring visibility to their supply chains. In this chapter, the important tools like ERP, EDI, EPS, Bar-coding, Scanners, RFID, GPS and E-Commerce are explained. The importance and its benefits are also elaborated. Shipping status and order processing tools are described with examples. In this context, India Post tracking system has been illustrated. Lean inventory principles, lean supply model, different types of wastes (mudas) and lean inventory approaches are explained. Warehouse functions are elaborated. Cross docking and value added activities in a warehouse and warehouse layout & tools are discussed. In supplier management, the strategic sourcing stages, supplier selection and development process, and rating methods are explained. Demand forecasting methods like qualitative methods and quantitative methods, issues, and benefits are elaborated with examples. Supply chain analytics, types of supply chain analytics, features, reports- dashboards and future trends supply chain analytics are also explained.

Model Questions

1. What is EDI? Mention two of its benefits.
2. What is ERP? List out the key modules of any ERP system.
3. Explain lean supply model.
4. Describe the key functions of a warehouse
5. List out any five WMS tools.
6. Identify the main wastes in any production system
7. What is Delphi method of forecasting? Mention its applications
8. List out three of the shipping status tools.
9. What is cross docking? Cite examples.
10. What is supply chain analytics? Mention its key features.

Reading Materials

1. Womack, J.P, J. (1996). *Lean Thinking*. New York: Simon & Schuster.
2. C, S. (2020). Implementation of Lean Practices in Warehouse Operations. *Shodh Sarita –An International Bilingual Peer Reviewed Referred Research Journal*, 29-37.

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1. David N.Burt, D. W. (2008). *World Class Supply Management The Key to Supply Chain Management*. Delhi: Tata McGraw-Hill.
2. Shah, J. (2009). *Supply Chain Management Text and Cases*. New Delhi: Pearson Education Inc.,.
3. Roberta S. Russell, B.W.(2012). *Operations Management along the Supply Chain*, Sixth Edition. New Delhi: Wiley India.

. Chapter 4 Mapping Supply Chain in Rural Context

Introduction

This chapter mainly focuses on supply chain mapping in rural context. Rural supply chain mapping has been explained with examples highlighting process time and static inventory. The importance of rural supply chain management, bottle necks and advantages are highlighted. Various initiatives of the governments and Corporate are detailed. Supply chain mapping process and methodologies like value stream mapping, six sigma, business process reengineering, SIPOC model and SCOR model are explained. Distinction between supply chain mapping and process mapping are highlighted. Value stream mapping is a tool used in supply chain mapping is explained with examples along with selected set of value stream mapping.

Chapter Objectives

After leaning this chapter, you will:

- i. Discuss rural supply chain mapping process
- ii. Explain the importance of rural supply chain management
- iii. Describe the supply chain mapping methodologies / tools
- iv. Get insights on supply mapping using value stream mapping
- v. Gain experiences in case analyzing case studies

Structure

4.1 Defining rural supply chain mapping
4.2 Importance of rural supply chain management
4.3 Supply chain mapping methodologies
4.4 Supply chain mapping using Value Stram Mapping
4.5 Case Studies

4.1 Defining Rural Supply Chain Mapping

A Map is a virtual form of language to communicate information (Muehreke & Murhreke, 2003). The mapping characteristics can be embedded as a map that shows the linkage between its suppliers and customers. It shows the reality of the supply chain which visualize the connectivity of all parties along the supply chain starting from raw material suppliers to the end consumers, flow of goods, information, processes and money that pass throughout the supply chain in both upstream and downstream (Yacher, 2011).

A good strategic supply chain map should consist with key characteristics such as (M Theodore Farris, 2010):

- i. Easily interpretable
- ii. Easily recognizable
- iii. Easy to disseminate
- iv. Use of standardize icons
- v. Should capture multiple levels and should be information rich but should not overloaded with unnecessary information

Supply chain mapping would serve as a strong starting point not only to supply chain managers, but also to engineers, production managers, production & purchasing planners, suppliers as well as customers to understand the characteristics of their supply chain and manage it effectively. To achieve an optimal supply chain performance, it is essential to map the supply chain to show the overall connectivity of each and every partner in the systems.

Importance of supply chain mapping (Gardner & Cooper, 2003):

- i. Enhance strategic planning process
- ii. Support information distribution
- iii. Supply chain design & configuration
- iv. Clearly shows channel dynamics
- v. Provide common base or perspective for supply chain design
- vi. Improve communications
- vii. Enhance monitoring strategies implemented
- viii. Support supply chain analysis

Strategic Supply Chain Mapping versus Process Mapping

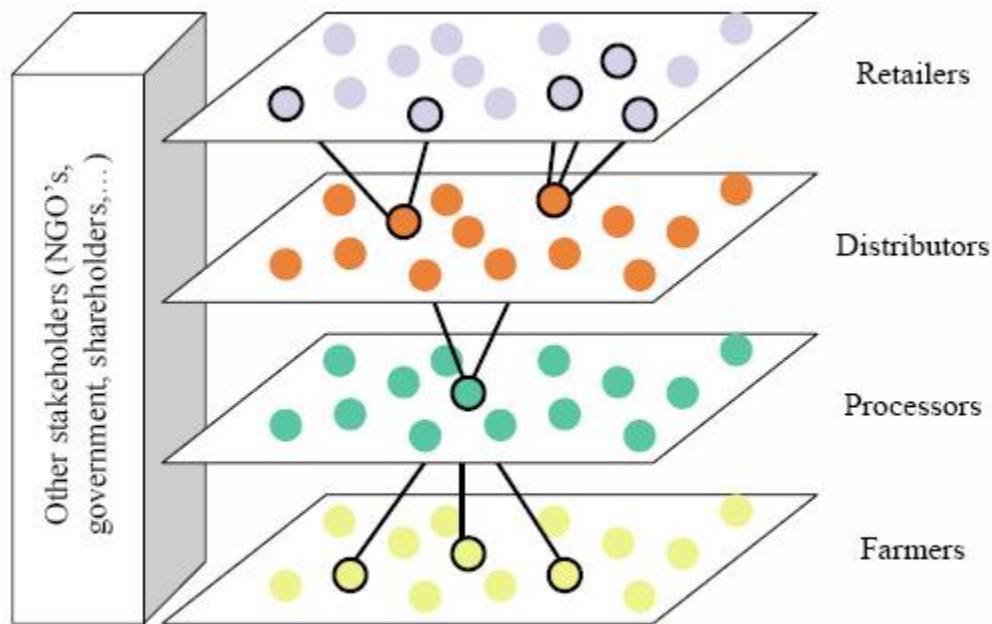
Strategic supply chain mapping is different from process mapping. Gardner and Cooper (2003) pointed out that there are three main differences between strategic supply chain mapping and process mapping with respect to the focus of the mapping level of details used. The main differences are highlighted in Table 4.1.

Table 4.1: Strategic Supply Chain Mapping versus Process Mapping

	Supply Chain Mapping	Process Mapping
Orientation	External	Internal
Level of detail	Low to Moderate	High
Purpose / Use	Strategic level	Operational / Tactical level

(Source: Gardner& Cooper, 2003)

The main stakeholders in the rural supply chain management are the farmers, producers, brokers/ commission agents, retailers and exporter (if any) where they all integrated at different stages. Figure 4.1 shows the rural supply chain stakeholders.



Schematic diagram of a supply chain from the perspective of the processor (bold flows) within the total FSCN (based on Lazzarini et al. 2001)

Figure 4.1: Rural Supply Chain Stakeholders

Rural Supply Chain Mapping

Supply chain mapping is collecting, storing and making available for reporting purposes information that relates to the production of a good or service in order to provide visibility, find areas for improvement or efficiency reduce the chances of disruption and stay competitive. As international trade becomes increasingly efficient and companies continue to expand their networks, the need to establish and maintain detailed understanding of supply is more crucial than ever.

Supply chain mapping is not only important for the purposes of compliance and regulation, but it also provides greater flexibility when it comes to monitoring threats and avoiding possible disruption among suppliers. So, the supply chain mapping is a tool used for restructuring the existing the supply by altering the customer ordering point (to bring it as early as possible), postponement of differentiation (may colors, style and size in the case of fabrics) and by changing the shape of the value-addition curve by adding more value at the later part not at the early stage.

Value Added through Time

Table 4.2 shows an actual analysis where the total process time was 40 weeks and yet value was only being added for 6.2 percent of that time.

Table 4.2: Value added through time

Sl. No	Process	Cumulative Time (Weeks in the supply chain)	Percent of total cost added by logistics processes	Remarks
1	Supply lead time	3.0	0.0	6.2 percent of value –added time over a 40 week supply chain
2	Material receipts	5.5	25.0	
3	Primary conversion	10.0	35.0	
4	Secondary conversion	14.0	45.0	
5	Packaging	17.0	50.0	
6	Shipment	22.0	55.0	
7	Distribution centre pick	31.0	65.0	
8	Distributor	37.0	70.0	
9	Ship to Customers	40	80.0	

(Christopher, 2003)

Supply Chain Mapping – An Example

A supply chain map is essentially a time-based representation of the processes and activities that are involved as the materials or products move through the chain. Simultaneously the map highlights the time that is consumed when those materials or precuts are simply standing still, i.e as inventory.

In these maps, it is usual to distinguish between ‘horizontal line’ time and ‘vertical time’. Horizontal time is time spent in process. It could be in-transit time, manufacturing or assembly time, and time spent in production planning or processing and so on. The other type of time is vertical time, this is time when nothing is happening and hence the material or product is standing still as inventory. No value is being added during vertical time, only cost. In supply chain mapping, the horizontal line represents ‘process time’ and vertical line represents ‘time spent as static inventory’ respectively. Table 4.3 depicts such a map of the manufacture and distribution of men’s underwear.

Table 4.3: Supply Chain Mapping- an example

Sl. No	Supply chain partner	Process	Processing time (days)	Days of inventory held
1	Fibre supplier	Sourcing of Fibre	3	20
2	Spinner/ Fabric Supplier	Spinning	15	10
		Knitting	10	5
		Dyeing & finishing	7	15
3	Underwear manufacturer	Component cutting	5	5
		Sewing	18	15
4	Distributor / retailer	Distribution	2	45
5	End user	End user		
Total time in days			60	115

(Source: Scott & Westbrook, 1991)

From this map it can be seen that horizontal time is 60 days. In other words, the various processes of gathering materials, spinning, knitting, dyeing, finishing, & sewing and so on take 60 days to complete from start to finish. This is important because horizontal time determines the time that it would take for

the system to respond to an increase in demand. The sum of horizontal and vertical time determines the consumption of inventory. So, in other words it would take 175 days to 'drain the system of inventory. So in volatile fashion markets (product life cycle is short), for instance, pipeline volume is a critical determinant of business risk. So a 60 day total process time would result in 60 days inventory. However, in the case highlighted here there are actually 175 days of inventory in the pipeline.

The importance of strategic lead-time management is that it forces us to challenge every process and every activity in the supply chain and to apply the acid test of 'does this activity add value for a customer or does it simply add cost?

Main Issues in the Rural Supply Chain Mapping

There are several issues that are related to the development of strategic supply chain mapping (M Theodore Farris, 2010).

- i. Lack of collaborative focus and integration among the partners along the supply chain whereas each stakeholders tries to maximize their own benefits instead of having shared benefits. Example, the farmer who is the most important stakeholder in the rural supply chain is facing a greater risk and challenge on maintaining long term sustainability in India.
- ii. On the other hand the small holder or farmers are completely ignored when sharing information on market demand and changes as they are not involved in the communication channel.
- iii. The dynamics nature along the supply chain is another contributing challenge in supply chain mapping. For example, sudden policy changes both within and outside of the country (import of onions, edible oil and sugar), volatile demand (during pandemic times) and other external factors such as political issues in importing countries are some concerns the impact on the rural supply chain.
- iv. Unavailability of standards icons for supply chain mapping has been problematic throughout the process.
- v. Supply chain is very time consuming and costly process.

To Do Activity

Visit a Poultry farm or handloom unit to study their supply chain processes and develop a supply chain mapping for them.

4.2 Importance of Rural Supply Chain Management

Until recently, the rural supply chain i.e agricultural sector has focused mainly on growing and harvesting. However, the agriculture sector is increasingly following the manufacturing / sector industries by forming more tightly aligned value chains. Therefore, the applications of supply chain management concepts are prominent in the agricultural sector also (Hill, 2000). Example, today tea or coir product is a tradable product and SCM concepts play an important role. It needs to focus on a wider area including not only growing but also managing other activities such as obtaining farming inputs/ supplies, value added activities, packaging and distribution which normally occur after harvesting the crops and activities such as research and development (R&D)(France, 2009).

Present Scenario of Rural Supply Chain Management in India

More than 60 percent of the population is in rural areas. India spends about 13 percent of its on logistics. It also found that double digit growth rate since 2002. Large consuming class is in rural areas. In India approximately 60 percent of food quality is lost in the supply chain from the farm to the final consumers. Consumers actually end up paying approximately about 35 percent more than what could be paying if the supply chain improved, because of wastage as well as multiple margins in the current supply structure. The farmers in India get around 30 percent of what the consumer pays at the retail store. Compare this with the situation in developed countries, where farmers may receive up to 70 percent of the final retail price and wastage levels are as low as 4 to 6 percent. One can easily understand the benefits that could be generated from emulating those practices and tapping that expertise for the rural supply chains in India.

Supply chain management has to play a key role in rural market of India, contributing to improved relationship with suppliers and customers and income generation. Managing rural supply has become a way of improving competitiveness by reducing uncertainty and improving service levels. Agriculture is vital to India. It produces 23 percent of the GDP, feeds a billion people and employs 66 percent of the workforce. Because of the Green Revolution, India's agricultural productivity has improved to the point that it is both self-sufficient and a net exporter of a variety of food grains. This has given rise to the per capita income of rural India and its standard of living also. Figure 4.2 shows Rural Supply Chain Network.

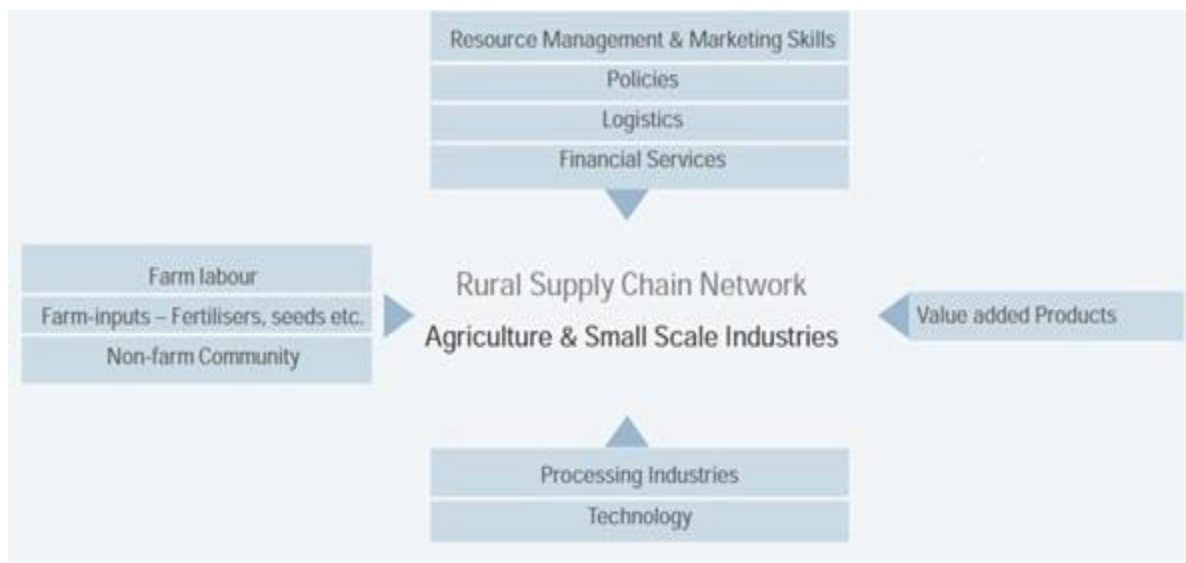


Figure 4.2: Rural Supply Chain Network (www.mbaskool.com)

Bottlenecks in Rural Supply Chains

The major bottlenecks in rural supply chains are:

- i. Transportation infrastructure: Road conditions in rural India are still not in good conditions.
- ii. Lack of Organization Relationship: Many companies are not willing to set up their facilities in rural India. So, there is a lack of organization relationship.
- iii. Warehousing: Not many warehouses are located in the rural areas, due to poor connectivity and infrastructure.
- iv. Communication: Communication plays a vital role in the business. No connectivity, IT infrastructure network issues and lack of communication channel.

- v. Cost Issues: Cost related issues, return on investment and profit margins are causing lot of concerns.

Importance of Rural Supply Chain Management

The major advantages of implementing the supply chain management concepts are many folds, some of them are:

- i. Reduce Inventory Capital Tie up Cost through vendor managed inventory (VMI) and just-in-time (JIT) practices.
- ii. Improved customer service is plays an important role in business. So, customer service level needs improvement.
- iii. Build competitive advantage for the channel. Every company builds its competitive advantage in some forms i.e through product, process, innovation, flexibility, cost, & quality and customer service.
- iv. Operational flexibility through agile operations and agility in supply chains.
- v. Realistic requirement prediction through sophisticated demand forecasting tools and supply chain analytics.
- vi. Network / Channel Development are the need of the hour. Rural supply chain networks should be improved and streamlined.

Government / Corporate Initiatives for Rural Supply Chain Management

The union government and state governments have also taken various measures and initiatives for rural supply chain management. Some of the important initiatives are:

- i. Bharat Nirman: The main objective of this is providing urban amenities in rural areas. Our beloved former president APJ Kalam was also emphasizing this through 'PURA'. PURA means providing urban amenities to rural areas. Under this, we could see lots of improvement in television networks, healthcare systems and improvement in roads.
- ii. Andhra Pradesh Rural Livelihoods Programme (APRLP): APRLP is an initiative to infuse new skills and technologies through cooperative movement helping the emergence of a service sector in rural areas, creation of markets and distribution networks and enabling extended networks that give maximum reach and value for products and services.
- iii. ITC's E-Choupal : ITC's e-Choupal was seen a medium of delivery critical market information independent of the Mandi, thus allowing the farmer an empowered choice of where and when to sell his crop. The e-Choupal model has shown that a large corporation can combine a social mission and an ambitious commercial venture; that it can play a major role in rationalizing markets and increasing the efficiency of an agricultural system and do so in ways that affects farmers and rural communities as well as company shareholders. This initiative has helped many farmers in procuring seeds, coffee, tobacco and chilies directly and also they are able to get better prices when they sell their produces.
- iv. Rural Moving Malls: The Madhya Pradesh state government has started with rural moving malls to improve rural supply networks.

Integrated Rural Supply Chain Network (IRSCN)

The main objective of IRSN is to flawlessly design a service or product efficiently manufacture it and finally deliver it to customers in optimum quality faster. IRSN is basically a strategic alliance of a bunch of independent companies operating out of different regions building a supply chain for rural India. Figure 4.3 shows the IRSN's.

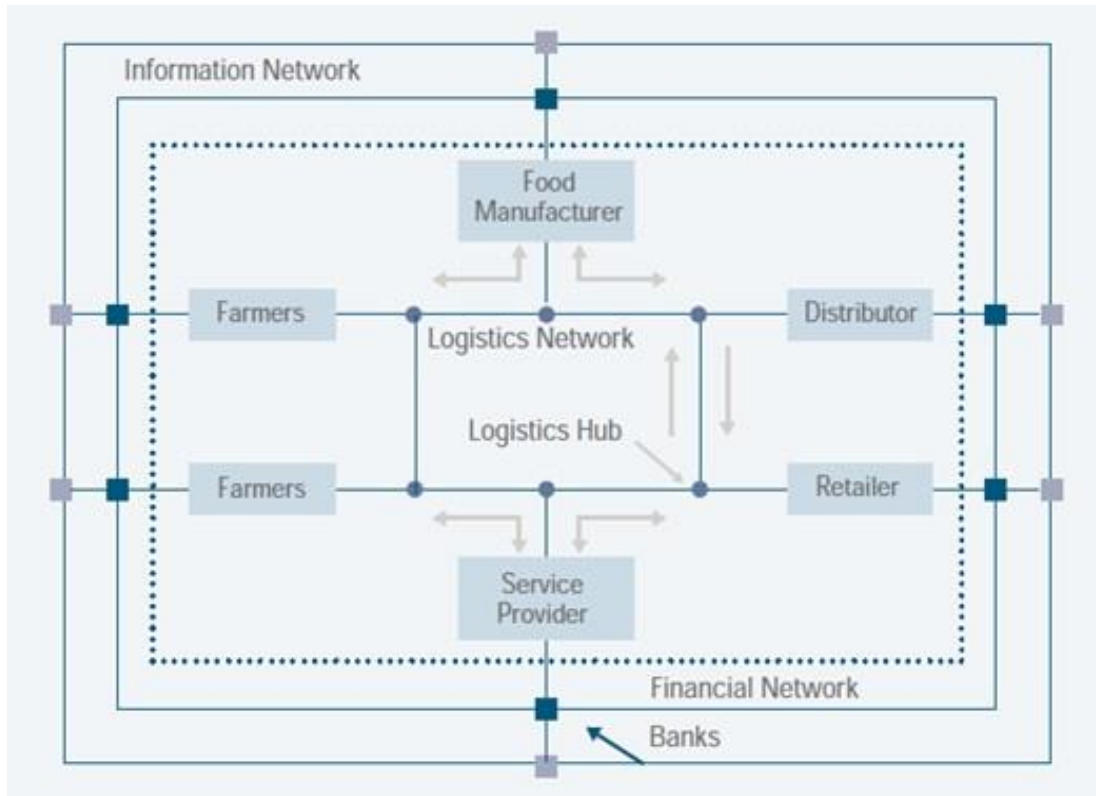


Figure 4.3: Integrated Rural Supply Chain Network (www.mbaskool.com)

IRSN's value delivering processes are essentially four. They are: i. Procurement, ii. Production, iii. Processing and iv. Retailing. Cold chains, mobile communications, techniques of pre-post harvesting handling of goods, packaging, proper resourcing, marketing and efficient running of financial services are quintessential to realize the core business processes.

To Do Activity

Visit a milk collection centre to study rural supply chain management. Identify the rural supply chain management process components.

4.3 Supply Chain Mapping Methodologies

A supply chain map is a representation of the linkage and entities of a supply chain (Gardner & Cooper, 2003). Supply chain mapping focuses on how goods, information and money flow in both the upstream and downstream directions and through an organization. All processes may be included. Supply chain mapping also emphasizes high-level measure such as volume, cost or lead time, and taking an overall. Supply chain mapping is an exercise which a company collects information on suppliers and sub-suppliers. This process aims to increase traceability and transparency of the entire supply chain. In fact, increased transparency benefits both the buyer and the seller in their businesses.

Supply chain mapping is collecting, storing and making available for reporting purposes information that relates to the production of a good or service in order to provide visibility, find areas for improvement or efficiency reduce the chances of disruption and stay competitive. As international trade becomes increasingly efficient and companies continue to expand their networks, the need to establish and maintain detailed understanding of supply is more crucial than ever.

Supply chain mapping is not only important for the purposes of compliance and regulation, but it also provides greater flexibility when it comes to monitoring threats and avoiding possible disruption among suppliers. The method used to capture current supply chain processes in termed as supply chain mapping.

As can be seen in Figure 4.4, existing supply chain processes can be characterized on the basis of the following dimensions (Shah. J, 2009):

- Shape of the value-addition curve
- Point of differentiation and
- Customer entry point in the supply chain

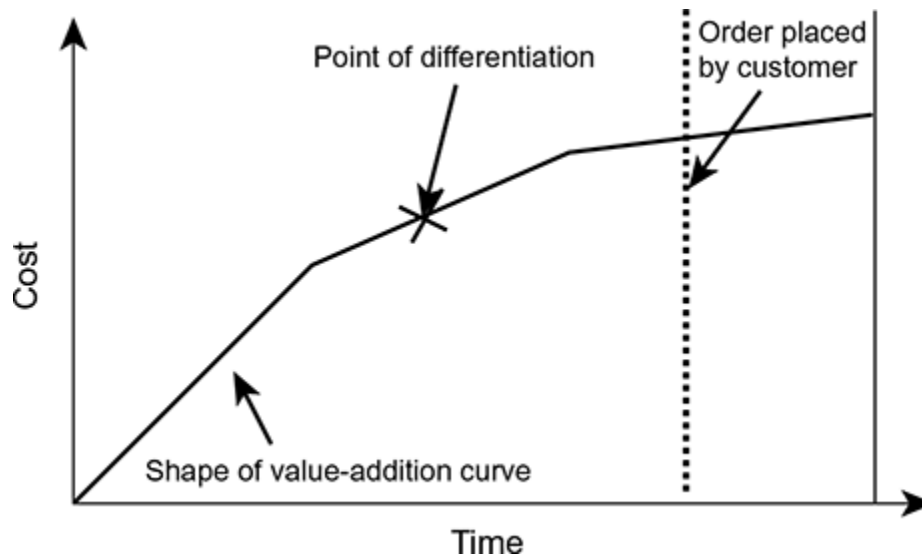


Figure 4.4: Supply chain mapping existing position (Shah.J, 2009)

Value –Addition Curve

The supply chain encompasses all the activities/ processes associated with transformation of goods from the raw material stage to the final stage when goods and services reach the end customer. Atypical supply chain starts with some input material and information, which are transformed into the end product and delivered to the customer. This transformation involves a number of activities, with each activity taking time, incurring cost and adding value. In this process, only value added activities are considered and non-value added activities are removed.

On the x-axis we have the total time in a chain or the average flow time in the chain and on the y-axis we have the total cost (cumulative) in the chain. To map this value-addition curve, we work backward from the time at which goods and services are delivered to the end customer and trace back all activities that were carried out to make the finished goods and services available. We map all the activities on two dimensions: time and cost. So the value addition curve essentially captures the way we add cost over a period of time in supply chain processes.

For example, a farmer comes with coconut broken pieces (kobra) to extract oil from the crusher. The coconut pieces are crushed and extracted oil with two three times repeating the process. After crushing the oil is separated and filtered before tinting. After tinting, the oil is taken for sale. Raw coconut pieces would have fetched him small money only. After the crushing and expelling, the oil is extracted and sold at higher price. In this case, coconut suppliers (farmers), preprocessing i.e breaking the coconuts and drying for some time, after that crushing at the oil expeller and extracting the oil. After that filtering & refining the oil and tinting / packaging will be completed. If we map all the operations (value-added and non-value added activities) we will get a curve as shown in Figure 4.4. All these processes on time line and cumulative value added are plotted on the graph sheet.

Point of Differentiation

The concept of the point of differentiation is valid for any organization that is offering a variety of end products to customers. Products are made in a supply chain consisting of multiple stages. As the product moves in the chain, progressively, the product assumes an identity that is closer to the end product. The point of differentiation is a stage where the product gets identified as a specific variant of the end product. Let us assume that the milk vendor offers variety only pack sizes / litres. In such a scenario, the packing stage is a point of differentiation. Similarly, at a garment manufacturing firm, at the stitching stage the firm is committing the fabric to different sizes and styles of garment. In automobile manufacturing firms like Tata and Maruti Suzuki, where usually large variety are offered in terms of colors, the painting stage becomes the point of differentiation because at that stage the firm makes an irreversible decision about the color of the car.

In reality, a firm may have multiple points of differentiation. For example, in the case of the garment manufacturer, the fabric dyeing and stitching stages represent two main points of differentiation. At the fabric dyeing stage, the garment firm makes an irreversible decision about the style of the garment. Before the point of differentiation, one has to forecast at the aggregate level, whereas after the point of differentiation one has to work at the variant level. So the point of differentiation determines the point at which a firm is forced to forecast at the variant level.

Customer Entry Point in the Supply Chain

The point at which a customer places an order is shown as a dotted line in Figure xx. In several industries customers expect material off the shelf in the neighborhood retail store. In such a case, the customer entry point is at the end of chain and is the same as the delivery time. Example, customer buys a sweet or buying a honey from a Khadi store. But in build-to-order situation, the customer entry point will be ahead of the delivery time. Example, somebody orders an ornament from a jeweler shop, this is customizing-to- order supply, in this situation, and the customer entry point will be ahead of the delivery time. But, in the make-to-stock situations, the customer entry point will be the same as delivery time.

Essentially, the customer entry point captures the order to delivery lead time. This dimension is important because all the operations before the customer order has to be done based on forecast , whereas after the customer order one will be working with actual orders. So if bulk of the activities can be carried out based on order rather than forecast one does not have to worry about the likely forecast error that is inherent in any forecasting exercise.

Supply chain mapping is used to restructure the supply chain process, in which one or two dimensions are altered. Companies initially will alter one dimension at a time and later on will take two dimensions.

Supply Chain Process Restructuring

Supply chain process restructuring involves playing around with at least one of the three dimensions of the supply chain in the direction explained below:

- i. **Postponement the point of differentiation:** By moving the point of differentiation as much as possible, a bulk of the activities can be carried out using aggregate-level forecast rather than the variant –level forecast.
- ii. **Alter the shape of the value-addition curve:** Shift the bulk of the cost addition as late as possible. This will reduce the inventory in the chain and also help the firm in having some flexibility. If the bulk of the cost addition takes place at a later point in time in the chain, one will be in a position to respond to unforeseen changes with the least cost.
- iii. **Advance the customer ordering point:** Move from a Make-to- Stock (MTS) to a Customizing –to – Order (CTO) supply chain. By moving the customer ordering point as early as possible one can carry out the bulk of the activities against an order, which reduces the importance of forecasting. If one were able to postpone the point of differentiation, one will be able to move from an MTS to a CTO supply chain. In a CTO supply chain, since the point of differentiation takes place after customer order, one does not have to prepare a variant-level forecast.

Figure 4.5 shows supply chain integration and supply chain optimization focus on lowering for value-addition curve. This results in overall reduction in cost and time and will result in an absolute shift in the point of differentiation but the relative position of the point of differentiation does not change. Unlike these approaches, supply chain restructuring affects the shape of the value-addition curve, shifts customer ordering, or shifts the point of differentiation. This will essentially require supply chain process restructuring and may also involve a change in product design or a change in the product service bundle offered to customers

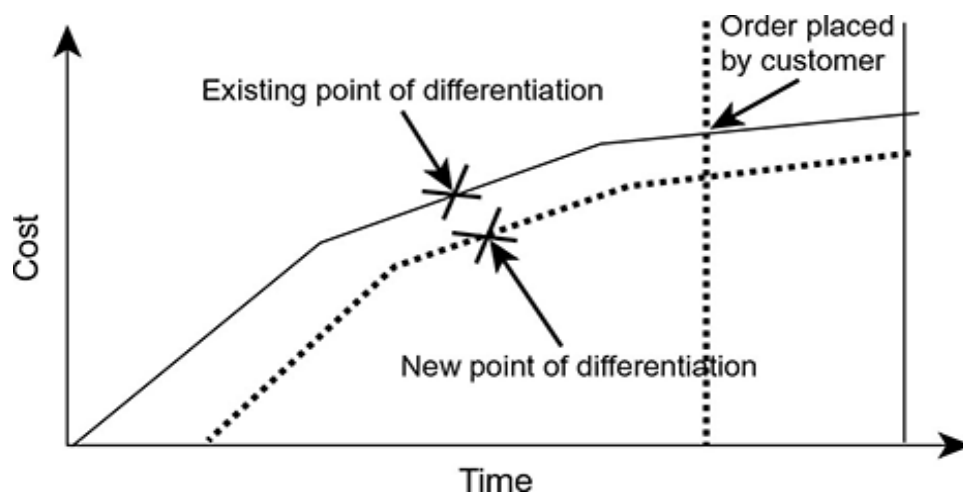


Figure 4.5: Impact of supply chain integration / optimization (Shah.J, 2009)

Supply chain restructuring is likely to bring in substantial business benefits in general and in special cases it fundamentally changes the way in which the supply chain is managed by moving from the MTS to the CTO business model.

Postponement the Point of Differentiation

Examples are Asian Paints, Hewlett- Packard, Benetton and Bicycle companies. Cement manufacturing companies like Dalmia, ACC cement and Birla cement.

Changing the Shape of the Value-addition Curve

We illustrate the example of Reliance Infocomm, which managed to come up with an innovative idea through which they could alter the shape of the value-addition curve.

Advance the Customer Ordering Point

Innovative firms have played with customer offering by understanding their own cost structures and customer utility functions. Understanding how different attributes of customer offering affects the value and utility of the customer segment is of crucial importance in this exercise. If the firm wants to move from the MTS to the CTO model, it will have to get the customers to advance their orders so that the customer ordering comes before the point of differentiation.

Altering Customer Offering Bundle

Customer offering consists of a bundle of product and services and can be characterized using following five attributes: Cost, Delivery time, Product variety, Quality and Supplementary services. Example: reducing oil extraction time or reducing jaggery (sugar) processing time. So, zero waiting time is important for the customers.

Supply Chain Mapping Methodologies

Supply chain mapping is the process of documenting information across companies, suppliers and customers who are involved in the company's supply chain to create a global map of their supply chain network. Various methodologies are used in supply chain mapping. The important methodologies are:

- i. Value stream mapping
- ii. SCOR Model
- iii. Business Process Reengineering (BPR)
- iv. Six Sigma
- v. SIPOC Model

- i. **Value stream mapping:** Value stream mapping is helpful because it creates a visual representation of every process involved in the flow of materials and information in a product's value stream, which can be used to identify the lean tools that are needed to reduce waste. Value stream mapping is a qualitative tool for eliminating waste or muda that involves a current state drawing, a future state drawing, and an implementation plan.
- ii. **SCOR Model:** SCOR Model represents Supply Chain Operations Reference Model postulated by International Federation of Purchasing and Supply Management (IFPSM), Austria. It deals with planning, sourcing, make, deliver and return processes, repeat again and again along the supply chain. Based on these process components metrics are derived and measured for performance measurements.
- iii. **Business Process Reengineering:** The fundamental rethinking and radical redesign of processes to improve performance dramatically in terms of cost, quality, service and speed.
- iv. **Six Sigma:** Six sigma is a tool or methodology used in quality improvement. Six sigma would enforce a more disciplined approach to SCM projects. Two important methodologies are used in six sigma, i.e DMAIC and DMADV. DMAIC means 'define measure, analyze, improve and control. This is applied in both product and services areas. DMADV means that define, measure, analyze, design & verify. The company General Electric (GE) is using both the methodologies in their six sigma projects. In India, TVS Group of companies and Dabbawallas of Mumbai have already reached six sigma levels. Motorola Company is the pioneer in six sigma methodologies in their operations.

- v. **SIPOC Model:** SIPOC model represents suppliers, inputs, process, outputs and customers. SIPOC integrates end to end, i.e suppliers to customers. So, this is used for supply chain mapping.

To Do Activity

Visit a coir manufacturing unit to study supply chain mapping. Submit a report.

4.4 Supply Chain Mapping using Value Stream Mapping

Value chain, a concept developed by Porter (1980, 1985) to define stages of the value-adding process in product flow. These stages produce a cumulative effect adding value to products through manufacturing and distribution. The logic of separate stages uses cost and location characteristics coupled with manufacturing and distribution strategy to define warehouse / distribution site, size and function. At the same time, they incur costs of transportation, communication and time in transit. Figure 4.6 value chain

WHAT IS A VALUE CHAIN?



Figure 4.6: Value Chain (www.aims.education)

The supply chain must be considered as a single integral unit creating value, both in the physical product and in delivery performance, and incurring costs. These overarching measures define the degree of success of the chain. Manufacturing, transportation, packing, materials handling and distribution add value by coordinating the sequence of operations and physical movement of products. Figure 4.7 depicts the value enhancement in each stage and time line.



Figure 4.7: Value Enhancement (www.istock.com)

Value stream mapping is a qualitative tool for eliminating waste or muda that involves a current state drawing, a future state drawing, and an implementation plan. Waste in many processes, also referred to as value streams, can be as high as 99 percent. The eight types of waste or muda are: overproduction, inappropriate processing, waiting, transportation, motion, inventory, defects and underutilization of Employees (Lee J. Krajewski, 2020).

Value stream mapping is helpful because it creates a visual representation of every process involved in the flow of materials and information in a product's value stream, which can be used to identify the lean tools that are needed to reduce waste. These maps consist of current state drawing, a future state drawing and an implementation plan. Value stream mapping spans the supply chain from the firm's receipt of raw materials or components to the delivery of the finished good to the customer. Thus, it tends to be broader in scope, displaying far more information than a typical process map or a flow chart used with Six Sigma process improvement efforts. Creating such a big picture representation helps managers identify the source of wasteful non-value added activities.

Value Stream Mapping Steps

Current State of Map: Value stream mapping follows the steps shown below (Rother & Shook, 2003):

- i. Product family
- ii. Current state drawing
- iii. Future state drawing
- iv. Work plan and Implementation

The first step is to focus on one product family for which mapping can be done. It is then followed by drawing a current state map of the existing processes. Analysts start from the customer end and work upstream to draw the map by hand and record actual process times rather than rely on information not obtained by firsthand observation. Information for drawing the material and information flows can be gathered from shop floor, including the data related to each process: cycle time (CT) setup or changeover time (C/O), uptime (on demand available machine time expressed as a percentage), production batch sizes, number of people required to operate the process, number of product variations, pack size (for moving the product to the next stage), working time (minus breaks), and scrap rate.

Value stream mapping uses a standard set of icons for material flow, information flow, and general information (to denote operators, safety stock buffers). Even though the completed VSM glossary is extensive, a representative set of these icons is shown in Figure 4.9. These icons provide a common language for describing in detail how a facility should operate to create a better flow.

Future State of Map: Once the current state map is done, the analysts can then use principles of lean systems to create a future state map with more streamlined product flows. Thus future state drawing eliminates the sources of waste identified on the current state drawing. The following steps are followed in preparing future set drawing:

- i. To determine the process capability, if the process is not capable, then theory of constraints concepts may be explored.
- ii. Combining similar operations or cycle time operations to reduce the inventories.
- iii. To create design pull systems to manage the remaining inventories.
- iv. Managing raw materials inventory by using Kanban cards that are sent to Production Control Department.
- v. Preparing and actively using an implementation plan to achieve the future state.

Figure 4.8 depicts the value stream mapping in a fabrication shop.

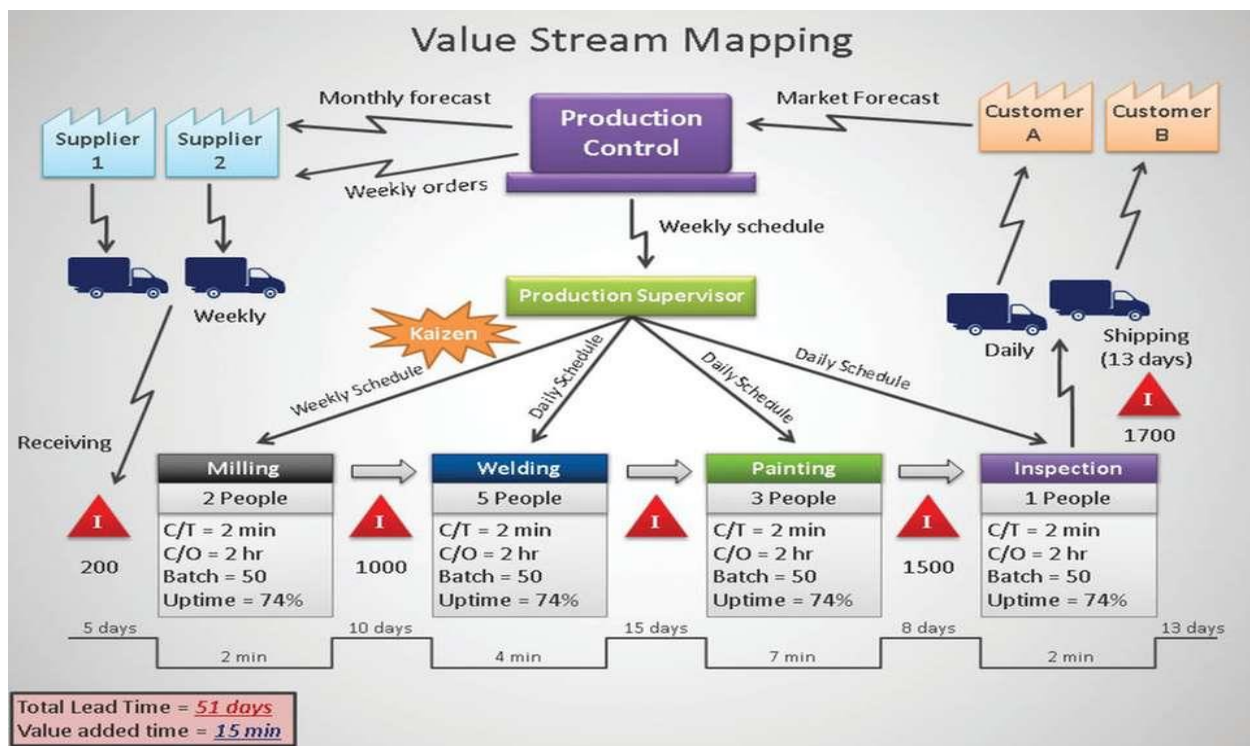


Figure 4.8: Value stream mapping (www.blog.daum.net)

Production Control Department receives the forecast demand from various markets and takes action for raw material procurement from various suppliers. Production supervisor prepares a weekly schedule and daily schedule to various sections like milling, welding, painting and inspection. Each section is having required manpower (people). The change overtime (C/O), cycle time(C/T), batch size, and uptime are calculated. From raw material receipt to the final product shipping, i.e. total lead time is 51 days and value added time is 15 minutes.

Standard Icons used in Supply Chain Mapping



Figure 4.9: Supply Chain Mapping Icons (www.dreamstime.com)

Material Flow Icons: Assembly, Supplier/ Customer, Data Box, Inventory, Truck Shipment, Movement of Material by PUSH and Finished Goods to Customer

General Icons: Operator

Information Flow Icons: Material Information Flow and Electronic Information Flow

Supply Chain Mapping Processes

A critical concept that underpins such reengineering opportunities is the idea of ‘value-adding ‘time versus ‘non-value adding ‘time. Value –adding time is time spent in doing something which creates a benefit for which the customer is prepared to pay. Thus, we could classify manufacturing as a value – added activity as well as the physical movement of the product and the means of creating the exchange. Value adding means that offering the right product in the right place at the right time to the customers. On the other hand, non-value adding time is spent on an activity whose elimination would lead to no reduction of benefit to the customer. Some non-value adding activities are necessary because of current design of processes but still represent a cost and should be minimized.

The difference between value-adding time and non-value adding time is crucial to an understanding of how logistics processes can be improved. If the value is added early in the process and hence it is more expensive when held as inventory. For example, in an oil extraction unit, two or three ingredients are added, but rapidly the stock keeping units (SKUs) increases because of its packing sizes, formats and numbers. Throughput efficiency is important. Throughput efficiency in a supply chain can be measured as the ratio between value added time and end-to-end pipeline time. It is expressed in percentage. To begin to make significant improvements in throughput efficiency firms requires a detailed understanding of the processes and activities that together comprise the supply chain. So, supply chain mapping is a useful tool.

A supply chain map is essentially a time-based representation of the processes and activities that are involved as the materials or products move through the chain. Simultaneously the map highlights the time that is consumed when those materials or products are simply standing still, i.e as inventory. In this map, it is usual to distinguish between 'horizontal' time and 'vertical time'. Horizontal time is spent in process. It could be in-transit time, manufacturing or assembly time, and time spent in production planning or processing and so on. It may not necessarily be time when customer value is being created but at least something is going on. The other type of time is vertical time, this is time when nothing is happening and hence the material or product is standing still as inventory. No value is being added during vertical time, only cost.

To Do Activity

Visit an oil extraction unit and study the implementation of supply chain mapping through value stream mapping. Submit report.

4.5 Case Studies

Case Study 1: Alpha Corporation

Alpha Corporation, a manufacturer of heavy trucks had a long, sad and bitter history of employee relations. Engineers and technicians dominated the culture. One of the company's assembly plant devoted major resource to statistical process control. An entire department staffed with engineers justified its existence by keeping control charts. The engineers collected and stored data on a computer and posted the charts in every production department once each week. They also posted lists of problems and defects attributable to each development. Another department kept itself busy with 'work re-design' and 'assembly line balancing'. The plant was highly product focused. Material moved smoothly from one operation to the next. Subassemblies flowed into assemblies like the tributes of a river, all moving towards the final assembly line.

Despite the effort, quality was mediocre at best. Alpha Corporation devoted more factory space to work and repair operations than to the original assembly. The individual and social aspects of the system were largely ignored. People lacked interpersonal skills, common goals and trust and they could not hope to attain these qualities under the existing power structure and reward system.

Discussion Questions:

1. Quality is always critical for all the organization. How Six Sigma will help the firm in maintaining quality?
2. If you take over as CEO of this firm, what changes would you like to make? How would you begin?

Case Study 2: Copper Kettle Catering

Copper Kettle Catering (CKC) is a full-service category company that provides services ranging from box lunches for picnics or luncheon meetings to large wedding, dinner or office parties. Established as a lunch delivery service for offices in 1972 by Wayne and Janet Williams, CKC has grown to be one of the largest catering businesses in Raleigh, North Carolina. The company divides customer demand into two categories: deliver only and deliver& serve.

The deliver-only side of the business delivers boxed meals consisting of a sandwich, salad, desert and fruit. The menu for this service is limited to six sandwich selections, three salads or potato ships and a brownie or fruit bar. Grapes and an orange slice are included with every meal, and iced tea can be ordered to accompany the meals. The overall level of demand for this service throughout the year is fairly constant, although the mix of menu items delivered varies. The planning horizon for this segment of the business is short: Customers usually can no more than a day ahead of time. CKC requires customers to call deliver-only orders in by 10.00 A.M to guarantee delivery the same day.

The deliver-and-serve side of the business focuses on catering large parties, dinners and weddings. The extensive range of menu items includes a full selection of hors d'oeuvres, entrees, beverages and special –request items. The demand for these services is much more seasonal, with heavier demands occurring in the late spring-early summer for weddings and late fall-early winter for holiday parties. However, this segment also has a longer planning horizon. Customers book dates and choose menu items weeks or months ahead of time.

CKC's food preparation facilities support both operations. The physical facilities layout resembles that of a job process. Five major work areas consist of a stove-oven area for hot food preparation; a cold area for salad preparation, a hors d'oeuvre preparation area, a sandwich preparation area, and an assembly area where deliver-only orders are boxed and deliver-and-serve orders are assembled and trayed. Three walk-in coolers store foods requiring refrigeration and large pantry houses non-perishable goods. Space limitations and the risk of spoilage limit the amount of raw materials and the risk of spoilage limit the amount of raw materials and prepared food items that can be carried in inventory at any one time. CKC purchases desserts from outside vendors. Some deliver the desserts to CKC; others require CKC to send someone to pick up desserts at their facilities.

The scheduling of orders is a two-stage process. Each Monday, Wayne and Janet develop the schedule of deliver- and- serve orders to be processed each day. CKC typically has multiple deliver-and-serve orders to fill each day of the week. This level of demand allows certain efficiency in the preparation of multiple orders. The deliver-only orders are scheduled day to day, owing to the short-order lead times. CKC sometimes runs out of ingredients for deliver-only menu items because of the limited inventory space.

Wayne and Jane have 10 full time employees; two cooks and eight food preparation workers, who also work as servers for the deliver-and-serve orders. In periods of high demand, they hire additional part time servers. The position of cook is specialized and requires a high degree of training and skill. The rest of the employees are flexible and move between tasks as needed. The business environment for catering is competitive. The competitive priorities are high-quality food, delivery reliability, flexibility, and cost-in that order. 'The quality of the food and its preparation is paramount', states Wayne Williams. 'Caterers with poor-quality food will not stay in business long'. Quality is measured by both freshness and taste.

Delivery reliability encompasses both on-time delivery and the time required to respond to customer orders (in effect, the order lead time). Flexibility focuses on both range of catering requests that a company can satisfy and menu variety. Recently, CKC began to notice that customers are demanding more menu flexibility and faster response times. Small specialty caterers who entered the market are targeting specific well-defined market segments. One example is a small caterer called Lunches-R-Us, which located a facility in the middle of a large office complex to serve the lunch trade and competes with CKC on cost.

Wayne and Janet Williams are impressed by lean systems concept, especially the ideas related to increasing flexibility, reducing lead times, and lowering costs. They sound like what CKC needs to remain competitive. However, the Williams wonder whether lean concepts and practices are transferable to a service business.

Discussion Questions:

1. Are the operations of Copper Kettle catering conducive to the application of lean concepts and practices? Explain.
2. What, if any, are the major barriers to implementing a lean system at Copper Kettle Catering?
3. What would you recommend that Wayne and Janet Williams do to take advantage of lean concepts in operating CKC?

Source: This case was prepared by Dr. Brooke Saladin, Wake Forest University, as a basis for classroom discussion. Taken from, Operations Management Processes and Supply Chains, 12 e, Pearson by Lee J. Krajewski et al, (2020).

Case Study 3: General Electric Company

General Electric (GE) set itself a corporate goal of becoming a six sigma quality company, which means one that produces virtually defect free products, services and transactions. Three to four sigma qualities is typically 10-15 percent of revenues. In GE's case, with over USD 80 billion in revenues this amounts to some USD 8-12 billion annually, mostly in scrap, reworking of parts and rectifying mistakes in transactions. So the financial rationale for embarking in this quality journey is clear.

But beyond the pure financials, there are even more important rewards that will come with dramatically improved quality. Among them is the unlimited growth from selling services and products universally recognized by customers as being on a completely different plane of quality from those of competitors. It is recognized that six sigma would be an exciting journey and the most difficult and invigoration stretch goal that GE had ever undertaken. The magnitude of the challenge of going from 35000 defects per million to fewer than 4 defects was huge. It would require the company to reduce the defect rates 10000 fold-about 84 percent for five consecutive years. But GE wanted to make its quality so special, so valuable to its customers, so important to their success that GE's service and products become their only real value choice.

Discussion Questions:

1. Do you justify the challenges set up by GE's for such a drastic improvement?
2. What will be the key task for GE to reach its goal?
3. Do you think implementation six sigma involves huge costs? How do you justify these costs?
4. How will this change the competitive factors in its markets and what strategic advantages will result?

Case Study 4: Just in Time (JIT) Action

A new phenomenon called 'Apparel on Demand' is slowly making its presence felt. It is an extension of JIT linking retailers and manufacturers for a just-in-time responsiveness. NaaR Clothing Inc., promoted by a young management graduate has recently ventured into the business of making reasonably priced custom jeans for women. It has partnered with many stores selling women garments. In the stores, women are electronically measured and information like color, fabric, style and size are recorded. The information reaches the NaaR manufacturing facility at Ahmadabad almost immediately through a state-of-the-art information system. NaaR guarantees delivery of the custom jeans within 10 days. With the growing acceptance of jeans among the women in India, especially in the urban areas, the market for women's jeans is growing at a fast pace. NaaR with its unique business model hopes to garner a significant share of this market. The promoter of NaaR along her top executives is confident that their concept of JIT would work.

Discussion Questions:

1. Will customers wait for 10 days to have the jeans delivered? What can NaaR do in terms of its production planning and control if delivery takes this much time?
2. Comment on the necessity of JIT and KANBAN in the context of NaaR Clothing Company.

Case Study 5: Technology Adoption in Handlooms

A startup in Bengaluru has developed an artificial intelligence –based method to authenticate handlooms. Vijaya Krishnappa, an alumni of XLRI, co-founder of Kosha was a business consultant when the government asked him to help develop the economy of a weaving cluster in Banaras. He studied the living conditions of weavers who produced saris worth Rs.20,000 to 30,000 stay in huts without even their basic needs being met. Market research showed that buyers were picking up machine-produced products from China that were slightly cheaper.

Imitation products are driving genuine products out of the market and as a result, skilled artisans are migrating to better paying, low skill jobs such as construction work, and auto driving. Kosha is using technology to ensure traceability for handloom products. The innovation leverages the power of Internet of Things (IoT), with a cookie- sized, sensor-activated device being fixed on the handloom. It analyses the movement of the loom to make out whether it is a handloom or a power loom.

Every product gets a tamper proof label stitched in during weaving and a unique QR code that includes artisan information and location, making it possible to trace the products route from weaver to customer. This label can only be stitched while manufacturing, so if someone tries to counterfeit the label they will know immediately.

The QR code on the products needs to be scanned by a phone app to extract information. When scanned, it also talks to the device on the loom. Now, even large –chain retailers can buy handmade products without fear and trace their origins.

Discussion Questions:

1. Identify the supply chain issues in handloom sectors.
2. What is Internet of Things (IoT)?
3. What is QR Code? Identify the applications of QR Code
4. Explain the process of identifying the handloom fabrics is genuine or counterfeit by using AI based technology developed by Kosha.

Summary of the Chapter

In this chapter, rural supply chain mapping process steps, main issues and value addition through time concepts are examined. The importance of rural supply chain management, main issues, advantages, various initiatives of the governments and corporate are discussed. ITC's E-Choupal initiative has been elaborated. Supply chain mapping process steps and methodologies like value stream mapping, six sigma, BPR, SCOR model and SIPOC model are explained. Supply chain mapping and process mapping are compared. Supply Chain Mapping using Value Stream Mapping is explained with an example. VAM process steps and icons used are elaborated. In this chapter five case studies with discussion questions are included for gaining practical insights.

Model Questions

1. What is supply chain mapping?
2. What is rural supply chain management?
3. Why supply chain mapping is important?
4. Describe the supply chain mapping process with examples.
5. Briefly explain the various methodologies that are used in supply chain mapping.
6. What is value stream mapping?
7. Distinguish between supply chain mapping and process mapping.
8. What is Six Sigma?
9. What is Business Process Reengineering?
10. What is the difference between DMAIC and DMADV methodologies?

Reading Material

1. Christopher (2003). Logistics and Supply Chain Management. New Delhi: Pearson Education Asia. Chapter 4, pp 101-124.

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1. Lee J.Krajewski et.al (2020). Operations Management Processes and Supply Chains. New Delhi: Pearson Education Inc.
2. Shah.J (2009).Supply Chain Management –Text and Cases. New Delhi: Pearson Education Inc,

Chapter 5 Scope of Rural Supply Chain Management in India

Introduction

After learning all the facets of supply chain management including the supply chain flows, inventory management, logistics management, & warehouse management, supply chain mapping process and tools, this chapter is written with special focus on rural supply chain management. In this chapter, current career opportunities in SCM with different roles and responsibilities are highlighted. This chapter highlights GST system and its impact on rural supply chains. Foreign Direct Investment is an important strategic interest area of every country for their economic development. Routes of FDIs, importance and benefits with illustrations have been explained. Rural managers' role in rural supply chain management and focus points are presented.

Chapter Objectives

After learning this chapter, you will:

- i. Gain insights on career opportunities in SCM.
- ii. Describe the GST systems and its importance in rural supply chains.
- iii. Explain the routes of FDI and its benefits.
- iv. Examine the improvement areas in rural supply chain management.
- v. Apply SCM tools in rural supply chain management

Chapter Structure

5.1 Current opportunities in SCM
5.2 Impact of Goods and Service Tax (GST) on rural supply chain
5.3 Impact of fireign direct investment on rural supply chain
5.4 Scope of rural managers in rural supply chain management
5.5 Case Studies

5.1 Current Opportunities in SCM

Supply chain management is an integrated approach in which activities like sourcing & procurement, manufacturing, warehousing, distribution, transportation and merchandizing seamlessly integrated for achieving superior efficiency. The main flows any supply chains are: physical flow of goods and services, money flow, information flow, risk flow and value flow. Supply chains are networks wherein suppliers, manufacturers, distributors, retailers and customers work in a coordinated manner to create the best value to the end users.

It seems to very gainful which has a big potential in India and abroad companies looking to hire supply chain management professional as they are the ones who will drive the business in the future. According to KPMG report titled ' Supply Chains post Covid-19', India has a unique opportunity to adopt a more inclusive and proactive role in leveraging its vast pool of skilled resources, competitive costing and developed ecosystem for select sectors to set ahead in the global supply chain reconfiguration race. The emerging verticals would be chemicals, pharmaceuticals, automotive and telecom. India is set to be home to a billion digital users by 2028 (KPMG Report, 2021).

It is quite evident that during the Covid-19 pandemic times, operations and supply chain management including logistics played the key role in terms of supply, movement of vaccines, oxygen (oxygen rails, tankers and storage facilities), life supporting equipments and other medical support systems. The main areas of SCM are sourcing & procurement, manufacturing / operations, warehousing, logistics and distribution. In all these areas, supply chain professionals are in demand. People with the required job knowledge, attitude and right skills set (KAS) will easily grab the job opportunities.

The logistics industry is important in economic growth and development. But this sector is working in a fragmented and also unorganized manner. The workers in the logistics and supply chain management field make sure that goods and services delivered to the customers on time and every time. The main 'Rights' in logistics are: right product, right time, right cost, with right mode of transportation, right place and with the right quantity. This needs lot of focus and specialized job knowledge. All types of business (e-Commerce and FMCG) need logistics managers to help with Inventory and account receivables. In small businesses /family owned businesses may one person in-charge of these duties, while large corporations have entire logistics and supply chain management department.

Supply chain management is one of the emerging areas in Indian industrial scenario. According to management experts, there is a lot scope for supply chain management in India due to increasing uncertainty of supply networks, shortening of the product life cycles (PLCs), increased customer expectations, fierce competitions and globalization of business. The employability potential of graduates (BBA in Supply Chain Management) is very high in India.

The current opportunities for supply chain management are:

- i. Sourcing & Procurement
- ii. Material Planner / Strategic Planner
- iii. Materials Analyst
- iv. Supply Chain Manager
- v. Warehouse Manager
- vi. Stores & Inventory Control Manager
- vii. Distribution Manager
- viii. Logistics Manager
- ix. Operations Manager

Now, let us understand the job role, responsibilities and career growth of each of the above mentioned job profiles.

- i. **Sourcing & Procurement Manager:** A Sourcing & Procurement Manager is also known as the supply manager or purchase manager or materials manager. Here, the role of the manager is to procure goods and services for company use or resale and they look for the best available at the lowest price. The responsibilities of the purchase manager vary depending upon the industry.

Materials management department is considered as 'Profit Centre' not a 'Cost Centre'. For example, traditional business equation is selling price is equal to total manufacturing cost plus profit. The selling price is fixed based on manufacturing cost plus a percentage as profit (say 10 percent or 20 percent depends). This was working well and also customers are willing pay. But, now (after globalization era) the business equation has changed to profit is equal to total revenue minus total manufacturing cost. In this scenario, the profit and selling are not decided by the manufacturer alone. The manufacturer can have control over on manufacturing cost. In the manufacturing cost, the material cost component amounts to 50 70 percent. This decides the selling price of the product. Even 5-10 percent of material cost reduction will improve the bottom line. So, the materials manager role is very important to an organization.

- ii. **Material Planner / Strategic Planner:** Material Planner involves in the planning of business for an organization. Because, the material planner knows the complete production and sales plan of the company. The role of material planner is staff function (indirect employee) at the entry level. After gaining sufficient experience and proven track record, one might be promoted to manager (corporate planning) / Head Strategic Group.
- iii. **Materials Analyst:** A Material Analyst ensures a smooth flow of goods between a company's distribution chains. The material analyst is responsible for inventory management and work with annual plans to meet the materials/inputs requirement.
- iv. **Supply Chain Manager:** Supply Chain Manager plays a main role in the manufacturing process. Supply chain manager involves right from the product development to delivery of products to the customers.
- v. **Warehousing Manager:** Warehouse Managers oversee the efficient, receipt, storage and dispatch of arrange of goods. Warehousing is responsible for managing processes and systems in order to ensure goods received and dispatched appropriately.
- vi. **Stores & Inventory Manager:** Stores & inventory Manager is responsible for receipts and issue of materials to the user departments. He is also responsible for inventory accounting, up keeping stores and binning of the materials in the shelves/ racks.
- vii. **Distribution Manager:** Distribution Managers are responsible for planning and managing logistics, warehouse, transportation, and customer services. They are also responsible for directing, optimizing and coordinating full order cycle. Liaising and negotiating with suppliers, manufacturers, retailers and customers are also coming under distribution managers' responsibilities.
- viii. **Logistics Manager:** Logistics are responsible for planning, coordinating and monitoring logistics operations such as transportation, inventory and warehousing.
- ix. **Operations Managers:** Operations Managers are responsible for managing activities that are part of the production of goods and services. They are directly responsible for managing operations, embracing design, planning, and operations strategy and control performance improvement.

Opportunities foreseen are plenty. But, our students / future managers should be ready to grab the opportunities. The current level of employment is less than 20 percent. Then what next? A question comes into everybody's mind. Following are some of the tips or focus points to face global competitive challenges.

What Next?

Our students and future managers should focus more on acquiring new job knowledge, development the right attitude and skills (KAS). It is said that the right attitude takes or lifts a person to high altitudes (career growth). In this direction, everyone should work in a focused manner. HR should focus human and personality development side, curriculum should focus on right skills and applications required for the job markets. Students should do a couple of certification programmes, in Blockchain, Artificial Intelligence/ Machine learning/ deep learning, Virtual Reality and Augmented Reality (VR &AR)/ Supply chain analytics, big data and data analytics. This will certainly help the students to prepare to meet the future challenges. Students should be groomed to become entrepreneurs or to take up entrepreneurial activities; they should not look for jobs, but should become job creators. Entrepreneurship Development Cells (EDCs) and Innovation and Incubation Centres (IICs) should be created at institution level and motivate everyone to involve EDCs and IICs activities.

Blockchain Technology

Blockchain technology holds an immense potential for the youth of today. The integration of Blockchain technology is now witnessing major demand across various sectors including banking, insurance, logistics & supply chain management, healthcare and public administration. Blockchain creates value to the companies. Companies like IBM, Oracle, JPMorgan Chase, Microsoft, Amazon and American Express. In India, a blockchain developer commands a salary package ranging from Rs.2 lakh to Rs.10 lakh per month. Blockchain can be applied in rural supply chains including the seeds selection, milk quality, yield level and productivity in rural sector.

Artificial Intelligence / Machine Learning: AI has become the most sought after domain with organizations implementing it across the sectors to benefit from AI applications. AI skills can open pathways to a variety of careers related to technology, from data scientists to software engineers to product managers. With AI companies remarkably expanding across domains, arming oneself with skills in this domain will reap benefits. AI improves productivity. Projected improvements in selected economies are ranging from 10 – 40 percent. AI applications can be adopted in rural supply chain management as well.

Applications of Artificial Intelligence are: Goods traceability in supply chain management, consumer insights, branding, customer connect, authentication of products, digitization and automation of routine activities.

Augmented Reality & Virtual Reality: These two technology application tools are widely used in education and tourism. The applications of AR & VR can be extended to village tourism, medical tourism and temple/spiritual tourism also.

Supply Chain Analytics: Supply chain analytics, business analytics and data science are promising areas. Many job and business opportunities are going to come in near future. So, these emerging skills will definitely improve employment opportunities in rural supply chains as well.

Supply Chain Management Courses/ Programmes: Learning is continuous journey, so should not stop learning. They are many online certification courses, PG Diploma and PG programmes through regular

mode and also part time mode are available in this space. Institutions like XLRI, IIMs, AIMA, Universities, Symbiosis Institutions, ISM-India, Indian Institute of Materials Management (IIMM) and many global institutions are offering six months, one year and two year programmes more focusing on employability angle. They are also providing campus selection support and assistance to the right candidates.

To Do Activity

Visit a Logistics Company or Warehouse and Interview the Manager to ascertain the current opportunities in SCM.

5.2 Impact of Goods and Service Tax (GST) on rural supply chain

Good and Services Tax (GST) is an indirect tax (or consumption tax) used in India on the supply of goods and services. The GST came into effect from 1st July, 2017 through the implementation of the One hundred One Amendment of the constitution of India by the union government. Goods and Services Tax (GST) is essential to improve the transparency, reliability, and timelines of supply chain mechanism. A better supply chain mechanism would ensure a reduction in wastage and cost for the farmers, retailers and consumers. GST would also help in reducing the cost of heavy machinery required for producing agricultural commodities.

Implementation of GST in India

In India, the idea of adopting GST was first suggested by the Atal Bihari Vajpayee Government in 2000. After several rounds of discussions by the various committees, the Honorable President of India gave his consent for the Constitution Amendment Bill to become an Act. In the year 2017, four bills related to GST become Act, the following approval in the parliament and the President's assent:

- i. Central GST Bill
- ii. Integrated GST Bill
- iii. Union Territory GST Bill
- iv. GST (Compensation to States) Bill.

The GST Council also finalized on the GST rates and GST rules. The government declares that the GST Bill will be applicable from 1st July 2017 except Jammu & Kashmir (J&K) State. But, later on GST was implemented in J&K also.

Constitution (One hundred and First) Amendment Act, 2016

In order to address prevalent issues in taxation, the constitution 122nd Amendment Bill was put forth in the Lok Shaba on 19th December, 2014. In September 2016, A Goods and services Tax Council (GSTC) was created by the union finance minister, revenue minister and ministers of state to take decisions on GST rates, thresholds taxes to be subsumed, exemptions and other features of the taxation system. The GST Council is separate entity that would oversee the implementation of the GST system.

Decisions taken by GST Council

Some of the major decisions taken by the GSTC so far are:

- i. There are four tax rates under GST regime, i.e 5 percent, 12 percent, 18 percent and 28 percent. Some goods and services were also classified as exempt from tax. A cess above the peak rate of 28 percent would be levied on certain sin and luxury goods.
- ii. The administrative control over 90 percent of tax payers with turnover less than Rs.1.50 crores would be with the state tax administration. 10 percent of control would be with the central tax administration. Administrative control over taxpayers having turnover above Rs.1.50 crores would be equally divided between the state and central tax administration.

Goods and Services Tax Network (GSTN)

Goods and Services Tax Network (GSTN) was set up a private company in 2013 by the Government under Section 25 of the Companies Act, 1956. GSTN is expected to offer the front –end services of registration, payment and returns to tax payers. GSTN has also identified 34 IT and financial technology companies and tagged them as GST Suvidha Providers (GSPs). These organizations are helping the tax payers when they interact with GSTN through various applications.

Features of GST

The main features of GST are as follows:

- i. GST is based on the principle of value added tax and either ‘input tax method’ or ‘subtraction method’ with emphasize on voluntary compliance and accounts based system. It is a comprehensive levy and collection of both goods and services, at the same rate with benefit of input tax credit or subtraction of value of penultimate transaction value.
- ii. Minimum number of floor rates of tax generally, not exceeding two rates. No scope of levy of cess, re-sale tax, additional tax, special tax, turnover tax and octroi tax. Also, no scope for levy of multiple levies of tax on goods and services such as sales tax, entry tax, entertainment tax, and luxury tax.
- iii. Taxing of capital goods and inputs whether goods or services relatable to manufacturers at lower rate, so as to reduce inventory carrying cost and cost of production.
- iv. GST is a destination based tax and levied at single point at the time of consumption of goods or services by the ultimate consumer. A common law and procedure throughout the country under a single administration.

Model of GST

There are three prime models of GST

- i. GST at Central (union) Government level only.
- ii. GST at State Government level only
- iii. GST at both, union and state government levels.

In India, the GST model is dual in nature, i.e GST is having both central and state GST Component levied on the same base. All goods and services barring few exceptions will be brought into the GST base. i.e CGST and SGST. Figure 5.1 shows the models of GST.

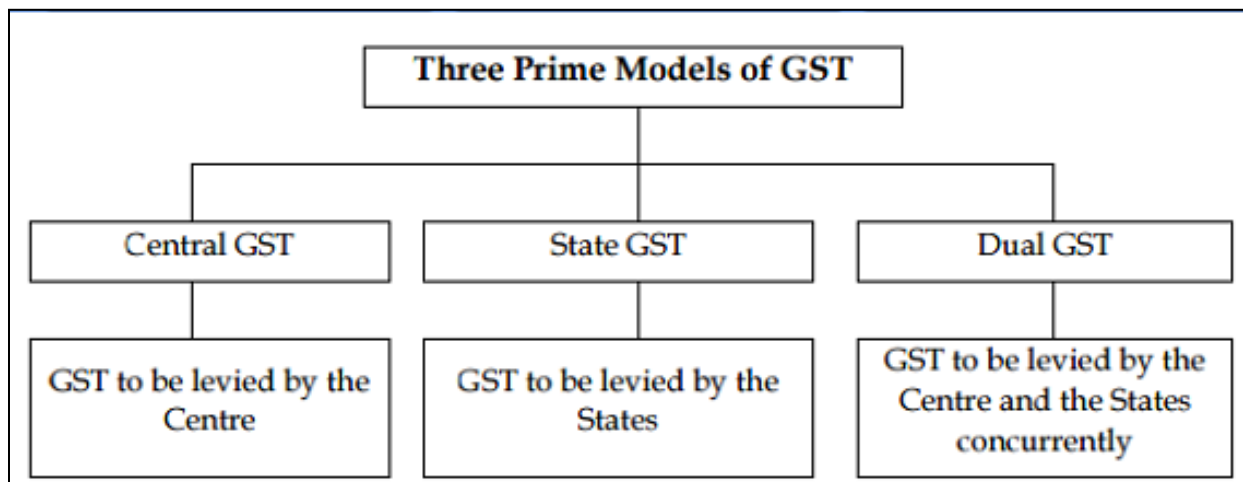


Figure 5.1: Prime Models of GST (www.gstindia.com)

Several countries have already established in the Goods and Services Tax. Table 5.1 shows the GST implementation by various countries.

Table 5.1: GST Implementation by various Countries

Sl. No	Name of the Country	Year of Implementation
1	France	1954
2	New Zealand	1986
3	Canada	1991
4	Singapore	1994
5	Australia	2000
6	Malaysia	2015
7	India	2017

More than 160 countries have already implemented GST. India is the 161st country to implement GST. According to Article 366 (12A) of the Indian Constitution a Goods and Services Tax is any tax on the sale of goods or services or both excluding taxes on the production of alcoholic beverages for human consumption. Article 366 (12) defines goods as 'all products, commodities and articles. Article 366 (26A) defines services as 'something other than commodities'. As a result the goods and services tax (GST) is a tax levied on all goods and services.

GST combines 17 distinct forms of central indirect taxes (service tax, excise duty, countervailing duty and so on and state indirect taxes (like luxury tax, entry tax, VAT, octroi and sales tax) to create a single consolidated Indian tax system. Figure 5.2 shows the tax system prior to GST.

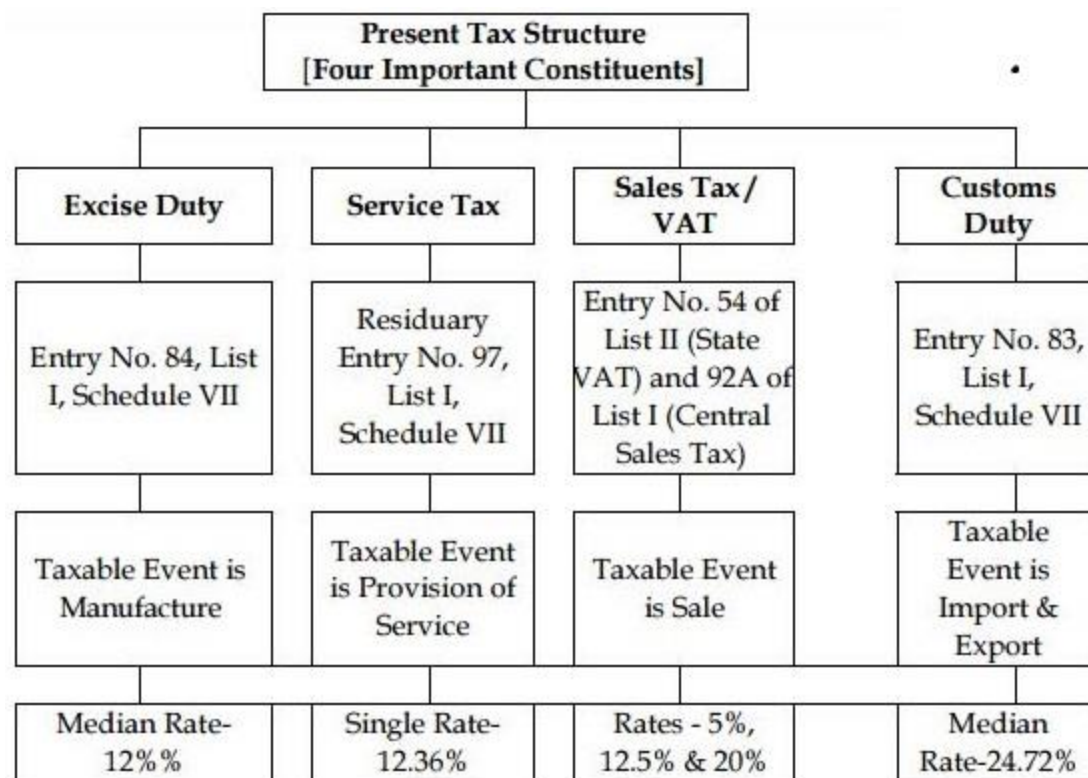


Figure 5.2: Tax System followed prior to GST (www.gstindia.com)

In India, four GST thresholds namely 5 percent, 12 percent, 18 percent and 28 percent have been implemented. Table 5.2 shows the category of items and levied GST.

Table 5.2: Category of Items and GST Rates

Sl. No	Category of Items	Levied GST in percent
1	Fruits, wheat, milk and rice	0
2	Skimmed milk, and Fertilizers	5
3	Ghee, butter, oil and dairy products	12
4	Equipments used agricultural processes like water pumps & milking machines	12
5	Pesticides	18
6	Farm equipments including Tractors	12
7	Condensed milk	18
8	Dry fruits, Paste, Jam and Juices	12-18

(Source: www.gstindia.com)

Under the model GST law, dairy farming, poultry farming and stock breeding are kept out of the definition of agriculture. Therefore, there will be taxable under the GST.

Illustration: If a product have levy at a base price of Rs.200 and rate of CGST and SGST are 8 percent, then such case both CGST and SGST will be charged on Rs.200, i.e CGST will be Rs.16 and SGST will be Rs.16 percent.

Fertilizers are important element of agriculture. These items were previously taxed at 6 percent (1 percent Excise plus 5 percent VAT). In the GST regime, the tax on fertilizers has been increased to 12 percent. The same input is on tractors. Waiver on the manufacture of tractors is removed and GST of 12 percent has been imposed. This is beneficial as of now the manufacturers will be able to claim input tax credit.

Earlier, only 2 percent VAT was charged on milk and certain milk products, but under GST the rate of fresh milk is nil (zero) and skimmed milk is levied with 5 percent GST and condensed milk is going to be taxed at the rate of 18 percent. Tea is one of the most crucial items in an Indian household. The price of tea might also increase due to the tax rate 5 percent under GST rate from the earlier VAT rate of 4-5 percent with Assam and West Bengal with the exception of 0.5 and 1.0 percent.

Benefits of GST Implementation

Key benefits of the GST implementation are:

- i. The cascading effect of taxation is mitigated.
- ii. There is uniformity in laws, rates of tax and production across the states.
- iii. GST system enables to create a common National Market that boosts foreign investment.
- iv. The GST is enabling to boost manufacturing activities and exports. This would in turn generate more employment and lead to the growth of the economy.
- v. GST is a simpler and unified taxation system with small number of exceptions.
- vi. These are automated and simplified methods for processes such as registration, returns of GST and tax payments.
- vii. The input tax credit process will be more accurate and transparent, as electronic matching will be performed.
- viii. All interactions will be handled by the common GSTN website.

Impact of GST on Rural Supply Chains

Impact of GST on Rural Supply Chains has both positive and negative impacts. The positive impacts of GST are:

- i. Enhanced mechanism of the supply chain: No levy on storage of farm products. This has lowered the farmers' tax burden.
- ii. Credit for Input Tax: For the tax already charged for each addition, GST provides each dealer with an Input Tax Credit (ITC). In this way, a trouble-free supply chain will be created, which will enable agri-food to travel freely throughout the country.
- iii. Transport time reduced: Farm products can be destroyed and also affected by the time they are transported and delivered to the markets.
- iv. Tax exemption: GST is a levy imposed on consumption, so it is only collected at destination.
- v. Ease of Intergovernmental Trade: In the past, different taxes were levied on the intergovernmental trade of a single commodity. The introduction of GST has also liberalized agricultural commodity marketing and made it possible for agricultural commodities to operate smoothly.

The negative impact of GST on rural supply chain is as follows:

- i. Doubling of the tax burden: Fish, meat, poultry, milk products, dried fruit and jellies can increase in taxes relative to previous (5 percent more) tax rates. As a result, the food sectors workload has doubled.

- ii. Reverse changes most agribusinesses rent warehouses to small property owners. But GST is responsible for the leasing of warehouses by storage and storage agency at the reverse cost of 18 percent.
- iii. Increased storage or cold storage building costs: Earlier these things were exempted. But now, both factory building and cold storage are also subject to 18 percent GST for farm products.
- iv. Modern facilities: Imports of project machinery to store agricultural goods such as mechanized handling system and pallet racking systems under the earlier indirect tax regime faced a 5 percent custom duty. But now, these items are levied with 18 percent IGST. This will have an impact or deterrent on modern-agri infrastructure development negatively.

The GST Council has reduced GST from rates to less rates and even Nil for some of the medicines, vaccines, and life saving equipments considering Covid-19 pandemic. It is a progressive approach and will benefit everyone in the society.

To Do Activity

Visit a Mall or Hyper Market and study the GST levied on vegetables, fruits, eggs, rice, wheat and milk products. Submit a report.

5.3 Impact of Foreign Direct Investment on Rural Supply Chain

Foreign Direct Investment (FDI) is considered as a major source of non-debt-financial resource for the economic development. FDI is an investment made by a firm or individual in one country into business interests located in another country. Generally, FDI takes place when an investor establishes foreign business operations or acquires foreign business assets, including establishing ownership or controlling interest in a foreign company.

Foreign Direct Investment (FDI) is strategic and vital tools for developing any country's infrastructure. In recent times, FDI in India is one of the most discussed topics in the world economy. FDI is fund flow between the countries in the form of inflow or outflow by which one can gain some benefit from their investment. Both countries, i.e. host country and home country are directly interested in investing FDI because they benefit a lot from such type of investment. FDI can also help to raise the output, production, and export at the sectoral level of the Indian economy.

Importance of FDI

In 2017, developing countries received 37 percent of total global FDI. They received 43 of worldwide investment. Investments rose 2 percent in Asia, the largest recipient region in the world. Foreign investment is generally seen as a catalyst for economic growth and can be undertaken by institutions, corporations and individual business firms. A comparative study of China and India, and found that 1 percent increase in FDI would result in 0.07 percent increase in GDP of China and 0.02 percent increase in GDP in India.

FDI has both positive and negative impacts on rural economy. The positive impacts of FDI on rural areas are:

- i. Increasing productivity
- ii. Employment creation
- iii. New technology transfer

- iv. Foreign company will also create a supply chain in Indian market
- v. FDI will help in lack of fund
- vi. Improving infrastructure
- vii. Capital formation
- viii. Economic boost
- ix. Resources transfer
- x. Company have to pay tax

The negative impacts of FDI on rural economy are:

- i. Worker exploitation
- ii. Farmers freedom will be curtailed
- iii. Risk from political changes
- iv. Environment and ecology will be misbalanced
- v. Less profits to host country
- vi. Competition between local and foreign firms
- vii. Modern day economic colonialism

In early nineties, Indian economy faced severe balance of payment crisis. During that critical time Indian then, Finance Minister Dr. Manmohan Singh introduced macro-economic stabilization and structural adjustment program with the help of World Bank and International Monetary Fund (IMF). As a result of these reforms India open its door to FDI inflows and adopted a more liberal foreign investors. Further, under the new foreign investment policy government of India constituted Foreign Investment Promotion Board (FIPB) whose main function was to invite and facilitated foreign investment through single window system from the Prime Minister's Office (PMO).

India also became the member of Multilateral Investment Guarantee Agency (MIGA) for protection of foreign investments. Government encourages FDI allow Multi-National Companies (MNCs) to operate in India. Thus, resulting in the partial liberalization of Indian Economy, Government also introduced reforms in individual sector and at increasing competency, efficiency and growth in industry through a stable, pragmatic and non-discriminatory policy for FDI flow.

Determinants of FDI in India

The determinants of FDI in rural area on the Indian economy are:

- i. In foreign countries they have capital in abundant, but don't have cheap, skilled and efficient labor to work. India has skilled people, but lack of capital which results in unemployment and wastage of human resource. So, FDI has two fold impacts, i.e foreign countries are getting skilled labor at lower prices and India is able to solve the problem of unemployment.
- ii. Investors prefer to invest in those countries which have stable policies then it has a negative impact in the mind of foreign investors. As Indian economic policy is stable, so it attracts foreign investors to invest their funds in India.
- iii. Economic factors include interest on loans, tax brackets, grants, subsidies and the removal of restrictions and limitations. The government of India has given many tax exemptions and subsidies to the foreign investors which would help in developing the economy. Though India has given many tax exemptions grants, subsidies to foreign investors and the removal of restrictions and limitations on FDI, still the government's needs to work on those factors so that it can be helpful in increasing FDI in India.

- iv. Advance technology is an important component of FDI in flow in Indian economy and the fund is helpful for uploading old technology.
- v. If any country wants to invest the money in either country, it sees whether there is any market for their products and services in host country or not. In India there is large scope for the investors because there is a large section of market which has not explored or which is unutilized. In India there is enormous potential customer market with large middle class income group who would be target group of foreign businesses.
- vi. If natural resources are available in host country they can be used by the foreign investors in production process or for extraction of mines. India has large volume of natural resources such as coal, iron ore, natural gas and other resources, which attract foreign investors to invest their money.

The Merger and Acquisitions (M&As) market is carrying over the momentum from the second half of 2020 and is expected to accelerate further. So, far in 2021, global M&As have totaled a record USD 2.4 trillion- up 158 percent from the year-ago period. Asia-Pacific M&A activity hit by USD 492.4 trillion during YTD 2021- up 75 percent from –ago levels. The outlook is positive companies to grow and scale. Table 5.3 shows M&A investments (USD billion)

Table 5.3: M&A Investments (USD billion)

Sl. No	Country	Investment (in USD Billion)	YOY Change (Percent)
1	United States	1293.00	275
2	China	232.00	75
3	United Kingdom	141.00	56
4	India	43.00	32
5	South Korea	37.00	50

(Source: Refinitiv)

India among Top Five FDI Recipients due to Merger &Acquisitions (M&As)

India’s strong fundamentals provide optimism for the medium term. FDI to India has been on a long-term growth trend its market size will continue to attract market seeking investments. India’s FDI rose to 25 percent to USD 64 billion, when global investments flow shrank 35 percent to USD 1 trillion. India, China and Hong Kong were among the countries which saw a recipient due to M&A. Table 5.4 postulates the top five FDI recipients due to M&A.

Table 5.4: Top five recipients due to M&A

Sl. No	Country	FDI (in USD billion)		Percent Change
		2019	2020	
1	United States	261.00	156.00	-40
2	China	141.00	149.00	6
3	Hong Kong	74.00	119.00	61
4	Singapore	114.00	91.00	-20
5	India	51.00	64.00	25

(Source: UNCTAD World Investment Report, 2021)

There are a significant number of companies looking to relocate their supply chain to India and also establish green field ventures. Their trust in the government and its efforts to create a better and easier environment for business and to focus not just on viability but profitability has encouraged them to look at India as a global hub for manufacturing.

The union commerce and industry minister expressed confidence that India will continue to attract high foreign direct investments (FDIs) in the current financial year also (2021-22). India has inked foreign trade agreements (FTAs) with several countries including Japan, South Korea, Singapore and ASEAN countries.

Modes / Routes of FDIs

There are three routes through which FDIs channelized in India.

Category 1: 100 percent FDI permitted through automatic route. Any NRI or company can use this route for their investments.

Category 2: 100 percent FDI permitted through government route.

Category 3: up to 100 percent FDI permitted through government plus automatic route.

The foreign investors have to select the sector like agriculture or broadcasting or infrastructure and should seek the approval the concerned administrative ministry for their investments. A detailed procedure has been mentioned in the consolidated FDI Policy 2020 document of Department for Promotion of Industry and Internal Trade, Ministry of Commerce and Industry, Government of India. Illustration 1 and 2 gives a bird's eye view on FDI opportunities in agriculture and plantation sectors.

Illustration 1: Agriculture Sector

Sector / Activity	Percent of FDI Cap/ Equity	Entry Route
i. Floriculture, Horticulture and Cultivation of vegetables & mushrooms under controlled conditions.	100 percent	Automatic
ii. Development & production of seeds and planting material		
iii. Animal Husbandry (including breeding of dogs), Pisciculture, Aquaculture, Apiculture and services related to agro and allied sectors		

Illustration 2: Plantation Sector

Sector /Activity	Percent of FDI /Equity Cap	Entry Route
i. Tea sector including tea plantations	100 percent	Automatic
ii. Coffee plantations		
iii. Rubber plantations		
iv. Cardamom plantations		
v. Palm oil tree plantations		
vi. Olive oil tree plantations		

(Source: Consolidated FDI Policy document 2020, DPIIT, MoC & I, Govt. of India)

Infrastructure projects, Bio-tech Parks, Cattle Parks and E-Commerce are also having 100 percent FDI opportunities under automatic route.

Impact of FDIs on Rural Supply Chains / Economy

- i. FDIs can create huge impact in infrastructure projects like cold chain, warehouse and roads development in rural areas. More than 60 percent of populations are still living in the rural areas.
- ii. Development of parks like Bio-tech, Smart cities or Providing Urban Amenities in Rural Areas (PURA) schemes, Cow park, Sheep / Goats park , Buffalo park, and Horse park are having huge opportunities, this will also help to achieve the objective of National Rural Livelihood Mission Projects (NRLMP).
- iii. Development of E-Commerce models to cater to rural supply chains. This will enable to deliver products to the customer faster, i.e last mile delivery by eliminating middlemen/ agents and their commissions.
- iv. Development of Palm trees, Coconut trees, Papaya trees, Almond trees, Teak trees and Olive trees projects are foreseen huge impact on rural supply chains. FDI in these sectors will definitely benefit both the host country and home country in the long run.
- v. Through FDIs route best practices i.e Wal-Mart's 'Every Day Low Price (EDLP) and technology, i.e Amazon can be learned and practiced to gain competitiveness.

To Do Activity

Go through the Consolidated FDI Policy document of India and identify the FDIs opportunities in Rural Supply Chain Management areas. Submit a report.

5.4 Scope of Rural Managers in Rural Supply Chain Management

A rural supply chain system consists of goods or items that flow through various levels of hierarchies of suppliers (farmers), distributors (wholesalers)/ middlemen, retailers and customers. Supply chain system in rural developing regions are extremely fragmented, fragile and volatile to a wide a range of competitive and security threats. India is going to become a booming market with 139 crores population after China in this world. After few years, India may overtake Chinese market. For continuing this speed we need to have sustained growth in our agriculture, manufacturing and service sectors also in our rural areas.

A typical rural economy is agriculture based and the quality of life in rural areas has always been an issue of concern around the world. Poor living standards manifest themselves in the form of lack of basic amenities such nutritious food, safe drinking water, organized healthcare, education, and income level.

India is the second fastest growing economy in the world. India is sixth largest economy in the world in terms of GDP and fourth largest economy in terms of Purchasing Power Parity. India presents a huge opportunity to the world at average age of working population, to use as a hub. Standing on the threshold of a retail revolution and witnessing a fast changing retail landscape, India is all set to experience the phenomenon of global village. India is the “promised land” for global brands and Indian retailers, a “Vibrant economy”. India tops in the list of emerging market for global retailer and India’s retail sector is expanding and modernizing rapidly in line with India’s economic growth. Retailing in India is gradually inching its way toward becoming the next boom industry.

Logistics and SCM practices defined as a set of activities undertaken to promote effective and efficient management of supply chains. These include supplier partnership, physical movement of goods, meeting customer demands and information sharing throughout the supply chain. Some of the key logistics and SCM practices that impact performance are related to estimation of customer needs, efficient and effective delivery, integration and collaboration throughout the supply chain, sharing of information and vision using ICT as well as informal methods and use of specialists for performing specific jobs across the supply chain. All of these practices impact logistics and supply chain performance.

Rural Supply Chain Management Challenges

Rural supply chain management challenges are many folds. Important challenges are: conditions of roads, warehousing facilities, cold chain facilities, & logistics cost and connectivity to markets. India is spending around 14 percent of GDP on logistics. This is very high compared to other countries like United States, Japan and other developed countries.

Rural road conditions are very pathetic in India. Most of the rural roads are in bad in shape (katcha roads). This needs improvement. Rural roads are not well connected to highway roads and rail routes. 30-40 percent of agri-produces are becoming waste before it reaches to markets. Examples are fruits, vegetables, sea food products, dairy products, flowers and eggs. These products should be handled carefully under temperature controlled (Reefer vehicles). So, cold chains are essentially needed. The government has plans to setup more than 100 cold chain facilities across the country. Rural supply chains are very much part of this supply development process.

Rural supply chains lacks Information, Communication and Technology (ICT) infrastructure. This needs improvement. Internet connectivity, smart mobile phones usage and online business transactions should be improved to manage rural supply chains more efficiently.

Role of Supply Chain Managers in Business

Supply chain managers can be the game changers in business many ways. The important areas including: operational efficiency, better utilization of resources, profitability improvement, quality improvement, customer value enhancement and improvement in customer service level.

Operational Efficiency: Operational efficiency is the ratio of value of outputs to the value of inputs. With minimum or fixed inputs the out should be produced more. Operational efficiency will have direct

impact profitability. There are many ways can be explored to reduce the cost of inputs by scientific purchasing, smart contracts, establishing rate contracts (RCs) & long term business agreements (LTBAs). Suppliers should be developed, nurtured and retained considering long term business relationships. Vendor rating should be introduced. Best practices (bench marking) should be adopted and implemented.

Better Utilization of Resources: Resources like men, machines, money, materials, methods, minute and meter square (space) should be utilized wise fully. Underutilized resources and over utilized resources should be identified and resource leveling put in to practice. Supply chain manager has to plan in utilizing resources. Supply chain should have short term and long term plans in people development, manpower planning and supply chain operations plans.

Profitability Improvement (Profit Centre Concept): Materials sourcing comes under the ambit of supply chain management. Traditionally, selling price of product is arrived by calculating the total manufacturing cost plus profit (say 10 percent or 20 percent). But, after the liberalization, privatization and globalization (LPG) era, the business equation has changed.

$$\begin{aligned} \text{Profit} &= \text{Selling price} - \text{Total manufacturing cost} \\ \text{Profit} &= \text{Total Revenue} - \text{Total Cost} \\ \text{Profit} &= (\text{Selling price} \times \text{No. of units sold}) - \text{Total fixed cost} + (\text{Total variable cost per unit} \times \text{No. of units produced}) \end{aligned}$$

It is seen that selling price and profit both are influenced by various factors like competitive pressures, market conditions, demand & supply and buying power of consumers. So, companies have started concentrating on reduction of their manufacturing costs. In the manufacturing cost, 50 -70 percent of cost component comes from material cost. So, even 5 percent material cost reduction will improve the profit of the company.

Another perspective is on Return on Investment (ROI).

$$\begin{aligned} \text{ROI} &= \text{Net profit} / \text{Total capital employed.} \\ \text{Where, Total employed} &= \text{Fixed assets} + \text{current assets} \\ \text{Current assets} &= \text{Cash on hand, inventory, and cash receivables} \\ \text{Profit} &= \text{Total Revenue (TR)} - \text{Total Cost (TC)} \end{aligned}$$

So, the supply chain can contribute to improve the profit by reducing material cost and also in ROI gain by managing inventory better (current assets). This is called as profit centre concept of materials management (sourcing & procurement and inventory management).

Total Quality Management: Product quality is important through which companies gain competitive advantage. So, right inputs, right process, right people and right machine will ensure the quality of outputs. The supply chain manager is knowledgeable in all these areas by deploying QCC tools, process capability, & embracing six sigma methodology and lean manufacturing i.e producing more with less by elimination of wastes (Mudas).

Customer value enhancement: Value means that what the customer willing to pay for it. Value can be classified into two: tangible and intangible value. Tangible value means that the value derived from the product attributes, whereas intangible value means that the value derived by the customer in terms service, treatments, emotional connect and a smiling sales personnel. Supply chain managers are focusing to enhance the customer values in both tangible and intangible.

Customer service level improvement: This is important in logistics and after sales service. Generally, companies sign service level agreements (SLAs). This can be measured in terms of percentage, say 80 percent or 95 percent level. This ensures the service availability.

Role of Rural Managers' in Rural Supply Chain Management

More than 70 percent of population lives in villages (rural) in India. Indian economy is an agrarian economy. Agriculture sector contributes greatly to GDP and employment. So, rural supply chains cannot be ignored just like that. Rural managers have to have to play a big role in managing rural supply chains. Because, rural supply chains are fragmented, fragile and volatile is in terms of integration, collaboration and performance measurements.

Streamlining of Rural Supply Chains: Rural supply chains streamlining is important. They are working in 'silos' not properly integrated and collaborated. Rural supply chains have to be internally integrated first, after that it has to be integrated with the customers. Supply chains integration is carried out in stages, i.e initial internal integration, integration with suppliers and integration with customers. Collaboration and adaption are important to improve the total business value. Example, sourcing, procurement, manufacturing / conversion, distribution / deliver, and return, all these process components should be seamlessly integrated. Supply chain coordination is important to counter the 'bullwhip effect' in the supply chain. Supply chain managers play a vital role in streamlining the supply chain components.

Rural Supply Chains Modeling: Supply chain modeling is important in any supply chain design decisions. For example, where to locate the plant, where to locate the warehouse and where to place the distribution centres, all these things are strategic decision areas. Supply chain managers are equipped with tools and techniques to handle supply chain network design decisions. Every decision should be data driven and supported with rationality, not on adhoc basis.

Bringing Professionalism in Rural Supply Chains: Supply chain managers are experts in their selected area. Rural supply chains are primitive in terms of implementation of SCM tools and concepts. So, the supply chain managers can bring lot of professionalism in rural supply chains in terms of ethical practices and values in their business approaches.

Deploying New Business Tools and Models: There is a lot of scope for adopting new business tools and models in the rural supply chain management. For example, adoption of online business models, implementation of Tally-ERP tools, deploys mobile apps and participation in Govt. E-Markets (GeM). Rural supply chain managers should aim to supply to defense, government departments, colleges and universities directly products like vegetables, fruits, dairy products and other essential items. Lots of scope has been envisaged in those markets.

Supply Chain Performance Measurements: Supply chain performance measurements are important. Supply chain managers can introduce supply chain performance tools in rural supply chain management. For example, SCOR metrics, logistics metrics, Economic Value Addition (EVA) and Market Value Addition (MVA) tools as part of supply chain performance measurements. ‘What gets measured, can be managed better, and improved further. So, supply chain performance measurement is important in any supply chain management. In rural supply chains it is all the more important. Supply chain managers can introduce the right tool for performance measurement.

Supply Chain Auditing: Supply chain auditing is a fact finding exercise, not a fault finding exercise. So, supply chain managers should in-built the supply chain auditing in the supply chain management. Various tools are available to audit the supply chains. Examples balanced score card (BSC), EVA and MVA are generally used tools in supply chain auditing. Supply chain auditing can be done by the trained people from the same organization and from outside as well. The outcome of audit report should be used for identifying the improvement areas and for possible improvements.

In the India, every state has co-operative societies, milk producing unions, handloom societies (Co-optex), coir products manufacturing units, coconut producers unions, oil producing units association, palm jiggery producing unions, seeds suppliers association and cattle feed suppliers association. In all these organizations, presently non-qualified and non-supply chain management professionals are managing their supply chains.

States like UP, Maharashtra, Tamilnadu, Haryana, Himachal Pradesh, Kerala, Andhra, Gujarat, West Bengal and Karnataka are having lots of co-operatives / societies. So, lot scope is available for managers in rural supply chain management. The improvement areas are: sourcing & procurement, conversion, value addition, distribution and return. In all these areas managers can contribute in the rural supply chain management.

Action / Focus points

The main focus points in rural supply chain management are:

Bulk Buying: Bulk buying is an important strategic approach; generally companies do source and procurement to reduce cost per unit. In many of the rural supply chain managers, presently, they are applying the consolidation or bulk buying approach due to various reasons.

Technology Adoption: The level or depth of technology adoption in rural supply chains is low. Technology tools bring lot of visibility to rural supply chains. Examples, bar coding, RFID, GPS, EDI and E-Procurement tools are good examples to enhance supply chain visibility. Technology tools really help to improve supply chain efficiency and productivity.

Last Mile Delivery: Many e-retail giants, they use last mile delivery as one of their core competencies. Examples are Amazon, Flipkart and Mynthra. Last mile delivery is important. Customers are having money, but no time. So, they are not willing to wait for their orders. Rural supply chain managers can adopt these incremental improvement methods to retain their customers. Customer retention is very important in business. Customers are your real brand ambassadors, so do something to retain the

customers. Supply chain managers can do lot of work in this space.

Value Addition: Value addition to customers is important in the business. In supply chain management, there is lot of scope to include value addition activities. Examples are sorting, grading, labeling, packing, bulk breaking and consolidation. Through these activities, value addition can be achieved, for that the customers are willing to pay for it additionally. In rural supply chain management, these things can be easily achievable. Example: Wal-Mart, they do all these things to retain their customers.

Customer Convenience: Customer convenience and sentiments are very important to improve your sales. Customer database, history of buying (first time buyer or regular buyer), importance of the customer (low value or high value) and categorization are important. Catching sentiments of the customers and working on that will fetch more dividends in business. Examples are birthday, wedding day and special occasions greetings and offering discounts sales or gifts will do lot many things in rural supply chain management.

To Do Activity

Visit a cooperative society to study their present supply chain management. Suggest scope of improvement in their supply chain. Submit a report.

5.5 Case Studies

Case Study 1: Mahindra & Mahindra

Mahindra & Mahindra (M & M) is a major player in the tractor and certain segments of the automobile market in India. After an impressive growth for a few years, the tractor market in India has been stagnating during 1998-1999 to 2000-2001.

M & M has been selling its tractors and utility vehicles in foreign markets including USA. Some of the components for its products have been sourced from abroad. M & M has a 100 per cent subsidiary in USA, Mahindra USA, with a strong network of 100 dealers. Mahindra has a five per cent market share in the US market in the 20-30 horse power (HP) range. As a part of the strategy aimed at building a global supply chain, Mahindra USA has signed a memorandum of understanding (MoU) with the Korean tractor major Tong Yang, a part of the \$ 2 billion Tong Yang Moolsam group, according to which Mahindra will source high horse power (mostly 25-40 hp range) and sell them around the world under the M & M brand name. To start with, the premium range of tractors will be sold in the US. M & M's current tractor range is more utility-oriented and lacks the aesthetic appeal that Tong Yang's tractors have a must for a strong presence in the US market.

Discussion Questions:

- 1) What are the advantages and disadvantages of global sourcing?
- 2) How will the foreign market expansion help M & M?
- 3) How does the strategic alliance with Tong Yang benefit M & M?
- 4) What are the possible risks of the alliance? How can they be overcome / minimized?

Case Study 2: Foreign Retailers in India

For years now, there has been intense debate in India about the wisdom of relaxing the country's restrictions on foreign direct investment into its retail sector. The Indian retailing sector is highly fragmented and dominated by small enterprises. Estimates suggest that barely 6 percent of India's almost \$500 billion in retail sales take place in organized retail establishments. The rest takes place in small shops, most of which are unincorporated businesses run by individuals or households. In contrast, organized retail establishments, account for more than 20 percent of sales in China, 36 percent of sales in Brazil, and 85 percent of all retail sales in the United States. In total, retail establishments in India employ some 34 million people, accounting for more than 7 percent of the workforce.

Advocates of opening up retailing in India to large foreign enterprises such as Wal-Mart, Carrefour, IKEA, and Tesco, make a number of arguments. They believe that foreign retailers can be a positive force for improving the efficiency of India's distribution systems. Companies like Wal-Mart and Tesco are experts in supply chain management. Applied to India, such know-how could take significant costs out of the economy. Logistics costs are around 14 percent of GDP in India, much higher than the 8 percent in the United States. While this is partly due to a poor road system, it is also the case that most distribution is done by small trucking enterprises, often with a single truck, that have few economies of scale or scope. Large foreign retailers tend to establish their own trucking operations and can reap significant gains from tight control of their distribution system.

Foreign retailers will also probably make major investments in distribution infrastructure such as cold storage facilities and warehouses. Currently, there is a chronic lack of cold storage facilities in India. Estimates suggest that about 25 to 30 percent of all fruits and vegetables spoil before they reach the market due to inadequate cold storage. Similarly, there is a lack of warehousing capacity. A lot of wheat, for example, is simply stored under tarpaulins, where it is at risk of rotting. Such problems raise food costs to consumers and impose significant losses on farmers.

Farmers have emerged as significant advocates of reform. This is not surprising because they stand to benefit from working with foreign retailers. Similarly, reform-minded politicians argue that foreign retailers will help to keep food processing in check, which benefits all. Ranged against them is a powerful coalition of small shop owners and left-wing politicians, who argue that the entry of large, well-capitalized foreign retailers will result in the significant job losses and force many small retailers out of businesses.

In 1997, it looked as if the reformers had the upper hand when they succeeded in changing the rules to allow foreign enterprises to participate in wholesale trading. Taking advantage of this reform, in 2009 Wal-Mart started to open up wholesale stores in India under the name Best Price. The stores are operated by a joint venture with Bharti, an Indian conglomerate. These stores are only allowed to sell to other businesses, such as hotels, restaurants, and small retailers. By 2012, the venture had 20 stores in India. Customers of these stores note that unlike many local competitors, they always have products in stock, and they are not constantly changing their prices. Farmers, too, like the joint venture because it has worked closely with farmers to secure consistent supplies and has made investments in warehouses

and cold storage. The joint venture also pays farmers better prices—something it can afford to do because far less produce goes to waste in its system.

For its part, in 2011 the Indian government indicated that it would soon introduce legislation to allow foreign enterprises like Wal-Mart entry into the retail sector. On the basis on this promise, Wal-Mart and Bharti were planning to expand downstream from wholesale into retail establishments, but their plans were put on hold in late 2011 when the Indian government announced that the legislation had been shelved for the time being. Apparently, opposition to such reform had reached such a pitch that implementing it was not worth the political risk. Opponents argued that global experience showed that FDI leads to job losses, although they cited no data to support this claim. Whether, India will further relax regulations limiting inward FDI into retail remains to be seen.

Discussion Questions:

1. Why do you think that the Indian retail sector is so fragmented?
2. What are the potential benefits to India of entry by foreign retail establishments? Who are the potential losers here?
3. Who stands to lose as a result of foreign entry into the India retail sector?
4. Why do you think reform of FDI regulations in India has been so difficult?

Case Study 3: Fevikwik Todo Nahi Jodo

With all the great campaigns that were made in the past, this is a personal favorite and has Top of the Mind (TOM) recall. The ad was released during ICC World Cup 2015 weeks before India vs Pakistan match. The ad showcases two soldiers representing both the nations at the Wagah border for the ‘ Beating Retreat ‘ ceremony, until something unexpected happens. During the act the Indian soldier notices that his Pakistani counterpart had some problem with his shoe sole. To save his counterpart from embarrassment the Indian soldier uses Fevikwik on his sole and makes it perfect again. The ad was aired during World Cup 2015 when the sentiments were at an all-time high to support India. After the ad was uploaded on Fewikwik’s You Tube channel it crossed a viewership of 9, 50,000 views! The brand promoted the ad with hashtag# Todo Nahi Jodo.

Discussion Questions:

1. What are the lessons learnt from the caselet?
2. Give your views to promote rural products (say mud pats) to urban markets.
3. Prepare new idea to market a handmade soaps car in the similar way to the rural markets.

Case Study 4: Exporting Disposable Plates to European Market

It is trend now to use disposable plates and glasses for any functions. Thermocoal responds very slowly to bacterial decomposition in the soil, thus making the soil infertile. It also releases poisonous gases on burning, which can cause respiratory problems, or even death, when inhaled. Considering the harmful effects, a group of business graduates have started the business of marketing and selling the eco-friendly plates made of areca palm leaves as a viable alternative to thermocoal. They have carried out an awareness campaign to generate sufficient demand for the products. Through they have made considerable progress in business, they realized that the ecological sensitivity is not high and the business did not grow very fast. It was at this time, one of their friends advised them to look for European market. The Europeans are very conscious about the environmental protection and adopt a eco-friendly way of living. They have decided to enter the European market by exporting the plates to Europe.

Discussion Questions:

1. What are the criteria's to be adopted for conducting market study to determine the demand? Explain how these strategy help in the European Market.
2. Suggest few strategies to Brand their products in the European Market.
3. Suggest plans to promote businesses for such items.

Case Study 5: Overall Improvement of the Company

A Jaggery (sugar) manufacturing company operates a centrally located storeroom in their manufacturing unit. Every afternoon each supervisor / foreman (sugarcane juice extraction shop, juice boiling shop, jaggery in the form balls preparation shop, packing shop etc) writes a requisition for common use items that will be required for the next weeks work. These common use items include consumables, nuts, bolts, gloves, belts, washers, and flashlight batteries. All specialty items are ordered separately. During the night shift, storeroom personnel fill the orders of items requested by the supervisor. Each morning, one or two workers from each department go to the storeroom with a four-wheel platform truck to pick up the filled order. Although studies have never been performed to determine the amount of time supervisors spend waiting for supplies, it is the thoughts of the management that idle manpower is a problem resulting from this procedure. How can time spent travelling to and from the described storeroom be reduced, thus eliminating or decreasing supervisors' personnel travelling time?

Discussion Question:

You are welcome to give any other suggestions for adding new methods and techniques for overall improvement of the company.

Summary of the Chapter

In this chapter, the current opportunities along with different job profiles and emerging new tools like Blockchain, AI, AR & VR, data science and supply chain analytics are explained. Students and future managers should develop new skills to grab the job opportunities are amplified. Different models of GST, history of GST in India, GST rates with specific reference to rural products are highlighted. FDI is an important strategic tool used by India in various sectors and activities are explained. Two illustrations have been included for better learning. FDI's importance and its benefits are prompted. In this chapter, the role of supply chain managers including in rural supply chain management is also highlighted with examples. Rural supply chains are playing an important role in the economic development of India. So, role of rural managers with specific reference rural supply chain management and their focus are highlighted.

Model Questions

1. List out the current opportunities in supply chain management.
2. Explain the role of logistics manager.
3. What is GST? Identify the GST rates levied for rice, farm tractors and fertilizers
4. Describe the benefits if GST implementation.
5. What is FDI? Why countries are looking for FDIs?
6. Explain the main impacts of FDI with examples.
7. Whether FDI will help rural supply chains, if yes how? If no, why not?
8. Identify the present conditions of rural supply chains.
9. Describe the role of managers in rural supply chain management
10. What is profit centre concept? Suggest ways to improve supply chain performance in rural supply chains.

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Additional Case Studies

Case Study 1: A Progressive Farmer

Suresh is a progressive farmer in Godhavari District, who wishes to export his agricultural products by processing them. He needs proper guidance in this regard. Supposing, he has approached you for guidance, guide him by elaborating following points.

- i. Types of products available for processing
- ii. Methods of processing
- iii. Finance
- iv. Export procedure
- v. Goods and Services (GST) compliance

Case Study 2: Co-operative Farming and Marketing

Thenali is a village. The main business of the village is Agriculture. The villagers in panchayat decide to do Co-operative farming & marketing of vegetable. Suggest them.

- i. Direct Sales & Marketing strategies
- ii. Crop pattern
- iii. Cultivation mode
- iv. Supply chain management challenges

Case Study 3: Food Processing for Exports

Nagesh exported 1200 containers of processed vegetables and fruits to United Kingdom. To his dismay the authorities rejected all the containers. Nagesh was at loss to understand what has happened after so much care that he had taken. As his manager suggest Nagesh.

- i. The remedial measures to be taken over to recover loss
- ii. Give him insights into key challenges to food processing industry in India
- iii. Discuss with Nagesh to discuss the right supply chain for his products.

Case Study 4: ABC & Café Coffee Day: A lot can happen over coffee

Background

Café Coffee Day (CCD) is owned by the ABCTCL, which is the largest producer of Arabian Coffee in Asia started in 1996 by VG Siddarth, Coffee Café Day pioneered the café concept in India by 2000, and the company has just 14 outlets in six cities. Then the company has on a massive expansion program that has seen it set up nearby 1000 outlets in India in ten years. It is also has shops in Vienna and Karachi and has plans to expand to other overseas destinations.

Key initiatives of Coffee Café Day

Brand experience: Coffee Café Day made coffee drinking popular among India youth by offering a brand experience environment and other value additions. This meant that customer were willing to pay much higher for a cup of coffee.

Reinforcing brand with cluster approach: Coffee Café Day created entry barriers by opening multiple

outlets with short distance of each other in major cities. The Mumbai suburbs of Bandra, for example has six outlets.

Multiple formats: Coffee Café Day has various formats of cafes including high street cafes, garden cafes, mall cafes, highway cafes etc.

Company owned franchisee: All the outlets are company owned, while thus makes it more expensive to run, it enforced that there was no brand dilution.

Vertical Integration: By integrating the value chain, ‘**from bean to the cup**’, Coffee Day Café was able to reduce costs, assure adequate supply demand and gain economies of operation.

Other details

There are 900 plus café coffee day shops in 130 cities in India. All the shops are owned and operated by the company. The store ranges from 800-2000 square feet. Coffee Café Day was voted India’s second most trusted brand in ‘Food Services’ in the Economic Times Brand Equity Survey 2008. Around 4,50,000 customers visit Coffee Café Day shops every day.

Discussion Questions:

- i. How do we measure process effectiveness and efficiency?
- ii. How do we measure financial success?
- iii. Discuss the key initiatives taken by Coffee Café Day.
- iv. Identify the supply chain issues in the coffee vending business.

Case Study 5: Indian Tobacco Company (ITC) – e- Choupal

Background

ITC is a leading Indian company with the gross sales of around Rs. 75,000 crores during the financial year 2020-21. Its International Business Division was created in 1990 for trading in agricultural commodities. The concept of e- Choupal was introduced in June 2000 as an initiative to improve the supply chain by linking directly with farmers for procurement. It was also designed to play the role of a social gathering place, for the exchange of information as well as a place for e-commerce transactions. What started initially as a way to modify the procurement process for crops like soy, and wheat, has now turned into a lucrative distribution and product development channel for ITC. The e-Choupals are operated by a sanchalak (operator), who also doubles up as an ITC salesman. A farmer can visit the kiosk and show a sample of his produce to the sanchalak, who gives him a quote. If the farmer finds the quote attractive, he can take the produce to an ITC collection centre and receive payment within two hours. The e-Choupal also provides other information to the farmer, including crop-prices, weather and knowledge on scientific farming techniques.

Innovative Strategies

The e-Choupal provided several economics benefits to ITC as well as the customer. Web-enabled real time data on crop prices provide the farmer with the market prices for their produce. ITC gains as intermediaries are removed, and transportation costs decrease.

The intermediaries were not removed from the value-chain; instead they were made as samyojaks (coordinators) who assist ITC in setting up new e-choupals. They also handle the physical

transportation of the goods and earn a commission on it.

By providing information on weather and scientific farming methods, and the supply of high quality farm inputs, ITC enabled the farmers to improve their efficiency and quality of their output. This also provided indirect benefits to the company reducing the risk in several areas of the supply chain e-Choupal also provided ITC with an effective marketing vehicle. ITC gives “Bonus points” for produce which are much higher than quality norm. This can be exchanged for other ITC products. ITC also uses e-Choupal as a medium to advertise consumer products.

Other Details

Launched in 2000, e-Choupal’s services now reach four million villagers growing a range of crops including soybean, coffee, maize, wheat, rice, pulses and shrimp in over 40,000 villages across 10 states in India. Farmers using e-Choupal on an average receive 2.5% higher prices than the traditional mandi system.

Discussion Questions:

- i. What is value chain? Suggest ways to improve value chain.
- ii. Who could create more value with our customer base than we can? Why?
- iii. Discuss the salient features of e- Choupal initiative of the company ITC and Its benefits

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Editors' Profile

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Dr. W. G. Prasanna Kumar, PhD in Education with basic degree in Social Work and Master's Degrees in Sociology, Public Administration and Political Science has professional education in Environmental Economics, Public Relations, Communication and Training and Development. Presently Chairman, Mahatma Gandhi National Council of Rural Education (MGNCRE) under the Ministry of Human Resource Development, in Government of India strives to promote resilient rural India through Higher Education interventions. The national initiative of reviving Mahatma Gandhi's ideas of NaiTalim, spearheaded by Dr. W G Prasanna Kumar, has met unprecedented success at both national and state levels. The primary objective of this initiative is to promote Gandhiji's ideas on Experiential Learning, NaiTalim, Work Education and Community Engagement, and mainstreaming them in School Education and Teacher Education Curriculum & Pedagogy. As Professor and Head Centre for Climate Education and Disaster Management in Dr MCR HRD Institute, conducted several capacity building and action research programmes in climate education, disaster management and crowd management. He has handled many regional, national and international environmental education programmes and events including UN CoP11 to Convention on Biological Diversity and Media Information Management on Environmental Issues.

He was Director in National Green Corps in the State Government for over 11 years and Senior Social Scientist in State Pollution Control Board for 6 years. Conducted various curriculum and non-curriculum related training programmes in environmental education. He was a Resource Person for AP Judicial Academy, AP Police Academy, AP Forest Academy, EPTRI, Commissionerate of Higher Education and Intermediate Education, State Council for Educational Research and Training and National Council for Educational Research and Training New Delhi, CCRT, Bharathiya Vidyapeet University Pune, CPR Environmental Education Centre Chennai and Centre for Environment Education Ahmedabad. Dr W G Prasanna Kumar was trained in Community Consultation for Developmental Projects in EPA Victoria Australia in 1997 trained as State Chief Information Officer by IIM Ahmedabad and MCRHRDI Government of Andhra Pradesh in 2004 and trained in Environmental Education and Waste Management Technique by JICA, Japan in 2011.

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Dr.Sengottuvelu has conducted FDPs under the sponsorship of AICTE. He has organized conferences / workshops under the sponsorship of ICSSR and Consultancy Development Centre (CDC), DSIR, Govt. of India. He has organized number of MDPs to the Managers of Nitta Gelatin India Ltd, and Indian Oil Corporation Dealers in Kerala. He is also a recognized doctoral supervisor for two universities. Three research scholars have already been awarded with doctoral degrees under his guidance and three more are ongoing.



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