


# LOGISTICS AND SUPPLY CHAIN MANAGEMENT

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# SYLLABUS

## Logistics and Supply Chain Management

***Objectives:*** This course introduces the concepts of Logistics and Supply Chain Management. It also provides an understanding of Logistics while underlining the importance Supply Chain Management in different kinds of Industries. This course provides an integrated view of purchasing, production, inventory, transportation, warehousing and administration.

| Sr. No. | Description |
|---|---|
| 1. | **21st Century Supply Chains:** Introduction and Concepts, Generalised Supply Chain Model, Financial Sophistication, Logistics Value Proposition, the Work of Logistics, Logistical Operations, Logistical Operating Arrangements, Flexible Structure, Supply Chain Synchronization. |
| 2. | **Customer Accommodation:** Customer-focused Marketing, Customer Service, Customer Satisfaction, Customer Success, Forecasting, CPFR, Procurement and Manufacturing. |
| 3. | **Information Technology Framework:** Comprehensive Information System Integration, Communication Technology, Rationale for ERP Implementation, ERP System Design, SC Information System Design. |
| 4. | **Inventory:** Functionality and Definitions, Inventory Carrying Cost, Planning Inventory, Managing Uncertainly, Inventory Management Policies and Practices. |
| 5. | **Transportation:** Transportation Infrastructure; Transport Functionality, Principles & Participants, Regulations, Transport Structure, Transport Service, Transport Operations; Transport Economics and Pricing, Transportation Administration, Documentation. |
| 6. | **Warehousing:** Strategic Warehousing, Warehouse Operations, Ownership Arrangements, Warehouse Decisions, Warehouse Management Systems. |
| 7. | **Packaging and Material Handling:** Packaging Perspectives, Packaging for Material Handling Efficiency, Materials Handling, Supply Chain Logistics Design: Global Strategic Positioning; Global SC Integration, SC Security, International Sourcing. |
| 8. | **Network Integration:** Enterprise Facility Network, Warehouse Requirements, Total Cost Integration, Formulating Logistical Strategy. |
| 9. | **Logistics Design and Operational Planning:** Planning Methodology Phase-I, II and III, SC Analysis Methods and Techniques. |
| 10. | **Supply Chain Logistics Administration:** Relationship Development and Management, Operational, Financial and Social Performance. |

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# Unit 1: 21st Century Supply Chains

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## Objectives

After studying this unit, you will be able to:

- Explain the Concepts of Supply Chains
- Discuss the Generalised Supply Chain Model
- Get an Overview of Value Chain
- Describe the Supply Chain Effectiveness
- Discuss about Financial Sophistication
- Provide Insight into Logistics in 21st Century

Notes

## Introduction

Supply Chain Management (SCM) maximizes profit by integrating three key flows across the boundaries of the companies that form the supply chain: flow of value (product/materials), information, and funds. Successful integration or coordination of these three flows produces improved efficiency and effectiveness for business organizations. In theory, supply chains can work as cohesive, singularly competitive units similar to a large, vertically integrated firm, without significant financial investments by the members of the chain. The basic difference between vertically integrated firms and a supply chain is that firms in a supply chain are relatively free to enter and leave supply chain relationships if these relationships are no longer proving beneficial.

This poses challenges; supply chains are often very dynamic or fluid, partners can change, each partner will look out for its long term advantage, and this can also cause problems in effectively managing supply chains. While supply chain management may allow organizations to realize the advantages of vertical integration, certain conditions must be present for successful supply chain management to occur. It also creates competition amongst supply chains and supply chain partners, therefore, supply chains can operate more effectively than many vertically integrated conglomerates.

## 1.1 Concepts of Supply Chains

Historically built on Procurement, Operations and Logistics foundations; Supply Chain Management exceeds these traditional concepts. Supply Chain Management is involved with integrating three key flows, between the different stages, across the boundaries of the companies:

- Flow of information,
- Product/materials, and
- Funds.

Members of the supply chain act as partners who are "linked" together through both physical and information flows. It is this that makes an effective supply chain. The flows that involve the transformation, movement, storage of goods and materials and money are called 'physical flows'. These flows are easily visible.

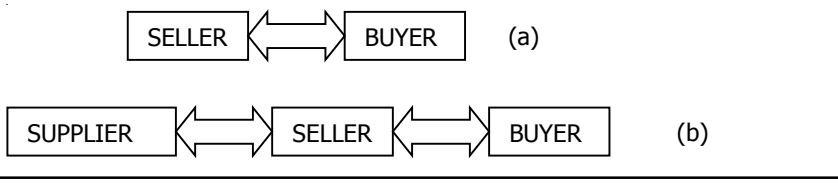
The physical flows are reinforced by information flows. Information flows are used by the various supply chain partners to coordinate their long-term plans, as well as efficiently control the day-to-day flow of goods and material to the supply chain. In essence, the supply chain enables the flow of products, services, and information goes both up and down the chain. Successful integration or coordination of these three flows produces improved efficiency and effectiveness for business organizations.

'Supply Chain Management' can be defined as the active management of supply chain activities to maximize customer value and achieve a sustainable competitive advantage. It represents a conscious effort by the supply chain firms to develop and run supply chains in the most effective and efficient ways possible. There can be various types of supply chains. There is a basic supply chain, and an extended supply chain. The definition of a basic supply chain is: a set of three or more companies directly linked by one or more of the upstream or downstream flows of products, services, finances and information from a source to a customer.

An extended supply chain includes suppliers of the immediate supplier and customers of the immediate customer, all linked by one or more of the upstream and downstream flows of products, services, finances, and information.

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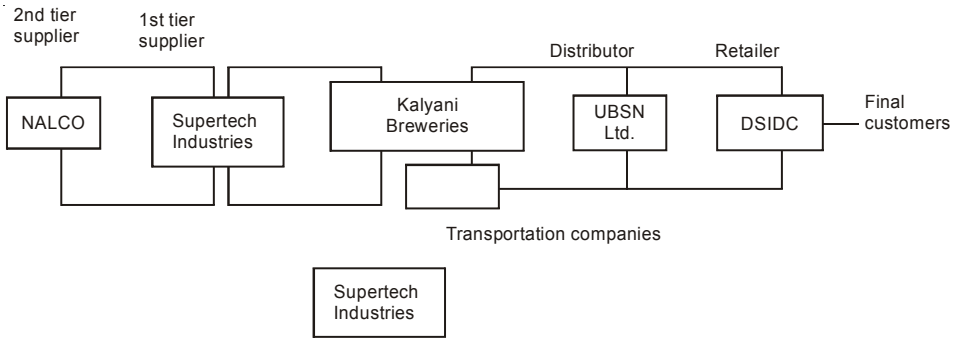
**Figure 1.1: (a) Traditional Supplier-Buyer Relationship, (b) Basis Supply Chain**




***Source:*** Upendra Kachru (2010), "Exploring the Supply Chain," Excel Books

Figure 1.1 shows a traditional seller-buyer relationship (a) and a basic supply chain (b). An extended supply chain is the supply chain shown in Figure 1.2. An extended supply chain consists of a number of relationships. These are called tiers. The simplified version of the supply chain of Kalyani Breweries, exemplifies this.

**Figure 1.2: A Simplified View of Kalyani Breweries Supply Chain**




***Source:*** Upendra Kachru, (2010), "Exploring the Supply Chain," Excel Books

For the product to reach a typical customer who goes to the shop to buy beer, these linkages and the steps necessary to bring the product to him are not probably apparent.

*Example:* Take Cans

National Aluminum (NALCO) extracts the aluminium ore and converts it into aluminium metal. The aluminium metal is shipped to Supertech Industries at Bangalore, who convert the aluminium into cans. Supertech Industries supplies cans to Kalyani Breweries. As Supertech Industries supplies directly to Kalyani Breweries, it is a first-tier supplier in the supply chain. Using the same logic, NALCO is a second-tier supplier. It is the supplier of a supplier.

The beer is produced from other raw materials, such as barley, hops, yeast, and water. Aluminium cans from Supertech Industries used to contain the product and combined with cartons, to produce the packaged beverage. Kalyani Breweries then sells the packaged beverage to UBSN Ltd., the distributor, who in turn sells the finished good to retailers like DSIDC. Transport carriers, who move the inputs and outputs from one place to the next along the supply chain, provide the logistic support.

In the example given, we see that goods and information flow travels both ways. In other words, members in a supply chain are both customers and suppliers, with respect to these flows.

*Example:* Supertech Industries places an order (information) with Nalco, who in turn ships aluminium (product) to Supertech Industries.

**Notes**

Supertech Industries is, therefore, a customer to Nalco and a supplier to Kalyani Breweries. We can visualize an extended relationship where Kalyani Breweries returns empty pallets or containers to its first-tier suppliers. This would result in a flow of physical goods back up the supply chain. If this happens, Kalyani Breweries becomes a supplier to Supertech Industries. This is in addition to its being the customer. An organization can be part of numerous supply chains. This follows from the definition given earlier.

For any supply chain, there is only one source of revenue: the customer. At DSIDC, a customer purchasing beer is the only one providing positive cash flow for the supply chain. All other cash flows are simply fund exchanges that occur within the supply chain given that different stages have different owners. When DSIDC pays its supplier, it is taking a portion of the funds the customer provides and passing that money onto the supplier. It is all these flows – information, products, or funds - that generate the costs within the supply chain.

The appropriate design of the supply chain will depend on both the customer's needs and the role of the stages involved. This relationship reflects a single strand in the supply chain. In a typical supply chain, there are many more participants than the ones – Kalyani Breweries has hundreds of suppliers who provide barley, hops, yeast, cartons, etc. It also has a large extended network of retailers throughout the country whose number is even higher.

Regardless of the number and different types of suppliers a firm uses to satisfy its requirements, the overall structure and its essential interfaces and control processes have to be identified, irrespective of how vast and complex the system is.

Any operation or facility in one supply chain arrangement may also be a part of different supply chains.



*Example:* As was mentioned earlier, Dabur is a part of the supply chain for consumer care products, consumer health products, food products, and home products.

A supplier typically participates in numerous different supply chains, which may involve a wide variety of industries and customers. In the case of the mail order business, such as Amazon.com, the company maintains an inventory of product from which it fills customer orders. In the case of retail stores, the supply chain may also contain a wholesaler or distributor, the store and, the manufacturer. The final consumer is always considered a member of the supply chain.

There can be many types of supply chains.



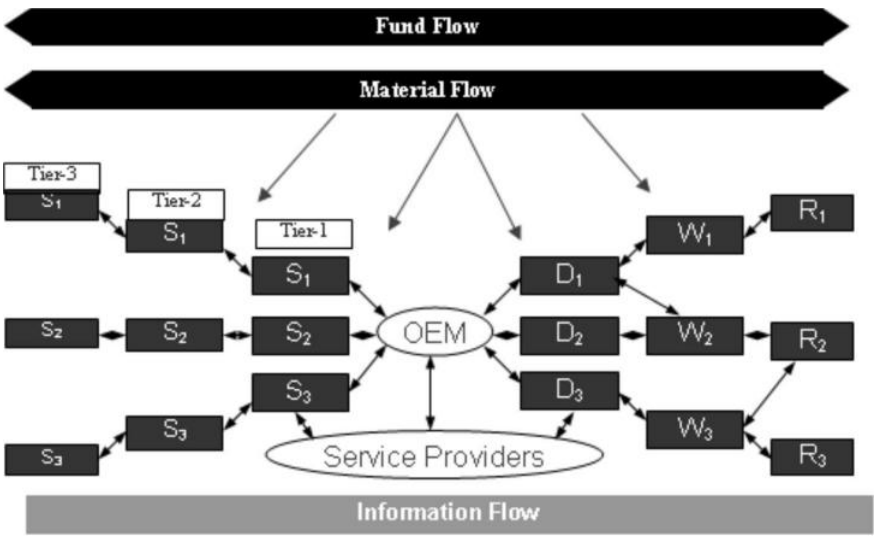
*Example:* A third-party logistics (3PL) provider may be a member of two supply chains where it is performing the logistics activities between companies that conventionally compete with each other.

An example of an even more complex relationship could be the case of Reliance Communications. Reliance Communications might find Nokia to be a customer in one supply chain, a partner in another, a supplier in a third, and a competitor in still a fourth supply chain. This multiple supply chain phenomenon also explains the complex nature of the network created by many supply chains.

In large enterprises, like Dabur, involved in marketing a broad product line to numerous customers – engaging in basic manufacturing and assembly, and procuring materials and components on a global basis, the supply chain is very complex. However, for any supply chain, there is only one source of revenue, the customer. Logically, the sources of cost are all flows of information, product, or funds. Thus, the appropriate management of these flows is a key to supply chain success. The conceptual framework of a supply chain is shown in Figure 1.3.

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**Figure 1.3: Conceptual Diagram of a Supply Chain**




***Source:*** Upendra Kachru, (2010), "Exploring the Supply Chain," Excel Books

In evaluating the success of the supply chain, the links between the manufacturer and the retailer have to function at a desired level. Even when the performance at earlier stages of the supply chain is outstanding, this is not important – if the product is not available to support retail sales. This is because the end customer is the only source of revenue for the supply chain and the linkage is the ultimate test to the success of the supply chain.

The basic objective of Supply Chain Management is to maximize the supply chain profitability. A more successful supply chain will, therefore, have higher profitability. The profitability of a supply chain is the difference between what the customer pays for the final product and the costs the supply chain expends in filling the customer's request.

FMCG major Hindustan Lever has reduced its inventory from about 45 days to less than 5 days; Mahindra & Mahindra has been able to reduce its inventory by 20-50 days, while in LG's case, the reduction has been around 30 days. These companies attribute a significant part of their success to the way they manage the operations of their supply chain.

*Caselet*

## Supply Chain Management of Dabbawala

As the story of the semi-literate tiffin-wallahs shows, a world-class supply chain basically requires the coordination of information and activities from the housewife (she supplies the tiffin and is considered as the supplier in the supply chain context) to the householder (he receives the tiffin and is the client), trust between the tiffin-wallahs (firms) and management of relationships (NMTBSCT).

How does this supply chain system work? The tiffin is filled with lunch at the client's kitchen by the housewife and kept outside the door of the residence at 8.25 a.m. At 8.30 a.m., the tiffin-wallah arrives, picks up the tiffin and moves on, knocking at the door only if the tiffin is not seen. Under normal circumstances, there is no interaction with any member of the client's household. By 8:38 a.m. the tiffin is placed on the bicycle or pushcart together with tiffins collected from other customers.

*Contd...*

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Bicycles and pushcarts drawn by individual tiffin-wallahs arrive from various collection centres to the suburban railway station by 9:20 a.m. At the stations, the sorting operation begins with tiffins sorted according to destinations and placed in cartages that are specific to each destination. The cartages come in two standard sizes, accommodating 24 and 48 tiffins each. This is completed by 9:41 a.m., when the suburban train arrives. The cartages, normally numbering 5-6, are loaded into the special compartment located next to the driver's cabin.

The train arrives at one of the major hubs by 10:21 a.m. The cartages are unloaded and bundled with those arriving from other collection centres. They are resorted according to destinations. By 11:05 a.m., the cartages are located into the suburban train for onward journey to the final destination terminals. When the suburban train reaches the terminal station, cartages are unloaded and tiffins are resorted, now according to specific delivery routes.

By 12:10 p.m., the tiffins are placed in destination-specific cartages and hitched, typically onto bicycles or pushcarts for delivery to individual clients and delivered at the doorstep of the client's workplace, at the latest by 12:30 p.m. The delivery process is reversed in the afternoon. The empty tiffin is picked up between 1:15 p.m. and 2:00 p.m. for its return to the client's home early that evening (e.g. by 5:30 p.m.).

As will be apparent, the whole operation is a marvel of product movement (through co-ordination, trust, multi-tasking and role changes) and perfect exchange of information (through the coding system, rail timings, and knowledge of Mumbai's geography) – this is a perfect supply chain. The supply chain is about information use and it is about product movement. There are three key areas of focus:

(a) Proper information use,

(b) Proper product movement, and

(c) Proper relationship management.

Factors that assist in enhancing information use, relationships, or product movement, help in improving and creating excellence in the supply chain.

***Source:*** Upendra Kachru, (2010), "Exploring the Supply Chain," Excel Books

### Self Assessment

State whether the following statements are true or false:

1. Members of the supply chain act as partners who are "linked" together through both physical and information flows.
2. Logistic can be defined as the active management of supply chain activities to maximize customer value and achieve a sustainable competitive advantage.
3. For any supply chain, there is only one source of revenue: the customer.

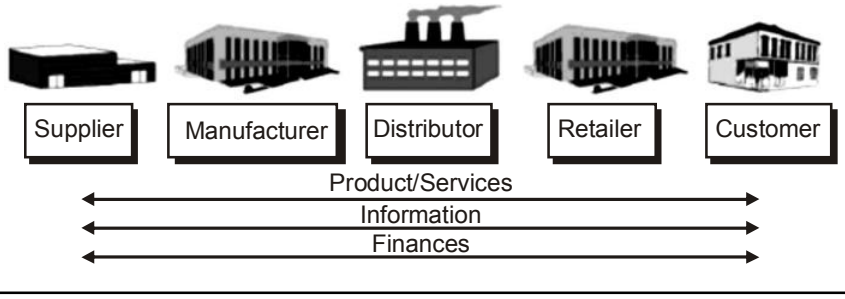
## 1.2 Generalised Supply Chain Model

The general concept of an integrated supply chain is typically illustrated by a line diagram that links participating firms into a coordinated competitive unit. A conventional supply chain is shown in Figure 1.4. It is a chain of firms that are involved in providing a product or service, each firm performing its own functions that begins activities with a customer order and ends when a satisfied customer has paid for his or her purchase. Generally, more than one player is

Notes

involved at each stage. A manufacturer may receive materials from several suppliers and then supply several distributors. Thus, most supply chains are actually networks.

**Figure 1.4: The Supply Chain**




***Source:*** Upendra Kachru, (2010), "Exploring the Supply Chain," Excel Books

Though many stages are shown in the Figure 1.4, each stage need not be present in a supply chain.

*Caution* The number of stages included should meet the primary purpose for the existence of the supply chain, i.e. is to satisfy customer needs.

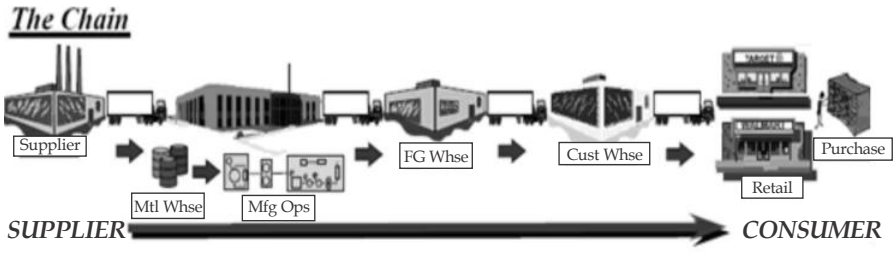
It is in the process that the organization generates profits for itself. A typical supply chain may involve a variety of stages. These supply chain stages include:

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

In materials management, most participants performed as buyers and sellers independently of other firms supplying to the buyer. Supply chain management differs in the sense that its efforts involve individual firms taking steps to improve the flow of information with its suppliers and reduce the variation in business processes and practices between the firms that form the supply chain. In essence, the supply chain concept tries to make each participant in the chain more efficient by coordinating their efforts towards a common goal.

A lot of interaction and trust between companies is required to make the supply chain work. In that respect, it is significantly different from materials management.

**Figure 1.5: Different Stages of a Supply Chain**




***Source:*** Upendra Kachru (2010). "Exploring the Supply Chain". Excel Books.

**Notes**

Consider the supply chain shown in Figure 1.5. The component supplier after making the component sends the material to the material warehouse. From the material warehouse, the material goes to the manufacturer. After completion of manufacturing operations, the material goes to the finished goods warehouse, where it is transferred to the customer warehouse on receipt of an order. From the customer warehouse, the product moves to the retail outlet, from where it is purchased by the customer.

This is basically what the philosophy of the supply chain management recognizes. Without the retail store, the supplier does not make any profit and without the supplier, the retail store has no business. In either case, the customer gets no value. But what does this mean in terms of the supply chain?

Firstly, every product that reaches an end user represents the cumulative effort of multiple organizations. And secondly, organizations have to pay attention to what is happening outside their "four walls" and manage the entire chain of activities that ultimately delivers products to the final customer in order to maximize profits. This means that the supply chain philosophy extends the concept of partnerships into a set of beliefs that each firm in the supply chain directly and indirectly affects the performance of all the other supply chain members. It also affects the ultimate, overall channel performance.

This philosophy recognizes that the purpose of supply chain management is to improve customer value and satisfaction. It directs supply chain members to focus on developing innovative solutions to create unique, individualized sources of customer value.



*Did u know?* The ultimate objective of Supply Chain Management (SCM) translates into a philosophy which has the following characteristics:

- Systems approach to viewing the channel as a whole, and to managing the total flow of goods inventory from the supplier to the ultimate customer,
- Strategic orientation towards cooperative efforts to synchronize and converge intra-firm and inter-firm operational and strategic capabilities into a unified whole, and
- Customer focus to create unique and individualized sources of customer value, leading to customer satisfaction.

SCM philosophy drives supply chain members to have a customer orientation. To do this successfully, you need to synchronize the intra-firm and inter-firm operational and strategic capabilities into a unified, compelling marketplace force. Therefore, the SCM philosophy suggests the boundaries of SCM include not only logistics, but also all other functions within a firm and within a supply chain to create customer value and satisfaction.

This follows directly from Forrester's early concepts. Forrester recognized the integrated nature of organizational relationships and argued that these influence the performance of different functions. He said, "Managements need to understand better the inter-relationships between separate company functions and between the company and its markets and its industry". The 'Forrester Effect' illustrates the phenomenon that he described. It shows the influence of order information flow on production and distribution performance for each supply chain member, as well as the entire supply chain system.

In adopting a supply chain management philosophy, firms must establish management practices that permit them to act or behave consistently with this philosophy. There are a number of activities that are necessary to implement an SCM philosophy successfully. In adopting a supply chain management philosophy, firms must establish management practices that permit them to act or behave consistently with the philosophy. Previous research has suggested various activities necessary to implement an SCM philosophy successfully.

**Notes**

The primary SCM activities are:

1. Integrated behaviour and integration of processes
2. Mutually sharing information
3. Mutually sharing channel risks and rewards
4. Co-operation
5. Goal-sharing and partnership

To be fully effective in today's competitive environment, firms must exhibit integrated behaviour with the supply chain partners, such as suppliers, carriers, and manufacturers, to dynamically respond to the needs of the end customer. Customer Relationship Management (CRM) and Demand Planning have given today's businesses better tools for managing and integrating customers' demands across a company's entire value chain. These tools, coupled with proven business strategies and processes, produce a uniform picture of demand that can then integrate the behaviour and drive all subsequent planning and operations helping in the integration of processes. The end result is an agile organization, capable of rapidly recognizing and responding to changes in the market.

Integrated behaviour and integration of processes leads to information sharing. Information sharing is the willingness to make strategic and tactical data available to other members of the supply chain. Open sharing of information such as inventory levels, forecasts, sales promotion strategies, and marketing strategies reduces the uncertainty between supply partners and results in enhanced performance.

Effective SCM also requires supply chain partners mutually sharing channel risks and rewards that yield a competitive advantage.



*Notes* Risk and reward sharing should happen over the long-term.

According to many experts, for long-term focus and cooperation among the supply chain members, risk and reward sharing is extremely important. Risk and reward sharing is a very, very difficult task. Though conceptually, it is possible, but no organization likes to forego its revenues and profits, and it becomes very difficult unless you can sell the benefits to the organization.

Co-operation among the channel members is required for effective SCM. Co-operation starts with joint planning and ends with joint control activities to evaluate performance of the supply chain members. It happens at several management levels involving cross-functional coordination across the channel members.

Getting people to co-operate is the most difficult part of supply chain management, even when it may produce superior mutual outcomes. People are generally concerned about them and would like to promote their individual parochial objectives and co-operation limits the freedom of firms to act in their own interest when performing similar or complementary activities.

A supply chain succeeds if all the members of the supply chain have the same goal and the same focus on serving customers. Establishing the same goal and the same focus among supply chain members means that they are working towards a form of policy integration. Most organizations go through four stages of policy integration:

***Stage 1:*** It represents the base line case. At this point, the supply chain is a function of fragmented operations within the individual company. It is based on traditional concepts and characterized

**Notes**

by staged inventories, independent and incompatible control systems and procedures, and functional segregation.

***Stage 2:*** It is the start of internal integration. It begins with a focus on cost reduction rather than performance improvement. It is characterized by an emphasis on internal trade-offs and reactive customer service.

***Stage 3:*** The firm attains internal corporate integration. It is characterized by full visibility of purchasing through distribution, medium-term planning, tactical focus, emphasis on efficiency, extended use of electronics support for linkages, and a continued reactive approach to customers.

***Stage 4:*** It has a strategic focus. The organization achieves supply chain integration by extending the scope of integration outside the company to embrace suppliers and customers.

All firms go through these four stages. Ultimately, policy integration is made possible by the supply chain members trying to create compatible cultures and management techniques. Collaboration takes place when two or more independent companies work jointly to plan and execute supply chain operations with greater success than when they are acting in isolation. This is not easy and requires a sustained effort through cross-functional teams, in-plant supplier personnel, and third party service providers.

Firms that have reached Stage 4 proceed to build-up a series of partnerships. Successful partnerships aim to integrate supply chain policy to avoid redundancy and overlap, while seeking a level of cooperation that allows participants to be more effective at lower cost levels. The organization should select a small number of partners to facilitate increased cooperation. You have an effective SCM when these partners build and maintain long-term relationships where the relationship time horizon extends beyond the life of the contract – perhaps indefinitely.

Supply Chain Management extends the supply chain philosophy across all members of the chain. By integrating behaviour and processes, sharing information, planning in collaboration with each other, sharing the risks and rewards, co-operation, goal sharing and partnerships, the operations in the supply chain can be streamlined and the profitability of all members in the chain improved.



*Example:* Dell and Wal-Mart have been the pioneers in this concept of Supply Chain Management.

They reflect some of the most successful examples of effective supply chain management. What is interesting is that they have created world-class supply chains by tackling the 'Forrester Effect' from different ends. Dell has been a pioneer in the build-to-order ('pull') cycle i.e. reducing forecasting based demand uncertainty, and Wal-Mart has been a pioneer in the use of information flow to reduce demand uncertainty.

Dell Computers builds-to-order, i.e. a customer order initiates manufacturing at Dell. Dell does not have retailers, wholesalers, or distributors in its supply chain. While other computer companies must stock a month of inventory, Dell carries only a few days worth of stock. It plans orders and signals suppliers every two hours, which enables it to manufacture and deliver exactly what its customers want. In fact, many of the components are delivered to Dell within a few hours of assembly and shipped to the customer.

The success of Wal-Mart is drawn from new technologies combined with new ways of doing business. It has used the power of information flow to create a global supply chain designed down to the last atom of efficiency. Automated replenishment and the smooth functioning of the Wal-Mart supply chain depend on reliable connectivity between the stores, the centralized database, and the distribution centres. The Wal-Mart network connects more than 2,400 stores, 100 distribution centres worldwide, and 950,000 Wal-Mart associates.

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The success of supply chains is based on their ability to deliver superior cost, quality, delivery, and technological performance. These, along with the process linkages between the participants, are critically important factors to make for a successful supply chain.

Finally, it is necessary to appreciate that in order to operate a supply chain successfully, you need to clearly understand intra-organizational and inter-organizational supply chain processes. Where organizations do not keep this in view or take too much time to evolve inter-organizational processes, it generally becomes too late for the supply chain to succeed. There are more failures in SCM than there are successes.

SCM is involved with integrating three key flows, between the different stages, across the boundaries of the companies:

- ***Product/Materials:*** This is the most obvious and visible part of the supply chain. Physically, the flow manifests itself in the form of goods and services. This is also called the 'value flow'. Goods and service flows follow a similar sequence.



*Example:* Goods flows constitute raw materials (including material being transported), work in process, finished goods, and spares, and reverse flows due to returns, rework or recycling of the goods. The vendor side of these flows is called 'upstream' and the flows towards the customer are referred to as 'downstream'.

- ***Flow of information:*** Information flows allow the various supply chain partners to coordinate their long-term plans, and to control the day-to-day flow of goods and material to the supply chain. It consists of flows both from vendor to the customer and from the customer to the vendor. The downstream flow of information has important components like capacity estimates for plans, stocks available, dispatch advices, stock transfer notes, quality assurance reports, warranties, etc. The upstream components of information flow are inputs for forecasts, marketing plans, dispatch plans, production plans and procurement quantities and timing, orders from customers and dealers, quality feedback, and warranties.
- ***Funds:*** This is the commercial part of the supply chain, and runs counter to the direction of the value flow. It reflects the money paid with respect to the transfer of title and/or service delivery in the supply chain. Other features of cash flow are credit periods/advances for payments from customers/dealers, and to vendors. The cash flow determines how the value flow is financed by the various actors in the supply chain.

### Self Assessment

Fill in the blanks:

4. In …… most participants performed as buyers and sellers independently of other firms supplying to the buyer.
5. SCM philosophy drives supply chain members to have a …… orientation.
6. Effective SCM also requires supply chain partners mutually sharing channel risks and rewards that yield a ……..

## 1.3 Value Chain

Within a typical enterprise the three areas, physical distribution, manufacturing support, and procurement overlap to provide integrated management of materials, semi-finished components, and products moving between locations, supply sources, and customers of the enterprise. Viewing each as an integral part of the overall value-adding process creates an opportunity to capitalize on the unique attributes of each while facilitating the overall process.

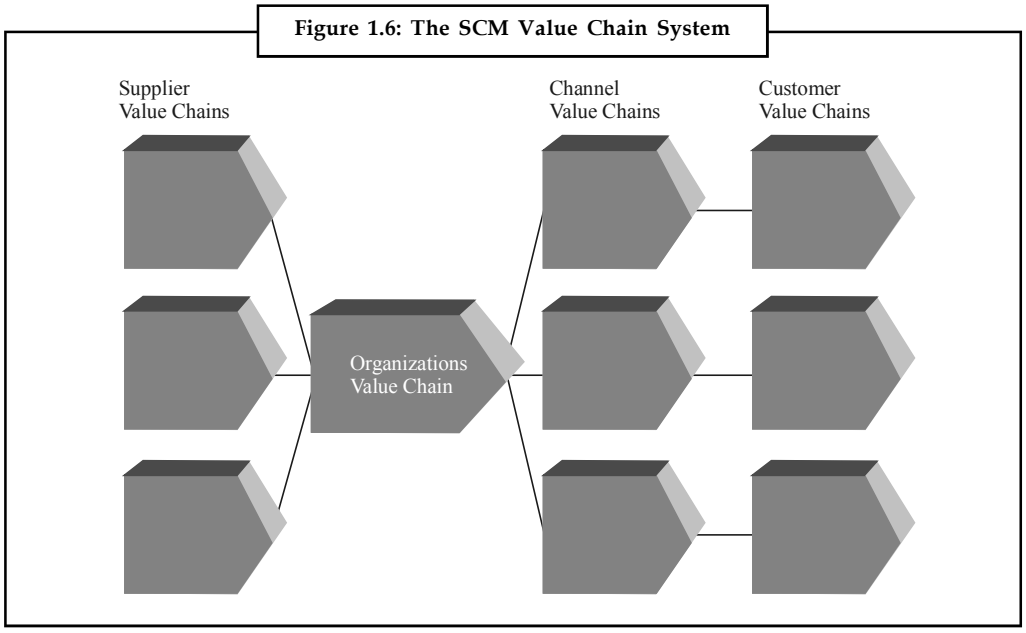
Notes

The product/material flow in a supply chain is concerned with the procurement, movement and storage of materials and finished products. For a large manufacturer, these operations may consist of thousands of components, raw materials and parts and their movements, which ultimately culminate in the delivery of products to an industrial user, retailer, wholesaler, dealer, or other customer.

*Did u know?* For a large retailer, supply chain operations may commence with the procurement of products from the manufacturer and may terminate with consumer pickup or delivery of the product.

One of the key features of modern industrial system is that organisations use specialist services, incorporate proprietary items into products, and develop ancillaries to support their product and services. Very rarely does a single company perform all activities from product design, production of components, and final assembly to delivery to the final user by itself. There is usually specialization of role and a number of organisations are involved in the creation of the final product. Therefore, all the organizations connected with delivering the product or services to the final consumer are elements of a value chain system of the supply chain. Figure 1.6 extends the concept of the value chain from a single enterprise to a supply chain.

**Figure 1.6: The SCM Value Chain System**




***Source:*** Upendra Kachru, (2010), "Exploring the Supply Chain," Excel Books

The value a supply chain generates is the difference between what the final product is worth to the customer and the effort the supply chain expends in filling the customer's request. Therefore, the profitability of the supply chain is based on the flows between and among stages in a supply chain, unlike the traditional measure of organizational success in terms of the profits at an individual stage. The final price of the goods should be such that it covers all of the costs involved, with a profit share for each participant in the chain.

Within the whole value system, there is only a certain value of profit margin available. This is the difference of the final price the customer pays and the sum of all costs incurred with the production and delivery of the product/service (e.g. raw material, energy etc.). The structure of the value system will determine, to a large extent, how this margin is distributed between the various elements of the value system.

Notes



*Example:* Suppliers, producers, distributors, customers, and others.

Each member of the value chain will use its standing in the value chain, market position and negotiating power to get a higher proportion of this margin. A successful value chain is developed when each member of the value chain believes that it obtains value from the relationship. The ability of an organization to influence the performance of other organizations in the value chain is often a core capability and a source of competitive advantage. Many organizations have special functions that are involved in ancillary development, dealer and distributor training, etc.

In looking at the strategic capability of an organisation, it is not sufficient to look inside the organisation. We must look into the interconnections. Much of the value creation will occur in the supply and distribution chain. Any analysis of the strategic capability has to be viewed from a holistic view that includes the entire value chain.



*Example:* An analysis into the value chain may show that some of these interconnections will be critical to the competitive advantage of the organisation; some can perhaps have substitutes; others can be eliminated.

Hence, value chain analysis should cover the whole value system in which the organization operates. A value chain is one of the most common sources of increasing the technological competence of organisations. Knowledge is spread between members in the value chain through the process of diffusion. This results in adding competencies both to the provider and receiver of the knowledge. The traditional structure of the Japanese industry is illustrative of this. Units attached to the mother unit cooperated with each other to improve their efficiency, teach each other and learn from each other new and better ways of accomplishing their tasks, and help each other to reduce their costs. In doing so, they are able to achieve a higher total margin to the benefit of all of the members in the system.

### 1.3.1 Value Chain Analysis

Value chain analysis is not a very difficult exercise conceptually. However, depending on the nature of the product, the linkages, the primary processes involved, etc. it is often an exercise that can be quite complex and requires a large amount of information and data processing capacity for the analysis. However, many of the concepts of breaking up functions into activities and attributing costs to them are now a standard cost accounting practice which makes the process easier. Once the basic information has been collected and the linkages established, it becomes a routine exercise. A typical value chain analysis can be performed in the following steps:

1. Analysis of own value chain – identify the primary and support activities. Each of these activity categories needs to be broken up into its basic components and costs are allocated to every single activity component.
2. Analysis of customers value chains – examine how does our product fit into the value chain of the customer.
3. Identify activities that differentiate the firm and the potential cost advantages in comparison with competitors.
4. Identify potential value added for the customer – how can our product add value to the customers value chain (e.g. lower costs or higher performance) – where does the customer see such potential?
5. The final step is to identify those activities that provide a differential advantage compared to competitors. These are the competencies or the core competencies of the organization.

Notes

A strong and supportive value chain works like the traditional Japanese system, where members of the chain look at the benefits that accrue to the entire value chain. Such cooperation is possible and often seen in such value chains, e.g. increasing productivity, reducing stocks at different levels, or process improvements etc., are undertaken by members of the value chain and the advantages that accrue benefit all members of the value chain.

### Self Assessment

Fill in the blanks:

7. The …… flow in a supply chain is concerned with the procurement, movement and storage of materials and finished products.
8. Within the whole ……, there is only a certain value of profit margin available.
9. A …… is one of the most common sources of increasing the technological competence of organisations.

## 1.4 Supply Chain Effectiveness

The effectiveness and value of the supply chain is determined by its ability to align with its partners, whether they are service providers, employees, suppliers or distributors. The processes and systems have to be set to common business goals. It includes the business activity analyses that allow you to optimize processes, both strategic and operational. Supply chain effectiveness is determined by some identified management traits that set them apart from others. These traits include the following:

### 1.4.1 Strategy

It starts with strategy. Firms with best supply chains have a corporate strategy that drives planning, tactical design, milestones and other steps in strategy development and implementation. The supply chain organization builds on and around this. The supply chain management strategy should enable firms to plan tactical operations and to prioritize suppliers, customers and products.

Strategy sets the platform for supply chain execution if the supply chain members understand the process crosses their company and extends beyond the company. The strategy has to be about the flow of products and information, which stretches from suppliers through to store shelves or to customer warehouses. If the company's strategy means a significant shift in markets, products or customers, then the supply chain must change.



*Notes* There is no such thing as "one" supply chain management approach and one-size supply chain does not fit all.

The strategy is long-term and has a growth focus. The strategy must be dynamic, and must take into account the resistance to change that can happen within companies. That means the supply chain strategy must be a facilitator of change, be agile and able to recognize, incorporate and adapt to drive toward the changes required.

### 1.4.2 Metrics

Results matter, but the right measures matter more. Performance management often gets lost in the maze of supply chain initiatives. There are many new initiatives firms are taking in SCM:

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Radio Frequency Identification (RFID), Six-sigma Quality, Lean Manufacturing, Outsourcing, Vendor-managed Inventory (VMI), Collaborative Planning, Forecasting and Replenishment (CPFR), Spend Management and Regulatory Compliance. All these initiatives promise to improve the speed of transactions, streamline processes, optimize throughput and minimize risk. But the effectiveness of these initiatives should also be evaluated as they relate in overall performance goals.

Financial measures are poor ways to evaluate, direct and manage supply chains. The key performance indicators are orders (if it is delivered complete, on time and accurate), lead-times, reliability, inventory levels, potential out of stock conditions and logistics costs. The metrics for these have to be got right.

### 1.4.3 Technology

Technology is a process enabler. Corporations invested trillions of dollars over the past two decades in supply chain management software and systems. Historically, however, their focus has been on improving transaction processing, streamlining processes and optimizing throughput – in short, on improving efficiency. Few firms, if any, have applied resources to supply chain effectiveness and the ability to plan strategically and detect exceptions before they become expensive problems.



*Caution* Without a strong process, many of the benefits of technology are lost or lessened.

Technology is vital for supply chain execution to provide event management, exception management, complete supply chain visibility from purchase orders to delivery orders, and as a tool for collaboration.

### 1.4.4 Supplier Performance

Supply chain success depends on supplier performance. Supplier performance, or the lack of, can create havoc on revenue, inventory and profitability. Companies and their supply chains must control suppliers, and gain insight into operational issues through interactions by identifying root causes and understanding the impacts of various actions. It is critical to align performance with demand planning. They should not let suppliers control their business as it will lead to much variability in performance.

### 1.4.5 Integration and Collaboration

The supply chain process requires integration throughout the organization and beyond with suppliers and customers Operations managers often make decisions about demand, supply, manufacturing, fulfilment and distribution without clearly understanding the impacts of these decisions on performance targets. This may result in gaps and blind spots in the supply chain that can significantly hinder results. Collaboration with key supply chain participants is important to provide additional focus and resources to the total supply chain.

### 1.4.6 Risk Mitigation

A supply chain is effective if the entire supply chain can be assessed to identify critical areas, including suppliers, logistics service providers, ports and other potential risks that could disrupt the company's supply chain and corrective action taken.

All this factors are critical for supply chain effectiveness. The supply chain, in the ultimate analysis, has to have agility and responsiveness to better adjust to changing market conditions and, to some degree, to control those forces.

Notes

### Self Assessment

Fill in the blanks:

10. …… sets the platform for supply chain execution if the supply chain members understand the process crosses their company and extends beyond the company.
11. Supplier performance, or the lack of, can create havoc on revenue, inventory and ……..
12. It is critical to align …… with demand planning.

## 1.5 Financial Sophistication

Few managers question the benefits of applying the time-based strategies to supply chain operations. However, a valid question is, How fast is fast enough? Speed simply for the sake of being fast has little, if any, enduring value. The answer concerning how much speed is desirable is found in the financial impact. The process of creating value dictates that faster, more flexible, and more precise ways of servicing customers are justified as long as they can be provided at competitive prices. A third force driving competitive supply chain strategy is the ability to manage in a timelier manner to achieve financially attractive working arrangements.

The financial benefits of timely response are straightforward. Fast delivery translates to less inventory and reduced need for distribution facilities. Faster to customers means less working capital is required to support supply chain operations. Three aspects of financial sophistication are cash-to-cash conversion, dwell time minimization, and cash spin.

### 1.5.1 Cash-to-Cash Conversion

The time required to convert raw material or inventory purchases into sales revenue is referred to as cash-to-cash conversion. Cash conversion is generally related to inventory turn: The higher the inventory turn, the quicker the cash conversion. A goal of supply chain design is to reduce and control order receipt-to-delivery time in an effort to accelerate inventory turns.

In traditional business arrangements, benefits related to cash-to-cash conversion have typically been enjoyed at the expense of business partners. Given typical purchase discounts and invoicing practices, it is operationally possible for arms to rapidly sell merchandise and still qualify for prompt payment discounts.



*Example:* Terms of sale offering a 2 percent discount net 10-day payment (2% no 10) means that a prompt payment discount is earned if the invoice is paid within 10 days from time of delivery. Thus, if the invoice is $1000, a payment made within 10 days will earn a $20 discount. If the firm sells the product for cash before the invoice payment date, it, in effect, enjoys free inventory and may even earn interest by investing cash while awaiting the payment date.

In response-based systems, cash-to-cash conversion benefits can be shared by managing inventory transfer velocity across the supply chain. This ability to manage inventory velocity from origin to final destination has the potential to achieve greater efficiencies than attainable by a single firm. Coordinated operations may require that a designated firm in the supply chain serve as the principal inventory stocking location.

Such practice means that risk and benefits related to inventory need to be shared by participating firms. To facilitate such arrangements, supply chain members often replace the discounts with dead net pricing. Dead net pricing means that all discounts and allowances are factored in the selling price. Thus, incentives for timely payment are replaced by specific performance

Notes

commitments at a specified net price. Invoice payment, based on negotiated net price is completed upon verification of physical receipt. Such payment is typically in the form of Electronic Funds Transfer (EFT), thereby streamlining both the flow of physical goods and cash among supply chain partners. Managing supply chain logistics as a continuous synchronized process also serves to reduce dwell time.

### 1.5.2 Dwell Time Minimization

Traditional distribution arrangements typically involve independent business units loosely linked together on a transaction-to-transaction basis. A transaction view of traditional business operations results in a series of independent transactions buffered by inventory. In contrast, a supply chain has the potential to function as a synchronized series of interdependent business units. At the heart of supply chain operating leverage is the willingness to transfer inventory on an as-needed basis, taking advantage of as much collaboration and information as possible. Such collaboration and information can be focused on maintaining the continued flow and velocity of inventory moving throughout the supply chain. The potential of such synchronization is a key benefit of supply chain connectivity. A significant measure of supply chain productivity is dwell time.

Dwell time is the ratio of time that an asset sits idle to the time required to satisfy its designated supply chain mission.



*Example:* Dwell time would be the ratio of the time a unit of inventory is in storage to the time that it is moving or otherwise contributing to achieving a supply chain's objectives.

To reduce dwell time, firms collaborating in a supply chain need to be willing to eliminate duplicate and non-value-adding work.



*Example:* If three different terms perform identical processes as a product flows along a supply chain, dwell times will accumulate.

Designating a specific firm to perform and be accountable for the value-added work can serve to reduce overall dwell. Likewise, timely arrival and continuous inventory flow between supply chain partners reduce dwell. When a product flows from a supplier through a retailer's cross dock sortation process without coming to rest or being diverted to warehouse storage, dwell time is minimized. A collateral benefit of reducing dwell time and the associated logistics cost is the ability to reduce investment in inventory and related assets.

### 1.5.3 Cash Spin

A popular term for describing the potential benefits of reducing assets across a supply chain is cash spin, sometimes referred to as free cash spin. The concept is to reduce overall assets committed to supply chain performance. Thus, a dollar of inventory or the rent of a warehouse, if eliminated by a reengineered supply chain arrangement, represents cash available for redeployment. Such free capital can be reinvested in projects that might otherwise have been considered too risky. Naturally, cash spin opportunity is not unique to the supply chain. The potential to spin cash applies to all areas of a firm. What makes the potential of supply chain cash spin so attractive is the opportunity to collaborate between firms. The benefits flowing from fast cash-to-cash conversion, reduced dwell time, and cash spin combine to increase the financial attractiveness of effective collaboration. Another major force driving expansion of supply chain management is the growing involvement of most firms in international operations. Expanded global business is a result of two significant opportunities: market expansion and operating efficiency.

Notes

### Self Assessment

State whether the following statements are true or false:

13. The time required to convert raw material or inventory purchases into sales revenue is referred to as cash-to-cash conversion.
14. Dead net pricing means that all discounts and allowances are factored in the selling price.
15. A transaction view of traditional business operations results in a series of independent transactions buffered by inventory.

## 1.6 Logistics in 21st Century

The changing business strategies in the 21st century drive the logistics management in enterprises. Implementation of relationship logistics model in the process of logistics management provide enterprises speed, flexibility and efficiency in their logistics functions.

In 21st century digital technologies enable the development of new economic models. Gradual reduction in the production costs effects demand and supply equilibrium. Reduction in costs leads to increase in supply. In this case, new marketing and distribution methods are required to meet the demand. As a result of successful logistics management faster flow of goods and services is achieved. In economies based on digital technologies payment systems are transferred to the electronic environment. It is possible to reach millions of people at the same time in the digital environment. Development of digital economy enables faster and more efficient sharing of information and thus the quality of logistics process improves.



*Caution* In digital environment it is ensured for all units of corporation to operate over a database system together with the suppliers and distribution channels.

New developments in internet area influence the market structure, consumption choices and competition in business world. As the organization structures of corporations get more simplified their logistics systems become elastic and quicker. The organization structures operating at 7 days 24 hours are becoming widespread. Markets now are more global and personal. Since customers are more informed about the developments, they desire to buy higher quality at a lower price. In digital environment everything is carried out "just in time". "Just in time" advertisement, "just in time" communication, and "just in time" delivery are becoming everyday concepts used by the marketing managers. Somewhat digital technologies mean reaching millions of people at the same time. So, as a result of the increasing importance of customers, corporations concentrate on the customer oriented marketing concept.

### 1.6.1 Information Technology and Logistics Management in 21st Century

Developing digital technology has enabled the boundaries to be removed in the world trade and increased competition has brought about the necessity of delivery of right product to the customer at the right time, at best price and with minimum cost. Distribution and logistics have been conceived as much important as the high quality standards of the product. It has been accepted that the way of providing the most appropriate and quickest distribution that takes a product from its production line and delivers it to the customer's shelf is as much important as producing that product. Corporations have discovered the logistics as the most effective competitive element in the conditions of the increased competition.

Notes



*Notes* Logistics should be fundamentally taken into account regardless of the high quality of the product.

In the digital marketing concept of 21st century logistics quality can outweigh the product itself in the competition among corporations. Now producer corporations give the same weight to the quick and effective realization of logistics services as the product and new production techniques. In the scope of logistics management, starting point of the physical distribution subsystem must be the customers' orders. Compared to traditional marketing activities in processes such as obtaining the orders, evaluating and classifying them, logistics information systems enhance the productivity of logistics activities and offer timesaving advantage. The cost of reaching a larger body of customers in logistics system is significantly lower than the other traditional ways by using the customer basis formed for the future marketing activities. Orders when obtained through the order forms in the internet web sites filled in by the customer's leads to the sales process mainly to be carried out in internet medium. During this process, a new distribution strategy must be developed instead of a distribution structure in a traditional purchasing process that will enable to reach a very large consumer body simultaneously and will include new mediator types.



*Caution* It should meet the needs of customers by an efficient and effective physical distribution subsystem.

New logistics systems have lower cost and work faster than the traditional systems in the flow of the larger scale orders to the buyers through the logistics information technologies. In compliance with this, putting the enterprises' information as buyer order into the physical distribution actions compatible with the buyer demand will be a factor providing competitive advantage among enterprises.



*Notes* It shouldn't be disregarded that the establishment of healthy and long-term relations with consumers is dependent on the fulfilment of buyer orders perfectly and on-time.

Development of appropriate and optimum transportation system and determining of transportation tools in this system considering the competitive advantages they offer is the other point that should be emphasized when the information technologies is used in logistics management.

Nevertheless, the enterprises which should establish a technological balance among the raw material resources, inventories, sales and production could obtain optimum stock level by taking the costs, demand, product features and competition conditions into account in the stage of inventory planning according to the quantity and variety. Warehousing is another area thought as one of the logistics actions starting point. This should be implemented in harmony with the high-tech distribution processes related to the storage of goods inside and outside of the enterprise by using the computer communication systems. While preparing the warehousing policy and strategies, the selection process of storage place which combines new technologies and the firm infrastructure in e-business environment should be planned to have minimum cost and maximum efficiency to create competitive advantage against the competitors.

Notes



*Task* Compare the concept of a modern supply chain with more traditional distribution channels. Be specific regarding similarities and differences.

## Self Assessment

Fill in the blanks:

16. Reduction in costs leads to increase in …….

17. In the …… concept of 21st century logistics quality can outweigh the product itself in the competition among corporations.

18. …… is another area thought as one of the logistics actions starting point.



*Case Study*

### Strengthening the Supply Chain: A Case of Delta-Sigma Pvt. Limited

Delta Group of Industries had set up their plant to produce Backhoe Loaders and Vibratory Compactors at Noida, near New Delhi in the year 1985-86. They started manufacturing Backhoe loaders in the year 1985 in the technical collaboration with PI-Sigma of U.K. They introduced another product Vibratory Compactor in the year 1992. On October 1, 1999, Delta made collaboration with the Sigma Corporation of U.K. and the company was renamed as DELTA-SIGMA Pvt. Limited. Sigma was world's largest manufacturer of Backhoe Loaders with more than 29% share worldwide and had manufacturing plants in U.A.E., U.K., France, Germany, Brazil, and Japan etc. and had headquarters in Tokyo, Japan. Sigma sold its products in 170 countries through a network of approximately 6200 independent dealers. The factory was established in a lush green environment, well laid out and spread over the area around 45 acres. It had its own machine shop equipped with the CNC Machines, Fabrication Shop, Assembly Shop and Paint Shop. A team of 220 persons were working in various departments. The company was manufacturing various models of Backhoe loaders and Compactors. Backhoe loaders were earthmoving machines used for loading, grading, ditch cleaning, trenching, backfilling, while Vibratory compactors (Rollers) were used basically in road construction, irrigation work, land developments and bridges. DELTA-SIGMA Pvt. Ltd. manufactured three types of road Vibratory Compactors of 12, 8 and 3-ton capacity. These Vibrators required 160, 180, 140 man-hours respectively. The strength of the Vibratory Compactors manufacturing shop was 20 employees. On an average, a workman worked 26 days a month and 8 hours in a shift. The market requirement of all the three types of Vibratory Compactors varied from 10 to 35 machines per month. But, with the existing capacity, only 26 Vibrators could be made per month. Peak requirement for the product existed during January to April. As the cost of machine was very high and certain parts like, Tyres, Batteries were to be delivered fresh to the customers, hence keeping inventories for more than a month was not feasible.

**Quality Policy**

DELTA-SIGMA operated in a highly competitive environment, where quality was of prime importance. Since, the company was in a service-oriented industrial sector, the

*Contd...*

Notes

quality objectives were laid down by the top management covering all the departmental functions and were updated every year. These objectives were clearly measurable in terms of performance, which facilitated an effective and efficient review by management. The effectiveness of the quality policy and objectives were discussed in every management review meeting to facilitate continuous improvement, promoting commitment to quality and achievement of objectives. Simultaneously, DELTA-SIGMA had appointed selling agents for marketing its products to encash the brand image of DELTA group. They would interact with customers, finalize orders and obtain the orders in the name of DELTA-SIGMA. DELTA would provide after-sales and product support. DELTA-SIGMA would provide spare parts to the customers through DELTA and/or their dealers. The company mostly focused on the satisfaction and expectations of the present and potential customers. In order to satisfy the customers, management had taken some initiatives such as understanding customer requirements, determination of key product characteristics, identifying and assessing competition in the market. Various documented procedures were established and implemented in the organization to assess the customer needs and satisfaction.

**Automation**

Right from the beginning, the company focused on computerization of various activities and covered functions like, Engineering, Purchase, Stores, Issue, WIP, Bill Passing, Attendance, etc. They installed in-house designed FoxPro based software. In 1999, a major up-gradation in terms of latest Client/Server technology and Satellite communication with other DELTA works/offices and inter-departmental communication had been done. They also Installed Enterprise Resource Planning (ERP) system. Initially, the company had faced lots of resistance from the employees during implementation of ERP. Data feeding and understanding the new system was quite a difficult task. But, conducting training programs for the employees of all the departments and at each level, motivating the employees and explaining the advantages of the new system, organization had succeeded and most of the departments had been connected through ERP. Since 2001, latest ERP system – SAP was controlling the company's day to day operations in Product Planning (PP), Materials Management (MM), Quality Management (QM), Production Management (PM), Financial (FI), and Sales and Distribution (SD) modules. IT department activities were outsourced to DELTA technologies. Computer-based various fabrication-related activities like, robotic welding; CNC gas and laser cutting machines etc. had been started. Painting line with conveyors had been installed for shot blasting, priming and painting of components. The company had its own standard room equipped with latest inspection measuring and testing equipment and their calibration facilities.

**Restructuring**

Till 2001, the company was working on the concept of departments and had three separate departments for purchase, quality control and production. In the year 2001, the company underwent restructuring and made two separate divisions for Backhoe loaders and Compactors. These departments were supposed to look after purchasing, quality control as well as production of their line. Charge of Compactor Division was given to Ramesh Sharma, who was previously the head of quality control department. Sharma was allotted a new team of people picked up from various departments. But, he had an edge since he had good rapport with some of the workmen who had already worked with him in other departments. Sharma was assigned the responsibility of increasing the production by 45% with the existing capacity, staff and infrastructure. New responsibilities of Sharma were purchase of parts, subassemblies, chassis manufacturing, and sub-assembly of outsourced components, quality testing and delivery of products. To improve productivity, Sharma formed PSGs (Problem Solving Groups) and involved middle level managers, supervisors

*Contd...*

Notes

and workmen. The PSGs maintained problems record register and recorded 126 problems in the first month itself. Sharma identified some problem areas such as rework, storage and handling damages, shortage of components and workmen sitting idle.

He found that 65% of the problems were due to inferior quality of components supplied by the vendors. Sharma surveyed the vendor's production units to check whether proper testing was done at the suppliers' site or not. Surprisingly, he found that the quality testing system (inspection tools) of vendor's was not at par with the desired standards. To rectify this problem, the company designed certain customized calibrated gauges and distributed to the vendors and also organized awareness camps at the plant and demonstrated methods of quality check. To avoid storage and handling damages and wastage time, DELTA-SIGMA provided customized racks and bins to the vendors for specific components. Vendors started supplying the finished components in these racks to the company and racks were moved directly to the shop floor, which reduced loading and unloading time dramatically. The empty racks were sent back to vendors. Sharma also explored the vendors who could supply complete subassembly to the company. This would minimize the problem of rework as well as shortage of component. In case of sudden purchase orders from the SIGMA-DELTA, many a time's vendors had shown their inability to supply the components on time. More vendors were explored. Some items were being procured from Bangalore and it took around 48 hours to deliver the components and they were suggested to identify warehouses near the plant to reduce the lead-time.

In order to minimize the workman sitting idle time, work-study was conducted. It was found that improper movement of overhead cranes in assembly lines and shortage of components were the major reasons. For optimum movement of cranes an amendment was done to the layout. To identify the critical assembly points, PERT/CPM analysis was also done. Workers were segregated on the basis of their specialization. Skilled workers were given responsibility in each sub-assembly on the basis of their primary and secondary specialization. Soon it was found that limitations of manual production scheduling were being eliminated and ERP facilitated overcoming the irregularities of placing an order. The assembly shop productivity was improved by 30%, rework was reduced from 9.6 to 2.1% and process capability was maintained above 1.33. Sharma was quite satisfied with the output and was wondering what else should be done for future.

**Questions**

1. Comment on the merging of the three departments like Purchase, Quality Inspection and Production.
2. Did the organization take right steps towards implementing ERP System?
3. If you were in Sharma's place, what other strategies you would have adopted to cope up with the fluctuating demands and strengthening the supply chain?

***Source:*** Upendra Kachru, (2010), "Exploring the Supply Chain," Excel Books

## 1.7 Summary

- 'Supply Chain Management' can be defined as the active management of supply chain activities to maximize customer value and achieve a sustainable competitive advantage.
- Members of the supply chain act as partners who are "linked" together through both physical and information flows.
- The general concept of an integrated supply chain is typically illustrated by a line diagram that links participating firms into a coordinated competitive unit.

Notes

- SCM philosophy drives supply chain members to have a customer orientation.
- Within a typical enterprise the three areas, physical distribution, manufacturing support, and procurement overlap to provide integrated management of materials, semi-finished components, and products moving between locations, supply sources, and customers of the enterprise.
- The effectiveness and value of the supply chain is determined by its ability to align with its partners, whether they are service providers, employees, suppliers or distributors.
- Few managers question the benefits of applying the time-based strategies to supply chain operations. However, a valid question is, How fast is fast enough? Speed simply for the sake of being fast has little, if any, enduring value.
- Traditional distribution arrangements typically involve independent business units loosely linked together on a transaction-to-transaction basis.
- A popular term for describing the potential benefits of reducing assets across a supply chain is cash spin, sometimes referred to as free cash spin.
- In 21st century digital technologies enable the development of new economic models. Gradual reduction in the production costs effects demand and supply equilibrium. Reduction in costs leads to increase in supply.

## 1.8 Keywords

***Cash-to-Cash Conversion:*** The time required to convert raw material or inventory purchases into sales revenue is referred to as cash-to-cash conversion.

***Collaborative Planning, Forecasting and Replenishment (CPFR):*** CPFR a trademark of the Voluntary Inter-industry Commerce Standards (VICS) Association, is a concept that aims to enhance supply chain integration by supporting and assisting joint practices.

***Flow of Information:*** Information flows allow the various supply chain partners to coordinate their long-term plans, and to control the day-to-day flow of goods and material to the supply chain.

***Funds:*** This is the commercial part of the supply chain, and runs counter to the direction of the value flow.

***Supply Chain Management (SCM):*** Supply chain management (SCM) is the management of a network of interconnected businesses involved in the provision of product and service packages required by the end customers in a supply chain.

***Third-party Logistics (3PL):*** A third-party logistics provider (abbreviated 3PL, or sometimes TPL) is a firm that provides service to its customers of outsourced (or "third party") logistics services for part, or all of their supply chain management functions.

***Value Chain:*** A value chain is a chain of activities that a firm operating in a specific industry performs in order to deliver a valuable product or service for the market.

***Vendor-managed Inventory (VMI):*** Vendor-managed inventory (VMI) is a family of business models in which the buyer of a product (business) provides certain information to a vendor (supply chain) supplier of that product and the supplier takes full responsibility for maintaining an agreed inventory of the material, usually at the buyer's consumption location (usually a store).

Notes

## 1.9 Review Questions

1. What are the basic concepts of Supply Chain Management?
2. Discuss about the traditional supplier-buyer relationship.
3. Explain the simplified view of Kalyani Breweries supply chain.
4. What is the basic objective of Supply Chain Management?
5. "A typical supply chain may involve a variety of stages". Elaborate.
6. What are the different stages of a supply chain?
7. "SCM philosophy drives supply chain members to have a customer orientation". Explain.
8. What are the primary SCM activities?
9. Briefly explain the SCM value chain system.
10. "Value chain analysis is not a very difficult exercise conceptually". Clarify.
11. What are the identified management traits that set them apart from others?
12. Discuss about financial sophistication.
13. Define and illustrate cash-to-cash conversion, dwell time minimization, and cash spin. How do supply chain strategy and structure impact each?
14. Discuss and support the following argument: "Supply chain arrangements may reduce consumer value."
15. Explain about Information Technology and Logistics Management in 21st Century.

### Answers: Self Assessment

| | | | |
|---|---|---|---|
| 1. | True | 2. | False |
| 3. | True | 4. | Materials management |
| 5. | Customer | 6. | Competitive advantage |
| 7. | Product/material | 8. | Value system |
| 9. | Value chain | 10. | Strategy |
| 11. | Profitability | 12. | Performance |
| 13. | True | 14. | True |
| 15. | True | 16. | Supply |
| 17. | Digital marketing | 18. | Warehousing |

## 1.10 Further Readings



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http://blog.kinaxis.com/

http://www.demanddrivenmrp.com/newrules.php

**Notes**

# Unit 2: Introduction to Logistic

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## Objectives

After studying this unit, you will be able to:

- Understand the Definition and Concept of Logistics
- Explain Logistics Value Proposition
- Discuss the Work of logistics
- Describe Logistical Operations
- Understand the Logistical Operating Arrangements
- Explain the Logistical Operating Arrangements
- Discuss Logistical Operating Arrangements

## Introduction

Logistics is the one of the most important segment of the phenomenon of Marketing in business. It is a subset of Supply Chain Management. In the business functioning, the trader gets order for supply of his goods or services through his marketing executives or directly from customers and then to execute the order to the satisfaction of the customer, the trader or his supplier company prepares the Logistics i.e., procures the product or services, puts labels on them, or gives some identification trademark name to them, makes necessary packing and packaging so as to save them from damage of any kind during loading, unloading, handling, transportation etc., till is supplied to the end customer. More simply, it is a bundle of goods finally ready to be supplied to the customer. In Logistics study, all factors contributing till the last stage, when the goods or service is finally supplied to the consumer are systematically studied.

## 2.1 Definition and Concept of Logistics

The word, 'Logistics' is derived from French word 'Loger', which means art of war pertaining to movement and supply of armies.

1. A military concept
2. Fighting a war requires:
   (i) Setting an objective
   (ii) Meticulous planning to achieve the objective
   (iii) Proper deployment of troops
   (iv) Supply lines consisting of weaponry, food, etc.
3. A logistics plan should be such that there is minimum loss of men and material.

Similar to fighting a war in battlefield, marketing managers also prepare a suitable logistics plan that is capable of fulfilling the company objective of meeting the demand of targeted customers in a profitable way.

Notes

Inbound logistics + Material Management + Physical Distribution = Logistics

1. Inbound logistics means the movement of materials received from suppliers.
2. Material management means the movement of material and components inside a firm.
3. Physical distribution refers to movement of goods outward from the end of the assembly line to the customer.
4. Supply-chain management is larger than logistics and it links logistics more directly within the user's total communication network and with the firm engineering staff. It not only includes manufacturer and suppliers but also transporters, warehouses, retailers and customers themselves.
5. According to Council of Logistics Management: "Logistics is the process of planning, implementing and controlling the efficient, effective flow and storage of goods, services and related information from the point of origin to the point of consumption for the purpose of conforming the customer requirement".



*Notes* Logistics management includes the design and administration of systems to control the flow of material, work-in-process, and finished inventory to support business unit strategy.

## 2.1.1 Concept of Logistics

Logistics is that part of the supply chain process that plans, implements and controls the effective forward and reverse flow and storage of goods, services, and related information between the point of origin and the point of consumption, in order to meet the customer's requirements.

### Logistics Activities

1. Customers service
2. Demand forecasting
3. Distribution communication
4. Inventory control
5. Material handling
6. Order processing
7. Part and service support
8. Plant and warehouse side selection
9. Procurement
10. Packaging
11. Return goods handling
12. Salvage and scrap disposal
13. Traffic and transportation
14. Warehousing and storage

Notes

Few areas of business involve the complexity or span the geography typical of logistics. Logistics is core, they expect products to be available and be fresh. It is rather difficult to visualize any marketing or manufacturing without logistical support.

Logistics has been carried out since the beginning of civilization – it is hardly new. However, implementing best practice of logistics has become one of the most exciting and challenging operational areas of business and public sector management.

Logistics is the designing and managing of a system in order to control the flow of material throughout a corporation. This is a very important part of an international company because of geographical barriers. Logistics of an international company includes movement of raw materials, coordinating flows into and out of different countries, choices of transportation, cost of the transportation, packaging the product for shipment, storing the product, and managing the entire process.

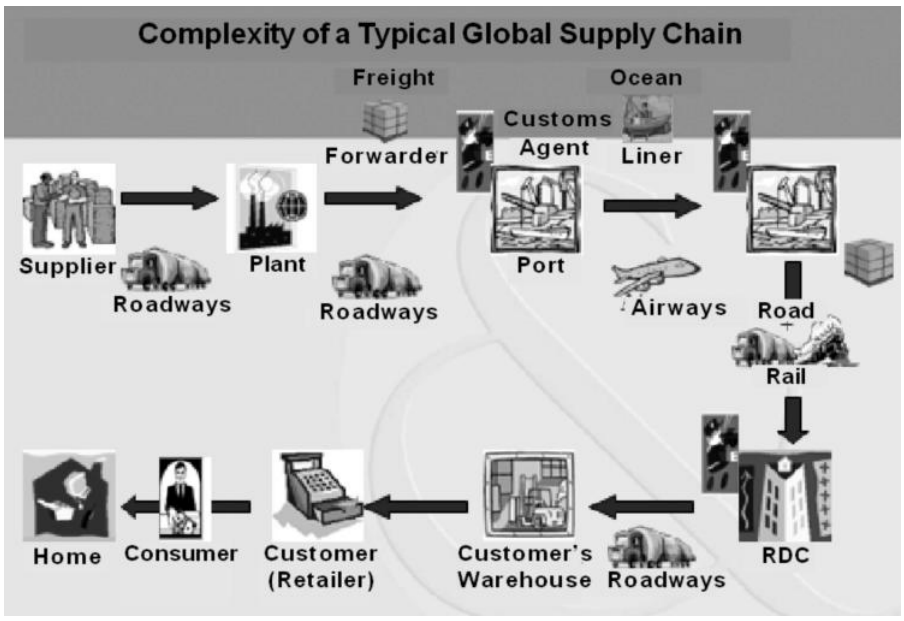
Supply Chain Management is the systematic, strategic coordination of the traditional business functions and the tactics across these business functions within a particular company and across businesses within the supply chain, for the purposes of improving the long-term performance of the individual companies and the supply chain as a whole.

*Did u know?* Logistics is typically considered as a sub-set of SCM. In SCM, five key functions are: Procure, Make, Move, Store, and Service. Most view logistics as the movement of products from point A to point B and all the activities involved to make this happen (from carrier selection to planning to execution).

Logistics is involved at various stages of a supply chain; from supplier to plants, from plants to distribution centres, from distributions centres to stores, from stores to customers, or any of these combinations.

Logistics is the process of movement of materials and products into, through and out of a firm.

**Figure 2.1: Complexity of a Typical Global Supply Chain**




***Source:*** Reji Ismail, (2008), "Logistics Management," Excel Books

Notes



*Caselet*

## Industry Leadership Enjoyed by Cisco Systems as a Result of Logistical Competency

Cisco's sales were growing by 100 percent per year in the mid-90s. Employment was swelling to keep pace and supply chain costs were unacceptably high. Product life cycles continued to shorten. Demands for reliability, flexibility, and speed escalated at an alarming rate. To keep pace, Cisco undertook a wholesale revamping of its business processes, from design and forecasting to raw materials acquisition, production, distribution, and customer follow-up.

The creation of Cisco's global networked business model arose in multiple departments at the same time, out of a shared realization of the need for change. Within this model, Cisco views its supply chain as a fabric of relationships, rather than in a linear fashion. The goal was to transcend the internal focus of Enterprise Resource Planning (ERP) systems to embrace a networked supply chain of all trading partners. Primary goals were servicing the customer better, coping with huge growth, and driving down costs. Utilizing the Internet, it is pursuing a single enterprise strategy. Today Cisco relies on five contract manufacturers for nearly 60 percent of final assembling and testing and 100 percent of basic production. Through strict oversight and a clear set of standards, Cisco ensures that every partner achieves the same high level of quality. All 14 of its global manufacturing sites, along with two distributors, are linked via a single enterprise extranet. The quest for a single enterprise has tied Cisco to its suppliers in unprecedented ways. Product now flows from first- and second-tier suppliers without the documentation and notifications on which most supply chains rely. Instead of responding to specific work orders, contract manufacturers turn out components according to a daily build plan derived from a single long-term forecast shared throughout the supply chain. Items move either to Cisco or directly to its customers.

Payment occurs automatically upon receipt; there are no purchase orders, invoices, or traditional acknowledgments. In exchange for getting paid sooner, suppliers are required to aggressively attack their cost structures but not to the point where they can't make a profit. "It's not a partnership if you're putting the other guy out of business," says Barbara Siverts, manager of supply chain solutions within Cisco's Internet Business Solutions unit. Cisco cites at least $128 million in annual savings from its single enterprise strategy. It has reduced time to market by 25 percent, while hitting 97 percent of delivery targets. Inventories have been cut nearly in half. Order cycle time has declined from 6 to 8 weeks 4 years ago to between 1 and 3 weeks now. Under a program known as dynamic replenishment, demand signals flow instantly to contract manufacturers. Inventories can be monitored by all supply chain partners on a real time basis. Some 55 percent of product now moves directly from supplier to customer, bypassing Cisco altogether. This has removed several days from the order cycle. Direct fulfilment means reduced inventories, labour costs, and shipping expenses. Cisco pegs savings at $10 per unit or around $12 million a year.

Working with UPS, Cisco took control of the outbound supply chain, allowing for time definite delivery throughout Europe within 5 to 8 days, via a single point of contact. With Oracle's inventory control system hooked directly into UPS's logistics management system. Cisco now tracks product to destination on a real time basis. The extra measure of control allows it to intercept, reroute, or reconfigure orders on short notice. Through deferred delivery, Cisco ensures that a component won't arrive at the customer's dock until it's

*Contd...*

Notes

ready to be installed. Cisco's outsourcing strategy took another step forward recently, with the decision to turn over shipping and warehousing functions to FedEx Corp. The air, ground, and logistics services provider will manage a merge-in-transit operation for direct shipment to end customers, resulting in the near elimination of Cisco-operated warehouses within 5 years.

***Source:*** Upendra Kachru, (2010), "Exploring the Supply Chain," Excel Books

### Self Assessment

Fill in the blanks:

1. The word, 'logistics' is derived from French word …….
2. …… management means the movement of material and components inside a firm.
3. Logistics is typically considered as a sub-set of …….

## 2.2 Logistics Value Proposition

Thus far it has been established that logistics should be managed as an integrated effort to achieve customer satisfaction at the lowest total cost. Logistics performed in this manner creates value. In this section, the elements of the logistical value proposition-service and cost minimization-we discussed in greater detail.

### 2.2.1 Service Benefits

Almost any level of logistical service can be achieved if a firm is willing to commit the required resources. In today's operating environment, the limiting factor is economics, not technology, For example, a dedicated inventory can be maintained in close geographical proximity to a major customer. A fleet of trucks can be held in a constant state of delivery readiness. To facilitate order processing, dedicated communications can be maintained on a real time basis between a customer and a supplier's logistical operation. Given this high state of logistical readiness, a product or component could be delivered within minutes of identifying a customer requirement.

### 2.2.2 Cost Minimization

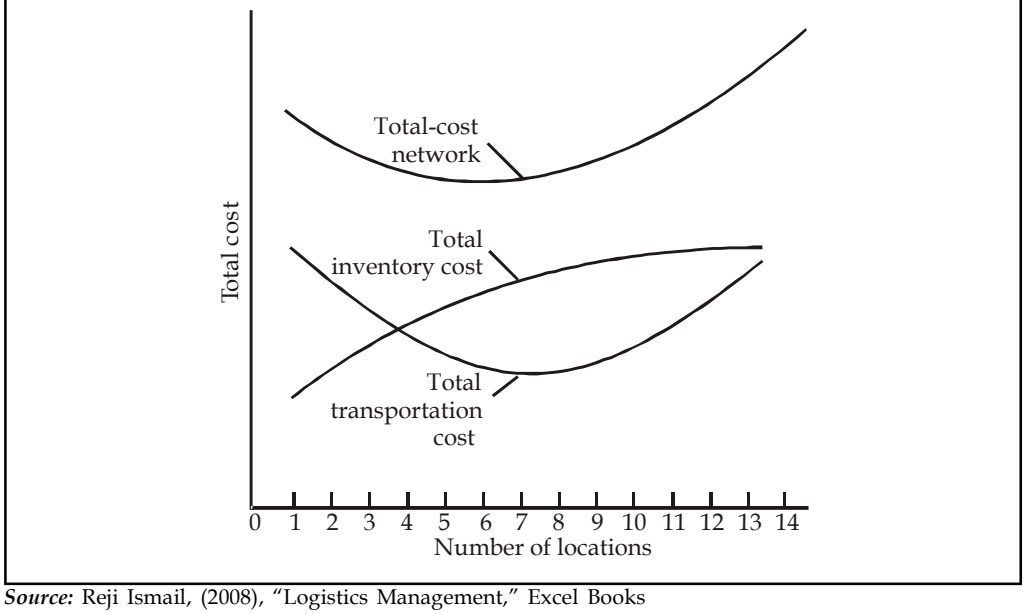
This is decision based on cost minimization criteria. The least-total-cost system design includes both the transportation costs as well as the inventory costs. Figure 2.2 illustrates the concept. In the figure, 'The total transportation cost' curve has a low at eight facilities. However, the 'Total inventory cost' curve shows an increase with each additional warehouse. For the overall system, the optimal system network is reflected by the 'Total cost network', which in this figure is shown to be six locations.

Though a great many problems must be overcome to effectively examine total cost, particularly the assumptions of single planning period and average size shipment, the analysis for least-total-cost solution shown in Figure 2.2 illustrates the trade-offs between cost-generating activities.

While the transportation costs determine the economically viable number of locations; the inventory cost modulates both the number and the size of the warehouse. The minimal total-cost point for the system is not at the point of least cost for either transportation or inventory reflecting the approach of integrated logistical analysis.

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**Figure 2.2: Total Cost Warehousing Network**

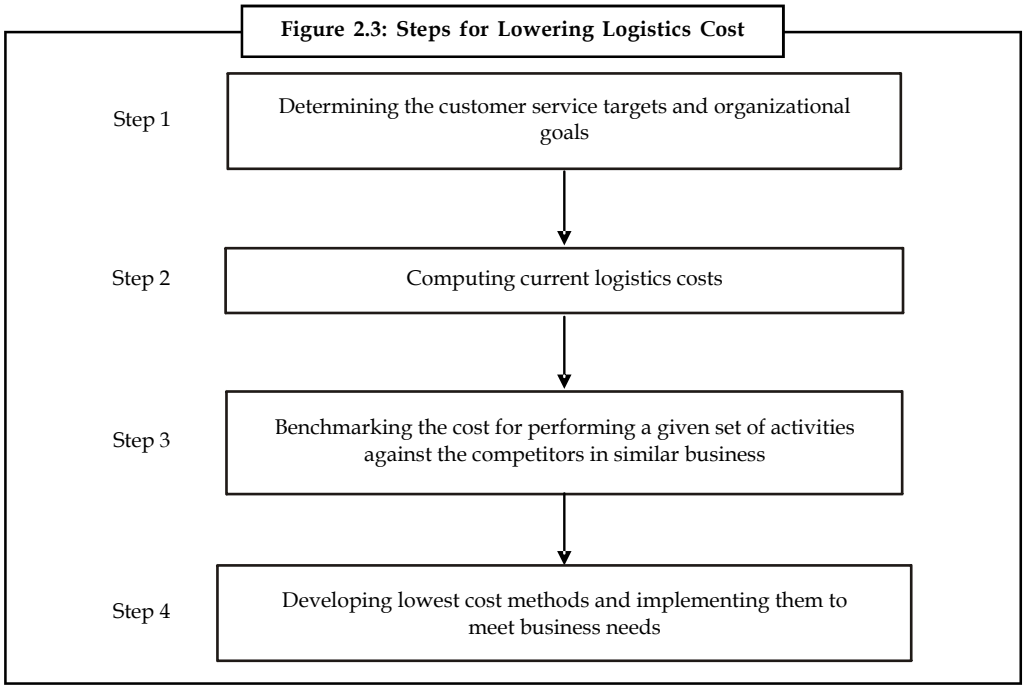



***Source:*** Reji Ismail, (2008), "Logistics Management," Excel Books

Logistics cost form an important part of the overall cost structure in any organization. Focus needs to be on renegotiating freight and shipping rates, reduction in overall freight costs and streamlining operations. Today logistics management has gained special attention because of high emphasize on quality of goods and services as well as intense price competition which is forcing companies to control the costs to survive in the market.

For lowering logistics cost one has to understand following:

**Figure 2.3: Steps for Lowering Logistics Cost**




***Source:*** Reji Ismail, (2008), "Logistics Management," Excel Books

Notes

The percentage of logistics cost to the total value added signifies the importance of logistics related activities from the cost perspective. It is high for bulk goods manufacturers, while it is low for consumer goods manufacturers. For bulk goods, total logistics cost as a proportion of value addition is about 70 per cent, out of which transportation costs constitute nearly two-thirds.

Four main areas of logistics management are procurement, transport, transshipment and storage of goods. Supply chain logistics costs account from 5% to 50% of a product's total cost, depending on the industry. Following are the tips to reduce cost in these four areas:

### Procurement

- ***Streamlining sourcing techniques:*** Understand the true costs of sourcing, which include:
  - Freight
  - Duty
  - Inventory carrying costs
  - Brokerage involved in procuring
- ***Order management:*** It includes understand various specifications and design order requirements with each suppliers, which will help in identifying ways of reducing cost and also help in reducing price structure. Other methods include: switching to lower priced substitutes, implementing just-in-time deliveries from suppliers that can lower a company's inventory as well as internal logistics costs, which in turn also allow suppliers to economize on company's shipping, warehousing, and production scheduling costs, which could be beneficial for both.

### Transportation

- ***Selecting of appropriate mode of transportation:*** Each mode has its own advantages and disadvantages in terms of costs, speed, capacity, flexibility and safety, therefore selecting optimal mode of transportation (air, water, rail, road and through pipeline) which can best suits the quantity and quality of goods to be supplied and required during delivery time reduces the opportunity costs involved due to unavailability of goods at right time.
- Loss due to damage to goods during transit can be avoided.
- Optimal vehicle routing and scheduling can reduce the in-transit inventory. Various mathematical and analytical methods like shortest route method, transportation method, etc. can be used for optimizing accompanying cost.
- Freight consolidation can also reduce the transportation cost to a greater extent. It involves bringing together smaller quantities of inventory, in order to create a bigger quantity for transportation. All these methods are elaborated further in coming sections.

### Transshipment

It mainly involves controlling the express shipping costs, typically when a company have an entire shipment sent on an express service level basis for which higher cost is incurred. This can reduced by proper planning and by calculating amount of goods required for immediate delivery by express service and can distribute the costs accordingly.

Notes

**Inventory**

To build up inventory sufficient capital has to be tied up for a length of time. Thus by proper analyzing demand and supply patterns and the nature of the product, will result in reduction of cost that will also help in optimizing the level of inventory.

### 2.2.3 Logistics Value Generation

The key to achieving logistical leadership is to master the art of matching operating competency and commitment to key customer expectations and requirements. This customer commitment, in an exacting cost framework, is the logistics value proposition. It is a unique commitment of a firm to individual or selected groups of its customers. The typical enterprise seeks to develop and implement an overall logistical competency that satisfies customer expectations at realistic total cost expenditure. Very seldom will either the lowest total cost or the highest attainable customer service constitute the fundamental logistics strategy. Likewise, the appropriate combination will be different for different customers.

A well-designed logistical effort must have high customer response and capability while controlling operational variance and minimizing inventory commitment. And, most of all, it must have relevancy to specific customers. Significant advances have been made in the development of tools to aid management in the measurement of cost/service trade-offs. Formulation of a sound strategy requires a capability to estimate operating cost required to achieve alternative service levels. Likewise, alternative levels of system performance are meaningless unless viewed in terms of overall business unit marketing, manufacturing, and procurement strategies. Leading firms realize that a well-designed and well-operated logistical system can help achieve competitive advantage. In fact, as a general rule, firms that obtain a strategic advantage based on logistical competency establish the nature of their industry's competition.

### Self Assessment

State whether the following statements are true or false:

4. The least-total-cost system design includes only the transportation costs.
5. 'Total inventory cost' curve shows an increase with each additional warehouse.
6. For bulk goods, total logistics cost as a proportion of value addition is about 50 per cent.

## 2.3 The Work of Logistics

In the context of supply chain management, logistics exits to move and position inventory to achieve desired time, place, and possession benefits at the lowest total costs. Inventory has limited value until it is positioned at the right time and at the right location to support ownership transfer or value added creation. If a firm does not consistently satisfy time and location requirements, it has nothing to sell. For a supply chain to realize the maximum strategic benefit from logistics, the full range of functional work must be integrated. Decisions in one functional area will impact cost of all others. It is this interrelation of functions that challenges the successful implementation of integrated logistical management. Integrated work related to these functional areas creates the capabilities needed to achieve logistical value.

### 2.3.1 Order Processing

The important of accurate information to achieving superior logistical performance has historically been underappreciated. While many aspects of information are critical to logistics

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operations, the processing of orders is of primary importance. Failure to fully comprehend this importance resulted from not fully understanding how distortion and operational failures in order processing impact logistical operations. Current information technology is capable of handling the most demanding customer requirements. When desired, order information can be exchanged between trading partners.

### 2.3.2 Inventory

The inventory requirements of a firm are directly linked to the facility network and the desired level of customer service. Theoretically, a firm could stock every item sold in every facility dedicated to servicing each customer. Few business operations can afford such a luxurious inventory strategy because the risk and total cost are prohibitive. The objective of an inventory strategy is to achieve desired customer service with the minimum inventory commitment. Excessive inventories may compensate for deficiencies in basic design of a logistic system but will ultimately result in higher-than-necessary total logistics cost. Logistical strategies should be designed to maintain the lowest possible financial investment in inventory. The basic goal is to achieve maximum inventory turn while satisfying service commitments. A sound inventory strategy is based on a combination of five aspects of selective deployment: (1) core customer segmentation, (2) product profitability, (3) transportation integration, (4) time-based performance, and (5) competitive performance.

### 2.3.3 Transportation

Transportation is the operational area of logistics that geographically moves and positions inventory. Because of its fundamental importance and visible cost, transportation has traditionally received considerable managerial attention. Almost all enterprises, big and small, have managers responsible for transportation. Transportation requirements can be satisfied in three basic ways. First, a private fleet of equipment may be operated. Second, contracts may be arranged with dedicated transport specialists. Third, an enterprise may engage the services of a wide variety of carriers that provide different transportation services as needed on a per shipment basis.

From the logistical system viewpoint, three factors are fundamental to transportation performance: (1) cost, (2) speed, (3) consistency. The ***cost*** of transport is the payment for shipment between two geographical locations and the expenses related to maintaining in-transit inventory. Logistical systems should utilize transportation that minimizes total system cost. This may mean that the least expensive method of transportation may not result in the lowest total cost of logistics. ***Speed*** of transportation is the time required to complete a specific movement. Speed and cost of transportation are related in two ways. First, transport firms capable of offering faster service typically charge higher rates. Second, the faster the transportation service is, the shorter is the time interval during which inventory is in transit and unavailable. Thus, a critical aspect of selecting the most desirable method of transportation is to balance speed and cost of service. ***Consistency*** of transportation refers to variations in time required to perform a specific movement over a number of shipments. Consistency reflects the dependability of transportation.

### 2.3.4 Warehousing, Materials Handling, and Packaging

The first three functional areas of logistics – order processing, inventory, and transportation – can be engineered into a variety of different operational arrangements. Each arrangement has the potential to contribute to a specified level of customer service with an associated total cost. In essence, these functions combine to create a system solution for integrated logistics. The fourth functionality of logistics – warehousing, materials handling, and packaging – also represents an integral part of a logistics operating solution. However, these functions do not have the independent status of those. Warehousing, materials handling, and packaging are an internal part of other logistics areas.

Notes

*Example:* Inventory typically needs to be warehoused at selected times during the logistics process.

Transportation vehicles require materials handling for efficient loading and unloading. Finally, individual products are most efficiently handled when packaged together into shipping cartons or other unit loads.

### 2.3.5 Facility Network Design

Classical economics neglected the importance of facility location and overall network design to efficient business operations. When economists originally discussed supply-and-demand relationships, facility location and transportation cost differentials were assumed either nonexistent or equal among competitors. In business operations, however, the number, size, and geographical relationship of facilities used to perform logistical operations directly impacts customer service capability and cost. Facility network design is a primary responsibility of logistical management, since a firm's facility structure is used to ship products and materials to customers. Typical logistics facilities are manufacturing plants, warehouses, cross-dock operations, and retail stores.

### Self Assessment

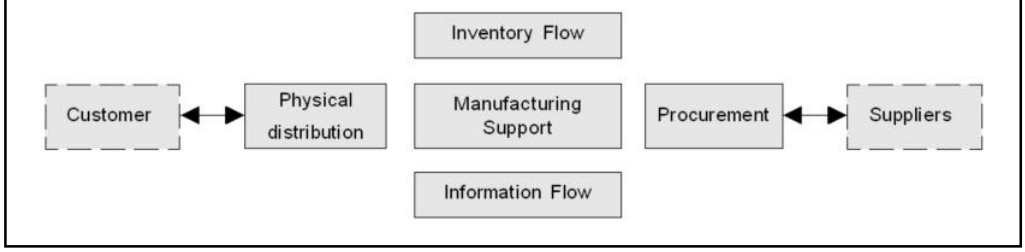
Fill in the blanks:

7. The …… requirements of a firm are directly linked to the facility network and the desired level of customer service.
8. …… is the operational area of logistics that geographically moves and positions inventory.
9. Facility …… is a primary responsibility of logistical management, since a firm's facility structure is used to ship products and materials to customers.

## 2.4 Logistical Operations

The conceptualization of integrated logistics is illustrated in the shaded area of the figure below. Logistics is viewed as the competency that links an enterprise with its customers and suppliers. Information from and about customers flows through the enterprise in the form of sales activity, forecasts and orders. The information is refined into specific manufacturing and purchasing plans. As products and materials are procured, a value-added inventory flow is initiated that ultimately results in ownership transfer of finished products to customers. Thus, the process is viewed in terms of two interrelated efforts, inventory flow and information flow. Prior to discussing each flow in greater detail, two observations are in order.

**Figure 2.4: Integrated Logistic**




***Source:*** Reji Ismail (2008), "Logistics Management," Excel Books

Notes

First, viewing internal operations (the shaded area of Figure 2.4) in isolation is useful to elaborate the fundamental importance of integrating all functions and work involved in logistics. While such integration is a prerequisite to success, it is not sufficient to guarantee that a firm will achieve its performance goals. To be fully effective in today's competitive environment, firms must expand their integrated behaviour to incorporate customers and suppliers.

Second, the basic process illustrated in Figure 2.5 is not restricted to for-profit business, nor is it unique to manufacturing firms. The need to integrate requirements and operations occurs in all businesses as well as within public sector organizations.



*Example:* Retailing or wholesaling firms typically link physical distribution and purchasing, since traditional manufacturing is not required. Nevertheless, retailers and wholesalers must complete the logistics value-added process. The same is true of all public sector organizations that manufacture products or provide other services.

### 2.4.1 Inventory Flow

The operational management of logistics is concerned with movement and storage of materials and finished products. Logistical operations start with the initial shipment of a material or component part from a supplier and are finalized when a manufactured or processed product is delivered to a customer.

From the initial purchase of a material or component, the logistical process adds value by moving inventory when and where needed. Providing all goes well, a material gains value at each step of its transformation into finished inventory. In other words, an individual part has greater value after it is incorporated into a machine. Likewise, the machine has greater value once it is delivered to a buyer.



*Caution* To support manufacturing, work-in-process inventory must be moved to support final assembly. The cost of each component and its movement becomes part of the value-added process. The final or meaningful value that is added occurs only with final ownership transfer of products to customers when and where specified.

For a large manufacturer, logistical operations may consist of thousands of movements, which ultimately culminate in the delivery of products to an industrial user, retailer, wholesaler, dealer, or other customer. For a large retailer, logistical operations may commence with the procurement of products for resale and may terminate with consumer pickup or delivery.



*Example:* For a hospital, logistics starts with procurement and ends with full support of patient surgery and recovery.

The significant point is that regardless of the size and type of enterprise, logistics is essential and requires continuous management attention. For better understanding, it is useful to divide logistical operations into three areas: physical distribution, manufacturing support, and procurement. These components are illustrated in the centre of Figure 2.4 as the combined logistics operational units of an enterprise.

### 2.4.2 Physical Distribution

The area of physical distribution concerns movement of a finished product to customers. In physical distribution, the customer is the final destination of a marketing channel. The availability of the product is a vital part of each channel participant's marketing effort.

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*Caution* Even a manufacturer's agent, which typically does not own inventory, must depend on inventory availability to perform expected marketing responsibilities. Unless a proper assortment of products is efficiently delivered when and where needed, a great deal of the overall marketing effort can be jeopardized.

It is through the physical distribution process that the time and space of customer service become an integral part of marketing. Thus, physical distribution links a marketing channel with its customers. To support the wide variety of marketing systems that exist in a highly commercialized nation, many different physical distribution systems are utilized. All physical distribution systems have one common feature: they link manufacturers, wholesalers, and retailers into marketing channels that provide product availability as an integral aspect of the overall marketing process.

### 2.4.3 Manufacturing Support

The area of manufacturing support concentrates on managing work-in-process inventory as it flows between stages of manufacturing. The primary logistical responsibility in manufacturing is to participate in formulating a master production schedule and to arrange for timely availability of materials, component parts, and work-in-process inventory. Thus, the overall concern of manufacturing support is not how production occurs but rather what, when and where products will be manufactured. Manufacturing support has one significant difference when compared with physical distribution. Physical distribution attempts to service the desires of customers and therefore must accommodate the uncertainty of consumer and industrial demand. Manufacturing support involves movement requirements that are under the control of the manufacturing enterprise. The uncertainties introduced by random customer ordering and erratic demand accommodated by physical distribution are not present in most manufacturing operations. From the viewpoint of overall planning, the separation of manufacturing support from outbound (physical distribution) and inbound (procurement) activities provides opportunities for specialization and improved efficiency.

### 2.4.4 Procurement

Procurement is concerned with purchasing and arranging inbound movement of materials, parts, and/or finished inventory from suppliers to manufacturing or assembly plants, warehouses, or retail stores. Depending on the situation, the acquisition process is commonly identified by different names. In manufacturing, the process of acquisition is typically called purchasing. In government circles, acquisition has traditionally been referred to as procurement. In retailing and wholesaling, buying is the most widely used term. In many circles, the process is referred to as inbound logistics. Although differences do exist concerning acquisition situations, the term procurement is used here to include all types of purchasing. The term material is used to identify inventory moving inbound to an enterprise, regardless of its degree of readiness for resale. The term product is used to identify inventory that is available for consumer purchase. In other words, materials are involved in the process of adding value through manufacturing, whereas products are ready for consumption. The fundamental distinction is that products result from the value added to material during manufacturing, sorting, or assembly.

Procurement is concerned with availability of the desired material assortments where and when needed. Whereas physical distribution is concerned with outbound product shipments, purchasing is concerned with inbound materials, sorting or assembly. Under most marketing situations involving consumer products, such as a grocery manufacturer that ships to retail

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food-chain, the manufacturer's physical distribution is the same process as a retailer's procurement operations. Although similar or even identical transportation requirements may be involved, the degree of managerial control and risk related to performance failure varies substantially between physical distribution and procurement.

Within a typical enterprise, the three areas of logistics overlap. Viewing each as an integral part of the overall value-adding process creates an opportunity to capitalize on the unique attributes of each while facilitating the overall process. The prime concern of an integrated logistical process is to coordinate overall value added inventory movement. The three areas combine to provide integrated management of materials, semi-finished components, and products moving between locations, supply sources, and customers of the enterprise. In this sense, logistics is concerned with strategic management of total movement and storage.

### 2.4.5 Information Flow

Information flow identifies specific locations within a logistical system that have requirements. Information also integrates the three operating areas. The primary objective of developing and specifying requirements is to plan and execute integrated logistical operations. Within individual logistics areas, different movement requirements exist with respect to size of order, availability of inventory, and urgency of movement. The primary objective of information sharing is to reconcile these differentials. In the discussion that follows it is important to stress that information requirements parallel the actual work performed in physical distribution, manufacturing support, and procurement. Whereas these areas contain the actual logistics work, information facilitates coordination of planning and control of day-to-day operations. Without accurate information the effort involved in the logistical system can be wasted.

Logistical information involves two major types of flows: coordination flows and operational flows.

The objective at this point is to provide an introductory overview of the information requirements necessary to drive an integrated logistics system.

### 2.4.6 Planning and Coordination Flows

Coordination is the backbone of overall information system architecture among value chain participants. Coordination results in plans specifying (1) strategic objectives, (2) capacity constraints, (3) logistical requirements, (4) inventory deployment, (5) manufacturing requirements, (6) procurement requirements, and (7) forecasting.

The primary drivers of the overall value chain are the strategic objectives that result from marketing and financial goals. Strategic objectives detail the nature and location of customers, which are matched to the required products and services to be performed. The financial aspect of strategic plans detail resources required to support inventory, receivables, facilities, equipment, and capacity.

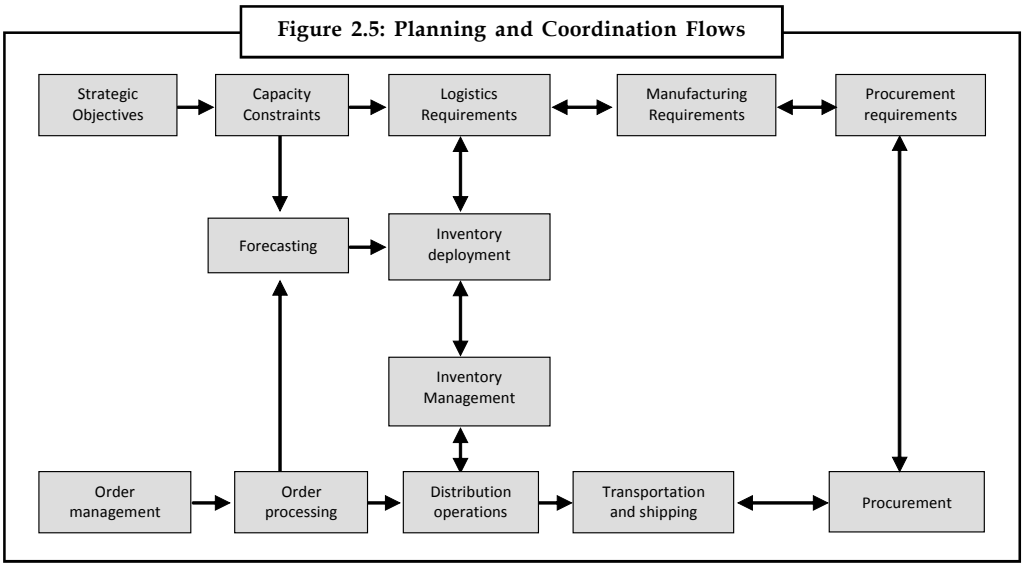
Capacity constraints coordinate internal and external manufacturing requirements. For non-manufacturing participants in the value chain, this form of capacity planning is not required. Given strategic objectives, capacities constraints identify limitations, barriers, or bottlenecks within basic manufacturing capabilities and determine appropriate outsource requirements.



*Example:* To illustrate, whereas Kellogg owns the brand and distributes Cracklin Oat Bran, a third party on a contract basis performs all manufacturing. The result of capacity constraints is a plan that places strategic objectives in a time-phased schedule that details facility utilization, financial resources and human requirements.

Notes

**Figure 2.5: Planning and Coordination Flows**




***Source:*** Reji Ismail, (2008), "Logistics Management," Excel Books

Logistics requirements specify the work that distribution facilities, equipment, and labour must perform to implement the capacity plan. Using inputs from forecasting, promotional scheduling, customer orders, and inventory status, logistics requirements specify value chain performance.

Inventory deployments are the interfaces between planning/coordination and operations that detail the timing and composition of where inventory will be positioned. A major concern of deployment is to balance timing and consolidation to create efficiency as inventory flows through the value chain. Inventory is unique in that it is an integral part of the planning/coordination and operational flows involved in logistics. From an information perspective, deployment specifies the what, where, and when of the overall logistics processes. From an operational viewpoint, inventory management is performed as a day-to-day event. Because of this duality, inventory deployment and management are illustrated in Figure 2.5 between the planning/coordination and operational information flows.

*Notes* In production situations, manufacturing plans are derived from logistical requirements and typically result in inventory deployment. The primary deliverable is a statement of time-phased inventory requirements that drives master production scheduling (MPS) and manufacturing requirements planning (MRP). The deliverable from manufacturing requirements is a day-to-day production schedule that can be used to specify material and component requirements.

Procurement requirements schedule material and components for inbound shipment to support manufacturing requirements. In retailing and wholesaling situations, procurement involves maintaining product supplies. In manufacturing situations, purchasing must facilitate inbound materials and component parts from suppliers. Regardless of the situation, purchasing coordinates decisions concerning supplier qualifications, degree of desired speculation, third-party arrangements, and feasibility of long-term contracting.

Forecasting utilizes historical data, current activity levels, and planning assumptions to predict future activity levels. Logistical forecasting is generally concerned with relatively short-term predictions (i.e., less than ninety days). The forecasts predict periodic (usually monthly or weekly) sales levels for each product, forming the basis of logistics requirement and operating plans.

Notes

The overall purpose of information planning/coordination flow is to integrate specific activities within a firm and to facilitate overall integrated performance. Unless a high level of coordination is achieved, the potential exists for operating inefficiencies and excessive inventory. Planning/coordination is illustrated in the health care business by the sidebar discussing how hospitals use information to improve efficiency and customer service.

### 2.4.7 Operational Requirements

The second aspect of information requirements is concerned with directing operations to receive, process, and ship inventory as required supporting customer and purchasing orders. Operational information requirements deal with (1) order management, (2) order processing, (3) distribution operations, (4) inventory management, (5) transportation and shipping, and (6) procurement.

Order management refers to the transmission of requirement information between value chains members involved in finished product distribution. The primary activity of order management is accurate entry and qualification of customer orders. This transfer of requirements between value chain participants is typically achieved by phone, mail, facsimile (fax), or electronic data interchange. The impact of information technology on order management is extensive. The availability of low-cost information transfer has revolutionized the order management process.

Order processing allocates inventory and assigns responsibility to satisfy customer requirements. The traditional approach has been to assign available inventory or planned manufacturing to customers according to predetermined priorities. In technology-rich order processing systems, two-way communication linkage is maintained with customers to generate a negotiated order that satisfies customers within the constraints of planned logistical operations.

Distribution operations involve information flows required to facilitate and coordinate performance within logistics facilities. The primary purpose of a logistical facility is to provide material or product assortments to satisfy order requirements. Emphasis is placed on scheduled availability of the desired assortment with minimal duplication and redundant work effort. The key to distribution operations is to store and handle specific inventory as little as possible while still meeting customer order requirements.

Inventory management is concerned with using information to implement the logistics plan as specified. Using a combination of human resources and information technology, inventory is deployed and then managed to satisfy planned requirements. The work of inventory management is to make sure that the overall logistical system has appropriate resources to perform as planned.

Transportation and shipping information directs the movement of inventory. To achieve efficiency, it is important to consolidate orders so as to fully utilize transportation capacity. It is also necessary to ensure that the required transportation equipment is available when needed. Finally, because ownership transfer often results from transportation, supporting documentation is required.

Procurement is concerned with the information necessary to complete purchase order preparation, modification, and release while ensuring overall supplier compliance. In many ways, information related to procurement is similar to that involved in order processing. Both forms of information exchange serve to facilitate operations that link a firm with its customers and suppliers. The primary difference between procurement and order processing is the type of operation that results from requirements transfer.

The overall purpose of operational information is to provide the detailed data required for integrated performance of physical distribution, manufacturing support, and procurement operations. Whereas planning/coordination flows provide information concerning planned activities, operational requirements are needed to direct the day-to-day logistics work. Within the context of information and inventory flows, the managers within an enterprise must achieve some specific objectives to fully exploit logistical competency.

Notes

### Self Assessment

State whether the following statements are true or false:

10. Logistics is viewed as the competency that links an enterprise with its customers and suppliers.
11. The area of physical distribution concerns movement of a finished product to customers.
12. The primary logistical responsibility in manufacturing is not to participate in formulating a master production schedule.

## 2.5 Logistical Operating Arrangements

The potential for logistical services to favourably impact customers is directly related to operating system design. The many different facets of logistical performance requirements make operational design a complex task, as an operating structure must offer a balance of performance, cost, and flexibility. When one considers the variety of logistical systems used throughout the world to service widely diverse markets, it is astonishing that any structural similarity exists. But keep in mind that all logistical arrangements have two common characteristics. First, they are designed to manage inventory. Second, the range of logistics alternatives is limited by available technology. These two characteristics tend to create commonly observed operating arrangements. Three widely utilized structures are echelon, direct, and combined.

### 2.5.1 Echelon Structured Logistics

Classification of a logistical system as having an echeloned structure means that the flow of products typically proceeds through a common arrangement of firms and facilities as it moves from origin to final destination. The use of echelons usually implies that total cost analysis justifies stocking some level of inventory or performing specific activities at consecutive levels of a supply chain. Echelon systems utilize warehouses to create inventory assortments and achieve consolidation economies associated with large volume transportation shipments. Inventories positioned in warehouses are available for rapid deployment to meet customer requirements. Typical echelon systems utilize either break-bulk or consolidation warehouses. A break-bulk facility typically receives large-volume shipments from a variety of suppliers. Inventory is sorted and stored in anticipation of future customer requirements. Food distribution centres operated by major grocery chains and wholesalers are examples of break-bulk warehouses. A consolidation warehouse operates in a reserve profile. Consolidation is typically required by manufacturing firms that have plants at different geographical locations. Products manufactured at different plants are sorted in a central warehouse facility to allow the firm to ship full-line assortments to customers. Major consumer product manufacturers are prime examples of enterprises using echeloned systems for full-line consolidation.

### 2.5.2 Direct Structured Logistics

In contrast to inventory echeloning are logistical systems designed to ship products direct to customer's destination from one or a limited number of centrally located inventories. Direct distribution typically uses the expedited services of premium transport combined with information technology to rapidly process customer orders and achieve delivery performance. This combination of capabilities, designed into the order delivery cycle, reduces time delays and overcomes geographical separation from customers. Examples of direct shipments are plant-to-consumer truckload shipments, direct store delivery, and various forms of direct-to-consumer fulfilment required to support e-commerce shopping. Direct logistical structures are

Notes

also commonly used for inbound components and materials to manufacturing plants because the average shipment size is typically large.

### 2.5.3 Flexible Logistics System

The ideal logistical arrangement is a situation wherein the inherent benefits of echeloned and direct structures are combined into a flexible logistics system. Anticipatory commitment of inventory should ideally be postponed as long as possible. Inventory strategies often position fast-moving products or materials in forward warehouses, while other, more risky or costly items are stocked at a central location for direct distribution to customers. The basic service commitment and the order size economics determine the most desirable and economical structure to service a specific customer.

(a) ***Emergency Flexible Structure:*** Emergency flexible operations are pre-planned strategies to resolve logistical failures. A typical emergency occurs when an assigned shipping facility is out of stock or for some other reason cannot complete a customer's order. For example, a warehouse may be out of an item with no replenishment inventory scheduled to arrive until after the customer's specified order delivery date. To prohibit back-order or product cancellation, a contingency operating policy may assign the total order, or at least those items not available, for shipment from an alternative warehouse. The use of emergency flexible operation procedures is typically based on the importance of the specific customer or the critical nature of the product being ordered.

(b) ***Routine Flexible Structure:*** A flexible logistics capability that has gained popularity as a result of improved communications involves procedures for serving specified customers developed as part of the basic logistical system design. The flexible logistics rules and decision scenarios specify alternative ways to meet service requirements, such as assignment of different shipping facilities. A strategy that exploits routine flexible operations may be justified in at least four different situations.



*Task* Find out why are market distribution operations typically more erratic than manufacturing support and procurement operations?

### Self Assessment

Fill in the blanks:

13. The use of …… usually implies that total cost analysis justifies stocking some level of inventory or performing specific activities at consecutive levels of a supply chain.

14. …… is typically required by manufacturing firms that have plants at different geographical locations.

15. A …… that exploits routine flexible operations may be justified in at least four different situations.

## 2.6 Supply Chain Synchronization

Synchronization is the ability to coordinate, organize and manage end-to-end supply chain flows – products, services, information, and financials – in such a way that the supply chain

Notes

functions as a single entity. Supply chain synchronization is the ability to coordinate, organize and manage end-to-end supply chain flows – including products, services, information and financials – in such a way that the supply chain functions as a single entity. In other words, it is a shared objective for supply chain members who are willing to work together to determine how best to perform the overall activities and tasks that are required to meet customer demand. With synchronized supply chains, the overall goal is the same as with traditional supply chain management.

There are three key differences, however. One is that companies work with their vendors in order to coordinate their processes and to achieve simultaneous production. Another difference is that the Internet and other types of technology are incorporated into the process to make those processes run smoother and more efficiently. Finally, the buying organization will need to hire, train, and restructure their workforce in order to be able to accommodate this type of supply chain management.

Synchronization enables companies to anticipate demand disruptions and anomalies in a timely manner in order to mitigate the infamous bullwhip effect. It helps firms move to a demand-driven environment that is better equipped to deal with uncertainty. Typically supply chain managers handle uncertainty through buffering – i.e., it maintains pools of inventory at multiple places in the supply chain. A synchronized supply chain operates by separating baseline demand from demand surges and then using strategic points in the supply chain for the placement and use of capacity and inventory.

Firms that aren't synchronized often find that they have higher costs than firms and supply chains that have some degree of synchronization in their supply chain. The higher costs can result from inefficiencies in everything from manufacturing change orders to expedited transportation costs. A cost that is not often known due to the lack of synchronization, however, is the total cost due to excess inventory carried by supply chain members in an attempt to cover their exposure to risk.

Simply recognizing that a firm is operating in a reactive mode does not guarantee that necessary changes will be made. That is, firms will not necessarily make the needed investment in improving synchronization unless organizational behaviour, management processes and technological infrastructure issues are addressed. Changes to these areas will not happen unless management is convinced that doing otherwise would be detrimental to the wellbeing of the firm. To achieve the ideal state of synchronization, a firm must consider an even broader perspective. It is not just what is good for the firm, but rather what is best for the many members of the entire supply chain.

### 2.6.1 Performance Cycle Structure

The performance cycle represents the elements of work necessary to complete the logistics related to market distribution, manufacturing, or support procurement. It consists of specific work ranging from identification of requirements to product delivery. Because it integrates various aspects of work, the performance cycle is the primary unit of analysis for logistical synchronization. At a basic level, information and transportation must link all firms functioning in a supply chain. The operational locations that are linked by information and transportation are referred to as nodes. In addition to supply chain nodes and links, performance cycles involve inventory assets. Inventory is measured in terms of the asset investment level allocated to support operations at a node or while a product or material is in transit. Inventory committed to supply chain nodes consists of base stock and safety stock. Base stock is inventory held at a node and is typically one-half of the average shipment size received. Safety stock exists to protect against variance in demand or operational lead time. It is at and between supply chain nodes

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that work related to logistics is performed. Inventory is stocked and flows through nodes, necessitating a variety of different types of materials handling and, when necessary, storage. While a degree of handling and in transit storage takes place within transportation, such activity is minor in comparison to that typically performed within a supply chain node, such as a warehouse. Performance cycles become dynamic as they accommodate input/output requirements.

The input to a performance cycle is demand, typically in the form of a work order that specifies requirements for a product or material. A high-volume supply chain will typically require a different and wider variety of performance cycles than a chain having fewer throughputs. When operating requirements are highly predictable or relatively low-volume throughput, the performance cycle structure required to provide supply chain logistical support can be simplified. The performance cycle structures required to support a large retail enterprise like Target or Walmart supply chains are far more complex than the operating structure requirements of a catalogue fulfilment company.

Supply chain output is the level of performance expected from the combined logistical operations that support a particular arrangement. To the extent that operational requirements are satisfied, the combined logistical performance cycle structure of the supply chain is effective in accomplishing its mission. Efficiency of a supply chain is a measure of resource expenditure necessary to achieve such logistical effectiveness. The effectiveness and efficiency of logistical performance cycles are key concerns in supply chain management.

Depending on the operational mission of a particular performance cycle in a supply chain structure, the associated work may be under the complete control of a single enterprise or may involve multiple firms.



*Example:* Manufacturing support cycles are often under the operational control of a single enterprise.

In contrast, performance cycles related to market distribution and procurement typically involve multiple firms. It is important to realize that transaction frequency and intensity will vary between performance cycles. Some performance cycles are established to facilitate a one-time purchase or sale. In such a case, the associated supply chain is designed, implemented, and abolished once the transaction is complete. Other performance cycles represent long-standing structural arrangements. A complicating fact is that any operation or facility in one logistical arrangement may simultaneously be participating in a number of other performance cycles.



*Example:* The warehouse facility of a hardware wholesaler might regularly receive merchandise from multiple manufacturers and service competing retailers. Likewise, a motor carrier may participate in numerous different supply chains, spanning a wide variety of industries.

When one considers a supply chain of national or multinational scope that is involved in marketing a broad product line to numerous customers, engaging in basic manufacturing and assembly, and procuring materials and components on a global basis, the notion of individual performance cycles linking all participating firms' operations is difficult to comprehend. It is almost mind-boggling to estimate how many performance cycles exist in the supply chain structure of General Motors or IBM. Regardless of the number and different missions of performance cycles a supply chain deploys to satisfy its logistical requirements, each must be individually designed and operationally managed. The fundamental importance of performance cycle design and operation cannot be overemphasized: The logistics performance cycle is the basic unit of supply chain design and operational control. In essence, the performance cycle structure is the framework for implementation of integrated logistics across the supply chain.

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### 2.6.2 Market Distribution Performance Cycles

Market distribution operations are concerned with processing and delivering customer orders. Market distribution is integral to sales performance because it provides timely and economical product availability. The overall process of gaining and maintaining customers can be broadly divided into transaction-creating and physical-fulfilment activities. The transaction-creating activities are advertising and selling. The physical fulfilment activities include (1) order transmission, (2) order processing, (3) order selection, (4) order transportation, and (5) customer delivery. From a logistical perspective, market distribution performance cycles link a supply chain with end customers. This interface can be conflictive.

Marketing is dedicated to satisfying customers to achieve the highest possible sales penetration. So, in most firms, marketing and sales impose liberal policies when it comes to accommodating customers. This may mean that marketing and sales will typically seek broad product assortments supported with high inventory or that all customer requirements, no matter how small or how profitable, will be satisfied. The marketing expectation is that zero logistical defect service will be achieved across the supply chain and customer-focused marketing efforts will be supported.

### 2.6.3 Manufacturing Support Performance Cycles

Manufacturing is the node in a supply chain that creates form value. To a significant degree, manufacturing efficiency depends on logistical support to establish and maintain an orderly and economic flow of materials and work-in-process inventory as required by production schedules. The degree of specialization required in market distribution and procurement can overshadow the importance of positioning and timing inventory movement to support manufacturing. Because customers and suppliers are not involved, manufacturing logistics is less visible than its counterparts.

The identification of manufacturing logistical support as a distinct operating area is a relatively new concept. The justification for focusing on performance cycles to support production is found in the unique requirements and operational constraints of flexible manufacturing strategies. To provide maximum flexibility, traditional manufacturing practices related to economy of scale are being re-evaluated to accommodate quick product switchover and shorter production runs. Exacting logistical support between supply chain participants is required to perfect such time-sensitive manufacturing strategies. It is important to once again stress that the mission of logistical manufacturing support is to facilitate the what, where, and when of production, not the how.

The goal is to support all manufacturing requirements in the most efficient manner. Manufacturing support operations are significantly different than either market distribution or procurement. Manufacturing support logistics is typically captive within individual firms, whereas the other two performance areas must deal with the behavioural uncertainty across the supply chain. Even in situations when outsource contract manufacturing is used to augment internal capacity, overall control of a single enterprise is greater than in the other two operating areas. The benefits to be gained by exploitation of this control opportunity are the prime justification for treating manufacturing logistical support as a distinct operating area.

### 2.6.4 Procurement Performance Cycles

Several activities or tasks are required to facilitate an orderly flow of materials, parts, or finished inventory along a supply chain: (1) sourcing, (2) order placement and expediting, (3) transportation, and (4) receiving. These activities are required to complete the procurement process. Once materials, parts or resale products are received, the subsequent storage, handling and transportation requirements to facilitate either manufacturing or market distribution are

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appropriately provided by other performance cycles. Because of the focus on external supplies, this facet of procurement is referred to as inbound logistics.

### 2.6.5 Performance Cycle Uncertainty

A major objective of logistics in all operating areas is to reduce performance cycle uncertainty. The dilemma is that the structure of the performance cycle itself, operating conditions, and the quality of logistical operations all combine randomly to introduce operational variance.

The performance cycle illustration is limited to finished goods inventory delivery. The time distributions, as illustrated, statistically reflect performance history for each task of a typical performance cycle. The diagram illustrates the minimum to maximum time historically required to complete each task and the related time distribution for the overall performance cycle. The vertical dashed line reflects the average time for performance of each task.

In terms of specific tasks, the variance results from the nature of the work involved. Order transmission is highly reliable when electronic transfer (EDI) or Web-based communications are used and more erratic when using telephone or routine mail. Regardless of the level of technology deployed, operational variance will occur as a result of daily changes in workload and resolution of unexpected events.

Time and variance related to order processing are a function of workload, degree of automation, and policies related to credit approval. Order selection, speed, and associated delay are directly related to capacity, materials handling sophistication, and human resource availability. When a product is out of stock, the time to complete order selection includes manufacturing scheduling. The required transportation time is a function of distance, shipment size, type of transport, and operating conditions. Final delivery to customers can vary depending on authorized receiving times, delivery appointments, workforce availability, and specialized unloading and equipment requirements.

### Self Assessment

State whether the following statements are true or false:

16. Supply chain output is the level of performance expected from the combined logistical operations that support a particular arrangement.
17. Market distribution is not an integral to sales performance because it provides timely and economical product availability.
18. Marketing is dedicated to satisfying customers to achieve the lowest possible sales penetration.



*Case Study*

**Improving Supply Chain Responsiveness at a Leading European Grocery Retailer**

How does a leading European Grocery Retailer with nearly 1000 stores and over 10 million SKU/Store combinations respond when the need to cater to rising consumer incomes, expectations and individualism translates into higher supply chain complexity and costs? The answer: Improve visibility and enhance collaboration between retail stores and central functions in order to replenish stores more efficiently while simultaneously lowering logistics costs.

*Contd...*

**Notes**

Working with a leading edge supply chain consulting form, the retailer realized that the increasingly unpredictable nature of consumer behaviour makes planning more and more difficult. So, more time is spent on planning but the results are less valuable because planning involves making assumptions about what will happen rather than reacting to what customers are actually doing. Consequently, the retailer determined that the only way to be responsive to increasing consumer demands was to build processes and define rules that required less day to day planning. According to the retailer's VP of Supply Chain, "Ten years ago, we made a fundamental choice to no longer believe in the power of forecasting. We don't believe in the predictability of customer behaviour. As the offer in products, information and services keeps growing forecasting is getting more difficult." They quickly determined that this required development of a highly automated replenishment process with a single point of customer demand forecasting and centralized control management.

"Now the supply chain is designed as a pull chain with input from customer behaviour and forecasting models. The base for logistics is what the customer buys supported by other parameters around when do customers visit." says the retailer's VP of Supply Chain. Decisions and store planning and forecasting needed to be much more reactive which required the availability of continuous, near real-time information. Traditional processes were typically built around batch processing cycles, usually one per day. Moving from a batch to a flow system (continuous operation and continuous decision making) facilitated individualized delivery schedules based on geography, transport costs, type of merchandise etc. Naturally, some batching still occurred in the process, such as deliveries to the distribution centre from suppliers or the start of a new promotion but the emphasis is on continuous flow of information, with no artificial barriers to impede the reaction time.

To determine how much of a particular product to send to a particular store requires knowledge of the present and historic service levels as well as constraints of both the product and the store. Each item/store combination has a unique set of parameters. For some products, such as dry groceries, the parameter is simple- when one full case is sold, one new case is ordered. But for items like fresh produce, factors like the desire for freshness, an attractive presentation and the cost of shrinkage must all be taken into account before deciding on an order schedule. Predictive forecasting is only used for special situations such as promotions and events. Once the promotion is started, however, ordering is quickly adjusted to reflect actual consumer behaviour in the store (e.g. real time POS data).

According to the retailer's VP of Supply Chain "The replenishment process is now fully automated. We have a central control room where the switchboard is operated. Here we monitor the assortment behaviour, the effect of the weather, the differences in revenues compared to that type of local store etc. It is all in one place and there is centrally integrated responsibility for all DCs, local stores, etc. Local stores only have to focus on sales, their store (clean, products available) and customer attention. The central department decides what products come in, in what amounts and prescribes how to fill the store. The store just has to execute." As a result of these enhancements to their planning and replenishment processes, the retailer was able to realize some substantial benefits including a 50% reduction in out of stocks. The amount of time employees spend on store processing has declined significantly and improved availability of goods, fewer leftovers and less time spent on ordering has translated into more time for employees to work directly with customers.

In addition, supplier investigation into product availability also proved that availability increased 14% during promotions. Most importantly, however, the net result of creating

*Contd...*

Notes

a collaborative, automated, real-time event driven system is increased confidence that on any given day a customer who walks in to any one of the retailer's stores will leave satisfied.

**Question**

Analyse the case and write down the case facts.

***Source:*** http://www.capgemini.com/m/en/tl/tl_18th_Annual_Trends_in_Logistics_and_Transportation__Synchronization.pdf

## 2.7 Summary

- Logistics is that part of the supply chain process that plans, implements and controls the effective forward and reverse flow and storage of goods, services, and related information between the point of origin and the point of consumption, in order to meet the customer's requirements.
- Logistics is the designing and managing of a system in order to control the flow of material throughout a corporation.
- Supply Chain Management is the systematic, strategic coordination of the traditional business functions and the tactics across these business functions within a particular company and across businesses within the supply chain, for the purposes of improving the long-term performance of the individual companies and the supply chain as a whole.
- Logistics cost form an important part of the overall cost structure in any organization.
- A well-designed logistical effort must have high customer response and capability while controlling operational variance and minimizing inventory commitment. Inventory has limited value until it is positioned at the right time and at the right location to support ownership transfer or value added creation.
- The first three functional areas of logistics – order processing, inventory, and transportation – can be engineered into a variety of different operational arrangements.
- Logistics is viewed as the competency that links an enterprise with its customers and suppliers.
- The operational management of logistics is concerned with movement and storage of materials and finished products. Logistical operations start with the initial shipment of a material or component part from a supplier and are finalized when a manufactured or processed product is delivered to a customer.
- The potential for logistical services to favourably impact customers is directly related to operating system design.
- Synchronization is the ability to coordinate, organize and manage end-to-end supply chain flows – products, services, information, and financials – in such a way that the supply chain functions as a single entity.

## 2.8 Keywords

***Inbound Logistics:*** It means the movement of materials received from suppliers.

***Information Flow:*** It identifies specific locations within a logistical system that have requirements. Information also integrates the three operating areas.

Notes

***Logistics:*** Logistics is the process of planning, implementing and controlling the efficient, effective flow and storage of goods, services and related information from the point of origin to the point of consumption for the purpose of conforming to the customer requirement.

***Material Management:*** It means the movement of material and components inside a firm.

***Materials Handling:*** Material Handling refers to activities, equipment, and procedures related to the moving, storing, protecting and controlling of materials in a system.

***Order Management:*** It includes understand various specifications and design order requirements with each suppliers, which will help in identifying ways of reducing cost and also help in reducing price structure.

***Physical Distribution:*** It refers to movement of goods outward from the end of the assembly line to the customer.

***Physical Distribution:*** Physical distribution is the set of activities concerned with efficient movement of finished goods from the end of the production operation to the consumer.

***Procurement:*** It is concerned with purchasing and arranging inbound movement of materials, parts, and/or finished inventory from suppliers to manufacturing or assembly plants, warehouses, or retail stores.

***Supply Chain Synchronization:*** It is the ability to coordinate, organize and manage end-to-end supply chain flows – including products, services, information and financials – in such a way that the supply chain functions as a single entity.

***Supply-chain Management:*** Supply chain management (SCM) is the management of a network of interconnected businesses involved in the provision of product and service packages required by the end customers in a supply chain.

***Synchronization:*** It is the ability to coordinate, organize and manage end-to-end supply chain flows – products, services, information, and financials – in such a way that the supply chain functions as a single entity.

***Transportation:*** It is the operational area of logistics that geographically moves and positions inventory.

***Transshipment:*** It mainly involves controlling the express shipping costs, typically when a company have an entire shipment sent on an express service level basis for which higher cost is incurred.

***Warehousing:*** A warehouse is a commercial building for storage of goods. Warehouses are used by manufacturers, importers, exporters, wholesalers, transport businesses, customs, etc.

## 2.9 Review Questions

1. Illustrate a common trade-off that occurs between the work areas of logistics.
2. Discuss and elaborate on the following statement: "The selection of a superior location network can create substantial competitive advantage."
3. Describe the logistics value proposition. Be specific regarding specific customer accommodation and cost.
4. Describe the fundamental similarities and differences between procurement, manufacturing support, and market distribution performance cycles as they relate to logistical control.
5. Discuss uncertainty as it relates to the overall logistical performance cycle.

**Notes**

6. Discuss and illustrate how performance cycle variance can be controlled.
7. What is the logic of designing echeloned logistical structures? Can echeloned and direct structures be combined?
8. Distinguish between Performance Cycle Structure and Market Distribution Performance Cycles.
9. Write brief note on Echelon Structured Logistics.
10. Define Order management.
11. "Coordination is the backbone of overall information system architecture among value chain participants." Elucidate.
12. Discuss the phases included in the Integrated Logistic.

### Answers: Self Assessment

| | | | |
|---|---|---|---|
| 1. | Loger | 2. | Material |
| 3. | SCM | 4. | False |
| 5. | True | 6. | False |
| 7. | Inventory | 8. | Transportation |
| 9. | Network Design | 10. | True |
| 11. | True | 12. | False |
| 13. | Echelons | 14. | Consolidation |
| 15. | Strategy | 16. | True |
| 17. | False | 18. | False |

## 2.10 Further Readings



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# Unit 3: Customer Accommodation

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3.8 Further Readings

## Objectives

After studying this unit, you will be able to:

- Explain the Customer-Focused Marketing
- Understand the Customer Service
- Discuss the Customer Satisfaction
- Describe the Customer Success

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## Introduction

Logistics contributes to an organization's success by providing customers with timely and accurate product delivery. The key question is who is the customer? For logistics, the customer is any delivery destination. Typical destinations range from consumers' homes to retail and wholesale businesses to the receiving docks of a firm's manufacturing plants and warehouses. In some cases, the customer is a different organization or individual who is taking ownership of the product or service being delivered. In many other situations, the customer is a different facility of the same firm or a business partner at some other location in the supply chain.

Regardless of the motivation and delivery purpose, the customer being serviced is the focal point and driving force in establishing logistical performance requirements. It is important to fully understand customer service deliverables when establishing logistical strategy. This unit details the nature of customer service and the development of facilitating strategies.

For a logistician, a customer is any delivery location. Typical destinations range from consumers' homes to retail and wholesale businesses to the receiving docks of manufacturing plants and distribution centres. In some cases the customer is a different organization or individual who is taking ownership of the product or service being delivered. In many other situations the customer is a different facility of the same firm or a business partner at some other location in the supply chain. It is common for the logistics manager of a retail distribution centre to think of the individual stores to be serviced as customers of the distribution centre, even though the stores are part of the same organization.

Regardless of the motivation and delivery purpose, the customer being serviced is the focal point and driving force in establishing logistical performance requirements. It is critical to fully understand customer needs that must be accommodated in establishing logistical strategy. This unit details the nature of various approaches to accommodating customer requirements.

## 3.1 Customer-Focused Marketing

The logical starting point is to understand how logistical competency contributes to marketing performance. Firms guided by market opportunity, view satisfying customer requirements as the motivation behind all activities. The objective of marketing initiatives is to penetrate specific markets and generate profitable transactions. This posture, often referred to as the marketing concept, emerged as part of the post-World War II shift from seller- to buyer-dominated markets. In this section, attention is directed to three fundamental concepts. First, the essence of a marketing orientation to business planning is developed. Next, the increased attention to developing logistics as a core competency is discussed. This notion of treating logistical competency as a strategic resource is critical to customer service planning. Finally, the changing nature of most desired logistics practice is examined in terms of product life-cycle requirements. It is important to understand that logistical performance should be modified over time to accommodate changing marketing requirements.

### 3.1.1 Managing Consumer Waiting Periods

Most good customer service benchmarks include the length of the waiting time – in airlines, banking, health service, shopping, etc. Customers tend to lose patience, and the service firm has to agonize in choosing speed over security. But the world over, delayed service is perceived as inefficiency. Waiting time management is a challenge but can be creatively handled. Doctors in their clinics have ergonomically designed lounges, magazines and softly played televisions. Hairdressers too have magazines and extra chairs while airlines are splurging on exclusive lounges. Some examples of customer wait management:

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1. Keep the customer occupied – reading magazines, listening to music or viewing TV.
2. Convey to the customer that the service process has began; it will make less fidgety. Bankers start the preliminary paperwork processes, while doctors shift patients to different examining rooms.
3. Make attempts to reassure the customers as anxiety makes waiting feel longer.
4. Share all the information possible with the customers, as this will reduce the anxiety level and give them cues for getting occupied.
5. Do not make it evident that some customers are more equal than others; discrimination will make customers indignant and restive.
6. Try to encourage customers to interact with each other as this will keep them occupied and engaged. If they are alone, the wait might seem interminable.

### 3.1.2 Dealing with Difficult Customers

The quality of service transactions, surprisingly, depends to a great extent also on the characteristics and traits of the customers:

1. Education and background – like profession, skills, experience, family background, social circle, etc.

A customer who is a professional, like a chartered accountant, will be in a better position to understand the savings account opening norms in a bank than an illiterate farmer. The latter would most probably require detailed explanations, in his mother tongue, and assistance in filling up all the forms. These would undoubtedly make the service transaction more time-consuming. In addition, the service delivery would suffer, if the provider was not conversant with the language of the customer or was incapable of coming down to the comprehension level of the customer.



*Example:* An educated housewife could be helpless inside an ATM kiosk, if there was a "system fault" and would have to resort to 'manned' banking procedures.

1. The mood, attitude and personality of the customer, which might prevent a smooth service transaction.
   (a) In a popular restaurant positioned for the family, when some rowdy non-family group disturbs the peaceful atmosphere, the service provider fails in delivering the promise.
   (b) The demeanour of the ill-mannered group is markedly different from the orderly behaviour of the rest of the family-type customers, and although they are smaller in number, they manage to ruin the experience of all other customers. This is also an uncontrollable factor for the service marketer.

Service transactions and the quality of service delivery depend a lot on both the provider and the customers carrying out their roles seamlessly as designed by the blueprints of operations. While it can to a great extent be possible to manage the quality of the performance of the internal customers, it becomes a challenge to extract compliant behaviour from the customers.

The customers of the same service firm and offer are different from each other due to the following:

- Differing backgrounds of education, family, occupation, income;

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- Differing skills, attitude and aptitude;
- Differing moods, involvement, experience, awareness and perception.

If the service has to be delivered with consistent quality – and customers' participation is taken as mandatory for the service delivery – then the differences in the characteristics of the customers have to be taken into account by the service marketer. The customer has to be managed, which can be attempted in the following ways:

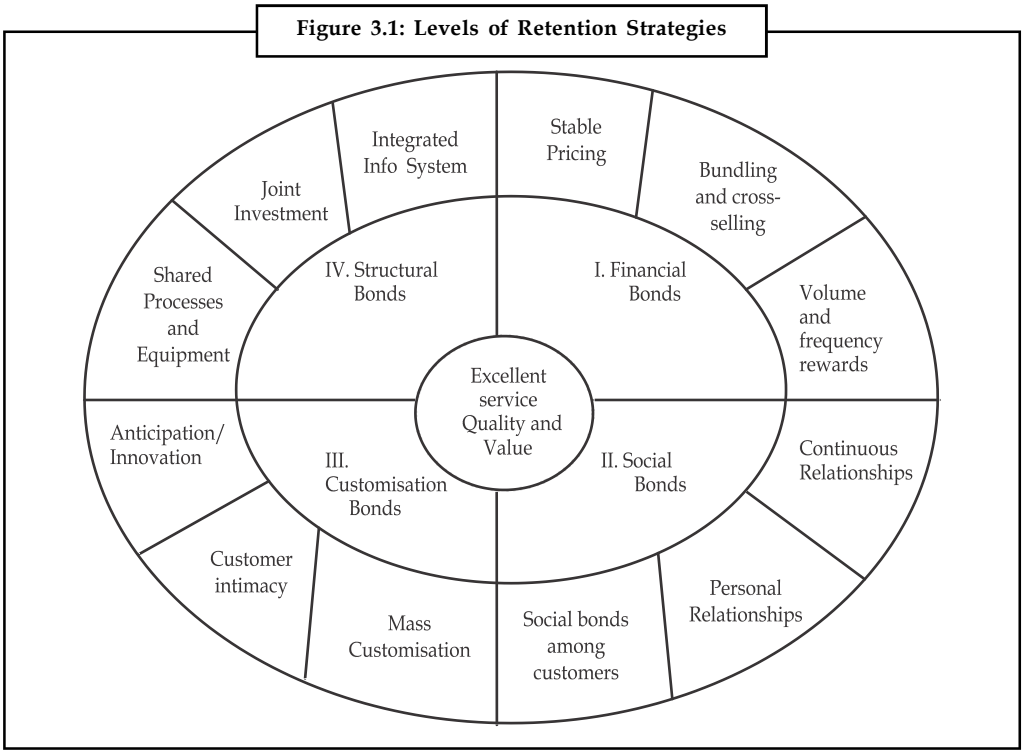
- Training and education of the customer;
- Choosing the appropriate segment of the customers that are desirable and manageable by the service marketer.

***Training and education of the customer:*** As mentioned before, airline staff pantomime and give verbal instructions on flight safety procedures before takeoff to the passengers. Package tour operators give detailed instruction booklets and other information brochures to their customers and make them sign many clauses of conduct and disclaimers.

***Targeting the chosen segment:*** Citibank took the lead followed by other foreign banks and then later by most private banks, to keep a high minimum-balance-maintaining clause for its account holders. In the process they got to avoid the vast mass-banking crowd who were not only unprofitable (from their point of view) but also greatly differed in their quality of service participation.

***Customer retention strategies:*** The service marketer should stress on retaining customers, as they are less expensive than customer acquisition. A retained customer will also contribute handsomely to the bottom line through positive referrals and repeat purchases over an entire lifetime. The service marketer can attempt four types of bonding with customers (see Figure):

**Figure 3.1: Levels of Retention Strategies**




***Source:*** David E. Bowen and Benjamin Schneider, "Boundary Spanning Role Employees and the Service Encounter: Some Guidelines for Management and Research" in The Service Encounter, ed. J. A. Czepiel, M. R. Solomon and C. F. Surprenant (Lexington, Mass: Lexington Books, 1985) pp. 127–148.

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- Financial bonds – through favourable pricing and incentives;
- Social bonds – by way of personal and enduring relationships;
- Customization bonds – through mass customization, feed forward and anticipation;
- Structural bonds – joint involvement and integrated systems.



*Caselet*

## Square D Co.

At Square D Co., a Palatine, Illinois-based manufacturer of electrical control products and unit of Paris-based Schneider Electric, VP of Marketing Chris Curtis enthusiastically promotes Square D's marketing approach toward its strategic accounts. These accounts, such as Daimler- Chrysler and IBM Cop., are high profile and generate significant sales. Square D uses a Relationship Management Process or RMP to market its products to these accounts. RMP stresses creating one-to-one marketing partnerships in which Square D customers are provided with exactly the products and level of service they want.

*For example*, Scott Chakmak is Square D's director of strategic accounts-DaimlerChrysler and spends his working days in DaimlerChrysler's Kenosha, Wisconsin, plant. This proximity to the customer allows Square D's sales staff to become well acquainted with DaimlerChrysler's needs. Prior to Daimler's acquisition of Chrysler, Mr. Chakmak realized that Square D's team could ease the workload of Chrysler's engineers by helping with the design of a new engine assembly line. He suggested that his team oversee the design of the electrical control system of each machine to ensure conformity. The consistency of the design would reduce training time and make Chrysler's employees more versatile. After more than 2 years, Chrysler finally agreed to Square D's proposal and put its supplier in charge of the project. Communicating via the Internet with more than 80 other contributing suppliers around the world, Square D completed the project in 27 months, significantly shorter than the industry standard of 36 months, according to Mr. Chakmak. Since that first project, Square D has overseen similar projects for various DaimlerChrysler plants around the world. "The first project took 2 years to sell," recalls Mr. Chakmak. "It took 9 months to sell the next time."

Then it was 30 days. Since then, it's basically been a handshake. Ultimately, RMP is about customer segmentation. If customers don't want or require value-added services, Square D simply sells them the products they need. For other customers, value-added services can be customized to meet their specific product needs. These extra efforts can be quite worthwhile for Square D, enhancing its value as a supplier to a strategic customer. *For example*, Square D is now the sole supplier of power supply equipment to IBM Cop. Square D must adhere to rigorous standards in handling strategic accounts. Square D and its sister Schneider brand, Modicon, sell to IBM approximately $I I million in electrical control products annually under a 3-year pact signed last year. This pact ensures that IBM receives volume discounting, standardization across plants, prompt shipping, available inventory for essential products, and responsive service. Mr. Curtis sums up Square D's RMP approach as an evolution of the total quality management movement of the 1980s. Instead of the manufacturing process, RMP scrutinizes Square D's relationship with its customers to better accommodate individual requirements and improve channel success.

***Source:*** Scan Callahan, "Getting a Square Deal: Advertising Age's Business Marketing", January/February 2000, p. 315

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### Self Assessment

Fill in the blanks:

1. The objective of …… initiatives is to penetrate specific markets and generate profitable transactions.
2. The …… marketer should stress on retaining customers.
3. A …… who is a professional, like a chartered accountant, will be in a better position to understand the savings account opening norms in a bank than an illiterate farmer.
4. Service transactions and the quality of service delivery depend a lot on both the provider and the customers carrying out their roles seamlessly as designed by the blueprints of ……..

## 3.2 Customer Service

Marketing identifies the appropriate logistical performance. The critical strategic issue is to determine the combination of services and their desired format that will support and stimulate profitable transactions.

Although most senior managers agree that customer service is important, they find it difficult to explain exactly what it is and does. Two interpretations commonly expressed are easy to do business with and sensitive to customer needs. While such generalizations have appeal from a qualitative perspective, it is difficult to interpret what "easy to do business with" means for firms that deal with numerous customers on a daily basis. To develop a customer service strategy, it is necessary to develop a working definition of customer service.

LaLonde and Zinszer have researched various ways that customer service can be viewed: (1) as an activity, (2) in terms of performance levels, and (3) as a philosophy of management.

Viewing customer service as an activity suggests that it is capable of being managed. Thinking of customer service in terms of performance levels has relevancy providing it can be accurately measured. The notion of customer service as a philosophy of management exemplifies the importance of customer-focused marketing. All three dimensions are important to understand what is involved in successful customer service.

A broad definition of customer service should embody elements from all three perspectives.

Customer service is a process for providing significant value-added benefits to the supply chain in a cost-effective way.

It is clear that excellent customer service performance seems to add value for all members of the supply chain. Thus, a customer service program must identify and prioritize all activities important to accomplish operating objectives. A customer service program also needs to incorporate measures for evaluating performance. Performance needs to be measured in terms of goal attainment and relevancy. The critical question in planning a customer service strategy remains. Does the cost associated with achieving the specified service goals represent a sound investment and, if so, for what customers? Finally, it is possible to offer key customers something more than high-level basic service. Extra service beyond the basics is typically referred to as value-added. Value-added services, by definition, are unique to specific customers and represent extensions over and above a firm's basic service program.

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### 3.2.1 Basic Service Capability

Three fundamental dimensions of customer service are identified: availability, performance, and reliability. These attributes are now discussed in greater detail. Numerous research studies have examined the relative importance of the three service attributes in different business situations. The general conclusion is that all three aspects of service are important. However, a given service attribute may be more or less important depending on the specific marketing situation.

### 3.2.2 Availability

Availability is the capacity to have inventory when it is desired by a customer. Availability can be achieved in a variety of ways. The most common practice is to stock inventory in anticipation of customer orders. The appropriate number, location, and stocking policy of warehouses are one of the basic issues in logistical system design. Typically an inventory stocking plan is based on forecasted requirements and may incorporate differential stocking strategies for specific items as a result of sales popularity, importance of the specific item to the overall product line, profitability, and the value of the merchandise.



*Did u know?* Inventory can be classified into two groups: base stock determined by forecasted requirements and held to support basic availability, and safety stock to cover demand that exceeds forecasted volumes and to accommodate unexpected operational variances.

An important aspect of availability is a firm's safety stock policy. Safety stock exists to accommodate forecast error and cushion delivery delays during base stock replenishment. Generally, the greater the desire to protect against out-of-stocks, the larger the safety stock required. Thus, high safety stock commitment typically means larger average inventory. In high-variance situations, safety stock can constitute greater than half of a firm's average inventory.

It should be clear that achieving high levels of consistent inventory availability requires a great deal more planning than allocating inventory to warehouses based on sales forecasts. In fact, the key is to achieve high levels of inventory availability for selected or core customers while holding overall investment in stock and facilities at a minimum. Such exacting performance requires total integration of all logistical resources and clear goals regarding availability commitments to specific customers. Exacting programs of inventory availability are not conceived or managed on "the average." Therefore, availability is based on the following three performance measures: stockout frequency, fill rate, and orders shipped complete. These three measures determine a firm's ability to meet specific customer inventory requirements.

### 3.2.3 Stockout Frequency

Stockout frequency is the probability that a stockout will occur. In other words, this measure indicates if a product is available to ship to customers. A stockout occurs when demand exceeds product availability. The stockout frequency is a measure of how many times demand for a specific product exceeds availability. The aggregation of all stockouts across all products is an indication of how well a firm is positioned to provide basic service commitments. This measure does not consider the fact that some products may be more critical in terms of availability than others. However, stockout frequency is a starting point in measuring inventory availability.

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### 3.2.4 Fill Rate

Fill rate measures the magnitude or impact of stockouts over time. Just because a product is out of stock does not necessarily mean that a customer requirement is going unsatisfied. Before a stockout affects service performance, it is necessary to confront a customer requirement. Then it becomes important to identify that the product is not available and to determine how many units the customer wanted. Fill rate performance is typically specified in customer service objectives. By measuring the magnitude of stockouts, a firm's track record in meeting customer requirements can be determined.



*Example:* If a customer orders 50 units and only 47 units are available, the order fill rate is 94 percent (47/50).

To effectively measure fill rate, the typical procedure is to evaluate performance over a specified time that includes multiple customer orders. Thus, fill rate performance can be calculated for a specific customer or for any combination of customers or business segment desired.

Fill rate can also be used to differentiate the level of service to be offered on specific products. In the earlier example, if all 50 products were critical, an order fill rate of 94 percent could result in a stockout in the customer's operation and create considerable dissatisfaction. However, if most of the 50 products were relatively slow movers, a fill rate of 94 percent could be satisfactory. The customer may accept a back-order or even be willing to reorder the short items. A firm can identify products that are critical and should have higher fill rates on the basis of customer requirements. Fill rate strategies can then be developed to meet customer expectations. Stockout frequency and fill rate both depend on customer order practices.



*Example:* If a firm places frequent replenishment orders for small quantities, the probability of stockout frequency will increase as a result of shipment variability. In other words, each replenishment order represents an equal chance for a delivery delay.

Thus, as the number of orders that impact safety stock increases, more stockouts will occur. On the other hand, if a firm places fewer large replenishment orders, the potential stockout frequency will be less and the expected fill rate will be higher.

### 3.2.5 Orders Shipped Complete

Orders shipped complete are a measure of the times that a firm has the entire inventory ordered by a customer. It is the strictest measure since it views full availability as the standard of acceptable performance. Orders shipped complete establishes the potential times that customers will receive perfect orders, providing all other aspects of performance have zero defects.

These three availability measures combine to identify the extent to which a firm's inventory strategy is meeting customer expectations. They also form the basis to evaluate the appropriate level of availability to incorporate in a firm's basic service platform.

### 3.2.6 Operational Performance

The performance cycle was positioned as the operational structure of logistics. Mission, type of customer being serviced, differentiated performance cycles and the degree of operational variance experienced over time. Operational measures specify the expected performance cycle in terms of (1) speed, (2) consistency, (3) flexibility and (4) malfunction/recovery. Operational performance involves logistical commitment to expected performance time and acceptable variance.

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## Speed

Performance-cycle speed is the elapsed time from when an order is placed until shipment arrival. Such commitment must be viewed from a customer's perspective. The time required for performance-cycle completion can be very different depending on logistical system design. Given today's high level of communication and transportation technology, order cycles can be as short as a few hours or as long as several weeks or months.

Of course, the highest commitment to both inventory availability and operational speed is customer inventory consignment. In consignment arrangements, the product is inventoried at a customer's business establishment in anticipation of need. While consignment may be ideal from a customer's perspective, it can be an expensive way for a supplier to do business. Consignment arrangements are typically limited to critical items that can result in significant loss in efficiency or effectiveness if they are not available exactly when required, such as machine parts and emergency medical supplies. Typical consignment situations are found in business-to-business marketing and the health care industry.



*Did u know?* The decision for a supplier to consign as contrasted to a customer holding safety stock is often a reflection of the relative power in a business relationship.

The more typical business arrangement is for a supplier's delivery commitment to be based on customers' expectations in terms of performance-cycle speed. In critical situations, service can be performed in a few hours by special delivery from a local warehouse or on an overnight basis using highly reliable transportation services. Usually, the business relationship is formed around performance-cycle expectations that facilitate efficient logistical operations while meeting customer requirements. In order words, not all customers need or want maximum speed if it results in an increase in price or effective logistics cost.

Performance-cycle timing has a direct relationship to inventory requirements. Typically, the faster the planned performance, the lower the level of inventory investment required by customers. This relationship between performance time and customer inventory investment is at the heart of time-based logistics arrangements reliability.

## Consistency

While speed of service is critical, most logistical managers place greater emphasis on consistency. Consistency refers to a firm's ability to perform at the expected delivery time over a large number of performance cycles. Failure to be consistent translates directly into customers needing to carry extra safety stock to protect against possible late delivery. Whereas availability is concerned with the ability to ship products when required and performance-cycle speed is concerned with the commitment to complete all work requirements necessary to deliver specific orders at a prescribed time, consistency deals with compliance to delivery commitments over time. The issue of consistency is fundamental to logistical operations.

## Flexibility

Operational flexibility refers to a firm's ability to handle extraordinary customer service requests. A firm's logistical competency is directly related to how well unexpected circumstances are handled. Typical events requiring flexible operations are as follow:

1. Modifications in basic service arrangements such as onetime changes in ship-to destinations
2. Support of unique sales and marketing programs

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3. New-product introductions
4. Product phase out
5. Disruption in supply
6. Product recall
7. Customization of service levels for specific markets or customers
8. Product modification or customization performed while in the logistics system, such as pricing, mixing; or packaging. In many ways the essence of logistical excellence rests in the ability to be flexible. As a rule, a firm's overall logistical competency depends on the capability to "go the extra yard" when appropriate to satisfy a key customer requirement.

**Malfunction/Recovery**

Regardless of how fine-tuned a firm's logistical operation is, malfunctions will occur. The continuous performance of service requirements under all types of operational situations is a difficult task. Sometimes, programs can be established to prevent or accommodate special situations, thereby preventing malfunction. Such extraordinary commitments must be reserved for justifiable situations. In terms of the basic service program, the key is to anticipate that malfunctions or service breakdowns will occur and to have in place contingency plans to accomplish recovery. Thus, the basic service program guarantees a high level of service with the realization that no program is fail-safe. When service failures occur, the customer service program should have contingency plans that identify expected recovery and measure compliance.

Logistics quality is all about reliability. A fundamental quality issue in logistics is the ability to comply with levels of planned inventory availability and operational performance. Beyond service standards, quality compliance involves a capability and willingness to rapidly provide accurate customer information regarding logistical operations and order status. Research indicates that the ability of a firm to provide accurate information is one of the most significant measures of customer service competency. Increasingly, customers indicate that advanced information concerning the contents and timing of an order is more critical than complete order fulfilment. Customers detest surprises! More often than not, customers can adjust to a stockout or late delivery situation if they receive advanced notification.

In addition to service reliance, a major part of service quality is continuous improvement. Logistical managers, similar to other managers within the firm, are concerned with meeting operational objectives with as few malfunctions as possible.



*Notes* One way to achieve these objectives is to learn from malfunctions and improve the operating system to prevent reoccurrence.

## 3.2.7 Service Reliability

Service reliability involves the combined attributes of logistics and concerns a firm's ability to perform all order-related activities, as well as provide customers with critical information regarding logistical operations and status. Beyond availability and operational performance, attributes of reliability may mean that shipments arrive damage-free; invoices are correct and error-free; shipments are made to the correct locations; and the exact amount of product ordered is included in the shipment. While these and numerous other aspects of overall reliability are difficult to enumerate, the point is that customers demand that a wide variety of business details be handled routinely by suppliers. Additionally, service reliability involves a capability and a

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willingness to provide accurate information to customers regarding operations and order status. Research indicates that the ability of a firm to provide accurate information is one of the most significant attributes of a good service program. Increasingly, customers indicate that advanced notification of problems such as incomplete orders is more critical than the complete order itself. Customers hate surprises! More often than not, customers can adjust to an incomplete or late delivery, if they have advanced notification.

### 3.2.8 The Perfect Order

The ultimate in logistics service is to do everything right and to do it right the first time. It is not sufficient to deliver a complete order but to deliver it late. Nor is it sufficient to deliver a complete order on time but to have an incorrect invoice or product damage incurred during the handling and transportation process. In the past, most logistics managers evaluated customer service performance in terms of several independent measures: fill rates were evaluated against a standard for fill; on-time delivery was evaluated in terms of a percentage of deliveries made on time relative to a standard; damage rates were evaluated relative to a standard for damage; etc. When each of these separate measures was acceptable relative to standard, overall service performance was considered acceptable.

Recently, however, logistics and supply chain executives have begun to focus attention on zero-defect or six-sigma performance. As an extension of Total Quality Management (TQM) efforts within organizations, logistics processes have been subjected to the same scrutiny as manufacturing and other processes in the firm. It was realized that if standards are established independently for customer service components, even if performance met standard on each independent measure, a substantial number of customers may have order-related failures.



*Example:* If orders shipped complete, average on-time delivery, average damage-free delivery, and average correct documentation are each 97 percent, the probability that any order will be delivered with no defects is approximately 88.5 percent. This is so because the potential occurrence of any one failure combined with any other failure is .97 x .97 x .97 x .97. The converse of this, of course, is that some type of problem will exist on as many as 11.5 percent of all orders.

The notion of the perfect order is that an order should be delivered complete, delivered on time, at the right location, in perfect condition, with complete and accurate documentation. Each of these individual elements must comply with customer specifications. Thus, complete delivery means all products the customer originally requested, on time means at the customer's specified date and time, etc. In other words, total order cycle performance must be executed with zero defects – availability and operational performance must be perfectly executed and all support activities must be completed exactly as promised to the customer. While it may not be possible to offer zero defects as a basic service strategy across the board to all customers, such high-level performance may be an option on a selective basis.

## Self Assessment

State whether the following statements are true or false:

5. Fill rate cannot also be used to differentiate the level of service to be offered on specific products.
6. Safety stock exists to accommodate forecast error and cushion delivery delays during base stock replenishment.
7. The performance cycle was not positioned as the operational structure of logistics.
8. Operational consistency refers to a firm's ability to handle extraordinary customer service requests.

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## 3.3 Customer Satisfaction

Customer satisfaction is the degree to which customer expectations of a product or service are met or exceeded. Logistics exists to satisfy customer requirements by facilitating important manufacturing and marketing operations. The most demanding service commitment is to focus on facilitating customer success. By definition, a success program and its related commitments focus on long-term business relationships that have growth potential and offer high probability of achieving the desired results.



*Caution* To ensure that a customer is successful may require a supplier to help reinvent the way a product is sold or distributed.

### 3.3.1 Measurement of Customer Satisfaction

There are a lot of challenges that service marketers face due to the basic difference that prevails between service and goods. Some of the challenges that they constantly face are:

- Understanding customer needs and their expectations from service;
- Tangibilising the service offering;
- Dealing with different types and varieties of people – internal as well as external customers – as also the delivery issues;
- Keeping promises made to customers.

But the most intriguing challenge is the measurement and monitoring of quality.

Some questions regarding quality of service still elude any definitive answers:

- How can service quality be defined and improved when the product is intangible and non-standardized?
- How can new services be designed and tested effectively when the service is essentially an intangible process?
- How can the service firm be certain that its communication has been effective, consistent and relevant, especially when its other marketing mixes are also communicating? This apprehension is especially true with respect to the role played by the providers in the service transaction.

The various operational objectives which logistics help in achieving and hence maximizing customer satisfaction and success are as follows:

- ***Rapid Response:*** Rapid response is concerned with a firm's ability to satisfy customer service requirements in a timely manner. Information technology has increased the capability to postpone logistical operations to the latest possible time and then accomplish rapid delivery of required inventory. The result is elimination of excessive inventories traditionally stocked in anticipation of customer requirements. Rapid response capability shifts operational emphasis from an anticipatory posture based on forecasting and inventory stocking to responding to customer requirements on a shipment-to-shipment basis. Because inventory is typically not moved in a time-based system until customer requirements are known and performance is committed, little tolerance exists for operational deficiencies.
- ***Minimum Variance:*** Variance is an unexpected event that disrupts performance of the system. Variance may result from any aspect of logistical operations. Delays in expected

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time of customer order receipt, an unexpected disruption in manufacturing, goods arriving damaged at a customer's location, or delivery to an incorrect location. These result in a time disruption in operations that must be resolved. Potential reduction of variance relates to both internal and external operations. Operating areas of a logistical system are subject to potential variance. The traditional solution to accommodate variance was to establish safety stock inventory or use high-cost premium transportation. These practices, given their expense and associated risk, have been replaced by using information technology to achieve positive logistics control. To the extent, variances are minimized; logistical productivity improves as a result of economical operations. Hence a basic objective of overall logistical performance is to minimize variance.

- ***Minimum Inventory:*** The aim of minimum variance involves assets, commitment and relative turn velocity. Total commitment is the financial value of inventory deployed throughout the logistical system. Turn velocity involves the rate of inventory usage over a period of time. High turn rates, coupled with inventory availability, means that assets devoted to inventory are being utilized effectively. The aim is to reduce inventory deployment to the least level consistent with customer service goals to achieve the least overall total logistics cost. Zero inventories have become increasingly important as managers seek to reduce inventory storage. The reality of reengineering a system is that operational defects do not become apparent until inventories are reduced to their least possible level.



*Notes* The goal of eliminating all inventories is attractive; it is important to note that inventory can and does facilitate some important benefits in a logistical system.

Inventories can provide improved return on investment when they result in economies of scale in manufacturing or procurement. The aim is to reduce and manage inventory to the lowest possible level while simultaneously achieving desired operating aim. To achieve the aim of minimum inventory, the logistical system design should control commitment and turn velocity for the entire firm, not only for each business location.

- ***Consolidated Movement:*** The most important logistical costs are transportation. Transportation cost is directly proportional to the type of product, size of shipment, and distance. Logistical systems that feature premium service depend on high-speed, small-shipment transportation. Premium transportation is typically high-cost. To decrease transportation cost, it is desirable to achieve movement consolidation. The larger the overall shipment and the longer the distance it is transported, the lower is the transportation cost per unit. To achieve this, it requires innovative programmes to group small shipments for consolidated movement. These kinds of programmes must be facilitated by working arrangements that transcend the overall supply chain.
- ***Improvement in Quality:*** Another logistical aim is to seek continuous improvement in quality. Total Quality Management (TQM) has become a major commitment in all departments of industry. Total commitment to TQM is one of the major forces which contribute to the logistics. In case a product becomes defective or if service promises are not kept, value is added by the logistics. Logistical costs, once increased, cannot be reversed. When quality fails, the logistical performance typically needs to be reversed and then repeated. Logistics itself must perform to the required quality standards. The challenge of achieving zero defect logistical performance is illustrated by the fact that logistical operations typically must be performed across a wide geographical area at all times of the day and night. The quality challenge is illustrated by the fact that most logistical work is performed due to supervisor's vision. Reworking a customer's order due to incorrect

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shipment or due to in-transit damage is more costly than performing it right the first time. Logistics is a main part of developing and maintaining continuous TQM improvement.

- ***Life-cycle Support:*** The final logistical aim is life-cycle support. Very few items are sold without some guarantee that the product will perform as advertised over a period. The normal value-added inventory flow toward customers must be reversed. Product recall is an important competency that results from increasing rigid quality standards, product expiration dating and responsibility for hazardous consequences. Return logistics requirements also result from the increasing number of laws prohibiting disposal and encouraging recycling of beverage containers and packaging materials. The most important aspect of reverse logistical operations is the need for maximum control when a potential health liability exists. A recall programme is similar to a strategy of maximum customer service that must be executed regardless of cost. The operational requirements of reverse logistics range from lowest total cost, such as returning bottles for recycling, to maximum performance solutions for critical recalls.



*Notes* The important point is that sound logistical strategy cannot be formulated without careful review of reverse logistical requirements.

The importance of service support logistics changes directly with the product and buyer. This applies especially to firms marketing consumer durables or industrial equipment. The commitment to life-cycle support constitutes a demanding operational requirement as well as one of the largest costs of logistical operations. The life-cycle support capabilities of a logistical system must be carefully designed. Reverse logistical competency, as a result of worldwide attention to environmental concerns, requires the capacity to recycle ingredients and packaging materials.

Logistical service is measured in terms of:

- ***Availability:*** Availability denotes having inventoried to consistently meet the need of the customer material or product requirements.
- ***Operational Performance:*** Operational performance means the elapsed time from order receipt to delivery. Operational performance involves delivery speed and consistency. A firm's operational performance can be measured in terms of how flexible it is in accommodating unusual and unexpected request of customer.
- ***Service Reliability:*** Service reliability pertains to the quality attributes of logistics. For logistics performance to continuously meet customer expectations, it is necessary that management should be committed to continuous improvement.

### 3.3.2 A Model of Customer Satisfaction

This model can help a firm desirous of improving service quality to focus better on its strategies and service processes. This model can not only be used to find and identify areas in service delivery and designs (which might lack quality), but also measure and monitor quality in service.

Quality in service is as perceived by the customer. There is no other way to either comprehend or administer. As service is intangible; the only way to measure quality in service is to measure the expectation of the customer before the receipt of service and measure his perception after the experience, that is, the service encounter. The gap between the two is a measure of the service quality. The larger the gap, the worse is the service quality; the narrower the gap, better the

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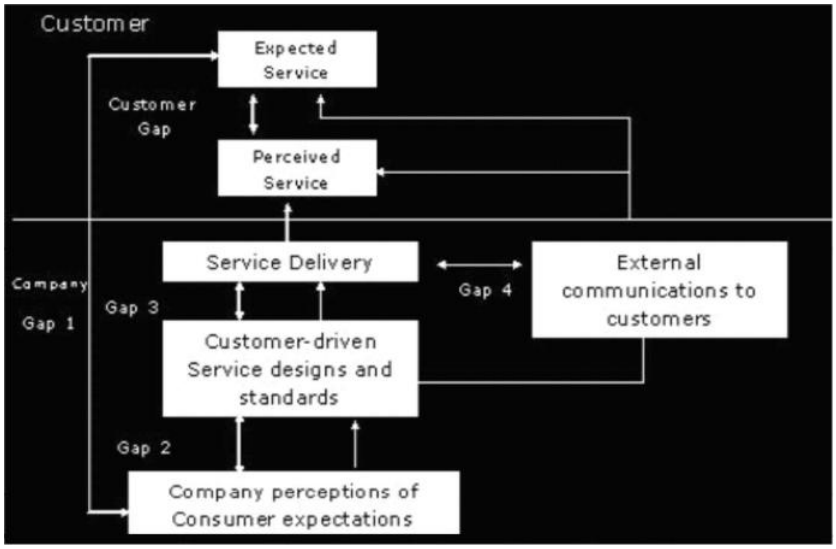
service quality of the firm; i.e., the firm is successful in meeting the customer's expectations... so far! Since consumer expectations keep inching upward constantly, so must the quality of service.

- the measurement of the expectation of the customers (in this case, students) before the service delivery (before admission)
- the measurement of perception of the experience, after the service encounter (after admission, during the 2-year course and after the convocation)
- thus measuring the gap between the two

The model professes two types of gaps:

- The Customer Gap – the gap between customer expectations and customer perceptions. This, in other words, is the service quality shortfall as seen by the customers. Customers develop expectations from receipt of external stimuli from many sources – ranging from those that are company – controlled to social influences. These form the bases of his reference-to-come for the service experience. The customer's perceptions indicate the service as actually received, for all practical purposes, since what we perceive is what is real to us. Perceptions are everything.
- Company-controlled external stimuli are: service product/offer, price, advertising, promotions, displays, outlets etc.

**Figure 3.2: Gaps Model of Service Quality**




***Source:*** Upendra Kachru, (2010), "Exploring the Supply Chain," Excel Books

Social influences as external stimuli are: word of mouth communications and reference groups. Other influencers of expectations are: personal needs and past experience of the customer.

The customer gap indicates the difference between actual performance and the customer's perception of the service. There are a lot of subjective judgments made by customers. Last experiences may prejudice them and change their estimation of quality.

*Example:* A customer is satisfied with a certain restaurant; but his last experience there (it could be because of a new waiter) could leave him embittered, washing away years of happy experiences at one go.

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Service quality is all about the responsiveness of an organization to meet the customer's expectations. The service performance is measured by the perceived service quality. The quality of a service has two components:

- ***Technical quality:*** This is the end result of the service operations process.
- ***Functional quality:*** This is about the process, especially concerning the interaction between the customer and service provider.

These two factors inject a heavy dose of subjectivity into the service process.

Any service organization would be desirous of closing the gap between what is expected and what the customer has received. To them, this would be absolutely necessary to build a long-term relationship with the customer, to retain him. But in order to close the Customer Gap, another type of gap has to be closed: the Provider Gap.

***The Provider Gap:*** There are four provider gaps and these in sum total are the cause of the Customer Gap. They are the shortfalls within the service firm. To close the customer gap, the provider gap (or, as also known, Company Gap) has to be bridged. The four provider gaps are:

***Gap-1: Customer expectation – management perception gap.***

It is the inability of top management to perceive what the customer wants, and is the main reason why a firm cannot meet a customer's expectations. The company is blinded by a perceptual veil of ignorance, arrogance or criminal neglect.

Some of the reasons why Gap-1 can occur are:

- Inadequate marketing research;
- Lack of upward communication in the organization;
- Insufficient focus on relationship building ('don't care' attitude), etc.

***Gap-2: Management perception – service quality expectation gap.***

This gap is created in the design process of the service product and laying down of specifications for service quality during service transactions. In the design process, this gap arises during the translation of management's perception of customer-expectation into design specifications. Managers would set specifications for service quality on the basis of what they believe the customer requires – a very dangerous presumption. The implications of this gap are that even if the firm has crystal-clear knowledge and understanding of the customer's expectations, there would be scope for misunderstanding this, leading to setting the wrong specifications, service designs and standards.



*Example:* A bank would believe that customer friendly interaction is what the customers prefer but the standard would be set on computerization – which is impersonal and neutral. There is no human contact to support the concept of 'friendliness'.

Some reasons for Gap-2 to occur are:

- Failure to connect service design to service positioning
- Unsystematic new-service development process
- Lack of customer-defined service standards
- Absence of a formal process of setting service quality goals etc.

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*Gap-3: Service quality specifications – service delivery gap.*

This occurs at the service provider level when there is deviation from service standards specified and actually delivered to the customers. This probably is the bane of all public sector institutions, be they banks, insurance companies, hotels, travel agencies, hospitals or any such. The management's perception and service design standards might be accurate and perfect. But if the interacting service provider during service delivery falls short of the standards specified, the customer will get an impression of a poorly performing firm. This becomes especially important for that firm that is heavily dependent on people in performing the last transaction. Public sector banks might have the best of design specifications set by Reserve Bank of India; yet late-coming staff, corrupt employees (the Harshad Mehta scam of misuse of Portfolio Management Funds and the internal document mess-up in State Bank of India) would bring large gaps in quality to put it mildly!

Some of the reasons for Gap-3 to occur are:

- Ineffective recruitment, role ambiguity;
- Role conflict;
- Lack of empowerment, control and poor teamwork
- Failure to match supply and demand (in a retail store there would be peak crowds during the evenings and slack demand during the afternoons, but the employee strengths would be the same), customers not co-operating or failing to live up to their roles (lack of knowledge and responsibilities);
- Channel conflicts, etc.



*Caution* The service firm must ensure that systems, processes and people are in the right place. This will make sure that service delivery is as per the design standards set.

*Gap-4: Service delivery – external communications to customer.*

This is essentially a communication gap. The gap is the difference between service delivery intention and capability and what is being communicated to the customers. An over-hyped communication raises the expectations of the customer – and his benchmark of service quality and his expectations from the service delivery sky-rocket. It will be difficult then for the firm to meet the expectation and there would inevitably be a shortfall. The tragedy is, the customers would have been satisfied without the hype. But now they go back with memories of disappointment and are actually dissatisfied. This results from inadequate communication from the firm. For instance, Doordarshan, the much-maligned state TV broadcaster, would announce a certain programme, say an interview with Mr. Amitabh Bachchan, to be broadcast at 7 p.m. and they would fail to do so at that hour – creating huge disappointment. The viewers would curse and would not forgive DD despite an apology – even if one were forthcoming.

The causes of Gap-4 are:

- Lack of cohesiveness in marketing communications;
- Absence of strong internal marketing programme, not being able to meet customers' expectations through communications;
- Over-promising in advertising and personal selling;
- Inadequate horizontal communication between sales and operations;
- Differences in policies and procedures across branches, etc.

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After examining ways and means of measuring service quality, what is more important is to establish any relationship, linear or otherwise, between service quality and marketing. This would go a long way to underscore the importance and relevance of measuring quality for services. We have established the following relationships:

- Customer retention and reduced costs (the 'leaking bucket theory')
- Customer satisfaction and customer loyalty
- Customer loyalty and profitability (the 'service-profit chain'), and
- Customer retention and customer net present value.

What remains to be established then are relationships between

- Service quality and profits
- Service quality and service marketing, and
- Service quality and customer service.

If the hypothesis is established that there are evidences of any linear relationships between the variables then customer service should become one of the most important tools for service marketing.



*Task* Which of the gaps in do you think represents the major problem for most firms? How can a company attempt to eliminate the knowledge gap?

### Self Assessment

Fill in the blanks:

9. …… is the degree to which customer expectations of a product or service are met or exceeded.
10. …… exists to satisfy customer requirements by facilitating important manufacturing and marketing operations.
11. …… is an unexpected event that disrupts performance of the system.
12. …… in service is as perceived by the customer.

## 3.4 Customer Success

In recent years, some firms have discovered that there is another commitment that can be made to gain true competitive advantage through logistical performance. This commitment is based on recognition that a firm's ability to grow and expand market share depends on its ability to attract and hold the industry's most successful customers. The real key, then, to customer-focused marketing lies in the organization's using its performance capabilities to enhance the success of those customers. This focus on customer success represents major commitment toward accommodating customers.



*Notes* A customer service focus is oriented toward establishment of internal standards for basic service performance.

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Firms typically assess their customer service performance relative to how well these internal standards are accomplished. The customer satisfaction platform is built on the recognition that customers have expectations regarding performance and the only way to ensure that customers are satisfied is to assess their perceptions of performance relative to those expectations.

Customer success shifts the focus from expectations to the customers' real requirements. Customer requirements, while forming the basis for expectations, are not the same as expectations. Requirements are frequently downgraded into expectations due to perceptions of previous performance, word-of-mouth, or communications from the firm itself. This explains why simply meeting expectations may not result in happy customers.



*Example:* A customer may be satisfied with a 98 percent fill rate, but for the customer to be successful in executing its own strategy, a 100 percent fill rate on certain products or components may be necessary.

### 3.4.1 Achieving Customer Success

Clearly, a customer success program involves a thorough understanding of individual customer requirements and a commitment to focus on long-term business relationships having high potential for growth and profitability. Such commitment most likely cannot be made to all potential customers. It requires that firms work intensively with customers to understand requirements, internal processes, competitive environment, and whatever else it takes for the customer to be successful in its own competitive arena. Further, it requires that an organization develop an understanding of how it can utilize its own capabilities to enhance customer performance.



*Caselet*

## Dow Plastics, a Division of Dow Chemical

In 1988, Dow hired the Anderson & Lembke ad agency, which is known for its cutting-edge creativity. Dow had just realigned its various plastics businesses into a single unit called Dow Plastics. Anderson & Lembke's tasks were to publicize the new entity and assist in its competitive positioning. Dow's customers and its competitors' customers were surveyed. They ranked Dow a distant third behind industry leaders DuPont and GE Plastics. However, customers were unhappy with the service level they received from all three. "Vendors peddled resins as a commodity," says Hans Ullmark, president of Anderson & Lembke. "They competed on price and delivered on time, but gave no service." These findings, confirmed by about 200 qualitative interviews, led to a positioning strategy that exceeded the standard customer service guarantee to promise customer success.

This strategy, which began as a tag line for a division, grew in influence until it became the core of the parent company's mission statement: "We don't succeed unless you do." It was concluded that whether a customer was using Dow plastics to manufacture grocery bags or complex aerospace applications, Dow Plastics needed to help them succeed in their markets. A campaign was developed which included print ads, direct-mail pieces, and supportive materials. The targeted communications promoted the different virtues of Dow Plastics' disparate products, but all carried the tag line "We don't succeed unless you do." This slogan and underlying philosophy tied the units together and created a brand identity for the division. These campaigns were instrumental in changing Dow Plastics from a sales-oriented company into a market-oriented company-from selling plastics to selling customer success. Dow has become the most preferred plastics supplier. Dow's philosophy is so transformed that when a new product or market is encountered, they ask, "How does this fit in with 'We don't succeed unless you do'?"

***Source:*** Naney Amott, "Getting the Picture," Sales and Marketing Management, June 1994, p. 74

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In many ways a customer success program requires a comprehensive supply chain perspective on the part of logistics executives. The typical focus in basic service and satisfaction programs is that the firm attempts to meet standards and expectations of next-destination customers, whether they are consumers, industrial end users, or intermediate or even internal customers. How those customers deal with their customer is typically not considered to be a problem. A supply chain perspective and a customer success program explicitly recognize that logistics executives must alter this focus. They must understand the entire supply chain, the different levels of customer within that supply chain, and develop programs to ensure that next-destination customers are successful in meeting the requirements of customers down the supply chain. If all supply chain members adopt this perspective, then all members share in the success.



*Caution* To ensure that a customer is successful may require a firm to reinvent the way a product is produced, market distributed, or offered for sale.

In fact, collaboration between suppliers and customers to find potential avenues for success may result in the greatest breakthroughs in terms of redefining supply chain processes. It is enough to say here that such arrangements are not possible without significant amounts of information exchange between the involved businesses to facilitate an in-depth understanding of requirements and capabilities. However, one important way that many firms have responded to the challenges of customer success is through the development of value-added services.

### 3.4.2 Value-Added Services

The notion of value-added service is a significant development in the evolution to customer success. By definition, value-added services refer to unique or specific activities that firms can jointly develop to enhance their efficiency and/or effectiveness. Value-added services help foster customer success. Because they tend to be customer specific, it is difficult to generalize all possible value-added services. When a firm becomes committed to value-added solutions for major customers, it rapidly becomes involved in customized or tailored logistics. It is doing unique things to enable specific customers to achieve their objectives.

IBM's ability to produce and deliver customized personal computers and networks to individual customers is one example of adding value to a rather standard product. In a logistical context, firms can provide unique product packages, create customized unit loads, place prices on products, offer unique information services provide vendor-managed inventory service, make special shipping arrangements, and so forth, to enhance customer success. In reality, some of the value-added services that buyers and sellers agree to involve integrated service providers who are positioned to provide such services. Transportation carriers, warehouse firms, and other specialists may become intimately involved in the supply chain to make such value-adding activities a reality. At this point, a few specific examples of how they may work within a specific supply chain to provide value-added services are sufficient.

Warehouses, whether private or third-party, can be utilized to perform a number of customization activities.



*Example:* A retail customer may desire a unique palletization alternative to support its cross-dock activities and meet the unique product requirements of its individual store units.

Each store requires different quantities of specific product to maintain in-stock performance with minimum inventory commitment. In another situation, first-aid kits consisting of many different items are actually assembled in the warehouse as orders are received to meet the unique configuration of kit desired by specific customers. It is also common for warehouses to

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provide pick price repack services for manufacturers to accommodate the unique product configurations required by different customers.

## Self Assessment

State whether the following statements are true or false:

13. Firms typically assess their customer service performance relative to how well these internal standards are accomplished.
14. A supply chain perspective and a customer success program do not recognize that logistics executives must alter this focus.
15. Warehouses, whether private or third-party, can be utilized to perform a number of customization activities.
16. The notion of value-added service is not a significant development in the evolution to customer success.



*Case Study*

### Nordstrom Uses People Profitably

Whenever customer service is discussed, department store Nordstrom is always quoted. This Seattle, US-based chain has over 60 stores in Washington, Utah, Oregon, Illinois, California, Alaska and Virginia. It is now a legend in having created a culture of the highest standards in customer service, and is the most respected amongst fashion retailers, – and highly profitable. It has been able to develop very high loyalty amongst its customer base due to its highly motivated sales force and no-questions-asked returns policy. This case details the 'Nordstrom way' in developing customer service as a highly effective marketing mix and examines the possibilities of Indian firms emulating them for differentiation, profitability as well as a decisive competitive advantage.

There are many legendary stories of Nordstrom's depth of customer service. In one, a lady customer demanded that Nordstrom replace her car tyres. When the customer associate enquired about the problem she pointed out to him the slogan of the store 'We take back goods. No questions asked' and refused any further explanation. The customer service associate referred back to the store manager who took the decision to replace the tyres with brand new ones. Funny thing was Nordstrom never sold that brand of tyres. When the top management heard of the incident, they did not admonish its manager for overstepping his authority; instead it gave to every employee a golden pen-stand in the shape of a tyre as a reminder of what the company stood for – excellence in customer service – and what all the employees should strive for.

Entrepreneurs: Nordstrom allows its people to operate like entrepreneurial shopkeepers rather than blocks in a retailing monolith. It gives sales people and managers a wide range of operational and cost controlling responsibility. This is mostly seen in their returns policy. The store takes back the sold merchandise, no questions asked, if the customers say that they aren't satisfied with them – for whatever reasons. This might be, and sometimes is, abused by customers but the Nordstrom customer service philosophy is not to punish the "98 percent for the dishonesty of a few". The company trains its sales associates to tell the customer, 'I guarantee [the return]. The company may not guarantee it, but I do.' That's a great selling tool.

*Contd...*

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Ann McLaughlin, Chairman, The Aspen Institute, described the return policy as symbolic of Nordstrom's authenticity. "They are authentic in that they say they're going to do something and they do it. They are authentic in how they represent themselves as a store to the customer." This is what she overheard a young woman in her twenties telling her mother while shopping at Nordstrom, about a pair of shoes that she was unable to decide: 'I really like them both, but if I decide when I get home that I don't want one, I know that I can always bring it back.' "I don't know how many times I've heard similar comments," she says. "That's the authenticity of Nordstrom living up to their commitment on their return policy. It emanates from their understanding of the customer."

An executive with a well-known Swedish-based manufacturer had purchased some $2,000 worth of shirts and ties at Nordstrom's Pentagon City, Virginia store. He had mistakenly washed the shirts in hot water and they all shrank. On writing to the store, and admitting that it was his mistake, he received a call from Van Mensah, a men's apparel sales associate, asking him to return the shirts – at Nordstrom's expense – and he would replace those shirts with new ones at no charge.

**Question:**

What drives Nordstrom's sales personnel to out-perform all industry benchmarks? How has Nordstrom motivated its in-store personnel to become profitable and unique?

***Sources:*** Ron Zemke and Dick Schaff, The Service Edge, (New York: Plume, 1989)

## 3.5 Summary

- A customer who is a professional, like a chartered accountant, will be in a better position to understand the savings account opening norms in a bank than an illiterate farmer.
- Service transactions and the quality of service delivery depend a lot on both the provider and the customers carrying out their roles seamlessly as designed by the blueprints of operations.
- The service marketer should stress on retaining customers, as they are less expensive than customer acquisition.
- Marketing identifies the appropriate logistical performance.
- Customer service is a process for providing significant value-added benefits to the supply chain in a cost-effective way.
- Three fundamental dimensions of customer service are identified: availability, performance, and reliability.
- The performance cycle was positioned as the operational structure of logistics.
- Customer satisfaction is the degree to which customer expectations of a product or service are met or exceeded.
- Logistics exists to satisfy customer requirements by facilitating important manufacturing and marketing operations.
- Quality in service is as perceived by the customer. There is no other way to either comprehend or administer.
- Customer success shifts the focus from expectations to the customers' real requirements.

## 3.6 Keywords

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***Availability:*** It is the capacity to have inventory when it is desired by a customer.

***Customer Satisfaction:*** It is the degree to which customer expectations of a product or service are met or exceeded.

***Customer Service:*** It is a process for providing significant value-added benefits to the supply chain in a cost-effective way.

***Customer:*** A person, company, or other entity which buys goods and services produced by another person, company, or other entity.

***Fill Rate:*** It measures the magnitude or impact of stockouts over time.

***Logistics:*** Logistics is that part of the supply chain process that plans, implements and controls the effective forward and reverse flow and storage of goods, services, and related information between the point of origin and the point of consumption, in order to meet the customer's requirements.

***Marketing:*** Marketing is the process of communicating the value of a product or service to customers.

***Operational Flexibility:*** It refers to a firm's ability to handle extraordinary customer service requests.

***Rapid Response:*** Rapid response is concerned with a firm's ability to satisfy customer service requirements in a timely manner.

***Service Reliability:*** It involves the combined attributes of logistics and concerns a firm's ability to perform all order-related activities, as well as provide customers with critical information regarding logistical operations and status.

***Stockout Frequency:*** It is the probability that a stockout will occur.

***Variance:*** Variance is an unexpected event that disrupts performance of the system.

## 3.7 Review Questions

1. How does logistics help in improving customer satisfaction?
2. How can the level of logistical service be measured?
3. What is meant by availability in logistics customer service? Provide examples of the different ways to monitor a firm's performance in availability.
4. Compare and contrast speed, consistency, and flexibility as operational performance activities. In some situations, is one activity more critical than others.
5. What is meant by value-added services? Why these services are considered essential in a customer success program?
6. "Marketing identifies the appropriate logistical performance." Elucidate.
7. Discuss the operational measures specify the expected performance cycle.
8. How will you measure the Customer Satisfaction?
9. Highlight Model of Customer Satisfaction.
10. How will you achieve Customer Success?

Notes

## Answers: Self Assessment

| | | | |
|---|---|---|---|
| 1. | Marketing | 2. | Service |
| 3. | Customer | 4. | Operations |
| 5. | False | 6. | True |
| 7. | False | 8. | False |
| 9. | Customer satisfaction | 10. | Logistics |
| 11. | Variance | 12. | Quality |
| 13. | True | 14. | False |
| 15. | True | 16. | False |

## 3.8 Further Readings



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*Online links*

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http://www.tutor2u.net/business/gcse/marketing_customer_focus.html

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http://marketingisus.com.au/5-benefits-of-being-design-customer-focused/

# Unit 4: Demand Planning and Forecasting

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## Objectives

After studying this unit, you will be able to:

- Understand the Demand Forecasting
- Explain the Collaborative Forecasting
- Discuss the Collaborative Planning, Forecasting, and Replenishment (CPFR)

## Introduction

Demand planning and forecasting is a business process that involves predicting future demand for products and services and aligning production and distribution capabilities accordingly. It involves a number of different business functions and requires the sharing of timely data, accurate processing of this data and agreement on joint business plans along the supply chain. Forecast and demand planning is the process of identifying and forecasting recipient needs to ensure that the end client consistently receives the required quantities of commodities at the right time and location, and in the most cost-effective manner. Demand Planning and Forecasting is both an art and a science. It requires informed judgment, business expertise, and technical skills. Done well, it can provide a true competitive edge and increased sales, while managing inventory and maintaining best-in-class customer service. Forecasting depends on both a structured process and modelling. Both are equally important. In this workshop, we will describe not only the fundamentals of forecasting and planning, but also why the forecasting process is important and what role it plays in demand planning.

## 4.1 Demand Forecasting

Our vision of the future guides us in deciding what product to provide, what process to use, and what values are to be provided to the customers. We need to be able to see around the corner to

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ensure that things do not go out of hand. To do so, we require a variety of tools. Forecasting tools help in the analysis of the environment and provide inputs on how the organization can use its resources for maximum leverage. This unit will explore some of these forecasting techniques.

An analysis of the factors that influence future values determines how future values are estimated. One way to characterize different kinds of forecasting can be based on how far into the future they focus. Detailed forecasts for individual items are generally short-term forecasting. Such forecasts are used to plan the short-run decisions which are used for inventory control, order sizing, or transport scheduling, etc.



*Did u know?* Medium-term forecasts are used to plan for capacity, location and layout over a much longer time span. Long-term forecasts are used for strategic decision-making.

Forecasting demand levels is a part of medium-term forecasts. This is vital to the firm as a whole, as it provides the basic inputs for the planning and control of all functional areas including the supply chain. The need for demand projections is a general need throughout the planning and control process. Demand planning tries to answer the questions raised by these concerns. Some such broad basic questions are the following:

- How to determine which new products or services to introduce or discontinue; which markets to enter or exit; and which products to promote?
- What sales plans to make, since sales quotas are generally based on estimates of future sales?
- How to absorb the fluctuations in demand that will occur over the next 6 to 18 months; how to make production, procurement, and logistical plans?
- What should be our financial plans; how can demand fluctuations be absorbed through inventory, workforce, work hours, supplier's activity, etc. and what is their impact on earnings expectations?
- Will the organization lose orders if it does not meet all demands? What policy should the firm adopt?

Each of these choices determines the tactical moves (medium term policy) of the organization. Once decided upon, the policy drives the activities of the organization. A successful policy needs to be based on a fundamental understanding of what customers' value. For example, if a policy of not meeting all demands shifts customers to a competitive product, the company may find it difficult to wean them back when demand falls.

Demand levels and their timing greatly affect capacity levels, financial needs, and general structure of the business. Each functional area has its special forecasting problems.



*Caution* Forecasting demand is also a critical component of supply and demand management.

Supply chain forecasting concerns the spatial as well as variation of demand with time, the extent of its variability, and its degree of randomness. Planning and controlling supply chain activities require accurate estimates of the product and service volumes to be handled by the chain. These estimates are typically in the form of forecasts and predictions. The supply chain professional often finds it necessary to take it upon him or herself to produce forecasts for short-term planning such as inventory control, order sizing, or transport scheduling. For longer-term decisions, demand planning becomes necessary.

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Supply and demand reflect the time dimension. It is important to recognize that both supply and demand can be influenced by management actions. In business and economics, forecasting has various meanings. There are two distinct quantities involved in forecasting, a forecast and a prediction. A prediction is a broader concept. It is an estimate of a future event achieved through subjective considerations other than just past data; this subjective consideration need not occur in any predetermined way.

In supply chain management, we adopt a rather specific definition of a forecast, which is given below:

A forecast is an estimate of a future event achieved by systematically combining and casting forward in a predetermined way data about the past.

The supply chain has both space and time dimensions. That is, the supply chain professional must know where demand volume will take place as well as when it will take place. Spatial location of demand is needed to plan warehouse locations, balance inventory levels across the supply chain network, and geographically allocate transportation resources.

The nature of demand can differ greatly, depending on the operations of the firm and the activity for which the forecast is required. There are two types of demand.



*Notes* The first is when demand is generated from many customers, each of whom purchases only a small fraction of the total volume. This type of demand is said to be independent. The second type of demand comes into play when the demand is derived from a production schedule. This type of demand is said to be dependent.

Independent demand uses statistical forecasting techniques. These models are based on independence and randomness of demand. In contrast, the demand is known in the case of dependent demand.

### 4.1.1 Forecasting Methods

Different forecasting methods can be used to develop the forecast. The appropriate method will depend on the nature of the item being forecast and the availability of historical data. These are two factors that often determine the method you choose to form the forecast.

There are four common approaches to forecasting which are given below:

- ***Qualitative:*** These forecasts are used where there is little or no historical performance data to determine demand. They are typically based on an expert's familiarity of products, the industry and customer preferences. An expert's opinion is usually useful when new products are being introduced into the market.
- ***Time Series:*** Time series forecasts rely on historical demand in order to predict the future demand. There are a variety of computational methods that can be used. Usually, this method is ideal for items that have a generally defined historical pattern that does not change radically from one year to the next e.g. "staple stock" items in a retail store.
- ***Causal:*** Causal forecasting is used when there is a visible correlation between one or more variables to the demand for the product. For example, disposable income, lifestyle indicators, etc. may be used to determine the demand for many consumer durable items. The method, however, requires a high level of sophistication in modelling.
- ***Simulation:*** This method is highly sophisticated and is mainly used where the organization needs to generate multiple 'what-if' scenarios. *For example*, such a model would be able to

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provide answers on the impact on product demand if prices are increased or if disposable income decreases. In many cases, firms require to evaluate these types of sensitivities so as to have a more robust forecast.

The method used should adequately meet the objectives of the forecasting model required. More than one method may be used to provide the types of outputs desired. For example, the method used for short-term forecasts could be different than the one used for long-term forecasts.

### 4.1.2 Accuracy and Validation Assessments

All models need to be validated and verified. Validation is concerned with the question "Are we building the right system?" Verification, on the other hand, seeks to answer the question "Are we building the system right?"

Since validation is used for the purpose of establishing a model's credibility, it is important that the method used for the validation is, itself, credible. Features of time series, which might be revealed by examining its graph, with the forecasted values, and the residuals behaviour, condition forecasting modelling.

An effective approach to modelling forecasting validation is to hold out a specific number of data points for estimation validation (i.e., estimation period), and a specific number of data points for forecasting accuracy (i.e., validation period). The data, which are not held out, are used to estimate the parameters of the model, the model is then tested on data in the validation period, if the results are satisfactory, then the forecasts are generated beyond the end of the estimation and validation periods.

A good model should have small error measures in both the estimation and validation periods and its validation period statistics should be similar to its own estimation period statistics.

Holding data out for validation purposes is probably the single most important diagnostic test of a model; it gives the best indication of the accuracy that can be expected when forecasting the future. It is a rule that one should hold out at least 20 per cent of data for validation purposes.



*Task* Find out the difference between demand planning and forecasting.



*Caselet*

**Gillette Company**

Gillette is one of the best practitioners of demand management in the consumer goods space. With manufacturing plants in 51 locations in 20 countries, Gillette caters to the need of more than 200 countries around the world. Globally, Gillette's portfolio of brands is organized into five business units: Blades and Razors, Personal Care, Oral Care, Duracell, and Braun.

The Gillette Company entered the Indian market in 1984 through a joint venture as a minority shareholder with the Kolkata based Poddars in 1984. The venture was called the Indian Shaving Products Limited (ISPL). ISPL marketed products under the 7 O'Clock brand. In 1996, the Gillette Company started Gillette Diversified Operations Private Limited (GDOPL) in India to market the electrical and kitchen appliance brand, Braun. The merger of ISPL, Duracell India Limited and Wilkinson Sword India Ltd in 2000 resulted in the formation of GIL.

*Contd...*

Notes

Gillette increased the equity stake in ISPL from 24 percent to 40 percent in 1989 and further to 51 percent in 1993. By 2002, Gillette had a stake of 75 percent in GIL. During these two decades, Gillette followed inorganic growth by acquiring domestic companies in oral care, battery, blades and razors and stationery business.

In 2003, the total razor blade market in India was ₹ 6 billion by value and 3.8 billion units by volume. Gillette had a 28 per cent (₹ 1.68 billion) market share in twin blades. Systems and disposables accounted for three per cent of the ₹ 6 billion market. The triple blade segment, a segment charting growth, occupied 2 percent of the market. In value terms, in 2003, double-edged blades comprised 78 percent, systems 15 percent and disposables 7 percent.

India is the world's largest market for Gillette in terms of volumes. Overall, Gillette was a $10 billion company. Out-of-stocks represented a large revenue loss. A 10 percent stockout rate could cost the company up to $1 billion. The opportunity afforded by higher fill rates, even when discounted 50, 60 or 90 percent, could still be worth $100 million. The challenge was to bridge supply and demand, especially as the manufacturer usually does not control replenishment.

The key performance indicators which Gillette uses are forecast accuracy and case fill rates. Gillette made significant improvements in forecast accuracy, from 40 percent in 2001 to 65 percent in 2003. In the case of fill rate, it improved from 80 percent in 2001 to 96 percent in 2003.

How did Gillette make these improvements? Gillette restructured its organization to improve the bridge between supply and demand. Gillette created an integrated, horizontal value chain, combining previous supply chain and commercial operations under one management point with a principal focus on the customer. Gillette then linked supply planning to its new customer focused organization. This new organizational structure by combining and aligning parts of the supply chain together with a focus on the customer, Gillette created a point of ownership for promises made to the customer.

Next, Gillette identified 11 key elements which it had to improve in order to improve overall value chain performance. These elements included increase in service levels, reduction in inventory, and improved costs. By creating an end-to-end value chain process, Gillette gained a more complete understanding of the whole process and created one face to the customer.

Gillette then created team-based selling as part of its Customer Value Chain strategy. The cross-functional teams created alignment from the functions inside Gillette to the corresponding ones inside the customer's organization. It worked with customers to map processes across company boundaries to avoid a gap between Gillette's processes and the customer's processes. The key element that has made these initiatives possible is Collaborative Planning, Forecasting, and Replenishment (CPFR), data synchronization (UCCNET) and Auto ID.

Gillette created a Centre of Expertise to pursue further value chain enhancements. These enhancements include standardizing the company's approach to forecasting across regions, customer-based forecasting for promotions, and redesigning some parts of the company's warehouse and transportation strategy to improve transit time to customers.

The Gillette story is the story of a company that had to undergo restructuring in 2001 due to large drop in its profit. It highlights how improved forecasts and demand planning revived the company and how it was able to increase profits and savings. New techniques such as CPFR have reinforced the traditional models of demand planning and forecasting.

***Source:*** Upendra Kachru, (2010), "Exploring the Supply Chain," Excel Books

Notes

### Self Assessment

Fill in the blanks:

1. ..... tools help in the analysis of the environment and provide inputs on how the organization can use its resources for maximum leverage.
2. Forecasting demand levels is a part of ..... forecasts.
3. Supply and demand reflects the ..... dimension.
4. ..... demand uses statistical forecasting techniques.
5. ..... location of demand is needed to plan warehouse locations, balance inventory levels across the supply chain network, and geographically allocate transportation resources.

## 4.2 Collaborative Forecasting

As technology becomes faster and smarter and as the willingness of supply chains to share information increases, companies will benefit from such forecasting models. Inventory will increasingly be replaced with information. This hope is reflected in Collaborative Planning Forecasting and Replenishment (CPFR). CPFR is accepted as an extension of supply chain management and as a part of supply chain philosophy.

The first CPFR exercise was undertaken by Wal-Mart and Warner-Lambert for Listerine products. They used special CPFR software to exchange forecasts. Supportive data, such as past sales trends, promotion plans and even the weather, were transferred in an iterative fashion. This allowed them to develop a single forecast based their original forecasts. The results were gratifying. Listerine sales increased, the fill rates improved, and there was a significant reduction of inventory investment.

CPFR is forecasting based on the concept of supply chain management. It is a business model that takes a holistic approach to supply chain management and information exchange among trading partners. It uses common metrics, standard language, and firm agreements to improve supply chain efficiencies for all participants.

In other words, collaborative forecasting is based on considering the entire supply chain or partnerships as a single unit and the sharing of information between the links in the chain. The objective is to collectively, as members of the supply chain, meet the needs of the final consumer. This is accomplished by supplying the right product at the right place, right time and right price to the customer.

According to the Round Table held at the University of Denver in May, 2002, the "CPFR Overview Committee" developed target objectives of business benefits using CPFR. These are shown below:

- Increased in-stock at shelf 5-8%
- Reduced average network inventory 10%
- Increased sales 8-10%
- Reduced operating expense 1-2%
- Reduced cost of goods 3-4%
- Reduced lead time/cycle time 25-30%
- Decreased account receivables 8-10%
- Reduced forecast error +/-20% (six weeks out) and +/-30% (twelve weeks out)

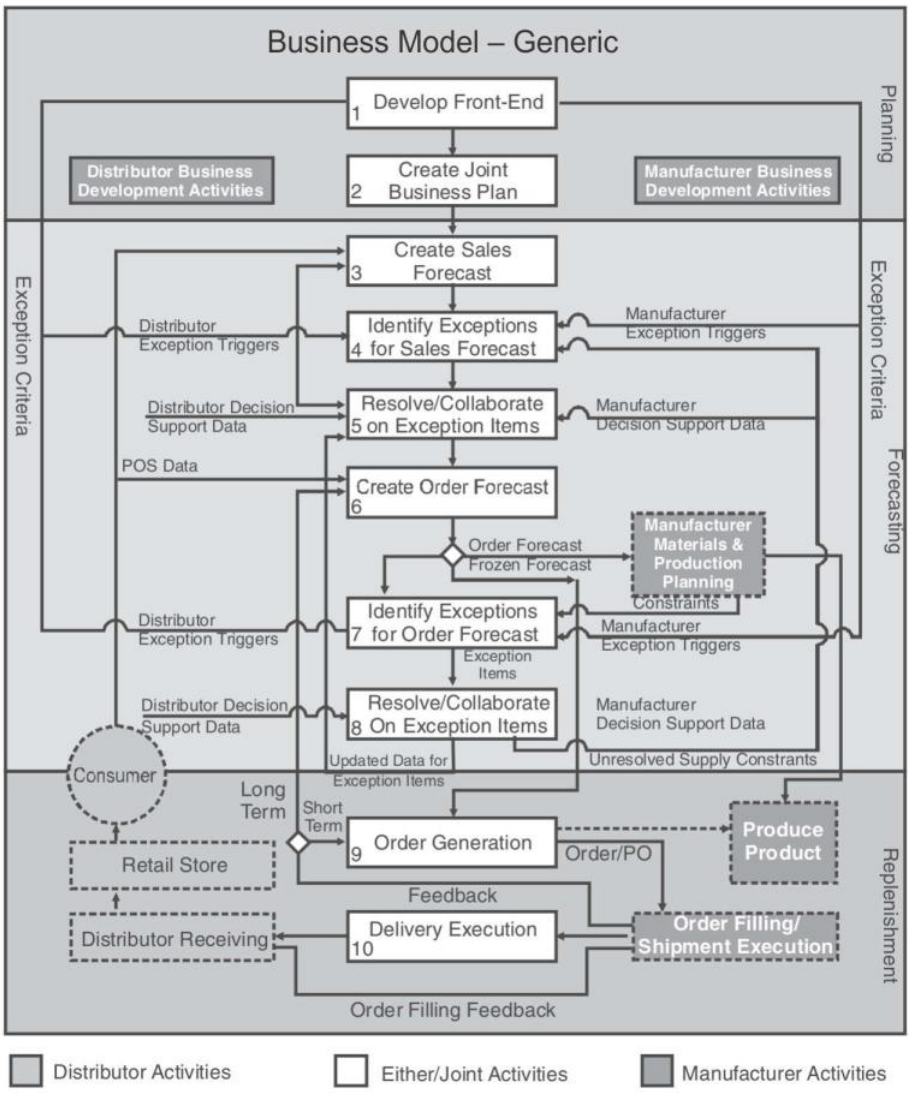
**Notes**

To successfully implement a supply chain management strategy, forecasting along with demand planning, are key factors. Bringing down investments in inventory and enhancing customer service levels is directly connected to the level of accuracy and efficiency with which this demand is forecast and is communicated up and down the supply chain.

Though accurate and effective forecasting is an elusive target, many companies are now using an approach of collaborative forecasting. Collaborative forecasting involves the entire supply chain that participates in decisions about demand. This demand involves gathering forecasting information both internally and externally, and is used to drive the activities of the supply chain.

Collaborative forecasting overcomes some of the inherent problems with traditional forecasting. It is a method by which enterprise-wide knowledge is unified into a forecast more accurate than a traditional forecast, and has the support of the entire supply chain. The objective is to be able to provide the best and most timely predictions of demand.

**Figure 4.1: CPFR Model**




***Source:*** Upendra Kachru (2010). "Exploring the Supply Chain". Excel Books

Notes

The need for collaborative forecasting arises due to increasing competition and the requirement that manufacturers in a supply chain must synchronize operations to derive the benefits of collaboration. Understocking as well as overstocking of inventory, both cause problems and decrease a manufacturer's competitiveness. Collaborative forecasting can help eliminate excess inventory and at the same time, support the supply chain management initiative of the participating companies. A generic model of CPFR system is shown as Figure 4.1.

### Self Assessment

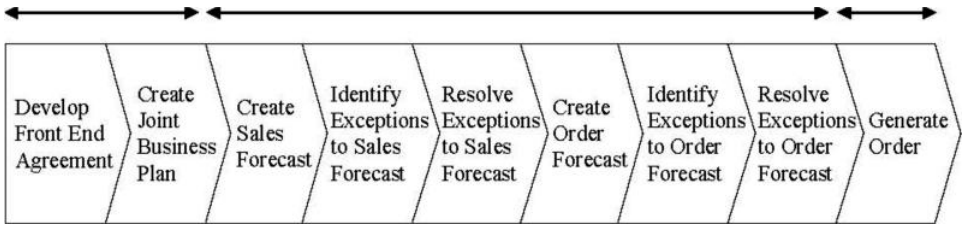
State whether the following statements are true or false:

6. CPFR is accepted as an extension of supply chain Philosophy and as a part of supply chain management.
7. Supportive data, such as past sales trends were transferred in an iterative fashion.
8. Collaborative forecasting overcomes some of the inherent problems with modern forecasting.
9. Collaborative forecasting can help eliminate excess inventory.
10. Collaborative forecasting involves the entire supply chain that participates in decisions about demand.

## 4.3 Collaborative Planning, Forecasting and Replenishment (CPFR)

Collaborative Planning, Forecasting, and Replenishment is a nine-step approach to improving supply chain management, and ties demand planning and supply planning into one process. The CPFR process has three major sub-processes – namely planning, forecasting and replenishment – each of which is formed by a number of steps as is shown in Figure 4.2.

**Figure 4.2: Activities in the CPFR Process**




***Source:*** Upendra Kachru, (2010), "Exploring the Supply Chain," Excel Books

It usually begins with identifying a 'forecasting champion'. The forecasting champion can be a single person, a department, or a firm. Identification of a 'forecasting champion' is critical to the collaborative forecasting technique. The role of the champion is to effectively communicate and lead the organizations involved to share and agree upon information sharing, forecasting methods and technologies. There are a number of methods used for collaborative forecasting. These forecasting processes are generally custom-built and developed to meet the specific needs of individual companies. To be successful in the task, the champion has to understand and emphasize the critical nature of the process. The champion also has to facilitate cross-functional efforts required for improved forecasting.

The next step is forming the forecast collaboration group. Each organization should choose its member in this group. However, the composition of the group should be such that its members represent a variety of functional areas including sales, marketing, logistics/operations, finance,

Notes

and information systems. This description includes the members from external partners like suppliers and customers. The effort has to be focused to ensure two objectives, (a) the most recent and best possible information is included in the final forecast, and (b) the forecast addresses the changing needs and environments facing the business.

The group is given the responsibility of deciding on the goals, objectives and immediate needs of the collaborative forecast process. These are based on the informational needs of all forecast users. The group will identify the factors, processes, technologies that impact the forecast, and the relevant sources of information available. The sources could be internal or external. The final result is dependant of the ability of the group to ensure that information can be accessed at all necessary levels by all the users.

Companies often hold at least two meetings during the month, scheduled on a regular basis. The first meeting is for the purpose of gathering information and preparing the base forecast. The second meeting is to bring alternative forecasts together and work through issues to arrive at a consensus.

Once the relevant information is decided upon and available, the next step is at the level of the firm. The members of the supply chain decide on the process by which the various pieces of information will be brought together. After necessary approvals, the consensus forecast is used for the company's sales and planning systems.



*Example:* Gillette found that senior managers connect to each other; distributors connect with Gillette; and so on.

The aligned teams give it an added advantage; they support the company's mission to strengthen key customer relationships through an effective, collaborative, improvement-oriented process. From doing it in this way, Gillette found numerous opportunities to improve issues such as shrinkage, shelf replenishment, packaging, and display design. It also makes sense because by worrying about customers' performance issues, they reduce the retailer loss of sale, and in the bargain increase their own sale, too.

However, to make this type of synergy happen, measurements and incentives must be a part of the process. These ensure that the forecast accuracy and related supply chain performance actually do improve as a result of the collaborative process. Measurements should be such that demonstrate the success of the collaborative efforts, not just at a fixed point in time, but that measure the rate of improvement over time.

Measurements can vary, but should include the measurement of the actual versus the forecast. These provide the firms the ability to compare the forecasts both for consistency and comparability. A common method is to compute the absolute error for each item (the actual minus the forecast, divided by the actual, without the sign).

Another key measurement is a bias indicator. This shows the percentage of items that were either over or under forecasted. The bias indicator points out trends and tendencies that lead to over or under forecast certain items. Compensating for this bias can be critical to improving the affected forecasts.

The collaborative approach is a deviation from tradition and requires members to make significant changes in the ways they worked in the past. The changes in working methods often result in resistance issues. If participants do not actually change their behaviour, the effort that goes into creating an improved forecast process will generally not produce the best results. In addition to changing old work habits, the collaborative process also demands more work for many of the participants. Participants who were previously not involved with the forecasting process often may view the process as extra work.

Notes

However, results do not come in immediately. It takes time to put the system in place and get results from it. There is a learning curve for participants, systems and sub-systems have to be developed and process decisions have to be made, before results come in. All of these issues combine to make a change to collaborative forecasting as a challenge to each of the organizations in the entire supply chain.

In the collaborative forecasting environment, the information is current and more accurate as companies supplement statistics with information gathered directly from the customer, the market, and other sources. This supplemental information reduces the uncertainty that exists in the forecast and therefore minimizes the inventory carried as it the need for inventory to cover uncertainty is reduced.

The driving premise of CPFR is that all supply chain participants develop a synchronized forecast. A company can collaborate with numerous other supply network members both upstream and downstream in the supply network. Every participant in a CPFR process – supplier, manufacturer, distributor, and retailer – can view and amend forecast data to optimize the process from end to end. Essentially, CPFR puts an end to guesswork in forecasting. It means that manufacturers and retailers share their plans, with detailed knowledge of each others' assumptions and constraints.

However, there is a high investment involved and sophistication required in using such systems. Gillette found that not everyone in the supply chain could become a member of the integrated supply chain. Finally, it decided to differentiate its customer strategy by customer size. More complex, sophisticated retail chains received the more differentiated and integrated service based on Gillette's value chain structure. Smaller, independent operators receive a standardized set of supply chain services. Both the cost-to-serve and the sophistication of the customer drive this distinction. Thus, Gillette only does CPFR with its largest accounts.



*Example:* There are many successful examples of CPFR. Heineken USA employs CPFR and has successfully cut its order-cycle time. It is extending its programme and is currently providing collaborative planning and replenishment software to its top 100 distributors.

### Self Assessment

Fill in the blanks:

11. The CPFR process usually begins with identifying a …….
12. The champion also has to facilitate …… efforts required for improved forecasting.
13. The composition of the group should be such that its members represent a variety of …… areas.
14. Companies often hold at least …… meetings during the month, scheduled on a regular basis.
15. The driving premise of CPFR is that all …… participants develop a synchronized forecast.

## 4.4 Quantitative Methods

Most firms, especially small and medium firms do not find the use of such IT-based models economical, even when they have the capability and sophistication to use these models. The option they have is to use traditional quantitative methods for generating their forecasts. The most commonly used method is the 'time series'.

Notes

### 4.4.1 Time Series

Time series is a characterization of change that takes place over a period of time. It is a quantitative model that reflects the change in demand for goods and services and the pattern in the order of occurrence, using historical data. These patterns or characteristics of the change process are known as a 'times series'.

One major theme in the continuing development of inventory theory is to develop inventory models that are realistic and reflect product demand. In real life, demand is uncertain and hard to forecast. Furthermore, as product life cycles get shorter, the randomness and unpredictability of these demand processes have become even greater.

In practice, inventory managers often rely on forecasts based on a time series of prior demand, such as a weighted moving average. Typically, these forecasts are predicted on a belief that the most recent demand observations are the best predictors for future demand. Time series are, therefore, commonly used for inventory decisions in order to:

- Generate and maintain forecasts at different levels of product,
- Provide appropriate forecasts for planning and replenishment for product and location, and
- Optimize demand history through demand cleansing and seasonal profiling,

The method chosen will depend on the accuracy demanded of the forecast and the pattern of historical demand. Some of the methods used to solve such problems are discussed below.

#### Moving Average Method

The simplest form of time series is the 'moving average method'. In this type of model, the raw data is converted into a moving average that reflects the trend in change of demand. The moving average is an arithmetic average of data over a period of time. By averaging historical data, the attempt is to remove the random fluctuations.

In this method, the data is updated regularly by replacing the item in the average by the new item. This type of model is especially useful when demand has no pronounced trend or seasonal influence. It is generally used to study this type of data, which is superior to the raw data because it eliminates or smoothens out the irregularity in the time series.

The general formula for moving average is:

$$F_{t+1} = (A_t + A_{t-1} + A_{t-2} + A_{t-3} + \ldots\ldots + A_{t-n+1})/n$$

Where: $F_{t+1}$ is the moving average for the period t + 1,

$A_t$, $A_{t-1}$, $A_{t-2}$, $A_{t-3}$ etc. are actual values for the corresponding period, and 'n' is the total number of periods in the average.

For example, suppose the prices for a product are given for 12 months and a five monthly average is to be computed. Each month sequentially designated as $A_1$, $A_2$, $A_3$, $A_4$, $A_5$……etc.

Then, the first 5-month moving average would be;

$$F_5 = [(A_1 + A_2 + A_3 + A_4 + A_5)/5]$$

The second moving average of the next five months would be;

$$F_6 = [(A_2 + A_3 + A_4 + A_5 + A_6)/5]$$

And so on.

**Notes**

The last item would be the average

$$F_{12} = [(A_8 + A_9 + A_{10} + A_{11} + A_{12}/5]$$

The stability of the series often determines how many periods to include in the moving average. Large values of 'n' should be used when the series is relatively stable, including more historical data in the average results in a forecast that is less susceptible to random variations. However, where the individual values are prone to change, small values of 'n' are recommended.

Simple Moving Averages (MA) is an effective and efficient approach to forecasting the future provided the time series is stationary in both mean and variance. This is important and needs to be ascertained. Also, if there is a trend in the data, the moving average has the adverse characteristic of lagging the trend.

### Weighted Moving Averages

In a simple moving average, each period has the same weight. However, very often, it may be desirable to emphasize specific elements more than others. For example, you may decide that recent demand needs more emphasis over earlier demand. In such a case, weights can be placed on each element as desired, subject to the condition that the total of the weights should add up to '1'.

The general formula for the weighted moving average then changes to:

$$F_{t+1} = [(w_tA_t + w_{t-1}A_{t-1} + w_{t-2}A_{t-2} + w_{t-3}A_{t-3} + \ldots\ldots + w_{t-n+1}A_{t-n+1})/n]$$

Where: $F_{t+1}$ is the weighted moving average for the period t+1,

And, $w_t$ is the weighing factor, and $w_t = 1$

For example, if 'n' is 5, we could weight the moving average as follows:

$w_1 = 5/(1 + 2 + 3 + 4 + 5) = 5/15 = 1/3;$

$w_2 = 4/15;$

$w_3 = 3/15 = 1/5;$

$w_4 = 2/15$ and

$w_5 = 1/15.$

$\Sigma w = 1/3 + 4/15 + 1/5 + 2/15 + 1/15 = 1$

In this example, the most recent period has the highest weight compared to the earlier periods. The weight progressively reduces as the period increases.

An advantage of this model is that it allows one to compensate for seasonality or any unusual event by carefully fitting the coefficients, $wA_t$. However, it must be remembered that the choice of the coefficient has to be made by management and this choice is critical to the applicability of the model.

### Exponential Smoothing

A forecast based on an exponential-weighted moving average is based on a belief that the most recent demand observations can best predict future demand. Therefore, exponential smoothing models are very popularly used in Supply Chain Management. It produces a smoothed time series when the forecasting horizon is relatively short and when there is little information about cause and effect relationship between the demand of an item and the independent factors that influence it.

**Notes**

Unlike regression models, which are discussed in the next section, exponential smoothing does not make use of information from series other than the one being forecast. These models are also readily available in standard computer software and require limited data storage and computational capacity.

The Exponential Smoothing method is:

- Easy to adjust for past errors,
- Easy to prepare follow-on forecasts from, and
- Ideal for situations where many forecasts need to be prepared.

Since exponential smoothing is an iterative process, we only need to define an initial value.

***Single Exponential Smoothing:*** The Single Exponential Smoothing method calculates the values for a smoothed series. You choose a damping coefficient which is called the weighting factor. This factor is used to smooth the data. It can have a value ranging from '1' to '0' and determines the sensitivity of the smoothing effect. The exponential relationship that was shown earlier can now be written as using standard notations:

$$F_{t+1} = \alpha D_t + (1 - \alpha) F_t$$

Where: $D_t$ is the actual value

$F_t$ is the forecasted value

$\alpha$ is the weighting factor, which ranges from 0 to 1

t is the current time period.

Since $F_{t+1} = \alpha D_t + (1 - \alpha) F_t$

$F_t = \alpha D_{t-1} + (1 - \alpha) F_{t-1}$ and so on

Therefore $F_{t+1} = \alpha D_t + (1 - \alpha) (\alpha D_{t-1} + (1 - \alpha) F_{t-1})$…….

$F_{t+1} = \alpha D_t + \alpha (1 - \alpha) F_{t-1} + \alpha (1 - \alpha)^2 F_{t-2} + \alpha (1 - \alpha)^3 F_{t-3}$…….

Thus, the forecast for the next period is the algebraic sum of the forecast for the last period and '?' times error in forecast in the last period.

Exponential Smoothing assigns *exponentially decreasing weights as the observation gets older. This means that recent observations are given relatively more weight in forecasting than the older observations.*

A small "smoothens the values by assigning lower weightages to recent changes, while a large" provides a fast response to the recent changes in the time series but provides a smaller amount of smoothing.

When the data is smoothed exponentially, the smoothed value becomes the forecast for period 't + 1'. Also, only three items of data are required for the analysis, unlike the moving averages where the first value is for the fifth week. It is interesting to note how for this particular series, the moving average, the weighted moving average and simple exponential smoothing smooth out the seasonality. The difference between the different weighting factors is increasingly visible as the number of reading increases.

The basic decision that needs to be taken by the manager is the selection of the smoothing constant. How should it be taken? The constant has to be either equal to or between the value range of '0' and '1'. The variance of the error increases as increases. To minimize the error, we would like to make as small as possible (0), but this makes the forecast unresponsive to a change in the underlying time series. To make the forecast responsive to changes, we want as large as possible (1), but this increases the error variance.

Notes

There are no specific rules of selecting the value for '$\alpha$'. If more weight has to be given to recent data, then the value should be closer to '1'. Values between 0.1 and 0.3 are most commonly used.

However, a method of choosing the best fit is by choosing the value of $\alpha$ such that the error variance is the minimum. This is shown in the worked example below:

## Practical Problems

***Problem – Choosing the Best Fit***

Saluja Brothers manufactures simple lathes for the export market. The manufacturing manager uses exponential smoothing technique to arrive at his forecasts. He has made a forecast using a smoothing constant of 0.2.

The sales manager has also made his forecast using the exponential smoothing method, but has used a smoothing constant of 0.5.

Compare the forecasts for the series data under two situations and determine which forecast will you accept and why?

| **Period** | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |
|---|---|---|---|---|---|---|---|---|---|---|
| **Observations** | 30 | 32 | 35 | 34 | 31 | 30 | 33 | 36 | 36 | 34 |

***Solution:***

The basic exponential smoothing model is $F_t = \dot{\alpha}\ D_t + (1 - \dot{\alpha})\ F_{t-1}$

Where: $D_t$ is the actual value

$F_t$ is the forecasted value

$\dot{\alpha}$ is the smoothing constant or weighting factor, and

$F_{t-1}$ is the current time period.

Assume that the smoothed value of the time series for the first period is equal to the actual first value of the time series. You can calculate the values as shown in the table below. The calculations are simple.

The table shows the forecasts under the two specified conditions i.e. $\dot{\alpha} = 0.2$ and $\dot{\alpha} = 0.5$:

| | **$\dot{\alpha}$ = 0.2** | | | | | **$\dot{\alpha}$ = 0.5** | | | |
|---|---|---|---|---|---|---|---|---|---|
| **Period** | **$D_t$** | **$D_t - F_{t-1}$** | **$\dot{\alpha}^* D_t - F_{t-1}$** | **$F_t$** | **$(D_t - F_{t-1})^2$** | **$D_t - F_{t-1}$** | **$\dot{\alpha}^* D_t - F_{t-1}$** | **$F_t$** | **$(D_t - F_{t-1})^2$** |
| 1 | 30 | 0.00 | 0.00 | 30.00 | 0.00 | 0.00 | 0.00 | 30.00 | 0.00 |
| 2 | 32 | 2.00 | 0.40 | 30.40 | 4.00 | 2.00 | 1.00 | 31.00 | 4.00 |
| 3 | 35 | 4.60 | 0.92 | 31.30 | 21.16 | 3.00 | 1.50 | 33.00 | 9.00 |
| 4 | 34 | 2.70 | 0.54 | 31.85 | 7.29 | 1.00 | 0.50 | 33.5 | 1.00 |
| 5 | 31 | -0.85 | -0.17 | 31.68 | 0.73 | -2.50 | -1.25 | 32.25 | 6.25 |
| 6 | 30 | -1.68 | -0.34 | 31.35 | 2.83 | -2.25 | 1.13 | 31.13 | 5.06 |
| 7 | 33 | 1.65 | 0.33 | 31.68 | 2.73 | 1.88 | 0.94 | 32.06 | 3.54 |
| 8 | 36 | 4.32 | 0.86 | 32.54 | 18.67 | 2.94 | 1.97 | 34.03 | 8.65 |
| 9 | 36 | 3.46 | 0.69 | 33.23 | 11.97 | 1.97 | 0.99 | 35.00 | 3.88 |
| 10 | 34 | 0.77 | 0.15 | 33.38 | 0.60 | -1.00 | -0.50 | 34.50 | 1.00 |
| Total | | | | | 69.98 | | | | 42.38 |

$\Sigma (D_t - F_{t-1})^2$ i.e. Total Variance when $\dot{\alpha} = 0.2$ is 69.98 [Col. 6]

**Notes**

Therefore,

Error Variance of the series = $\Sigma (D_t - F_{t-1})^2/(n - 1) = 69.98/9 = 7.75$

Similarly, $\Sigma (D_t - F_{t-1})^2$ i.e. Total Variance with $\dot{\alpha} = 0.5$ is 42.38 [Col. 10]

Therefore,

Error Variance of the series = $\Sigma (D_t - F_{t-1})^2/(n - 1) = 42.38/9 = 4.70$

Where 'n' is the number of observations.

One measure of the accuracy of the forecast is the error variance, which is the mean squared error between the forecast and the actual data in the next period [$\Sigma (D_t - F_{t-1})^2/(n - 1)$] which has been calculated above. You have to pick the $\dot{\alpha}$ that gives you the smallest mean squared error or error variance.

Since the error variance for the case of $\dot{\alpha} = 0.2$ is greater than for $\dot{\alpha} = 0.5$, the forecast with $\dot{\alpha} = 0.5$ is the correct choice as it is more accurate.

***Simple Moving Average and Exponentially Weighted Moving Average:*** An exponentially weighted moving average with a smoothing constant '$\alpha$', roughly corresponds to a simple moving average period of length 'n', where '$\alpha$' and 'n' are related by the following equation:

$$\alpha = 2/(n + 1) \text{ OR } n = (2 - \alpha)/\alpha.$$

Therefore, an exponentially weighted moving average with a smoothing constant equal to 0.1 would roughly correspond to a 19 day moving average. Similarly, a 40-day simple moving average would correspond roughly to an exponentially weighted moving average with a smoothing constant equal to 0.04878. These values are based on the equations given above.

This goes to show that 'simple moving average' is a special case of exponential smoothing. The forecasts generated by exponential smoothing have the same average age as a moving average of order 'n' such that the integer part is $(2 - \alpha)/\alpha$.

***Double Exponential Smoothing:*** An exponential smoothing over an already smoothed time series is called double-exponential smoothing. Double exponential smoothing allows forecasting data with trends. While the single exponential method is used for problems where the trends are stationary, the double exponential method is used to handle trends that are not stationary.

By exponentially smoothening a smoothened series again, a linear trend in the forecasted value is obtained. The extrapolated series has a constant growth rate, equal to the growth of the smoothed series at the end of the data period.

***Triple Double Exponential Smoothing:*** When the trends are non-linear, it may be necessary to extend it even to a triple-exponential smoothing. Triple Exponential Smoothing is better at handling parabola trends and is normally used for such data.

While simple exponential smoothing requires stationary conditions in the demand parameters, the double-exponential smoothing can capture trends when the demand is changing in a linear fashion. Triple-exponential smoothing can be used to handle almost all other business time series.

The advantages of exponential smoothing are that it does not impose any deterministic model to fit the series other than what is inherent in the time series itself. It can be modified to capture seasonal patterns for a time series. Whereas moving averages provide for equal weights for past observations, exponential smoothing assigns exponentially decreasing weights as the observation gets older.

Notes

## Self Assessment

State whether the following statements are true or false:

16. Time series is a characterization of change that takes place over a period of time.

17. Inventory managers often rely on forecasts based on a time series of prior demand, such as a weighted moving average.



*Case Study*

### Order Processing Client

Business process outsourcing division of one of the world's largest IT and BPO services company with presence in over 60 countries and with turnover over 20 billion US dollars. Client has service offering in areas of application development and maintenance, infrastructure management, business process outsourcing and transformational services. The business process outsourcing division's product offerings include coupon processing, mail order processing, product fulfilment, product warehousing, distribution, customer care services and customer relationship management.

Business Challenge The client's manual order processing systems receives over 200,000 documents daily. These were distributed manually to on-site/off-site locations for processing. Processing of these orders were done using standalone keying applications. Major problems were in consolidation of orders, quality of processes, which were a result of logistics and operational issues in managing off-site resources. This resulted in higher turn around time, cost of customer care and cost of processing Client needed an integrated image based order processing solution with on-site, off-site and offshore processing system with high degree of security and tracking. Additional requirements included reduction in manual processing by incorporation of intelligent character recognition (ICR), improvement in quality of processing and reduction in turn around time significantly.

**Suma Soft Impact Solution**

The project required streamlining the order process system for the client through a fully integrated image based workflow system. Using the most current imaging and document management technologies, Suma Soft designed, developed and migrated the order processing system from a manual process to completely automated imaging system, which converts scanned order slips to data that can be easily integrated into back-end fulfilment systems. Additionally high degree of flexibility was available in the system to enable orders to be processed from on-site, off-site or offshore facility with transparent tracking and high degree of security. Suma Soft delivered the project in two-phases, minimizing the project risk for the client and facilitating a smooth transition to the new technology. Phase I provided the detailed system architecture and ensured that all modules worked as anticipated and seamlessly integrated with the client's batch processing mainframe application. Phase II focused on designing and building system functionality for the end-to-end order fulfilment processes, including workflow infrastructure, an intuitive front-end, image scanning, intelligent character recognition, data capture and management reporting capabilities. Suma Soft's BPO service team significantly increased the quality of orders processed to above 99.9% quality benchmark. Using Suma Soft's solution over 60 million orders have been processed. Suma Soft provides a 24x7 helpdesk for resolution of any problems faced by client's team.

*Contd...*

Notes

**Results Achieved**

The automated platform and service provided by Suma Soft helped in significantly decreasing the turn around time. The fast and efficient technical solutions has helped the client to decrease turn around time, improve the quality of orders, significantly reduce cost and decreased customer care cost.

**Question**

Analyse the case and write down the case facts.

***Source:*** www.sumasoft.com

## 4.5 Summary

- An analysis of the factors that influence future values determines how future values are estimated.
- Forecasting demand levels is a part of medium-term forecasts.
- A successful policy needs to be based on a fundamental understanding of what customers' value.
- Demand levels and their timing greatly affect capacity levels, financial needs, and general structure of the business.
- Supply chain forecasting concerns the spatial as well as variation of demand with time, the extent of its variability, and its degree of randomness.
- Supply and demand reflect the time dimension.
- A forecast is an estimate of a future event achieved by systematically combining and casting forward in a predetermined way data about the past.
- Different forecasting methods can be used to develop the forecast.
- A good model should have small error measures in both the estimation and validation periods and its validation period statistics should be similar to its own estimation period statistics.
- CPFR is forecasting based on the concept of supply chain management.
- Collaborative forecasting overcomes some of the inherent problems with traditional forecasting.
- Collaborative Planning, Forecasting, and Replenishment is a nine-step approach to improving supply chain management, and ties demand planning and supply planning into one process.

## 4.6 Keywords

***Causal:*** Causal forecasting is used when there is a visible correlation between one or more variables to the demand for the product.

***Collaborative Forecasting:*** Collaborative forecasting enables companies to transition from periodic, disparate and isolated forecasting activities to a single, real-time enterprise forecasting process.

***Collaborative Planning Forecasting and Replenishment (CPFR):*** Collaborative Planning, Forecasting and Replenishment, is a concept that aims to enhance supply chain integration by supporting and assisting joint practices.

Notes

***Demand Forecasting:*** Demand forecasting is a method of projecting the demand for goods and services over a specific period of time.

***Forecast:*** A forecast is an estimate of a future event achieved by systematically combining and casting forward in a predetermined way data about the past.

***Replenishment:*** Replenishment is the movement of inventory from upstream – or reserve – product storage locations to downstream – or primary – storage, picking and shipment locations.

***Simulation:*** This method is highly sophisticated and is mainly used where the organization needs to generate multiple 'what-if' scenarios.

***Supply Chain Forecasting:*** It concerns the spatial as well as variation of demand with time, the extent of its variability, and its degree of randomness.

***Time Series:*** Time series forecasts rely on historical demand in order to predict the future demand.

***Validation Assessments:*** Assessment validation refers to a process where assessors compare and evaluate against the relevant competency standard/s to ensure, validity, reliability, fairness, flexibility and effectiveness.

## 4.7 Review Questions

1. Define Demand Forecasting.
2. Highlight different forecasting methods.
3. Discuss Accuracy and Validation Assessments.
4. Discuss Collaborative Planning Forecasting and Replenishment (CPFR).
5. Do you agree with the statement that CPFR is forecasting based on the concept of supply chain management? If yes, give reasons.
6. "Collaborative forecasting overcomes some of the inherent problems with traditional forecasting." Explain.
7. Write brief note on CPFR Model.
8. What are the activities in the CPRF Process?
9. Define collaborative approach.
10. "Supply and demand reflects the time dimension." Discuss.

### Answers: Self Assessment

1. Forecasting
2. Medium-term
3. Time
4. Independent
5. Spatial
6. False
7. True
8. False
9. True
10. True
11. Forecasting Champion
12. Cross-functional
13. Functional
14. Two
15. Supply Chain
16. True
17. True

## 4.8 Further Readings

**Notes**



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Notes

# Unit 5: Procurement and Manufacturing Strategies

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## Objectives

After studying this unit, you will be able to:

- Explain the Procurement Strategies
- Understand the Sourcing Strategies
- Discuss the Manufacturing concept
- Describe the Manufacturing Strategy

## Introduction

Procurement is a process of purchasing goods, works or services, to any specific requirements. The procurement process should be optimised, and at the most economical total cost for benefit of the authority, supplier, or individuals. Procurement usually involves the acquisition of goods,

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works or service which is required either as a raw material or for operational purposes for a company or individual. Vendor development is a key function in procurement. Sourcing and vendor development are some of the skill sets required to be developed by Procurement team. Procurement function works closely with procurement logistics or inbound supply chain.

## 5.1 Procurement Strategies

Effective procurement strategy to support supply chain operations requires a much closer working relationship between buyers and sellers than was traditionally practiced. Specifically, three strategies have emerged: volume consolidation, supplier operational integration, and value management. Each of these strategies requires substantial collaboration between supply chain partners and should be considered as stages of continuous improvement.

### 5.1.1 Volume Consolidation

An important step in developing an effective procurement strategy is volume consolidation through reduction in the number of suppliers. Beginning in the 1980s many firms faced the reality that they dealt with a large number of suppliers for almost every material or input used. In fact, purchasing literature prior to that time emphasized that multiple sources of supply constituted best procurement practice. First, potential suppliers were continually bidding for a buyer's business, ensuring constant pressure to quote low prices. Second, maintaining multiple sources reduced the buyer's dependence on any one supplier. This in turn served to reduce the buyer's risk should a specific supplier encounter supply disruptions such as a strike, a fire, or internal quality problems.

By consolidating volumes with a limited number of suppliers, procurement is also positioned to leverage its share of a supplier's business. At the very least, it increases the buyer's negotiating strength in relationship to the supplier. More important, volume consolidation with a reduced number of suppliers provides a number of advantages for those suppliers. The most obvious advantage of concentrating a larger volume of purchases with a supplier is that it allows the supplier to improve economies of scale by spreading fixed cost over a larger volume of output. Additionally, assured of a volume of purchases, a supplier is more likely to make investments in capacity or processes to improve customer service.



*Caution* When a buyer is constantly switching suppliers, no one firm has an incentive to make such investment.

Clearly, when a single source of supply is used, risk increases. For this reason, supply base reduction programs are almost always accompanied by rigorous supplier screening, selection, and certification programs. In many instances, procurement executives work closely with others in their organization to develop preferred or certified suppliers. It should be noted that volume consolidation does not necessarily mean that a single source of supply is utilized for every, or any, purchased input. It does mean that a substantially smaller number of suppliers are used than was traditionally the case in most organizations. Even when a single source is chosen, it is essential to have a contingency plan.

The savings potential from volume consolidation is not trivial. One consulting firm has estimated that savings in purchase price and other elements of cost can range from 5 to 15 percent of purchases. If the typical manufacturing firm spends 55 percent of its revenue on purchased items and can save 10 percent through volume consolidation, the potential exists to deliver a $5.5 million improvement on revenue of $100 million to the bottom line.

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### 5.1.2 Supplier Operational Integration

The next stage of development occurs when buyers and sellers begin to integrate their processes and activities in an attempt to achieve substantial performance improvement. Such integration typically involves alliances or partnerships with selected suppliers to reduce total cost and improve operational integration. Such integration takes many different forms.



*Example:* The buyer may allow the supplier to have access to sales and ordering information, thereby giving the supplier continuous knowledge of which products is selling.

Detailed sales information allows the supplier to be better positioned to effectively meet buyer requirements at a reduced cost. Cost reduction occurs because the supplier has more information to plan and can reduce reliance on cost-inefficient practices, such as forecasting and expediting.

Further operational integration can result for buyers and suppliers working together to identify processes involved in maintaining supply and searching for ways to redesign those processes. Establishing direct communication linkages to reduce order time and eliminate communication errors is a common benefit of such integration. More sophisticated integrative efforts may involve eliminating redundant activities that both parties perform.



*Example:* In some sophisticated relationships, activities such as buyer counting and inspection of incoming deliveries have been eliminated as greater reliance and responsibility are assumed by suppliers.

Many firms have achieved operational integration focused on logistical arrangements, such as continuous replenishment programs and vendor-managed inventory. Such integration has considerable potential for reducing TCO.

Some of the efforts in operational integration strive to reduce total cost through two-way learning.



*Example:* Honda of America works closely with its suppliers to improve their quality management. Honda visits supplier facilities and helps identify ways to increase quality. Such improvements ultimately benefit Honda by reducing the supplier's costs of rework and by providing Honda with higher levels of quality materials.

The primary objective of operational integration is to cut waste, reduce cost, and develop a relationship that allows both buyer and seller to achieve mutual improvements. Combined creativity across organizations can create synergy that one firm, operating in isolation, would be unable to achieve. It has been estimated that operational integration with a supplier can provide incremental savings of 5 to 25 percent over and above the benefits of volume consolidation.

### 5.1.3 Value Management

Achieving operational integration with suppliers creates the opportunity for value management. Value management is an even more intense aspect of supplier integration, going beyond a focus on buyer-seller operations to a more comprehensive and sustainable relationship. Value engineering, reduced complexity, and early supplier involvement in new product design represent some of the ways a company can work with suppliers to reduce TCO.

Value engineering is a concept that involves closely examining material and component requirements at the early stage of product design to ensure that a balance of lowest total cost and

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quality is incorporated into new product design. Early supplier involvement can be critical in achieving cost reductions. As a firm's new product development process proceeds from idea generation through the various stages to commercialization, the company's flexibility in making design changes decreases. Design changes are easily accommodated in the early stages, but by the time prototypes have been developed, a design change becomes difficult and expensive. The earlier a supplier is involved in the design process, the more likely an organization is to capitalize on that supplier's knowledge and capabilities.

An example from an automobile manufacturer demonstrates the benefit of early supplier involvement. In designing the front bumper for a new model, the design engineer was completing design of the bracket assembly for the bumper. During the process, an engineer from the assembly supplier, which had already been identified even though actual production was in the future, asked if the bracket location could be moved by about ½ inch. The design engineer, after some consideration, replied that it could be done with no impact on the final product. The design engineer was interested to know why the supplier requested the change. The answer was that by moving the bracket, the supplier would be able to use existing tools and dies to manufacture the bracket. Under the original design, major capital investment would have been required for new tooling. The result was approximately a 25 to 30 percent reduction in cost of the bracket.

Clearly, value management extends beyond procurement in an organization and requires cooperation between numerous participants, both internal and external.



*Notes* Teams representing procurement, engineering, manufacturing, marketing, and logistics as well as key supplier personnel jointly seek solutions to lower total cost, improve performance, or improved accommodation of customer requirements.



*Caselet*

## Microsoft Dynamics® AX Procurement for Manufacturing

In Manufacturing Companies, the Purchase Order may not be the first phase of the Supply Chain, but the acquisition of Raw Materials by negotiated contract. The availability of the commodities from these contracts has a direct impact on production, but in many cases, they are not visible to Production Scheduling.

These commodities typically have a high value and high cost with volatile pricing on open markets. Many manufacturing organizations buy raw materials under predetermined contract terms and are responsible for the shipping of those commodities.

The manufacturing company must be agile in its processes and procedures to ensure not only the timely transportation of the commodity to their production plants but also control of all costs associated with a contract.

Larger manufacturing organizations may have risk strategies in place to manage overall exposure to the market. These strategies can include hedging their physical position on exchange traded futures market and covering their foreign exposure position with forward foreign exchange contracts. In the current economic climate manufacturers need access to as many tools as possible to help them mitigate risk.

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Unlike stand-alone Commodity Trading systems, or in-house systems using dozens of spread sheets, Scalable's Commodity Procurement for Manufacturing solution is tightly integrated with the Dynamics AX manufacturing process through the MRP modules to ensure Raw Material/Commodities are resourced and delivered on time. This helps prevent delays in the production schedule and allows Manufacturers to adopt just-in-time production strategies that strive to improve cash flow by reducing inventory levels and the costs associated with higher inventory holdings.

Allocation and accrual of all additional cost information associated with the acquisition of raw materials and shipments improves the flow of information from trading, logistics and production to the financial department. Improved access to contract position details contributes to improved efficiency in logistics, production and risk management functions.

In addition manufacturers can hedge futures and foreign exchange contracts to minimize the effect of volatility of raw materials pricing. Details of these hedged contracts are also available inside of Dynamics AX and help improve overall financial reporting.

The procurement of physical commodities directly effects the operations of many manufacturers. Sourcing the right quantities and qualities of a given commodity immediately impacts the costs and profitability of subsequent products and not having the readily available information can be a risk factor.

Due to the unpredictable nature of commodity markets, many manufacturers face difficulties with the efficient administration of contracts, shipments and associated risks. Often this information is captured in separate systems or spread sheets within separate departments. This inhibits efficient data flow and therefore communication between the procurement, trading, logistics, manufacturing and finance departments.

***Source:*** http://www.scalable.com.au/index.php/industries/commodity-procurement-for-manufacturing

### Self Assessment

Fill in the blanks:

1. An important step in developing an effective …… strategy is volume consolidation through reduction in the number of suppliers.
2. Maintaining multiple sources reduced the …… dependence on any one supplier.
3. The primary objective of …… integration is to cut waste, reduce cost, and develop a relationship that allows both buyer and seller to achieve mutual improvements.
4. Many firms have achieved operational integration focused on …… arrangements.

## 5.2 Sourcing Strategies

Although interlinked closely, both procurement process and sourcing strategy are not one and same. While, sourcing strategy deals with planning, designing and building a reliable and competitive supplier base, procurement process deals with operational business process of procurement function and ensuring performance. Sourcing also helps in determining the strategy for procurement, defining pricing strategies and supply chain requirements. The strategy involves integration of its objectives in line with or confirming to the objectives of stake holders in

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operations, finance, marketing and distribution. Lastly sourcing strategy involves planning to competitive buying sources for its raw materials, components and services along with alternative variables.

Sourcing is a standard and formal process that incorporates ongoing analysis to evaluate the right mix of tools and technologies to improve right supplier generation and management and also reducing the total cost. Outsourcing can be at three levels which are:

1. Transactional outsourcing
2. Tactical outsourcing
3. Strategic outsourcing

### 5.2.1 Shift in Sourcing Strategic Approach

Having realized that suppliers play a key important role in the supply chain network of the business, there has been a change in the way organizations perceive and approach supplier relationships. Several factors have contributed to the shifting of the perceive value of supplier partnerships. Complex business models at global scales coupled with market demands have necessitated companies to set up manufacturing or assembly facilities closer to markets as well as in locations where conversion costs are relatively cheaper.



*Did u know?* This necessitates that the business be supported by a solid vendor base which is able to ensure supplies at all locations.

Lean Manufacturing and cost per unit concept is demanding that the managers keep looking to reduce the procurement cost as well as procurement logistics cost. By developing a relationship with suppliers in a collaborative mode, buyers are able to get supplier companies to hold inventories for them at buyer location and postpone taking inventory ownership up to the point of consumption. Today preferred suppliers follow the buyer into countries where buyer is setting up facilities and take on value added services including managing warehousing in the spirit of customer relationship management. Therefore managements have realized the fact that to be able to develop global business model, they have to develop supplier partnerships and work with collaboration spirit and invest in developing the supplier capabilities as well as invest into building the relationship. Supplier management is no longer just transactional.

### 5.2.2 Third Party Provider (3PL)

Third Party Logistics Provider (3PL) is defined as, "the services offered by a middleman in the Logistics Channel that has specialized in providing, by contract, for a given period, all or a considerable number of the logistics activities for other firms."

A middleman could be a broker, a freight forwarder, Shippers' Association etc.

#### How is a 3PL Distinguished from a Transportation Provider?

Transportation provider gets product from point A to point B and could be believed a 3PL. However, transportation provider carries out just one function of logistics whereas a 3PL provider assists in multiple functions.

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## Types of 3PL Providers

Types of 3PL providers are discussed as below:

1. ***Transportation-Based:*** Here, the Services extend beyond transportation to offer a comprehensive set of logistics offerings. There can be two types of Transportation-based service providers – leveraged and non-leveraged. Leveraged 3PLs use assets of other firms whereas Non-leveraged 3PLs use assets belonging solely to the parent firm.



*Example:* Ryder, Schneider Logistics, FedEx Logistics, and UPS Logistics are examples of 3PLs.

2. ***Warehouse/Distribution-Based:*** Many, but not all, have former warehouse and/or distribution experience. Transition to integrated logistics has been less complex than for the transportation-based providers.



*Example:* DSC Logistics, USCO, Excel, Caterpillar Logistics, and IBM are examples of warehouse/distribution-based 3PLs.

3. ***Forwarder-Based:*** These service providers are fundamentally very independent middlemen extending forwarder roles. These are Non-asset owners that capably provide a wide range of logistics services.



*Example:* AEI, Kuehne & Nagle, Fritz, Circle, C. H. Robinson, and the Hub Group are examples of forwarder-based 3PLs.

4. ***Financial-Based:*** These Service providers offer freight payment and auditing, cost accounting and control, and tools for monitoring, booking, tracking, tracing, and managing inventory.



*Example:* Cass Information Systems, CTC, GE Information Services, and Fleet Boston are examples of financial-based 3PLs.

5. ***Information-Based:*** Noteworthy growth and development in this alternative category of Internet-based, business-to-business, electronic markets for transportation and logistics services.



*Example:* Transplace and Nistevo are examples of information-based 3PLs.

## Advantages of Outsourcing to 3PL

The normal advantages are: Reduction in workforce, Flexibility in operations, Reduction in Cycle Time, Improved Responsiveness, Reduction in Logistics Operations Cost, Reduction in Investment on Infrastructure facilities and Hiring of the expertise at a reasonable cost.

## Disadvantages

The disadvantages are loss of control and a negative impact on in-house workforce.

1. Service level commitments are not realized.
2. Strategic management skills are lacking at the Service Provider's firm.

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3. Cost reduction goals are not realized, as the service provider does not own the objectives.
4. Cost "creep" up and price increases occur due to lack of a proper monitoring system at the service provider's end.
5. Improvements and achievements too are lacking.
6. Control of outsourced functions has diminished.
7. Consultative, knowledge-based skills are lacking.
8. Technology capabilities are not being delivered.
9. Time and effort spent on logistics not reduced.

### 5.2.3 Fourth Party Logistics Provider (4PL)

The Fourth Party Logistics Provider (4PL) is a new-fangled concept in Outsourcing. A 4PL forms an alliance between multiple 3PL service providers, technology providers and management consultants. A 4PL provider is a Supply Chain integrator who assembles and manages the resources, capabilities and technology of its own organization with those of complementary service providers.

**LSCM Alliances 3PL + 4PL = 7PL**

The progress of 4PL solutions leverages the capabilities of 3PL providers, technology service providers and business process managers to deliver a comprehensive supply chain solution all the way through a centralized point of contact. The 4PL will integrate the client's supply chain activities and supporting technologies across these "best of breed" service providers with the potential of its own organization.

**3PL + 4PL = 7PL**

The expression 7PL was coined by the Value Logistics Group and is a concept describing the developing trend of 3PL and 4PL combined. Through this service, the client has one service provider that oversees the whole logistics chain.

**The 7PL Concept**

7PL is the combination of 3PL and 4PL into one (3PL + 4PL = 7PL). One service provider can now provide a client with both 3PL and 4PL services with a complete 7PL solution to clients and can undertake turnkey projects for its clients where all services and activities are provided for, under one roof.

### 5.2.4 E-Procurement

E-procurement or electronic procurement is sometimes called supplier exchange. It is the business-to-consumer, business-to-government, or business-to-business sale and purchase of supplies and services over the web. Normally, e-procurement websites let registers users look for buyers or sellers of goods and services. Depending on the type of site, the buyers or sellers may invite bids. Transactions can be initiated and completed online. E-procurement software can even automate certain buying and selling processes. Companies that use e-procurement services can control their parts inventories better, reduce overhead, and make their manufacturing cycles more efficient.

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*Did u know?* The latest generation of e-procurement software is done with an application that incorporates features for supply management and complex auction procedures.

When companies integrate e-procurement into their business model, operational efficiencies multiply through cost savings, cost comparisons, ease of access, quicker turnaround times, and ease of use of the system. Organizations that use e-procurement can automate the procurement work steps. They can control inventories, cut down on purchasing costs, improve delivery schedules, and generally become more efficiency.

E-commerce and e-procurement are gaining widespread use as businesses realize the greater efficiency of these systems. Inefficiencies due to paper processing, and internal inconsistencies in procurement procedures are diminished or cut out altogether. Digital broadcasters is there to help you put these efficient processes to work for your company so you can start realizing gains from improved efficiency.

### Self Assessment

State whether the following statements are true or false:

5. Both procurement process and sourcing strategy are not one and same.
6. Sourcing is a standard and formal process that does not incorporates ongoing analysis to evaluate the right mix of tools and technologies.
7. A middleman could be a broker, a freight forwarder, Shippers' Association.
8. Transportation provider gets product from point A to point B and could be believed a 2PL.

## 5.3 Manufacturing

Since the Industrial Revolution, when we exchanged handmade manufactured goods for machine-made, the changing nature of manufacturing has been apparent, and its evolution continues today. Such new developments as micro and nano manufacturing, computer-aided manufacturing, and innovative supply chain management are only a few of the current advances in a long history of manufacturing innovations. Manufacturing is an important part in corporate success and manufacturing strategy is linked to manufacturing success which is linked to business success. Manufacturing has become familiar as an important element of corporate strategy. Integration in different aspects has become a key issue and must be replicated in manufacturing strategy.

Concept of lean production has taken birth from Japan; the changes in the economic and competitive climate in Japan led the manufacturing organisations to devise innovative and cost-effective production methods. And, this encouraged the organisations to look for a revision of the production models as well as the Japanese management system. While the overall Japanese economy has suffered; some well organised Japanese manufacturing companies such as Toyota, Honda, and Canon still remain competitive in the global market. JIT production, TQM and concurrent engineering are considered as the main strengths of the Japanese manufacturers, besides their techNnological advantages. After World War II when Japanese manufacturers realised that they could not afford the expense to build facilities like the USA, they concentrated on lean concept. They began the process of developing and refining the process of manufacturing with a view to minimise waste.

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### 5.3.1 Manufacturing Objectives

The changing nature of competitive pressure now requires companies to compete on several aspects of performance simultaneously. This reality departs from the traditional idea that organizations must find a specific area of competency and choose between objectives such as low cost, quality, or flexibility. Hence, the degree to which companies resolve manufacturing performance trade-offs, and the understanding of the processes whereby companies manage to achieve this, emerge as a set of research questions. Let us discuss the concept of manufacturing objectives.

Manufacturing objectives cover such things as cost, quality, delivery and flexibility and usually there are trade-offs between them. Trade-off decisions are also required in a number of key areas in order to support the manufacturing objectives. Skinner identified five decision areas:

(a) Plant and equipment;

(b) Production planning and control;

(c) Labour and staffing;

(d) Product design/engineering; and

(e) Organisation and management.

These basic ideas (trade-offs and consistency of objectives/policies) have formed a foundation from which the current understanding of manufacturing strategy has developed. It can be formally defined as follows:

"A manufacturing strategy is defined by a pattern of decisions, both structural and infrastructural, which determine the capability of a manufacturing system and specify how it will operate to meet a set of manufacturing objectives which are consistent with overall business objectives".

The analysis of trade-offs between competitive priorities is one of the core issues in manufacturing strategy. A critical decision that firms are facing across industries is the selection of a mix of products to offer in the marketplace. The operational implications of product line decisions have been largely ignored, even while the importance and complexity of interactions among products in the manufacturing environment increase with broadening product lines. Furthermore, consideration of manufacturing synergies among products, in product line design is increasingly beneficial given efforts in many industries to improve co-ordination of manufacturing activities across products.

### 5.3.2 Manufacturing Decisions

Manufacturing is characterised by tangible outputs (products), outputs that customers consume overtime, jobs that use less labour and more equipment, little customer contact, no customer participation in the conversion process (in production), and sophisticated methods for measuring production activities and resource consumption as products are made. Every dollar in final sales in manufacturing products supports $1.37 in other sectors of the economy. By contrast, the financial services sector generates only about 50 cents for every dollar of activity.



*Task* Try to design various phases of technological aging/lifecycle by taking up the example of Electricity and power generation. Give practical answers to support your answer.

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### Self Assessment

State whether the following statements are true or false:

9. Manufacturing has become familiar as an important element of corporate strategy.
10. Integration in similar aspects has become a key issue and must be replicated in manufacturing strategy.
11. Concept of lean production has taken birth from China.
12. Manufacturing objectives cover such things as cost, quality, delivery and flexibility and usually there are trade-offs between them.

## 5.4 Manufacturing Strategy

Since the 1980s the phrase "manufacturing strategy" has become increasingly common. There is some confusion in terms of both when and where manufacturing strategy appears in the overall strategic planning process of the firm. It has been asked whether manufacturing strategy has been replaced by concepts such as JIT and TQM. Managers often find it hard to tell the difference between programs such as JIT and manufacturing strategy.

Two definitions seem to sum up best what manufacturing strategy is,

(a) "Manufacturing strategy consists of a sequence of decisions that over time, enables a business unit to achieve a desired manufacturing structure, infrastructure and set of specific capabilities."

***—Hayes and Wheelwright, 1984***

(b) "Manufacturing strategy is viewed as the effective use of manufacturing strengths as a competitive weapon for the achievement of business and corporate goals."

***—Swamidass, 1987***

Manufacturing strategy will be related to three adjacent concepts:

(a) Manufacturing mission, which may establish a link to corporate strategy;

(b) Manufacturing concept, which will provide an overall, integrated picture of how manufacturing is intended to be in the future; and

(c) A manufacturing implementation plan, which will indicate the chosen rate and scope of change.

Thus we can define manufacturing strategy as a pattern of decisions, both structural and infrastructural, which determine the capability of a manufacturing system and specify how it will operate to meet a set of manufacturing objectives which are consistent with overall business objectives.

### 5.4.1 Formulation of Strategy

Let us understand the basic steps in analysing existing manufacturing activities and reviewing current manufacturing strategy.

A manufacturing strategy is a working document which outlines the basis for competitive advantage, the key issues which will affect the organisation, the strategic manufacturing aims and the broad strategic initiatives to be pursued. Not all manufacturing companies have a manufacturing strategy, but, most organisations operate with a business plan and a broad

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corporate strategy. Competitive advantage can be gained by having a superior mix of people, technology, focus and direction. A manufacturing strategy explores all these issues.



*Notes* The time scale of completing a radical manufacturing change dictates that a long-term view is essential to permit planned investment and implementation.

## Formulation of Strategy

Following are the process of formulation of manufacturing strategy which includes quality, technology, skills requirements, and training and make-or-buy decisions.

### *Appoint a Project Team*

The full-time attention of a number of knowledgeable people from the management team is required for planning a strategy. Team members need to have a detailed understanding of the aims of the organisation, its products and markets, skills in competitor analysis and manufacturing technology.

### *Gain an Understanding of the Existing Market Position*

A thorough understanding of your existing products is essential to the strategy formulation process. Following questions must be answered:

*What strategy does your organisation compete?*

The three generic strategies are competing on cost (cost leadership), on superior features or service (differentiation), or on a subset of the market (niche market focus).

*What family products do you have?*

- Use product life cycles as a framework to think about the manufacturing requirements of different products.
- Plotting product life cycles for existing key products and future projects can build a picture of the size and shape of the business in the future.
- In addition, measure the performance of each product.
- Focus upon the contribution, market share, and market growth.
- Identify the competitive edge produced by each family product. Competitive features might include quality, delivery lead time, delivery flexibility, design flexibility or price.
- Determine the criterion which gives you the greatest competitive advantage.

### *Identify the Drivers of Change*

In identifying the drivers of change consider the business criteria i.e. product performance, market demands, the evolution of manufacturing philosophies and management structures. We should also consider the change in technological developments and financial pressures. After that we should analyse the external influence on the organisation, internal resources and capabilities, and the skills and competencies of the staff by undertaking a SWOT analysis.

### *Analyse Your Current Performance*

Assessment of the performance against competitive edge criteria can be difficult. Some factors are not easy to measure directly, while comparative data may be hard to obtain. Thus, we can

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use techniques such as Pareto Analysis and activity sampling to facilitate data collection and obtain comparative data through published reports, databases, or by directly talking to customers and suppliers. Consider destructive analysis of a competitor's product. Participate in benchmarking studies. We should also focus upon product performance features, such as quality, delivery, flexibility, material costs and capital costs.

### *Identify Critical Components*

The identification of those components most critical to the long-term success of the organisation helps you to maximise the use of the limited investment capital available. Components can be placed on a continuum of high or low business content, with those at the high end being of strategic importance. Components with a high added value should be added to the list of strategic components whilst those with low business content should be considered for buying in.

### *Assess Your Manufacturing Operation*

This can be the most complicated task, which require lots of time. In assessing manufacturing operations we examine current practice with regard to a range of criteria. The nine key areas most often covered include facilities, span of process (the degree of vertical integration), capacity, processes and the way they are organised, human resources, quality, control policies, suppliers and new products. After that, gaps should be found out by comparing the strengths and weaknesses of current practice with the established competitive edge criteria.

### *Set New Targets*

Targets can cover tooling costs, the utilisation of equipment, defective materials or inventory. Without targets it is difficult not only to measure achievement but to maintain the pressure to achieve them.

### *Develop a New Manufacturing Strategy*

Now the new manufacturing strategy is formulated. But in order to formulate the new manufacturing Strategy Company they must have a thorough understanding of existing manufacturing strategy and ensure it has the knowledge of strengths and weaknesses of existing product line.

### *Develop Your Supplier Network*

We should consider the relationship with each supplier.

For those components which we have decided to buy in, we should go through the process of identifying a potential supplier network and evaluating its ability to meet the demands of in-house manufacture.

### *Review*

We should review the manufacturing plan annually against the developing business situation and set revised targets.



*Task* Take any one manufacturing company by your own choice, and by using your knowledge for the company's most important family products, competitive advantage criteria, and the existing performance gaps, identify the weaknesses of the existing policies. Discuss your answer for possible actions and strategic choices with your course mates.

## Self Assessment

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Fill in the blanks:

13. Since the 1980s the phrase …… has become increasingly common.
14. The full-time attention of a number of knowledgeable people from the …… is required for planning a strategy.
15. …… of the performance against competitive edge criteria can be difficult.
16. …… can cover tooling costs, the utilisation of equipment, defective materials or inventory.



*Case Study*

### Third Party Innovation

Tradeteam is a joint venture of Exel Logistics, along with its parent company NFC Plc., and Bass Brewers to provide a national distribution network service to the U.K. beverage industry. Tradeteam was developed in response to changing pressures and shifting market conditions in the industry. The beer market in the United Kingdom had been in long-term decline, with pub consumption shrinking at approximately 1 percent per year. Overall, the industry had been suffering from excess capacity and lower margins. On top of this, the government had required brewers to divest themselves of their interest in pubs, a directive with major marketplace implications. Between 1992 and 1999, for example, pub ownership by regional and national brewers declined from 74 percent to 33 percent. The end result was typical of low-growth industries: Brewers were consolidating and repositioning and were in need of a fresh approach to marketing and distribution. As the United Kingdom's largest provider of brewery distribution services, Exel Logistics had a significant interest in protecting a business that was under pressure from individual brewers and emerging pub ownership groups. Exel's idea was to take over one major brewer's existing distribution infrastructure to achieve the critical mass associated with that company's market share. Leveraging that infrastructure, it would then offer cost-effective logistics services to other beverage suppliers. This concept led to the formation of the Tradeteam joint venture between Exel Logistics and Bass, which already was the industry's low-cost producer. Tradeteam is now the U.K.'s leading independent logistics provider to the beverage industry. It has annual revenues of $200 million and delivers approximately 280 million gallons of beer and other beverages to more than 27,000 retail customers on behalf of a number of beverage suppliers. Uniquely situated as a multiuser distributor between the consumer and the supplier, Tradeteam has revolutionized the beverage industry supply chain. Results to date have been encouraging. Tradeteam has enabled the brewers and beverage suppliers to reduce their operating costs, increase revenues through market expansion, and provide superior service levels to their customers. Market share for this innovative joint venture has reached the 40 to 50 percent range. In fact, this represents the largest outsourcing initiative yet undertaken in the United Kingdom.

**Question**

Analyse the case and write down the case facts.

***Source:*** Anonymous. "One Example of Third-Party Innovation," Supply Chain Management Review, Fall 1999, p. 87

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## 5.5 Summary

- Effective procurement strategy to support supply chain operations requires a much closer working relationship between buyers and sellers than was traditionally practiced.
- An important step in developing an effective procurement strategy is volume consolidation through reduction in the number of suppliers.
- Cost reduction occurs because the supplier has more information to plan and can reduce reliance on cost-inefficient practices, such as forecasting and expediting.
- Many firms have achieved operational integration focused on logistical arrangements, such as continuous replenishment programs and vendor-managed inventory.
- The primary objective of operational integration is to cut waste, reduce cost, and develop a relationship that allows both buyer and seller to achieve mutual improvements.
- Value management is an even more intense aspect of supplier integration, going beyond a focus on buyer-seller operations to a more comprehensive and sustainable relationship.
- Value engineering is a concept that involves closely examining material and component requirements at the early stage of product design to ensure that a balance of lowest total cost and quality is incorporated into new product design.
- Sourcing is a standard and formal process that incorporates ongoing analysis to evaluate the right mix of tools and technologies to improve right supplier generation and management and also reducing the total cost.
- Lean Manufacturing and cost per unit concept is demanding that the managers keep looking to reduce the procurement cost as well as procurement logistics cost.
- Third Party Logistics Provider (3PL) is defined as, "the services offered by a middleman in the Logistics Channel that has specialized in providing, by contract, for a given period, all or a considerable number of the logistics activities for other firms."
- The Fourth Party Logistics Provider (4PL) is a new-fangled concept in Outsourcing.
- Concept of lean production has taken birth from Japan; the changes in the economic and competitive climate in Japan led the manufacturing organisations to devise innovative and cost-effective production methods.
- Manufacturing objectives cover such things as cost, quality, delivery and flexibility and usually there are trade-offs between them.

## 5.6 Keywords

***E-Procurement:*** It is the business-to-consumer, business-to-government, or business-to-business sale and purchase of supplies and services over the web.

***Lean Manufacturing:*** Lean Manufacturing is part of a business wide strategy aimed to increase market share whilst at the same time attempting to minimise operating costs.

***Manufacturing Strategy:*** A manufacturing strategy is defined by a pattern of decisions, both structural and infrastructural, which determine the capability of a manufacturing system and specify how it will operate to meet a set of manufacturing objectives which are consistent with overall business objectives.

***Manufacturing Strategy:*** Manufacturing strategy consists of a sequence of decisions that over time, enables a business unit to achieve a desired manufacturing structure, infrastructure and set of specific capabilities.

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***Manufacturing:*** Manufacturing is the production of goods for use or sale using labour and machines, tools, chemical and biological processing, or formulation.

***Procurement Strategy:*** Long-range plans for ensuring timely supply of goods and/or services that is critical to a firm's ability to meet its core business objectives.

***Sourcing Strategy:*** Sourcing strategy deals with planning, designing and building a reliable and competitive supplier base.

***Sourcing:*** It is a standard and formal process that incorporates ongoing analysis to evaluate the right mix of tools and technologies to improve right supplier generation and management and also reducing the total cost.

***Supplier:*** Suppliers are people or businesses that provide goods and services to vendors.

***Third Party Logistics Provider (3PL):*** It is defined as the services offered by a middleman in the Logistics Channel that has specialized in providing, by contract, for a given period, all or a considerable number of the logistics activities for other firms.

***Value Engineering:*** Value engineering is a concept that involves closely examining material and component requirements at the early stage of product design to ensure that a balance of lowest total cost and quality is incorporated into new product design.

***Value Management:*** Application of value analysis (value engineering) techniques for improvement of business effectiveness and efficiency.

## 5.7 Review Questions

1. Discuss Supplier Operational Integration.
2. Define Value Management with the help of example.
3. Do you think that value engineering is a concept that involves closely examining material and component requirements? If yes, give reason.
4. Highlight the three levels of outsourcing.
5. How is a 3PL distinguished from a Transportation Provider?
6. What are the types of 3PL providers?
7. Throw some light in the advantages and disadvantages of Outsourcing to 3PL.
8. Write brief note on Fourth Party Logistics Provider (4PL).
9. Define manufacturing strategy.
10. Explain the objectives of manufacturing.
11. What do you understand by manufacturing strategy?
12. Discuss the Manufacturing strategy will be related to three adjacent concepts.

### Answers: Self Assessment

1. Procurement
2. Buyers
3. Operational
4. Logistical
5. True
6. False
7. True
8. False

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9. True
10. False
11. False
12. True
13. Manufacturing Strategy
14. Management Team
15. Assessment
16. Targets

## 5.8 Further Readings



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*Online links*

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http://www.canadianmanufacturing.com/purchasing-and-procurement/news/five-procurement-strategies-for-profitability-49598

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http://www.ccila-portugal.com/fileadmin/Newsletter/Banners/News/BME_FietenPorto.pdf

# Unit 6: Information Technology Framework

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## Objectives

After studying this unit, you will be able to:

- Understand the Information Functionality – The Supply Chain
- Explain the Principles of Logistics Information
- Discuss the Logistics Information System Architecture
- Describe the Comprehensive Information System Integration
- Understand the Communication Technology
- Explain the Rationale for ERP implementation
- Discuss the ERP System Design
- Describe the SC Information System Design

## Introduction

The information technology wave has created new ways to conduct business in this millennium. Typewriters have largely been replaced by word processors. Electronic mail has made it easy to transmit textual messages (possibly containing embedded picture and sound files) worldwide, using computers, cellular telephones, and specially equipped televisions via telephone, satellite, and cable television networks. Office automation has made the concept of a "paperless office" become a reality. Workstations, printers, database systems, and other tools are now linked by means of a local area network (LAN).

While today's Web is significantly more compelling than it was just a decade ago, yet in many ways, we're still in the "horse and buggy" era of the Internet. In 2004, $184 billion worth of retail spending was conducted on the Web.

The next-generation Internet will provide small businesses and large corporations alike the kind of agility necessary to compete and succeed in the digital economy. Today, it could take a company several weeks to find the right supplier for a particular component, hammer out a contract, and set up the complex business processes to ensure that it arrives when and where it is needed. Advanced Internet software is on the horizon that will accomplish all of this in a day, if not a matter of minutes. If you think today's Web is transforming the way business is done, imagine the kind of impact tomorrow's Web will have.

One will be able to collaborate and communicate seamlessly, no matter where one is or what device one is using. It will be possible to interact with computers in more natural ways, using

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speech, handwriting and simple gestures. The PC may still sit on the desk, but it will be the hub of a broad "personal network" of devices and services that, in combination with smart Internet software, will keep you connected, informed and entertained no matter where you are.

The Internet Generation – those born since 1994 – will become tomorrow's knowledge workers and leaders of industry and government – the first generation for whom the Internet is as ubiquitous as the television was for baby boomers. Technology will enrich their learning experiences, and create connected learning communities where teachers, parents, students, public libraries and organizations can work together. We'll also see a generation for whom the Internet is an everyday means of communicating, making new friends, shopping and being entertained.

## 6.1 Information Functionality – The Supply Chain

Information is one of the greatest facilitators in supply chain management. Supply Chain information is a critical component of a firm's ability to respond rapidly to the end consumer demand in today's highly competitive marketplace. Timely and accurate information is also critical for three reasons:

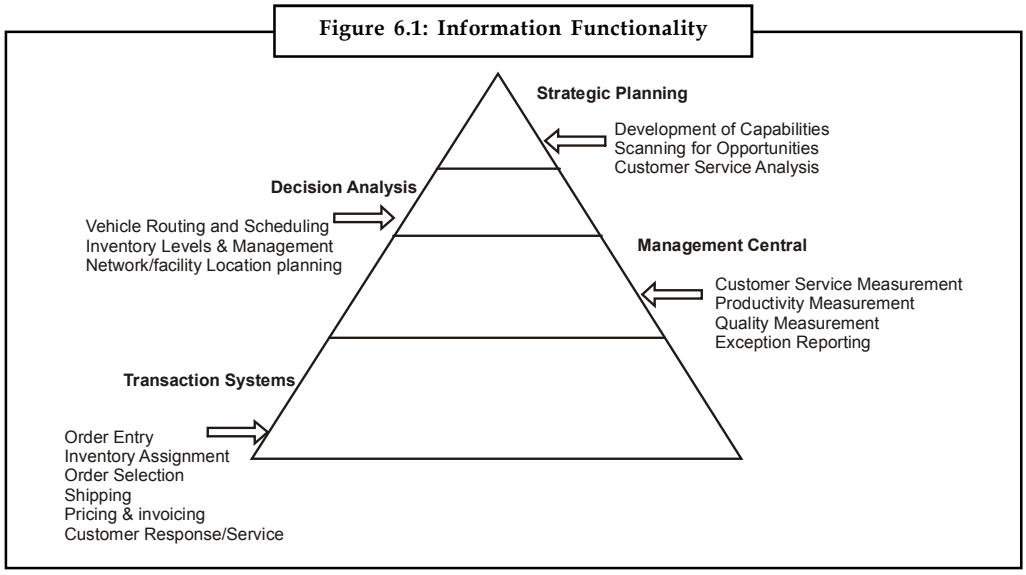
- Information on order status, product availability, delivery schedule, and invoices is perceived by customers as a necessary element of total customer service;
- Information can reduce inventory by minimizing demand uncertainty; and
- Information increases flexibility with regard to how, when, and where resources may be utilized for strategic advantage.

Information integrates supply chain activities by building on four levels of functionality:

- Transaction,
- Management control,
- Decision analysis, and
- Strategic planning systems.

The schematic arrangement, shown as Figure 6.1, identifies the level and identifies major decision areas associated at each level.

**Figure 6.1: Information Functionality**




***Source:*** Upendra Kachru, (2010), "Exploring the Supply Chain," Excel Books

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### 6.1.1 Transaction

Transaction activities include order entry, inventory assignment, order selection, shipping, pricing, invoicing, and customer inquiry. The customer order performance cycle order starts with an entry transaction on the receipt customer order. This initiates the next transaction i.e. assign inventory to the order. A third transaction is then generated to direct the material handlers to select the order. This is followed by a transaction directing the movement, loading, and delivery of the order. The final transaction prints or transmits the invoice for payment. Thus, the customer order performance cycle is completed through a series of information system transactions. The process also enables order status information to be available to customers as and when they desire such information.

The transaction system is characterized by formalized rules, inter-functional communications, a large volume of transactions, and an operational day-to-day focus. Because of the large number of system users, heavy communication demands, high transaction volume, and significant software complexity transaction system costs can be relatively high. In the transactions system, the major emphasis is on information system efficiency. However, as the processes are highly structured, the system costs are relatively well-defined and benefits or returns can be easily computed.

### 6.1.2 Management Control

Management Control is characterized by an evaluative, tactical, intermediate-term focus that evaluates past performance and identifies alternatives. Information on common performance measures includes financial, customer service, productivity, and quality indicators.



*Example:* Some measures could be: transportation and warehousing cost per kilogram (cost measure), inventory turnover (asset measure), order fill rate (customer service measure), cases per labour hour (productivity measure), and customer perception (quality measure).

While some management control measures, such as cost, are very well-defined, other measures such as customer service are less specific.



*Caution* The Supply Chain Information System (SCIS) should be proactive and capable of predicting future issues that need management attention.

It should have the capability for measurement of competitive capability and addition of potential improvement areas. This is accomplished through exception reporting as information is being processed. Information provided through exception reporting is often useful to identify potential customer or order problems, inventory shortages on the basis of forecasted requirements and anticipated receipts, or a firm's ability to leverage price etc.

### 6.1.3 Decision Analysis

This focuses on decision applications to identify, evaluate, and compare logistics strategic and tactical alternatives for managerial decisions. There are a number of analytical tools that are commonly available in most supply chain application packages. Some of the common ones include inventory planning and management, forecasting, vendor scheduling, vehicle routing, and cost-benefit analysis of operational trade-offs and arrangements. Similar to the management control, decision analysis is characterized by a tactical, evaluative focus. However, unlike management control, decision analysis focuses on evaluating future tactical alternatives.

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Decision analysis SCIS emphasis shifts more to effectiveness (identifying profitable versus unprofitable accounts) rather than efficiency (faster processing or increased transaction volume while utilizing fewer staff resources). To do so effectively, the SCIS needs to be relatively unstructured and flexible to allow consideration of a wide range of options.

Newer SCIS applications show great potential in providing competitive advantage: using these applications enterprises are re-engineering their supply chain procedures to reduce the number of cycles and sequential activities.

### 6.1.4 Strategic Planning

As is apparent from the title, the focus is on information that supports the ability of the organization to develop and refine supply chain strategy. These decisions are less structured than the other areas, but have a long-term focus.



*Example:* Strategic planning decisions include restructuring networks, exploiting firm capabilities and market opportunities, strategic alliances, and major customer service improvements, etc.

The SCIS strategic planning level information must reflect lower-level data collection and convert this into a wide range of business planning and decision-making information. This information can then be used in models that assist in evaluating the probabilities and payoffs of various strategies. Strategic planning ability to assess customer/product profitability, segment contribution, or alliance synergies can have a major impact on enterprise profitability and competitiveness.

Traditionally, information flow was used to improve transaction system efficiency. While this has offered returns in terms of speed and lower operating costs, expected benefits in terms of cost reductions are diminishing as competitors develop their competencies. With increasing competitiveness, the area in SCIS applications that has the maximum potential for providing major savings is shifting focus on the management control, decision analysis, and strategic planning components.



*Caselet*

## An Infomediary for Supply Chain

TradeMatrix.com is an e-business platform that enhances design, operations, and evaluation of B2B marketplaces to better meet consumer demands. This electronic marketplace allows firms to focus efforts on key customers, determine segmental profitability, and accelerate time-to market. The TradeMatrix concept is to allow firms to build, launch, and service Internet marketplaces that facilitate ocused customer relationships. The Internet becomes the central trading system for major manufacturers and service providers. *For example*, participating firms can now instantly check the inventory – and the production capacity – of all their major suppliers at the same time to determine how quickly orders can be delivered. Such information sharing can substantially reduce supply chain uncertainty and results in less inventory and shorter, more consistent performance cycles. The visibility can also assist in new product development by allowing suppliers, manufacturers, and even customers to design, refine, and source components prior to initiating production.

A cross-industry trade portal supported by the collaboration of a number of supply chain product and service providers, TradeMatrix includes the application functionality to support

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procurement, marketing, fulfilment, planning, product development, and customer care. While many of the participating firms offer e-business services, through TradeMatrix they are also providing the hardware and software infrastructure to allow other firms to initiate e-business activities. TradeMatrix provides the complete suite of software, tools, and services to facilitate design and launch of an electronic marketplace and improve trading with supply chain partners. The establishment of an online marketplace like TradeMatrix requires a combination of shared technology services and e-marketplace management. Shared technology services provide a set of guidelines and standards to facilitate applications design, deployment, runtime operations, and monitoring. The e-marketplace management provides the managerial and technical expertise for system hosting, catalogue management, personalization, billing, profile management, relationship management and services management.

Sun Microsystems and IBM applied the TradeMatrix concept to their own supply chains. Sun operates in a fabless (no internal component manufacturing) environment with contract manufacturers who produce its electronic components. With this model, Sun must oversee and coordinate the business processes of several component suppliers, their contract manufacturers, and third-party logistics providers. 'The system has allowed Sun to address some of its most critical business challenges, including large fluctuations in forecasted product mix, long product lead times through the supply chain, long collaborative planning lead times with suppliers, and balancing inventory turns with customer satisfaction. IBM Personal Systems Group focused its efforts on reducing channel inventory while enhancing service levels. IBM enhanced communications with distribution channel partners by using POS data provided using EDI along with other data to create a recommended forecast. The channel partners collaboratively edit the forecast and provide it back to IBM planners. The resulting forecasts then form the input to an integrated planning process for supply/ demand matching and allocation. The collaboration reports increased customer service levels to near 100 percent availability, reduced channel inventory by 80 percent, and reduced order scheduling time from 10 to 3 days.

***Source:*** www.TradeMatrix.com and www.i2.com/marketspaceslcasasestudies/index.hIm

### Self Assessment

Fill in the blanks:

1. …… is characterized by an evaluative, tactical, intermediate-term focus that evaluates past performance and identifies alternatives.
2. The …… strategic planning level information must reflect lower-level data collection and convert this into a wide range of business planning and decision-making information.

## 6.2 Principles of Logistics Information

Logistics information systems must incorporate six principles to meet management information needs and adequately support enterprise planning and operations.

#### Availability

First, logistics information must be readily and consistently available. Examples of information required include order and inventory status. While enterprises may have substantial data regarding logistics activities, these data are often paper-based or very difficult to retrieve from computer systems. Rapid availability is necessary to respond to customers and improve

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management decisions. This is critical since customers frequently need quick access to inventory and order status information. Another aspect of availability is the ability to access required information, such as order status, regardless of managerial, customer, or product order location.

### Accuracy

Second, logistics information must accurately reflect both current status and periodic activity for measures such as customer orders and inventory levels. Accuracy is defined as the degree to which LIS reports match actual physical counts or status.

### Timeliness

Third, logistics information must be timely to provide quick management feedback. Timeliness refers to the delay between when an activity occurs and when the activity is visible in the information system.



*Example:* In some situations, it takes hours or days for the system to recognize a new order as actual demand, since the order is not always directly entered into an active demand database.

Information system timeliness refers to system status, such as inventory levels, as well as management controls, such as daily or weekly performance reports. Timely management controls provide information when there is still time to take corrective action or to minimize the loss. In summary, timely information reduces uncertainty and identifies problems, thus reducing inventory requirements and increasing decision accuracy.

### Exception

Based LIS Fourth, LIS must be exception-based to highlight problems and opportunities. Logistics operations typically contend with a large number of customers, products, suppliers, and service companies.



*Example:* The inventory status for each product-location combination must be reviewed regularly to schedule replenishment orders.

Another repetitive activity is the status review of outstanding replenishment orders. In both cases, a large number of products or replenishment orders typically require review. Often times, the review process requires asking two questions. The first question concerns whether any action should be taken for product or replenishment orders. If the first answer is yes, the second question concerns the type of action that should be taken. Many LIS require that reviews be completed manually, although they are increasingly being automated. The rationale for still using manual procedures is that many of the decisions are unstructured and require judgment on the part of the user. State-of-the-art LIS incorporate decision rules to identify these exception situations that require management attention and/or decision making.

### Flexibility

Fifth, logistics information systems must contain the capability to be flexible in order to meet the needs of both system users and customers. Information systems must be able to provide data tailored to specific customer requirements.



*Example:* Some customers may want order invoices aggregated across certain geographic or divisional boundaries. A flexible LIS must be able to accommodate both types of requirements.

Notes

Internally, information systems must be upgradable to meet future enterprise needs without incurring debilitating costs in terms of financial investment and/or programming time.

### Appropriate Format

Finally, logistics reports and screens should be appropriately formatted, meaning that they contain the right information in the right structure and sequence.



*Example:* LIS often include a distribution centre inventory status screen, with one product and distribution centre listed per screen.

This format requires that a customer service representative check inventory status at each distribution centre when attempting to locate inventory to satisfy a specific customer order. In other words, if there are five distribution centres, it requires a review and comparison of five computer screens. Appropriate format would provide a single screen with the inventory status for all five-distribution centres. The combined screen makes it much easier for a customer representative to identify the best source for the product. Another example of an appropriate format is a screen or report that contains and effectively presents all relevant information for a decision maker. The screen integrates past and future information regarding on-hand inventory, minimum inventory, and demand forecast, and planned receipts for a single item at a distribution centre.

Another example of an appropriate format is a screen or report that contains and effectively presents all relevant information for a decision maker. The screen integrates past and future information regarding on-hand inventory, minimum inventory, and demand forecast, and planned receipts for a single item at a distribution centre. The graphical presentation, which integrates inventory flows and level, facilitates inventory planning and ordering by focusing the planner on the weeks when projected on-hand inventory may drop below minimum levels.

## Self Assessment

State whether the following statements are true or false:

3. Information system timeliness refers to system status, such as inventory levels, as well as management controls.
4. Logistics reports and screens should not be appropriately formatted.

## 6.3 Logistics Information System Architecture

Logistics information systems combine hardware and software to manage, control, and measure the logistics activities. Hardware includes computers, input/output devices, and storage media. Software includes system and application programs used for processing transactions, management control, decision analysis, and strategic planning. The architecture includes both the information base to maintain the data warehouse and the execution components. The information base contains purchase orders, inventory status, and customer orders. The data warehouse contains information describing the past activity levels and the current status, and is the basis for planning future requirements.

Planning and coordination include the activities necessary to schedule procurement, production, and logistics resource allocation throughout the enterprise. Specific components include definition of strategic objectives, rationalization of capacity constraints, and determination of logistics, manufacturing, and procurement requirements.

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Operations include the transaction activities necessary to manage and process orders, operate distribution facilities, schedule transportation, and integrate procurement resources. This process is completed for both customer and enterprise replenishment orders.

Customer orders reflect demands placed by enterprise customers. Replenishment orders control finished good movement between manufacturing and distribution facilities.

### 6.3.1 Planning and Coordination

Logistics system planning/coordination components form the information system backbone for manufacturers and merchandisers. These components define core activities that guide enterprise resource allocation and performance from procurement to product delivery. The specific components are discussed as follows:

1. ***Strategic Objectives:*** Primary information drivers for many enterprises are strategic objectives that define marketing and financial goals. These strategic objectives are typically developed for a multiyear planning horizon that often includes quarterly updates. Marketing's strategic objectives define target markets, products, marketing mix plans, and the role of logistics value-added activities such as service levels or capabilities. The objectives include customer base, breadth of products and services, planned promotions, and desired performance levels. Marketing goals are the customer service policies and objectives that define logistics activity and performance targets. The performance targets include service availability, capability, and the quality elements. Financial strategic objectives define revenue, sales and production levels, and corresponding expense, as well as capital and human resource constraints.

   The combination of marketing and financial objectives defines the markets, products, services, and activity levels that logistics managers must accommodate during the planning horizon. Specific goals include projected annual or quarterly activity levels such as shipments, dollar volume, and total cases. Specific events that must be considered include product promotions, new-product introductions, market rollouts, and acquisitions. Ideally, the marketing and financial plans should be integrated and consistent. Inconsistencies will result in poor service, excess inventory, or failure to meet financial goals.

   The combination of marketing and financial strategic objectives provides direction for other enterprise plans. While the process of establishing strategic objectives is, by nature, unstructured and wide ranging, it must develop and communicate a plan detailed enough to be operationalised.

2. ***Capacity Constraints:*** Capacity constraints and logistics, manufacturing, and procurement requirements evolve from the strategic objectives. Internal and external manufacturing, warehousing, and transportation resources determine capacity constraints. Using activity levels defined by the strategic objectives, capacity constraints identify material bottlenecks and effectively manage resources to meet market demands. For each product, capacity constraints determine the "where," "when," and "how much" for production, storage, and movement. The constraints consider aggregate production and throughput limitations such as annual or monthly capacity.

   Capacity problems can be resolved by resource acquisition, speculation, or postponement of production or delivery. Capacity adjustments can be made by acquisition or alliances such as contract manufacturing or facility leasing. Speculation reduces bottlenecks by anticipating production capacity requirements through prior scheduling or contract manufacturing. Postponement delays production and shipment until specific requirements are known and capacity can be allocated. It may be necessary to offer customer incentives such as discounts or allowances in order to postpone delivery. The capacity constraints

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introduce the time dimension into the enterprise's strategic objectives by considering facility, financial, and human resource limitations. These constraints have a major influence on logistics, manufacturing, and procurement schedules.

Capacity constraints link the enterprise's aggregate operating plan to weekly or daily logistics requirements. These constraints are a major influence on monthly or weekly production for each manufacturing location. Capacity flexibility depends on the nature of the product and lead-time. For the long term, there is usually substantial flexibility, since a full range of postponement, speculation, and acquisition strategies may be used. However, in the short term, such as within the current week, there is limited flexibility, since resources are generally committed. Capacity constraint integration with the remaining enterprise requirement systems varies across organizations. The best enterprises typically demonstrate a high level of integration across all planning/coordination components.

3. ***Logistics Requirements:*** Logistics requirements coordinate the facility, equipment, labour, and inventory resources necessary to accomplish the logistics mission.



*Example:* The logistics requirement component schedules shipments of finished product from manufacturing plants to distribution centres and retailers.

The shipment quantity is calculated as the difference between customer requirements and inventory level. Logistics requirements are often implemented using distribution requirements planning (DRP) as an inventory management and process control tool. Future requirements are based on forecasts, customer orders, and promotions. Forecasts are based on sales and marketing input in conjunction with historical activity levels. Customer orders include current orders, future committed orders, and contracts. Promotional activity is particularly important when planning logistics requirements, since it often represents a large percentage of total volume and has a large impact on capacity.

Current inventory status is product available to ship. Specifically, for each planning period (e.g., weekly or monthly), the sum of forecast plus future customer orders plus promotional volume represents period demand. It is not easy to determine the percentage of the forecasted volume that is accounted for by the known customer orders, so some judgment must be made. Typically, period demand is actually a combination of the three, since current forecasts may incorporate some future orders and promotional volume. When determining period demand, it is important that the overlap between forecast, future customer orders, and promotions be considered. Period logistics requirements then equal period demand less inventory-on-hand less planned receipts. Using this form, each period would ideally end with zero inventories available so that planned receipts would exactly equal period demand. While perfect coordination of demand and supply is ideal from an inventory management perspective, it may not be the best strategy for the firm.

Logistics requirements must be integrated with both capacity constraints (up-stream) and manufacturing requirements (downstream) to obtain optimal system performance. Poorly integrated logistics and manufacturing components typically result in finished goods inventory at the end of the production line that is not visible when logistics requirements are determined.

4. ***Manufacturing Requirements:*** Manufacturing requirements schedule production resources and attempt to resolve day-to-day capacity bottlenecks within the materials management system. Primary bottlenecks result from raw material shortages or daily capacity limitations. Manufacturing requirements determine the master production schedule (MPS)

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and manufacturing requirements plan (MRP). The MPS defines weekly or daily production and machine schedules. Given the MPS, the MRP coordinates the purchase and arrival of materials and components to support the desired manufacturing plan. Although this discussion presents logistics requirements and manufacturing requirements serially, they actually must operate in parallel. This is particularly true for enterprises utilizing demand flow or market paced manufacturing strategies. These strategies coordinate production schedules directly with market demands or orders and reduce the need to forecast or plan. In a sense, demand flow or market-paced manufacturing strategies design all production as "make to order" and thus totally integrate logistics and manufacturing requirements.

5. ***Procurement Requirements:*** Procurement requirements schedule material releases, shipments, and receipts. Procurement requirements build on capacity constraints, logistics requirements, and manufacturing requirements to demonstrate long-term material requirements and release schedules. The requirement and release schedule is then used for purchasing negotiation and contracting.

### Self Assessment

Fill in the blanks:

5. The …… includes both the information base to maintain the data warehouse and the execution components.
6. …… orders control finished good movement between manufacturing and distribution facilities.

## 6.4 Comprehensive Information System Integration

A comprehensive information system initiates, monitors, assists in decision making, and reports on activities required to complete logistics operations and planning. There are many components that must be combined to form an integrated information system, and there are many ways to organize and illustrate the combined components. The major system components include: (1) Enterprise Resource Planning (ERP) or legacy systems, (2) communication systems, (3) execution systems, and (4) planning systems.

### 6.4.1 ERP or Legacy Systems

The ERP or legacy systems are the backbone of most firms' supply chain information systems. This backbone maintains current and historical data and processes transactions to initiate and track performance. Legacy systems refer to the mainframe applications that were developed prior to 1990 to automate transactions such as order entry, order processing, warehouse operations, inventory management, transportation, and related financial transactions.



*Example:* Systems related to customer orders were often labelled Order Management Systems (OMS) since they managed the order fulfilment process. In addition to order information, legacy systems typically maintain information regarding customers, products, inventory status, and facility operations.

In many cases, these legacy systems represent independently developed software modules that lack integration and consistency; consequently, problems with data reliability and integrity abound. These problems are further complicated by the fact that multidivisional firms often use different legacy systems for each division or country.

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### 6.4.2 Communication Systems

The communication module facilitates information flow between functional areas within the firm and between supply chain partners. The major communication components required for supply chain operations. Logistics information consists of real time data on company operations inbound material flows, production status, product inventories, customer shipments, and incoming orders.

From an external perspective, firms need to make order, shipment, and billing information available to suppliers, financial institutions, transportation carriers, and customers. Internal operating units must be able to share and exchange information on production schedule and status. Typical supply chain communication technologies include bar coding, scanning, Electronic Data Interchange (EDI), satellite communication, radio frequency, and the Internet.

### 6.4.3 Execution Systems

Enterprise execution systems work in conjunction with the firm's ERP to provide specific functionality to support logistics operations. While some ERP systems include reasonable logistics functionality, many lack the capabilities to facilitate contemporary warehouse and transportation operations. Most execution systems are "bolted-on" or integrated into the ERP system to facilitate data exchange. In addition to facilitating standard warehouse management functionality such as receiving, storage, shipping, and warehouse automation, Warehouse Management Systems (WMS) typically include management reporting, support for value-added services, and decision support capability.



*Notes* The Transportation Management System (TMS) typically includes routing, load building, consolidation, and management of reverse logistics activities as well as scheduling and documentation. Yard Management Systems (YMS) track inventory in vehicles stored in facility yards.

### 6.4.4 Planning Systems

While the ERP system processes transactions to execute specific logistics activities, transaction systems in general don't evaluate alternative strategies or assist with decision making. Supply chain planning systems, now being termed Advanced Planning and Scheduling (APS) systems, are designed to assist in evaluating supply chain alternatives and advise in supply chain decision making. Sophisticated supply chain planning systems are becoming increasingly common to allow for consideration of complex alternatives under tight decision time constraints. Typical supply' chain planning applications include production scheduling, inventory resource planning and transportation planning. Using the historical and current data maintained in the data warehouse, APS software systematically identifies and evaluates alternative courses of action and recommends a near optimal solution within the constraints imposed. Typical constraints involve production, facility, transportation, inventory, or raw material limitations.

Planning systems can generally be grouped into two categories, strategic and tactical. Strategic planning systems are designed to assist in analyses where there is a large number of alternatives and data outside the range of current history is required. Examples of strategic planning applications include supply chain network design and structural analyses such as which combination of supplier, production, and distribution facilities should he used and how product should flow between existing or potential facilities.

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Tactical planning focuses on operational issues as constrained by short-term resource constraints such as production, facility, or vehicle capacity. The information support for tactical planning is typically available from a firm's data warehouse. Tactical planning processes evaluate customer requirements and identify an operational combination of production, inventory, facilities, and equipment utilization that can he applied within capacity constraints. The result is an action plan to guide short-term operations.

### Self Assessment

State whether the following statements are true or false:

7. The communication module facilitates information flow between functional areas within the firm and between supply chain partners.
8. There is only one component that must be combined to form an integrated information system.

## 6.5 Communication Technology

Information technology is also critical for information sharing to facilitate logistics and supply chain planning and operations. Historically, coordination of logistics has been difficult since logistics activities are often performed at locations distant from information technology hardware. As a result, information was not available at the location of essential work in terms of both time and content. The past decade has witnessed remarkable advances in logistical communication systems capability. EDI, the Internet, Extensible Markup Language (XML), and satellite technology exist to facilitate communication between firms and facilities.



*Notes* Radio frequency allows short-range communication within facilities such as warehouses. Image, bar coding, and scanner technologies allow communication between supply chain information systems and their physical environment.

### 6.5.1 Electronic Data Interchange

While the phone, fax, and direct computer connection have enabled information exchange in the past, EDI and the Internet are quickly becoming the standards for effective, accurate, and low-cost information exchange. EDI is defined as intercompany computer-to-computer exchange of business documents in standard formats to facilitate high-volume transactions. It involves both the capability and practice of communicating information between two organizations electronically instead of via the traditional forms of mail, courier, or even fax.

Direct EDI benefits include increased internal productivity, improved channel relationships, increased external productivity, increased ability to compete internationally, and decreased operating cost. EDI improves productivity through faster information transmission and reduced redundancy. Accuracy is improved by reducing repetitive data entry and interpretation. EDI impacts logistics operating cost through (1) reduced labour and material cost associated with printing, mailing, and handling paper-based transactions; (2) reduced telephone, fax, and Telex; and (3) reduced clerical cost. The graphics industry has found that EDI can eliminate up to 90 percent of paper-based systems, can reduce receipt processing time by 50 percent, and can save $8.00 per invoice document.

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In another example, Texas Instruments reports EDI has reduced shipping errors by 95 percent, field inquiries by 60 percent, data entry resource requirements by 70 percent, and global procurement cycle time by 57 percent.

While EDI has made significant inroads into logistics communication, its penetration is beginning to plateau at about 50 percent of the transactions. Large manufacturers, distributors, and retailers have adopted EDI as a means to exchange information with major trading partners, but the substantial setup costs and expertise required have limited its application by medium and small firms.

Communication and information standards are essential for EDI. Communication standards define technical characteristics so that the computer hardware can correctly perform the interchange. Communication standards deal with character sets, transmission priority, and speed. Information standards dictate the structure and content of the message. Standards organizations have developed and refined two general standards as well as numerous industry-specific standards in an effort to standardize both communication and information interchange.

### Communication Standards

The most generally accepted communication standards are ANS X.I 2 (American National Standards Committee X.12) and UN/EDIFACT (United Nations/Electronic Data Interchange for Administration, Commerce, and Transport). X.12 is promoted as the U. S. standard; while EDIFACT is promoted by the United Nations as more of a global standard. Each organization has defined a structure for exchanging common data between supply chain partners. Experts indicate that the most likely migration path is to EDIFACT standards. The National Institute of Standards and Technology (NIST) and automotive experts are further driving information integration by experimenting with approaches to exchanging data for the entire business cycle. The program, known as STEP (Standard for the Exchange of Product Model Data), was designed for exchanging design and engineering data between supply chain partners. STEP should allow users to integrate business and technical systems data involving all elements of the business cycle including design, analysis, manufacturing, sales, and service.

### EDI Transaction Sets

Communication standards are implemented via transaction sets. A transaction set provides a single common standard to facilitate information interchange between partners in any industry and country. For each industry, the transaction set defines the types of document that can be transmitted. Documents cover common logistics activities such as ordering, warehouse operations, and transportation. The transaction set consists of a transaction code (or ID) and is followed by the required data. The transaction code indicates whether the electronic communication is a warehouse shipping order (code 940) or a warehouse stock transfer receipt (code 944), for example. In addition to the transaction code, a warehouse transaction contains warehouse number, item number, and quantity.

## 6.5.2 Internet

The widespread availability of the Internet and standardized interfaces offered through Internet browsers such as Netscape and Internet Explorer has substantially expanded the opportunities and capability to exchange information between firms of all sizes. The Internet is quickly becoming the supply chain information transmission tool of choice for forecasted requirements, orders, inventory status, product updates, and shipment information. In conjunction with a PC and an Internet browser, the Internet offers a standard approach for order entry, order status inquiry,

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and shipment tracking. The Ohio State University survey predicts the Internet will carry 20 percent of customer orders by the year 2010.

The increasing availability of the Internet has also enabled the development of the exchange portal, a communication medium that has significant supply chain implications. An exchange portal is an infomediary that facilitates horizontal and vertical information exchange between supply chain partners. An exchange portal of a firm designed to facilitate communication between the firm's customers and suppliers. The firm can provide information regarding raw material requirements, product availability, or price changes and allow the marketplace to react by placing bids or orders based on the most timely information. It is projected that 60 percent of Fortune 500 firms will have exchange portals by 2003 to facilitate communication with key customers and suppliers. While a single firm site might provide good Internet advertising, it does increase complexity, as all the partners have to contend with multiple, unique interfaces resulting in high transaction cost.

A second type of exchange portal is industry-based. It facilitates communication between all supply chain partners within an industry and can substantially reduce transaction costs. While the information can be made available to all interested parties, it is also possible to restrict information availability. There is increasing fear that industry portal collaborations might increase the potential of monopolistic practices and trade restraints. The Federal Trade Commission (FTC) can be expected to play an increasing role in the evolution of the exchange portals, particularly for B2B activities.

The Internet and the exchange portal have advanced supply chain communication from one-to-one or limited capability to a one-to-many environment capable of being extended to a many-to-many capability. The result is that extended Internet communication is a reality that offers substantial challenge in terms of exploiting widely available information.

One of the major challenges to the wide adoption of exchange portals is the definition and acceptance of online catalogues. Much like the paper version, an online catalogue contains a listing of the products and services offered along with their descriptions and specifications. A catalogue that is consistent across participating firms is critical to facilitate effective comparison of products and services across firms.



*Example:* A firm desiring to purchase a simple T-shirt from a portal would like all the T-shirt suppliers on that portal to have a similarly formatted entry describing the shirt, its colouring, its contents, as well as other minute details so that the customer can make an effective comparison.

While customers prefer consistent catalogues, suppliers prefer to use a catalogue as a differentiator and are thus reluctant to deviate from their proprietary format. To facilitate information sharing and exchange, the Voluntary Interindustry Commerce Standards (VICS) and Collaborative Planning, Forecasting, and Replenishment (CPFR) are actively promoting common and consistent catalogue definitions and standards.

### 6.5.3 Extensible Markup Language

Extensible Markup Language (XML) is a flexible computer language that facilitates information transfer between a wide range of applications and is readily interpretable by humans. It was published in 1998 by the World Wide Web Consortium to facilitate information transfer between systems, databases, and Web browsers. Since EDI is very structured, the setup cost and required expertise are relatively high, limiting applications to situations involving high transaction volumes. XML is emerging as the information transfer medium between firms and service

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providers that do not have transaction volumes to justify EDI. XML is facilitating communication by breaking down many information technology barriers that have constrained EDI adoption.

A basic XML message consists of three components: the actual information being transmitted, data tags, and a DTD (Document Type Definition) or schema. The data tag is a key feature as it defines the data being transmitted.



*Example:* In a shipment XML, the tag for address would be "address" and might appear <address>123 Main St.</address>.

The tags tell computers what the data between the brackets are and where the data should go in a database or Web page. The use of common terms and the lack of sequencing requirements make XML transactions much easier to use than EDI. The XML DTD or schema tells the computer what document format to refer to when decoding a message. A DTD is essentially a template that maps out a standard form, its tags, and their relation to a database.



*Example:* There would be separate schema for customer orders, advanced shipping notifications, or transportation documentation.

In situations characterized by low volume, XML is superior to EDI for three reasons. First, it is not expensive to install. It is easy to design an application and requires much less time to implement. Second, XML is easy to maintain because it can be easily converted to HTML (HyperText Markup Language), the language of Web browsers. This makes it much easier to modify and share data between applications. Finally, XML is more flexible, allowing for broad applications and quick definition and extension of standards. One of the major challenges for the growth of XML is the definition of industry standards. Launched in 1998, Rosettanet, a consortium of over 60 companies, has begun developing common definitions for business practices and products as well as standards for using XML to transmit information through the supply chain. Such a common vocabulary is necessary to enable supply chain participants to communicate with each other and have the confidence that the information exchange is secure.

### 6.5.4 Satellite Technology

Satellite technology allows communication across a wide geographic area such as a region or even the world. The technology is similar to microwave dishes used for home television in areas outside the reach of cable. Satellite communication provides a fast and high-volume channel for information movement around the globe. Schneider National, a nationwide truckload carrier, uses communication dishes mounted on its trucks to enable two-way communication between drivers and their dispatchers. Such real time interaction provides up-to-date information regarding location and delivery information and allows dispatchers to redirect trucks based on need or congestion. Retail chains also use satellite communication to quickly transmit sales information back to headquarters. Walmart uses daily sales figures to drive store replenishment and to provide input to marketing regarding local sales patterns.

### 6.5.5 Radio Frequency Exchange

Radio Frequency Data Communication (RFDC) technology is used within relatively small areas, such as distribution centres, to facilitate two-way information exchange. A major application is real time communication with mobile operators such as forklift drivers and order selectors. RFDC allows drivers to have instructions and priorities updated on a real time basis rather than using a hard copy of instructions printed hours earlier. Real time instructions to guide work flow offer increased flexibility and responsiveness and have the potential to improve service using fewer resources.

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*Did u know?* Logistics RFDC applications also include two-way communication of warehouse selection cycle count verification and label printing.

Advanced RFDC capabilities in the form of two-way voice communication are finding their way into logistics warehouse applications. Instead of requiring warehouse operations personnel to interface with a mobile or handheld computer, voice RFDC prompts operators through tasks with audible commands and waits for verbal responses or requests. United Parcel Service uses speech-based RFDC to read zip codes from incoming packages and print routing tickets to guide packages through their newer sortation facilities. The voice recognition systems are based on keywords and voice patterns of each operator. The primary benefit of voice-based RFDC is easier operator interface; since keyboard data entry is not required; two hands are available for order picking.

Radio Frequency Identification (RFID) is a second form of radio frequency technology. RFID can be used to identify a container or its contents as it moves through facilities or on transportation equipment. RFID places a coded electronic chip in the container or box. As the container or box moves through the supply chain, it can be scanned for an identifying code or even for the list of contents. Retailers are beginning to use RFID to allow entire cartloads of merchandise to be scanned simultaneously. The U.S. Department of Defense uses RFID to list the contents of pallets so that they can be tracked as they are loaded on transportation equipment or move through facilities.

### 6.5.6 Image Processing

Image processing applications rely upon facsimile (fax) and optical-scanning technology to transmit and store freight bill information, as well as other supporting documents such as proof of delivery receipts or bills of lading. The rationale for this new service is that timely shipment information is almost as important to the customer as delivering the goods on time. As freight is delivered to customers, support documentation is sent to image processing locations, electronically scanned, and logged into the system.

Electronic images of the documents are then transmitted to a main data centre where they are stored on optical laser disks. By the next day, customers can access the documents through computer linkages or a phone call to their service representative. Customer requests for a hard copy of a document can be filled within minutes by a facsimile transmission. Customer benefits include more accurate billing, faster response from carrier personnel, and easy access to documentation. The carrier also benefits because the system eliminates the need to file paper documents, reduces the chance of loss, and provides improved credibility with customers.

Satellite technology, RF, and image processing require substantial capital investment prior to obtaining any returns. Experience has shown, however, the primary benefit of these communication technologies is not lower cost but improved customer service. Improved service is provided in the form of more timely definition of tasks, quicker shipment tracing, and faster transfer of sales and inventory information. There will be increased demand for these communication technology applications as customers observe the competitive benefits of real time information transfer.

### 6.5.7 Bar Coding and Scanning

Auto Identification (ID) systems such as bar coding and electronic scanning were developed to facilitate logistics information collection and exchange. Typical applications include tracking receipts at warehouses and retail sales. These ID systems require significant capital investment

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for users, but necessarily replace former paper-based information collection and exchange processes that were error-prone and time-consuming. In fact, increased domestic and international competition is driving shippers, carriers, warehouses, wholesalers, and retailers to develop and utilize Auto ED capability to compete in today's marketplace.

Auto ID allows supply chain members to quickly track and communicate movement details with a low probability of error, so it is fast becoming a fundamental service requirement for freight tracking by carriers. Both consumers and B2B customers expect to be able to track the progress of their shipment using the Web-based system offered by carriers such as United Parcel Service and FedEx.

Bar coding is the placement of computer readable codes on items, cartons, containers, pallets, and even rail cars. Most consumers are aware of the Universal Product Code (UPC) that is present on virtually all consumer products. UPC bar codes, used first in 1972, assign a unique 12-digit number to each manufacturer and product. Standardized bar codes reduce errors when receiving, handling, or shipping product.



*Example:* A bar code distinguishes package size and flavour. European Article Numbering (EAN) is the European and United Nations standard for bar coding of items. It is likely that the UPC and EAN systems will become more harmonized due to pressures of global trade.

### 6.5.8 Enterprise Resource Planning (ERP)

Enterprise Resource Planning (ERP) and enterprise execution systems are the major software components of logistics information systems. ERP provides the database and the transaction capability to initiate, track, monitor, and report on customer and replenishment orders. ERP systems provide firms with information consistency, economies of scale, and integration. ERP system design includes the central database and application modules to facilitate supply chain, financial and human resource management. Supply chain system design includes components for planning/coordination, operations, and inventory deployment. The planning/coordination component manages firm and supply chain resources including production, storage, and transportation resources. The operations component controls transaction processing to initiate, manage, fulfil, and ship both customer and replenishment orders. Inventory deployment manages firm and increasingly supply chain inventory resources.

Enterprise execution systems provide the interface between the ERP and the day-to-day operations with the customer, transportation, and the warehouse. Customer relationship management systems offer insight regarding the firm's activity level and performance with key customers. Transportation management systems initiate shipments and record movements to monitor the firm's transportation performance and cost. Warehouse management systems initiate warehouse activities, control material handling equipment, monitor labour performance, and report warehouse performance levels and cost.



*Task* Will there be any enrolment data changes (*e.g.*, provider IDs, data elements changing)? When will these changes take place?

### Self Assessment

Fill in the blanks:

9. …… allows communication across a wide geographic area such as a region or even the world.

10. …… systems such as bar coding and electronic scanning were developed to facilitate logistics information collection and exchange.

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## 6.6 Rationale for ERP Implementation

When firms introduced extensive computing to control and monitor operations and financials in the early 1970s, much of the development was completed piecemeal. The financial and accounting systems were typically introduced first, followed by some type of sales and order management system. When additional functionality was needed, other applications were developed or purchased. These added modules frequently used inconsistent processes, conflicting assumptions, and redundant data. In some cases functional systems were developed internally by the firm to fit internal work processes. The result was a series of legacy systems that incorporated much of the firm's history regarding processes and information but was unique in terms of processes, capabilities, and features. Since processing and storage hardware were often very expensive at the time these legacy systems were introduced, their developers often used sophisticated and complex programming techniques to minimize storage and run-time requirements.



*Example:* As an example, many of these legacy systems included programs with the Year 2000 Millennium Bug (Y2K) embedded into the operating logic. By only storing two digits of the year, less disk storage was required to store dates, thus reducing the cost of the technology. This combination of events relating to legacy systems along with the availability of relatively inexpensive information-storage technology caused firms to reinvest in their enterprise systems during the 1990s. Firms were also looking to enhance their internal integration. While the capabilities of the new technologies are certainly well beyond those of the original legacy systems, the costs of implementation are quite substantial – exceeding millions or tens of millions of dollars in some cases. At this point, most if not all of the Fortune 1000 firms either has implemented or is in the process of implementing an ERP system and there is substantial growth potential in the market for ERP systems for small and mid-level firms. Regardless of the size of the firm, such investments are typically rationalized through three factors: consistency, economies of scale, and integration.

### 6.6.1 Consistency

Many firms or divisions of firms developed legacy systems to meet their own specific requirements and processes. This was also true for international divisions as the firm extended markets and operations globally. Similarly, the many acquisitions and mergers that occurred during the 1980s and 1990s brought together firms with incompatible legacy systems. The result was many different systems that provided different and, in many cases, inconsistent processing. One manager from consumer products multinational reported that he had to look into 15 different computer systems to determine the sales and inventory situation for their South American subsidiaries.

### 6.6.2 Economies of Scale

As firms merged and expanded globally, management made increasing demands to take advantage of global scale economies through resource rationalization. Similarly, customers began looking for suppliers that could provide product globally using consistent system capabilities and interfaces to take advantage of scale economies. ERP offers firms potential economies of scale in several ways. First, a single centralized processor or network of decentralized processors with common configured hardware offers the potential for substantial procurement and maintenance scale economies.

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Second, the centralized ERP approach offers significant software scale economies since only a limited number of software licenses are necessary with all divisions and regions using the same application. While the initial software license cost might be substantial, the license and maintenance fees for the single ERP application should be less than the multiple copies required for each division or region. However, the real scale economy benefits result from the reduced personnel required to implement and maintain a common ERP system. Multiple divisional or regional systems require many individuals with varying hardware and software expertise to implement, maintain, and modify each application. Since some knowledge has limited transferability across hardware and software platforms, the expertise of the individuals typically cannot be used effectively. While potential scale economies for ERP expertise do exist, they may not be apparent today as relatively few individuals have developed extensive skills and they are highly sought after as employees.

Finally, the centralized ERP approach increases the potential for a multidivisional firm to implement shared resources and services across divisions or even regions. The ability to review the production, storage, or transportation resource requirements of multiple divisions in the common system increases the potential for sharing of critical resources. The integrated information facilitates use of common suppliers, production facilities, storage facilities, or transportation equipment, resulting in substantial potential for negotiating and operating economies.

While there is not adequate evidence that current ERP implementations are yielding these scale economies, the benefits will likely begin to accrue as the relatively recent implementations stabilize.

### 6.6.3 Integration

The final ERP benefit is enhanced system integration both within the firm and enterprise and between suppliers and customers. Internal integration results from a common integrated database and implementation of common processes across divisions and regions. Typical common processes included in ERP are order entry, order processing, warehouse management, invoicing, and accounting. Such commonality offers the capability to merge processes and provide major customers with a common and consistent interface with the firm. Such integration also results in standard financial practices across business units. The standardized interfaces offered by many ERP systems also facilitate external communication with supply chain partners.



*Example:* Many firms in the automobile and chemical industries are standardizing on the ERP system offered by SAP. The major manufacturers are then asking their suppliers to interface with their SAP database to obtain requirements data and to provide release schedules.

Such information and process integration substantially enhances supply chain information sharing, which reduces uncertainty within the firm and between supply chain partners. The growth in ERP implementations has slowed among large firms as most absorb and refine what they have implemented. In contrast, smaller firms are just beginning their investment and implementation.

A new generation of ERP systems is evolving to provide additional integration, particularly with customers. These systems, identified as ERP II, integrate traditional ERP along with a Customer Relationship Management (CRM) system to better integrate the requirements of key customers with the firm's supply chain plans. The major improvement offered through ERP II is the external connectivity that is so critical for supply chain collaboration. It is also becoming more common for these integrated applications to be accessed via the Internet, thus providing a common global interface.

## Self Assessment

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State whether the following statements are true or false:

11. When firms introduced extensive computing to control and monitor operations and financials in the early 1990s, much of the development was completed piecemeal.

12. A new generation of ERP systems is evolving to provide additional integration.

## 6.7 ERP System Design

The centre of the system is the central database or information warehouse where all information is maintained to facilitate access to common and consistent data by all modules. Surrounding the database are the functional modules that initiate and coordinate business activities. Although total ERP benefits can best be achieved when all functions are integrated into a common application, many firms elect to implement systems using a modular approach to spread resource requirements and minimize risk as a limited number of firm functions are in transition at any time.

### 6.7.1 Central Database

The central database is the relational information repository for the entire ERP system. The central database is described as relational because it relates or links information regarding operational entities so that there is minimal information redundancy in the database. Over time, information redundancy usually leads to inaccuracy because one reference to a data item is eventually changed without a comparable change in the other reference.



*Example:* If a customer address is contained in two different locations in the database, it is likely that eventually one reference will be changed if the customer moves but the second reference will be forgotten. At that point, the database would no longer be consistent and all references to the second address would be incorrect.

Some ERP applications use a proprietary data structure that limits access. In these cases, all communication with the database must be accomplished through the ERP. Having the ERP system act as an interface doesn't have to be a problem, but it may reduce flexibility and data consistency. In most cases, however, the database structure uses one of several open database architectures that can be accessed by other systems. Open database architecture means that the interface is publicly defined and documented and can be used by a range of other applications.

### 6.7.2 Supply Chain Applications

The ERP supply chain applications include the modules labeled inventory and supply applications, manufacturing applications, and sales and delivery applications. These three modules support supply chain activity, including raw materials acquisition, production, and customer order fulfilment. These modules incorporate the transactions and processes that initiate the entire range of supply chain activities.

### 6.7.3 Financial Applications

The financial module incorporates the transactions necessary to maintain the firm's financial and accounting records. Specifically, the module maintains the contents and references to the firm's general ledger and tracks payables and receivables. The module also facilitates the

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development of standardized income statements and balance sheets for divisions, geographic regions, or for the entire global operation. The typical transactions include accounts receivable and payable, invoicing, financial accounting, and management reporting.

### 6.7.4 Service Applications

The service module supports post sales product service and warranty support. Customers of expensive capital equipment such as manufacturing, medical, communication, or transportation equipment require strong after-sales support for maintenance and repair.



*Caution* The system has to track equipment types and versions to ensure that the correct repair parts are available and can be dispatched to the required location quickly.

The service module can also track usage and repair records to anticipate potential problems with preventative maintenance or equipment adjustment.

### 6.7.5 Human Resource Applications

The human resource module tracks employee records, assignments, and performance. This information is used to support payroll, tax, and work history documentation. In addition to the typical human resource applications, this module aids in costing supply chain activities by tracking time individuals spend on an order, an activity, or a process. Detailed activity tracking allows supply chain managers to determine the relative expense associated with customized or specialized cost of manufacturing and service.

### 6.7.6 Reporting Applications

The reporting module generates the standard and customized management reports for monitoring, performance measurement, and decision support. Using the central data warehouse, these report applications provide management with the capability to monitor activity levels and identify performance deficiencies and issue.

### 6.7.7 Common ERP Systems

Just as in manufacturing, the software industry, particularly for ERP software, is experiencing substantial consolidation. The result is that there are fewer and larger providers of ERP software. While a limited number of providers focus their efforts on specialized industries, most of the major systems incorporate a broad range of functions and features and market to a broad range of industries.

### Self Assessment

Fill in the blanks:

13. The central database is the relational information repository for the entire …… system.
14. The …… module tracks employee records, assignments, and performance.

## 6.8 SC Information System Design

The supply chain information system is the backbone of modem logistics operations. In the past, this infrastructure focused on initiating and controlling activities required taking, process, and

Notes

shipping customer orders. For today's enterprises to remain competitive, the role of information infrastructure must be extended to include requirements planning, management control, decision analysis, and integration with other members of the supply chain.

The key processes initiate, monitor, and measure activities required to fulfil customer and replenishment orders. These processes take two forms. The first are the planning and coordination processes to produce and deploy inventory. The second are the operating processes to receive, process, ship, and invoice customer orders.

Planning and coordination include the processes necessary to schedule and coordinate procurement, production, and logistics resource allocation throughout the enterprise. Specific components include definition of strategic objectives, rationalization of capacity constraints, and determination of market/distribution, manufacturing, and procurement requirements.

Operations include the processes necessary to manage customer order fulfilment, including order processing, inventory assignment, distribution operations, transportation operations, and procurement coordination. These processes are completed for both customer and replenishment orders. Customer orders reflect demands placed by enterprise customers. Replenishment orders initiate finished goods movement between manufacturing and distribution facilities.

Inventory deployment and management is the interface between planning/coordination and operations that controls the cycle and safety inventory stock whenever a Make-to-Order (MTO) or Assemble-to-Order (ATO) strategy is not possible. When an enterprise is able to utilize an MTO manufacturing strategy, the planning/coordination and operations processes essentially mirror each other.



*Example:* When an MTO strategy is possible, it may not be necessary to schedule anticipatory raw materials and production or maintain buffer inventory.

### Planning/Coordination

Supply chain system planning/coordination components form the information system foundation for manufacturers and merchandisers. These components define core activities that guide enterprise resource allocation and performance from procurement to product delivery planning/coordination includes materials planning processes both within the enterprise and between supply chain partners. The specific components are (1) strategic objectives; (2) capacity constraints; (3) logistics requirements; (4) manufacturing requirements; and (5) procurement requirements.

### Strategic Objectives

Primary information drivers for many enterprises are strategic objectives that define marketing and financial goals. These strategic objectives are typically developed for a multiyear planning horizon that often includes quarterly updates. Marketing's strategic objectives define target markets, product development, marketing mix plans, and the role of logistics value-added activities such as service levels or capabilities. The objectives include customer scope, breadth of products and services, planned promotions, and desired performance levels. Marketing goals are the customer service policies and objectives that define logistics and supply chain activity and performance targets. The performance targets include service availability, capability, and quality elements. Financial strategic objectives define revenue, financial and activity levels and corresponding expenses, as well as capital and human resource constraints.

The combination of marketing and financial objectives defines the scope of markets, products, services, and activity levels that logistics and supply chain managers must accommodate during

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the planning horizon. Specific goals include projected annual or quarterly activity levels such as revenue, shipments, and case volume. Events that must be considered include product promotions, new product introductions, market rollouts, and acquisitions. Ideally, the marketing and financial plans should be integrated and consistent as inconsistencies result in poor service, excess inventory, or failure to meet financial goals.

The combination of marketing and financial objectives provides direction for other enterprise plans. While the process of establishing strategic objectives is, by nature, unstructured and wide ranging, it must develop and communicate a plan detailed enough to be operationalised.

### Capacity Constraints

Logistics and manufacturing capacity limitations are imposed by internal and external manufacturing, warehousing, and transportation resource constraints. Based on the activity levels defined by the strategic objectives, these constraints determine material bottlenecks and guide resource allocation to meet market demands. For each product, capacity constraints influence the where, when, and how much for production, storage, and movement. The constraints consider aggregate limitations such as periodic production, movement, and storage capacities.

Capacity problems can be resolved by resource acquisition or speculation/postponement of production or delivery. Capacity adjustments can be made by acquisition or alliances such as contract manufacturing or facility leasing. Speculation reduces bottlenecks by anticipating production capacity requirements through prior scheduling or contract manufacturing. Postponement delays production and shipment until specific requirements are known and capacity can be allocated. It may be necessary to offer customer incentives such as discounts or allowances to postpone customer delivery. The capacity limitations time phase the enterprise's strategic objectives by considering facility, financial, and human resource limitations. These constraints have a major influence on logistics, manufacturing, and procurement schedules.

### Logistics Requirements

Logistics requirements include time phased facility, equipment, labour, and inventory resources necessary to accomplish the logistics mission.



*Example:* The logistics requirement component schedules shipments of finished product from manufacturing plants to distribution centres and retailers.

The shipment quantity is calculated as the difference between customer requirements and inventory level. Logistics requirements are often implemented using Distribution Requirements Planning (DRP) as an inventory management and process control tool. Future requirements are based on forecasts, customer orders, and promotions. Forecasts are based on sales and marketing input in conjunction with historical activity levels. Customer orders include current orders, future committed orders, and contracts. Promotional activity is particularly important when planning logistics requirements since it often represents a large percentage of variation in volume and has a large impact on capacity. Current inventory status is product available to ship.

Specifically, for each planning period, day, week, or month, the sum of forecast plus future customer orders plus promotional volume represents period demand. It is not easy to determine the percentage of the forecasted volume that is accounted for by known customer orders, so some judgment must be made. Typically, period demand is actually a combination of the three since current forecasts may incorporate some future orders and promotional volume. When determining period demand, it is important that the overlap between forecast, future customer orders, and promotions be considered. Period logistics requirements are then determined as the period demand less inventory-on-hand plus planned receipts.

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### Manufacturing Requirements

Manufacturing requirements schedule production resources and attempt to resolve day-to-day capacity bottlenecks within the materials management system. Primary bottlenecks result from raw material shortages or daily capacity limitations. Manufacturing requirements determine the Master Production Schedule (MPS) and Manufacturing Requirements Plan (MRP). The MPS defines weekly or daily production and machine schedules. Given the MPS, MRP time phases the purchase and arrival of materials and components to support the desired manufacturing plan. Although this discussion presents logistics requirements and manufacturing requirements serially, they actually must operate in parallel. This is particularly true for enterprises utilizing demand flow or market-paced manufacturing strategies. These strategies coordinate production schedules directly with market demands or orders and reduce the need to forecast or plan. In a sense, demand flow or market-paced manufacturing strategies design all production as make to order and thus totally integrate logistics and manufacturing requirements. Within limits, the Dell model of MTO computers illustrates a process that matches manufacturing with demand. However, even the Dell model must operate within capacity constraints within a limited time horizon.

### Procurement Requirements

Procurement requirements schedule material purchase order releases, shipments, and receipts. Procurement requirements build on capacity constraints, logistics requirements, and manufacturing requirements to determine long-term material requirements and release schedules. The requirement and release schedule is then used for purchasing negotiation, contracting, coordination of transportation equipment, and arrival scheduling.

### Planning/Coordination Integration

While each planning/coordination component can and frequently has operated independently, such independence often leads to inconsistencies that create excess manufacturing and logistics inventory as well as operating inefficiencies. It was not uncommon for enterprises to have different forecasts for each functional module since each was controlled by a separate organizational function.



*Example:* The strategic objectives may develop high forecasts to motivate the sales force while logistics may plan on more conservative forecasts.

Similarly, differences between logistics, manufacturing, and procurement forecasts resulted in inconsistencies between product acquisition, production scheduling, and logistics deployment which in turn gave rise to unnecessary safety stocks to buffer independent operations.

Historically, the individual planning/coordination processes had limited ability to plan within capacity constraints. Each planning process was essentially uncapacitated as though there were infinite capacity.

### Operations

Coordinated, integrated operations information systems are also essential for supply chain competitiveness. Coordination and integration facilitate smooth and consistent customer and replenishment order information flow throughout the enterprise and offer current order status visibility. Integrated information sharing reduces delays, errors, and resource requirements. The operations processes required for customer order fulfilment and to coordinate the receipt of

Notes

purchase orders are (1) order processing, (2) order assignment, (3) distribution operations, (4) transportation, and (5) procurement.

### Order Processing

Order processing is the entry point for customer orders and inquiries. It allows entry and maintenance of customer orders by using communication technologies such as mail, phone, fax, EDE and the Internet. As orders or inquiries are received, order processing enters and retrieves required information, edits for appropriate values, and retains acceptable orders for assignment. Order processing can also offer information regarding inventory availability and delivery dates to establish and confirm customer expectations. Order processing, in conjunction with customer service representatives, forms the primary interface between the customer and the ERP or legacy system.

### Order Assignment

Order assignment allocates available inventory to open customer and replenishment orders. Assignment may take place in real time, as orders are received, or in a batch mode. Batch mode means that orders are grouped for periodic processing such as by day or shift. While real time allocation is more responsive, a batch process provides the firm with more control over situations when inventory is low. *For example*, in a batch process, order assignment can be designed to allocate stock from current inventory only or from scheduled production capacity. The operational system is more responsive if it allows inventory assignment from scheduled production quantities or capacity. Assignment of production quantities is referred to as using available to promise inventory, while assignment of production capacity refers to capable to promise inventory. However, there is a trade-off since assigning scheduled production capacity reduces the firm's ability to reschedule production.

### Distribution Operations

Distribution operations incorporate processes to guide distribution centre physical activities, including product receipt, material movement and storage, and order selection. For this reason, they are often termed inventory control or warehouse management systems and sometimes warehouse locator systems, referring to the capability to track inventory storage locations in warehouses. Distribution operations direct all activities within distribution centres using a combination of batch and real time assignments. In a batch environment, the distribution operations system develops a "to do" list of instructions or tasks to guide each material handler in the warehouse.

### Transportation and Shipping

Transportation and shipping processes, often referred to as the Transportation Management System (TMS), plan, execute, and manage transport and movement functions. The TMS includes shipment planning and scheduling, shipment consolidation, shipment notification, transport documentation generation, and carrier management. These processes facilitate efficient transport resource utilization as well as effective carrier management.

A unique characteristic of the TMS is that it often involves three parties – shipper, carrier, and consignee (recipient). To effectively manage the process, a basic level of information integration must exist. Information sharing requires standardized data formats for transport documents. In the United States, the Transportation Data Coordinating Committee (TDCC) and VICS have initiated and refined the standardization of transport document formats.

**Procurement**

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Procurement manages PO preparation, modification, and release as well as tracks vendor performance and compliance. Although procurement systems have not traditionally been considered part of logistics systems, the importance of integrating procurement with logistics schedules is critical to facilitate the coordination of material receipt, facility capacity, and transportation backhaul.

## Self Assessment

State whether the following statements are true or false:

15. The supply chain information system is not the backbone of modem logistics operations.

16. Customer orders reflect demands placed by enterprise customers.



*Case Study*

### Achieving Integration through Decentralisation

Since its founding in 1984, Cisco has always seemed to be able to look a bit further over the horizon than its competitors. It concentrated on networking when the rest of the world was point-to-point. It specialized in the enhanced functionality of routing when most people thought switches were all they'd ever need. And it moved rapidly to put a large portion of its sales operations online before most people thought this was practical. As a result, Cisco now manages 75 percent of its revenues through its website: $25 million per day, $8 billion per year. This is believed by many industry observers to be the largest electronic commerce site in the world. Despite Cisco's indisputable record of success, the journey hasn't always been an easy one. Growth, was one reason. By 1994, Cisco had rapidly outgrown its application systems. "We were experiencing growth rates of more than 70 percent per year," says Andy Starr, IS Manager.

Revenues had reached nearly $1 billion, but Cisco was still operating on applications meant to support a company half that size. To remedy the situation, Cisco embarked on an aggressive ERP implementation using an Oracle database and applications. In 1995, after only 9 months the company went live with a big bang implementation – a complete switch of all worldwide transactions systems. Five thousand orders in backlog were converted in just one weekend. Peter Solvik, Cisco's CIO, says, "The applications provided the architecture on which we could very, very rapidly grow, adapt, and scale the company."

Acquisitions were another reason. In 5 years Cisco has acquired 27 companies. When acquiring a company, systems integration is critical to support the 60- to 90-day closing period applied by Cisco. The goal is to take orders for that company's products on Cisco's information system the day the deal is closed. The acquired firm's legacy systems are then replaced quickly, creating a common worldwide ordering environment. "We wouldn't have acquired these companies if we didn't have the ability to integrate them fluidly. They wouldn't provide value to our customers or our shareholders," says Solvik. Cisco's ERP framework has grown from a single server into three U.S.-based servers and one in the Netherlands. This network of servers coordinates Cisco's manufacturing and order fulfilment processes, providing immediate response to requests and better availability of products to its customers. *For example*, an order loaded into the Amsterdam server is scheduled for delivery using the U.S. Available-to-Promise (ATP) server. The ATP server schedules according to the supply is said to be available by the U.S. manufacturing server.

*Contd...*

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The customer order is then built and shipped from one of five manufacturing sites and invoiced from the Amsterdam server. All of these servers combined provide Cisco with four benefits: increased reliability, reduced risk of server failure, enhanced flexibility and scalability of the ERP system, and a reduction in lead times from 4 weeks to 1. Solvik states that Cisco's entire Internet commerce initiative is based on a simple truth: "customers prefer self-service." To achieve a higher degree of self-service, Cisco was the first company to integrate its website with an Oracle Applications ERP infrastructure. The Cisco Connection Online (CCO) Internet site offers customers and suppliers global communications with 49 pages of country- or region-specific support services and product and contact information translated into 14 different languages. It operates with dedicated server links located in Australia, China, France, Hong Kong, Japan, the Netherlands, and South Korea that support 200 offices in 54 countries around the world.

Within the CCO is the "internet Product Centre" where customers can configure and place orders; look up pricing, lead times, and order status; and access invoicing information. This has reduced order entry cycle time from 1 week to less than 3 days. It has also reduced order acknowledgment cycle time from 12 hours to 2 hours, with the goal of achieving real time acknowledgment in the next 6 months. Cisco has the unique ability to process billing in multiple currencies and manage tax and regulatory issues in every country where it conducts business, yet consolidate financial performance based upon U.S. currency. "The CCO allows the salesperson to focus on the strategic aspect of the relationship," says Solvik, "and improves responsiveness to the customer through automation of mundane tasks."

Thanks to the capabilities of its Oracle ERP infrastructure, Cisco has been able to add outsourced manufacturing to its operations over the last 4 years. "Over 50 percent of the units shipped are untouched by a Cisco factory or a Cisco employee," Solvik says. "We run our worldwide outsource factory across almost 50 suppliers entirely on Oracle Manufacturing Applications."

Cisco has also extended its communications throughout the supply chain to about 100 suppliers. "Now our component suppliers can bid against each other on a new product over the Internet," says Solvik. Changes in Bills of Materials are broadcast to suppliers through the CCO site. "We've reduced the engineering change order cycle time from 25 to 10 days within the last four years.

This improves quality significantly and reduces inventory write-offs," says Solvik. Most important, Solvik can appreciate the benefits of a good relationship in dollars and cents. "By adding together the benefits of electronic commerce, electronic self-service, manufacturing initiatives, and a few [benefits] offered by the Internet, the annual contribution to the company amounts to over $550 million from these top areas alone."

**Question**

Analyse the case and write down the case facts.

***Source:*** http:llwww.oracle.com/customers/sia/cisco.html.

## 6.9 Summary

- Supply Chain information is a critical component of a firm's ability to respond rapidly to the end consumer demand in today's highly competitive marketplace.
- The transaction system is characterized by formalized rules, inter-functional communications, a large volume of transactions, and an operational day-to-day focus.

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- Management Control is characterized by an evaluative, tactical, intermediate-term focus that evaluates past performance and identifies alternatives.
- Logistics information systems combine hardware and software to manage, control, and measure the logistics activities.
- Planning and coordination include the activities necessary to schedule procurement, production, and logistics resource allocation throughout the enterprise.
- A comprehensive information system initiates, monitors, assists in decision making, and reports on activities required to complete logistics operations and planning.
- The ERP or legacy systems are the backbone of most firms' supply chain information systems.
- Enterprise execution systems work in conjunction with the firm's ERP to provide specific functionality to support logistics operations.
- Planning systems can generally be grouped into two categories, strategic and tactical.
- Information technology is also critical for information sharing to facilitate logistics and supply chain planning and operations.
- Enterprise Resource Planning (ERP) and enterprise execution systems are the major software components of logistics information systems.
- The centre of the system is the central database or information warehouse where all information is maintained to facilitate access to common and consistent data by all modules.
- The supply chain information system is the backbone of modem logistics operations.

## 6.10 Keywords

***Architecture:*** Architecture is both the process and product of planning, designing and construction.

***Comprehensive Information System:*** A comprehensive information system initiates, monitors, assists in decision making, and reports on activities required to complete logistics operations and planning.

***Customer Orders:*** It reflects demands placed by enterprise customers.

***Decision Analysis:*** This focuses on decision applications to identify, evaluate, and compare logistics strategic and tactical alternatives for managerial decisions.

***Enterprise Resource Planning (ERP):*** It systems refer to the mainframe applications that were developed prior to 1990 to automate transactions such as order entry, order processing, warehouse operations, inventory management, transportation, and related financial transactions.

***Extensible Markup Language (XML):*** It is a flexible computer language that facilitates information transfer between a wide range of applications and is readily interpretable by humans.

***Information:*** Information is stimuli that have meaning in some context for its receiver.

***Logistics Information Systems:*** Logistic information system is nothing but a part of Management Information System to manage, control and measure the logistical activities.

***Logistics Requirements:*** Logistics requirements coordinate the facility, equipment, labour, and inventory resources necessary to accomplish the logistics mission.

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***Management Control:*** It is characterized by an evaluative, tactical, intermediate-term focus that evaluates past performance and identifies alternatives.

***Manufacturing Requirements:*** Manufacturing requirements schedule production resources and attempt to resolve day-to-day capacity bottlenecks within the materials management system.

***Procurement Requirements:*** Procurement requirements schedule material releases, shipments, and receipts.

***Radio Frequency Data Communication (RFDC):*** It refers to the technology which is used within relatively small areas, such as distribution centres, to facilitate two-way information exchange.

***Replenishment Orders:*** Replenishment orders control finished good movement between manufacturing and distribution facilities.

***Strategic Planning:*** Strategic planning is an organization's process of defining its strategy, or direction, and making decisions on allocating its resources to pursue this strategy.

***Transaction Activities:*** It includes order entry, inventory assignment, order selection, shipping, pricing, invoicing, and customer inquiry.

## 6.11 Review Questions

1. "Information integrates supply chain activities by building on four levels of functionality." Explain with the help of diagram.
2. Highlight the principles of Logistics Information.
3. "Logistics system planning/coordination components form the information system backbone for manufacturers and merchandisers." Elucidate.
4. Define ERP or Legacy Systems.
5. What is Execution Systems?
6. Throw some light on the Planning Systems.
7. What do you understand by Electronic Data Interchange?
8. Write brief note on Internet.
9. Define Extensible Markup Language (XML).
10. Describe the usage of Radio Frequency Data Communication (RFDC) technology.
11. Discuss the rationale for ERP implementation.
12. Explain the design of ERP System.
13. Discuss supply chain system planning/coordination components.
14. Elucidate the Logistics and manufacturing requirements in supply chain system.

### Answers: Self Assessment

| | | | |
|---|---|---|---|
| 1. | Management Control | 2. | SCIS |
| 3. | True | 4. | False |
| 5. | Architecture | 6. | Replenishment |
| 7. | True | 8. | False |

| | | | |
|---|---|---|---|
| 9. | Satellite technology | 10. | Auto Identification |
| 11. | False | 12. | True |
| 13. | ERP | 14. | Human Resource |
| 15. | False | 16. | True |

Notes

## 6.12 Further Readings



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*Online links*

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# Unit 7: Inventory Management

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## Objectives

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After studying this unit, you will be able to:

- Understand the Definition of Functionality
- Explain the Inventory Costs
- Discuss the Planning Inventory
- Describe the Managing Uncertainly
- Understand the Inventory Management Policies
- Explain the Inventory Management Practices

## Introduction

Inventory decisions are high-risk and high-impact from the perspective of logistics operations. Commitment to a particular inventory assortment and subsequent shipment to a market or region in anticipation of future sales determine a number of logistics activities. Without proper inventory assortment, marketing may find that sales are lost and customer satisfaction will decline. Likewise, inventory planning is critical to manufacturing. Raw material shortages can shut down a manufacturing line or modify a production schedule, which, in turn, introduces added expense and potential for finished goods shortages. Just as shortages can disrupt planned marketing and manufacturing operations, overstocked inventories also create problems. Overstocks increase cost and reduce profitability through added warehousing, working capital requirements, deterioration, insurance, taxes, and obsolescence.

## 7.1 Functionality and Definitions

The ideal inventory process consists of manufacturing a product to a customer's specifications once an order is placed. This is called a make-to-order operation and is characteristic of customized equipment. Such a system does not require stockpiles of materials or finished goods in anticipation of future sales.

### 7.1.1 Geographical Specialization

One function of inventory is to allow geographical specialization for individual operating units. Because of the requirements for factors of production such as power, materials, water, and labour, the economical location for manufacturing is often a considerable distance from major markets.



*Example:* Tires, batteries, transmissions, and springs are significant components in automobile assembly.

The technology and expertise to produce each of these components are traditionally located in proximity to material sources in order to minimize transportation. This strategy leads to geographical separation of production so that each automobile component can be produced economically. However, geographical separation requires internal inventory transfer to completely integrate components into final assembly.

Geographical separation also requires inventories to create market assortments. Manufactured goods from various locations are collected at a single warehouse and then combined as a mixed-product shipment.

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Geographical separation permits economic specialization between the manufacturing and distribution units of an enterprise. When geographical specialization is utilized, inventory in the form of materials, semi-finished goods or components, and finished goods is introduced to the logistical system. Each location requires a basic inventory. In addition, in-transit inventories are necessary to link manufacturing and distribution. Although difficult to measure, the economies gained through geographical specialization are expected to more than offset increased inventory and transportation cost.

### 7.1.2 Decoupling

A second inventory function, decoupling, provides maximum operating efficiency within a single manufacturing facility by stockpiling work-in process between production operations. Decoupling processes permit each product to be manufactured and distributed in economical lot sizes that are greater than market demands. Warehouse inventory produced in advance of need permits distribution to customers in large quantity shipments with minimum freight cost. In terms of marketing, decoupling permits products manufactured over time to be sold as an assortment. Thus decoupling tends to "buffer," or cushion, the operations of the enterprise from uncertainty.



*Did u know?* Decoupling differs from geographical specialization: the former enables increased operating efficiency at a single location, while the latter includes multiple locations.

### 7.1.3 Balancing Supply and Demand

A third inventory function, balancing, is concerned with elapsed time between consumption and manufacturing. Balancing inventory reconciles supply availability with demand.



*Example:* The most notable examples of balancing are seasonal production and year-round consumption. Orange juice is one such product. Another example of year-round production with seasonal consumption is antifreeze. Balancing inventories link the economies of manufacturing with variations of consumption.

### 7.1.4 Buffer Uncertainties

The safety stock or buffer stock function concerns short-range variation in either demand or replenishment. Considerable inventory planning is devoted to determining the size of safety stocks. In fact, most overstocks are the result of improper planning.

The safety stock requirement results from uncertainty concerning future sales and inventory replenishment. If uncertainty exists, it is necessary to protect inventory position. In a sense, safety stock planning is similar to purchasing insurance.

Safety stock protects against two types of uncertainty. The first type concerns demand in excess of forecast during the performance cycle. The second type of uncertainty involves delays in the performance-cycle length itself. An example of demand uncertainty is a customer request of more or less units than planned. Performance-cycle length uncertainty results from a delay in order receipt, order processing, or transportation.

Thus we can say that or rather we can conclude that:

1. The four functions of inventory are geographical specialization, decoupling, balancing supply and demand, and buffering uncertainties with safety stock.

Notes

2. Inventory policy consists of guidelines concerning what to purchase or manufacture, when to take action, and in what quantity. It also includes decisions regarding inventory positioning and placement at plants and distribution centres.



*Example:* Some firms may decide to postpone inventory positioning by maintaining stock at the plant.

3. The second inventory policy element concerns inventory management strategy.

4. The service level is a target specified by management. It defines the performance objectives that the inventory function must be capable of achieving.

5. The service level can be defined in terms of an order cycle time, case fill rate, line fill rate, order fill rate, or any combination of the above.

6. The performance cycle is the elapsed time between the release of a purchase order by a customer and the receipt of the corresponding shipment.

7. Average inventories include cycle, safety stock, and transit inventory components.

8. Cycle Inventory Cycle inventory, or base stock, is the portion of average inventory that results from the replenishment process. At the beginning of a performance cycle, stock is at a maximum level. Daily customer demands "draw off" inventory until the stock level reaches zero.

9. A replenishment order is initiated so that stock will arrive before a stock out occurs. The replenishment order must be initiated when the available inventory is greater than or equal to the customer demand during the performance-cycle time. The amount ordered for replenishment is called the order quantity.

10. The average inventory held as a result of the order process is referred to as base stock.

11. Another commonly used term to identify this aspect of inventory is lot size stock.

12. Transit Inventory represents stock that is either moving or awaiting movement in transportation vehicles. This portion of total inventory is referred to as transit or pipeline inventory.

13. From a logistics management perspective, transit inventory introduces two sources of complexity into the supply chain. First, transit inventory represents real assets and must be paid for, even though it is not accessible or usable. Second, there has typically been a high degree of uncertainty associated with transit inventory because shippers were unable to determine where a transport vehicle was located or when it was likely to arrive.

14. The second part of average inventory is the stock held to protect against the impact of uncertainty on each facility. This portion of inventory is called safety stock. Safety stock inventory is used only at the end of replenishment cycles when uncertainty has caused higher than expected demand or longer than expected performance-cycle times.



*Caselet*

## Koutons Retail Set for Better Days

Investors in Delhi-based Koutons Retail have not been able to rake in much moolah despite the overall market rally. The stock has been a laggard in the past year, posting a negative return of 31%. But it's gradually gaining ground having recorded its 52-week low of ₹ 293 on January 11.

*Contd...*

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Koutons' performance on bourses, over a longer period, has been consistently bad. For instance, in the past three months, returns on the stock were a negative 5%. And over a six-month period, it was negative 11% whereas the Sensex reported a return in excess of 30% during this period. On an annual performance basis also, the stock underperformed the benchmark index Sensex as well as the ET Retail index that gained 92% and 90%, respectively.

Koutons, which grossed ₹ 1,155 crore in the past four quarters in revenue, manufactures semi-formal and casual wear under the brands Koutons, Charlie Outlaw, Les Femme and Koutons Kids. Each of these brands operates in a separate segment, ranging from the premium to value segment, with Koutons positioned as the higher-end brand.

The company currently has 230 family stores and 1,388 Exclusive Brand Outlets (EBOs). Most of these are on a franchisee basis, which keeps it an asset-light model for Koutons. Last year, the company also forayed into women and kids' wear, as these are high-margin segments, which will help improve the overall return on the capital employed.

The company has seen a subdued 15% growth in profits in the first half of FY10 despite a good 36% increase in operating margins. Improved inventory management, lesser markdowns and higher volumes were the key contributors to this. However, in the second half of FY10, the company is not be able to record a 25% growth in sales as seen in the first half, with the festive period over.

The company reported ₹ 347-crore sales in the quarter to September '09, a 23% year-on-year (YoY) growth. With an operating profit of ₹ 61 crore and net profit of ₹ 24 crore, margins have improved on a YoY basis, but higher interest outflows still weigh heavy on quarterly growth in profits. This has impacted its interest coverage ratio which has come down from 2.36 times as on March '09 to 1.74 times as on September '09. Interest coverage is a measure of the ability of the company to pay interest out of its earnings.

Going forward, the company expects to grow the ladies and kids segment that will improve the overall margin. It also expects higher realisation and improved inventory management system that will reduce its working capital cycle. The management expects a 300-bp reduction in its interest cost that will further improve margins. At ₹ 348 and an annualised EPS of ₹ 22.9 for FY10, the stock is valued at 15.3 times its earnings, cheaper than some other retail players.

***Source:*** www.theeconomictimes.com

### Self Assessment

Fill in the blanks:

1. ..... permits economic specialization between the manufacturing and distribution units of an enterprise.
2. ..... processes permit each product to be manufactured and distributed in economical lot sizes.
3. The ..... function concerns short-range variation in either demand or replenishment.

## 7.2 Inventory Costs

Inventory is the major source of cost in the supply chain and also the basis for improving customer service and enhancing customer satisfaction.

Notes

*Example:* High inventory at retail outlets may help in making the goods easily available to customers and also result in a growth in sales, but it will also increase costs and bring down profitability.

These are two major issues in conflict with each other that need to be resolved, in order to optimize the inventory carried by the organization.

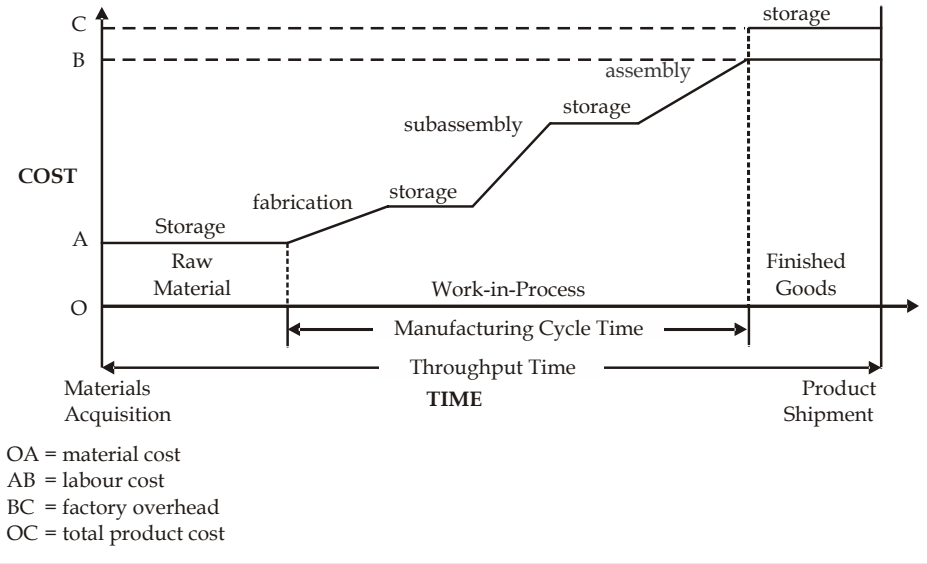
Excess inventory is a cost burden to industry in terms of capital tied up, the cost of obsolescence and the cost of servicing product in the supply chain. However, having the right amount of inventory to meet customer requirements is critical. Inventory management is about two things: not running out, and not having too much.

Essentially, inventory is a reserve system to prevent stockouts. However, as important as it is to prevent such a stockout, you also don't want to hold onto too much inventory because holding costs can become a major encumbrance. So how do you balance the two and what is the right amount? More importantly, when should you reorder in order to prevent a stockout. The answer to this can be determined by obtaining and applying the appropriate inventory models in decision-making.

The heart of inventory decisions lies in the identification of inventory costs and optimizing the costs relative to the operations of the organization. As inventory is a necessary but idle resource, stock levels and inventory costs in manufacturing need to be minimized.

*Notes* Large holdings of inventory also cause long cycle times which may not be desirable.

**Figure 7.1: Cost of Inventory with Time**



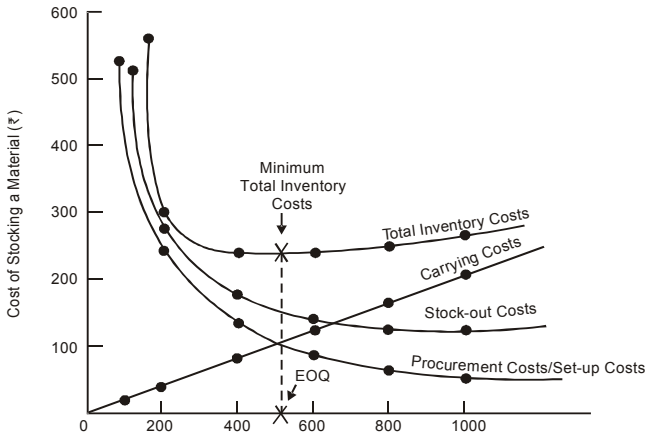

***Source:*** Upendra Kachru, (2010), "Exploring the Supply Chain," Excel Books

The total inventory held is additive in nature. Raw materials are converted to finished goods through a number of incremental processes. Regardless of the operating process, all production costs incurred during a particular period to the jobs or products produced during that time period are assigned to the inventory. These processes also add to the cost of inventory held by the organization. Therefore, the cost of inventory increases with time. This is shown in Figure 7.1.

Notes

What are the costs identified with inventory? The costs generally associated with inventories are shown in Figure 7.2 and each component of this cost is described below.

**Figure 7.2: Total Inventory Costs**




***Source:*** Upendra Kachru, (2010), "Exploring the Supply Chain," Excel Books

## 7.2.1 Average Inventory

Average inventory is defined as half the batch size plus safety stock.

Average inventory = (Order quantity + Safety stock)/2

The assumption made is that at any point in time, the cycle stock (stock planned to be used excluding safety stock) is on an average half the recipient quantity i.e. it is half-way in-between the receipt quantity and zero left. The practical implication of this is that it reduces order quantity and the average cycle stock by half. If a part is manufactured in smaller batches, the inventory goes down.

*Notes* Safety stock is determined from such factors as customer service level required, demand variability and replenishment lead-time. Once the customer service level required is agreed upon, safety stock is calculated.

## 7.2.2 Holding (or Carrying) Costs

The very fact that an item is held in stock accrues cost. These are the real costs to hold inventory. Such costs are called inventory holding costs or carrying costs. This broad category includes the costs for:

- ***Storage and Handling:*** This includes the total warehousing facility. This is typically 6 percent. It is estimated that the total cost to the company is 35 percent per annum of the value of inventory held, or 3 percent a month.
- ***Insurance:*** Insurance accounts for a portion of the inventory costs. Since it is better to be safe than sorry, companies generally get the material insured. It generally works out to 1 percent.
- ***Pilferage and Spoilage:*** This accounts for anything from 2 percent upwards, depending on the industry and the type of inventory that is being carried.

Notes

- ***Obsolescence and Deterioration:*** This is inventory which is classified as being unfit to sell, or lying in the storage waiting for the appropriate use. It is typically estimated to be about 1 percent of the inventory carrying cost.
- ***The Opportunity Cost of Capital:*** This is the cost to set-up the warehousing facility. This is charged at the "Lost opportunity cost" and not the interest rate.



*Notes* Typically rated at 25 percent, this "Lost opportunity cost" is the return that could have been obtained if the capital had been invested in anything other than inventory.

In addition, there are some other charges that may among other things include depreciation and taxes.

As can be seen from Figure 7.2, holding costs is shown as a straight line. These costs increase proportionately with the increase in the inventory level. Obviously, if the holding costs are high, the organization should try to carry lower inventory and frequently replenish the stock.

Though holding costs are represented by a straight line, there are some fixed and variable costs of holding inventory i.e. some of the costs will not change by increase or decrease in inventory levels, while some costs are dependent on the levels of inventory held. The general breakdown for inventory holding costs has been shown in Table 7.1.

**Table 7.1: Fixed and Variable Holding Costs**

| Fixed Costs | Variable Cost |
|---|---|
| • Capital costs of warehouse or store<br>• Cost of operating the warehouse or store<br>• Personnel costs | • Cost of capital in inventory<br>• Insurance on inventory value<br>• Losses due to obsolescence, theft, spoilage<br>• Cost of renting warehouse or storage space |

***Source:*** Upendra Kachru, (2010), "Exploring the Supply Chain," Excel Books

Capital costs and costs of operating the warehouse including the personnel are fixed, but interest costs of capital held in inventory etc. are variable.



*Did u know?* The reason why the cost curve for holding inventory is a straight line is that the contribution of the variable costs in the total holding costs is much greater than that of the fixed costs.

### 7.2.3 Ordering Costs

What is the real cost of placing and processing a purchase order? The total cost includes the cost of purchasing, receiving, incoming inspection and the accounts payable. Each of these departments exists to satisfy continuous demand for material. We arrive at a simple equation to calculate the Avg. cost per order as:

Avg. Cost per Order = Total Budget/Number of Orders placed per year

Although it costs money to hold inventory, it also, unfortunately, costs money to replenish inventory, either through the purchase cycle or through the manufacturing cycle.

Notes

Inventory Ordering Costs are those costs that are incurred in the purchase cycle are called procurement costs or inventory ordering costs. Ordering costs have two components:

(a) One component that is relatively fixed, and

(b) Another component that will vary.

**Table 7.2: Fixed and Variable Ordering Costs**

| Fixed Costs | Variable Costs |
|---|---|
| • Staffing costs (payroll, benefits, etc.)<br>• Fixed costs on IT systems<br>• Office rental and equipment costs<br>• Fixed costs of vendor development | • Shipping costs<br>• Cost of placing and order (phone, postage, order forms)<br>• Running costs of IT systems<br>• Receiving and inspection costs<br>• Variable costs of vendor development |

***Source:*** Upendra Kachru (2010), "Exploring the Supply Chain," Excel Books

The fixed and variable components of the ordering or procurement costs are shown in Table 7.2. Referring back to Figure 7.2, it will be seen that inventory ordering costs decrease increasingly with the increase in inventory. This can be explained if we are able to clearly differentiate between those ordering costs that do not change much and those that are incurred each time an order is placed.

One major component of cost associated with inventory is the cost of replenishing it. If a part or raw material is ordered from outside suppliers, and places orders for a given part with its supplier three times per year instead of six times per year, the costs to the organization that would change are the variable costs, and which would probably not are the fixed costs.

There are costs incurred in maintaining and updating the information system, developing vendors, evaluating capabilities of vendors. Ordering costs also include all the details, such as counting items and calculating order quantities. The costs associated with maintaining the system needed to track orders are also included in ordering costs. This includes phone calls, typing, postage, and so on.



*Did u know?* Though vendor development is an ongoing process, it is also a very expensive process. With a good vendor base, it is possible to enter into longer-term relationships to supply needs for perhaps the entire year. This changes the "when" to "how many to order" and brings about a reduction both in the complexity and costs of ordering.

Clearly, the fixed costs related to procurement or order placement are significantly greater than the variable costs associated with placing orders.

## 7.2.4 Setup (or Production Change) Costs

Ordering costs are incurred in the purchase cycle, while set-up costs are incurred in the manufacturing cycle. Therefore the set-up cost is actually represented by the inventory ordering costs. These two costs are considered to be exclusive.

For manufactured items, the equivalent cost is known as Set-Up. In the case of subassemblies, or finished products that may be produced in-house, the costs associated with changing over equipment from producing one item to producing another is usually referred to as setup costs.

Notes

This includes all the costs that are not related to the order quantity (the costs incurred to prepare the order paperwork, processing and tracking the order operations, the cost of setting up the machine, and first off inspection). This total ordering/processing cost is eventually passed on to the products.

Set-up costs reflect the costs involved in obtaining the necessary materials, arranging specific equipment setups, filling out the required papers, appropriately charging time and materials, and moving out the previous stock of materials, in making each different product.



*Notes* If there were no costs or loss of time associated in changing from one product to another, many small lots would be produced, permitting reduction in inventory levels and the resultant savings in costs.

### 7.2.5 Shortage or Stock-out Costs

No manufacturing facility can afford to keep sufficient stock to meet every demand. Stock-outs occur at some point. Stock-outs result in either a lost sale, or if the customer is prepared to wait, a back order. Lost sale reflects the risk of losing the business to competition. In addition, back orders cause additional costs, viz. extra paperwork, the time spent handling this extra paperwork, a system to handle the back orders, extra delivery notes, and invoices, extra packing and delivery costs.

When the stock of an item is depleted, an order for that item must either wait until the stock is replenished or be cancelled. There is a trade-off between carrying stock to satisfy demand and the costs resulting from stockout. The costs that are incurred as result of running out of stock are known as stock out or shortage costs.

Understanding the cost of a stockout is critical to the implementation of any inventory model. Unless these costs are known, the organization cannot balance the costs (and risk) of holding inventory with the loss of profits when an item is out of stock.

For a retailer, the costs include both the lost profits from the immediate order because of cancellations, and the long-run costs if stockouts reduce the likelihood of future orders. For a manufacturer, these include the loss of production as well as capacity. In addition, the ultimate consequence is that sales of goods may be lost, and finally customers can be lost.

If the unfulfilled demand for the items can be satisfied at a later date (back order case), in this case, cost of back orders are assumed to vary directly with the shortage quantity (in rupee value) and the cost involved in the additional time required to fulfill the backorder (₹/₹/year).

However, if the unfulfilled demand is lost, the cost of shortages is assumed to vary directly with the shortage quantity (₹/unit shortage). When this is related to the total cost of inventory, the cost decreases increasingly with the increase in inventory, as this cost is relatively fixed with respect to the value of the inventory.

Frequently, the assumed shortage cost is little more than a guess, although it is usually possible to specify a range of such costs.

## Self Assessment

State whether the following statements are true or false:

4. Raw materials are converted to finished goods through a number of incremental processes.

Notes

5. Inventory is not a reserve system to prevent stockouts.
6. Average inventory is defined as half the batch size plus safety stock.

## 7.3 Planning Inventory

This section describes the key parameters and procedures for planning inventory. The discussion focuses on three issues: when to order, how much to order, and inventory control procedures.

### 7.3.1 Determining Order Point (When to Order?)

The reorder point determines when a re-supply shipment should be initiated. The reorder point, which is defined by item and distribution centre, can be specified in terms of units or days of supply.

This discussion focuses on determining reorder points under conditions of demand and performance-cycle certainty. The certainty conditions imply that future demands and performance-cycle lengths are known.

The basic reorder point formula is:

$$R = D \times T$$

where R = reorder point in units

D = average daily demand

T = average performance-cycle length

To illustrate this calculation, assume demand of 10 units/day and a 20-day performance cycle. In this case,

$$10 \text{ units/day} \times 20 \text{ days} = 200 \text{ units}$$

The use of the reorder point formulations implies that the re-supply shipment will arrive just as the last unit is shipped to a customer. This approach is satisfactory as long as both demand and performance cycles are certain. When there is uncertainty in either demand or performance-cycle length, an inventory buffer is necessary to compensate for the uncertainty.



*Did u know?* The buffer, which is usually called safety stock, handles customer demands during longer than expected performance cycles or above average daily demand.

When this buffer stock is necessary for conditions of uncertainty, the reorder point formula is

$$R = D \times T + SS$$

where R = reorder point in units

D = average daily demand

T = average performance-cycle length

SS = safety or buffer stock in units

### 7.3.2 Determining Lot Size (How Much?)

The lot sizing concept balances the cost of maintaining inventories against the cost of ordering. The key to understanding the relationship is to remember that average inventory is equal to

Notes

one-half the order quantity. Therefore, the larger the order quantity, the larger the average inventory and consequently, the greater the maintenance cost per year. However, the larger the order quantity, the fewer orders required per planning period and, consequently, the lower the total ordering cost. Lot quantity formulations identify the precise quantities at which the annual combined total cost of ordering and maintenance is lowest for a given sales volume.

### Economic Order Quantity

The Economic Order Quantity (EOQ) is the replenishment order quantity that minimizes the combined cost of inventory maintenance and ordering. Identification of such a quantity assumes that demand and costs are relatively stable throughout the year.



*Caution* Since an EOQ is calculated on an individual product basis, the basic formulation does not consider the impact of joint ordering of products.

The most efficient method for calculating economic order quantity is mathematical. To make the appropriate calculations, the standard formulation for EOQ is

$$EOQ = \sqrt{2CoD/CiU}$$

Where EOQ = economic order quantity (EOQ)

Co = cost per order

Ci = annual inventory carrying cost

D = annual sales volume, units

U = cost per unit

While the EOQ model determines the optimal replenishment quantity, it does require some rather stringent assumptions that constrain its direct application. The major assumptions of the simple EOQ model are:

1. Satisfaction of all demand
2. Continuous, constant, and known rate of demand
3. Constant and known replenishment performance-cycle time
4. Constant price of product that is independent of order quantity or time (i.e., no purchase quantity or transportation price discounts are available)
5. Infinite planning horizon
6. No interaction between multiple items of inventory
7. No inventory in transit
8. No limit on capital availability. The constraints imposed by some of these assumptions can be overcome through computational extensions. However, the EOQ concept illustrates the importance of the trade-offs associated with holding and acquisition cost.

### EOQ Extensions

While the EOQ formulation is relatively straightforward, there are some other factors that must be considered in actual application. The most persistent problems are those related to various adjustments necessary to take advantage of special purchase situations and unitization characteristics.

Notes

Three typical adjustments are volume adjustment, Quantity discounts, other adjustments, volume transportation rates.

In the EOQ formulation, no consideration was given to the impact of transportation cost on order quantity. When products are purchased on a delivered basis and the seller pays transportation cost from origin to the inventory destination, such neglect may be justified. The seller is responsible for the shipment until it arrives at the customer's place of business. However, when product ownership is transferred at origin, the impact of transportation rates on total cost must be considered when determining order quantity.

As a general rule, the greater the weight of an order, the lower will be the cost per pound of transportation from any origin to destination. A freight-rate discount for larger-size shipments is common for both truck and rail and is found in most transportation rate structures. Thus, all other things being equal, an enterprise naturally wants to purchase in quantities that maximize transportation economies. Such quantities may be larger than the purchase quantity determined using the EOQ method.



*Notes* Increasing order size has a two-fold impact on inventory cost.

### Rates

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The second impact is a decrease in the number of orders required. The decreased number of orders increases the shipment size, which provides better transportation economies.

To complete the analysis, it is necessary to formulate the total cost with and without transportation savings. While this calculation can be directly made by modification of the EOQ formulation, comparison provides a more insightful answer. The only additional data required are the applicable freight rates for ordering in quantities to complete the analysis.

The impact of volume transportation rates on total cost of procurement cannot be neglected. Thus, any EOQ must be tested for transportation cost sensitivity across a range of weight breaks if transportation expenses are the buyer's responsibility. Finally, two factors regarding inventory cost under conditions of origin purchase are noteworthy. (Origin purchase means that the buyer is responsible for freight cost and product risk when the product is in transit.) First, the buyer assumes full risk on inventory at time of shipment. Depending on time of required payment, this could mean that transit inventory is part of the enterprise's average inventory and therefore subjected to an appropriate charge. It follows that any change in weight break leading to a shipment method with a different in-transit time should be assessed the added cost or savings as appropriate in a total-cost analysis.

Notes

Second, the transportation cost must be added to the purchase price to obtain an accurate assessment of the value of goods tied up in inventory. Once the inventory has been received, the amount invested in the product must be increased by the transportation expenses. Inventory carrying cost should then be assessed on the combined cost of the item plus transportation.

Quantity discounts can be handled directly with the basic EOQ formulation by calculating total cost at any given volume-related purchase price to determine associated EOQs. If the discount at any associated quantity is sufficient to offset the added cost of maintenance less the reduced cost of ordering, then the quantity discount offers a viable alternative. It should be noted that quantity discounts and volume transportation rates each affect larger purchase quantities. This does not necessarily mean that the lowest total-cost since it represents a fixed cost once the decision is made to replenish product. If it is decided to use a private fleet to transport replenishment product, the enterprise should fill the truck regardless of the EOQ.



*Caution* It does not make sense to transport a half-empty truck simply so that the order quantity represents the EOQ.

Another consideration when establishing the order quantity is the unitization characteristic. Many products are stored and moved in standard units such as cases or pallets. Since these standardized units are designed to fit transportation or handling vehicles, there may be significant diseconomies when the EOQ is not a unit multiple.

***Problem 1:***

Assume you have a product with the following parameters:

Annual Demand = 360 units

Holding cost per year = ₹ 1.00 per unit

Order cost = ₹ 100 per order

What is the EOQ for this product?

***Solution:***

$$EOQ = \sqrt{\frac{2 * Demand * Order\ Cost}{Holding\ cost}} = \sqrt{\frac{2 * 360 * 100}{1}} = \sqrt{72000} = 268.33 \text{ items}$$

The EOQ model assumes any real quantity is feasible. The actual quantity ordered may need to be an integer value and may be affected by packaging or other item characteristics. In the following Problems an EOQ of 268 is assumed.

***Problem 2:***

Given the data from Problem 1, and assuming a 300-day work year, how many orders should be processed per year? What is the expected time between orders?

***Solution:***

$$N = \frac{Demand}{Q} = \frac{360}{268} = 1.34 \text{ orders per year}$$

$$T = \frac{Working\ days}{Expected\ number\ of\ orders} = 300/1.34 = 224 \text{ days between orders}$$

Notes

***Problem 3:***

What is the total cost for the inventory policy used in Problem 1?

***Solution:***

$$TC = \frac{\text{Demand} * \text{Order Cost}}{Q} + \frac{(\text{Quantity of Items}) * (\text{Holding Cost})}{2}$$

$$= \frac{360 * 100}{268} + \frac{268 * 1}{2} = 134 + 134 = \$268$$

Notice that at the EOQ Total Holding Cost and Total Ordering Cost are equal.

***Problem 4:***

Based on the material from Problems 1-3, what would cost be if the demand was actually higher than estimated (i.e., 500 units instead of 360 units), but the EOQ established in Problem 3 above is used? What will be the actual annual total cost?

***Solution:***

$$TC = \frac{\text{Demand} * \text{Order Cost}}{Q} + \frac{(\text{Quantity of Items}) * (\text{Holding Cost})}{2}$$

$$= \frac{500 * 100}{268} + \frac{268 * 1}{2} = 186.57 + 134 = \$320.57$$

Note that while demand was underestimated by nearly 50%, annual cost increases by only 20% (320/268 = 1.20) an illustration of the degree to which the EOQ model is relatively insensitive to small errors in estimation of demand.

***Problem 5:***

If demand for an item is 3 units per day, and delivery lead-time is 15 days, what should we use for a simple re-order point?

***Solution:***

ROP = Demand during lead-time = 3 * 15 = 45 units

***Problem 6:***

Assume that our firm produces Type C fire extinguishers. We make 30,000 of these fire extinguishers per year. Each extinguisher requires one handle (assume a 300 day work year for daily usage rate purposes). Assume an annual carrying cost of ₹ 1.50 per handle, production setup cost of ₹ 150, and a daily production rate of 300. What is the optimal production order quantity?

***Solution:***

The equation used differs from the basic EOQ model by allowing for gradual replenishment, which affects the average level of inventory.

$$Q_p^* = \sqrt{\frac{2 * \text{Demand} * \text{Order Cost}}{\text{Holding Cost}\left(1 - \frac{\text{Daily Usage Rate}}{\text{Daily Production Rate}}\right)}} = \sqrt{\frac{(2)(30,000)(150)}{1.50\left(1 - \frac{100}{300}\right)}}$$

= 3000 units

Notes

### Other EOQ Adjustments

A variety of special situations may occur that will require adjustments to the basic EOQ. Examples are:

1. Production lot size
2. Multiple-item purchase
3. Limited capital
4. Private trucking. Production lot size refers to the most economical quantities from a manufacturing perspective. Multiple-item purchase describes situations when more than one product is bought concurrently, so that quantity and transportation discounts must consider the impact of product combinations. Limited capital refers to situations with budget limitations for total inventory investment. Since the product line must be satisfied within the budget limitations, order quantities must recognize the need to allocate the inventory investment across the product line.

## 7.3.3 Discrete Lot Sizing

Not all resupply situations operate with uniform usage rates like those in the previous EOQ computations. In many manufacturing situations, the demand for a specific component tends to occur at irregular intervals and for varied quantities. The irregular nature of usage requirements is a consequence of demand being dependent upon the production schedule. That is, the required assembly parts must be available at the time manufacture occurs. Between requirement times, no need exists to maintain component inventory in stock if it can be obtained when needed. Inventory servicing of dependent demand requires a modified approach to the determination of order quantities, referred to as discrete lot sizing. Identification of the technique as "discrete" means that the procurement objective is to obtain a component quantity equal to the net requirements at a specific point in time. Because component requirements fluctuate, purchase quantities using discrete lot sizing will vary between orders. Varieties of lot sizing techniques are available. The options of:

1. Lot-for-lot sizing
2. Period order quantity
3. Time-series lot sizing

### Lot-for-lot Sizing

The most basic form of discrete ordering is to plan purchases to cover net requirements over a specified period. No consideration is given to the cost of ordering under lot-for-lot sizing. In one sense, the lot-for-lot technique is pure dependent-demand-oriented, since no ordering economies are considered. The order quantity exactly matches manufacturing or demand quantity. The basic technique is often used when the item being purchased is inexpensive and the requirements are relatively small and irregular. Lot-for-lot sizing often uses electronic order transfer and premium transportation to minimize processing and delivery time.

### Period Order Quantity

The Period Order Quantity (POQ) technique builds on the EOQ logic. Here, three steps are performed to accomplish component procurement. First, the standard EOQ is calculated. Second, the EOQ quantity is divided into forecasted annual usage to determine order frequency.

Notes

Third, the number of orders is divided into the relevant time period (e.g., fifty-two for weeks or twelve for months) to express the order quantity in time periods.

To illustrate, let's work with an EOQ of 300 and a forecast of 2,400. To adjust to a twelve-period year, the POQ technique would be as follows:

EOQ = 300

Forecast = 2400

Orders per Year = 2400/300

= 8.00

Order Interval = 12/8.00

= 1.5 Months

Under the POQ application, orders are planned approximately every six weeks. The typical order is 300 units unless usage deviates from planned quantity and requires a "catch-up" or "light" re supply order.

The main advantage of the POQ approach is that it considers inventory-carrying cost and thereby minimizes inventory carryover. The disadvantage is that similar to the basic EOQ, POQ also requires stable demand to realize its full potential.

### Time-series Lot Sizing

The fundamental objective of time-series lot sizing is to combine requirements over several periods to arrive at procurement logic. The time-series approach is dynamic because the order quantity is adjusted to meet current requirement estimates. This is in contrast to basic EOQ, which is static in the sense that once the order quantity is computed, it continues unchanged for the demand-planning horizon.

The key to dynamic lot sizing is that requirements are expressed in varying quantities across time rather than in usage rates per day or week, as is typical of the basic EOQ. Given substantial usage fluctuation, fixed order quantities are replaced by a lot sizing system that can calculate an economical order given changing and intermittent usage. Three such techniques are widely discussed in the literature and are briefly reviewed here: least unit cost, least total cost, and part period balancing.

#### *Least Unit Cost*

It seeks to identify a combination of requirements over a number of periods resulting in the lowest cost per SKU. Starting with initial period net requirements, each future period's per unit requirements are evaluated to determine a combined quantity for a given number of periods in which the unit cost is minimized. The least-unit-cost approach essentially evaluates purchasing requirements in incremental number of weeks of supply into the future.

The first week considers one week of supply. The analysis then considers adding a second week. Unit cost-including quantity discounts, ordering cost, inventory-carrying cost, and transportation cost-is evaluated for each option.

While the discount, ordering, and transportation costs will cause average unit cost to decline as more periods are added, inventory-carrying cost will increase as more time periods are added because of the additional inventory. Thus, order quantities and order frequency will vary substantially under the least-unit-cost technique. While this approach does provide a way to overcome the static features of EOQ and POQ, the technique may cause unit costs to vary widely between time periods.

Notes

### *Least Total Cost*

The least-total-cost approach seeks the quantity that minimizes total cost for successive periods. In this sense, least total cost, which is the balancing of ordering and carrying, is similar to EOQ in objective. The fundamental difference is that order interval is varied to seek the least total cost. The calculation is based on a ratio of ordering to carrying cost (CdCi), called the economic part period. The economic part period defines the quantity of a specific component that, if carried in inventory for one period, would result in a carrying cost equal to the cost of ordering. The least-total-cost technique selects order sizes and intervals that most nearly approximate the economic part-period calculation. Thus, order sizes remain fairly uniform; however, substantial differences do occur in elapsed time between order placements. The least-total-cost technique overcomes the failure of the least unit cost to consider trade-offs across the overall planning period.

### *Part-period Balancing*

Part-period balancing is a modified form of the least-total-cost technique that incorporates a special adjustment routine called look-ahead look-back.

The main benefit of this feature is that it extends the planning horizon across more than one ordering point to accommodate usage peaks and valleys when calculating order quantities. Adjustments are made in order time or quantity when a forward or backward review of more than one order requirement indicates that modifications to the economic part-period may be beneficial. The typical procedure is to first test the look-ahead feature to determine if more time results in approximation of the economic part-period quantity. Look-back is typically utilized if look-ahead leaves the lot size unchanged. In this sense, look-back means that a future order, which under the economic part-period rule would normally be scheduled for delivery during the fourth period, should be advanced if earlier delivery would reduce total cost. The net result of incorporating the look-ahead/look-back feature is that it turns the application of the economic part period concept into a simultaneous review of multiple periods.

### Self Assessment

Fill in the blanks:

7. The …… determines when a re-supply shipment should be initiated.
8. The …… is the replenishment order quantity that minimizes the combined cost of inventory maintenance and ordering.
9. The …… technique builds on the EOQ logic. Here, three steps are performed to accomplish component procurement.

## 7.4 Managing Uncertainty

Global optimization is made even more difficult because supply chains need to be designed for, and operated in, uncertain environments, thus creating sometimes enormous risks to the organization. A variety of factors contribute to this:

1. Matching supply and demand is a major challenge:
   (a) Boeing Aircraft announced a write-down of $2.6 billion in October 1997 due to "raw material shortages, internal and supplier parts shortages and productivity inefficiencies . . ."

**Notes**

(b) "Second quarter sales at U.S. Surgical Corporation declined 25 percent, resulting in a loss of $22 million. The sales and earnings shortfall is attributed to larger than anticipated inventories on the shelves of hospitals".

(c) "EMC Corp. said it missed its revenue guidance of $2.66 billion for the second quarter of 2006 by around $100 million, and said the discrepancy was due to higher than expected orders for the new DMX-3 systems over the DMX-2, which resulted in an inventory snafu".

(d) "There are so many different ways inventory can enter our system it's a constant challenge to keep it under control" [Johnnie Dobbs, Wal-Mart Supply Chain and Logistics Executive].

(e) "Intel, the world's largest chip maker, reported a 38 percent decline in quarterly profit Wednesday in the face of stiff competition from Advanced Micro Devices and a general slowdown in the personal computer market that caused inventories to swell".

Obviously, this difficulty stems from the fact that months before demand is realized, manufacturers have to commit themselves to specific production levels. These advance commitments imply huge financial and supply risks.

2. Inventory and back-order levels fluctuate considerably across the supply chain, even when customer demand for specific products does not vary greatly. In a typical supply chain, distributor orders to the factory fluctuate far more than the underlying retailer demand.

3. Forecasting doesn't solve the problem. Indeed, we will argue that the first principle of forecasting is that "forecasts are always wrong." Thus, it is impossible to predict the precise demand for a specific item, even with the most advanced forecasting techniques.

4. Demand is not the only source of uncertainty. Delivery lead times, manufacturing yields, transportation times, and component availability also can have significant supply chain impact.

5. Recent trends such as lean manufacturing, outsourcing, and offshoring that focus on cost reduction increase risks significantly.



*Example:* Consider an automotive manufacturer whose parts suppliers are in Canada and Mexico. With little uncertainty in transportation and a stable supply schedule, parts can be delivered to assembly plants "just-in-time" based on fixed production schedules.

However, in the event of an unforeseen disaster, such as the September 11 terrorist attacks, port strikes, or weather-related calamities, adherence to this type of strategy could result in a shutdown of the production lines due to lack of parts. Similarly, outsourcing and off shoring imply that the supply chains are more geographically diverse and, as a result, natural and man-made disasters can have a tremendous impact.



*Example:*

- On August 29, 2005, Hurricane Katrina devastated New Orleans and the Gulf coast. Proctor & Gamble coffee manufacturing, with brands such as Folgers that get over half of their supply from sites in New Orleans, was severely impacted by the hurricane. Six months later, there were, as a P&G executive told the New York Times, "still holes on the shelves" where P&G's brands should be.

Notes

- A 2002 West Coast port strike shut down ports from Seattle to San Diego. Economists estimate that this strike cost the economy up to $1 billion a day, as stores could not be stocked, fruits and vegetables rotted, and factories were shut down due to lack of parts.
- In September 1999, a massive earthquake devastated Taiwan. Initially, 80 percent of the island's power was lost. Companies such as Hewlett-Packard and Dell, who source a variety of components from Taiwanese manufacturers, were impacted by supply interruptions.
- Fabric shipments from India were delayed in the wake of the January 26, 2001, earthquake in the Indian state of Gujarat, impacting many U.S. apparel manufacturers.

Although uncertainty and risk cannot be eliminated, we will explore a variety of examples that illustrate how product design, network modelling, information technology, procurement, and inventory strategies are used to minimize uncertainty, and to build flexibility and redundancy in the supply chain in order to reduce risks.



*Task* Illustrate how fine-line inventory classification can be used with product and market segments. What are the benefits and considerations when classifying inventory by product, market, and product/market?

### Self Assessment

State whether the following statements are true or false:

10. Matching supply and demand is a major challenge.
11. Demand is only a source of certainty.
12. Forecasting solve the problem.

## 7.5 Inventory Management Policies

Business owners and managers focus on this activity because inventory typically represents the second largest expenditure in a company behind payroll. Policies and procedures help companies actively manage the different products in their facilities. While standard policies and procedures exist for inventory management, owners and managers have some latitude to develop standards for their own companies.

Inventory management is the process that implements inventory policy. The reactive or pull inventory approach uses customer demand to pull product through the distribution channel. An alternative philosophy is a planning approach that proactively allocates inventory based on forecasted demand and product availability. A third, or hybrid, logic uses a combination of push and pull.

### 7.5.1 Inventory Control

Inventory control is the managerial procedure for implementing an inventory policy. The accountability aspect of control measures units on hand at a specific location and tracks additions and deletions. Accountability and tracking can be performed on a manual or computerized basis. Inventory control defines how often inventory levels are reviewed to determine when and how much to order. It is performed on either a perpetual or a periodic basis.

Notes

### 7.5.2 Reactive Methods

The reactive or pull inventory system, as the name implies, responds to a channel member's inventory needs by drawing the product through the distribution channel. Replenishment shipments are initiated when available warehouse stock levels fall below a predetermined minimum or order point. The amount ordered is usually based on some lot-sizing formulation, although it may be some variable quantity that is a function of current stock levels and a predetermined maximum level.

### 7.5.3 Planning Methods

Inventory planning methods use a common information base to coordinate inventory requirements across multiple locations or stages in the supply chain. Planning activities may occur at the plant warehouse level to coordinate inventory allocation and delivery to multiple destinations. Planning may also occur to coordinate inventory requirements across multiple channel partners such as manufacturers and retailers.

***The Advanced Planning and Scheduling (APS) systems planning method applications:*** While APS systems computerize the process, it is important for logistics managers to understand the underlying logic and assumptions. Two inventory planning methods are Fair Share Allocation and Distribution Requirements Planning (DRP).

***Fair share allocation:*** It is a simplified inventory management planning method that provides each distribution facility with an equitable or "fair share" of available inventory from a common source such as a plant warehouse.

***Distribution Requirements Planning (DRP):*** DRP is a more sophisticated planning approach that considers multiple distribution stages and their unique characteristics. DRP is the logical extension of Manufacturing Requirements Planning (MRP), although there is one fundamental difference between the two techniques. MRP is driven by a production schedule that is defined and controlled by management policy. On the other hand, DRP is driven by customer demand.

So, while MRP generally operates in a dependent demand situation, DRP operates in an independent demand environment where uncertain customer demand drives inventory requirements. MRP coordinates scheduling and integration of materials into finished goods, and so controls inventory until manufacturing or assembly is completed. DRP takes coordination responsibility once finished goods are received in the plant warehouse.

### 7.5.4 Collaborative Inventory Planning

Replenishment programs are designed to streamline the flow of goods within the distribution channel. There are several specific techniques for collaborative replenishment, all of which build on the common denominator of rapidly replenishing inventory according to actual sales experience. The intent is to reduce reliance on forecasting when and where inventory will need to be positioned to meet consumer or end-user demand and instead allow suppliers to respond to demand on a just-in-time basis. Effective collaborative replenishment programs require extensive cooperation and information sharing among distribution channel participants. Specific techniques for automatic replenishment include quick response, continuous replenishment, vendor managed inventory, and profile replenishment.

### 7.5.5 Adaptive Logic

A combined inventory management system may be used to overcome some of the problems inherent in using either a reactive or a planning method. The factors that might make a reactive system better in one situation may change over time to favour the use of an inventory planning

Notes

system. Thus, the ideal approach is an adaptive inventory management system that incorporates elements of both types of logic and allows different strategies to be used with specific customer or product segments. The rationale for an adaptive system is that customer demand must usually be treated as independent; however, there are some supply chain collaborations where demand can be treated as dependent. Thus, at some locations and time within the supply chain, an interface exists between independent and dependent demand. The closer that interface is to the final customer, the lower the amount of overall system inventory since dependent demand environments reduces system demand uncertainty.



*Example:* A major consumer promotion might cause demand even at the consumer level to behave like dependent demand since a major demand spike can be anticipated through knowledge of the promotion schedule.

### Self Assessment

Fill in the blanks:

13. …… management is the process that implements inventory policy.
14. Inventory control is the …… procedure for implementing an inventory policy.
15. …… is driven by a production schedule that is defined and controlled by management policy.

## 7.6 Inventory Management Practices

An integrated inventory management strategy defines the policies and process used to determine where to place inventory, when to initiate replenishment shipments, and how much to allocate. The strategy development process employs three steps to classify products and markets, define segment strategies, and operationalise policies and parameters.

### 7.6.1 Product/Market Classification

The objective of product market classification is to focus and refine inventory management efforts. Product/market classification, which is also called fine-line or ABC classification, groups products, markets, or customers with similar characteristics to facilitate inventory management. The classification process recognizes that not all products and markets have the same characteristics or degree of importance. Sound inventory management requires that classification be consistent with enterprise strategy and service objectives.

Classification can be based on a variety of measures. The most common are sales profit contribution, inventory value, usage rate, and nature of the item. The typical classification process sequences products or markets so that entries with similar characteristics are grouped together. The products are classified in descending order by sales volume so that the high volume products are listed first, followed by slower movers. Classification by sales volume is one of the oldest methods used to establish selective policies or strategies. For most marketing or logistics applications, a small percentage of the entities account for a large percentage of the volume. This operationalisation is often called the 80/20 rule or Pareto's law. The 80/20 rule, which is based on widespread observations, states that for a typical enterprise 80 percent of the sales volume is typically accounted for by 20 percent of the products. A corollary to the rule is that 80 percent of enterprise sales are accounted for by 20 percent of the customers. The reverse perspective of the rule would state that the remaining 20 percent of sales are obtained from 80 percent of the products, customers, etc. In general terms, the 80/20 rule implies that a majority of sales results from a relatively few products or customers.

Notes

Once items are classified or grouped, it is common to label each category with a character or description. High-volume, fast-moving products are often described as "A" items. The moderate volume items are termed the "B" items, and the low-volume or slow movers are known as "Cs." These character labels indicate why this process is often termed ABC analysis. While fine-line classification often uses three categories, some firms use four or five categories to further refine classifications. Grouping of similar products facilitates management efforts to establish focused inventory strategies for specific product segments.



*Example:* High-volume or fast-moving products are typically targeted for higher service levels. This often requires that fast-moving items have relatively more safety stock.

Conversely, to reduce overall inventory levels, slower-moving items may be allowed relatively less safety stock, resulting in lower service levels.

### 7.6.2 Segment Strategy Definition

The second step is to define the integrated inventory strategy for each product/market group or segment. The integrated strategy includes specification for all aspects of the inventory management process including service objectives, forecasting method, management technique, and review cycle.

The key to establishing selective management strategies is the realization that product segments have different degrees of importance with respect to achieving the enterprise mission.



*Caution* Important differences in inventory responsiveness should be designed into the policies and procedures used for inventory management.

### 7.6.3 Operationalise Policies and Parameters

The final step in implementing a focused inventory management strategy is to define detailed procedures and parameters. The procedures define data requirements, software applications, performance objectives, and decision guidelines. The parameters delineate values such as review period length, service objectives, inventory carrying cost percentage, order quantities, and reorder points. The combination of parameters either determines or can be used to calculate the precise quantities necessary to make inventory management decisions. Once the procedures and parameters have been implemented, the environment and performance characteristics must be monitored on a regular basis. Ongoing monitoring is necessary to ensure that the inventory management system is meeting desired objectives and that the customer and product environment does not change substantially.



*Example:* As demand increases for a specific product, inventory process monitoring should recognize the need and perhaps suggest a shift from a reactive to an inventory planning system.

### Self Assessment

State whether the following statements are true or false:

16. The strategy development process employs five steps to classify products and markets.
17. Classification can be based on a variety of measures.
18. Ongoing monitoring is necessary to ensure that the inventory management system is meeting desired objectives.

Notes



*Case Study*

## TATA Motors CVBU

TATA Motors Commercial Vehicle Business Unit enhances balanced scorecard with COVENARK® Strategist.

Tata Motors is the largest and most prominent market leader in the manufacture of commercial business vehicles in India. In the year 2000, its Commercial Vehicles Business Unit (CVBU) suffered its first loss in its more than fifty years history. This loss was massive. It was in the tune of $ 108.62 Million. This prompted Tata Motors to take a profound look into itself; to find reason in this debacle.

Subsequently, the executive director of CBVU, Mr. Ravi Kant, called for stringent cost cutting across unit operations, supported by more effective formulation and execution of strategy. To augment this process, the management of Tata Motors resolved to adopt the Balanced Scorecard and Performance Framework as the key tool in the endeavour to rebuild the Organisational Performance Chart. The challenge here was to undertake deployment of the Balanced Scorecard across all the functional units and departments of the CBVU.

Soon, however, with the process underway, the real problem revealed itself. It turned out that the manual nature of the review procedures of such a huge structure was well neigh impossible, being, at best, extremely difficult to implement and incredibly time consuming. A watertight solution was needed; quickly. After further examination of the situation, a decision was taken to implement a Balanced Scorecard Automation Tool that would centralise, integrate and collate the data, providing rapid review and analytical functionality and presenting a rapid and comprehensive one view picture of organisational performance.

Commencing this process, the CVBU management reviewed many solution providers and evaluated each of them upon the basis of a variety of diverse factors. At the end of this exhaustive process, a solution was decided in the form of COVENARK® Strategist, a prominent Balanced Score Card Automation Tool developed by MPOWER Information Systems to integrate with the existing ERP and legacy systems with the help of data integration suite.

The results were immediate and spectacular. Within two years of this, CVBU had turned over to register a profit of $ 107 Million from the loss of $ 108.62 Million, accounting for a whopping 60% of TATA Motors inventory turnover. The success path of Balanced Score Card did not stop here. In the beginning CVBU has started the Balanced Scorecard with only Corporate Level Scorecard; at this time they have expanded it to six Hierarchical Levels with three hundred and thirty one Scorecards, additionally looking forward to proliferate it to the lowest level of organisational structure. In this way, MPOWER, through COVENARK® Strategist played a vital role in the success story of TATA Motors CVBU.

**Question**

Analyse the case and write down the case facts.

***Source:*** www.mpower.com

## 7.7 Summary

- The ideal inventory process consists of manufacturing a product to a customer's specifications once an order is placed.

Notes

- Decoupling processes permit each product to be manufactured and distributed in economical lot sizes that are greater than market demands.
- The safety stock or buffer stock function concerns short-range variation in either demand or replenishment.
- Safety stock protects against two types of uncertainty.
- Inventory is the major source of cost in the supply chain and also the basis for improving customer service and enhancing customer satisfaction.
- Average inventory is defined as half the batch size plus safety stock.
- One major component of cost associated with inventory is the cost of replenishing it.
- Ordering costs are incurred in the purchase cycle, while set-up costs are incurred in the manufacturing cycle.
- The reorder point determines when a re-supply shipment should be initiated.
- Global optimization is made even more difficult because supply chains need to be designed for, and operated in, uncertain environments, thus creating sometimes enormous risks to the organization.
- Business owners and managers focus on this activity because inventory typically represents the second largest expenditure in a company behind payroll.
- An integrated inventory management strategy defines the policies and process used to determine where to place inventory, when to initiate replenishment shipments, and how much to allocate.

## 7.8 Keywords

***Average Inventory:*** It is defined as half the batch size plus safety stock.

***Decoupling Processes:*** It permit each product to be manufactured and distributed in economical lot sizes that are greater than market demands.

***Economic Order Quantity (EOQ):*** It is the replenishment order quantity that minimizes the combined cost of inventory maintenance and ordering.

***Excess Inventory:*** It is a cost burden to industry in terms of capital tied up, the cost of obsolescence and the cost of servicing product in the supply chain.

***Inventory Costs:*** Costs associated with the maintenance of inventory.

***Inventory Management:*** It is the process that implements inventory policy.

***Inventory Ordering Costs:*** These are those costs that are incurred in the purchase cycle are called procurement costs or inventory ordering costs.

***Inventory:*** Stocking of raw materials, in-process, finished, packaging, tools and equipments, spares and others in order to meet an expected demand or distribution in future.

***Ordering Costs:*** These are incurred in the purchase cycle, while set-up costs are incurred in the manufacturing cycle.

***Period Order Quantity (POQ):*** A term used when ordering raw materials or supplies in lots based on the quantity that will be used over a given time period or series of periods.

***Production Lot Size:*** It refers to the most economical quantities from a manufacturing perspective.

Notes

***Safety Stock:*** The safety stock or buffer stock function concerns short-range variation in either demand or replenishment.

***Stock-out Costs:*** Revenue lost because a lack of inventory results in a firm being unable to fill all of its customer orders.

## 7.9 Review Questions

1. Define Decoupling.
2. What is Buffer Uncertainties?
3. Explain the Cost of Inventory with time.
4. Discuss Total Inventory Costs.
5. What is Holding (or Carrying) Costs?
6. Distinguish between Fixed and Variable Ordering Costs.
7. Do you agree with the statement that ordering costs are incurred in the purchase cycle? If yes, give reason.
8. Write brief note on Planning Inventory.
9. Highlight the factors that contribute to manage uncertainty.
10. Throw some light on Inventory Management Policies.

### Answers: Self Assessment

| | | | |
|---|---|---|---|
| 1. | Geographical separation | 2. | Decoupling |
| 3. | Safety Stock or Buffer Stock | 4. | True |
| 5. | False | 6. | True |
| 7. | Reorder Point | 8. | Economic Order Quantity (EOQ) |
| 9. | Period Order Quantity (POQ) | 10. | True |
| 11. | False | 12. | False |
| 13. | Inventory | 14. | Managerial |
| 15. | MRP | 16. | False |
| 17. | True | 18. | True |

## 7.10 Further Readings



*Books*

Douglas M. Lambert, James R. Stock and Lisa M. Ellram, "*Fundamentals of Logistics Management,*" McGRAW-Hill International Editions

Vinod V. Sople, "*Logistics Management – The Supply Chain Imperative,*" Pearson Education

H. Kaushal, "*Case Study Solutions – Materials Management,*" Macmillan India Ltd.

**Notes**

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Tompkins, J.A. and D.A. Harmelink (Editors), "*The Distribution Management Handbook,*" McGraw Hill, 1993

Donald Waters, "*Logistics-An Introduction to SCM*," Palgrave, 2003

Bowersox, D.J. and D.J. Closs, "*Logistical Management: The Integrated Supply Chain Process,*" McGraw Hill, 1996



*Online links*

http://www.barcodesinc.com/articles/what-is-inventory-management.htm

http://www.managementstudyguide.com/inventory-management.htm

http://scm.ncsu.edu/scm-articles/scm-inventory-management

http://www.regentsurgicalhealth.com/assets/root/Document%20Attachments/Presentations/Supply%20Chain%20Mangement%20and%20Inventory%20Control.pdf

# Unit 8: Transportation

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## Objectives

After studying this unit, you will be able to:

- Understand the Transportation Infrastructure
- Discuss the Transport Functionality & Principles
- Explain the Participants

Notes

- Describe the Regulations in Transportation
- Understand the Transport Structure
- Discuss the Transport Service
- Explain the Transportation Administration and Documentation

## Introduction

The transportation system is the physical link connecting a company with the customers, raw material suppliers, plants, ware houses and distribution channel members. It's interesting to note that all these elements of logistic system are fixed points, transportation is the connecting medium. The better is the performance and efficiency of transportation system the better will be organisational performance in terms of cost and customer's satisfaction. Knowledge of logistics and transportation is fundamental to the operations of any business. Transportation adds value to the goods by providing time and place utility, by ensuring availability of items when they are needed, and where they are needed. For most companies there is a geographical spread between the source and market of goods produced because of economies of scale and mass production, specialization of labour, infrastructural facilities, etc. Transportation is the connecting link.

In any organisation involved in manufacturing or production of goods and services, management of logistics assumes significance. Appropriate planning, implementing and controlling the flow of goods, its storage and the effectiveness with which several activities follow, from the point of origin, to the point of consumption, occupies a significant place in modern business. The function of logistics includes sourcing, procurement, production planning, scheduling, packaging, assembly and customer services. Each one of these activities is very important. The developments in the field of transportation and communication are resulting in emergence of global supply chains and logistics processes. Technology is also having impact on logistics management.

## 8.1 Transportation Infrastructure

Transportation infrastructure can broadly be classified as hardware and software. Hardware consists of physical assets that comprise terminals, storage facilities, right of way for movement and vehicles/equipment. Software, which is essentially the service superstructure, consists primarily of maintenance, operations and value added services.

The nature of the infrastructure also determines a variety of economic and legal characteristics for each mode or inter-modal (multimodal) system. A mode identifies the basic transportation method or form. Bulk goods are typically transported in large shipment sizes. Therefore, dedicated vehicles and specialized modes of transport and handling are important. Industrial goods have high value and are often critical. Therefore, there is a need for speedier transport of goods. The selection of the mode of transportation is based on these criteria.

Transportation infrastructure consists of the rights-of-way, vehicles, and carrier organizations that offer transportation services on a for-hire or internal basis. The nature of the infrastructure also determines a variety of economic and legal characteristics for each mode or multimodal system. A mode identifies the basic transportation method or form.

### 8.1.1 Modal Characteristics

The five basic transportation modes are rail, highway, water, pipeline, and air. The relative importance of each mode can be measured in terms of system mileage, traffic volume, revenue, and the nature of traffic composition. Each mode is discussed with respect to these measures.

Notes

## Rail Network

Historically, railroads have handled the largest number of ton-miles continental. As a result of the early establishment of a comprehensive rail network connecting almost all cities and towns, railroads dominated intercity freight tonnage until after World War II. This early superiority resulted from the capability to transport large shipments economically and to offer frequent service, which gave railroads a somewhat monopolistic position. However, with the advent of serious motor carrier competition following World War II, the railroads' share of revenues and ton-miles started to decline.

The capability to efficiently transport large tonnage over long distances is the main reason railroads continue to handle significant intercity tonnage and revenue. Railroad operations incur high fixed costs because of expensive equipment, right of way (railroads must maintain their own track), switching yards, and terminals. However, rail experiences relatively low variable operating costs. The replacement of steam by diesel power reduced the railroads' variable cost per ton-mile, and electrification offers potential for more reductions.



*Did u know?* New labour agreements have reduced workforce requirements, further decreasing variable costs.

## Motor Carriers

Highway transportation has expanded rapidly since the end of World War II. To a significant degree the rapid growth of the motor carrier industry results from door-to-door operating flexibility and speed of intercity movement.

Motor carriers have flexibility because they are able to operate on all types of roadways. In comparison to railroads, motor carriers have relatively small fixed investments in terminal facilities and operate on publicly maintained highways. Although the cost of license fees, user fees and tolls is considerable, these expenses are directly related to the number of over-the-road units and miles operated. The variable cost per mile for motor carriers is high because a separate power unit and driver are required for each trailer or combination of tandem trailers. Labour requirements are also high because of driver safety restrictions and the need for substantial dock labour.



*Notes* In comparison to railroads, motor carriers are best suited to handle small shipments moving short distances.

The characteristics of motor carriers favour manufacturing and distributive trades, short distances, and high-value products. Motor carriers have made significant inroads into rail traffic for medium and light manufacturing. Because of flexibility of delivery, they have captured almost all freight moving from wholesalers or warehouses to retail stores. The prospect for maintaining stable market share in highway transport remains bright.

The primary difficulties relate to increasing cost to replace equipment, maintenance, driver wages, and platform and dock wages. Although accelerating labour rates influence all modes of transport, motor carriers are more labour-intensive, which causes higher wages to be a major concern. To counteract this trend, carriers have placed considerable attention on improved line-haul scheduling that bypasses terminals, computerized billing systems, mechanized terminals, tandem operations that pull two or three trailers by a single power unit, and utilization of coordinated intermodal systems. These enhancements reduce labour intensity and, thus cost.

Notes

Specialty carriers include package haulers such as Federal Express and United Parcel Service. These firms focus on specific requirements of a market or product. Despite the aforementioned problems, it is quite apparent that highway transportation will continue to function as the backbone of logistical operations for the foreseeable future.

### Water Transport

Water is the oldest mode of transportation. The original sailing vessels were replaced by steamboats in the early 1800s and by diesel power in the 1920s. A distinction is generally made between deep-water and navigable inland water transport.

The main advantage of water transportation is the capacity to move extremely large shipments. Water transport employs two types of vessels. Deep-water vessels, which are generally designed for ocean and great lakes use, are restricted to deep-water ports for access. In contrast, diesel-towed barges, which generally operate on rivers and canals, have considerably more flexibility.

Water transport ranks between rail and motor carrier in respect to fixed cost. Although water carriers must develop and operate their own terminals, the right-of-way is developed and maintained by the government and results in moderate fixed costs compared to rail and highway.



*Notes* The main disadvantages of water transport are the limited range of operation and speed. Unless the origin and destination of the movement are adjacent to a waterway, supplemental haul by rail or truck is required.

The capability of water to carry large tonnage at low variable cost places this mode of transport in demand when low freight rates are desired and speed of transit is a secondary consideration.

Typical inland water freight includes mining and basic bulk commodities such as chemicals, cement, and selected agricultural products. In addition to the restrictions of navigable waterways, terminal facilities for bulk and dry cargo storage and load-unload devices limit the flexibility of water transport. Labour restrictions on loading and unloading at docks create operational problems and tend to reduce the potential range of available traffic. Finally, a highly competitive situation has developed between railroads and inland water carriers in areas where parallel routes exist.

### Pipelines

It operates on a twenty-four-hour basis, seven days per week, and is limited only by commodity changeover and maintenance. Unlike other modes, there is no empty "container" or "vehicle" that must be returned. Pipelines have the highest fixed cost and lowest variable cost among transport modes. High fixed costs result from the right-of-way, construction and requirements for control stations, and pumping capacity. Since pipelines are not labour-intensive, the variable operating cost is extremely low once the pipeline has been constructed. An obvious disadvantage is that pipelines are not flexible and are limited with respect to commodities that can be transported: only products in the form of gas, liquid, or slurry can be handled.

### Air Transport

The newest but least utilized mode of transport is air freight. Its significant advantage lies in the speed with which a shipment can be transported. A coast-to-coast shipment via air requires only a few hours contrasted to days with other modes of transportation. One prohibitive aspect of air

Notes

transport is the high cost. However, this can be traded off for high speed, which allows other elements of logistical design, such as warehousing or inventory, to be reduced or eliminated.

Air transport still remains more of a potential opportunity than a reality. Although the mileage is almost unlimited, airfreight accounts for significantly less than 1 percent of all intercity ton-miles. Air transport capability is limited by lift capacity (i.e., load size constraints) and aircraft availability. Traditionally, most intercity airfreight utilized scheduled passenger flights. While this practice was economical, it resulted in a reduction of both capacity and flexibility.



*Caution* The high cost of jet aircraft, coupled with the erratic nature of freight demand, has limited the assignment of dedicated planes to all-freight operations.

However, premium air carriers such as Federal Express and United Parcel Service Overnight provide dedicated global freight operation. While this premium service was originally targeted at documents. It has expanded to include larger parcels.

For example, both United Parcel and Federal Express have extended their air freight service to include overnight delivery from a centralized distribution centre located at their air hub. This is an ideal service for firms with a large number of high-value products and time-sensitive service requirements.

The fixed cost of air transport is low compared to rail, water, and pipeline. In fact, air transport ranks second only to highways with respect to low fixed cost. Airways and airports are generally developed and maintained with public funds. Likewise, terminals are normally maintained by local communities. The fixed costs of airfreight are associated with aircraft purchase and the requirement for specialized handling systems and cargo containers. On the other hand, air freight variable cost is extremely high as a result of fuel, maintenance, and the labour intensity of both in-flight and ground crews.

**Table 8.1: Modal Comparison and Dominant Traffic Composition**

| Mode | Nature of Traffic Composition |
|---|---|
| Rail | Extracting industries, Heavy manufacturing, Agricultural commodities |
| Highway | Medium and light manufacturing, Distribution between wholesalers and retailers |
| Water | Mining and basic bulk commodities, Chemicals, Cement, Some agricultural products |
| Pipeline | Petroleum, Coal slurry, No particular commodity |
| Air | Emergency rather than regular basis |

***Source:*** Upendra Kachru, (2010), "Exploring the Supply Chain," Excel Books



*Caselet*

## Systemic Approach to a Better Transport System

The Theory of Constraints (TOC) is a business philosophy invented by Israeli physicist and management specialist Dr Eliyahu Goldratt in the 1980s. The theory is all about striving to achieve the global objective or the "goal" of any system by understanding and analysing the cause and effect relationships between the parts of the system and the variations within it.

TOC advocates balancing the flow of a system instead of balancing the capacity. Though a radical shift from the past, it worked so well that it became very popular. The same is the

*Contd...*

**Notes**

case with the Just-in-Time (JIT) approaches invented in the 1950s and statistical process control that dates back to the 1920s. All these techniques are still with us primarily because they are systemic.

Systemic approaches are concerned with the system as a whole rather than parts of the system in isolation. Though most of these approaches mainly evolved out of the manufacturing domain, they have also found broader applicability in marketing, sales, finance, strategy, and project management.

However, it is unfortunate that our policy makers and administrators are yet to learn and apply the thinking behind these techniques.

**Transportation Woes**

Take, for instance, the traffic congestions on our city roads. These congestions are at their worst at intersections. To address this, our administrators build flyovers. Anyone with a basic understanding of the operations theory will know that any system will have bottlenecks and these cannot be removed completely.

Adding capacity, at best, only shifts the bottleneck from one point to another. So, a flyover may ease the congestion at a particular point but the bottleneck will only shift to another point in the system. But then, our administrators probably know this.

So how do they propose to address this issue? This issue can be addressed by building elevated expressways for several kilometres, costing hundreds of crores. All this is in the name of infrastructure building and development agenda.

Perhaps building under-passages at some of these intersections would achieve the same for a fraction of the cost. There are, probably, other better ways to address the road congestions. This is not an argument against building flyovers or elevated expressways. It is about lack of systemic thinking among our policy makers and administrators.

Flyovers and elevated expressways are essential for infrastructure development and nation building provided they are part of the larger and well thought through strategy or agenda that aims at global system optimisation – in this case, easing traffic congestions on city roads and ensuring free flow of traffic. By addressing parts of the system in isolation, we may achieve local optimisation, but not overall system optimisation, which is the goal.

Today in large metropolitan cities, the mode share for motorised, non-public transportation systems such as cars, two-wheelers, autos, taxis etc. is about 34 per cent, while the mode share for public transportation systems is about 66 per cent. This is expected to change by 2031 to 64 per cent and 36 per cent respectively.

The national average for public transport is about 26 per cent and this is expected to come down to 14 per cent by 2031, while the share for private vehicles and other intermediate modes of transportation, such as autos and taxis, is expected to increase from 74 per cent to 86 per cent in the same period.

In today's consumption driven economy, it is unlikely that any Government will adopt policies that will discourage private ownership of vehicles in which case the vehicular congestion on our roads will only worsen.

The expected average journey speed in the major metropolitan cities that is about 17 kmph now is progressively expected to fall to six kmph by 2031 if the public transportation systems are not augmented.

*Contd...*

Notes

**Integrated Approach**

Part of the problem lies in the fact that there is no integrated approach to problem solving among our policy makers and administrators. As a result, problems are addressed in parts or in isolation from the entire system typically by building flyovers, cutting trees and widening roads, shrinking round-abouts and so on.

What is required is the systemic approach to solve the transportation problems. Major cities and towns must constitute an integrated transport authority that works in a co-ordinated manner with the respective city and town development authorities to address their land use developmental needs as well as transportation needs. These bodies must be staffed and operated with professionals in their respective fields and not political appointees.

The National Urban Transport Policy mentions a Unified Metropolitan Development Authority, but recommends constituting such a body only for cities with million-plus populations, with no guidance or suggestions on how it can be constituted. Even Tier-II cities must be mandated to constitute such a body and formulate policies that can take care of their transportation needs. Strengthening transportation infrastructures in Tier-II cities will encourage industries to look at such cities for expansion and new investments.

This would slow down the migration towards large metropolitan cities and relieve them of congestion. The long-term solution to easing traffic congestion also lies in augmenting and strengthening our public transportation systems.

Today there is a great deal of debate about the suitability of transportation systems such as monorail and sky-bus for Indian cities. By and large, the thinking seems to be in favour of a Mass Rapid Transport System (MRTS) such as a metro rail. Perhaps systems like mono-rail or sky-bus systems can co-exist with MRTS and facilitate last mile connectivity.

From this perspective, it is no longer an either-or but a combination of all types of transport systems carefully planned, designed, built and operated with the larger objective of easing traffic congestion on the city roads. What is required today is a "systemic" thinking to "systematically" address the transportation needs of the country – both urban and rural.

***Source:*** www.thehindubusinessline.com

## Self Assessment

Fill in the blanks:

1. …… is the oldest mode of transportation.
2. Highway transportation has expanded rapidly since the end of ……
3. The …… cost of air transport is low compared to rail, water, and pipeline.

## 8.2 Transport Functionality & Principles

Transportation functionality provides two major functions:

1. ***Product Movement:*** Whether the product is in the form of materials, components, assemblies, work in process, or finished goods, transportation is necessary to move it to the next stage of the manufacturing process or physically closer to the ultimate customer. A primary transportation function is product movement up and down the value chain. Transportation utilizes temporal, financial, and environmental resources, it is important that items be moved only when it truly enhances product value.

Notes



*Did u know?* The major objective of transportation is to move product from an origin location to a prescribed destination while minimizing temporal, financial, and environmental resource costs. Loss and damage expenses must also be minimized. At the same time, the movement must take place in a manner that meets customer demands regarding delivery performance and shipment information availability.

2. ***Product Storage:*** A less common transportation function is temporary storage. Vehicles make rather expensive storage facilities. However, if the in-transit product requires storage but will be moved again shortly (e.g., in a few days), the cost of unloading and reloading the product in a warehouse may exceed. A second method to achieve temporary product storage is diversion. This occurs when an original shipment destination is changed while the delivery is in transit. Traditionally, the telephone was used to direct diversion strategies. Today, satellite communication between enterprise headquarters and vehicles more efficiently handles the information.

In summary, although product storage in transportation vehicles can be costly, it may be justified from a total-cost or performance perspective when loading or unloading costs, capacity constraints, or the ability to extend lead times are considered.

### 8.2.1 Principles

There are two fundamental principles guiding transportation management and operations. They are economy of scale and economy of distance.

#### Economy of Scale

It refers to the characteristic that transportation cost per unit of weight decreases when the size of the shipment increases.



*Example:* Truckload (TL) shipments (i.e., shipments that utilize the entire vehicle's capacity) cost less per pound than less-than Truckload (LTT) shipments (i.e., shipments that utilize a portion of vehicle capacity).

It is also generally true that larger capacity transportation vehicles such as rail or water are less expensive per unit of weight than smaller capacity vehicles such as motor or air. Transportation economies of scale exist because fixed expenses associated with moving a load can be spread over the load's weight. As such, a heavier load allows costs to be "spread out," thereby decreasing costs per unit of weight. The fixed expenses include administrative costs of taking the transportation order, time to position the vehicle for loading or unloading, invoicing, and equipment cost. These costs are considered fixed because they do not vary with shipment volume.

#### Economy of Distance

It refers to the characteristic that transportation cost per unit of distance decreases as distance increases.

Notes

*Example:* A shipment of 800 miles will cost less than two shipments (of the same combined weight) of 400 miles.

Transportation economy of distance is also referred to as the tapering principle since rates or charges taper with distance. The rationale for distance economies is similar to that for economies of scale. Specifically, the relatively fixed expense incurred to load and unload the vehicle must be spread over the variable expense per unit of distance. Longer distances allow the fixed expense to be spread over more miles, resulting in lower overall per mile charges.

These principles are important considerations when evaluating alternative transportation strategies or operating practices. The objective is to maximize the size of the load and the distance that it is shipped while still meeting customer service expectations.

### Self Assessment

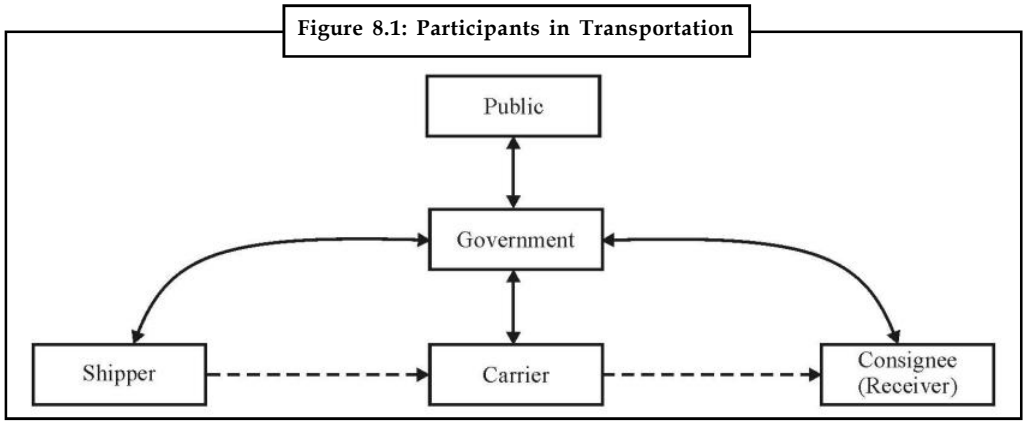
State whether the following statements are true or false:

4. A less common transportation function is a permanent storage.
5. Economy of Distance refers to the characteristic that transportation cost per unit of distance decreases as distance increases.
6. Shorter distances allow the fixed expense to be spread over more miles, resulting in lower overall per mile charges.

## 8.3 Participants

Transport transactions are often influenced by five parties: the shipper (the original party), the consignee (destination party or receiver), the carrier, the government, and the public.

**Figure 8.1: Participants in Transportation**




***Source:*** Upendra Kachru, (2010), "Exploring the Supply Chain," Excel Books

### 8.3.1 Relationship between the Shipper, the Consignee and the Public

Figure 8.1 illustrates the relationship between these parties. They may be related by ownership in some situations, such as when company-owned vehicles are used to transport goods between two company locations. In many cases, however, the parties are independently owned and operated. In order to understand the complexity of the transportation environment, it is necessary to review the role and perspective of each party.

Notes

### Shippers and Consignees

The shipper and consignee have the common objective of moving goods from origin to destination within a prescribed time at the lowest cost. Services include specified pickup and delivery times, predictable transit time, zero loss and damage, as well as accurate and timely exchange of information and invoicing.

### Carriers

The carrier, as the intermediary, takes a somewhat different perspective. Carriers desire to maximize their revenue associated with the transaction while minimizing the costs necessary to complete the transaction. The perspective suggests that a carrier wants to charge the highest rate that the shipper (or consignee) will accept and minimize the labour, fuel, and vehicle costs required to move the goods. To achieve this objective, the carrier desires flexibility in pickup and delivery times to allow individual loads to be consolidated into economic moves.

### Government

The government maintains a high interest level in the transaction because of transportation's impact on the economy. Government desires a stable and efficient transportation environment to sustain economic growth. Transportation enables the efficient movement of products to markets throughout the country and thus promotes product availability at a reasonable cost. The situation in the Soviet Union prior to its break-up demonstrates the impact of an inadequate transportation system. Although not he only reason, the transportation system was a contributing factor in the Soviet economy's inability to supply food to the market even though adequate production existed.

A stable and efficient commercial economy requires that carriers offer competitive services while operating profitably. Many governments are more involved with carrier activities and practices than with other commercial enterprises. Involvement may take the form of regulation, promotion, or ownership. Governments regulate carriers by restricting the markets they can service or by setting the prices they can charge. Governments promote carriers by supporting research and development or by providing rights-of-way such as roadways or air traffic control systems. In countries like the United Kingdom or Germany, some carriers are owned by the government, which maintains absolute control over markets, services, and rates. Such control allows government to have a major influence on the economic success of regions, industries, or firms.

### Public

The final participant, the public, is concerned with transportation accessibility, expense, and effectiveness, as well as environmental and safety standards. The public ultimately determines the need for transportation by demanding goods from around the world at reasonable prices. While minimizing transportation cost is important to consumers, trade-offs associated with environmental and safety standards also require consideration. The effects of air pollution and oil spills remain a significant transportation issue even though there have been tremendous strides in pollution reduction and consumer safety during the past two decades. The cost of reducing the risk of environmental or vehicle accidents is passed on to consumers, who must collectively judge how much safety is necessary.

The transportation relationship is complex because of the interaction between the parties. This leads to frequent conflicts between parties with micro interest shippers, consignees, and carriers – as well as parties with a macro interest – government and the public. These conflicts have led to duplication, regulation, and restrictions of transportation services.

Notes

### 8.3.2 Transport Infrastructure

Transportation infrastructure consists of the rights-of-way, vehicles, and carrier organizations that offer transportation services on a for-hire or internal basis. The nature of the infrastructure also determines a variety of economic and legal characteristics for each mode or multimodal system. A mode identifies the basic transportation method or form.

### Self Assessment

Fill in the blanks:

7. Transport transactions are often influenced by …… parties.
8. …… desire to maximize their revenue associated with the transaction while minimizing the costs necessary to complete the transaction.
9. The …… maintains a high interest level in the transaction because of transportation's impact on the economy.

## 8.4 Regulations in Transportation

Various documents are prepared and submitted for smooth movement of goods from one country to another country. In this unit, you will learn about various perspectives, kinds and functions of export – import documents. You will also learn about the documents needed for fulfilling the commercial obligations of an exporter and importer and various legal and other documents involved in export – import trade. Since transportation has a major impact on both domestic and international commerce, government has historically taken special interest in both controlling and promoting transportation. Control takes the form of federal and state government regulation as well as a wide range of administration and judicial administration. With the passage of the Act to Regulate Interstate Commerce on February 4, 1887, the federal government became active in protecting the public interest with respect to performance and provision of transportation services.

### 8.4.1 Types of Regulation

Government transportation regulation can be grouped into two categories: economic regulation and safety and social regulation. Regulatory initiatives have historically focused on economic issues; however, recent regulatory initiatives have increasingly been directed toward safety and social issues.

#### Economic Regulation

Regulation of business practices is the oldest form of government control. To provide dependable transportation service and to foster economic development, both federal and state governments have actively engaged in economic regulation. For over 100 years, government regulation sought to make transportation equally accessible and economical to all without any discrimination. Regulatory policy has attempted to foster competition among privately owned transportation companies. To encourage economical and widespread transportation supply, government invested in public infrastructure such as highways, airports, waterways, and deep water ports. However, to actually provide transportation service, the government supported and regulated a system of privately owned for-hire carriers.

Notes

### Safety and Social Regulation

In direct contrast to reduced transportation regulation, another trend in the 1970s and 1980s was expanded safety and social regulation. Since its inception in 1966, the federal Department of Transportation (DOT) has taken an active role in controlling the transport and handling of hazardous material and rules related to maximum driver hours and safety. The form of regulation was institutionalized by the passage of the Transportation Safety Act of 1974, which formally established safety and social regulation as a governmental initiative. Substantial legislation impacting logistical performance was passed during the next three decades. The Hazardous Materials Transportation Uniform Safety Act of 1990, which provided federal government control over equipment design, hazardous material classification, packaging, and handling, took precedence over state and local environmental regulations. Additional emphasis on transportation safety has increased due to environmental and related liability lawsuits.

## 8.4.2 Rationale for Documentation

Export documentation is commonly considered to be the most complex and difficult part of overseas marketing. You may have come across such comments as such comments tend to discourage people from entering into export business. It is therefore, necessary to emphasize that documentation is as much of an important activity as the conclusion of an export order and its fulfilment.

Why is documentation needed in export business? The answer to this question lies in the nature of the business relations between the exporter and the importer, who are operating from two countries. If one is doing domestic business, one knows or can easily know the commercial practices, which bind the buyer and the seller. Similarly, the possibility of business disputes is reduced since both the buyer and the seller know or can easily know laws governing contracts. However, when the buyer and the seller are operating in two countries, the commercial practices and legal systems are different. Thus, for ensuring that the respective interests of the buyer and the seller are protected, certain documentary formalities become essential.

Similarly, every country has its own laws governing imports and exports. Consequently, the exporter has to comply with laws in his country through documentary formalities. At the same time, he has to send some documents to the importer, which will enable him to take possession of the goods after getting permission from the concerned government department (i.e. the customs authorities). There is yet another reason for documentation in export trade. Such documentation is linked with the claim of export incentives given by almost all countries world over. Since most of these incentives are to be claimed after shipment, the exporter has to give documentary proof of the fact of shipment.

Documentation formalities are necessary to enable the importer to get the contracted goods and the exporter to get sale value as well as to secure export incentives. In other words, export documents are needed to comply with commercial, legal and incentive requirements.

### 8.4.3 Standardized Document

The standard documents are the

1. Invoice (Commercial Invoice, Proforma Invoice)
2. Packing list
3. Certificate of Origin
4. Bill of Lading

Notes

5. Shipping Order
6. Mate's Receipt
7. Shipping Bill
8. Port Trust Document
9. Marine Insurance
10. Declaration Form
11. Marine Insurance Certificate
12. Airway Bill
13. Post Parcel Receipt
14. Bill of Exchange
15. Bill of Entry

Each of these documents can be reproduced from the same master by using the relevant mask. Reproduced signatures on individual documents may in deep present some problem. Until an agreement is reached among all concerned as to their acceptability it would be necessary to mask the signature column also on the master and to sign the individual documents manually. Besides, as all the copies of the reproduced documents, particularly where the spirit duplicator is used, will have the same impression, it will be difficult to distinguish the original from the copies of the document. This is however, not a serious problem and can be solved by a universal understanding that unless 'Copy' is marked, the document will be treated as original. It is no doubt convenient to give the dates on the documents in the numeric way. In doing so, however, the exporter should ensure that such dates would be interpreted abroad in the same way as they interpret them.



*Notes* To avoid ambiguity, it would be better to express the date of the month in two figures, followed by the name of the month in three letters and the year in four figures.

### Self Assessment

State whether the following statements are true or false:

10. Government transportation regulation can be grouped into four categories.
11. Regulation of business practices is the oldest form of government control.
12. Import documentation is commonly considered to be the most complex and difficult part of overseas marketing.

## 8.5 Transport Structure

The freight transportation structure consists of the rights-of-way, vehicles, and carriers that operate within five basic transportation modes. A mode identifies a basic transportation method or form. The five basic transportation modes are rail, highway, water, pipeline, and air. The relative importance of each transportation mode in the United States is measured in terms of system mileage, traffic volume, revenue, and nature of freight transported.

Notes

Historically, railroads have handled the largest number of ton-miles within the continental United States. A ton-mile is a standard measure of freight activity that combines weight and distance. As a result of early development of a comprehensive rail network connecting almost all cities and towns, railroads dominated intercity freight tonnage until after World War II. This early superiority resulted from the capability to transport large shipments economically and to offer frequent service, which gave railroads a somewhat monopolistic position. However, with the advent of serious motor carrier competition following World War II, the railroads' share of revenues and tonmiles declined. Railroads once ranked first among all modes in terms of the number of miles in service. The extensive development of roads and highways to support the growth of automobiles and trucks after World War II altered this ranking. In 1970 there were 206,265 miles of rail track in the United States. By 1998, track mileage had declined to 128,730 miles due to significant abandonment. Over the last few years, track mileage has stabilized.

The capability to efficiently transport large tonnage over long distances is the main reason railroads continue to handle significant intercity tonnage. Railroad operations have high fixed costs because of expensive equipment, right-of-way and tracks, switching yards, and terminals. However, rail enjoys relatively low variable operating costs. The development of diesel power reduced the railroads' variable cost per tonmile, and electrification is providing further reductions. Modified labour agreements have reduced human resource requirements, resulting in variable cost reductions.

As a result of deregulation and focused business development, rail traffic has shifted from transporting a broad range of commodities to specific freight. Core railroad tonnage comes from raw material-extractive industries located a considerable distance from improved waterways and items such as automobiles, farm equipment, and machinery. The rail fixed-variable cost structure offers competitive advantages for long-haul moves. Starting in the mid-1970s, railroads began to segment the transportation market by focusing on carload, intermodal, and container traffic. Marketing emphasis became even more segmented following passage of the Staggers Rail Act. Railroads became more responsive to specific customer needs by emphasizing bulk industries and heavy manufacturing, as contrasted to standardized boxcar service. Intermodal operations were expanded by forming alliances and motor carrier ownership.



*Example:* United Parcel Service, primarily a multifaceted motor carrier, is the largest user of rail service to transport trailers in the United States.

India's transport sector is large and diverse; it caters to the needs of 1.1 billion people. In 2007, the sector contributed about 5.5 percent to the nation's GDP, with road transportation contributing the lion's share. Good physical connectivity in the urban and rural areas is essential for economic growth. Since the early 1990s, India's growing economy has witnessed a rise in demand for transport infrastructure and services. However, the sector has not been able to keep pace with rising demand and is proving to be a drag on the economy. Major improvements in the sector are required to support the country's continued economic growth and to reduce poverty.

- ***Railways:*** Indian Railways is one of the largest railways under single management. It carries some 17 million passengers and 2 million tonnes of freight a day in year 2007 and is one of the world's largest employers. The railways play a leading role in carrying passengers and cargo across India's vast territory. However, most of its major corridors have capacity constraint requiring capacity enhancement plans.
- ***Roads:*** Roads are the dominant mode of transportation in India today. They carry almost 90 percent of the country's passenger traffic and 65 percent of its freight. The density of India's highway network at 0.66 km of highway per square kilometre of land – is similar to that of the United States (0.65) and much greater than China's (0.16) or Brazil's (0.20).

Notes

However, most highways in India are narrow and congested with poor surface quality, and 40 percent of India's villages do not have access to all-weather roads.

- ***Ports:*** India has 12 major and 187 minor and intermediate ports along its more than 7500 km long coastline. These ports serve the country's growing foreign trade in petroleum products, iron ore, and coal, as well as the increasing movement of containers. Inland water transportation remains largely undeveloped despite India's 14,000 kilometres of navigable rivers and canals.
- ***Aviation:*** India has 125 airports, including 11 international airports. Indian airports handled 96 million passengers and 1.5 million tonnes of cargo in year 2006–2007, an increase of 31.4% for passenger and 10.6% for cargo traffic over previous year. The dramatic increase in air traffic for both passengers and cargo in recent years has placed a heavy strain on the country's major airports.



*Did u know?* Passenger traffic is projected to cross 100 million and cargo to cross 3.3 million tonnes by year 2010.

Transport infrastructure in India is better developed in the southern and south-western parts of the country.

While the Bank will continue to support the upgrading and development of roads and highways in the country, it plans to scale up its involvement in railways and urban transportation.

**Table 8.2: India: Transport Sector Key Statistics**

| | Units | As of 2009 |
|---|---|---|
| Length of Roads | Km. | 3,516,452 |
| Main Roads | Km. | 666,452 |
| Paved Roads | % | 47.3 |
| Access to All-Season-Roads | % | 61 |
| Road Density | km/1,000 sq. km. | 1115 |
| Rail Track Length | Km. | 63,327 |
| No. of Ports | | 199 |
| Turnaround time | Days | 3 |
| Airports | | 125 |
| International | | 11 |

***Source:*** http://web.worldbank.org/WBSITE/EXTERNAL/COUNTRIES/SOUTHASIAEXT/EXTSARREGTOPTRANSPORT 0,,contentMDK:20703625~menuPK:868822~pagePK:34004173~piPK:34003707~theSitePK:579598,00.htm

## Self Assessment

Fill in the blanks:

13. A …… identifies a basic transportation method or form.
14. A …… is a standard measure of freight activity that combines weight and distance.
15. India's transport sector is large and diverse; it caters to the needs of …… billion people.

Notes

## 8.6 Transport Service

Transportation service is achieved by combining the capabilities of modes. Prior to deregulation government policy limited carriers to operating in a single mode. Such restrictive ownership sought to promote competition between modes and limit the potential for monopoly practices. Following deregulation carriers were free to develop integrated modal services in efforts to more efficiently and effectively meet the needs of customers. The following section reviews the current range of services offered by different carriers. The description also includes examples of carriers, representative of each category.

The selection of a suitable mode of transport to provide an effective transport service to the customer is an important aspect of transport operations. The modes and specific operations of transporting passengers are explored, the logistics regarding passenger tickets, passenger belongings and claims and refunds to passengers are investigated to ensure smooth performance of all activities and safe operations when dealing with the transportation of passengers.

### 8.6.1 Traditional Carriers

The most basic carrier type is a transportation firm that provides service utilizing only one of the five basic transport modes. Focus on a single operational mode permits a carrier to become highly specialized. Although single-mode operators are able to offer extremely efficient transport, such specialization creates difficulties for a shipper who desires intermodal transport solutions because it requires negotiation and business planning with multiple carriers.



*Example:* Airlines are an example of a single-mode carrier for both freight and passenger service that traditionally limits service from airport to airport. Since deregulation most carriers are developing services that facilitate multimodal integration.

### 8.6.2 Package Service

Over the past several decades, a serious problem existed in the availability of small shipment transportation. It was difficult for common carriers to provide reasonably priced small-shipment service due to overhead cost associated with terminal and linehaul operations. This overhead forced motor carriers to charge a minimum charge. The minimum was generally in the range of $100, regardless of shipment size or distance.

Due to the minimum charge and lack of alternatives, an opportunity existed for companies offering specialized service to enter the small-shipment or package-service market.

Package services represent an important part of logistics, and the influence of carriers in this segment is increasing due to their size and intermodal capabilities. The advent of e-commerce and the need for consumer-direct fulfilment have significantly increased demand for package delivery. While package services are expanding, the services required do not fall neatly into the traditional modal classification scheme. Packages are regularly transported using the line-haul services of rail, motor, and air. Package service provides both regular and premium services.

### 8.6.3 Intermodal Transportation

Intermodal transportation combines two or more modes to take advantage of the inherent economies of each and thus provide an integrated service at lower total cost. Many efforts have been made over the years to integrate different transportation modes. Initial attempts at modal coordination trace back to the early 1920s, but during that early period, cooperation was

Notes

restrained by regulatory restrictions designed to limit monopoly practices. Intermodal offerings began to develop more successfully during the 1950s with the advent of integrated rail and motor service commonly termed piggyback service. This common intermodal arrangement combines the flexibility of motor for short distances with the low line-haul cost associated with rail for longer distances.

### 8.6.4 Non-operating Intermediaries

The overall transportation industry also includes several business types that do not own or operate equipment. These non operating intermediaries broker the services of other firms. A transportation broker is somewhat analogous to a wholesaler in a market channel. Non operating intermediaries economically justify their function by offering shippers lower rates for movement between two locations than would be possible by direct shipment via common carrier. Because of peculiarities in the common-carrier rate structure, such as minimum freight charges, surcharges, and less-than-volume rates, conditions exist whereby non-operating intermediaries can facilitate savings for shippers.

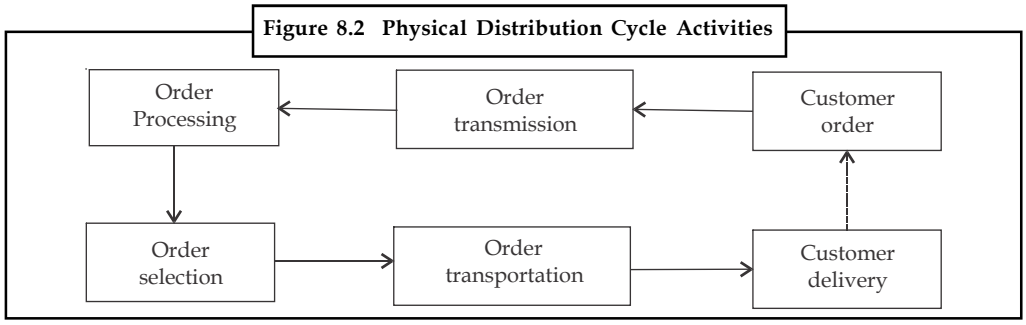
Interestingly, there are cases where non-operating intermediaries charge higher rates than offered by carriers. The justification for the higher charges is based on ability to arrange faster delivery and/or more complete service. The primary intermediaries are freight forwarders, shipper associations, and brokers.

### 8.6.5 Transport Economics and Pricing

The area of *physical distribution* concerns movement of a finished product to customers. In physical distribution, the customer is the final destination of a marketing channel. It is through the physical distribution process that the time and space of customer service become an integral part of marketing, linking marketing channels with its customers.

The typical physical distribution performance cycle involves five activities: order transmission, order processing, order selection, order transportation and customer delivery. These activities have been shown in Figure 8.2.

**Figure 8.2 Physical Distribution Cycle Activities**



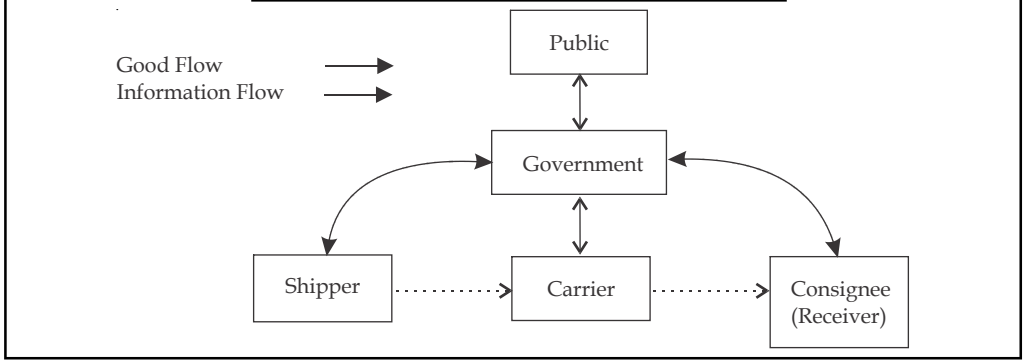

***Source:*** Upendra Kachru, (2010), "Exploring the Supply Chain," Excel Books

This cycle links the seller and the buyer. We will discuss one element in this cycle, namely transportation. Transportation decisions should be based on sound economics. In order to understand transportation economics, it is necessary to first understand the transportation environment, which is unique compared to many commercial enterprises.

***The Players:*** Transportation transactions are influenced by five parties – the shipper (originating party), the consignee (destination party or receiver), the carrier, the government, and the public. The relationship is shown in Figure 8.3. In order to understand the complexity of the transportation environment, it is necessary to review the role and perspective of each party.

Notes

**Figure 8.3: Physical Distribution Cycle Activities**




***Source:*** Upendra Kachru, (2010), "Exploring the Supply Chain," Excel Books

The shipper and consignee have the common objective of moving goods from origin to destination within a prescribed time at the lowest cost. Carriers, as the intermediary, want to charge the highest rate that the shipper (or consignee) will accept and minimize the labour, fuel, and vehicle costs required to move the goods. To achieve this objective, the carrier desires flexibility in pickup and delivery times to allow individual loads to be consolidated into economic moves.

The government is the largest investor in infrastructure and therefore maintains a high interest in transportation's impact on the economy. The government provides rights-of-way such as roadways, ports, airports and air traffic control systems. Government's involvement takes the form of regulation, promotion, or ownership. As a monopoly owner who maintains absolute control over markets, services and rates, the government can regulate carriers by restricting the markets they can service or by setting the price they can charge.

*Example:* Indian Railways is a government monopoly.

The final participant, the public, is concerned with transportation accessibility, expense, and effectiveness, as well as environmental and safety standards. The public ultimately determines the need for transportation by demanding goods and services and determining the value of such services. The development of the airfreight industry shows that consumers may find cost less important than speed and service. Very often, trade-offs are associated with cost, environmental and safety standards.

The transportation relationship is complex because of the interaction between the parties. This leads to frequent conflicts between parties with a micro interest shippers, consignees, and carriers – as well as parties with a macro interest – government and the public.

*Notes* These conflicts lead to duplication, regulation, and restrictions of transportation services which impact the economics of transportation.

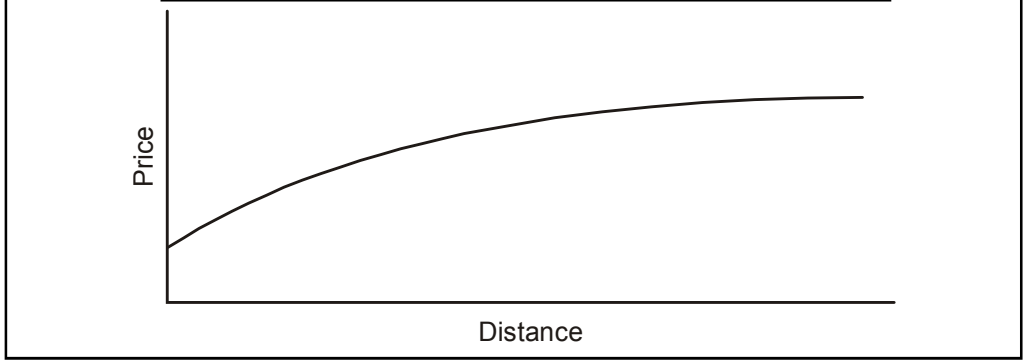
### 8.6.6 Transport Economics

Transport economics and pricing are concerned with the factors and characteristics that determine transport costs and rates. Transport economics is influenced by seven factors. These factors are important while developing transportation rates. The specific factors are discussed below.

Notes

- ***Distance:*** Distance is a major influence on transportation cost since it directly contributes to variable cost, such as labour, fuel, and maintenance. This is reflected by the cost-distance curve. The cost curve does not begin at the origin because there are fixed costs associated with shipment pickup and delivery regardless of distance. It increases at a decreasing rate as a function of distance. This is shown in Figure 8.4.

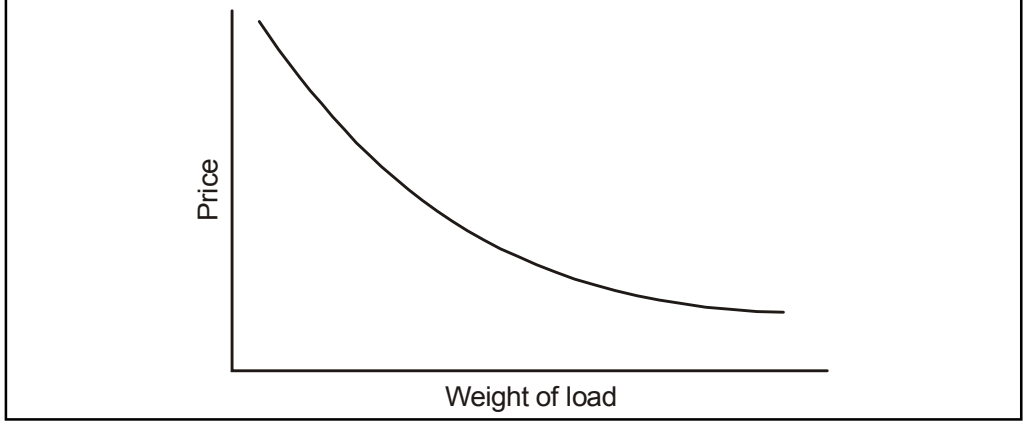
**Figure 8.4: Relationship between Distance and Transportation Cost**




***Source:*** Upendra Kachru, (2010), "Exploring the Supply Chain," Excel Books

- ***Volume:*** The load volume relationship reflects economies of scale in transportation activities. This is illustrated in Figure 8.5. The curve indicates that transport cost per unit of weight decreases as load volume increases. The relationship is limited to the maximum size of the vehicle. Economic transportation requires the consolidation of small loads into larger loads to take advantage of scale economies.

**Figure 8.5: Relationship between Weight and Transportation Cost**




***Source:*** Upendra Kachru, (2010), "Exploring the Supply Chain," Excel Books

- ***Density:*** The product weight is a function of the product density and volume. Figure 8.5 reflects weight considerations. If the product is light, it is not possible to increase the amount carried if the space consideration has been met. Since vehicles are limited by both space and weight considerations, once the vehicle is full, actual labour and fuel expenses are not dramatically influenced. Generally, higher density products are assessed at lower transport costs per unit of weight as the capacity is better utilized.
- ***Stowability:*** Stowability refers to vehicle space utilization as is reflected by product dimensions. Odd sizes and shapes, as well as excessive weight or length, do not stow well and typically waste space.

Notes



*Example:* While steel blocks and rods have the same density, rods are more difficult to stow because of their length and shape. Sometimes large numbers of items can be 'nested' that might otherwise be difficult to stow in small quantities, improving stowability. Products with good stowability attract lower transportation rates.

- ***Handling:*** Special handling equipment may be required for loading or unloading trucks, railway wagons or ships. By grouping together products, e.g. taping, boxing, or palletizing products, for transport and storage, handling costs can be reduced.
- ***Liability:*** Liability includes susceptibility to damage, property damage to freight, perishability, susceptibility to theft, susceptibility to spontaneous combustion or explosion, and value per kilogram. Carriers insure their cargoes to protect against possible claims or accept responsibility for any damage. Shippers can reduce their risk, and ultimately the transportation cost, by improved protective packaging or by reducing susceptibility to loss or damage.
- ***Market Factors:*** Since transportation vehicles and drivers must return to their origin, either they must find a load to bring back ("back-haul") or the vehicle is returned empty ("deadhead"). When deadhead movements occur, labour, fuel, and maintenance costs must be charged to the shipper. A "Balanced" move, where volume is equal in both directions, is rarely possible because of factors such as demand imbalances in manufacturing and consumption locations, seasonality, etc.



*Example:* The movement of fruits and vegetables coincide with the growing season. These result in transport rates changing with direction and season.

Logistics system design must take this factor into account and add back-haul movement where possible.

### 8.6.7 Total Transportation Costs

In addition to the basic cost charged for movement of goods, the total transportation cost reflects a large number of other factors, such as transit time costs, obsolescence and deterioration costs, protective packaging costs, and transit insurance costs, etc. These components are discussed below.

- ***Transit Time Cost:*** This element reflects the temporal cost of transportation. From total logistics costs point of view, cost of inventory in transit is a very significant factor. The longer the transit time of a particular mode of transport, the inventory is inaccessible to the user. This adds to the safety stock the company has to carry and the requirement of working capital. The transportation cost must consider that if inventory is available after a longer period of time, it will result in higher total costs.
- ***Obsolescence and Deterioration Costs:*** There are certain categories of products which are perishable and delicate in nature, whose physical attributes deteriorate over a period of time, gradually resulting into devaluation of the product. For instance, vegetables such as tomatoes are transported from Punjab to Delhi; any delay in transit or poor stowing may force the marketers to sell them at a less-than-desired price. Such a cost is classified as obsolescence and deterioration costs during transportation.
- ***Protective Packaging Costs:*** For many products, there may be requirements of special packaging. This cost is also a part of the total transport cost. For instance, if a product is shipped using a container, it may require less protective packaging for safe shipment in comparison being shipped in a truck. Another example is given later on for transportation of glass in the rating system for goods transportation.

Notes

- ***Insurance Cost:*** Goods in transit insurance covers property against loss or damage while it is in transit from one place to another or being stored during a journey. This insurance can be for goods being distributed in company's vehicle or by a third-party carrier, both domestically and abroad. Policies often specify the means of transport to be used, which may include the postal service.
- ***Class Rates:*** In transportation terminology, the price per kilogram to move a specific product between two locations is referred to as the rate. The rate is also called the tariff. The classification does not define the price charged for movement of a product. It refers to a product's transportation characteristics in comparison to other commodities.

  Classification of individual products is based on a relative percentage index of 100. Class 100 is considered the class for an average product, while other classes run as high as 500 and as low as 35. Each product is assigned an item number for listing purposes and then given a classification rating. As a general rule, the higher the class rating, the higher the transportation cost for the product.

  Products are also assigned different ratings on the basis of packaging. Glass may have a different rating when shipped loose, in crates, or in boxes than when shipped in wrapped protective packing. Very often, packaging differences influence product density, stowability and liability. The same product may be differently classified depending on where it is being shipped, shipment size, transport mode, and product packaging.
- ***Other Costs:*** Common costs, such as terminal or management expenses are often allocated to a shipper according to a level of activity like the number of shipments handled. Other costs may also include local taxes, octroi, toll taxes, etc. These are generally applicable in case of road transportation.
- ***Joint Costs:*** Joint costs are expenses unavoidably created by the decision to provide a particular service.

  *Example:* When a carrier transports a truckload from point A to point B, there is an implicit decision to incur a 'joint' cost for the back-haul from point B to point A. Either the cost must be covered by the original shipper from A to B, or a back-haul shipper must be found.

  These costs have significant impact on transportation charges as in the absence of an appropriate backhaul shipper; the original shipper pays for an empty trip.

Transportation has been recognized for many years as being one of the most important activities in the physical distribution function. The shipper's choice of transportation option in a single market could be viewed as a cost model that provides the total transportation and inventory cost associated with each transportation option. There exists a correlation between purchase quantity and transportation mode decision.

Strategic transportation decisions include choice of transportation mode (rail, truck, air, ship) and choice of type of carriage (common, contract, private). Other decisions can include the size of shipments (or shipment frequency), and assignment of loads to vehicles. These decisions are generally taken with the help of models.

## Self Assessment

Fill in the blanks:

16. …… service is achieved by combining the capabilities of modes.
17. …… services represent an important part of logistics.

Notes

18. ..... transportation combines two or more modes to take advantage of the inherent economies of each.

## 8.7 Transportation Administration and Documentation

While traffic managers administer many different activities, they are fundamentally responsible for: (1) operations management, (2) freight consolidation, (3) rate negotiation, (4) freight control, (5) auditing and claims, and (6) logistical integration.

1. ***Operations Management:*** In large-scale organizations, traffic operations management involves a wide variety of administrative responsibilities. From an operational perspective, key elements of transportation management are equipment scheduling, load planning, routing, and carrier administration.

2. ***Freight Consolidation:*** Freight consolidation is a service offered by some shipping companies to lower the total shipping cost and to increase shipping security. It is also known as consolidation service, assembly service, and cargo consolidation. The fact that freight costs are directly related to size of shipment and length of haul, places a premium upon freight consolidation. From an operational viewpoint, freight consolidation techniques can be grouped as reactive and proactive. Each type of consolidation is important to achieving transportation efficiency.

3. ***Rate Negotiation:*** For any given shipment it is the responsibility of the traffic department to obtain the lowest possible rate consistent with service requirements. The prevailing price for each transport alternative-rail, air, motor, pipeline, water, and so on-is found by reference to tariffs.

4. ***Freight Control:*** Other important responsibilities of transportation management are tracing and expediting. Tracing is a procedure to locate lost or late shipments. Expediting involves the shipper notifying a carrier that it needs to have a specific shipment move through the carrier's system as quickly as possible and with no delays.

5. ***Auditing and Claim Administration:*** When transportation service or charges are not performed as promised, shippers can make claims for restitution. Claims are typically classified as loss and damage or overcharge/undercharge. Auditing freight bills is an important function of the traffic department. The purpose of auditing is to ensure billing accuracy.

6. ***Logistical Integration:*** For any given operating period, traffic management is expected to provide the required transportation services at budgeted cost. It is also traffic management's responsibility to search for alternative ways to deploy transportation to reduce total logistics cost.

   As operational expectations become more precise, order-to-delivery performance cycles more compact, and margins for error reduced near zero, successful firms have come to realize that there is no such thing as cheap transportation. Unless transportation is managed in an effective and efficient manner, procurement, manufacturing, and customer accommodation performance will not meet expectations.

### Documentation

Well-defined documentation is required to perform a transportation service. With the exception of private transfer within the confines of a single firm, products are typically being sold between the shipper and the consignee. Three primary types of transport documentation are bills of lading, freight bills, and shipment manifests.

Notes

1. ***Bill of Lading:*** The bill of lading is the basic document utilized in purchasing transport services. It serves as a receipt and documents products and quantities shipped. The bill of lading specifies terms and conditions of carrier liability and documents responsibilities for all possible causes of loss or damage except those defined as acts of God.
2. ***Freight Bill:*** The freight bill represents a carrier's method of charging for transportation services performed. It is developed using information contained in the bill of lading. The freight bill may be either prepaid or collect.
3. ***Shipment Manifest:*** The shipment manifest lists individual stops or consignees when multiple shipments are placed on a single vehicle. Each shipment requires a bill of lading. The manifest lists the stop, bill of lading, weight, and case count for each shipment. The objective of the manifest is to provide a single document that defines the overall contents of the load without requiring review of individual bills of lading. For single-stop shipments, the manifest is the same as the bill of lading.

   Well-defined documentation is required to perform a transportation service. With the exception of private transfer within the confines of a single firm, products are typically being sold when being transported. Thus, legal title to ownership occurs during the time the transport service is performed. When for-hire carriers are engaged to perform the transportation, the transaction must establish clear legal responsibility for all parties involved. Students shall keep it in mind that the primary purpose of transportation documentation is to protect all parties involved in the performance of the transaction.



*Task* Critically analyse the condition of transportation system of our country.

## Self Assessment

State whether the following statements are true or false:

19. In small-scale organizations, traffic operations management involves a wide variety of administrative responsibilities.
20. Freight consolidation is a service offered by some shipping companies to lower the total shipping cost and to increase shipping security.
21. Well-defined documentation is required to perform a transportation service.



*Case Study*

### Deutsche Post

Deutsche Post has integrated traditional air and ocean forwarding, express parcel delivery, and mail services in a 2-year buying spree. Germany will eliminate Deutsche Post's monopoly on mail delivery in 2003, which will inevitably lead to a loss of significant revenue. It hopes to replace lost sales with international transport business. Customer demand, more than postal deregulation, is driving Deutsche Post's vision. "More and more customers are seeing the advantage of directly working with their suppliers," says Klaus Zumwinkel, CEO of Deutsche Post. They will not use only one supplier, but they will choose from a few suppliers. To be one of those suppliers, one has to be global. One cannot say, 'Well, in Africa business is so complicated. Please, mister customer, we would love to have United States and Europe, but in Africa we do not have

*Contd...*

Notes

any facilities.' To some extent, Deutsche Post is creating a consolidation trend more than following one. More than just reacting to competition, the largest transport firms want to position themselves as premium providers of global logistics services to multinational clients. Deutsche Post and Lufthansa have merged their respective 25 percent voting stakes in DHL International into a joint venture called Aerologic, which will seek out areas of cooperation for the three partners.

Deutsche Post will take management control over Aerologic because DHL sits closer to the German post office's core interest-pickup and delivery. DHL is a key part of Deutsche Post's international expansion plans. DHL offers a world mail delivery product of which Deutsche Post is a heavy supporter. Deutsche Post's Global Mail division has been expanding aggressively, particularly in South America. DHL provides cross-border express transport services, but also offers Deutsche Post a valuable global pickup and delivery network. "All of the global shippers-and also more and more of the local and smaller ones-are demanding transparency," said Jean-Peter Jansen, the new chairman of Lufthansa Cargo. "They want to have a continuous flow of information and a continuous flow of the goods themselves." Lufthansa's core deliverable product will always be international air freight capacity.

Lufthansa wants to strengthen its leading position through alliances with other freight carriers. Lufthansa describes its alliance strategy geometrically. It will partner with airlines in horizontal alliances and with forwarders in vertical industry partnerships. 'Through its deal with Deutsche Post, the airline added a diagonal line to its chart, representing new initiatives in electronic commerce. Deutsche Post and Lufthansa have formed a joint venture called e-logic to pursue mutual interests in e-commerce logistics. The new company will make investments in new technology and startup ventures and also work to develop joint fulfillment solutions for e-commerce shippers. Jansen states, "We believe that putting us more closely together, not in a way that we integrate, but in a way that we support each other, will make a lot of difference for the future. What we are looking for really is growth and stabilization of our market position."

**Question**

Analyse the case and write down the case facts.

***Source:*** Gordan Forsyth, 'The New Integrators," American Shipper, July 2000, pp. 284–5

## 8.8 Summary

- Transportation infrastructure can broadly be classified as hardware and software.
- The five basic transportation modes are rail, highway, water, pipeline, and air.
- Although product storage in transportation vehicles can be costly, it may be justified from a total-cost or performance perspective when loading or unloading costs, capacity constraints, or the ability to extend lead times are considered.
- Transportation economy of distance is also referred to as the tapering principle since rates or charges taper with distance.
- Transport transactions are often influenced by five parties: the shipper (the original party), the consignee (destination party or receiver), the carrier, the government, and the public.
- Government transportation regulation can be grouped into two categories: economic regulation and safety and social regulation.

Notes

- Export documentation is commonly considered to be the most complex and difficult part of overseas marketing. You may have come across such comments as such comments tend to discourage people from entering into export business.
- The freight transportation structure consists of the rights-of-way, vehicles, and carriers that operate within five basic transportation modes.
- India's transport sector is large and diverse; it caters to the needs of 1.1 billion people.
- Transportation service is achieved by combining the capabilities of modes.
- Transport economics and pricing are concerned with the factors and characteristics that determine transport costs and rates.
- Transportation has been recognized for many years as being one of the most important activities in the physical distribution function.
- While traffic managers administer many different activities, they are fundamentally responsible for: (1) operations management, (2) freight consolidation, (3) rate negotiation, (4) freight control, (5) auditing and claims, and (6) logistical integration.

## 8.9 Keywords

***Bill of Entry***: A bill of entry is a formal declaration describing goods that are being imported or exported.

***Consignees***: In a contract of carriage, the consignee is the person to whom the shipment is to be delivered whether by land, sea or air.

***Economy of Distance***: It refers to the characteristic that transportation cost per unit of distance decreases as distance increases.

***Export documentation***: In general export documentation refers to the bill of lading, or shipping document, the commercial invoice reflecting the transaction between the buyer and the seller, the packing list showing the goods actually being sent and, occasionally, a certificate of origin or some other supporting documentation.

***Fixed Cost***: A cost that does not change with an increase or decrease in the amount of goods or services produced.

***Freight Transport***: Freight transport is the process of moving different types of goods from one point to another.

***Intermodal transportation***: It combines two or more modes to take advantage of the inherent economies of each and thus provide an integrated service at lower total cost.

***Invoice***: An invoice is a bill sent by a provider of a product or service to the purchaser.

***Product movement***: Economy of Scale: It refers to the characteristic that transportation cost per unit of weight decreases when the size of the shipment increases.

***Regulation***: A process of the promulgation, monitoring, and enforcement of rules, established by primary and/or delegated legislation.

***Shippers***: Consignor, exporter, or seller (who may be the same or different parties) named in the shipping documents as the party responsible for initiating a shipment, and who may also bear the freight cost.

***Transportation infrastructure***: Transportation infrastructure consists of the rights-of-way, vehicles, and carrier organizations that offer transportation services on a for-hire or internal basis.

Notes

## 8.10 Review Questions

1. Define Transportation infrastructure.
2. Explain the five basic transportation modes.
3. Highlight the modal comparison and dominant traffic composition.
4. What are the two functions of transportation functionality?
5. Describe the fundamental principles guiding transportation management and operations.
6. "Transport transactions are often influenced by five parties." Elucidate.
7. Discuss the types of regulation in transportation.
8. What do you understand by Export documentation?
9. Write brief note on standard documents.
10. Define Transportation service.
11. Explain Transport Economics and Pricing.
12. Discuss Total transportation costs.
13. Throw some light on the Transportation Administration and Documentation.
14. Discuss Intermodal Transportation.

### Answers: Self Assessment

| | | | |
|---|---|---|---|
| 1. | Water | 2. | World War II |
| 3. | Fixed | 4. | False |
| 5. | True | 6. | False |
| 7. | Five | 8. | Carriers |
| 9. | Government | 10. | False |
| 11. | True | 12. | False |
| 13. | Mode | 14. | Ton-mile |
| 15. | 1.1 | 16. | Transportation |
| 17. | Package | 18. | Intermodal |
| 19. | False | 20. | True |
| 21. | True | | |

## 8.11 Further Readings



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*Online links*

http://www.uj.ac.za/EN/Faculties/management/departments/transport/research/Pages/JournalofTransportandSupplyChainManagement.aspx

http://www.siam.org/journals/plagiary/1657.pdf

http://www.cambridgecollege.co.uk/coursesattachments/LSCTMMOD1.pdf

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Notes

# Unit 9: Warehousing

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## Objectives

After studying this unit, you will be able to:

- Understand the Strategic Warehousing
- Explain the Warehouse Operations

- Discuss the Ownership Arrangements
- Describe the Warehouse Decisions

Notes

## Introduction

Manufacturers were able to recognize the fact that the customer needs need to be fulfilled as soon as he is asking for the product in order to retain him. This perspective of storage created a tendency to consider warehouses "a necessary evil" that added costs to the distribution process and that resulted in creation of operating expenses with little appreciation of the broader logistical spectrum in which warehousing played a vital role. Warehousing capability used to group products into assortments desired by customers was given little emphasis. Internal control and maximum inventory turnover received little managerial attention.

Literature of the early era correctly described the situation. Firms seeking to operate effectively between points of procurement, manufacturing, and consumption gave little attention to internal warehouse operations. The establishment of warehouses was essential for survival, but little emphasis was placed on improving storage and handling effectiveness. Engineering efforts were cantered on manufacturing problems.

Operation of early warehouses illustrated the lack of concern with material handling principles. The typical warehouse received merchandise by rail car or truck. The items were moved manually to a storage area within the warehouse and hand-piled in stacks on the floor. When different products were stored in the same warehouse, merchandise was continually lost. Stock rotation was handled poorly. When customer orders were received, products were handpicked for placement on wagons. The wagons or carts were then pushed to the shipping area where the merchandise was reassembled and hand-loaded onto delivery trucks. Because labour was relatively inexpensive, human resources were used freely. Little consideration was given to efficiency in space utilization, work methods, or material handling. Despite their shortcomings, these early warehouses provided the necessary bridge between production and marketing.

## 9.1 Strategic Warehousing

Benefits realized from strategic warehousing are classified on the basis of economics and service. From a conceptual perspective, no warehouse should be included in a logistical system unless it is fully justified on a cost-benefit basis. While there is some overlap, the major warehouse benefits are reviewed individually.

### 9.1.1 Economic Benefits

Economic benefits of warehousing materialise when overall logistical costs are directly reduced by utilizing one or more facilities. It is not difficult to quantify the return on investment of an economic benefit because it is reflected in a direct cost-to-cost trade-off.

For example, if adding a warehouse to a logistical system will reduce overall transportation cost by an amount greater than the fixed and variable cost of the warehouse, then total cost will be reduced. Whenever total-cost reductions are attainable, the warehouse is economically justified. Four basic economic benefits are consolidation, break bulk and cross dock, processing/ postponement, and stockpiling.

#### Consolidation

Shipment consolidation is an economic benefit of warehousing. With this arrangement, the consolidating warehouse receives and consolidates materials from a number of manufacturing

Notes

plants destined to a specific customer on a single transportation shipment. The benefits are the realization of the lowest possible transportation rate and reduced congestion at a customer's receiving dock. The warehouse allows both the inbound movement from the manufacturer to the warehouse and the outbound movement from the warehouse to the customer to be consolidated into larger shipments.

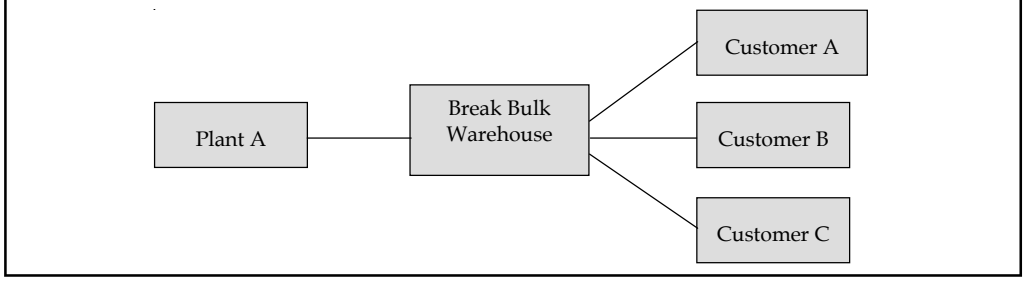
In order to provide effective consolidation, each manufacturing plant must use the warehouse as a forward stock location or as a sorting and assembly facility.

The primary benefit of consolidation is that it combines the logistical flow of several small shipments to a specific market area. Consolidation warehousing may be used by a single firm, or a number of firms may join together and use a for-hire consolidation service. Through the use of such a programme, each individual manufacturer or shipper can enjoy lower total distribution cost than could be realized on a direct shipment basis individually.

### Break Bulk and Cross Dock

Break bulk and cross-dock warehouse operations are similar to consolidation except that no storage is performed. A break bulk operation receives combined customer orders from manufacturers and ships them to individual customers Figure 9.1 illustrates the break bulk flow. The break bulk warehouse or terminal sorts or splits individual orders and arranges for local delivery. Because the long-distance transportation movement is a large shipment, transport costs are lower and there is less difficulty in tracking.

**Figure 9.1: Break Bulk Flow**




***Source:*** Upendra Kachru, (2010), "Exploring the Supply Chain," Excel Books

A cross-dock facility is similar except that it involves multiple manufacturers. Retail chains make extensive use of cross-dock operations to replenish fast-moving store inventories, e.g., full trailerloads of product arrive from multiple manufacturers. As the product is received, customer either sorts it if it is labelled or allocated to customers. If it has not been labelled, the product is then literally moved "across the dock" to be loaded into the trailer destined for the appropriate customer. The trailer is released for transport to the retail store once it has been filled with mixed product from multiple manufacturers. The economic benefits of cross docking include full trailer movements from manufacturers to the warehouse and from the warehouse to retailers, reduced handling cost at the cross-dock facility since product is not stored, and more effective use of dock facilities because all vehicles are fully loaded, thus maximizing loading dock utilization.

### Processing/Postponement

Warehouses can also be used to postpone, or delay, production by performing processing and light manufacturing activities. A warehouse with packaging or labelling capability allows postponement of final production until actual demand is known.

Notes



*Example:* Vegetables can be processed and canned in "Brights" at the manufacturer. Brights are cans with no preattached labels.

The use of Brights for a private label product means that the item does not have to be committed to a specific customer or package configuration at the manufacturer's plant. Once a specific customer order is received, the warehouse can complete final processing by adding the label and finalizing the packaging.

Processing and postponement provide two economic benefits. First, risk is minimized because final packaging is not completed until an order for a specific label and package has been received. Second, the required level of total inventory can be reduced by using the basic product (Brights) for a variety of labelling and packaging configurations. The combination of lower risk and inventory level often reduces total system cost even if the cost of packaging at the warehouse is more expensive than it would be at the manufacturer's facility.

### Stockpiling

The direct economic benefit of this warehousing service is secondary to the fact that seasonal storage is essential to select businesses.



*Example:* Lawn furniture and toys are produced year-round and primarily sold during a very short marketing period.

In contrast, agricultural products are harvested at specific times with subsequent consumption occurring throughout the year. Both situations require warehouse stockpiling to support marketing efforts. Stockpiling provides an inventory buffer, which allows production efficiencies within the constraints imposed by material sources and the customer.

### Service Benefits

Service benefits gained through warehouses in a logistical system may or may not reduce costs. When a warehouse is primarily justified on the basis of service, the supporting rationale is an improvement in the time and place capability of the overall logistical system.



*Example:* Placing a warehouse in a logistical system to service a specific market segment may increase cost but might also increase market share, revenue and gross margin.

At a conceptual level, a service-justified warehouse would be added if the net effect was profit-justified. At an operational level, the problem is how to measure the direct revenue impact.

Five basic service benefits are achieved through warehousing: spot stock, assortment, mixing, product support, and market presence.

### Spot Stock

Stock spotting is most often used in physical distribution. In particular, manufacturers with limited or highly seasonal product lines are partial to this service. Rather than placing inventories in warehouse facilities on a year-round basis or shipping directly from manufacturing plants, delivery time can be substantially reduced by advanced inventory commitment to strategic markets. Under this concept, a selected amount of a firm's product line is placed or "spot stocked" in a warehouse to fill customer orders during a critical marketing period. Utilizing warehouse facilities for stock spotting allows inventories to be placed in a variety of markets adjacent to key customers just prior to a maximum period of seasonal sales.

Notes

Suppliers of agricultural products to farmers often use spot stocking to position their products closer to a service-sensitive market during the growing season. Following the sales season, the remaining inventory is withdrawn to a central warehouse.

### 9.1.2 Assortment

An assortment warehouse is one which may be utilized by a manufacturer, wholesaler, or retailer-stocks product combinations in anticipation of customer orders. The assortments may represent multiple products from different manufacturers or special assortments as specified by customers. In the first case, for example, an athletic wholesaler would stock products from a number of clothing suppliers so that customers can be offered assortments. In the second case, the wholesaler would create a specific team uniform including shirt, pants, and shoes.

The differential between stock spotting and complete line assortment is the degree and duration of warehouse utilization. A firm following a stock spotting strategy would typically warehouse a narrow product assortment and place stocks in a large number of small warehouses dedicated to specific markets for a limited time period. The distribution assortment warehouse usually has a broad product line, is limited to a few strategic locations, and is functional year-round.

Notes: Assortment warehouses improve service by reducing the number of suppliers that a customer must deal with. The combined assortments also allow larger shipment quantities, which in turn reduce transportation cost.

### 9.1.3 Mixing

Warehouse mixing is similar to the break bulk process except that several different manufacturer shipments may be involved. When plants are geographically separated, overall transportation charges and warehouse requirements can be reduced by in-transit mixing. In a typical mixing situation, carloads or truckloads of products are shipped from manufacturing plants to warehouses. Each large shipment enjoys the lowest possible transportation rate. Upon arrival at the mixing warehouse, factory shipments are unloaded and the desired combination of each product for each customer or market is selected.

The economies of in-transit mixing have been traditionally supported by special transportation tariffs that are variations of in-transit privileges. Under the mixing warehouse concept, inbound products may also be combined with products regularly stored in the warehouse. Warehouses that provide in-transit mixing have the net effect of reducing overall product storage in a logistical system. Mixing is classified as a service benefit because inventory is sorted to precise customer specifications.

### 9.1.4 Production Support

The economics of manufacturing may justify relatively long production runs of specific components. Production support warehousing provides a steady supply of components and materials to assembly plants. Safety stocks on items purchased from outside vendors may be justified because of long lead times or significant variations in usage. In these, as well as a variety of other situations, the most economical total-cost solution may be the operation of a production support warehouse to supply or "feed" processed materials, components, and sub-assemblies into the assembly plant in an economic and timely manner.

### 9.1.5 Market Presence

While a market presence benefit may not be as obvious as other service benefits, it is often cited by marketing managers as a major advantage of local warehouses. The market presence factor

Notes

is based on the perception or belief that local warehouses (and presumably local inventory) can be more responsive to customer needs and offer quicker delivery than more distant warehouses. As a result, it is also thought that a local warehouse will enhance market share and potentially increase profitability. While the market presence factor is a frequently discussed strategy, little solid research exists to confirm its actual benefit impact.



*Caselet*

## Future Starts Third-party Logistics with Hitachi, Nestle

Plan for 50% revenue from outside Future Group in three years. Future Logistics Solutions, an arm of Kishore Biyani's Future Group, has forayed into third-party logistics (3 PL) operations by signing leading electronic and fast moving consumer goods (FMCG) players such as Hitachi and Nestle.

Future Logistics was hitherto catering to the logistics needs of more than 1,100 outlets of the group in the country. However, over three years, the company is expected to earn half its revenues from outside the group, as it is in talks with over 15 companies, said sources.

The company is expected to post revenues of ₹ 300 crore in the current financial year and plans to triple its income in the next three years with multi-model transportation, international logistics, reverse logistics and brand distribution services, the sources said.

A third-party logistics provider helps manufacturers with part or all of their operations such as transportation, distribution and warehousing. The 3 PL space in the country grew from a ₹ 4,500-crore industry in 2005 to around ₹ 10,000 crore in 2009. The entire Indian logistics market is now expected to be around ₹ 5 lakh crore, with the share of organised players around 6 per cent. This organised segment is expected to grow at 25–30 per cent yearly in the next couple of years.

When asked, Anshuman Singh, chief executive officer of Future Logistics, confirmed the company has started 3 PL but declined to comment on the clients. "There is a huge opportunity in the space, as there are no end-to-end third party logistics players here. We want to build an entire consumption-led logistics company to take care of all segments of consumption,'' he said.

Recently, Fung Capital, the private equity arm of the Hong Kong-based Li & Fung Group, bought a 25 per cent stake in Future Logistics for ₹ 150 crore ($30 million), valuing the company at ₹ 600 crore.

According to sources, Future Logistics also plans to start brand distribution services in the country in the next six to eight months, where it will buy merchandise from international and domestic brands and supply it to retailers. The company is expected to manage the logistics needs of the Future Group when the latter starts supplying its private labels in fashion, food and apparel products to other retailers and stores in the country.

Future Logistics has a fleet of 600 vehicles, with warehousing space of over three million sq ft. It plans to have total warehousing space of 7.5 million sq ft by 2010–11.

***Source:*** www.business-standard.com

## Self Assessment

Fill in the blanks:

1. …… benefits of warehousing materialise when overall logistical costs are directly reduced by utilizing one or more facilities.

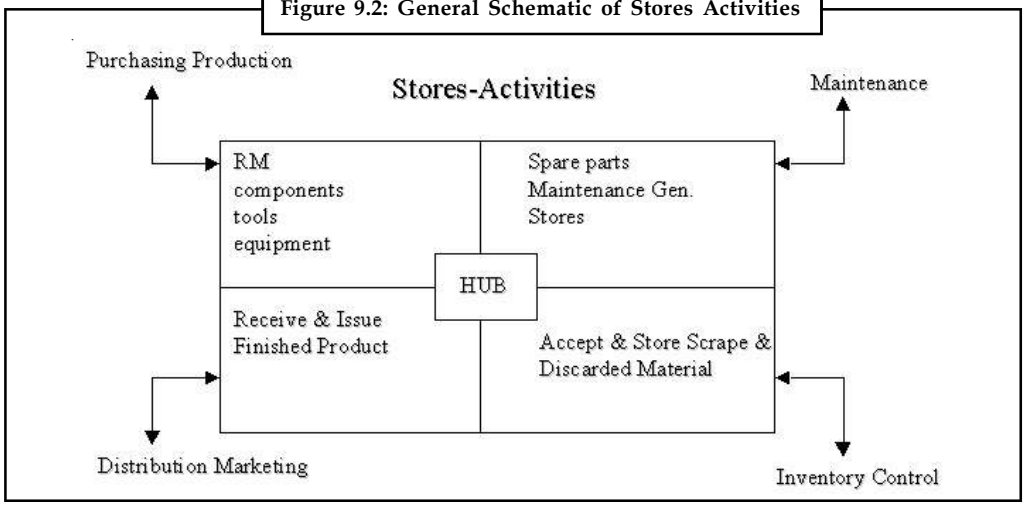
Notes

2. Shipment …… is an economic benefit of warehousing.
3. A …… with packaging or labelling capability allows postponement of final production until actual demand is known.
4. …… is most often used in physical distribution.

## 9.2 Warehouse Operations

Stores range from ordinary ones with shelves and bins to cold or dehumidified storages, huge silos for storage of food grains or bonded stores for keeping goods on which customs and excise duties have not been paid. The number of different storage devices is almost as large as the number of different materials. A schematic diagram of production support store's activities is given in Figure 9.2.

**Figure 9.2: General Schematic of Stores Activities**




***Source:*** Upendra Kachru, (2010), "Exploring the Supply Chain," Excel Books

Stores functions focus on the physical movement and storage of goods and materials. This involves managing the physical flow of materials into and out of the organization and developing and managing networks of warehouses when needed.

*Caution* The stores department should be under the control of a stores manager. He is responsible for receipt, storage and issue of materials.

The functions can be divided into a number of duties and responsibilities. These are as follows:

(a) To receive materials, arrange for inspection and accept them after proper verification of documents

(b) To prepare stores received note promptly and circulate the copies to other departments

(c) To store the accepted materials of right quantities against authorized stores requisitions

(d) To issue correct materials of right quantities against authorized stores requisitions

(e) To enter receipt, issues and return of materials in the bin cards, and to maintain other stores records

(f) To issue purchase requisition when reordering level is reached

(g) To check bin card balances with the physical quantities in the bins periodically

Notes

(h) To follow rotation of stocks to avoid holding old stocks

(i) To report on waste, scrap, slow-moving, non-moving and obsolete items

(j) To maintain stores in a tidy manner for easy access to bin at any time

(k) To receive and issue finished products for despatch to the distribution chain

The procedures for receipt start even before the time the material reaches the plant; when a purchase order is placed, a copy is sent to the stores. Once a Purchase Order has been issued, the information sits in the system until the goods/service is received. Inbound deliveries which include stock transport orders, production orders, and Advanced Shipping Notification (vendor document) contain the exact materials, quantities, and the delivery date with reference to a purchase order. This becomes the basis for the receipt process.

## 9.2.1 Goods Receipt

The goods received are entered into the Inward Consignment Register shown as Table 9.1. This document keeps the record of all the P.O. No., date of receipt, incoming Railway Receipt, Lorry Receipt, Consignment Note, Airway Bills etc.

**Table 9.1: Inward Consignment Register**

| Sl. No. | PO. No. | Date of receipt of R/R, L/R in Stores | R/R L/R No. & Date | No. of Packages | Mode of Transport | Consignor | Consignment cleared on | Expenses Incurred with details |
|---|---|---|---|---|---|---|---|---|
| | | | | | | | | |
| | | | | | | | | |
| | | | | | | | | |
| | | | | | | | | |
| | | | | | | | | |

***Source:*** Upendra Kachru, (2010), "Exploring the Supply Chain," Excel Books

The receipt of stores is a follow-on activity to a purchase order. It forms the basis for updating the financials and inventory records and can trigger warehouse management and the quality management processes. Traditionally, receiving and inspection share facilities. As soon as material is received, it is documented and passed on to quality control for inspection and then moved to stores for inward distribution to manufacturing.

**Table 9.2: Daily Receipts Register**

DAILY RECEIPTS REGISTER

Date: .....

| Sl. No. | GRN No. & Date | Nomen-clature | Supplier | Challan No. & Date | Qty. as per Challan | Qty. actually received | Remarks | Received by (Stores Assistant) |
|---|---|---|---|---|---|---|---|---|
| | | | | | | | | |

***Source:*** Upendra Kachru, (2010), "Exploring the Supply Chain," Excel Books

**Notes**

The materials that arrive from the supplier come with a challan. From the original copy of challan, the receipt is entered in Daily Receipts Register (shown as Table 9.2) which is maintained in the receipt section. This is done after verification with the specifications given in the purchase order and physical counting.

**Figure 9.3: Goods Receipt Note (GRN)**

Sample Goods Received Note GRN Number:

**Goods Received Note**

Supplier .....Date..... Advice note number .....

Order Number.....Delivery Location.....Cost-Centre.....

| | Goods | Pack Size | Price | Order Quantity | Delivered Quantity | Comments |
|---|---|---|---|---|---|---|
| 1 | | | | | | |
| 2 | | | | | | |
| 3 | | | | | | |
| 4 | | | | | | |
| 5 | | | | | | |
| 6 | | | | | | |
| 7 | | | | | | |
| 8 | | | | | | |
| 9 | | | | | | |
| 10 | | | | | | |

Received by..... Checked by.....

1. Accounts/Finance dept. copy
2. Supplier Copy
3. Stores/Goods Inwards copy

***Source:*** Upendra Kachru, (2010), "Exploring the Supply Chain," Excel Books

The storekeeper then prepares a Goods Receipt Note (GRN), which can be computerized or manual shown in Figure 9.3. The storekeeper then sends two copies of the GRN to quality control department along with sample material for inspection an approval of quality.

The GRN specifies the circulation, supplier's name, codes, date, purchase order no., challan no. and date, description code number, unit quantity, bin card and received/rejected/accepted reference. It also has information relating to what has been received, how much and when.

**Figure 9.4: Manual GRN**

Goods Receipt and Acceptance note

Supplier's Name & Address_____ Supplier's Invoice No. _____Date _____ PP No./____ RR No./
Air Consignment No. & Date _____
Challan No. _____ Date _____ Case No. _____
Gross Weight _____
size _____
Purchase Order No._____ Date _____ Type of Stores_____

| Sl. No. | Description | Unit of Measurement | Quantity | | | | | | Rate & Amount | Reasons for Rejection |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | Ordered | Received | Short | Excess | Rejected | Accepted | | |
| | | | | | | | | | | |

Entered in Bin Card by _____
Entered in Stock Register at Page No. _____
Entered in Stock Register by _____
Signature of Receiver

Stores & Purchase Manager
Inspecting Officer

***Source:*** Upendra Kachru, (2010), "Exploring the Supply Chain," Excel Books

Notes

The goods received note is a temporary document to ensure that the financial stock and physical products in stock are accurate from the moment when the products are received until the moment the purchase invoice is issued. It will:

- Debit the stock asset account with the quantity and cost of the products net of VAT
- Credit pending goods received notes account for the net amount on the goods received note

Even though the goods received note contains VAT amounts, no VAT postings are made. It is not permitted to deduct VAT until a proper VAT invoice is received from the supplier.



*Did u know?* The function of the pending goods received notes account is to capture the liability incurred by the receipt of the products.

### 9.2.2 Supplier Payment

When the materials are accepted by the quality control department, one copy of the GRN is sent to stores for recording in the bin card, while the first copy is sent to accounts department as a record of acceptance of materials ordered and supplied by the vendor. Once this has happened and you have an invoice, it is time to complete a GRN. The GRN copy is matched with the invoice, for payment. After it is checked and priced out by accounts department with reference to purchase order, it is cleared for issue of pay order.

When materials are rejected by the quality control department, the purchase department informs the supplier for replacement free of cost. The storekeeper shall keep the rejected material separately for return to supplier. If payment has already been made, the accounts department shall raise a debit note on the supplier, when rejected store is not replenished.

### 9.2.3 Recordkeeping

For planning and controlling operations, accurate information regarding materials must be available to all the related departments. Information regarding description of all the materials, quantity received and their locations is entered into the organization's information system in receiving. This is done by entering the data in a bin card. Each bin or location in the store has a bin card which provides all the information on the material.

A bin card is shown in Figure 9.5. It is a quantitative record of receipt, issue and closing balance of each item of stores. Separate bin cards are maintained for each item. Each card is filled up with physical movement of goods i.e. on receipt and issue. Whenever you take out or put in your goods, it records the movement. This makes it easy to work out the consumption for each article. Without a bin card, you would have to go back to your issue orders to determine the status of each item, which could be quite laborious. Therefore, bin cards are an essential measure of internal control, as well as a very helpful tool for position/consumption reports.

Normally, an account will be maintained for each item carried in stores, which will be debited for the quantity and value of stores purchased and credited for the quantity and value of stores issued. This account is called the stores ledger shown in Figure 9.6. Stores Ledger is a quantitative and value record of receipt, issue and closing balance of each item of stores. It is filled with the help of goods received note and material issue requisitions.

Notes

**Figure 9.5: Bin Card**

*(To be Printed on Obverse)*

Bin Card No.....
From.....
.....
From.....

Article .....
Code No.....
Unit.....
Issue Rate.....

Maximum Stock.....
Minimum Stock .....
Ordering Level.....

Signature of Issuing Officer

| Date | GRS/ Indent No. | Quantity | | Balance | Initials of Stores Keeper/ Sectional Officer | Remarks |
|---|---|---|---|---|---|---|
| | | In | Out | | | |
| 1 | 2 | 3A | 3B | 4 | 5 | 6 |
| | | | | | | |

*(To be Printed on Reverse)*

| Date | GRS/ Indent No. | Quantity | | Balance | Initials of Stores Keeper/ Sectional Officer | Remarks |
|---|---|---|---|---|---|---|
| | | In | Out | | | |
| 1 | 2 | 3A | 3B | 4 | 5 | 6 |
| | | | | | | |

***Source:*** Upendra Kachru (2010). "Exploring the Supply Chain". Excel Books

**Figure 9.6: Stores Ledger**

**STORES LEDGER**

Sub-Division.....
Section .....

Article .....
Maximum.....
Minimum .....
Ordering level.....
Code No.....
Unit.....
Issue Rate.....from.....

| Sl.No. | Date | From whom received/To whom issued | GRS/Indent No. | Receipts | | | | | Issues | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | Quantity A | Rate B | Value C | Incidentals D | Total E | Quantity A | Value B |
| 1 | 2 | 3 | 4 | | | 5 | | | 6 | |
| | | | | Rs. | Rs. | Rs. | Rs. | Rs. | | |

| Balance | | Reference to payment or adjustment of debit | | | Initials of Poster | Initials of Divisional Acctt. | Remarks including reference to Serial No. of item to which excess/short amount paid, if any, relates |
|---|---|---|---|---|---|---|---|
| Quantity | Value | Voucher | TEO No. | Date | | | |
| A | B | A | | B | | | |
| 7 | | 8 | | | 9 | 10 | 11 |
| Rs. | | | | | | | |

***Source:*** Upendra Kachru (2010), "Exploring the Supply Chain," Excel Books

All transactions are entered into the Stores Ledger from copies of vouchers received from the different sections.

*Notes* Stores ledger, for both quantity and value, should be closed at the end of each month and reconciled with the summaries of purchase and indents.

Notes

In managing a warehouse, you can control the goods receipt and goods issue processes at a physical level. Store has as its objective the rapid flow of material into a facility. Ideally, the material would move directly to the production line without making an intermediate stop in a warehouse or other storage area. However, if the material cannot be used immediately, it is placed in storage.

## 9.2.4 Issue of Materials

**Figure 9.7: Stores Material Requisition Note (SMRN)**

**Stores Material Requisition Note**

SMRN No (pre-numbered) : _____

Department: _____ Ministry: _____

Date: _____

Cost center: _____ Stores no: _____

Purpose for Stock Issue :

_____

| Item code | Item description | Measuring unit | Quantity of items requested | Quantity of items issued | Quantity of items remaining in stores | Comments |
|---|---|---|---|---|---|---|
| | | | | | | |
| | | | | | | |
| | | | | | | |
| | | | | | | |
| | | | | | | |
| | | | | | | |
| | | | | | | |
| | | | | | | |

Requested by: _____ Position: _____

Authorised by: _____ Position: _____

| Recurrent | | | |
|---|---|---|---|
| Vote | Cost center | Responsability center | Account |
| | | | |

*Source:* Upendra Kachru (2010), "Exploring the Supply Chain," Excel Books

Issue of materials from storage is controlled through Material Requisition Note and Material Transfer Note shown as Figures 9.7 and 9.8. The data required for goods issue posting is copied from the Material Requisition Note into the Material Transfer Note so that:

- Warehouse stock is reduced by the delivery quantity.
- Value changes are posted to the balance sheet account in inventory accounting.
- Requirements are reduced by the delivery quantity.
- The serial number status is updated.
- The goods issue posting is automatically recorded in the document flow.
- Stock determination is executed for the vendor's consignment stock.
- A work list for the proof of delivery is generated.

Notes

**Figure 9.8: Material Requisition Note and Stock Material Transfer Note**

To:
The Store Manager,
Please issue materials
To .....
Department

No: .....
Date: .....
Job No: .....
Prod. Order No:.....

| Code or Item No. | Description | Quality | | COST OFFICE | | |
|---|---|---|---|---|---|---|
| | | | Rate Unit Price | Unit | Amt (₦) | Stores |

Authorized by:..... Date: .....
Storekeeper: ..... Date: .....
Received by: ..... Date: .....

Price by..... Date.....
Calculation check by: .....
Posted to:.....

Bin Card No: .....

*Source:* Upendra Kachru, (2010), "Exploring the Supply Chain," Excel Books

After goods issue is posted for an outbound delivery, the delivery might be shipped to the customer directly from the fulfilling locations (more than one delivery), or consolidation may occur at one location before one complete shipment is transported to the end customer.

**Figure 9.9: Packing Slip**

PACKING SLIP

Name & Address of Consignee:

Our Reference: Date:

Your Reference: Date:

| Sl. No. | Nomenclature | Quantity | Value of Material |
|---|---|---|---|
| | | | |

Packed by: Checked by:

Authorized by:

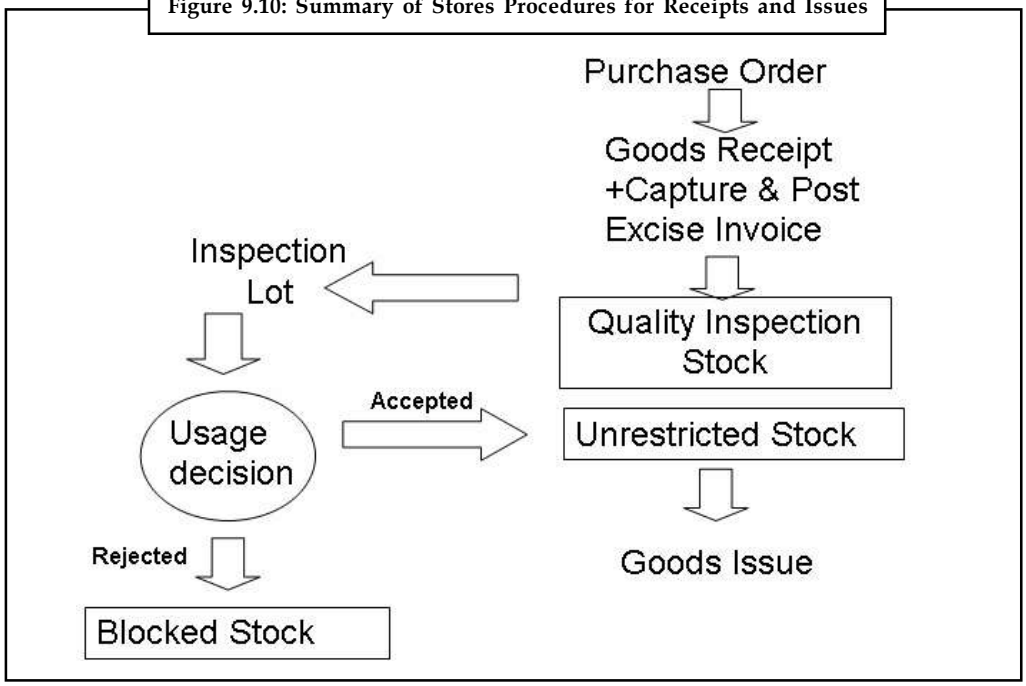
(Signature with seal)
STORES & PURCHASE MANAGER

*Source:* Upendra Kachru, (2010), "Exploring the Supply Chain". Excel Books

Notes

When the materials are despatched for an outbound delivery, a packing slip (format is shown in Figure 9.9) is prepared, which is added to other documents on despatch. Its purpose is to identify the items packed at the receiver's end. In case of any discrepancies, it facilitates the consignee to check the contents and inform the consignor if there are any discrepancies.

**Figure 9.10: Summary of Stores Procedures for Receipts and Issues**




***Source:*** Upendra Kachru, (2010), "Exploring the Supply Chain," Excel Books

Figure 9.10 summarizes the procedures for receipts and issues in Stores. It provides a flow chart from the time the purchase order is issued to the time that goods are issued. In brief, the basic requirements of documentation related to receipt and issues in store should be as follows:

Receipt of Stores has to put in place adequate physical safeguards in the goods receipt procedure; properly document and account for each goods receipt voucher; establish policies and procedures for handling exceptional matters of goods receipt; and establish written procedures for lodging claims for supply and delivery problems.

Issue of Stores has to properly document and account for all delivery vouchers; issue store items on a consistent basis; and properly controls the issue of goods e.g. check the voucher authorizations against a record of specimen authorized signatures.

The ultimate requirement of stores documentation is to ensure that goods are received, checked, stored, delivered and returned in a consistent manner.

## Self Assessment

State whether the following statements are true or false:

5. Stores functions focus on the physical movement and storage of goods and materials.
6. The procedures for receipt start after the time the material reaches the plant.
7. The receipt of stores is a follow-on activity to a purchase order.
8. The GRN does not specify the circulation, supplier's name.

Notes

## 9.3 Ownership Arrangements

It is not necessary for the firm to own and operate its warehousing requirements. The different options include owner operated, private, and public warehousing.

An owner operated warehouse is owned or/and managed by the same enterprise that owns the merchandise handled and stored at the facility.

A *private warehouse* facility is warehousing on a contractual basis by Third Party Logistics Providers (3PL), who provide unique and specially tailored warehousing and logistics services to clients.

A *public warehouse*, in India, is a warehouse operated by the Central Warehousing Corporation of India or by State Warehousing Corporations.

These definitions are often confusing; especially as terminology of 'private' and 'public' in many US learned papers are differently used. Therefore, this clarity is important.



*Task* Find out the relationship between the size and shape of a distribution warehouse and the materials handling system. Why do some warehouses have square design while others are rectangular?

### 9.3.1 Owner-operated Warehouses

An owner-operated warehouse is operated by the firm owning the product. The actual facility, however, may be owned or leased. The decision to own or lease the facility is essentially a financial decision. The major benefits of owner operated warehousing are that there is better control and flexibility. Control, especially, facilitates the ability to integrate warehouse operations with the rest of the firm's internal logistics processes. Where there is need for flexibility, owner-operated facilities provide the freedom to adjust operating policies and procedures to meet unique requirements of the firm. In many cases, owner operated warehouse could be less costly than private warehousing because the profit markup is eliminated. This benefit may be misleading since private warehouses often are more efficient as they utilize their resources more effectively.

There could also be a number of other intangible benefits particularly with respect to market presence. A private warehouse with a firm's name on it may produce customer perceptions of responsiveness and stability. This perception can provide a marketing advantage over other enterprises.



*Notes* It is not uncommon now for private investors and property owners to build distribution warehouses to a firm's specifications or provide land on a leased basis. This reduces the capital investment for the firm in such transactions.

### 9.3.2 Private Warehouses

Private warehouses charge clients a basic fee for handling and storage. The handling charge is based on the number of cases or weight handled. For storage, the charge is assessed on the number of cases or weight in storage during the month. When economies of scale are not possible in a private facility, public warehousing is a low-cost alternative.

Notes

A classification of private warehouses, on the basis of the range of specialized operations performed, is as follows:

1. General merchandise,
2. Refrigerated,
3. Special commodity, and
4. Bonded warehouse.

Each warehouse type differs in its material handling and storage technology as a result of the product and environmental characteristics.

***General Merchandise Warehouses:*** This is a warehouse that is used to store goods that are readily handled, are packaged, and do not require a controlled environment, such as paper, small appliances, and household supplies.

Traditional general warehousing companies receive and ship goods on behalf of their customers, serving as middlemen in the transportation process and a vital part of the logistics business. The carrier is chosen either by the customer or by the warehouse operator who then acts as the customer's agent.

The increased reliance on warehouse operators for services other than storage prompted some warehouses to diversify into different transportation areas, such as operating private trucking fleets used for distribution. Others became involved in combining small shipments of freight from various shippers into truckload shipments. These types of services were more typical of freight forwarders or transport companies than of general warehouse operators. Such overlap in services resulted in the emergence of the 3PL industry with many warehouse operators developing from temporary caretakers of raw materials and finished goods into logistics experts.

Just-in-Time (JIT) inventory management is being used by more companies than ever before. The successful execution of JIT requires constant monitoring of inventory levels and flexibility on the part of shippers. JIT generally requires more frequent, but smaller shipments of goods to and from warehouses. Private and contract warehouses are often better equipped than in-house warehouses to execute time-based inventory management. A critical advantage of private warehouses is their ability to create economies of scale in distribution. With this volume, the warehouses often have more leverage than small manufacturers with suppliers and carriers and better meet JIT inventory requirements.

General warehouses use EDI and other electronic devices such as bar coding and radio frequency monitoring to enhance the productivity and efficiency of warehouse operations and simplified inventory tracking. As customer expectations have become more stringent and competition in the general warehouse industry has increased, more warehouses are investing in technology to remain contenders in the market.



*Did u know?* Private warehouses owned by 3PL operators are extensively used in logistical systems. Almost any combination of services is offered by such operators, either for a short-term or over a long duration.

***Refrigerated warehouses (either frozen or chilled):*** These are specialist warehouses designed to handle and maintain products that are perishable such as food, medical items, and chemical products with special temperature requirements.

For example, onions are available year round because they are stored in such warehouses and released to the market based on demand. Onions must be cured and stored at an optimum temperature of 0°C with 65–70 percent relative humidity.

Notes

Beyond consistently meeting high standards for product quality and safety, these warehouses must also possess the efficiency and reliability. Energy is a major contributor to the cost of business, and the prospect of power price hikes can heighten the pressure on the profit margin. There are also issues of environmental regulation, equipment flexibility, and logistics management to deal with. Even a minor change in consumer's eating habits such as the advent of in-store take-out and heat-and-serve products can create a ripple affecting the refrigerated food supply chain.

Unfortunately, the nature of refrigeration systems makes it difficult to implement wholesale changes. The standard operating procedures and process hazard analyses need to be undertaken regularly. Planning on a long-term basis and partnerships with equipment manufacturers is increasing in importance. Many such warehouses work with professional service providers for solutions with regard to preventive maintenance, special lubrication systems and filtration, consistent chemical water treatment, etc.

New technologies in refrigeration design are proving quite successful in eliminating pathogens from processed foods. Ammonia refrigeration systems are replacing systems based on Freon, due to environmental concerns. Operators of private refrigerated warehouses are increasingly using automation technology to provide the efficient, cost-effective services demanded by today's food processors.

***Commodity Warehouses:*** These are designed to handle bulk material such as wheat, rice, sugar, lentils, cotton, edible beans, and milk etc. Non-food commodities include jute, fertilizers, tires wood pulp, tobacco, etc. Some commodities can also be in liquid form, this includes most petroleum products as well as many chemicals.

Due to the diverse nature of commodities, many commodity items require special handling or storage considerations, such as grain storage warehouses may require elevators, liquid commodities may require tank farms, and a commodity like tobacco requires a barn.

In India, most agricultural commodities are handled by the Central and State Warehousing Corporations. These are discussed in the section on public warehouses.

***Bonded Warehouses:*** These warehouses are licensed by the government to store goods prior to payment of taxes or duties. The facility of warehousing of imported goods in Customs Bonded Warehouses, without payment of Customs duty otherwise leviable on import, is permitted under the Customs Act, 1962. Basically, goods after landing are permitted to be removed to a warehouse without payment of duty and duty is collected at the time of clearance from the warehouse. The law lays down the time period up to which the goods may remain in a warehouse, without incurring any interest liability and with interest liability.

The warehouses are to be appointed/licensed at particular places only which have been so declared by Central Board of Excise and Customs. The Board has delegated its power for declaring places to be Warehousing Stations to the Chief Commissioners of Customs. In respect of 100 percent EOUs, the powers to declare places to be Warehousing Stations have been delegated to the Commissioners of Customs.

Licences are issued by Customs and are classified into two categories viz., storage of sensitive goods such as liquor, cigarettes, foodstuffs, consumables, etc. and other non-sensitive goods. All warehoused goods are subject to the control of the Customs officers. The owner of the warehoused goods may inspect, sort, show for sale, take samples, etc. from the bonded goods with the permission of the proper officer. The owner of the bonded goods has also to pay warehouse-keeper rent and warehouse charges at the rates fixed under law.

In addition to bonded warehouses for imported items, bonded warehouses are also used for items that are subject to excise. Excise duty is a tax on manufacture or production of goods. Excise duty on alcohol, alcoholic preparations, and narcotic substances is collected by the State

Notes

Government and is called "State Excise" duty. The Excise duty on rest of goods is called "Central Excise" duty. Manufacturers can have holding bonded warehouses for storing non-duty paid goods. While different procedures have been prescribed for levy and collection of Central Excise Duties keeping in view the needs of different industries sectors, Self Assessment Procedure covers a major portion of excisable items. However, for state excise, each state has its own procedures.

### 9.3.3 Public Warehousing

The Central Warehousing Corporation (CWC) was set up in 1957 under the Agricultural Produce Development and Warehousing Corporations Act, 1956. Functions of CWC under the provisions of the Act are:

(a) Acquire and build godowns and warehouses at such suitable places in India as it thinks fit;

(b) Run warehouses for the storage of agricultural produce, seeds, manures, fertilizers, agricultural implements and notified commodities offered by individuals, cooperative societies and other institutions;

(c) Arrange facilities for the transport of agricultural produce, seeds, manures, fertilizers, and agricultural implements and notified commodities to and from warehouses;

(d) Subscribe to the share capital of a State Warehousing Corporation;

(e) Act as agent of the government for the purposes of the purchase,sale, storage and distribution of agricultural produce, seeds, manures, fertilizers, agricultural implements and notified commodities; and

(f) Carry out such other functions as may be prescribed.

The Central Warehousing Corporations Act of 1962 had twin objectives, that is, to provide scientific storage for agricultural produce and also to provide market finances. CWC plays an important role in the chain of marketing for agricultural produce. It serves not only as a time and space value but also adds place value to the goods.

There are three agencies in the public sector which are engaged in building large scale storage/ warehousing capacity namely, Food Corporation of India (FCI) Central warehousing Corporation (CWC) and 17 State Warehousing Corporation (SWCs). The total capacity of public warehousing as of October, 2006 was 56.50 million tonnes.

The Central Warehousing Corporation (CWC) was set up in 1957 and is the largest public warehousing organization. It had a turnover of $ 6,190 million during the year 2005–06 with a net profit of $ 1060 million. The CWC has two types of warehouses: Owned Capacity and Hired Capacity. CWC holds 4,564 warehouses in India with a capacity of 8.00 million MTs, under the owned capacity category. The hired capacity is around 2.40 million tonnes.

Apart from storage, CWC also offers services in the area of clearing and forwarding, handling and transportation, distribution, disinfestation, fumigation and other ancillary services like safety and security, insurance, standardization and documentation. The CWC has also introduced a scheme, called the Farmers' Extension Service at selected centres to educate farmers about the benefits of a scientific storage.

The CWC is also operating custom bonded warehouses. These bonded warehouses are constructed at a seaport or airport and accept imported commodities for storage till the payment of customs duties by the importer of the commodities. Though the primary focus of CWC is on trade and commerce in and supply and distribution of food grains, the most lucrative and profitable segment of CWC is custom-bonded warehouses.

Notes



*Did u know?* The Food Corporation of India (FCI) is a public sector undertaking which is also in warehousing. It has warehousing capacity of 24.40 million tonnes of which 7.90 million tonnes is hired from the CWC and SWCs. A large part of the remaining capacity comes from private operators and rural and mandi godowns.

In addition, seventeen states also have State Warehousing Corporations (SWCs) that supplement the capacity of CWC. If any state provides 50 percent of the initial capital for state warehouses, CWC is obligated to invest the remaining 50 percent of the equity capital of the SWCs, though CWC may have no representation on the Boards.

State Warehousing Corporations have a warehousing capacity of 19.40 million tonnes. These state warehouses are primarily for the storage of agricultural produce, seeds, manures, fertilizers, etc.

The Warehousing Corporations (Amendment) Bill, 2001 is being introduced that facilitates the Central Warehousing Corporation to diversify and widen its activities further to strengthen the service sector. This also allows it to place its members on the boards of the SWCs.

### Self Assessment

Fill in the blanks:

9. A …… facility is warehousing on a contractual basis by Third Party Logistics Providers.
10. A ……, in India, is a warehouse operated by the Central Warehousing Corporation of India or by State Warehousing Corporations.
11. The successful execution of …… requires constant monitoring of inventory levels and flexibility on the part of shippers.
12. …… warehouses are licensed by the government to store goods prior to payment of taxes or duties.

## 9.4 Warehouse Decisions

Once it has been determined to use a warehouse, the next step is designing it. The following discussion reviews basic warehouse design principles. Whether the warehouse is a small manual operation or a large automated facility, the following three principles are relevant: design criteria, handling technology, and storage plan. Each is discussed and illustrated.

### 9.4.1 Design Criteria

Warehouse design criteria address physical facility characteristics and product movement. Three factors to be considered in the design process are the number of stories in the facility, height utilization, and product flow.

#### Designing a Warehousing System

In most cases, products flow from the factory to the consumer through a long winding chain, consisting of multiple tiers of warehouses and multiple tiers of marketing intermediaries. In designing a warehousing system, the following basic questions relating to this flow become significant.

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1. How many warehouses should we have?
2. Where should we locate them?
3. What should be the size or capacity of each of them?

The ideal warehouse design is limited to a single story so that product does not have to be moved up and down. The use of elevators to move product from one floor to the next requires time and energy. The elevator is also often a bottleneck in product flow since many material handlers are usually competing for a limited number of elevators. While it is not always possible, particularly in central business districts where land is restricted or expensive, warehouses should be limited to a single story.



*Notes* Regardless of facility size, the design should maximize the usage of the available cubic space by allowing for the greatest use of height on each floor.

Most warehouses have 20- to 30-foot ceilings, although modem automated and high-rise facilities can effectively use ceiling heights up to 100 feet. Through the use of racking or other hardware, it should be possible to store products up to the building's ceiling. Maximum effective warehouse height is limited by the safe lifting capabilities of material-handling equipment, such as forklifts, and fire safety regulations imposed by overhead sprinkler systems.

Warehouse design should also allow for straight product flow through the facility whether items are stored or not. In general, this means that product should be received at one end of the building, stored in the middle, and then shipped from the other end.

### 9.4.2 Handling Technology

The second principle focuses on the effectiveness and efficiency of material-handling technology. The elements of this principle concern movement continuity and movement scale economies.

Movement continuity means that it is better for a material handler or piece of handling equipment to make a longer move than to have a number of handlers make numerous, individual, short segments of the same move. Exchanging the product between handlers or moving it from one piece of equipment to another wastes time and increases the potential for damage. Thus, as a general rule, fewer longer movements in the warehouse are preferred.



*Did u know?* Movement scale economies imply that all warehouse activities should handle or move the largest quantities possible.

Instead of moving individual cases, warehouse activities should be designed to move groups of cases such as pallets or containers. This grouping or batching might mean that multiple products or orders must be moved or selected at the same time. While this might increase the complexity of an individual's activities since multiple products or orders must be considered, the principle reduces the number of activities and the resulting cost.

### 9.4.3 Storage Plan

According to the third principle, a warehouse design should consider product characteristics, particularly those pertaining to volume, weight and storage.

Product volume is the major concern when defining a warehouse storage plan. High-volume sales or throughput product should be stored in a location that minimizes the distance it is

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moved, such as near primary aisles and in low storage racks. Such a location minimizes travel distance and the need for extended lifting. Conversely, low-volume product can be assigned locations that are distant from primary aisles or higher up in storage racks.

Similarly, the plan should include a specific strategy for products dependent on weight and storage characteristics. Relatively heavy items should be assigned to locations low to the ground to minimize the effort and risk of heavy lifting. Bulky or low-density products require extensive storage volume, so open floor space or high-level racks can be used for them. On the other hand, smaller items may require storage shelves or drawers. The integrated storage plan must consider and address these.

### 9.4.4 Warehouse Management Systems

The development of work procedures goes hard in hand with training warehouse personnel. Most firms implement a WMS to standardize work procedure and encourage best practice. It is management's responsibility to see that all personnel understand and use these procedures.

In a mechanized warehouse, approximately 65 percent of personnel are employed in some facet of order selection. The two basic methods of order picking are individual and area selection, also known as batch selection. Using individual selection, one employee completes a customer's total order. This system is not widely used. Its primary application occurs when a large number of small orders are selected for repack or consolidated shipment, such as e-commerce fulfilment. Under the more commonly used area selection system each employee is assigned responsibility for a specific portion of the warehouse. To complete a customer's order, several different selectors are required. Because each employee has a thorough knowledge of a specific selection area, less time is required to locate items.

Work procedures are also important for receiving and shipping. Established procedures for receiving and ensuring product entry into inventory records are critical. If pallets are used, the merchandise must be stacked in appropriate patterns to ensure maximum load stability and consistent case counts. Personnel working in shipping must have knowledge of trailer loading practices. In specific types of operations, particularly when merchandise changes ownership, items must be checked during loading.

Work procedures are not restricted to floor personnel. Procedures must be established for administration and maintenance. Replenishment of warehouse inventory can cause operational problems if proper ordering procedures are lacking. Normally, there is limited interaction between buyers and warehouse personnel although such communication is improving with integrated supply chain management organizations. Buyers tend to purchase in quantities that afford the best price, and little attention is given to pallet compatible quantities or available warehouse space.

Ideally buyers should coordinate with warehouse personnel before commissioning large orders or introducing new products. The experience of some companies has forced management to require buyers to predetermine warehouse space assignment prior to ordering. Another potential problem is the quantity of cases ordered. The goal is to purchase in pallet-multiple quantities.

For example, if a product is ideally stacked on pallets in a 50-case pattern, the buyer should order in multiples of 50. If an order is placed for 120 cases, upon arrival the cases will fill two pallets plus 20 on a third pallet. The extra 20 cases will require the warehouse cubic space typically used for a pallet of 50 and will require the same amount of materials handling capacity to move.

### 9.4.5 Material Handling

Material handling is an important part of managing materials. How will the material be moved? Physically moving material requires equipment of various kinds, depending on the type and

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amount of material to be moved. Handling technology has developed to such an extent that it has dramatically changed the traditional concept of a warehouse.

Material handling equipment can be generally classified as:

- Transport equipment,
- Positioning equipment, and
- Unit load formation equipment.

Transport equipment is used to move materials from one location to another. It includes cranes and industrial trucks.

Positioning equipment is used to handle material at a single location, so that it is in the correct position for subsequent handling, machining, transport, or storage. It includes hoists and lifts. Unlike transport equipment, positioning equipment is usually used at a single workplace.

Unit load formation equipment is used to maintain integrity when handling a single load during transport and for storage. It includes pallets, bags and skids.

Though the above classification is based on application, the Material Handling Equipment Industry classifies itself on the basis of equipment category into four different sectors, namely:

- Cranes and hoists,
- Conveying equipment which includes specialist bulk handling equipment such as stackers and reclaimers,
- General equipment such as elevators, industrial trucks etc., and
- Forklift trucks.

## Self Assessment

State whether the following statements are true or false:

13. Warehouse design criteria address physical facility characteristics and product movement.
14. Most warehouses have 10- to 20-foot ceilings.
15. Product volume is the major concern when defining a warehouse storage plan.
16. High-volume product can be assigned locations that are distant from primary aisles or higher up in storage racks.



*Case Study*

### Integrated Warehouse Management Solution Provides Significant Productivity Increase

SGI (Silicon Graphics, Inc.), headquartered in Mountain View, California, is the world's leader in high-performance computing, visualization and the management of complex data with over $1 billion in revenue for 2002. SGI products, services and solutions enable its technical and creative customers to gain strategic and competitive advantages in their core businesses. The company services five key market segments: Government, sciences, manufacturing, energy and media.

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SGI's high-end, built-to-order systems range from desktop workstations to high-productivity servers and supercomputers. A $50 million inventory of more than 2,500 different part numbers is housed in a 125,000 square foot warehouse and distribution centre located in Chippewa Falls, Wisconsin. This ISO 9002-compliant facility contains components that include sheet metal, memory devices, drives, monitors, electronic components and an assortment of nuts and bolts. SGI's inventory is frequently transferred from the warehouse and distribution centre to the 80,000 square foot manufacturing facility located nearby. In managing such a large, diverse and valuable inventory, SGI's advanced technology experts recognized the potential for improved efficiency with an integrated warehouse management system.

The SGI manufacturing team analyzed and identified several bottlenecks in the day-to-day operations. For example, a dozen employees shared a few terminals, and manual data entry in the warehouse was often inaccurate and inefficient. Due to a recent consolidation of worldwide manufacturing, warehouse workers sometimes spent hours looking for hard-to-find parts, wasting valuable time. Even the physical movement of boxes between picking and shipping areas became a more cumbersome process. SGI realized that these inefficiencies had a direct impact on the company's bottom line.

**The Challenge**

To address the inefficiencies, SGI added the Oracle Warehouse Management System (WMS) module to expand its existing Oracle E-Business Suite. The manufacturing IT team, working with the factory's logistics management, determined that the Oracle WMS deployment would help the warehouse and production facility realize significant productivity gains and efficiencies. An advanced mobility solution would streamline processes, improve productivity and increase efficiencies to deliver a higher return on investment.

Wireless technology and bar code data capture were a natural fit. SGI already successfully implemented Symbol's enterprise mobility solutions and wanted to continue to work with Symbol's rugged handhelds. Since every mobile computer purchased needed to meet Oracle WMS requirements, Symbol's complete line of Oracle-certified devices enabled SGI to find the right handheld to meet their application needs. RedLine Solutions, a premier Symbol partner and expert in bar code data capture, wireless and automatic data capture (ADC) systems, delivered the integration and Oracle expertise to meet SGI's needs.

**The Solution**

SGI tested a variety of Symbol's rugged mobile computers, built to withstand rigorous warehouse environments. Everyday users – the warehouse workers – selected the best form and functionality. "Our first step was to put the products to the test in a real-world environment, so we gave our workers a choice," stated Jon Rauch, factory logistics manager for SGI. "Testing the handhelds during the course of daily operations guaranteed an easier selection and transition process. This led to productivity improvements much faster than we expected."

SGI warehouse and distribution employees selected the PDT 6846, a rugged, lightweight mobile computer with well balanced, forward-scanning ergonomics that is comfortably suited for scan-intensive environments. Whether counting inventory, receiving parts or putting away components, the large 16-line backlit display provides greater data content and readability, to enable quick movement between activities. Symbol partner RedLine Solutions, configured the Telnet client on each device with an IP address while meeting SGI's security requirements.

RedLine also provided the wireless systems engineering and integration services. After the site survey, RedLine configured Wavelink's Avalanche device management software

*Contd...*

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and Telnet clients to communicate with the Oracle mobile wireless application server (MWAS). This provided a direct connection between Oracle WMS and the Symbol PDT 6846 handhelds, empowering warehouse workers to perform transactions right from the shop floor. Avalanche also offered an easier way to update flash firmware and Telnet clients with increased security that required no additional infrastructure.

Together, Symbol and RedLine Solutions delivered a powerful mobility solution that worked seamlessly in the Oracle WMS environment. One key factor in the purchase decision was Symbol's wireless technology expertise and bar code data capture leadership, as well as prior positive experience with Symbol products. Another major factor was RedLine's excellent customer service, Oracle expertise and impressive technical support. From the mobility tools to the applications, SGI is well positioned for a more streamlined process, improved productivity and increased efficiencies throughout the supply chain.

**The Benefits**

At the start of the project, a 12-month Return on Investment (ROI) was estimated. Key metrics were established to measure the effectiveness of the new integrated solution:

- Labor savings
- Reduce inventory write-offs
- Reduce total inventory
- Reduce warehouse space

"Of all the metrics, SGI's ROI timeline demonstrated the most significant gain of all," stated Richard Westover, manufacturing IT project manager at SGI. "The Oracle, RedLine and Symbol mobility solution delivered full ROI within six months, which clearly exceeded our earlier expectations. It's equally important to note that the ROI gains began to show in the first quarter following deployment." All other metrics were also met or exceeded. The same transaction volume was maintained with less staff hours. Improved data accuracy and a reduced number of lost parts delivered more productivity gains. As for efficiencies, SGI realized a high payback with a drop of 82 percent in inventory write-offs. Maintaining full production capacity and improving purchase planning ensured that the optimum balance of parts was available at any time, reducing warehouse space requirements.

Each of these streamlined processes contributed to more cost-effective inventory management with significant gains in productivity and efficiency. With the powerful warehouse and distribution mobility solution from Oracle, RedLine and Symbol, SGI achieved project success.

**Question**

Make a discussion on the case given above. Also provide case facts.

***Source:*** www.tmcnet.com

## 9.5 Summary

- Economic benefits of warehousing materialise when overall logistical costs are directly reduced by utilizing one or more facilities.
- Shipment consolidation is an economic benefit of warehousing.
- A break bulk operation receives combined customer orders from manufacturers and ships them to individual customers.

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- A cross-dock facility is similar except that it involves multiple manufacturers.
- A warehouse with packaging or labelling capability allows postponement of final production until actual demand is known.
- The direct economic benefit of this warehousing service is secondary to the fact that seasonal storage is essential to select businesses.
- Stock spotting is most often used in physical distribution.
- Warehouse mixing is similar to the break bulk process except that several different manufacturer shipments may be involved.
- Stores functions focus on the physical movement and storage of goods and materials.
- A *private warehouse* facility is warehousing on a contractual basis by Third Party Logistics Providers (3PL), who provide unique and specially tailored warehousing and logistics services to clients.
- A *public warehouse*, in India, is a warehouse operated by the Central Warehousing Corporation of India or by State Warehousing Corporations.
- Once it has been determined to use a warehouse, the next step is designing it.
- Material handling is an important part of managing materials.

## 9.6 Keywords

***Assortment:*** The collection of goods or services that a business provides to consumers.

***Bonded Warehouses:*** These warehouses are licensed by the government to store goods prior to payment of taxes or duties.

***Break Bulk:*** Packaged but non-containerized cargo. Loose cement, grains, ores, etc., are termed bulk cargo, whereas cargo shipped as a unit (bags, bales, barrels, boxes, cartons, drums, pallets, sacks, vehicles, etc.) is termed break bulk.

***Commodity Warehouses:*** These are designed to handle bulk material such as wheat, rice, sugar, lentils, cotton, edible beans, and milk etc.

***Cross Dock:*** Cross-docking is a practice in logistics of unloading materials from an incoming semi-trailer truck or railroad car and loading these materials directly into outbound trucks, trailers, or rail cars, with little or no storage in between.

***Distribution Centre:*** Warehouses where product storage is considered a very temporary activity.

***General Merchandise Warehouses:*** This is a warehouse that is used to store goods that are readily handled, are packaged, and do not require a controlled environment, such as paper, small appliances, and household supplies.

***Goods Receipt Note:*** Goods Receipt Note is a document used to record the inward entry of the any goods received at the premises of the organization.

***Inventory:*** Stocking of raw materials, in-process, finished, packaging, tools and equipments, spares and others in order to meet an expected demand or distribution in future.

***Just-in-Time (JIT):*** JIT is a production strategy that strives to improve a business return on investment by reducing in-process inventory and associated carrying costs.

***Material Handling:*** Material Handling refers to activities, equipment, and procedures related to the moving, storing, protecting and controlling of materials in a system.

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***Private Warehouse:*** A private warehouse facility is warehousing on a contractual basis by Third Party Logistics Providers (3PL), who provide unique and specially tailored warehousing and logistics services to clients.

***Public Warehouse:*** A public warehouse, in India, is a warehouse operated by the Central Warehousing Corporation of India or by State Warehousing Corporations.

***Receipt:*** A receipt is a written acknowledgment that a specified article or sum of money has been received.

***Recordkeeping:*** Systematic procedure, by which the records of an organization are created, captured, maintained, and disposed of.

***Refrigerated Warehouses (either Frozen or Chilled):*** These are specialist warehouses designed to handle and maintain products that are perishable such as food, medical items, and chemical products with special temperature requirements.

***Stockpiling:*** A stockpile is a pile or storage location for bulk materials, forming part of the bulk material handling process.

***Warehouse:*** A large building where raw materials or manufactured goods may be stored before their export or distribution for sale.

***Warehouse Management Systems:*** A warehouse management system (WMS) is a software application that supports the day-to-day operations in a warehouse.

## 9.7 Review Questions

1. Define Economic Benefits.
2. What are Break Bulk and Cross Dock?
3. Highlight the five basic service benefits are achieved through warehousing.
4. Throw some light on the general schematic of stores activities.
5. Write brief note on Goods Receipt Note (GRN).
6. What do you understand by Stores Material Requisition Note (SMRN)?
7. Distinguish between private and public warehouse.
8. Highlight the classification of private warehouses.
9. Discuss the design criteria of warehouse.
10. What is Warehouse Management Systems?
11. Explain the criteria of Material handling equipment.

### Answers: Self Assessment

| | | | |
|---|---|---|---|
| 1. | Economic | 2. | Consolidation |
| 3. | Warehouse | 4. | Stock spotting |
| 5. | True | 6. | False |
| 7. | True | 8. | False |
| 9. | Private Warehouse | 10. | Public Warehouse |
| 11. | JIT | 12. | Bonded |

Notes

13. True
14. False
15. True
16. False

## 9.8 Further Readings



*Books*

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# Unit 10: Packaging and Material Handling

**Notes**

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## Objectives

After studying this unit, you will be able to:

- Understand the Packaging Perspectives
- Explain the Packaging for Material Handling Efficiency
- Discuss the Materials Handling

## Introduction

If produce is packed for ease of handling, heavily waxed cartons, wooden crates or rigid plastic containers are preferable to bags or open baskets, since bags and baskets provide no protection to the produce when stacked. Sometimes locally constructed containers can be strengthened or lined to provide added protection to produce. Waxed cartons, wooden crates and plastic containers, while more expensive, are reusable and can stand up to the high relative humidity found in the storage environment. Containers should not be filled either too loosely or too tightly for best results. Loose products may vibrate against others and cause bruising, while over packing results in compression bruising. Shredded newspaper is inexpensive and lightweight filler for shipping containers.

For small-scale handlers interested in constructing their own cartons from corrugated fibreboard, provide detailed information. Many types of agricultural fibres are suitable for paper making, and handlers may find it economically sensible to include these operations in their post harvest system.

Throughout the entire handling system, packaging can be both an aid and a hindrance to obtaining maximum storage life and quality. Packages need to be vented yet be sturdy enough to prevent collapse. Collapsed packages provide tattle or no protection, requiring the commodity inside to

Notes

support all of the weight of the overhead load. Packing is meant to protect the commodity by immobilizing and cushioning it, but temperature management can be made more difficult if packing materials block ventilation holes. Packing materials can act as vapour barriers and can help maintain higher relative humidities within the package. In addition to protection, packaging allows quick handling throughout distribution and marketing and can minimize impacts of rough handling.

## 10.1 Packaging Perspectives

Packaging refers to a container in which the product reaches the end use consumer. It is a part of the presentation of the product and stays right till the customer takes it from the retail store. It should not be confused with packing. Packing refers to the external protective covering used for the safe transportation of the goods to the importer.



*Example:* Plastic box used to pack a set of embroidered handkerchiefs is an example of packaging.

On the other hand, the corrugated fireboard boxes, which are used for packing the plastic boxes for their safe transportation to the importer in the foreign country, would represent packing.

Packaging plays a very important role in the marketing of a product; it is a part of the augmented product. The augmented product is that part of the product which deals with adding new features to the basic product in order to exceed the customer expectations. These features take the form of packaging, delivery arrangements, warehousing, customer advice etc., in order to add value to the product. As a matter of fact, the competition between the exporters at the foreign market place is not in relation to the core product or its basic tangible features but it is about the augmented product. For instance, an expensive chessboard offered to a customer wrapped in the old newspaper is very likely to lose out to an identical chessboard set neatly presented in a nice matching box. In the latter case, the packaging makes it a more valuable product and offers more 'value' to the customer.

Exporters should formulate value rich offers to be made to the prospective buyers in the foreign markets. The exporters can gain an edge over their competitors and secure business if their offer is better than the best. This requires creativity in the formulation of the offer. The famous four P's (product, price, place and promotion) of marketing provide the framework of various decisions to formulate the value rich offer. In relation to the product, creativity is not only in regard to the basic product design, finish, use of various materials, quality specifications etc. but also in terms of labelling and packaging of the product. Besides, the exporter can turn the growing awareness with regard to protection of environment from pollution into a very effective promotional tool in the foreign markets. The issues relating to environment protection, use of eco-labels and environment friendly packaging has occupied the central place in the area of international business during the later half of the decade of 90's. Packing of the export cargo and proper marking on the export boxes are equally important.

The logistics of execution of the export order suggests that once the goods have been procured and processed or manufactured for the purpose of export, then the exporter should turn to the issues relating to labeling and packaging. The decision-making processes involved in procurement of materials/goods and mobilization of adequate amount of financial resources.



*Caution* The functions relating to labelling, packaging, packing and marking are in essence, the marketing functions and the exporters should view them in this perspective to be successful in the export markets.

**Notes**

### Self Assessment

Fill in the blanks:

1. …… refers to a container in which the product reaches the end use consumer.
2. …… should formulates value rich offers to be made to the prospective buyers in the foreign markets.
3. The …… processes involved in procurement of materials/goods and mobilization of adequate amount of financial resources.
4. Packaging plays a very important role in the marketing of a ……
5. The issues relating to environment protection, use of eco-labels and environment friendly packaging has occupied the central place in the area of …… business.

## 10.2 Packaging for Material Handling Efficiency

There are various types of materials available for packaging of the goods. These materials are paper, plastics, wood, cardboard etc. Selection of the packaging materials should be made keeping in view primarily the specifications given by the importer because he has to plan further for consumer packaging of the goods. Broadly, the selection of the packaging materials would depend upon the following factors:

1. Product characteristics.
2. Transportation and storage methods.
3. Climate and culture.
4. Standards and environmental considerations.
5. Market position.

The type and quality of the packaging is specific to the given product.



*Example:* Certain products such as garments, shoes, textiles etc. are sold to the consumers without any packaging.

They are usually displayed without any packaging at the retail stores. Such goods do not require very expensive packaging.



*Notes* The exporters have to ensure that the packaging used by them should be such that it prevents the products from getting dirty. These goods are often packaged in polyethylene bags.

Card board boxes are used for the packaging of items such as sets of glasses or tableware, decoration with several delicate parts, pairs of candle holders, glass vases, delicate statuettes etc., to ensure that they are not damaged and their appearance is not spoiled during handling and display.

Expensive products and gift items such as jewellery require a high standard of packaging. In fact, the more expensive or exclusive the product, the more justified high quality and more expensive the packaging is.

Notes

### 10.2.1 Kinds of Packaging

Depending on the use of packaging materials, the packaging for export products can be classified into the following categories:

#### Plastic Packaging

The various kinds of plastic materials are used for packaging of the export products. The most common plastic materials used for packaging are polyethylene (PE) and polypropylene (PP). Polyethylene film has two main varieties of consumer packaging namely, low density polyethylene (PE-LD) film and high-density polyethylene (PE-HD).

PE-LD film is used for making plastic bags, shrink wrapping and stretch wrapping. This film is very useful to provide protection against moisture and dirt. It does not however, provide any mechanical protection. The exporters can use the plastic bags made of PE-LD films for wrapping articles to package products like T-shirts, table cloths, napkins, leather hand bags etc. These products are placed inside the plastic bags, which are transparent and are suited for retail display.

In shrink-wrapping, a specially treated film is loosely wrapped around the product(s) and then shrunk with heat to form a tight package. This kind of wrapping is suitable for solid products like sets of drinking glasses, a group of egg-cups, sets of table mates and so on.

In stretch wrapping, a thin film is tightly wound around the product, often in several layers. When the wrap is completed, the stretched film tries to return to its original size, thereby holding the product or group of products tightly in place.

PE-HD is also used for making plastic bags because it provides better resistance against moisture and fats than PE-LD. PE-HD is more expensive than the PE-LD. Both the forms of plastic films are environment friendly as they are easy to recycle.

The PP films are stronger than the PE films. It is better to use bags made of PP films for packaging textiles and garments as these can be printed or can be used in plain form as well. PP films are better than PE films in terms of providing better moisture protection but these films are more expensive. Another alternative to PP films is polyvinyl chloride (PVC) material.



*Caution* But from environmental point of view, PVE materials should not be used, as these are not recyclable.

Plastic boxes can be used especially as retail packages for jewellery and other small, precious products. They are also well-suited to add appeal to products such as embroidered handkerchiefs or tablecloths, souvenir dolls, etc. They come in square, oval or round shapes; printed or plain.

#### Paper Based Packaging

Paper based materials are used as wrapping, as paperboard cartons or corrugated fibreboard boxes. The various types of paper can be coated with plastics, waxed or treated with anti corrosion agents. Paper is either produced from virgin wood fibres or recycled fibres. The former is stronger than the latter.

Paper wrappings provide protection against dust and light, but do not provide mechanical protection.

Paper absorbs moisture when the surrounding air is more humid than the paper, and it gives up, moisture when the surroundings are drier. Thus, paper wrappings can be used to some extent as

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moisture protection inside the packages as well to slow down the harmful effect of moisture in the air.



*Caution* One should use tissue paper instead of newspaper to protect the surface of products.

### Paperboard Folding Cartons

Folding cartons made of different paperboard qualities can be used as retail packaging for variety of reasons. Folding cartons are economical; they can be shaped in almost unlimited number of ways; they can be printed very decoratively; properly designed cartons provide mechanical protection to products; they protect products against dust and light, and are easy to handle in retail shops. The most important property of such cartons is their stiffness.

### Paper Board Cans

The paperboard can is a form of paper based retail packaging, which is quite inexpensive and is used to pack different types of products. These cans can be lined inside with aluminium foil or plastic films to provide additional protection against humidity. Such cans are used for packaging toys, puzzles, games, tennis-balls and other sports goods.

### Combined Plastic and Card Board Packaging

There are three main types of packaging that combine paperboard and plastic materials. These are as follows:

1. Skin Packaging,
2. Blister Packaging, and
3. Plastic Bags with a Paperboard Card.

These packages are used mainly for retail packaging of pens, small toys, gift items and lightweight souvenir articles. This type of packaging has several advantages: the product is visible through the plastic; the paperboard card can be printed to provide information and to add sales appeal; especially small products are not lost or stolen easily.

1. ***Skin Packaging:*** Skin packaging is a form of packaging where the product is first placed on a paperboard card with heat seal coating. It is suitable for products, which need protection against moisture and are not very heavy or expensive. It is however, not suitable for products which are sensitive to heat.
2. ***Blister Packaging:*** In this form of packaging, the product is first placed into a pre-formed plastic blister. Then a paperboard card is attached to it. Blister packaging can be used for a variety of products such as toys, pens, textile articles and decorations etc.



*Notes* It should not be used for those products, which are too delicate as there is always some space for movement inside the blister. This might damage the delicate product.

3. ***Plastic bag with Paperboard Card:*** In this form of packaging, a paperboard card is attached to the plastic bags through a hole in the bag. This adds sales appeal to plain plastic bags and is always very cost effective. The paperboard card can be printed on adding information

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and attraction. The plastic bags can be made of any materials but PP film should be preferred in the interest of better product presentation.

### Miscellaneous Packaging

Exporter can make use of wood, textiles, straw, leaves or any other locally available materials for packaging of the goods. Specially made wooden boxes can be used to package traditional ceramics, woodcarvings, various gift items, pieces of jewellery, etc. If wooden packaging is used as a gift or retail package, it has to be made with as much care as the product itself. This means that it should be smooth, clean, and dry, with any hinges or locks well made and functioning. It is also important to pack the product with sufficient cushioning material into a wooden package, so that the product is not damaged during transport. Before using wood as packaging material, one should always check, whether there are any regulations concerning the treatment or certification of wooden materials.



*Did u know?* Paperboard cartons or boxes can be covered or lined with cloth to give them a more decent appearance. Bags made of jute; cotton, velvet or other fabric could be used for the packaging of products, which do not need much protection. Baskets made of local materials can also provide very attractive packaging for handicraft products.



*Caselet*

## AGVS Eases Traffic at the Home Depot

The home improvement business at The Home Depot (HD) Imports Distribution Centre in Savannah, Georgia, has grown to an estimated $365 billion business. Estimates take into account total purchases of do-it-yourselfers and professional business customers, including construction trades people and building maintenance professionals. Don Harrison, HD's public relations director, says, "We stock upward of 50,000 different kinds of building material, home improvement supplies, and home and garden products. The 1.4-million square foot distribution centre services approximately 500 stores located in the eastern half of the U.S. Imported products range from ceiling fans and window blinds, to table saws and park benches. Containerized shipments from many countries in Europe and the Far East arrive by sea, at either the Port of Charleston or Savannah Harbour. Some items arrive by air freight."

Marc Schumacher, maintenance manager at the distribution centre, says, "Material receiving, incoming product storage, and order picking activities are handled smoothly using conventional distribution strategy and techniques. It's at the shipping end of the supply chain where advanced automation tools are considered imperative to expedite the final distribution step maintaining a steady stream of merchandise out the door and on its way to HD retail stores." A seven-vehicle AGVS has simplified traffic patterns and coordinated individual AGV moves to remove potential for shipping floor gridlock. Each AGV can handle two full pallets at a time. The "main street" for AGV travel is 113 mile long. Located on one side are six pallet pickup zones, each having room for two pallets. On the other side, 100 shipping lanes await delivery of full pallet loads. HD's TRACE (Traffic Routing AGV Command Executive) system assigns an available AGV to a request for pallet movement, commands the AGV to perform proper sequences of movement to carry out the request, monitors the status of the AGV throughout the process, and prevents vehicles from colliding.

*Contd...*

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The materials handling area is compartmentalized: compartment A is for full pallets, compartment B is for stack of items too big for palletizing, and compartment C is for partial mixed load pallets. As pallets exit a main conveyor, they are scanned by a stationary bar code scanner, and then advance to the AGV pickup zone. A vehicle is assigned to pick up the pallets, pickup is confirmed, and the vehicle is sent to either the shipping lane or the partial pallet drop-off location. Schumacher says, "The AGV system is designed to shuttle full pallets from pick conveyor LO shipping lanes. Other physical moves – sending partial pallets to staging zones for manual handling later, and diverting problematical pallet loads out of the handling system – are important to the operation. "The TRACE system performs secondary tasks such as logging for historical and reporting purposes, diagnostic functions, and reporting system and AGV malfunctions if they occur. All system maintenance and programming alterations can be performed by our staff. The time and expense saved by HD personnel is obvious."

***Source:*** Anonymous, "AGVS Ease Traffic at Home Depot," Material handling management, April 2000, p. 97

### Self Assessment

State whether the following statements are true or false:

6. Market position is used for the packaging of items.
7. Expensive products and gift items such as jewellery require a low standard of packaging.
8. PE-LD film is used for making plastic bags, shrink wrapping and stretch wrapping.
9. The PP films are not stronger than the PE films.
10. Paper wrappings provide protection against dust and light, but do not provide mechanical protection.

## 10.3 Materials Handling

The handling of products is a key to warehouse productivity for several important reasons.

First, the relative number of labour hours required to perform material handling creates a vulnerability to any reduction in the output rate per labour hour. Warehousing is typically more sensitive to labour productivity than manufacturing since material handling is highly labour-intensive.

Second, the nature of warehouse material handling is limited in terms of direct benefits gained by improved information technology. While computerization has introduced new technologies and capabilities, the preponderance of material handling requires significant manual input.

Third, until recently, warehouse material handling has not been managed on an integrated basis with other logistical activities, nor has it received a great deal of top management concern. Finally, automation technology capable of reducing material-handling labour is only now beginning to reach its full potential.

Within the warehouse system, material handling is the prime consumer of labour. The application of labour to product selection and handling represents one of logistics highest personnel cost components. The opportunity to reduce this labour intensity and improve productivity lies with emerging handling technologies. In logistics, the primary emphasis is placed on material and product inbound and outbound flows rather than inventory storage.

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*Notes* The warehouse represents the primary arena for material-handling operations.

Therefore, warehouse design is an integral aspect of overall handling efficiency and is also of vital concern in obtaining increased labour productivity.

### 10.3.1 Handling Requirements

The primary handling objective in a warehouse is to sort inbound shipments according to precise customer requirements. The three handling activities are receiving, in storage handling, and shipping.

#### Receiving

Merchandise and materials typically arrive at the warehouse in larger quantities than when they depart. The first handling activity required is unloading the transportation vehicle. In most warehouses, unloading is manual. Limited automated and mechanized methods have been developed that are capable of adapting to varying product characteristics. Generally, one or two people unload a shipment. The product is hand-stacked on pallets or slip sheets to form a unit load for movement efficiency. In some cases, conveyors are employed to unload vehicles more rapidly. Larger types of merchandise may be unloaded directly from the car or truck to be moved into the warehouse. Containerized or unit-load shipments dramatically reduce unloading time.

#### In Storage Handling

Storage handling consists of all movement within a warehouse facility. Following product receipt, it is necessary to transfer merchandise within the warehouse to position it for storage or order selection. Finally, when an order is received, it is necessary to accumulate the required products and to transport them to a shipping area. The two types of in storage handling are transfer and selection.

There is at least two and sometimes three transfer movements required within a typical warehouse. The merchandise is first moved into the building and placed at a designated storage location. The inbound movement is handled by forklift trucks when pallets or slip-sheets are used or other mechanical traction for larger unit loads. A second internal movement may be required prior to order assembly depending on the operating procedures of the warehouse. When products are required for order selection, they are transferred to an order selection or picking area. When the merchandise is physically large or bulky, such as a stove or washing machine, this second movement may be omitted. In the final transfer, the assortment of products required for a customer shipment is moved from the warehouse to the shipping dock

Selection is the primary function of the warehouse. The selection process groups materials, parts, and products into customer orders. It is typical for one section of the warehouse to be established as a selection area to minimize travel distance. The typical selection process is coordinated by a computerized control system. The primary focus for warehouse automation is the selection process.

#### Shipping

Shipping consists of checking and loading orders onto transportation vehicles. As in receiving, shipping is manually performed in most systems. Shipping with units loads is becoming

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increasing popular because considerable time can be saved in vehicle loading. A unit load consists of grouped products, while a dead-stack or floor-stack load consists of boxes loaded directly from the floor. A checking operation is required when merchandise changes ownership as a result of shipment.



*Did u know?* Checking generally is limited to carton counts, but in some situations a piece-by-piece checks for proper brand, size, and so on, is necessary to ensure that all items ordered by the customer are being shipped.

One extremely encouraging aspect of contemporary logistics is the productivity potential that can be realized from capital investment in material-handling equipment. Material handling cannot be avoided in the performance of logistics. It should, however, be minimized. The technical aspects of material handling are extensive and beyond the scope of this text. However, the following section will discuss handling methods and efficiency. Then the discussion will focus on recent developments in automated handling.

### Basic Handling Considerations

Material handling in the logistics system is concentrated in and around the warehouse facility. A basic difference exists in the handling of bulk materials and master cartons. Bulk handling is a situation where protective packaging at the master carton level is unnecessary. Specialized handling equipment is required for bulk unloading, such as for solids, fluids, or gaseous materials. The following discussion focuses on master carton handling within the logistical system.

Over the years a variety of guidelines have been suggested to assist management in the design of material-handling systems. These are representative:

1. Equipment for handling and storage should be as standardized as possible.
2. When in motion, the system should be designed to provide maximum continuous product flow.
3. Investment should be in handling rather than stationary equipment.
4. Handling equipment should be utilized to the maximum extent possible.
5. In handling equipment selection, the ratio of deadweight to payload should be minimized.
6. Whenever practical, gravity flow should be incorporated in system design.

Handling systems are classified as:

1. Mechanized
2. Semi automated
3. Automated
4. Information-directed

A combination of labour and handling equipment is utilized in mechanized systems to facilitate receiving, processing, and/or shipping. Generally, labour constitutes a high percentage of overall cost in mechanized handling.



*Did u know?* Automated systems, in contrast, attempt to minimize labour as much as practical by substituting capital investment in equipment.

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An automated handling system may be applied to any of the basic handling requirements depending on the situation. When selected handling requirements are performed, using automated equipment and the remainder of the handling is completed on a mechanized basis, the system is referred to as semi automated.

An information-directed system uses computers to maximize control over mechanized handling equipment. Mechanized handling systems are the most common. However, the use of semi automated and an automated system is rapidly increasing. As noted earlier, one factor contributing to low logistical productivity is that information-directed handling has yet to achieve its full potential. This situation is predicted to dramatically change during the 1990s.

### 10.3.2 Handling Equipments

Mechanized systems employ a wide range of handling equipment. The types of equipment most commonly used are:

1. ***Forklift Trucks:*** Forklift trucks can move loads of master cartons both horizontally and vertically. A pallet or slip sheet forms a platform upon which master cartons are stacked. A slip sheet consists of a thin sheet of material such as solid fibre or corrugated paper. Slip sheets are an inexpensive alternative to pallets and are ideal for situations when product is handled only a few times. A forklift truck normally transports a maximum of two unit loads (two pallets) at a time. However, forklifts are not limited to unit-load handling. Skids or boxes may also be transported depending on the nature of the product.

   Many types of forklift trucks are available. High-stacking trucks capable of up to 40 feet of vertical movement, palletless side-clamp versions and trucks capable of operating in aisles as narrow as 56 inches, can be found in logistical warehouses. Particular attention to narrow-aisle forklift trucks has increased in recent years, as warehouses seek to increase rack storage density and overall storage capacity. The forklift truck is not economical for long-distance horizontal movement because of the high ratio of labour per unit of transfer. Therefore, forklifts are most effectively utilized in shipping and receiving, and to place merchandise in high cube storage. The two most common power sources for forklifts are propane gas and electricity. Many forklift operations are utilizing new forms of communication technology to increase their productivity.

   *Example:* Radio frequency data communication (RFDC) is utilized to speed load put away and retrieval assignments for forklift truck operators in warehousing, manufacturing, and distribution operations.

   Instead of following handwritten or preprinted instructions, workers receive their assignments through either handheld or vehicle-mounted RF terminals. Use of RF technology provides real-time communication capability to central data processing systems, and when combined with bar code scanning of cartons and pallets, it allows forklift truck operators to receive and update item status inquiries, material orders and movements, and inventory adjustments. The Pioneer Hi-Bred International Company exhibits this application of technology to forklift operations.

2. ***Walkie-Rider, Pallet Trucks:*** Walkie-rider pallet trucks provide a low-cost, effective method of general material-handling utility. Typical applications include loading and unloading, order selection and accumulation, and shuttling loads over longer transportation distances throughout the warehouse. Electricity is the typical power source.

3. ***Towlines:*** Towlines consist of either in-floor or overhead-mounted drag devices. They are utilized in combination with four-wheel trailers on a continuous power basis. The main

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advantage of a towline is continuous movement. However, such handling devices do not have the flexibility of forklift trucks. The most common application of towlines is for order selection within the warehouse. Order selectors place merchandise on a four-wheel trailer, which is then towed to the shipping dock. A number of automated decoupling devices have been perfected that route trailers from the main line to selected shipping docks.

A point of debate involves the relative merits of in-floor and overhead towline installation. In-floor installation is costly to modify and difficult to maintain from a housekeeping viewpoint. Overhead installation is more flexible, but unless the warehouse floor is absolutely level, the line may jerk the front wheels of the trailers off the ground and risk product damage.

4. ***Tow Tractor with Trailers:*** A tow tractor with trailer consists of a driver guided power unit towing a number of individual four-wheel "trailers" that hold several palletized loads. The typical size of the trailers is 4 by 8 feet. The tow tractor with trailer, like the towline, is typically used to support order selection. The main advantage of tow tractor with trailers is flexibility. It is not as economical as the towline because it requires greater labour participation and is often idle. Considerable advancements have been made in automated-guided vehicle systems (AGVS). These are discussed under semi automated material handling.

5. ***Conveyors:*** Conveyors are used widely in shipping and receiving operations and form the basic handling device for a number of order selection systems.

   Conveyors are classified according to:

   (a) Power

   (b) Gravity

   (c) Roller or belt movement

   In power systems, the conveyor uses a drive chain from either above or below. Considerable conveyor flexibility is sacrificed in such power configuration installations.

   *Did u know?* Gravity and roller or belt systems permit the basic installation to be modified with minimum difficulty.

   Portable gravity-style roller conveyors are often used at the warehouse for loading and unloading and, in some cases, are transported on over-the-road trailers to assist in unloading at the destination.

6. ***Carousels:*** A carousel operates on a different concept than most other mechanized handling equipment. It delivers the desired item to the order selector by using a series of bins mounted on an oval track. The entire carousel rotates and brings the desired bin to the operator. A wide variety of carousels are available. The typical application involves selection of individual packages in pack and repack as well as service parts operations. The rationale behind carousel systems is to shrink order selection labour requirements by reducing walking length/paths and time. Carousels, particularly modern stackable or multitiered systems, also significantly reduce storage floor requirements.

7. ***Pick-to-Light Systems:*** Technology has also been applied to carousel systems in an application known as "pick to light." In these systems, order selectors pick designated items and put them directly into cartons from carousel bins or conveyors. A series of lights or a "light tree" in front of each pick location indicates the number of items to pick

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from each location. The light system may also be used to indicate when a carton is ready to move on. In systems where an item is picked to fill multiple orders, "softbars" show the order selector how many items are needed in a carton, since each carton typically represents a separate order. Some carousel systems also utilize computer-generated pick lists and computer-directed carousel rotation to further increase selection productivity. These systems are referred to as "paperless picking" because no paperwork exists to slow down employee efforts.

The types of mechanized material-handling equipment discussed are basic samples of the wide range available for use. Most systems combine different types of handling devices.



*Example:* Forklift trucks may be used for vertical movements while tow tractor with trailers and walkie-rider pallet trucks are used for horizontal transfers.

8. ***Semi-automated Handling:*** The semi automated system supplements a mechanized system by automating specific handling requirements. Thus, the semi-automated warehouse is a mixture of mechanized and automated handling. Typical equipments utilized in semi-automated warehouses are automated-guided vehicle systems, computerized sortation, robotics, and various forms of live racks.

9. ***Automated-guided Vehicle Systems:*** The automated-guided vehicle system (AGVS) performs the same type of handling function as a mechanized tow tractor with trailer or rider pallet truck. The essential difference is that an AGVS does not require an operator. It is automatically routed and positioned at the destination without operator intervention.

   Typical AGVS equipment relies on an optical or magnetic guidance system. In the optical application, tape is placed on the warehouse floor, and the equipment is guided by a light beam that focuses on the guide path. A magnetic AGVS follows an energized wire installed in the floor. The primary advantage is the elimination of a driver. Newer AGVs use video and information technology to follow paths without the need of fixed tracks. Contemporary AGVs are smaller, simpler and more flexible than their predecessor systems of the 1980s. AGVs have declined in popularity in recent years and industry orders have dropped by 40 percent (in dollar volume) since 1985. It is possible that the new, more flexible systems may reverse this trend.

10. ***Sortation:*** Automated sortation devices are typically used in combination with conveyors. As products are selected in warehouse and conveyorized out, they must be sorted to specific shipment docks. In order for automated sortation systems to operate, the master carten must have a distinguishing code. These codes are read by optical scanning devices and automatically routed to the desired location. Most controllers are able to be programmed to permit a customized rate of flow through the system to meet changing requirements.

    Automated sortation provides primary benefits. The first is an obvious reduction in labour, while the second benefit is a significant increase in speed and accuracy.

    High speed sortation systems can divert and align packages at rate exceeding one package per second. In this system, packages are diverted to the desired destination and can be positioned to accommodate unit loading.

11. ***Robotics:*** The robot is a humanlike machine that can be programmed by microprocessors to perform one or a series of activities. The appeal of robotics lies in the ability to program the robot to function as an expert system capable of implementing decision logic in the handling process. The popularity of robotics resulted from their widespread adoption in the automotive industry during the early 1980s to replace selected manual tasks. However,

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a warehouse provides a different type of challenge than a typical manufacturing plant. In warehousing, the goal is to accommodate the exact merchandise requirements of a customer's order. Thus, warehouse specification can vary extensively from one customer order to the next and results in far less routine activities than typically found in manufacturing.

The primary use of robotics in warehousing is to break down and build unit loads. In the breakdown process, the robot is programmed to recognize stocking patterns and place products in the desired position on a conveyor belt. The use of robots to build unit loads is essentially the reverse operation.

Another prime potential use of robotics in warehousing occurs in environments where humans find it difficult to function.



*Example:* Include high noise areas and extreme temperature environments like cold-storage freezers.

Significant potential exists to use robots in a mechanized warehouse to perform selected functions. The capability to incorporate artificial intelligence in addition to their speed, dependability, and accuracy makes robotics an attractive alternative to traditional manual handling methods.



*Task* Compare and contrast order selection and unit load automation.

12. ***Live Racks:*** Live Racks Storage rack design, in which product flows forward to the desired selection position, is a commonly used device to reduce manual labour in warehouses. The typical live rack contains roller conveyors and is constructed for rear loading. To complete the installation, the rear of the rack is elevated higher than the front, causing a gravity flow forward. When unit loads are removed from the front, all other loads in that specific rack automatically move forward.



*Example:* Live racks are a prime example of incorporating gravity flow into material-handling system design.

The use of the live rack replaces the need to use fork trucks to reposition unit loads. A significant advantage of this form of storage is the automatic rotation of product that results from rear loading of a live rack. Rear loading facilitates "first-in, first-out" management of inventory. Applications of gravity flow racks are extremely diverse.



*Example:* Such racks are utilized to "stage," or store and position, fresh biscuits or bread for bakery manufacturers on individual pallet loads in preparation for shipping.

Flow-rack staging is also typically utilized for automotive seats in JIT systems.

### 10.3.3 Automated Material Handling

For several decades, the concept of automated handling has been long on potential and short on accomplishment. Initial efforts directed toward automated handling concentrated on order selection systems at the master carton level. Recently, emphasis has switched to automated high-rise storage and retrieval systems (ASRS). Each is discussed in turn after a brief review of automated handling concepts.

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### Potential of Automation

The appeal of automation is that it substitutes capital investment in equipment for labour required in mechanized handling systems. In addition to using less direct labour, an automated system operates faster and more accurately. Its shortcomings are the high degree of required capital investment and the complex nature of development and application.

To date, most automated systems have been custom-designed and constructed for each application. The six guidelines previously noted for selection of mechanized handling systems are not applicable to automated systems.



*Example:* Storage equipment in an automated system is an integral part of the handling capability and can represent as much as 50 percent of the total investment.

The ratio of deadweight to payload has little relevance in an automated handling application. Although computers play an important part in all handling systems, they are essential to automated systems. The computer provides programming of the automated selection equipment and is used to interface the warehouse with the remainder of the logistical system. The warehouse control system is vastly different in automated handling. One factor that prohibited rapid development of automated systems was the high cost of minicomputers. Breakthroughs in microprocessors have eliminated this barrier.

## Self Assessment

Fill in the blanks:

11. Within the warehouse system, …… is the prime consumer of labour.
12. …… handling consists of all movement within a warehouse facility.
13. …… consists of checking and loading orders onto transportation vehicles.
14. …… can move loads of master cartons both horizontally and vertically.
15. …… consist of either in-floor or overhead-mounted drag devices.



*Case Study*

### ASRS at IBM's Charlotte

After more than 16 years of continuous service, the ASRS at IBM's Charlotte, North Carolina, manufacturing facility was showing extensive wear and tear. Much of the existing control system was quickly becoming obsolete. Parts were either proprietary or very difficult to find. Plus, there were Y2K problems. Safety was also an issue, as cracks had appeared in the rails used to guide the system's Storage and Retrieval Machines (SRMs). IBM faced either the purchase of a new system or a total upgrade to its existing ASRS, which serves as the primary warehousing system for raw materials used in production of PCs and point-of-sale terminals. About one-fifth of the ASIRS capacity is also used for finished goods. After investigating the alternatives, it was determined that a true systems upgrade would provide substantial savings-about one-tenth the estimated cost of a new system.

Since completing the upgrade, the ASRS' operating costs have been greatly reduced. Productivity has increased, storage density is higher, and better tracking systems have

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been implemented. The system can now handle 50 percent more throughput at 220 moves an hour, and uptime is now 98 percent. Today, the ASRS houses more than 28,000 SKUs in its 10 80-foot high, 500-foot long aisles. An S/RM is dedicated to each aisle, handling both receiving and picking functions. The entire ASRS system is controlled by a series of PCs networked to an RSl6000 computer. The mainframe decides which products are needed for the day's manufacturing and builds a list of materials. An SIRM is instructed to travel to an individual location where parts are stored. Photo eyes direct the S/RM to the exact location of the desired SKU, and an extractor removes the load. The SRM then delivers the part to a pickup deposit station at the front of the aisle, placing the pallet on a slipsheet. A conveyor delivers the unit to the manufacturing workstation. Previously, controllers for the conveyor that replenishes the front of the ASIRS and the conveyor that outputs to production worked independently and required separate control rooms.

After the upgrade, both operate from the same PLCs, eliminating one control room and the need for operators in two locations. Monitoring and reporting functions have also been greatly improved. Installing the new ASIRS system was not an easy task. As an essential component of the plant's production process, the ASRS needed to continue to store and retrieve inventory throughout the entire retrofit process. The crew had to meet a tight schedule to perform that day's installation work, do required testing and verification, and then be ready to switch it all back over for full production the next day. The upgrade on the S/RM was performed aisle by aisle, with the first aisle taking 7 days for its upgrade and 3 days each for the remaining nine aisles.

All 4800 feet of floor rails that guide the SRMs were also replaced with new thermite welded epoxy-grouted rails designed to prevent deterioration. The original safety concerns have now vanished. Gone too are obsolete and proprietary parts, as all components are state-of-the-art and Y2K compliant and readily available from a variety of suppliers.

**Question**

Analyse the case and write down the case facts.

***Source:*** David Maloney, "ASIRS Upgrade Puts Big Blue in the Black," Modern Modelling handling. 54, no. 4 (April 1999). pp. 40–41.

## 10.4 Summary

- Packaging refers to a container in which the product reaches the end use consumer.
- Packaging plays a very important role in the marketing of a product; it is a part of the augmented product.
- The logistics of execution of the export order suggests that once the goods have been procured and processed or manufactured for the purpose of export, then the exporter should turn to the issues relating to labeling and packaging.
- There are various types of materials available for packaging of the goods which are paper, plastics, wood, cardboard etc.
- Polyethylene film has two main varieties of consumer packaging namely, low density polyethylene (PE-LD) film and high-density polyethylene (PE-HD).
- Paper based materials are used as wrapping, as paperboard cartons or corrugated fibreboard boxes.
- There are three main types of packaging that combine paperboard and plastic materials – Skin Packaging, Blister Packaging and Plastic Bags with a Paperboard Card.

Notes

- The primary handling objective in a warehouse is to sort inbound shipments according to precise customer requirements.
- Storage handling consists of all movement within a warehouse facility.
- Material handling in the logistics system is concentrated in and around the warehouse facility.

## 10.5 Keywords

***Blister Packaging***: In this form of packaging, the product is first placed into a pre-formed plastic blister.

***Card board boxes***: These are used for the packaging of items such as sets of glasses or tableware, decoration with several delicate parts, pairs of candle holders, glass vases, delicate statuettes etc., to ensure that they are not damaged and their appearance is not spoiled during handling and display.

***Conveyors***: They are used widely in shipping and receiving operations and form the basic handling device for a number of order selection systems.

***Forklift trucks***: It can move loads of master cartons both horizontally and vertically.

***Materials Handling***: Material Handling refers to activities, equipment, and procedures related to the moving, storing, protecting and controlling of materials in a system.

***Packaging***: It refers to a container in which the product reaches the end use consumer.

***Paper Board Cans***: The paperboard can is a form of paper based retail packaging, which is quite inexpensive and is used to pack different types of products.

***Polyethylene film***: Polyethylene film is a resinous material often used to make plastic wrap, protective covers, and grocery bags.

***Robotics***: The robot is a humanlike machine that can be programmed by microprocessors to perform one or a series of activities.

***Skin Packaging***: Skin packaging is a form of packaging where the product is first placed on a paperboard card with heat seal coating.

***Towlines***: A line used in towing a vessel or vehicle.

***Walkie-rider pallet trucks***: It provides a low-cost, effective method of general material-handling utility.

## 10.6 Review Questions

1. Define Packaging.
2. "Packaging plays a very important role in the marketing of a product." Elucidate.
3. Highlight the factors involved in the selection of the packaging materials.
4. What are the various kinds of Packaging?
5. Explain the three main types of packaging that combine paperboard and plastic materials.
6. Discuss the activities involved in handling requirements.
7. Explain the types of handling equipment.
8. Describe automated material handling.

9. Write brief note on Robotics.

10. What do you understand by Sortation?

Notes

### Answers: Self Assessment

| | | | |
|---|---|---|---|
| 1. | Packaging | 2. | Exporters |
| 3. | Decision-making | 4. | Product |
| 5. | International | 6. | False |
| 7. | False | 8. | True |
| 9. | False | 10. | True |
| 11. | Material Handling | 12. | Storage |
| 13. | Shipping | 14. | Forklift trucks |
| 15. | Towlines | | |

## 10.7 Further Readings



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# Unit 11: Supply Chain Logistics Design

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## Objectives

After studying this unit, you will be able to:

- Understand the Supply Chain Design
- Explain the Global Strategic Positioning
- Discuss the Global Supply Chain Integration
- Describe the SC Security
- Explain the International Sourcing

## Introduction

There has been a major change in how companies operated in the 1980s and how they operate today. Earlier, large multinational companies tended to focus their efforts on establishing leaner manufacturing processes, total quality controls and new offices in strategic markets as the means to develop new business. Their logistics functions were generally handled in-house or by several in-country third-party logistics providers.

But with the advent of the new global economy, previously closed or protected world markets have begun to open, often with improved regional trading infrastructures. Economies are beginning to flourish with the increasing growth of mid-sized, high-tech businesses. Senior managements of successful multinational companies have begun questioning the need to replicate every element of their organisation in each marketplace.

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The result is that multinationals are increasingly focusing on manufacturing and marketing and are outsourcing warehousing, distribution and other logistics services to expert third-party logistics providers (3PLs) that can develop logistics networks to keep down the cost of entry into global markets.

As companies expand their supply chains worldwide, logistics complications grow and solutions become more problematic.

## 11.1 Supply Chain Design

Customer requirements are diverse for different types of products and range enormously from one market sector to another. It is therefore not possible to service everybody with everything via a single all embracing supply chain strategy. Most companies require some level of mix of the two approaches in designing the supply chain.

This is especially true of multi-product companies and consumer-oriented companies. In general, they have to live with the problem that they do not have the freedom to settle for one competitive strategy. The competition forces them to pursue cost leadership for one product line and a focus strategy for another within the same business unit. This requires separate supply chain processes within the same business unit.

This is likely to be a major constraint in the design of a supply chain that has the best strategic fit and all the benefits of good strategic fit that include cost reduction, improved efficiencies, better responsiveness, and the transfer of knowledge and skills may not be achieved. One way to handle this issue is that the process and model for designing supply chain should be cross-functional.

In general too, the design process and supply chain model requires inputs (estimates, real values and empirical values based on experience) from marketing, engineering, finance, manufacturing and supply chain teams so that reasonable estimates of the supply chain performance can be obtained. By handling supply chain design as a cross-functional problem, a solution to both the issues can be found.

It is difficult to conceptualize the principles of 'strategic fit' and how it is applicable in the design of supply chains without a practical example. Therefore, let us try out the concepts with a simple example.



*Example:* You are asked to design a supply chain for Style and Grace at Connaught Place. Style and Grace is a retail outlet for menswear. It sells cloth and readymade menswear of some of the well-known brands. In addition, it has a tailoring department that manufactures custom made menswear, basically suits for customers. The store caters to the high and high-middle income groups. You have to determine its competitive strategy. You also have to where you would place the demand on the implied uncertainty spectrum and why. Based on these you have to outline your considerations in designing the supply chain.

The customer profile of Style and Grace is high end and high middle income group clientele. For the readymade menswear, the customers would generally be ladies, whereas for the tailor-made suits, the customers would generally be men, as the measurement and fitment of suits requires their presence.

Customers, with this socio-economic profile, would be less price sensitive and more brand and quality conscious. They would also be highly conscious of the time utility, especially men, as they would be working people. They will appreciate good service especially if it is personalized.

Style and Grace is located at Connaught Place. This is a major shopping area and in addition, it is also the commercial centre in Delhi. The locational attributes are a distinct competitive

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advantage for it. A customer could leave his office for a short while, either for measurements or fitment, without much problem.

The supply chain in this industry consists of suppliers of branded products, some of whom are established in the market. The established players normally provide 30 to 60 days credit for stock delivered to the retailer. Suppliers of branded products that are not established may provide their goods on a 'consignment' basis, i.e. the goods are paid for when they are sold and unsold goods are taken back by the manufacturer.

For the tailor-made products, such shops normally employ a few master tailors who take the customers measurements and oversee the fitting. The stitching is normally carried out by independent tailors, who are attached to the organization.

When you analyze the product range of Style and Grace, it is clear that there are two distinct supply chains, one for the branded readymade, and the other for the tailor-made custom products.

For the branded products, the demand uncertainty is high. You do not know what product the customer will buy. If the customer is unable to find his size, style, brand or colour, the sale will be lost. For the branded products, we need to have a supply chain that is responsive so as to avoid stock-out situations.

In the case of the tailor-made products, as the customer would come and order for the product and then its manufacturing would start, the demand is certain. For these products, we need to have an efficient supply chain so that we can supply the product to the customer with the right quality and with speed i.e. at the right time.

The overall strategy calls for coordination of two different supply chains. The functional spectrum aspect depicts two supply chains that move in opposite directions.

A good strategy would be to use the certain demand of tailor-made products complement the demand for branded shirts and accessories whose demand is uncertain.



*Example:* If a customer comes in for a suit, we could cross-sell him the matching shirt, tie, belt etc.

They could have catalogues which would be promoted by the tailors, while they are measuring or fitting the customer. Also, it must be remembered that men are generally less price conscious than women. The supply chain for the branded items should be responsive enough to supply the items on the date the suit is to be delivered. This means the concept of cross-functional teams would help Style and Grace.

The design requires a strategic fit between the two supply chains. Each functional strategy must support the other functional strategy so that acting in harmony, Style and Grace can attain competitive advantage. For successful execution of the supply chain strategy, we first need to understand the supply chain capabilities and demand uncertainty. Secondly, we need to streamline the three flows such that they are efficient enough to reduce the time required to complete the cycle.

For the readymade products, Style and Grace needs to have a cooperative relationship with its suppliers. These relationships should be based on cost focus. There must be highly personalized and responsive customer service. Proper customer relationship management becomes important. If Style and Grace are able to create high customer loyalty, they will be in a position to take advantage of the more lucrative deals offered by the less established brands, and also get better credit facilities from the established brands.

All customer information has to be captured and regularly upgraded. This is especially important as the pattern of demand of its customers may be unique.

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*Notes* To capture this information requires a progressive IT strategy. The data is required for the firm to decide their demand flow strategy.

Managing demand uncertainty in a cost effective manner can lead to significant benefits for a company from lower supply chain costs to improved customer service levels. More importantly, this can be a huge competitive differentiator for Style and Grace. The merchandise order, the ratio in which sizes need to be ordered, minimum base quantities and establishing reorder points are determined by the demand flow strategy.

For the tailor-made products, the relationship with the suppliers and the speed of processing and delivery are crucial. Style and Grace will have to maintain a collaborative or alliance relationship with the suppliers.

Proper supplier relationship management becomes important. It will have to help its suppliers in developing the capability to deliver high quality products. Also, speed has to be a focus. The fitment time should not exceed three days and the suit should be delivered within a week. Service quality is critical. In case there are any mistakes, the garment should be corrected on priority and delivered at the place of the customer within 24 hours.

This example explains the concept and issues involved in designing a supply chain and the concept of strategic fit. It also addresses the issue of separate supply chain processes within the same business unit.

Strategic fit determines the extent to which the activities of organizations working in partnership complement each other in such a way as to contribute to competitive advantage. A number of generic techniques – namely, integrated supply chain, lead-time compression, waste elimination, inventory and capacity buffers, process flexibility, level-scheduling, process redesign, can be used when there are mismatches between strategy and demand uncertainty and this needs correction. Always remember, an effective supply chain design is a supply chain whose strategy is integrated with the competitive strategy of the firm.

### Self Assessment

Fill in the blanks:

1. It is difficult to conceptualize the principles of …… and how it is applicable in the design of supply chains without a practical example.
2. The …… profile of Style and Grace is high end and high middle income group clientele.
3. For the …… products, the relationship with the suppliers and the speed of processing and delivery are crucial.

## 11.2 Global Strategic Positioning

With increased globalization and offshore sourcing, global supply chain management is becoming an important issue for many businesses. Like traditional, supply chain management, the underlying factors behind the trend are reducing the costs of procurement and decreasing the risks related to purchasing activities. The big difference is that global supply chain management involves a company's worldwide interests and suppliers rather than simply a local or national orientation.

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Because global supply chain management usually involves a plethora of countries, it also usually comes with a plethora of new difficulties that need to be dealt with appropriately. One that companies need to consider is the overall costs. While local labour costs may be significantly lower, companies must also focus on the costs of space, tariffs, and other expenses related to doing business overseas. Additionally, companies need to factor in the exchange rate. Obviously, companies must do their research and give serious consideration to all of these different elements as part of their global supply management approach.

Time is another big issue that should be addressed when dealing with global supply chain management. The productivity of the overseas employees and the extended shipping times can either positively or negatively affect the company's lead time, but either way these times need to be figured into the overall procurement plan. Other factors can also come into play here as well.



*Example:* The weather conditions on one side of the world often vary greatly from those on the other and can impact production and shipping dramatically.

Also, customs clearance time and other governmental red tape can add further delays that need to be planned for and figured into the big picture.

Besides contemplating these issues, a business attempting to manage its global supply chain must also ask itself a number of other serious questions. First, the company needs to make decisions about its overall outsourcing plan. For whatever reason, businesses may desire to keep some aspects of supply chain closer to home. However, these reasons are not quite as important as other countries advance technologically.



*Example:* Some parts of India have now become centres for high-tech outsourced services which may once have been done in-house only out of necessity.

Not only are provided to companies by highly qualified, overseas workers, but they are being done at a fraction of the price they could be done in the United States or any other Western country.

Another issue that must be incorporated into a global supply chain management strategy is supplier selection. Comparing vendor bids from within the company's parent-country can be difficult enough but comparing bids from an array of global suppliers can be even more complex. How to make these choices is one of the first decisions companies must make, and it should be a decision firmly based on research. Too often companies jump on the lowest price instead of taking the time to factor in all of the other elements, including those related to money and time. Additionally, companies must make decisions about the number of suppliers to use. Fewer supplies may be easier to manage but could also lead to potential problems if one vendor is unable to deliver as expected or if one vendor tries to leverage its supply power to obtain price concessions.

Finally, companies who choose to ship their manufacturing overseas may have to face some additional considerations as well. Questions regarding the number of plants that are needed, as well as the locations for those plants can pose difficult logistical problems for companies. However, it often helps to examine these issues in terms of the global supply chain.



*Example:* If a business uses a number of vendors around Bangalore, India than it may make sense to locate the manufacturing plant that would utilize those supplies in or around Bangalore as well. Not only will this provide lower employee costs, but overall shipping and tariff expenses should also be reduced. This would then save the company money.

## 11.2.1 Factors Driving Global Supply Chain Management

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Most companies recognize the need to respond to shorter product lifecycles, increased customer expectations, fluctuating inventory levels and changing costs. But a small number of companies recognize the impact of that strategy on their supply chain, nor the shifts they will need to make to move from simply being efficient and to becoming truly responsive.

The fast moving consumer goods, electronics, and petroleum industries reflected upon the challenges of designing and optimizing a supply chain in today's dynamic environment. The challenges and how they have changed over time – executives from many firms around the world are discussing on these issues. While they had often not organized their decision criteria in the same format, most executives operating regionally and globally agreed with the general shift, are convinced about the nature, importance and implications of the shift.

The shift and its implications for today's logistics and supply chain have been mainly influenced by the globalisation. The shift refers to the prioritization or importance of the factors driving supply chain design. The major decision factors for global supply chain management include:

1. ***Demand Location:*** It refers to the geographic location and shipment profile (relative volume, size and characteristics) of the market. All other things being equal, firms would rather locate production and/or distribution centres near the consumer markets. The fact that demand in Asia, India, South America, and Eastern Europe is growing at double digit rates strongly motivates global firms to shift supply chain activities to those regions.
2. ***Labour Cost:*** It refers to the relative cost of production and distribution actions such as manufacturing and handling. This factor is a driver of the move by many firms towards low-cost-country production such as in China, India, and Eastern Europe. Labour cost comprises direct labour rate as well as both benefits and assigned overhead cost.
3. ***Material Cost:*** It refers to the total cost of the raw material and workings, including both the direct and indirect cost. The direct cost represents the specific purchase cost of the material as well as the duties and packaging.



*Did u know?* The material indirect cost comprises the transaction and risk related costs such as security, obsolescence, and potential intellectual property risks.

4. ***Transportation Cost:*** It includes the cargo cost required for obtaining raw material, moving material between plants and distribution facilities, and ultimate distribution to customers and consumers.

Tax structures and tax rates have at all times been design considerations, particularly when selecting between alternative sites within a local geography. These tax incentives have frequently been done through property tax allowances or holidays. While such tax incentives have been used to attract facilities to specific municipalities within a specific region, it was not usual that they could make enough difference to substantially change the region. Of late however, tax allowances have been extended to include holidays from value-added, income, and duty payment terms. As a result, the location of production and additional value added sites is now often strongly influenced by regional and national tax strategies.



*Example:* Ireland's use of reduced value added tax rates on manufacturing of electronics and pharmaceuticals has done much to return industry and jobs to the Emerald Isle.

Similarly, Singapore has established tax advantages for goods that have value added activities completed in Singapore. The value added activities could include everything from physical

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manufacturing processes to inventory risk management. Major Chinese cities are employing the similar strategy to attract firms or industries to their industrial parks, and their success is copied in other countries, such as Vietnam and Cambodia. Even the U.S. has witnessed increased interest in "Free Trade Zones" or "Tax Free Zones" as a motivator to magnetize jobs.

There has been a shift in the priorities for supply chain design. While proximity to market demand is still the main factor ("Location, Location, Location"), the order of significance (most to least important) for the remaining four factors is: tax policy; transportation cost; production cost; and raw material cost. In many cases, the differential due to tax policy habitually overwhelms the differences due to production or labour rates.

First, it is significant that supply chain managers understand the various dimensions of local, state and federal tax policy and how that may impact supply chain design. The use of incentives for property, income, value added and corporate taxes and their relative impact on a variety of supply chain activities need significant consideration for supply chain design.

Second, the use of tax policy as a strong contemplation in supply chain design introduces a number of issues for logistics and supply chain management. These include infrastructure concerns, tax policy dynamics and action integration. Infrastructure concerns refer to the logistics and transportation infrastructure that is in place to support supply chain activities.

For instance, while both Ireland and China used tax incentives to attract supply chain value added activities to their countries, the transportation infrastructure was not initially able to handle the competence required. While the Irish infrastructure is beginning to catch up, it will be a while before the Chinese infrastructure can accommodate the new level of activity. Supply chain and logistics managers need to understand the implications of these infrastructure problems; and should be able to communicate them with the planners evaluating the design strategy.

Tax policy dynamics refers to the detail that; such tax incentives may change quickly, resulting in a need to adapt the supply chain design. Specifically, the decisions based on the tax incentives are inherently long-term while the tax incentives may sunset after a recommended time or may change due to the political environment. Activity integration refers to the combination of locations within the supply chain when specific value added activities take place.



*Example:* The tax incentive may motivate production or other value added operations or inventory risk.

For instance, some firms manage global or regional inventory from Singapore by having a Singaporean entity purchase product from global production operation at the customary production cost and then resell it to markets around the world, resulting in the profits being generated in a tax preferred environment. While there are certainly limits in a firm's ability to administer the location of global profits, such strategies can make a significant impact.

Third, since tax incentives and transportation cost have an increasingly significant role in supply chain design, logistics and supply chain managers need to develop a deep understanding and awareness regarding their dynamics and interactions. Distinctly, what is the relative impact of value-added income, property, or income taxes on specific supply chain activities? Similarly, changing transportation cost consequential from capacity congestion, lane imbalances, and mode shifts due to global activity can be an incentive for a change in the supply chain network design.

These challenges call for the improvement of transport cost dynamics and inclusion of tax policy implications in supply chain academic and management education. These are topics that not numerous supply chain managers have much knowledge about today. Individuals involved in supply chain design need an in-depth understanding of the relative impact of transportation and tax incentives and their dynamics based on policy, fuel volatility, congestion and capacity. It is

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significant that supply chain and logistics managers begin to develop this understanding to accurately evaluate, compare, and explain the relative trade-offs.



*Task* Find out some other factors affecting global supply chain management.

## Self Assessment

State whether the following statements are true or false:

4. Time is not a big issue that should be addressed when dealing with global supply chain management.
5. Labour Cost refers to the relative cost of production and distribution actions such as manufacturing and handling.
6. Tax structures and tax rates have at all times been design considerations, particularly when selecting between alternative sites within a local geography.

## 11.3 Global Supply Chain Integration

Global economies are increasingly interlinked by material suppliers, logistical systems, manufacturing capacity, and markets. It is natural that this interconnectedness takes the form of regional alliances that leverage geographic proximity and scale economies. The major triad regions developing are North America, Europe, and the Pacific Rim. It is likely that Eastern Europe will join with the Western European countries and that South America will ultimately link up with North America. Although there is considerable speculation, the ultimate resolution involving the former Soviet Union states and African countries is not clear. As regional alliances emerge, they evolve through four stages of integration. This section introduces these stages and reviews each region's development status.

### 11.3.1 Stages of Regional Integration

The four stages of economic integration are free trade agreement, customs union, common market, and economic union. The first stage, a free trade agreement, eliminates tariffs on trade between countries in a region. Specifically, a free trade agreement is defined when:

Each participant in the free-trade area expects to gain by specializing in the production of goods and services in which it possesses comparative advantages and by importing from other countries in the group products and services in which it faces comparative disadvantages. Thus, trade should be created among member countries, giving them less expensive access to more goods.

A free trade agreement may either stimulate or reduce interregional trade. Such agreements can also reduce access of the firms to more efficient producers or markets outside their region.

The second stage, a customs union, eliminates tariffs between member countries and establishes a common external tariff structure toward other regions and non-member countries. Under this and the remaining two stages, member countries are required to give some control over economic policies to the group. The advantage of a customs union is that none of the member nations in the union can position themselves to gain a tariff advantage at the expense of other countries.

The third integration stage, a common market, is characterized by the same tariff policy as the customs union. In addition, a common market allows factors of production such as labour and capital, as well as goods and people, to move freely between member countries as dictated by market conditions.

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The economic union is the fourth and most advanced stage of development because it implies harmonization of economic policies beyond a common market. Economic union standardizes monetary and fiscal policy among member countries. While not absolutely required, an economic union likely includes common currency and harmonized tax structures. The economic union implies that all goods and production factors can move freely according to market conditions and that no major fluctuations in monetary exchange and interest rates will occur.

### 11.3.2 Integration Status

This section reviews the current status of each major global region, including a summary of current and proposed trade acts. It also discusses the logistics implications of each trade act and the strategies reported by enterprises to accommodate and take advantage of regional changes.



*Caselet*

## IBM Evolves a Globally Integrated Supply Chain

IBM's global supply chain encompasses hundreds of thousands of suppliers and is used to address every product and service offering the company produces – from mainframe computers, servers and other hardware, to software, services and spare parts. Orchestrating a supply chain of this size and complexity while achieving end-to-end visibility and total integration is not a small task. In many respects, it came about as the company itself evolved.

"Last year, IBM celebrated its 100th anniversary," said Mike Ray, Vice President of Business Integration and Strategy for IBM's Integrated Supply Chain. "I mention this because in many respects, the changes we have made to the supply chain over the years can be mapped to the changes in the company over the years".

There was a point in time, for example, when IBM, as a multi-national organization, let every business unit within the company run itself. "The supply chain was similar," Ray acknowledges. "It was characterized by a widely distributed infrastructure and by widely distributed procurement practices. Later, as IBM became a global and integrated enterprise, the supply chain changed radically as well. Today, all of our supply chain processes are fully integrated on a global basis, from purchasing to manufacturing and logistics. Nothing in the system is done locally."

Along with this company and supply chain integration was the recognition that if the supply chain was going to be successful, it had to function in a circular and networked fashion, and not in the older, linear model.

Like most global enterprises, IBM has gone through years of both evolution and transformation in its business and supply chain. Today's challenges require the company to be competitive and responsive in an ever-changing global marketplace. This focus demands a set of sound best business practices and best supply chain practices that will enable the company to reach its goals.

***Source:*** http://www.highbeam.com/doc/1G1-291360206.html

### Self Assessment

Fill in the blanks:

7. …… economies are increasingly interlinked by material suppliers, logistical systems, manufacturing capacity, and markets.

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8. A …… agreement may either stimulate or reduce interregional trade.

9. …… standardizes monetary and fiscal policy among member countries.

## 11.4 SC Security

Securing the global supply chain, while ensuring its smooth functioning, is essential to our national security and economic prosperity. This vital system provides the goods that feed our domestic critical infrastructures and support our way of life. Other nations worldwide also rely upon the goods transported by the global supply chain system – in that sense it is a truly global asset that all stakeholders must collaboratively work to strengthen.

As a number of recent events have shown us, the global supply chain is dynamic, growing in size and complexity, and is vulnerable to a host of threats and hazards such as natural disasters, accidents, or even malicious attacks. A common approach, involving the range of stakeholders with supply chain roles and responsibilities, is necessary.

The Strategy, focused on the worldwide network of transportation, postal, and shipping pathways, assets, and infrastructures (including communications and information infrastructures) is an important step forward. It provides strategic guidance to departments and agencies within the United States Government and identifies our priorities to stakeholders with whom we hope to collaborate going forward.

### 11.4.1 The Strategy

The Strategy establishes two goals. The first is to promote the efficient and secure movement of goods and the second is to foster a global supply chain system that is prepared for and can withstand evolving threats and hazards, and rapidly recovery from disruptions. As we work to achieve our goals, we will be guided by two overarching principles established in the Strategy. First, we will work to galvanize and integrate efforts across the United States Government and with other key stakeholders. And second, we will continue and enhance our risk management efforts. The Strategy also identifies a number of priority areas upon which we will focus our immediate implementation efforts. We invite creative and smart ideas on how to improve policies and activities relevant to these priorities or other areas of interest.

### Self Assessment

State whether the following statements are true or false:

10. Securing the global supply chain is not essential to our national security and economic prosperity.

11. The Strategy establishes two goals.

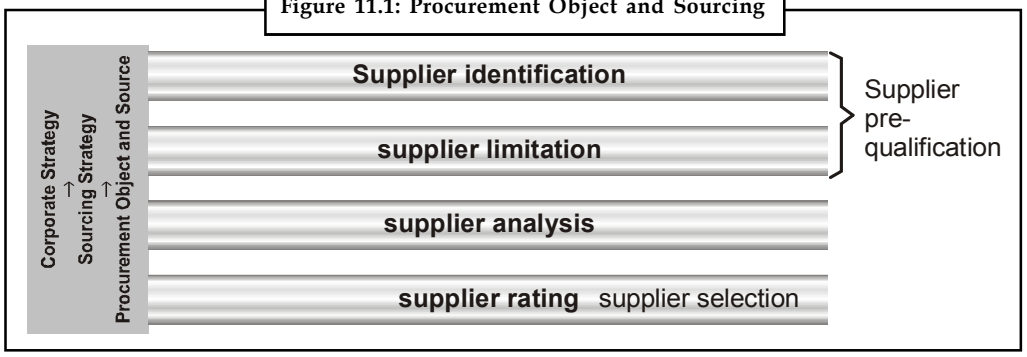
12. The Strategy does not focused on the worldwide network of transportation, postal, and shipping pathways.

## 11.5 International Sourcing

Sourcing, is the way in which companies select their suppliers, determine the number they will work with, and define the type of contractual agreements that will exist. This often includes determining parameters for supplier pre-qualification, supplier analysis and evaluation. Sourcing is the key to the development of a successful supply chain. Figure 11.1 summarizes the object of sourcing.

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Figure 11.1: Procurement Object and Sourcing




*Source:* Upendra Kachru (2010). "Exploring the Supply Chain". Excel Books

Sourcing decisions have to be consistent with supply chain strategy of the firm.

*Caution* To ensure this compatibility, generally a cross-functional team with purchasing representation carries out the analysis.

Analysis is in two parts:

- ***Internal/external analysis:*** Details of the company's internal capabilities as well as the capability of outside suppliers are collected. This is the heart of the review. To carry out the analysis, some answers are required:
  - What competence factors to use in analysing the firm and evaluating suppliers (e.g. flexibility, understanding the company's business, technology leadership)?
  - Who has the technical capabilities to provide the good or service?
  - Who can deliver a quality product?
  - Who can make timely deliveries?
  - What costs are associated with each alternative?
- ***Generate/evaluate options:*** From the information generated, purchasing has to decide the number of suppliers the firm will utilize. There are three sourcing alternatives or combinations of these three that the firm can choose from:
  - Multiple Sourcing,
  - Single Sourcing, and
  - Network Sourcing.

It also has to decide who can qualify to make the product or component required by the firm and what type of relationship it has to develop with the supplier.

Global sourcing is a strategic sourcing strategy that effectively broadens the scope of the procurement process to include companies that operate in other countries. Strategic sourcing is the internal business process used to manage the bidding and vendor selector process.

*Notes* Procurement is also known as purchasing and refers to the laws surrounding fair and equitable bidding opportunities.

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The use of global sourcing has been the driving force behind the development and expansion of the global economy. Including suppliers from around the world in the bidding process for large contracts reduces prices and increases competition. The creation of this type of infrastructure allows firms to create subsidiary offices in locations around the world. There are three main industries that are ideal for this strategy: manufacturing, skilled services and telephone call centres.

Manufacturing costs vary internationally due to currency conversion and the cost of living in different countries. The costs of labour and materials are lower in developing nations than in North America. This difference translates into significant savings in salary and benefit costs.

Skilled services such as purchasing, engineering, information technology professionals and consultants are a growing area of global sourcing. The level of skill and knowledge held by these professional allows them to provide high quality services to their employers. Due to the lower cost of living in different nations, many firms are building their professional services departments outside North America.

Telephone call centres have grown exponentially in India and other countries where English is the primary language. The staff, equipment and construction costs for these facilities are significantly less than in North America. In addition, there is a large pool of potential employees who are interested in this type of employment opportunities.

Global sourcing has both benefits and risks. The benefits of sourcing for the employer include lower labour costs, less government oversight and a larger pool of potential employees and customers. For the employees, the benefits include a higher wage, improved working conditions and learning transferable skills. The risks include higher costs due to cultural and language related issues.

Diversifying business operations across different countries increases business travel and local management issues.



*Did u know?* Most companies prefer to transfer knowledgeable staff to global locations for senior management positions. In addition, they limit local management hiring to the supervisory levels.

Logistics and transportation issues are critical to sourcing decisions. Any company considering international suppliers must create an infrastructure of staging and storing locations in these nations. Contracts with shipping and transportation companies add to the costs of global sourcing for manufacturing plants.

## Self Assessment

Fill in the blanks:

13. …… is the way in which companies select their suppliers, determine the number they will work with, and define the type of contractual agreements that will exist.

14. …… sourcing is the internal business process used to manage the bidding and vendor selector process.

15. …… costs vary internationally due to currency conversion and the cost of living in different countries.

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*Case Study*

## Total Logistics Adding Value for Premier Farnell

Farnell InOne is Premier Farnell's web-based eBusiness, stocking more than 250,000 products. In delivering the full catalogue in Europe while simultaneously cutting costs, Premier Farnell commissioned Total Logistics supply chain consultancy to design and implement the required logistics solution for expanding the company's Preston and Leeds distribution hubs to include Liege in Belgium.

Premier Farnell had successfully expanded its Farnell InOne eBusiness to cover the whole of Europe using its Leeds distribution hub, but wanted to cut the next-day delivery costs - particularly the express air carrier charges – required to maintain service levels. In addition, the company simultaneously wanted to expand its CPC business – currently based in Preston – into Europe.

With a new European distribution centre strategy in place for delivering cost-effective international fulfilment from mainland Europe, three preferred sites were subsequently identified in Liege, Belgium. Moving European operations to Liege would ease pressures on next-day delivery while allowing a significant volume of goods to be delivered more cheaply by road.

Several sites were considered: one existing building, one developer building about to be constructed and one 'Greenfield' purchase and construct site. The initial warehouse design work identified and optimum building requirement of 23,000 sq m, starting at 14,000 sq m and then expanding as required. Premier Farnell has a significant amount of in-house logistics expertise but felt that additional skills were required on the project. Total Logistics was selected after a lengthy evaluation process. Premier Farnell's key selection criteria included practicality, cost-effectiveness, on-time delivery and an implementation that would not impact on existing operations.

Total Logistic's role was six-fold: to develop a good planning base for the Liege centre; to evaluate alternative technologies for its operation; to develop the centre scheme designs; to support the design of the site layout and the site searching process; to produce an overall implementation plan; and to demonstrate the requirements of the inter-site replenishment operations at all sites - Leeds, Preston and Liege.

In addition, Total Logistics supply chain consultants identified three optional areas that would add value to the project and increase the effectiveness of the solution. These were to support Premier Farnell's IT team with Warehouse Management System (WMS) development; to develop tender specifications for all storage and handling equipment; and to implement the final solution design. Total Logistic's own analysis methodology-Insight-was central to the project approach. Insight is a set of proprietary tools, developed and applied to translate raw and often incomplete data into relevant information that helps optimise the resulting solution. Modules spanning inventory, warehousing, transport and process modelling were applied, all linked across a dynamically maintained, common database platform.

With the strategy established, planning began by gathering detailed data (to order line level) and overall familiarisation with the operation. This drove the Total Logistics Insight models which then generated a number of potential design options to ensure that every relevant factor was taken into account.

*Contd...*

**Stock Modelling**

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The dynamic modelling exercises provided flow and stockholding models for the Liege operation, future planning base using growth forecasts and overall network flow charts based on product allocations to Leeds and Liege. In addition, modelling provided a stock allocation and replenishment strategy between the two sites plus centre handling and storage methods for peak, average, current and forecast volumes. The design evaluation produced a range of solutions across a number of operational areas. The first stage was unit load allocation. This optimised the unit load format for each stock keeping unit (SKU), driving efficiencies for each product's movements through the warehouse. The analysis provided the basis for modelling all the remaining warehouse functional areas.

Total Logistics consultants also evaluated the receiving, storage, picking, returns processing and value added activities. These included pre-bagging, ROM programming and calibration. Within the picking operation, Total Logistics assessed the allocation of products to picking zones through a number of strategies. Order completion was simulated (with resultant activity profiles and work content) alongside with calculated pick rates based on activity profiles and analysed pick zone congestion.

Stock modelling was used to evaluate optimum inventory and replenishment levels and also addressed network replenishment rules: each option was then detailed in terms of space requirements, capital and operating costs. Using team workshops, Total Logistics outlined the options modelled and agreed the preferred technologies for the final scheme design. This was applied to layout drawings for an 'ideal' greenfield site and evaluated against the sites already under consideration.

Having evaluated the options, Total Logistics consultants designed the optimum solution that featured increased pre-bagging, pick handling cut by 20% and counting errors cut by over 25% using narrow aisle bulk storage. A single level picking area using radio data terminals (RDT) with zoned picking would despatch product to the conveyor.

Finally, the mechanised packing and a replenishment optimisation strategy included supplier direct delivery on selected SKUs to reduce network handling costs. Completing the picture were equipment and manning levels in detail plus full capital expenditure, annual operational budgets and a project implementation plan.

According to Premier Farnell, the Total Logistics' solution took into account the lowest cost based on the mix of space, productivity, capital expenditure and operational efficiency. It also allowed flexibility to allow for day-to-day changes, unplanned operations and future possible variations to throughput and configuration - all achieved without significant additional capital investment and allowing for the planned growth strategy.

One specifically important feature of the solution was the conveyor system: the data analysis revealed a high level of single line and single zone orders in the Premier Farnell order profile. This meant that significant efficiency gains could be achieved by improving the current batching process. This was incorporated into the final design by developing a zoned picking system linked by conveyor.

To maximise benefits, the conveyor had to be as seamless as possible and simple to operate. In addition, it had to cope easily with volume variations, imbalances and breakdowns and by incorporating multiple entry and exit routes, downtime was minimised and no control point was required. Innovatively, orders could be launched at any point along the conveyor.

In addition to the solution budgets, resource requirement plans and timelines, Total Logistics developed a complete set of deliverables including: section and elevation

*Contd...*

Notes

drawings; an operational description; outline warehouse management system requirements; key building requirements; their interfaces and an outline of the replenishment operations at other sites - to and from the Liege centre.

**Project Management**

With the solution design agreed, Total Logistics acted as the project 'Engineer', a role with officially defined responsibilities for managing the tender process. In this instance, Total Logistics was responsible for the procurement of all internal equipment required for the warehouse: detailed specifications went out to 26 companies for tender, managed through a number of short-listing stages before final selection took place. Simultaneously, Premier Farnell reviewed its WMS strategy with Total Logistics. Total Logistics were retained to provide full support during implementation, with a high level of responsibility for solution testing and delivery, including managing all supplier contracts.

As the extent of the global economic downturn in 2001 became apparent, the full implementation of the project was postponed for one year. However, the costs of fulfilling European orders from Leeds were still high. In response, Total Logistics designed a smaller manual intermediate solution that could rapidly deliver important parts of the overall cost reduction with minimal capital investment.

Total Logistics knew that to derive maximum benefit from the interim solution, work content had to be optimised. The maximum number of orders was profiled with the minimum number of lines. This identified the SKUs that could be positioned in Liege to give the lowest start-up and operational costs plus the greatest savings on shipping.

**Planning Contingencies**

The data was re-modelled but the original solution had been designed with sufficient flexibility to accommodate the majority of range and volume changes. The interim solution could therefore be a scalable subset of the final design.

The interim Liege solution went live in September 2002 and is delivering the planned cost reductions. It features a 19,000 sq m greenfield warehouse in two sections (initially 15,000 sqm followed by an additional 4,000 sq m) with a clear height of 10m and a usable height of 8.5m to accommodate sprinklers. There are 24 conveyorised picking zones covering around 20,000 shelf locations. Products are stored in four tote sizes, in manufacturers' containers or as free stock (for larger items) on shelving.

All picking and stock movements are confirmed with wrist mounted RDTs feeding into the network of Dell PCs; scanning of barcodes is done via finger-mounted scanners and label printing via belt-mounted printers. Improved batching and picking techniques have generated substantial improvements in picking productivity, saving time and money. The conveyor servicing the picking zones is self-routing and able to handle more than 1,000 orders per hour. The design incorporates routing flexibility and fault tolerance, allowing continued operation in the event of breakdown.

The picking process includes an inspection area, a consolidation area and picking spurs. The consolidation area is automatically routed if there is more than one tote and the picking spurs have semi-automatic case-sealers.

The interim design has three zones of bulk storage with 3,000 pallet locations, 6,000 shelf locations and a reserve of 1,600 pallet locations. All pallet racking is adjustable and fireprotected. About 40% of the storage area is static protected with conductive storage bins and totes and special earth conductive flooring.

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Protection has been included for building columns and rack legs where appropriate and all narrow aisles use rail guidance and are suitable for narrow aisle equipment. The materials handling equipment (MHE) consists of narrow aisle combis, VNA order picking vehicles, reach trucks, a counterbalance truck plus hand pallet trucks. The specification for MHE is tied in tightly with that of the racking so that they work effectively together.

**The Benefits**

A clear and costed upgrade path has been provided to respond to unplanned volume increases. It details the actions required, the cost and the resulting output. The interim solution provides three quarters of the 24 zones of shelving with no conveyor-and the solution is handling around half the expected order volume planned for the final start-up configuration.

Total Logistics continued to support Premier Farnell through the phased implementation with the remaining picking area being first followed by two stages of bulk storage implementation. Its approach throughout has given flexibility to allow for 'step' implementation, without the requirement for costly re-engineering. The interim racking configurations and SKU storage locations mirror the final solution and all Premier Farnell's growth and planning objectives have been built in to the interim and final designs.

Critically - and despite necessary changes to the original solution design - Premier Farnell is accruing the delivery savings it first sought for its international eBusiness. Total Logistics has streamlined the operations to save time and money, maximised available warehousing space and integrated a third distribution hub into the business while ensuring that customer service levels remained high and operations uninterrupted.

**Questions**

1. What are the benefits stated in the case?
2. Critically analyze the case study.

***Source:*** http://www.total-logistics.eu.com/logistics-clients/logistics-case-studies/p-farnell-case-study.html

## 11.6 Summary

- Customer requirements are diverse for different types of products and range enormously from one market sector to another.
- The customer profile of Style and Grace is high end and high middle income group clientele.
- Suppliers of branded products that are not established may provide their goods on a 'consignment' basis, i.e. the goods are paid for when they are sold and unsold goods are taken back by the manufacturer.
- The overall strategy calls for coordination of two different supply chains. The functional spectrum aspect depicts two supply chains that move in opposite directions.
- Managing demand uncertainty in a cost effective manner can lead to significant benefits for a company from lower supply chain costs to improved customer service levels.
- Strategic fit determines the extent to which the activities of organizations working in partnership complement each other in such a way as to contribute to competitive advantage.
- With increased globalization and offshore sourcing, global supply chain management is becoming an important issue for many businesses.

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- Time is another big issue that should be addressed when dealing with global supply chain management.
- Most companies recognize the need to respond to shorter product lifecycles, increased customer expectations, fluctuating inventory levels and changing costs.
- Tax structures and tax rates have at all times been design considerations, particularly when selecting between alternative sites within a local geography.
- Global economies are increasingly interlinked by material suppliers, logistical systems, manufacturing capacity, and markets.
- Securing the global supply chain, while ensuring its smooth functioning, is essential to our national security and economic prosperity.
- Sourcing, is the way in which companies select their suppliers, determine the number they will work with, and define the type of contractual agreements that will exist.
- The use of global sourcing has been the driving force behind the development and expansion of the global economy.

## 11.7 Keywords

***Consignment***: An arrangement under which items are delivered by a consignor to a consignee to be resold or used and paid for by the consignee.

***Customers***: A person, company, or other entity which buys goods and services produced by another person, company, or other entity.

***Demand Location***: It refers to the geographic location and shipment profile (relative volume, size and characteristics) of the market.

***Labour Cost***: It refers to the relative cost of production and distribution actions such as manufacturing and handling.

***Material Cost***: It refers to the total cost of the raw material and workings, including both the direct and indirect cost.

***Positioning***: Positioning is defined as the act of designing the company's offering and image to occupy a distinctive place in the target market's mind.

***Sourcing***: It is the way in which companies select their suppliers, determine the number they will work with, and define the type of contractual agreements that will exist.

***Strategic Fit***: It determines the extent to which the activities of organizations working in partnership complement each other in such a way as to contribute to competitive advantage.

***Strategy***: A plan of action or policy designed to achieve a major or overall aim.

***Supply Chain***: A supply chain is a system of organizations, people, technology, activities, information and resources involved in moving a product or service from supplier to customer.

***Tax Rates***: The percent of income paid as tax, or the percent of the value of a good, service or asset paid as tax.

***Transportation Cost***: It includes the cargo cost required for obtaining raw material, moving material between plants and distribution facilities, and ultimate distribution to customers and consumers.

## 11.8 Review Questions

Notes

1. Discuss the importance of customer requirements in Supply Chain Design.
2. "The overall strategy calls for coordination of two different supply chains." Elucidate.
3. Do you think that proper supplier relationship management becomes important? If yes, give reasons.
4. Define Strategic fit.
5. Highlight the issues related to Global Strategic Positioning.
6. What are the factors driving global supply chain management?
7. "There has been a shift in the priorities for supply chain design." Discuss.
8. What do you understand by Tax policy?
9. Explain the stages of Regional Integration.
10. Write brief note on SC Security.
11. Discuss procurement object and sourcing.

### Answers: Self Assessment

| | | | |
|---|---|---|---|
| 1. | Strategic Fit | 2. | Customer |
| 3. | Tailor-made | 4. | False |
| 5. | True | 6. | True |
| 7. | Global | 8. | Free trade |
| 9. | Economic union | 10. | False |
| 11. | True | 12. | True |
| 13. | Sourcing | 14. | Strategic |
| 15. | Manufacturing | | |

## 11.9 Further Readings



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# Unit 12: Network Integration

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## Objectives

After studying this unit, you will be able to:

- Discuss the Concept of Enterprise Facility Network
- Explain the Various Warehouse Requirements
- Get an Overview of Total Cost Integration
- Provide Insight into the Formulation of Logistical Strategy

Notes

## Introduction

For the most part, managers confront a new and challenging assignment when they are asked to participate in a logistical system reengineering. Because of the rapid rate of change in almost every facet of logistical operations, managers can expect considerable discontinuity when they try to use previous experience to guide the creation and integration of new logistical competencies. Therefore, success or failure may depend on how well the planning team is able to quantify the forces at work and rationalize them into a logical and believable action plan. Having a comprehensive understanding of the theoretical constructs that serve as the foundation of logistical integration provides an important step toward conceptualizing an integrated strategy.

In earlier units, the essence of logistical strategy was identified as achieving least total cost operations while simultaneously maintaining flexibility. Flexibility is the key to providing high-level basic customer service while maintaining sufficient operating capacity to meet and exceed key customer expectations. To exploit flexibility, an enterprise needs to achieve a high level of logistical process integration. Integration is required at two operating levels. First, the operating areas of logistics must be integrated across a network of facilities supportive of market distribution, manufacturing, and procurement requirements. Such network integration is essential if a firm is using logistical competency to gain competitive advantage. Second, integration must extend beyond a single firm by supporting relationships across the supply chain. This unit presents a framework to assist managers in achieving such integration.

## 12.1 Enterprise Facility Network

Prior to the availability of low-cost dependable surface transportation, most of the world's commerce relied on movement by water. During this early period, commercial activity concentrated around port cities. Overland transport of goods was costly and slow.



*Example:* The lead time to order custom clothing from across the continental United States could exceed 9 months.

Although the need for fast and efficient transport existed, it was not until the invention of the steam locomotive in 1829 that the transportation technology revolution began in the United States. Today, the transportation system in this country is a highly developed network of rail, water, and air, highway, and pipeline services. Each transport alternative provides a different type of service for use within a logistical system. This availability of economical transportation creates the opportunity to establish a competitively superior facility network to service customers.

The importance of location network analysis has been recognized since the middle of the 19th century, when the German economist Joachim von Thunen wrote The Isolated State. For von Thunen, the primary determinant of economic development was the price of land and the cost to transport products from farm to market. The value of land was viewed as being directly related to the cost of transportation and the ability of a product to command an adequate price to cover all cost and result in profitable operation. Von Thunen's basic principle was that the value of specific produce at the growing location decreases with distance from the primary selling market.

Following von Thunen, Alfred Weber generalized location theory from an agrarian to an industrial society. Weber's theoretical system consisted of numerous consuming locations spread over a geographical area and linked together by linear weight-distance transportation costs. Weber developed a scheme to classify major materials as either ubiquitous or localized. Ubiquitous materials were those available at all locations. Localized raw materials consisted of mineral deposits found only at selected areas. On the basis of his analysis, Weber developed a

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material index. This was the ratio of the localized raw material in the weight of the finished product. Various types of industry were assigned a locational weight based on the material index. Utilizing these two measures, Weber generalized that industries would locate facilities at the point of consumption when the manufacturing process was weight-gaining and near the point of raw material deposit when the manufacturing process was weight-losing. Finally, if the manufacturing process were neither weight-gaining nor weight-losing, firms would select plant locations at an intermediate point of convenience.

### 12.1.1 Spectrum of Location Decisions

In terms of logistical planning, transportation offers the potential to link geographically dispersed manufacturing, warehousing, and market locations into an integrated system. Logistical system facilities include all locations at which materials, work-in-process, or finished inventories are handled or stored. Thus, all retail stores, finished goods warehouses, manufacturing plants, and material storage warehouses are logistical network locations. It follows that selection of individual locations, as well as the overall locational network, represents important competitive and cost-related logistical decisions.

A manufacturing plant location may require several years to fully implement.



*Example:* General Motors' decision to build a new Cadillac assembly plant in Lansing, Michigan, spanned over 5 years from concept to reality.

In contrast, some warehouse arrangements are sufficiently flexible to be used only at specified times during a year. The selection of retail locations is a specialized decision influenced by marketing and competitive conditions. The discussion that follows concentrates on warehouse location. Among all the location decisions faced by logistical managers, those involving warehouse networks are most frequently reviewed.

### 12.1.2 Local Presence: An Obsolete Paradigm

A long-standing belief in business is that a firm must have facilities in local markets to successfully conduct business. During economic development of North America, erratic transportation services created serious doubt about a firm's ability to promise delivery in a timely and consistent manner. In short, customers felt that unless a supplier maintained inventory in local market areas it would be difficult, if not impossible, to provide consistent delivery. This perception, commonly referred to as the local presence paradigm, resulted in logistical strategies committed to forward deployment of inventory. As recently as the early 1960s it was not uncommon for manufacturers to operate 20 or more distribution warehouses to service mainland United States. Some firms went so far as to have full line inventory warehouses located near all major sales offices.

When a tradition is part of a successful strategy, it is difficult to change. However, for the past several decades inventory cost and risk associated with local presence have driven re-examination. Transportation services have dramatically expanded, and reliability has increased to the point where arrival times are dependable and predictable. Rapid advances in information technology have reduced the time required to identify and communicate customer requirements. Technology is available to track transportation vehicles, thereby providing accurate delivery information. Next-day delivery from a warehouse facility located as far away as 800 to 1000 miles is common practice.

Transportation, information technology, and inventory economics all favour the use of fewer rather than greater numbers of distribution warehouses to service customers within a geographical area.

Notes



*Caution* In many situations, customer perceptions concerning local presence continue to influence decentralization of inventory. The answer to the question, how much local presence is desirable, is best understood by carefully examining the relationships that drive logistical system design.

## Self Assessment

Fill in the blanks:

1. …… include all locations at which materials, work-in-process, or finished inventories are handled or stored.
2. Rapid advances in …… have reduced the time required to identify and communicate customer requirements.

## 12.2 Warehouse Requirements

Warehouses are established in a logistical system to lower total cost or to improve customer service. In some situations, the benefits of lower cost and improved service can be achieved simultaneously. Warehouses create value for the processes they support. Manufacturing requires warehouses to store, sort, and sequence materials and components. Facilities used for inbound materials and components are often referred to as supply facing warehouses. Warehouses are also used to store, sequence, and combine inventory for consolidated shipment to next level customers in the supply chain. Warehouses used support market distribution is often referred to as demand facing warehouses.



*Did u know?* Demand facing warehouse requirements are directly related to manufacturing and market distribution strategies.

Because of specialized materials handling and inventory process requirements, warehouses typically specialize in performing either supply or demand facing services. Warehouses committed to supporting manufacturing are typically located close to the factories they support; in contrast, warehouses dedicated to marketing distribution are typically strategically located throughout the geographical market area serviced.

The combinations of information technology, e-procurement fulfilment, and response-based business strategies have combined to radically alter how and why warehouses are used. The economic justification and desired functionality of a warehouse can be distinctly different for facilities dedicated to procurement, manufacturing, or market distribution.

### 12.2.1 Procurement Drivers

Procurement drivers centre on using warehouses to help purchase materials and components at the lowest total cost. Sophisticated purchasing executives have long realized that the combination of purchase price, quantity discount, payment terms, and logistical performance is required to achieve lowest delivered cost. In an effort to develop and support improved working relationships, most firms have reduced the number of suppliers they do business with. The logic is to develop a limited number of relationships with suppliers who can be operationally integrated into a firm's supply chain.

Notes



*Notes* The goals of relationship buying are to eliminate waste, duplication, and unplanned redundancy.

In an effort to improve overall operating efficiency, life cycle considerations have become prominent in purchase decisions. This relational dynamic of working with limited suppliers is based on a cradle-to-grave philosophy. The relationship is positioned to focus on all aspects of life cycle spanning from new product development to reclamation and disposal of unused materials and unsold product inventory. Such a life cycle focus is the result of distinct buying practices that directly impact the nature and functionality of supply faced warehousing. Value-added services related to procurement are increasingly being debundled from the purchase price. Such debundling facilitates functional absorption and spin-off between manufacturers and their suppliers. There is also a trend toward more response-based business strategies which is redefining expectations concerning supplier support and participation in the value-added process. The result is new structural relationships, such as tier one suppliers and lead facilitators. Finally, the seasonality of selected supplies, opportunities to purchase at reduced prices, and the need to rapidly accommodate manufacturing spikes continue to make selected warehousing of materials a sound business decision.

As a result, the role of supply facing warehouses continues to change. Warehouses were traditionally used to stockpile raw materials and component parts. Today such facilities place greater emphasis on sorting and sequencing materials as they flow into manufacturing. In many organizations the unbundling of services from the price of materials has facilitated outsourcing of warehouse requirements. Warehouse services required to most efficiently support manufacturing are increasingly being provided by lead suppliers or integrated logistics service providers. The goal is to streamline the flow of materials and components by eliminating duplicate handling and storage of identical inventories at multiple locations throughout the material supply network.

### 12.2.2 Manufacturing Drivers

Warehouses that support manufacturing are used to combine finished product for customer shipment. The capability to consolidate is in contrast to individual order shipment. A primary advantage of a manufacturing demand facing warehouse is the ability to offer customers full line product assortment on a single invoice at truckload transportation rates. In fact, a manufacturer's capability to provide such consolidation may be the primary reason for its selection as a preferred supplier.

Leading examples of demand facing warehouses are the networks used by such firms as General Mills, Johnson & Johnson, Kraft, Kimberly-Clark, and Nabisco Foods. At Johnson & Johnson, warehouses are used to support hospital and consumer business sectors by serving as consolidators for a variety of different business units. As a result, customers are afforded full assortments of products from different business units on a single invoice for shipment in one transportation vehicle. Kimberly-Clark produces a wide variety of individual products on specific manufacturing lines at specialized plants.

Such products as Kleenex®, Scott Tissue®, and Huggies® disposable diapers are manufactured at economy-of-scale volume, and then temporarily are positioned in demand facing warehouses. Customer-specific truckloads of assorted products are assembled at the warehouse. At Nabisco, branch warehouses are located adjacent to individual bakeries. Inventories of all major products are maintained at each branch to facilitate full-service shipments to customers.

Notes

The primary determinant of the warehousing required to support manufacturing is the specific production strategy being implemented. Three basic manufacturing strategies – make to plan (MTP), make to order (MTO), and assemble to order (ATO). The extent of demand faced warehousing can be directly linked to the support requirements of each manufacturing strategy. In a general sense, MTO manufacturing strategies require supply facing warehousing support but little, if any, demand facing storage. Conversely, MTP manufacturing strategies, which focus resources to achieve maximum manufacturing economy of scale, require substantial demand facing warehouse capacity.

### 12.2.3 Market Distribution Drivers

Market support warehouses create value by providing inventory assortments to whole-salers and retailers. A warehouse located geographically close to customers seeks to minimize inbound transportation cost by maximizing consolidation and length of haul from manufacturing plants followed by relatively short outbound movement to final destination customers. The geographic size of a market area served from a support warehouse depends on the desired service speed, size of average order, and cost per unit of local delivery. A large number of market distribution warehouses are operated as public or contract facilities by third-party logistics service providers. Regardless of who operates the warehouse, the facility exists to provide inventory assortment and re-plenishment to customers. A warehouse is justified if it offers a way to achieve a competitive service or cost advantage.

#### Rapid Replenishment

Market distribution warehouses have traditionally provided assortment of products from varied manufacturers and various suppliers for retailers. A retail store typically does not have sufficient demand to order inventory in large quantities directly from wholesalers or manufacturers. A typical retail replenishment order is placed with a wholesaler who sells a variety of different manufacturer products.

Market support warehouses are common in the food and mass merchandise industries. The modern food distribution warehouse usually is located geographically near the retail stores it services. From this central warehouse, consolidated product assortments can rapidly replenish retail inventories because of the close geographical proximity. Large retail stores may receive multiple truckloads from the warehouse on a daily basis.



*Notes* Location of the warehouse within the market served is justified as the least cost way to rapidly replenish an assortment of inventory to either an end customer or a retailer.

#### Market-Based ATO

The design of a market distribution warehouse network is directly related to inventory deployment strategy. The establishment of market distribution warehouses is a result of forward inventory deployment in anticipation of future market requirements. This assumption means that a manufacturing firm utilizing such a distributive network is to some degree depending upon anticipatory inventory deployment to offset response time to meet customer requirements. Based on the preceding discussion, inventories deployed forward after manufacturing are typical in situations where firms are manufacturing to plan and when they are engaged in decentralized assembly to order. In ATO situations, common or undifferentiated components are stocked in warehouse inventory in anticipation of performing customized manufacturing or assembly at the warehouse upon receipt of customer orders.

Notes

An increasing amount of ATO operations are performed in market-positioned warehouses as contrasted to centralized manufacturing locations. Assembly in close proximity to major markets allows the benefits of postponement while avoiding the high cost and time related to long-distance direct shipment.

### 12.2.4 Warehouse Justification

Warehouses are justified in a logistical system when a service or cost advantage results from their positioning between suppliers, manufacturers, and customers. Competitive advantage generated by establishing a warehouse network can result from lower total cost or faster to-destination service. From the viewpoint of transportation economies, cost advantage results from using the warehouse to achieve freight consolidation. However, freight consolidation typically requires inventory to support assembly of customized orders. Alternatively, consolidation or assortment may be achieved by establishing flow-through facilities or cross-dock sortation that operates without preestablished inventories.

Such continuous movement effectively converts warehouses from inventory storage to mixing facilities. Of course, some business situations will justify a combination of inventory storage and continuous flow-through to effectively and economically service customers. From the perspective of integrative management, the key logistics system design questions become: How many and what kinds of warehouses should a firm establish? Where should they be located? What services should they provide? What inventories should they stock? And which customers should they service? This sequence of interrelated questions represents the classical logistics network design challenge. For manufacturing firms, network design begins with marketing strategy and continues into manufacturing and procurement planning. In retailing and wholesaling enterprises the framework spans from purchasing to market distribution strategies.

### Self Assessment

Fill in the blanks:

3. Warehouses used support market distribution is often referred to as …… warehouses.
4. A primary advantage of a manufacturing demand facing …… is the ability to offer customers full line product assortment on a single invoice at truckload transportation rates.
5. The …… of a market area served from a support warehouse depends on the desired service speed, size of average order, and cost per unit of local delivery.
6. An increasing amount of …… are performed in market-positioned warehouses as contrasted to centralized manufacturing locations.

## 12.3 Total Cost Integration

Economic forces such as transportation and inventory determine a firm's most appropriate network of warehouse facilities. This discussion identifies cost trade-offs related to transportation and inventory followed by integration to identify the least total cost facility network.

### 12.3.1 Transportation Economics

The key to achieving economical transportation is summarized in two basic principles. The first, often called the quantity principle, is that individual shipments should be as large as the involved

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carrier can legally transport in the equipment being used. The second, often called the tapering principle, is that large shipments should be transported distances as long as possible. Both of these principles serve to spread the fixed cost related to transportation over as many pounds and as many miles as possible.

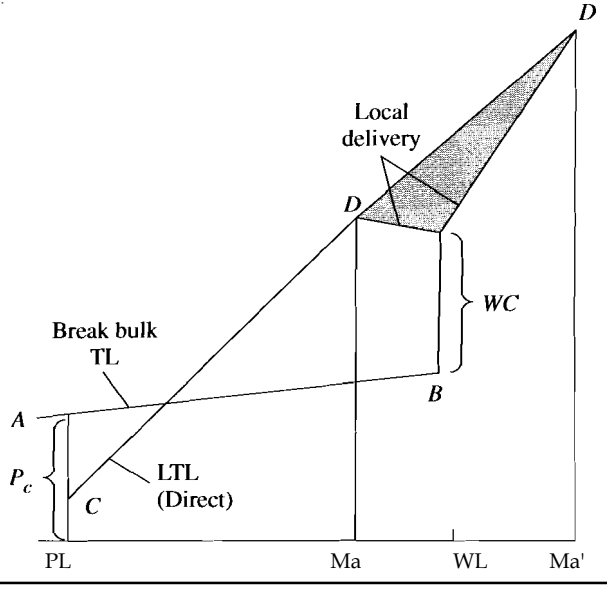
*Tasks* Economies of transportation consolidation may justify establishment of a single warehouse or may be achieved across a network of warehouses.

## 12.3.2 Cost-based Warehouse Justification

The basic economic principle justifying establishment of a warehouse is transportation consolidation. Manufacturers typically sell products over a broad geographical market area. If customer orders tend to be small, then the potential cost savings of consolidated transportation may provide economic justification for establishing a warehouse.

To illustrate, assume a manufacturer's average shipment size is 500 pounds and the applicable freight rate to a customer is $7.28 per hundred weight. Each shipment made direct from the manufacturing location to the market would have a transportation cost of $36.40. The quantity or volume transportation rate for shipments 20,000 pounds or greater is $2.40 per hundred weight. Finally, local delivery within the market area is $1.35 per hundred weight. Under these conditions, products shipped to the market via quantity rates and distributed locally would cost $3.75 per hundred weight, or $18.75 per 500-pound shipment. If a warehouse could be established, stocked with inventory, and operated for a total cost of less than $17.65 per 500-pound shipment ($36.40 – $18.75) or $3.53 per hundred weight, the overall cost of distributing to the market using a warehouse would be lower. Given these economic relationships, establishment of a warehouse offers the potential to reduce total logistics cost.

**Figure 12.1: Economic Justification of a Warehouse Facility based on Transportation Cost**




***Source:*** Donald J. Bowersox, David J. Closs, M. Bixby Cooper, "Supply Chain Logistics Management," Michigan State University

Notes

Figure 12.1 illustrates the basic economic principle of warehouse justification. PL is identified as the manufacturing location, and WL is the warehouse location within a given market area. The vertical line at point PL labeled P reflects the handling and shipping cost associated with preparation of a 500-pound LTL shipment (C) and a 20,000-pound truckload shipment (A). The slope of line AB reflects the truckload freight rate from the plant to WL, the warehouse, which is assumed for this example to be linear with distance. The vertical line labeled WC at point WL represents the cost of operating the warehouse and maintaining inventory. The lines labeled D reflect delivery cost from the warehouse to customers within the market area Ma to Ma'. The slope of line CD reflects the LTL rate from the plant to customers located between the plant and the boundary Ma'. The shaded area represents the locations to which the total cost of a 500-pound customer shipment using a consolidation warehouse would be lower than direct shipment from the manufacturing plant.

From the perspective of cost alone, it would make no difference whether customers located exactly at points Ma and Ma' were serviced from the manufacturing plant or the warehouse.

### 12.3.3 Inventory Economics

Inventory level in a logistical system directly relates to the location network. The framework for planning inventory deployment is the performance cycle. Although one element of the performance cycle is transportation, which provides spatial closure, the key driver of inventory economics is time. The forward deployment of inventory in a logistical system potentially improves service response time.



*Notes* Such deployment also increases overall system inventory, resulting in greater cost and risk.

#### Service-based Warehouse Justification

The use of warehouses can be a vital part of the logistics strategy of a firm engaged in national distribution. The inventory related to a warehouse network consists of base, transit, and safety stock. For the total logistical network, average inventory commitment is

$$\bar{I} = \sum_{i=1}^{n} \frac{Q_s}{2} + SS_i,$$

where $\bar{I}$ = Average inventory in the total network;

n = Number of performance cycles in the network;

$Q_s$ = Order quantity for a given performance cycle identified by the appropriate subscript; and

$SS_s$ = safety stock, for a given performance cycle identified by the appropriate subscript.

As warehouses are added to a logistics system, the number of performance cycles increases. This added complexity directly relates to the quantity of inventory required across the network.

***Base Inventory:*** The impact on base stock by adding inventory is not significant. The base stock level within a logistical system is determined by manufacturing and transportation lot sizes, which do not change as a function of the number of warehouses. The combination of maintenance and ordering cost, adjusted to take into consideration volume transportation rates and purchase discounts, determines the replenishment EOQ and the resultant base stock. In just-in-time procurement situations, base stock is determined by the discrete order quantity required to support the planned manufacturing run or assembly.

Notes



*Caution* In either situation, the base stock determination is independent of the number of warehouses included in the logistical system.

***Transit Inventor:*** Transit stock is inventory captive in transportation vehicles. While in transit, this inventory is available to promise but it cannot be physically accessed. Available to promise means it can be committed to customers by use of a reservation or inventory mortgaging capability in the order management system. As more performance cycles are added to a logistical network, the anticipated impact is that existing cycles will experience a reduction in transit inventory.



*Notes* This reduction occurs because the total network transit days are reduced.

***Safety Stock Inventory:*** Safety stock is added to base and transit stock to provide protection against sales and performance cycle uncertainty. Both aspects of uncertainty are time-related. Sales uncertainty is concerned with customer demand that exceeds forecasted sales during the replenishment time. Performance cycle uncertainty is concerned with variation in the total days required to replenish the inventory of a warehouse. From the viewpoint of safety stock, the expected result of adding warehouses will be an increase in average system inventory. The purpose of safety stock is to protect against unplanned stockouts during inventory replenishment. Thus, if safety stock increases as a function of adding warehouses, then the overall network uncertainty must also be increasing.

### 12.3.4 Total Cost Network

Total cost related to average inventory commitment increases with each additional warehouse. For the overall system, the lowest total cost network is 6 locations. The point of lowest inventory cost would be a single warehouse.

#### Trade-off Relationships

The minimal total cost point for the system is not at the point of least cost for either transportation or inventory. This is the hallmark of integrated logistical analysis.

In actual practice, it is difficult to identify and measure all aspects of total logistical cost. Many assumptions are required to operationalise logistical network analysis.

#### Critical Assumptions and Limitations

Transportation requirements are represented by a single average size shipment. In actual operations, it is likely that neither of these simplifying assumptions will be valid. First, the nature of logistical network design is not a short-term planning problem. When facility decisions are involved, the planning horizon extends across several years and must accommodate a range of different annual sales projections. Second, actual shipment and order sizes will vary substantially around an average.

A realistic approach to planning must incorporate a range of shipment sizes supported by alternative logistical methods to satisfy customer service requirements. In actual operation, alternative modes of transportation are employed, as necessary, to upgrade the speed of delivery.

Notes

Significant cost trade-offs exist between inventory and transportation. Inventory cost as a function of the number of warehouses is directly related to the desired level of inventory availability. If no safety stock is maintained in the system, total inventory requirement is limited to base and transit stock. Under a no safety stock situation, the total least cost for the system would be at or near the point of lowest transportation cost. Thus, assumptions made with respect to the desired inventory availability and fill rate are essential to trade-off analysis and have a significant impact on the least total cost design solution.

### Self Assessment

Fill in the blanks:

7. The basic economic principle justifying establishment of a warehouse is …… consolidation.
8. The …… of inventory in a logistical system potentially improves service response time.
9. In …… procurement situations, base stock is determined by the discrete order quantity required to support the planned manufacturing run or assembly.
10. The purpose of …… is to protect against unplanned stockouts during inventory replenishment.

## 12.4 Formulating Logistical Strategy

To finalize logistical strategy, it is necessary to evaluate the relationships between alternative customer service levels and associated cost. While substantial difficulties exist in the measurement of revenue, the comparative evaluation of marginal service performance and related cost offers a way to approximate an ideal logistical system design. The general approach consists of (1) determining a least total cost network, (2) measuring threshold service availability and capability associated with the least total cost system design, (3) conducting sensitivity analysis related to incremental service and cost directly with revenue generation, and (4) finalizing the plan.

### 12.4.1 Cost Minimization

Just as a physical replication of a geographical area illustrates elevations, depressions and contours of land surface, an economic map can highlight logistical cost differentials. Generally, peak costs for labour and essential services occur in large metropolitan areas. However, because of demand concentration, least total logistics cost resulting from transportation and inventory consolidation benefits is often minimized in metropolitan areas.

A strategy of least total cost seeks a logistical system network with the lowest fixed and variable costs. A system design to achieve least total cost is driven purely by cost-to-cost trade-offs. The level of customer service that is associated with a least cost logistical design results from safety stock policies and the locational proximity of warehouses to customers.



*Did u know?* The overall level of customer service associated with any given least total cost system design is referred to as the threshold service level.

Notes

### 12.4.2 Threshold Service

To establish a threshold service level it is necessary to initiate network reengineering with policies regarding desired inventory availability and capability. It is common practice to have the customer service capability based on the existing order entry and processing system, warehouse operations based on standard order fulfillment time at existing facilities, and transportation delivery time-based on capabilities of least cost transportation methods. Given these assumptions, existing performance is the starting point for evaluating potential service improvement.

The typical starting point for customer service availability analysis is to assume performance at a generally acceptable fill rate. Often the prevailing industry standard is used as a first approximation.



*Example:* If the safety stock availability goal were established at a 97.75 percent performance for combined probability of demand and lead time uncertainty, it would be anticipated that approximately 98 out of 100 items ordered would be delivered to specification.

Given the initial assumptions, each customer is assigned a shipment location on the basis of least total cost. In multiproduct situations, selection of service territories for each facility will depend on the products stocked at each warehouse and the degree of consolidation required by customers. Because costs have significant geographical differentials, the service area for any given facility will vary in size and configuration.

### 12.4.3 Service Sensitivity Analysis

The threshold service resulting from the least total cost logistical design provides a basis for sensitivity analysis. The basic service capabilities of a network can be increased or decreased by variation in number of warehouses, change in one or more performance cycles to increase speed or consistency of operations, and/or change in safety stock policy.

#### Locational Modification

The warehouse structure of the logistical system establishes the service that can be realized without changing the performance cycle or safety stock policy. To illustrate the relationship between number of warehouses and resultant service time, assume an important measure is the percentage of demand fulfilled within a specified time interval.

First, incremental service is a diminishing function.



*Example:* The first five warehouse locations provided 24-hour performance to 42 percent of all customers. To double the percentage of 24-hour service from 42 to 84 percent, 9 additional warehouses, or a total of 14, are required.

Second, high degrees of service are achieved much faster for longer performance intervals than for the shorter intervals.



*Example:* Four warehouse locations provide 85 percent performance within the 96-hour performance cycle. Increasing the total locations from 4 to 14 improved the 96-hour performance by only 9 percent. In contrast, a total of 14 warehouses cannot achieve 85 percent given a 24-hour performance cycle.

Notes

Finally, the total cost associated with each location added to the logistical network increases dramatically. Thus, while the incremental service resulting from additional locations diminishes, the incremental cost associated with each new location increases: the service payoff for each new facility is incrementally less.

Logistics managers are often asked to estimate the inventory impact of adding or deleting warehouses. This relationship between uncertainty and required inventory is called the portfolio effect. The portfolio effect can be estimated using the square root rule. The square root rule, originally proposed by Maister, suggests that the safety stock increase as a result of adding a warehouse is equal to the ratio of the square root of the number of locations in the newly prepared network divided by the square root of the number of existing locations.

### Performance Cycle Modification

Speed and consistency of service can be varied to a specific market or customer by a modification of some aspect of the performance cycle. To improve service, electronic ordering and premium transportation can be used. Therefore, geographical proximity and the number of warehouses do not equate directly to fast or consistent delivery. The decision to increase service by adopting a faster performance cycle arrangement will typically increase variable cost. In contrast, service improvement, by virtue of added warehouses, involves a high degree of fixed cost and could result in less overall system flexibility.

No generalizations can be offered regarding the cost/service improvement ratio attainable from performance cycle modification. The typical relationship of premium to lowest cost transportation results in a significant incentive in favour of large shipments. Thus, if order volume is substantial, the economics of logistics can be expected to favour use of a warehouse or consolidation point to service a market area.

The impact of using premium transportation will increase total cost. Adjustments from the least total cost logistical system can typically be justified if the improved service results in increased revenue.

### Safety Stock Modification

A direct way to change service is to increase or decrease the amount of safety stock held at one or more warehouses. The impact of increasing the safety stock across a total system will shift the average inventory cost curve upward. A goal of increasing customer service availability will result in increased safety stocks at each warehouse.



*Notes* As availability is increased, the safety stocks required to achieve each equal increment of availability increase at an increasing rate.

## 12.4.4 Finalizing Strategy

Management often falls into the trap of being overly optimistic in terms of service commitments to customers. The result may be excessively high customer expectations followed by erratic performance. In part, such over commitment results from lack of understanding of the total cost required to support high, zero-defect service.

The final step in establishing a strategy is to evaluate the cost of incremental service in terms of generating offsetting revenue. To illustrate, assume that the current system is geared to service

Notes

at least 90 percent of all customers at 95 percent inventory availability within 60 hours of order receipt. Furthermore, assume that the current logistical system is meeting these objectives at lowest total cost by utilizing a network of five warehouses. Marketing, however, is not satisfied and believes that service capability should be increased to the point where 90 percent of all customers would receive 97 percent inventory availability delivered within 24 hours. Logistical management needs to estimate the cost of this strategic commitment.



*Caselet*

## Timberland Co.

At Timberland Co. reengineering has unravelled some old assumptions. The Hampton, New Hampshire, shoemaker had always measured productivity by the size of each delivery, so priority was given to department store orders rather than those from the small boutiques that were a growing chunk of its business. Two years ago, Timberland set out to change its routine. Timberland began by scheduling two or more shipments to each customer a week, instead of one big delivery. Scanners automatically track inventory and create shipping bills, so it's as efficient to handle small orders as big ones. Reengineering is hitting other operations, too. Instead of having one department take orders and another verify credit, the two were merged. Now, orders are sent to manufacturing via a network, faster and with fewer errors. Timberland is also taking to the electronic highway to reach customers. By letting stores transmit orders automatically to its computers, the company expects to double sales volume for every 25 percent increase in its sales force. At Timberland, staying a top shoemaker means not sticking to its last – or the past.

***Source:*** From Gary McWilliams, 'The Technology Payoff: A Sweeping Reorganization of Work Itself Is Roosting Productivity," Business Week, June 14, 1993, p. 59

### Maximum Service

A maximum service strategy is rarely implemented. A system designed to provide maximum service shifts design emphasis from cost to availability and delivery performance. Maximum service areas can be developed similar to the least cost service areas. The limits of each facility service area are determined by the capability to provide the required delivery. As with cost-oriented service areas, time-oriented areas will be irregular because of transport-route configurations. Total cost variation from a least cost to a maximum service system to service the same customers will be substantial. Servicing the total U.S. market on an overnight basis could require from 30 to 40 warehouses and the use of highly dependable transportation. The number of warehouses could be reduced by the use of premium transportation.

### Maximum Profit

Most enterprises aspire to maximize profit in the design of logistical systems. Theoretically, the service area of each warehouse should be determined by establishing a minimum profit contribution for customers located at varying distances from the facility. Because warehouses are normally located near high-volume markets, the greater the distance a customer is located from the service area centre, generally the higher the cost of logistics. This cost increase occurs not only because of distance but also because of lower customer density at the periphery of the warehouse service area.

Notes



*Did u know?* At the point where the cost of serving peripheral customers results in minimum allowable profit margins, further extensions of the service territory become unprofitable on a total-cost-delivered basis.

If the customer were provided improved service, it is possible that it would purchase more of the overall product assortment sold by a firm. In theory, additional service should be introduced to the point where marginally generated revenue equals marginal costs. At this point of equilibrium, no additional service would be justified. Additional service may or may not result from increasing the number of warehouses. The desired service might be provided best by a supplemental delivery system using direct or dual distribution. The theoretical profit maximization position is easier to state than to actually measure.

### Maximum Competitive Advantage

Under special situations, the most desirable strategy to guide logistical system design may be to seek maximum competitive advantage. Although there are many ways in which systems can be modified to gain competitive advantage, two are presented to illustrate strategic considerations.

- ***Segmental Service:*** A common modification in least cost design consists of improving service to protect major customers from competitive inroads. Management needs to be concerned with how expectations of key customers are being satisfied. If the existing service policy is only capable of providing 42 percent of the customers with 24-hour delivery at 95 percent inventory availability, care must be taken to be sure that the most profitable customers are getting the best service possible.
- ***Justified High-cost Warehouse:*** An additional application of design modification to capitalize on competitive situations is an economically justified high-cost warehouse. This situation is pertinent especially to smaller or niche businesses. Because of the rigidities inherent in large firms, pricing policies are likely to be inflexible. Antitrust legislation reinforces such rigidities. The result is that large firms selling in broad geographical markets tend to disregard unique cost and demand situations in localized markets or find it nearly impossible to adjust marketing and logistical systems to accommodate such unique opportunities. This inflexibility creates opportunities for smaller firms, enabling them to make significant investment in logistical capability to attract the localized market segment.

### Minimal Asset Deployment

A final logistical strategy may be motivated by a desire to minimize assets committed to the logistical system. A firm that desires to maintain maximum flexibility may use variable cost logistical components such as public warehouses and for-hire transportation. Such a strategy might result in higher total logistical costs than could be realized by asset commitment to obtain economies of scale. However, risk would be less and the strategy would increase overall flexibility.

Integration of logistical strategy to support overall enterprise operations requires precise customer service commitment. From the viewpoint of designing a logistical system, total least cost and associated threshold service offer an ideal platform for undertaking cost/service sensitivity analysis.

Notes



*Task* In what ways can customer service performance be improved by incorporating flexible distribution operations into a logistical system design?

## Self Assessment

State whether the following statements are true or false:

11. A strategy of least total cost seeks a logistical system network with the lowest fixed and variable costs.
12. The typical starting point for customer service availability analysis is to assume performance at a generally acceptable fill rate.
13. The basic service capabilities of a network can be increased or decreased by variation in number of warehouses, change in one or more performance cycles to decrease speed or consistency of operations, and/or change in safety stock policy.
14. Logistics managers are often asked to estimate the inventory impact of adding or deleting warehouses.
15. No generalizations can be offered regarding the cost/service improvement ratio attainable from performance cycle modification.



*Case Study*

### PepsiCo's Distribution and Logistics Operations

PepsiCo has continually been at the forefront of standards adoption, promoting industry efficiency and adding value throughout our supply chain.

*- Al Carey, Chief Operating Officer, PepsiCo Beverages and Foods, North America*

Headquartered in New York, the US-based PepsiCo is one of the world's leading beverage and snacks food companies. In its 2002 annual report, the company claimed to have the largest share in the US beverage markets.

PepsiCo served diverse markets with its six group companies – Frito-Lay North America, Frito-Lay International, Pepsi-Cola North America, Pepsi Beverages International, Gatorade/Tropicana North America and Quaker Foods North America. For the fiscal year ended December 2002, PepsiCo Inc. (PepsiCo) reported revenues of $25.11 billion, an increase of 6.8% from the 2002 revenues of $23.51 billion.

Analysts felt that one of the main reasons for the company's massive growth over the decades and the leadership status it has acquired in almost all its business segments was PepsiCo's efficient distribution and logistics management operations. Depending on the product involved, PepsiCo chose between the various standard distribution methods employed, such as the Direct Store Delivery (DSD) system, the broker warehouse system, the vending and food service system and the pre-sell method.

PepsiCo adapted these systems to the local conditions of the various countries in which it operated. PepsiCo's highly advanced distribution system was well supported by state-of-the-art logistics systems. PepsiCo upgraded its technical capabilities consistently in order

*Contd...*

Notes

to strengthen its logistics management activities. PepsiCo's bottlers employed wireless technologies to strengthen their distribution system and effectively serve the customers in the markets in which they operated. However, with its vast worldwide operational network and good market presence globally, PepsiCo still did not put enough effort into integrating and streamlining the operations of its various group companies/divisions.

This was undoubtedly a difficult task, but the then CEO Roger Enrico (Enrico) announced the launch of the 'Power of One' program through which, he said, the company would achieve this streamlining of operations, in 1998. PepsiCo would generate savings worth millions of dollars if the program was implemented well. However, the program had not got off the ground even by early 2004.

In 1898, Caleb Bradham (Bradham) invented Pepsi-Cola in his pharmacy in North Carolina, US. Bradham started marketing Pepsi-Cola in 1903 and a year later, purchased a factory to manufacture and bottle the new drink. Bradham started bottling his drink in 1904. He quickly developed a system of bottling franchises for the drinks. By 1909, Bradham had established a network of 250 bottlers for Pepsi-Cola with operations in 24 states in the US. By 1910, the network had increased to about 300 Pepsi-Cola bottlers.

Bradham went bankrupt in 1923, after incorrect speculation on sugar prices. Pepsi-Cola's ownership changed hands several times until Charles Guth (Guth), who headed Loft Candy Company, bought it in 1931.

Guth employed aggressive pricing tactics in his efforts to increase Pepsi-Cola's sales. He doubled Pepsi-Cola's bottle size to 12 ounces for the same price two years later. He also used Pepsi-Cola syrups in his soda fountains. By the end of 1934, Pepsi-Cola's profits had increased and the company started an aggressive campaign to sign up more bottlers to join as its franchisees. By 1937, Pepsi-Cola was running five concentrate plants and 313 bottlers operating in the US.

**Pepsico's Distribution Operations**

Since its inception, PepsiCo attached a lot of importance to its distribution operations. Each day, the company's products such as snack foods and beverages, were distributed through various retail channels in the US and across the world. PepsiCo's distribution system was aimed at making available all or most of the products in its portfolio within a distance easily reachable by consumers. PepsiCo was conscious of the need to adapt its distribution systems according to the needs and preferences of global customers. Based on its experience, PepsiCo had developed various distribution models to offer its products and services to customers in the US. These included the Direct Store Delivery (DSD), Broker Warehouse Distribution (BWD) and Vending & Food Service (V&FS) systems.

**Pepsico's Logistics Operations**

In order to manage its distribution systems effectively, PepsiCo had put in place advanced logistics systems. PepsiCo sold beverage concentrate to bottlers, who added carbon dioxide, sweetener and water to make beverages and beverage syrup. Syrup was either sold directly to the fountain accounts or was combined with carbonated water for bottling. Bottling companies were (with a few exceptions) owned and operated by local companies in the countries where PepsiCo operated.

Through their use of the most modern technology in recent years, PepsiCo and its bottlers were able to improve their distribution and logistics management operations significantly. To further improve the market penetration of its products globally, PepsiCo launched two new distribution methods in the initial years of the new millennium. These were the chilled DSD system and the hybrid system.

*Contd...*

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The chilled DSD system was a relatively small distribution method, created for items which required continuous refrigeration. This was primarily created for the fruit juices product line.

**Question**

Discuss the distribution operations and the distribution channels utilized by a leading multinational company in the beverage and snack food industry.

***Source:*** http://www.icmrindia.org/casestudies/catalogue/Operations/OPER031.htm

## 12.5 Summary

- The primary determinants of logistics network design are requirements established by integrated procurement, manufacturing, and market distribution strategies. Within the framework of these interlocking strategies, logistics requirements are satisfied by blending transportation and inventory capabilities. These capabilities play out across a network of enterprise facilities.
- Important in the performance of logistics requirements are warehouse facilities. Such facilities are justified by logistical system design in terms of their contribution to cost reduction, service improvement, or a combination of both.
- Transportation and inventory economics are critical network design considerations. When seeking least cost logistics, transportation deals with the spatial aspects of logistics. The ability to consolidate transportation is a primary justification for including warehouses in a network design. Inventory introduces the temporal dimension of logistics.
- Average inventory increases as the number of warehouses in a system increase given a constant demand situation. Total cost integration provides a framework for simultaneous integration of logistics, manufacturing, and procurement costs. Thus, total cost analysis provides the methodology for integration across the network.
- Accurate total cost analysis is not without practical problems. Foremost is the fact that a great many important costs are not specifically measured or reported by standard accounting systems.
- A second problem involved in total cost analysis is the need to consider a wide variety of network design alternatives. To develop complete analysis of a planning situation, alternative shipment sizes, modes of shipment, and range of available warehouse locations must be considered.
- These problems can be overcome if care is taken in network analysis. The cost format recommended for total cost analysis is to group all functional costs associated with inventory and transportation.
- The significant contribution of total cost integration is that it provides a simultaneous analysis of time- and space-related costs in logistical network design.
- The formulation of a logistical strategy requires that total cost analysis be evaluated in terms of customer service performance. Logistical service is measured in terms of availability, capability, and quality of performance.
- The ultimate realization of each service attribute is directly related to logistical network design. To realize the highest level of logistical operational support within overall enterprise integration, customers should be provided service to the point where marginal cost equates to marginal revenue. Such marginal equalization is not practical to achieve; however, the relationship serves as a normative planning goal.

Notes

- The formulation of a service policy starts from the identification and analysis of the least total cost system design. Given a managerially specified inventory availability target, service capability associated with the least cost design can be identified. This initial service level is referred to as the threshold service level.
- To evaluate potential modifications to the least cost design, sensitivity analysis is used. Service levels may be improved by modifying (1) variation in the number of facilities, (2) change in one or more aspects of the performance cycle, and/or (3) change in safety stock.
- Beyond least cost design, four potential strategies are maximum service, maximum profit, maximum competitive advantage, and minimal asset deployment.
- From among this range of strategic options the end objective of logistical system design is to select a logistics strategy that supports overall business strategy.

## 12.6 Keywords

***Procurement:*** Procurement is the acquisition of goods, services or works from an external source.

***Quantity Principle:*** This means individual shipments should be as large as the involved carrier can legally transport in the equipment being used.

***Replenishment:*** Replenishment is "filling again by supplying what has been used up." It is the movement of inventory from upstream – or reserve – product storage locations to downstream – or primary storage, picking and shipment locations.

***Safety Stock:*** Safety stock (also called buffer stock) is a term used by logisticians to describe a level of extra stock that is maintained to mitigate risk of stockouts (shortfall in raw material or packaging) due to uncertainties in supply and demand.

***Tapering Principle:*** This means large shipments should be transported distances as long as possible.

***Total Cost:*** It is the total economic cost of production and is made up of variable costs, which vary according to the quantity of a good produced and include inputs such as labour and raw materials, plus fixed costs, which are independent of the quantity of a good produced and include inputs (capital) that cannot be varied in the short term, such as buildings and machinery.

***Transit Inventor:*** Transit stock is inventory captive in transportation vehicles.

***Warehouse:*** A warehouse is a commercial building for storage of goods. Warehouses are used by manufacturers, importers, exporters, wholesalers, transport businesses, customs, etc.

## 12.7 Review Questions

1. Describe in your words the meaning of spatial/temporal integration in logistical system integration.
2. What justification of logic can be presented to support the placement of a warehouse in a logistical system?
3. Why do transportation costs decrease as the number of warehouses in a system increases? Why do inventory costs increase as the number of warehouses in a system increases?
4. Briefly explain the market distribution drivers.
5. In your words, what is the locational impact of inventory? How does it differ for transit inventories and safety stocks?

Notes

6. What is meant by the level of threshold service of a least cost system?
7. Why does customer service not increase proportionately to increases in total cost when a logistical system is being designed?
8. Why does customer service speed of performance increase faster for customer's located greater distances from a warehouse facility? What is the implication of this relationship for system design?
9. Discuss the differences between improving customer service through faster and more consistent transportation, higher inventory levels, and/or expanded numbers of warehouses.
10. What is the difference between minimum total cost and short-range profit maximization policies in system design?

### Answers: Self Assessment

1. Logistical system facilities
2. Information Technology
3. Demand facing
4. Warehouse
5. Geographic size
6. ATO operations
7. Transportation
8. Forward deployment
9. Just-in-time
10. Safety stock
11. True
12. True
13. False
14. True
15. True

## 12.8 Further Readings



*Books*

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Vinod V. Sople . "*Logistics Management – The Supply Chain Imperative*". Pearson Education

Tompkins, J.A. and D.A. Harmelink (Editors), *The Distribution Management Handbook*, McGraw Hill, 1993

**Notes**



*Online links*

http://www.scribd.com/doc/44198919/Network-Integration

http://www.serco-na.com/docs/materials/air-force-space-command-enterprise-network-management-facility.pdf

http://www.manh.com/solutions/distribution-management/warehouse-management

http://www.astera.com/about/total-cost-of-ownership

http://www.wdlc.net/category-integration-theory.html

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# Unit 13: Logistics Design and Operational Planning

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## Objectives

After studying this unit, you will be able to:

- Discuss the Planning Methodology
- Explain the Phase I i.e. Problem Definition and Planning
- Get an Insight of Phase II i.e. Data Collection and Analysis
- Explain the Phase III i.e. Recommendations and Implementation
- Describe the SC Analysis Methods and Techniques

## Introduction

The logistics environment is constantly evolving as a result of changes in markets, competitors, suppliers, and technology. To develop and focus the enterprise strategy to match this changing environment, a systematic planning and design methodology is required to effectively evaluate alternatives. This unit describes a generalized methodology that includes an overview of techniques used for logistics planning.

## 13.1 Planning Methodology

Even for established industries, a firm's markets, demands, costs, and service requirements change rapidly in response to customer and competitor behaviour. In response to these changes,

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firms often face questions such as: (1) How many distribution warehouses should be used and where should they be located? (2) What are the inventory/service trade-offs for each warehouse? (3) What types of transportation equipment should be used and how should vehicles be routed? and (4) Is investment in a new materials handling technology justified?

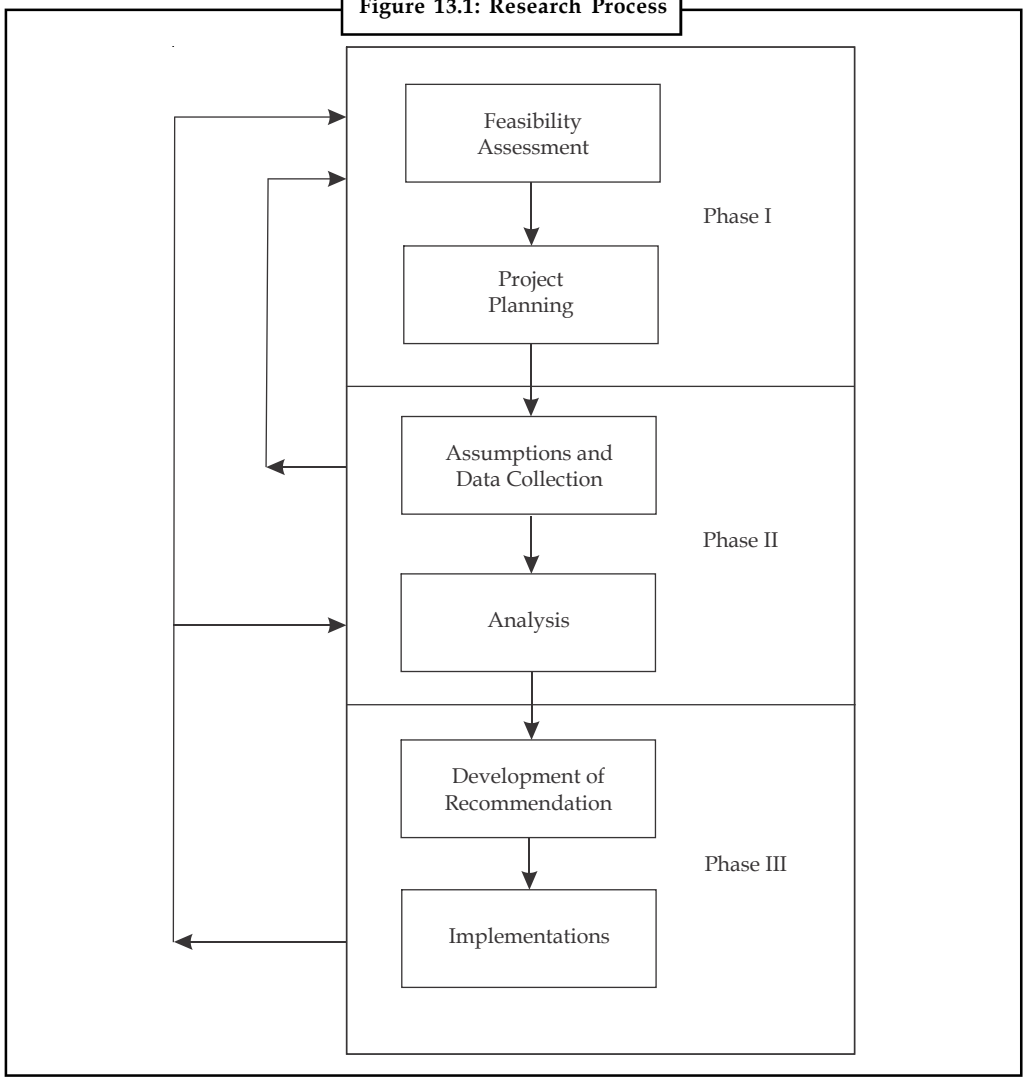
Such questions are usually characterized as complex and data-intensive. The complexity is due to the large number of factors influencing logistics total cost and the range of alternative solutions.

*Did u know?* The data-intensiveness is due to the large amount of information required to evaluate logistics alternatives.

Typical information analyses must include possible service alternatives, cost characteristics, and operating technologies. These analyses require a structured process and effective analytical tools.

Just as no ideal logistical system is suitable for all enterprises, the method for identifying and evaluating alternative logistics strategies can vary extensively. However, there is a general process applicable to most logistics design and analysis situations.

**Figure 13.1: Research Process**




***Source:*** Donald J. Bowersox, David J. Closs, M. Bixby Cooper, "Supply Chain Logistics Management," Michigan State University

Notes

Figure 13.1 illustrates the generalized process flow. The process is segmented into three phases: problem definition and planning, data collection and analysis, and recommendation and implementation.

### 13.1.1 Phase I: Problem Definition and Planning

Phase I of logistics system design and planning provides the foundation for the entire project. A thorough and well-documented problem definition and plan are essential to all that follows.

#### Feasibility Assessment

Logistics design and planning must begin with a comprehensive evaluation of the current logistics situation.



*Notes* The objective is to understand the environment, process, and performance characteristics of the current system and to determine what, if any, modifications might be necessary.

The process of evaluating the need for change is referred to as feasibility assessment, and includes the activities of situational analysis, supporting logic development, and cost/benefit estimation.

#### Situational Analysis

Situational analysis is the collection of performance measures and characteristics that describe the current logistics environment. A typical appraisal requires an internal review, a market assessment, a competitive evaluation, and a technology assessment to determine improvement potential and opportunities.

The internal review is necessary to develop a clear understanding of existing logistics processes. It profiles historical performance, data availability, strategies, operations, and tactical policies and practices. The review usually covers the overall logistics process as well as each logistics function.

A complete self-appraisal for an internal review examines all major resources, such as workforce, equipment, facilities, relationships, and information. In particular, the internal review should focus on a comprehensive evaluation of the existing system's capabilities and deficiencies. Each element of the logistics system should be carefully examined with respect to its stated objectives and its capabilities to meet those objectives.



*Example:* Is the logistics management information system consistently providing and measuring the customer service objectives desired by the marketing department? Likewise, does the material management process adequately support manufacturing requirements? Does the current network of distribution centres effectively support customer service objectives? Finally, how do logistics performance capabilities and measures compare across business units and locations?

These and many similar questions form the basis of the self-appraisal required for the internal analysis. The comprehensive review attempts to identify the opportunities that might motivate or justify logistics system redesign or refinement.

Notes

The suggested format is not the only approach, but it does highlight the fact that the assessment must consider the processes, decisions, and key measures for each major logistics activity. Process considerations focus on physical and information flows through the value chain. Decision considerations focus on the logic and criteria currently used for value chain management. Measurement considerations focus on the key performance indicators and the firm's ability to measure them.

The specific review content depends on the scope of the analysis. It is unusual that the information desired is readily available. The purpose of the internal review is not detailed data collection but rather a diagnostic look at current logistics processes and procedures as well as a probe to determine data availability. Most significantly, the internal review is directed at the identification of areas where substantial opportunity for improvement exists. The external assessment is a review of the trends and service demands required by customers. The market assessment objective is to document and formalize customer perceptions and desires with regard to changes in the firm's logistics capabilities. The assessment might include interviews with select customers or more substantive customer surveys.



*Caution* The assessment should focus on external relationships with suppliers, customers, and consumers. The assessment should consider trends in requirements and processes as well as enterprise and competitor capabilities.

Technology assessment focuses on the application and capabilities of key logistics technologies, including transportation, storage, materials handling, packaging, and information processing. The assessment considers the firm's capabilities in terms of current technologies and the potential for applying new technologies.



*Example:* Can advanced materials handling capabilities offered through third-party suppliers enhance logistics performance? What is the role of advanced information technology, communication, and decision support systems in guiding responsive logistics capabilities?

Finally, what can satellite and scanning communications technologies contribute to logistics system capability? The objective of the technology assessment is to identify technology advancements that can provide effective trade-offs with other logistics resources such as transportation or inventory.

### Supporting Logic Development

The second feasibility assessment task is development of a supporting logic to integrate the findings of the internal review, external assessment, and technology study. Supporting logic development often constitutes the most difficult part of the strategic planning process. The purpose of the situational analysis is to provide senior management with the best possible understanding of the strengths and weaknesses of existing logistics capabilities for both current and future environments. Supporting logic development builds on this comprehensive review in three ways.

First, it must determine if there are sufficient logistics improvement opportunities to justify detailed research and analysis. In a sense, supporting logic development forces a critical review of potential opportunities and a determination of whether additional investigation is justified. Supporting logic development uses the logistics principles (e.g., tapering principle, principle of inventory aggregation) to determine the feasibility of conducting detailed analysis and the potential benefits. While completing the remaining tasks in the managerial planning process does not commit a firm to implementation or even guarantee a new logistics system design, the potential benefits of change should be clearly identified when developing the supporting logic.

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Second, supporting logic development critically evaluates current procedures and practices with a comprehensive factual analysis to remove perceptual biases. Identification of areas with improvement potential, as well as those where operations are satisfactory, provides a foundation to determine the need for strategic adjustment.



*Example:* It may be apparent that excess inventory is a serious problem and significant potential exists to reduce cost and improve service.

While the appraisal process frequently confirms that many aspects of the existing system are more right than wrong, the conclusion should be based on improvement. If supporting logic affirms the current number and location of distribution centres, subsequent analysis can focus on streamlining inventory levels without serious risk of sub-optimization. The deliverables of this evaluation process include classification of planning and evaluation issues prioritized into primary and secondary categories across short- and long-range planning horizons.

Third, the process of developing supporting logic should include clear statements of potential redesign alternatives. The statement should include: (1) definition of current procedures and systems, (2) identification of the most likely system design alternatives based on leading industry and competitive practices, and (3) suggestion of innovative approaches based on new theory and technologies. The alternatives should challenge existing practices, but they must also be practical. The less frequently a re-design project is conducted to re-evaluate current procedures and designs, the more important it is to identify a range of options for consideration.



*Example:* Evaluation of a total logistics management system or distribution network should consider a wider range of options if done every 5 years than if completed every 2 years.

At this point in the planning and design process, it is well worth the effort to construct flow diagrams and/or outlines illustrating the basic concepts associated with each alternative. The illustrations frame opportunities for flexible logistics practices, clearly outline value-added and information flow requirements, and provide a comprehensive overview of the options. Some refined or segmented logistics practices are difficult to illustrate in a single flow diagram.



*Example:* Regional variations, product-mix variations, and differential shipment policies are difficult to depict, although they do form the basis of design alternatives.

When segmental strategies are proposed, it is easier to portray each option independently. A recommended procedure requires the manager responsible for evaluating the logistical strategy to develop a logical statement and justification of potential benefits.

### Cost/Benefit Estimate

The final feasibility assessment task, the cost/benefit estimate, is an estimate of the potential benefits of performing a logistics analysis and implementing the recommendations.



*Caution* Benefits should be categorized in terms of service improvements, cost reduction, and cost prevention.

The categories are not mutually exclusive given that an ideal logistics strategy might include some degree of all three benefits simultaneously.

Service improvement includes results that enhance availability, quality, or capability. Improved service increases loyalty of existing customers and may also attract new business.

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Cost reduction benefits may be observed in two forms. First, benefits may occur as a result of a one-time reduction in financial or managerial resources required to operate the logistics system.



*Example:* Logistical redesign may allow the sale of distribution facilities, materials handling devices, or information technology equipment.

Reductions in capital deployed for inventory and other distribution-related assets can significantly enhance a firm's performance if ongoing costs are eliminated and capital is freed up for alternative development. Second, cost reductions may be found in the form of out-of-pocket or variable expenses.



*Example:* New technologies for materials handling and information processing often reduce variable cost by allowing more efficient processing and operations.

Cost prevention reduces involvement in programs and operations experiencing cost increases. For example, many materials handling and information technology upgrades are at least partially justified through financial analysis of the implications of future labour availability and wage levels. Naturally, any cost-prevention justification is based on an estimate of future conditions and therefore is vulnerable to some error. While logistics system redesign may not be approved entirely on the basis of cost prevention because of such uncertainty, these preventative measures are still important to consider.

No rules exist to determine when a planning situation offers adequate cost/benefit potential to justify an in-depth effort. Ideally, some review should be completed on a continuous basis at regularly specified intervals to assure the viability of current and future logistics operations. In the final analysis, the decision to undertake in-depth planning will depend on how convincing the supporting logic is, how believable estimated benefits are, and whether estimated benefits offer sufficient return on investment to justify organizational and operational change. These potential benefits must be balanced against the out-of-pocket cost required to complete the process.

Although they are not always a goal of a planning and design project, immediate improvement opportunities are a frequent feasibility assessment result. Enhanced logistics performance achieved through immediate improvements can often increase revenue or decrease cost sufficiently to justify the remainder of an analysis.



*Caution* As the project team identifies these opportunities, a steering committee should evaluate each opportunity to determine the return and implementation requirements.

## Project Planning

Project planning is the second Phase I activity. Logistics system complexity requires that any effort to identify and evaluate strategic or tactical alternatives must be planned thoroughly to provide a sound basis for change. Project planning involves five specific items: statement of objectives, statement of constraints, measurement standards, analysis procedures, and project work plan.

## Statement of Objectives

The statement of objectives documents the cost and service expectations for the logistics system revisions. It is essential that they be stated specifically and in terms of measurable factors. The objectives define market or industry segments, the time frame for revisions, and specific

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performance requirements. These requirements typically define specific service levels that management is seeking to achieve. For example, the following suggest a combination of measurable objectives that might be used to guide a logistics analysis:

- Inventory availability:
  - 99% for category A products,
  - 95% for category B products,
  - 90% for category C products;
- Desired delivery of 98% of all orders within 48 hours of order placement;
- Minimize customer shipments from secondary distribution centres;
- Fill mixed commodity orders without back order on a minimum of 85 percent of all orders;
- Hold back orders for a maximum of 5 days; and
- Provide the 50 most profitable customers with perfect order performance on 98 percent of all orders.

Specific definition of these objectives directs system design efforts to achieve explicit customer service performance levels. Total system cost to meet the service objectives can then be determined using the appropriate analytical method. To the extent that logistics total cost does not fall within management expectations, alternative customer service performance levels can be evaluated using sensitivity analysis to determine the impact on overall logistics cost.

Alternatively, performance objectives can establish maximum total cost constraints, and then a system that achieves maximum customer service level within an acceptable logistics budget may be designed.



*Notes* Such cost-oriented objectives are practical since recommendations are guaranteed to function within acceptable budget ranges but lack sensitivity to service-oriented system design.

### Statement of Constraints

The second project planning consideration concerns design constraints. On the basis of the situational analysis, it is expected that senior management will place restrictions on the scope of permissible system modifications. The nature of such restrictions will depend upon the specific circumstances of individual firms. However, two typical examples are provided to illustrate how constraints can affect the overall planning process.

One restriction common to distribution system design concerns the network of manufacturing facilities and their product-mix assortment. To simplify the study, management often holds existing manufacturing facilities and product mix constant for logistical system redesign. Such constraints may be justified on the basis of large financial investments in existing production facilities and the ability of the organization to absorb change.

A second example of constraints concerns marketing channels and physical distribution activities of separate divisions. In firms with a traditional pattern of decentralized profit responsibility, management may elect to include some divisions while omitting others from redesign consideration. Thus, some divisions are managerially identified as candidates for change while others are not.

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All design constraints serve to limit the scope of the plan. However, as one executive stated, "Why study things we don't plan to do anything about?" Unless there is a reasonable chance that management will be inclined to accept recommendations to significantly change logistics strategy or operations, their limitations may best be treated as a study constraint.

The purpose of developing a statement of constraints is to have a well-defined starting point and overall perspective for the planning effort. If computerized analysis techniques are used, major constraints may be reconsidered later. In contrast to the situation assessment the statement of constraints defines specific organizational elements, buildings, systems, procedures, and/or practices to be retained from the existing logistical system.

### Measurement Standards

The feasibility assessment often highlights the need for development of managerial performance standards. Such standards direct the project by identifying cost structures and performance penalties and by providing a means to assess success. Management must stipulate measurement standards and objectives for each category as a prerequisite to plan formulation. It is important that the standards adequately reflect total system performance rather than a limited, suboptimal focus on logistics functions. Once formulated, such standards must be monitored and tracked throughout system development to allow benchmarking the result of the changes. Although considerable managerial discretion exists in the formulation of standards, care must be exercised not to dilute the validity of the analysis and subsequent results by setting impractical goals.

An important measurement requirement is to quantify a list of assumptions that underlie or provide the logic supporting the standards. These assumptions should receive top-management approval because they can significantly shape the results of the strategic plan.



*Example:* A relatively small variation in the standard cost and procedure for evaluating inventory can create major variations in the strategic plan.

Measurement standards should include definitions of how cost components such as transportation, inventory, and order processing are calculated, including detailed financial account references. The standards must also include specification of relevant customer service measures and methods for calculation.

### Analysis Technique

Once the critical issues and alternatives are defined, the appropriate analysis technique should be determined. Analysis techniques range from simple manual analysis to elaborate computerized decision support tools.



*Example:* Models incorporating optimization or simulation algorithms are common when evaluating and comparing alternative logistics warehouse networks.

However, many planning and design projects can be effectively completed using only manual or spreadsheet-based analyses. Once the project objectives and constraints are defined, project planning must identify alternative solution techniques and select the best approach. Accenture annually publishes information regarding software applications for logistics decision support.

Selection of an analysis technique must consider the information necessary to evaluate the project issues and options. Specifically, critical performance measures and logistics system scope must be identified and evaluated. Technique selection must also consider the availability and format of required data.

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### Project Work Plan

On the basis of feasibility assessment, objectives, constraints, and analysis technique, a project work plan must be determined and the resources and time required for completion identified. The alternatives and opportunities specified during the feasibility assessment provide the basis for determining the scope of the study. In turn, the scope determines the completion time.

Project management is responsible for the achievement of expected results within time and budget constraints. One of the most common errors in strategic planning is to underestimate the time required to complete a specific assignment. Overruns require greater financial expenditures and reduce project credibility. Fortunately, there are a number of PC-based software packages available to structure projects, guide resource allocation, and measure progress. Such methodologies identify deliverables and the interrelationship between tasks.

## 13.1.2 Phase II: Data Collection and Analysis

Once the feasibility assessment and project plan are completed, Phase II focuses on data collection and analysis. This includes activities to define assumptions and collect data and to analyze alternatives.

### Assumptions and Data Collection

This activity builds on the feasibility assessment and project plan to develop detailed planning assumptions and identify data collection requirements by (1) defining analysis approaches and techniques, (2) defining and reviewing assumptions, (3) identifying data sources, (4) collecting data, and (5) collecting validation data.

#### *Defining Analysis Approaches and Techniques*

Although it is not necessarily first, an early task is the determination of the appropriate analysis approach and the acquisition of necessary analysis techniques. While a wide number of options are available, the most common techniques are analytical, simulation, and optimization. The analytical approach uses standard numerical methods such as those available through spreadsheets to evaluate each logistics alternative. Spreadsheet availability and capability have increased the application of analytical tools for distribution applications.

A simulation approach can be likened to a laboratory for testing supply chain alternatives. Simulation is widely used, particularly when significant uncertainty is involved. The testing environment can be physical, such as a model materials handling system that physically illustrates product flow in a scaled-down environment, or numerical, such as a computer model of a materials handling environment that illustrates product flow on a computer screen. Current software makes simulation one of the most cost-effective approaches for evaluating dynamic logistics alternatives.



*Example:* A PC-based simulation can model the flows, activity levels, and performance characteristics.

Many simulations can also illustrate system characteristics graphically.



*Example:* Supply chain dynamic simulation can be used to illustrate the trade-off between inventory allocation strategy and supply chain performance.

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Optimization uses linear or mathematical programming to evaluate alternatives and select the best one. While it has the benefit of being able to select the best option, optimization applications are often smaller in scope than typical simulation approaches. Because of its powerful capabilities, optimization is used extensively for evaluating logistics network alternatives such as the number and location of distribution centres.

### *Defining and Reviewing Assumptions*

Assumption definition and review builds on the situation analysis, project objectives, constraints, and measurement standards. For planning purposes, the assumptions define the key operating characteristics, variables, and economics of current and alternative systems. While the format will differ by project, assumptions generally fall into three classes: (1) business assumptions, (2) management assumptions, and (3) analysis assumptions.

Business assumptions define the characteristics of the general business environment, including relevant market, consumer, and product trends and competitive actions. The assumptions define the broad environment within which an alternative logistics plan must operate. Business assumptions are generally outside the ability of the firm to change.

Management assumptions define the physical and economic characteristics of the current or alternative logistics environment and are generally within the firm's ability to change or refine. Typical management assumptions include a definition of alternative distribution facilities, transport modes, logistics processes, and fixed and variable cost.

Analysis assumptions define the constraints and limitations that must be included to fit the problem to the analysis technique. These assumptions frequently concern problem size, degree of analysis detail, and solution methodology.

### *Identifying Data Sources*

In actual practice, the process of data collection begins with a feasibility assessment. In addition, a fairly detailed specification of data is required to formulate or fit the analytical technique. However, at this point in the planning procedure, detailed data must be collected and organized to support the analysis. For situations when data is extremely difficult to collect or when the necessary level of accuracy is unknown, sensitivity analysis can be used to identify data collection requirements.



*Example:* An initial analysis may be completed using transportation costs estimated with distance-based regressions. If analysis indicates that the best answer is very sensitive to the actual freight rates, there should be additional effort to obtain more precise transport rates from carrier quotes.

Once operational, sensitivity analysis can be used to determine the major factors involved. When these factors, such as outbound transportation expense, are identified, more effort can be directed to increasing transportation accuracy; correspondingly, less effort can be directed toward other data requirements.

The majority of data required in a logistical study can be obtained from internal records. Although considerable searching may be needed, most information is generally available.

The first major data category is sales and customer orders. The annual sales forecast and percentage of sales by month, as well as seasonality patterns, are usually necessary to determine logistics volume and activity levels. Historical samples of customer invoices are also necessary to determine shipping patterns by market and shipment size. The combination of aggregate measures of demand and shipment profiles characterizes the logistics requirements that must be met.

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Specific customer data are also required to impart a spatial dimension to a logistics analysis. The spatial dimension reflects the fact that effective logistics must consider the cost and time associated with moving product across distance. Customers and markets are often aggregated by location, type, size, order frequency, growth rate, and special logistical services to reduce analysis complexity while not substantially reducing analysis accuracy.

For integrated channel analysis, it is necessary to identify and track the costs associated with manufacturing and purchasing. This often requires further classification using a bill of materials. While manufacturing plant locations may not be a variable component in a logistical system design, it is often necessary to consider the number and location of plants, product mix, production schedules, and seasonality. Policies and costs associated with inventory transfer, reordering, and warehouse processing must be identified. In particular, inventory control rules and product allocation procedures are often important elements. Finally, for each current and potential warehouse, it is necessary to establish operating costs, capacities, product mix and storage levels, and service capabilities.

Transportation data requirements include the number and type of modes utilized, modal selection criteria, rates and transit times, and shipping rules and policies. If private transportation is included in the analysis, then corresponding information is required for the private fleet.

The preceding discussion offers some perspective regarding the necessary data to evaluate logistics alternatives. The primary justification for placing the formal data collection process after the selection of analysis technique is to allow data collection to match specific analysis technique requirements. In other words, the design solution can be no better than the data it is based on.

For most logistics analysis applications, market data is useful for evaluating future scenarios. Management can normally provide an estimate of anticipated sales for future planning horizons. The difficulty lies in obtaining market-by-market projections.

One solution to the problem is to use demographic projections that correlate highly with sales.



*Example:* Assume that sales or usage correlates highly with population. Using such a correlation and government population projections, it is possible to estimate future demand levels and thus determine future logistics requirements.

A variety of projections concerning demographic factors are regularly published by various government agencies and universities. A number of zip code sources exist which provide useful data for logistics planning. Thus, a reasonable data bank of environmental information is readily available.

It is also useful to document competitive logistical system designs and flows to provide information regarding competitor strategies and capabilities. In most cases, this information is readily available from published material, annual reports, and general knowledge of company executives. The main purpose in collecting such data is to provide competitive benchmarks that compare customer service capabilities, distribution networks, and operating capabilities.

### *Collecting Data*

Once alternative data sources have been identified, the data collection process can begin. The process includes assembly of required data and conversion to appropriate formats for the analysis tool. This is often a tedious and time-consuming task, so errors are likely. Potential errors include collecting data from a misrepresentative time period and overlooking data that do not reflect major components of logistics activity, such as customer pickup volume. For this reason, the data collection process should be carefully documented to assist in identifying errors that might reduce analysis accuracy and to determine any necessary changes to achieve acceptable accuracy.

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### *Collecting Validation Data*

In addition to collecting data to support alternative analyses, base case or validation data must also be collected to verify that the results accurately reflect reality. The specific question concerns whether the chosen analytical approach accurately replicates historical results when distribution practices and operating environments are evaluated.



*Caution* Comparison should focus on historical activity (e.g., sales and volume) and expense levels both in total and by facility, if possible.

The objective of validation is to increase management credibility regarding the analysis process. If the process does not yield credible results, management will have little confidence in the alternative analyses. It is critical that data collection efforts include investigations into why analytical results may not accurately reflect the past.



*Example:* Changes in distribution centre operating practices or a one-time event such as a strike may make it impossible to exactly replicate the past. When such situations occur, the validation data collection process should include an assessment of the likely impact of such changes so that appropriate considerations can be made.

## Analysis

The analysis activity uses the technique and data from the previous activity to evaluate strategic and tactical logistics alternatives. This four-stepped activity includes the following specific tasks: (1) defining analysis questions, (2) completing and validating a baseline analysis, (3) completing analyses of alternatives, and (4) completing sensitivity analysis.

### *Defining Analysis Questions*

The first task defines specific analysis questions concerning alternatives and the range of acceptable uncertainty. The specific questions build on research objectives and constraints by identifying specific operating policies and parameters.



*Example:* The questions for a distribution centre site analysis must identify the specific location combinations to be evaluated.

In the case of an inventory analysis, questions might focus on alternative service and uncertainty levels.

Suppose that a strategic planning effort is focusing on the identification of an optimal network of distribution facilities to serve the U.S. domestic market. Assume that the current network uses four distribution centres located in Newark, New Jersey; Atlanta, Georgia; Chicago, Illinois; and Los Angeles, California. Shipment volume is defined in terms of weight shipped; cost, in terms of transportation and inventory carrying expenses; and service level, in terms of the percentage of sales volume within 2 days' transit of the distribution centre. Likely questions for the sample analysis include: (1) What is the performance impact of removing the Chicago distribution centre? (2) What is the performance impact of removing the Los Angeles distribution centre? and (3) What is the performance impact of removing the Atlanta distribution centre?

These questions represent a small subset of the potential alternatives for evaluation. Other alternatives could include fewer or more distribution centres or evaluation of different locations.

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It is important to recognize that care must be taken to define the analysis questions so that a wide range of possible options can be evaluated without requiring time-consuming analysis of options that have little likelihood of implementation.

### *Completing and Validating Baseline Analysis*

The second task completes the baseline analysis of the current logistics environment using the appropriate method or tool. Results are compared with the validation data collected previously to determine the degree of fit between historical and analytical findings. The comparison should focus on identifying significant differences and determining sources of possible error. Potential errors may result from incorrect or inaccurate input data, inappropriate or inaccurate analysis procedures, or unrepresentative validation data. As discrepancies are encountered, errors should be identified and corrected. In some cases the error cannot be corrected but can be explained and rationalized. Once discrepancies have been removed or explained to ±2 percent, the application can be accepted as valid and the analysis can continue.

### *Completing Analyses of Alternatives*

Once the approach has been validated, the next step is to complete an evaluation of supply chain alternatives. The analysis must be accomplished to determine the relevant performance characteristics of each alternative design or strategy. The options should consider possible changes in management policies and practices involving factors such as the number of distribution centres, inventory target levels, or the transportation shipment size profile.

### *Completing Sensitivity Analysis*

Once this analysis is completed, the best performing alternatives can be targeted for further sensitivity evaluation. Here uncontrollable factors such as demand, factor costs, and competitive actions are varied to assess each alternative's ability to operate under a variety of conditions.



*Example:* Suppose that the alternative analysis indicates that five distribution centres provide the ideal cost/service trade-off for the firm's market area assuming the base demand level.

Sensitivity analysis investigates the appropriateness of this ideal solution for different demand or cost levels. In other words, would five distribution centres still be the correct decision if demand increased or decreased by 10 percent? Sensitivity analysis in conjunction with an assessment of potential scenario probabilities is then used in a decision tree to select the best alternative.

## 13.1.3 Phase III: Recommendations and Implementation

Phase III operationalises planning and design efforts by making specific management recommendations and developing implementation plans.

### Develop Recommendations

Alternative and sensitivity analysis results are reviewed to determine recommendations for proposal to management. This review process includes four tasks: (1) identifying the best alternative, (2) evaluating costs and benefits, (3) developing a risk appraisal, and (4) developing a presentation.

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### *Identifying Best Alternative*

The alternatives and sensitivity analyses should identify the best options to consider for implementation. However, multiple alternatives often yield similar or comparable results. Performance characteristics and conditions for each alternative must be compared to identify the two or three best options. Although the concept of best may have different interpretations, it will generally be the alternative that meets desired service objectives at the minimum total cost.

### *Evaluating Costs and Benefits*

In the earlier discussion of strategic planning, potential benefits were identified as service improvement, cost reduction, and cost prevention. It was noted that these benefits are not mutually exclusive and that a sound strategy might realize all benefits simultaneously. When evaluating the potential of a particular logistics strategy, an analysis comparing present cost and service capabilities with projected conditions must be completed for each alternative. The ideal cost/benefit analysis compares the alternatives for a base period and then projects comparative operations across some planning horizon. Benefits can thus be projected on the basis of both one-time savings that result from system redesign as well as recurring operating economies.

### *Developing Risk Appraisal*

A second type of justification necessary to support strategic planning recommendations is an appraisal of the risk involved. Risk appraisal considers the probability that the planning environment will match the assumptions. Additionally, it considers the potential hazards related to system changeover. Risk related to adoption of a specific alternative can be quantified using sensitivity analyses.



*Example:* Assumptions can be varied and the resulting impact on system performance for each alternative can be determined.

To illustrate, sensitivity analysis can be used to identify the system performance for different demand and cost assumptions. If the selected alternative is still best even though demand increases or decreases by 20 percent, management can conclude that that there is little risk associated with moderate errors in the demand environment. The end result of a risk appraisal provides a financial evaluation of the downside risk if planning assumptions fail to materialize.

Risk related to system change over can also be quantified. Implementation of a logistics strategic plan may require several years to execute. The typical procedure is to develop an implementation schedule to guide system changeover. To evaluate the risk associated with unanticipated delays, a series of contingency plans can be tested to determine their possible impact.

Typical sources of external risk include uncertainty associated with demand, performance cycle, cost, and competitive actions. Common sources of internal risk include labour and productivity considerations, changes in firm strategy, and changes in resource accessibility. These considerations must be assessed both quantitatively and qualitatively to provide management with direction and justification.

### *Developing a Presentation*

The final task develops a presentation to management that identifies, rationalizes, and justifies suggested changes. The presentation and accompanying report must identify specific operating and strategic changes, provide a qualitative rationale as to why such change is appropriate, and

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then quantitatively justify the changes in terms of service, expense, asset utilization, and productivity improvements. The presentation should incorporate extensive use of graphs, maps, and flowcharts to illustrate changes in logistics operating practices, flows, and distribution network.

## Implementation

The actual plan or design implementation is the final process activity. An adequate implementation plan is critical since putting the plan or design into action is the only means to obtain a return on the planning process.



*Did u know?* While actual implementation may require a number of events, there are four broad tasks: defining the implementation plan, scheduling implementation, defining acceptance criteria, and implementing the plan.

### *Defining the Implementation Plan*

The first task defines the implementation plan in terms of the individual events, their sequence, and dependencies. While the initial plan may be macro level, it must ultimately be refined to provide individual assignment responsibility and accountability. Plan dependencies identify the interrelationships between events and, thus, define the completion sequence.

### *Scheduling Implementation*

The second task schedules the implementation and time phases the assignments identified previously. The schedule must allow adequate time for acquiring facilities and equipment, negotiating agreements, developing procedure, and training. Implementation scheduling should employ one of the software scheduling aids.

### *Defining Acceptance Criteria*

The third task defines the acceptance criteria for evaluating the success of the plan. Acceptance criteria should focus on service improvements, cost reduction, improved asset utilization, and enhanced quality. If the primary focus is service, acceptance criteria must identify detailed components such as improved product availability or reduced performance cycle time. If the primary focus is cost, the acceptance criteria must define the expected positive and negative changes in all affected cost categories. It is important that the acceptance criteria take a broad perspective so that motivation focuses on total logistics system performance rather than performance of an individual function. It is also important that the acceptance criteria incorporate broad organizational input.

### *Implementing the Plan*

The final task is actual implementation of the plan or design. Implementation must include adequate controls to ensure that performance occurs on schedule and that acceptance criteria are carefully monitored.

It is critical that a formalized process be used to guide logistics system design and refinement projects to ensure that the objectives are documented and understood and the analyses are completed appropriately. While the preceding methodology supports logistics planning and design analysis, it can also be adapted to guide logistics information system design. For a system design application, the situation analysis focuses on the characteristics and capabilities

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of the current system, while the data collection and analysis activities focus on new system design, development, and validation.

### Self Assessment

Fill in the blanks:

1. …… of logistics system design and planning provides the foundation for the entire project.
2. Logistics design and planning must begin with a comprehensive …… of the current logistics situation.
3. …… focuses on the application and capabilities of key logistics technologies, including transportation, storage, materials handling, packaging, and information processing.
4. Service improvement includes results that enhance ……
5. Once the feasibility assessment and project plan are completed, …… focuses on data collection and analysis.
6. …… define the constraints and limitations that must be included to fit the problem to the analysis technique.
7. The majority of data required in a logistical study can be obtained from ……
8. …… operationalises planning and design efforts by making specific management recommendations and developing implementation plans.

## 13.2 SC Analysis Methods and Techniques

High-performance logistics requires regular comprehensive analysis of supply chain tactics and strategies. Regular freight lane analysis is necessary to respond to rate changes and balance of freight flows; tactical inventory analyses, to identify items with excess inventory and to determine the appropriate inventory target levels; and location analysis, now often termed supply chain planning, to perform the strategic evaluation of supply chain alternatives such as sourcing, plant location, warehouse location, and market service areas, increasingly important to optimize flows for global supply chains. Dynamic simulation is used to investigate the dynamics of multiple-stage inventories such as among suppliers, plants, and distribution centres, and tactical transportation analysis assists in truck routing and scheduling. For each of these types of decisions, the following sections describe the specific questions, alternative analytical techniques, and typical data requirements.

### 13.2.1 Freight Lane Analysis

One common logistics analysis concerns transportation movements on specific freight lanes. A *freight lane* refers to the shipment activity between a pair of origin and destination points. The analysis can be completed on a very specific basis between facilities or on a broader regional basis. Freight lane analysis focuses on the balance of volume between origin and destination points. To maximize vehicle utilization, movements should be balanced, or roughly equal, in both directions. Triangular freight lanes attempt to coordinate movement between three points by moving combinations of material and finished product between suppliers, manufacturers, and customers.

Freight lane analysis involves both movement volume and the number of shipments or trips between points. The objective is to identify imbalances that offer opportunities for enhanced

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logistics productivity. Once lane imbalances are identified, management attempts to identify volume that can be transported in the under utilized direction. This might be accomplished by switching carriers or modes, shifting volume to or from a private fleet, increasing backhaul of raw materials, or creating an alliance with another shipper. Conversely, volume in the over utilized direction might be diverted to other carriers or shippers or sourced from an alternative location.

### 13.2.2 Inventory Analysis

The second common logistics ad-hoc analysis focuses on inventory performance and productivity. Typical inventory analysis considers relative product sales volume and inventory turnover and is performed on an ABC basis.



*Example:* By listing the top 10 sales and inventory groupings in decreasing sequence, a logistics manager can quickly determine product groups that have a major influence on volume and inventory levels.

As we know, 80 percent of sales are typically accounted for by 20 percent of the items. It is also typical that 80 percent of the inventory accounts for only 20 percent of the volume. Knowledge of these characteristics and the items that make up each product group is useful in targeting inventory management efforts. Items that demonstrate a large inventory commitment relative to sales can be selected for intensive management efforts to reduce inventory level and improve performance (e.g., turnover).

### 13.2.3 Location Decisions

Plant and distribution centre location is a common problem faced by logistics managers. Increased production economies of scale and reduced transportation cost have focused attention on warehouses. In recent years, location analysis has been further extended to include logistics channel design as a result of global sourcing and marketing considerations. Because global operations increase logistics channel decision complexity, design alternatives, and related logistics cost, the importance of location analysis has increased substantially. Now described as supply chain design, location analysis frequently considers material suppliers, manufacturing sites, distribution centres, and service providers.

As the name implies, location decisions focus on selecting the number and location of warehouses. Typical management questions include: (1) How many warehouses should the firm use, and where should they be located? (2) What customers or market areas should be serviced from each warehouse? (3) Which product lines should be produced or stocked at each plant or warehouse? (4) What logistics channels should be used to source material and serve international markets? and (5) What combination of public and private warehouse facilities should be used? More refined logistics network problems increase issue complexity by requiring combinatorial analysis integrating the above questions.

Typical location analysis problems can be characterized as very complex and data-intense. Complexity is created by the number of plant, distribution centre, market, and product alternatives that can be considered; data intensity is created because the analysis requires detailed demand and transportation data. Sophisticated modelling and analysis techniques must be employed to effectively deal with such complexity and data intensity to identify the best alternatives. The tools used to support location analysis can generally be categorized as mathematical programming and simulation.

## Mathematical Programming

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Mathematical programming methods, which are classified as optimization techniques, are one of the most widely used strategic and tactical logistics planning tools. *Linear programming*, one of the most common techniques used for location analysis, selects the optimal supply chain design from a number of available options while considering specific constraints. House and Karrenbauer provided a long-standing definition of optimization relevant to logistics:

An optimization model considers the aggregate set of requirements from the customers, the aggregate set of production possibilities for the producers, the potential intermediary points, the transportation alternatives and develops the optimal system. The model determines on an aggregate flow basis where the warehouses should be, where the stocking points should be, how big the warehouses should be and what kinds of transportation options should be implemented.

To solve a problem using linear programming, several conditions must be satisfied. First, two or more activities or locations must be competing for limited resources.



*Example:* Shipments must be capable of being made to a customer from at least two locations.

Second, all pertinent relationships in the problem structure must be deterministic and capable of linear approximation. Unless these enabling conditions are satisfied, a solution derived from linear programming, while mathematically optimal, may not be valid for logistical planning.

While linear programming is frequently used for strategic logistics planning, it is also applied to operating problems such as production assignment and inventory allocation. Within optimization, distribution analysts have used two different solution methodologies for logistics analysis.

One of the most widely used forms of linear programming for logistics problems is *network optimization*. Network optimization treats the distribution channel as a network consisting of nodes to identify production, warehouses, and markets and arcs reflecting transportation links. Costs are incurred for handling goods at nodes and moving goods across arcs. The network model objective is to minimize the total production, inbound and outbound transportation costs subject to supply, demand, and capacity constraints.

Beyond the basic considerations for all analytical techniques, network optimization has specific advantages and disadvantages that both enhance and reduce its application for logistics analyses. Rapid solution times and ease of communication between specialists and non-specialists are the primary advantages of network models. They may also be applied in monthly, rather than annual, time increments, which allows for longitudinal or across-time analysis of inventory level changes. Network formulations may also incorporate fixed costs to replicate facility ownership. The results of a network model identify the optimum set of distribution facilities and material flows for the logistics design problems as it was specified for the analysis.

The traditional disadvantages of network optimization have been the size of the problem that can be solved and the inclusion of fixed cost components. The problem size issue was of particular concern for multistage distribution systems such as those including suppliers, production locations, distribution centres, wholesalers, and customers. While problem size is still a concern, advancements in solution algorithms and hardware speed have significantly improved network optimization capabilities. The fixed cost limitation concerns the capability to optimize both fixed and variable costs for production and distribution facilities. There have been significant advancements in overcoming this problem through the use of a combination of network optimization and mixed-integer programming.

Notes

*Mixed-integer programming* is the other optimization solution technique successfully applied to logistics problems. The formulation offers considerable flexibility, which enables it to incorporate many of the complexities and idiosyncrasies found in logistics applications. The primary advantage of the mixed-integer format is that fixed as well as different levels of variable cost can be included in the analysis.



*Example:* Demand can be treated on a non-integer basis, thus allowing increments to system capacity in specific step increases.

In other words, mixed-integer programming allows solutions to accurately reflect increased fixed costs and economies of scale as larger distribution centres are employed. The mixed-integer approach permits a high degree of practicality to accommodate restrictions found in day-to-day logistics operations.

Historically, the major limitation of optimization has been constraints on problem sizes. Along with other advances in mixed-integer programming, problem size constraints have been overcome, for a considerable period of time, through the application of decomposition to the solution techniques. Decomposition permits multiple commodities to be incorporated into logistical system design. Most firms have a variety of products or commodities that are purchased by customers in varied assortments and quantities. While such products may be shipped and stored together, they are not inter-changeable from the viewpoint of servicing customers.

The *decomposition technique* provides a procedure for dividing the multi-commodity situation into a series of single-commodity problems. The procedure for arriving at commodity assignment follows an iterative process wherein costs associated with each commodity are tested for convergence until a minimum cost or optimal solution is isolated.

These optimization approaches provide effective tools for analysis of location-related issues such as facility location, optimum product flow, and capacity allocation. Mixed-integer approaches are typically more flexible in terms of capacity to accommodate operational nuances, while network approaches are more computationally efficient.



*Did u know?* Both types of linear programming optimization approaches are effective techniques for evaluating situations where significant facility capacity limitations exist.

### *Simulation*

A second location analysis method is static simulation. The term simulation can be applied to almost any attempt to replicate a situation. Robert Shannon originally defined simulation as "the process of designing a model of a real system and conducting experiments with this model for the purpose of either understanding system behaviour or of evaluating various strategies within the limits imposed by a criterion or set of criteria for the operation of the system."

Static simulation replicates the product flows and related expenses of existing or potential logistics channel networks. The network includes plants, distribution centres, and markets. The major expense components include raw material sourcing, manufacturing, inbound freight, fixed and variable distribution centre cost, outbound customer freight, and inventory carrying cost.

Static simulation evaluates product flow as if it all occurred at a single point during the year. In this sense, the primary difference between static and dynamic simulation is the manner in which time-related events are treated. Whereas dynamic simulation evaluates system performance across time, static simulation makes no attempt to consider the dynamics between time periods. Static simulation treats each operating period within the overall planning horizon as a finite interval. Final results represent an assumption of operating performance for each period in the planning horizon.

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*Example:* In the formulation of a 5-year plan, each year is simulated as an independent event.

*Caselet*

## Optimizing Transportation

JELD-WEN Inc. is a perfect example of a vertically integrated company. From its own timber-lands, this large manufacturer of doors, windows, millwork, and specialty wood products cuts lumber and ship it off to its own cut-stock plants.

There, the lumber is prepared and sent to JELD-WEN's manufacturing plants, which in turn feed the company's distribution business. The latter sells products to the end user, thus completing a full chain of vertical integration.

Bob Smith, transportation manager in JELD-WEN's corporate office in Winnipeg, Canada, oversees 18 Canadian locations. The company has 150-plus divisions, more than 20,000 employees worldwide, and is well diversified. Manufacturing and distribution activities take place in both the U.S. and Canada, making the need for a streamlined, productive supply chain on both sides of the border critical for the company's growth. "Basically, we always want to make sure that our transportation system is as efficient as our plants are when it comes to production," says Smith. "To do that, we focus on trying to reduce both time and waste from our supply chain."

With that in mind, JELD-WEN embarked on an effort to overhaul its Canadian locations. In reviewing the company's geographically dispersed facilities north of the border, JELD-WEN realized that some had become unnecessary over the years. "We decided that we could provide the same type of services from larger locations," says Smith, "and realize a lot of improvements in our operations at the same time." The end result was a consolidation of five locations.

This consolidation also released a transportation fleet and an assortment of excess equipment that needed to be disposed of efficiently. "We went in and conducted physical inspections of all the units while also doing a detailed review of the maintenance records," says Smith. "We reviewed the equipment usage, the mileage, and other important aspects of unit use over the last few years." Smith sold a good portion of the equipment at fair market value. "We also tapped into some other options," he says, "such as what early return penalties we might expect with regard to leased equipment. We also discussed swapping those over-specified units for vehicles that would be more suitable for us." In addition, before disposing of any equipment or vehicle, Smith's team first consulted with other facilities within the JELD-WEN family to see if they could use it. "We also did careful checks of new vehicle orders to see if they could be filled with some of these existing units and we sought out opportunities to upgrade some of our existing vehicles at other locations with a unit that might have had lower mileage, or that was in better condition," says Smith. After exhausting those options, any units left over were sold.

The consolidation process yielded positive results for JELD-WEN by reducing transportation-related costs by more than $1 million and reducing its overall warehousing costs. "As a company, we want to be known for providing world-class customer service all the time," says Smith. "Though we reduced our number of warehouses, we know we'll be able to meet our service objectives. In fact, without the reduction and the sell-off of the equipment, we probably wouldn't have been able to realize the level of transportation, inventory, and warehousing cost savings that we did in the last year."

***Source:*** Bridget McCrea, "Optimizing Transportation," Warehousing Management. March 2001, pp. T2–T3.

Notes

### 13.2.4 Location Analysis Data Requirements

The primary location analysis data requirements are definitions of markets, products, network, customer demand, transportation rates, and variable and fixed costs.

***Market Definition:*** Location analysis requires that demand be classified or assigned to a geographic area. The combination of geographic areas constitutes a logistics service area. Such an area may be a country or global region. The demand for each customer is assigned to one of the market areas. The selection of a market definition method is an extremely important element of the system design procedure.

A number of market definition structures have been developed. The most useful structures for logistics modelling are (1) county, (2) standard metropolitan statistical area (SMSA), and (3) zip or postal codes. (Postal codes are the international equivalent of zip codes.) The most common structure uses zip or postal codes since company records usually include such information. In addition, extensive government and transportation data is available by zip codes. The major issues for selecting a market definition approach concern the number of areas required to provide accurate results. While more market detail increases accuracy, it also increases analysis efforts. Research indicates that approximately 200 markets offer an effective trade-off between accuracy and analysis effort.

***Product Definition:*** Although individual product flows can be considered when performing location analysis, it is usually not necessary to use such detail. Individual items, especially those with similar distribution characteristics, production sites, and channel arrangements, are grouped or aggregated to simplify the analysis. Typical supply chain analyses are completed at the product family level.

***Network Definition:*** The network definition specifies the channel members, institutions, and possible locations to be included in the analysis. Specific issues concern the combinations of suppliers, production locations, distribution centres, wholesalers, and retailers that are to be included. Network definition also includes consideration of new distribution centres or channel member alternatives. While using a more comprehensive definition reduces the chance of sub optimizing system performance, total channel location analysis increases analysis complexity. Supply chain analysts must evaluate the trade-offs between increasing analysis complexity and improved potential for total supply chain optimization.

***Market Demand:*** Market demand defines shipment volume to each geographic area identified as a market. Specifically, supply chain analysis is based on the relative product volume shipped to each market area. While the volume may pertain to the number of units or cases shipped to each market, most location analyses are based on weight since transportation cost is strongly influenced by weight moved. Market demand utilized in the analysis may also be based on historical shipments or anticipated volume if substantial changes are expected. The market demand must be profiled into different shipment sizes since transportation cost is significantly influenced by shipment size.

***Transportation Rates:*** Inbound and outbound transportation rates are a major data requirement for location analyses. Rates must be provided for shipments between existing and potential distribution channel members and markets. In addition, rates must be developed for each shipment size and for each transportation link between distribution centres and markets. It is common for supply chain analysis to require in excess of a million individual rates.



*Did u know?* Because of the large number, rates are commonly developed using regressions or are retrieved from diskettes provided by most carriers.

Notes

***Variable and Fixed Costs:*** The final location analysis data requirements are the variable and fixed costs associated with operating distribution facilities. Variable cost includes expenses related to labour, energy, utilities, and materials. In general, variable expenses are a function of throughput. Fixed costs include expenses related to facilities, equipment, and supervisory management. Within a relevant distribution facility operating range, fixed costs remain relatively constant. While variable and fixed cost differences by geography are typically not substantial, there are minor locational considerations, which should be included to ensure analysis accuracy. The major differences result from locational peculiarities in wage rates, energy cost, land values, and taxes.

Substantial logistics planning emphasis is placed on location analysis. In the past, distribution networks were relatively stable, so it was unnecessary for firms to complete logistics system analyses regularly; however, the dynamics of alternative supply chain options, changing cost levels, and availability of third-party services requires that supply chain networks be evaluated and refined more frequently today. It is common for firms to perform evaluations annually or even monthly.

### 13.2.5 Inventory

Inventory analysis decisions focus on determining the optimum inventory management parameters which meet desired service levels with minimum investment. Inventory parameters refer to safety stock, reorder point, order quantity, and review cycles for a specific facility and product combination. This analysis can be designed to refine inventory parameters on a periodic or daily basis. Daily refinements make parameters more sensitive to environmental changes such as demand levels or performance cycle length; however, they also result in nervous inventory management systems. System nervousness causes frequent expediting and de-expediting of numerous small shipments.

Inventory analysis focuses on the decisions. Specific questions include: (1) How many products should be produced during the next production cycle? (2) Which distribution centres should maintain inventories of each item (e.g., should slow-moving items be centralized)? (3) What is the optimum size of replenishment orders (the order quantity decision)? and (4) What is the necessary re-order point for replenishment orders (the safety stock decision)?



*Did u know?* There are two types of methods to evaluate and select from inventory management options: analytic and simulation.

#### Analytic Inventory Techniques

Analytic inventory methods utilize functional relationships such as those to determine ideal inventory stocking parameters and the desired service level. The technique uses service objectives, demand characteristics, performance cycle characteristics, and the logistics system characteristics as input to calculate optimum inventory parameters. From an inventory management perspective, service objectives are typically defined in terms of case or order fill rates. Demand characteristics describe the periodic average and standard deviation of customer demand; performance cycle characteristics, the average and standard deviations for replenishment performance cycles; and logistics system characteristics, the number of distribution stages or echelons requiring inventory management decisions. The analytical inventory technique is based on assumptions describing the logistics system characteristics (stocking echelons) and the probabilities relating demand and performance cycle characteristics. The probability relationships, along with the service level objectives, determine the optimal inventory management parameters in terms of replenishment order quantities and reorder points. Numerous

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examples of software applications exist that utilize analytic techniques to determine optimum inventory management parameters.

The advantage of analytic inventory techniques is the ability to directly determine optimum inventory parameters given certain assumptions regarding operating environment. On the other hand, analytic inventory techniques are limited in terms of accuracy when assumptions are not met.



*Example:* Since most analytic inventory techniques assume normally distributed demand and performance cycles, the techniques lose accuracy when the shape of actual demand or performance cycles deviates from the normality assumption.

Nevertheless, analytical inventory techniques are often a good place to start when attempting to determine optimum inventory parameters.

### Simulation Inventory Techniques

The inventory simulation approach creates a mathematical and probabilistic model of the logistics operating environment as it actually exists. The simulation approach is similar to creating a laboratory testing environment for the logistics network and operating policies. Simulation is similar to the analytic approach except the roles of the inventory parameters and service levels are reversed.

In simulation, inventory parameters such as the order quantities and the reorder points that are to be tested become the simulation inputs. These inputs define the environment to be tested. The major simulation outputs are the service level and inventory performance characteristics of the testing environment. The simulation, in effect, evaluates the performance of a specific situation. If the reported performance does not achieve desired objectives, the inventory parameters must be changed and a new environment is simulated.



*Caution* It is sometimes necessary to complete a number of simulations to identify the combination of inventory parameters that yields optimum performance.

The major benefit of inventory simulation techniques is the ability to model a wide range of logistics environments without requiring simplifying assumptions. It is possible to accurately simulate virtually any logistics environment by incorporating characteristics and operating policies. The major shortfall of simulation techniques is their limited ability to search for and identify optimum solutions. While there are inventory simulation examples that incorporate search algorithms, they are limited in capability and scope. There are indications that simulation is becoming more popular as firms attempt to understand inventory dynamics in the logistics channel.

Inventory decision support applications are increasing in importance because of the emphasis on streamlining inventory levels to reduce the logistics asset base. The demand for more refined inventory parameters has increased the need for more sophisticated inventory analysis techniques. Software firms have responded by developing both stand-alone and integrated applications.

## 13.2.6 Transportation Decisions

Transportation analyses focus on routing and scheduling of transportation equipment to optimize vehicle and driver utilization while meeting customer service requirements. Transportation

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decisions can be characterized as strategic or tactical. Strategic transportation decisions concern long-term resource allocation, such as for extended time periods. Thus, strategic routing decisions identify fixed transport routes that may be used for months or years. Tactical transportation decisions concern short-term resource allocations such as daily or weekly routes. The objective of transportation analysis is to minimize the combination of vehicles, hours, or miles required to deliver product. Typical transportation analysis questions include: (1) How should deliveries be grouped to form routes? (2) What is the best delivery sequence for servicing customers? (3) Which routes should be assigned to which vehicle types? (4) What is the best type of vehicle for servicing different customer types? and (5) How will delivery time restrictions be imposed by customers? The distribution centre represents the central departure site for all delivery vehicles, and each stop represents a customer location, such as a retailer.

### Transportation Analysis Techniques

Routing and scheduling analyses have been well researched for logistics design and planning. They are particularly important for firms completing partial load delivery activities such as package or beverage distribution. The techniques can generally be classified as heuristic approaches, exact approaches, interactive approaches, and combination approaches. Heuristic approaches utilize rule-of-thumb clustering or savings techniques to develop routes by sequentially adding and deleting stops. Exact, or optimal, approaches use mathematical (linear) programming to identify the best routes. Historically, optimization solution methods have been too computationally complex for even the fastest computers, but recent mathematical programming advances have enhanced their capabilities.



*Notes* The main difficulties with most exact procedures are (1) the large number of constraints and variables needed to represent even the basic routing and scheduling problem and (2) the impact of this size on computation time and computer storage space.

Interactive approaches utilize a combination of simulation, cost calculator, or graphics capability to support an interactive decision process. The decision maker identifies the alternatives for evaluation. The interactive decision support system then determines and plots the routes and calculates the performance characteristics in terms of time and cost. The decision maker then interactively evaluates the performance characteristics of each alternative and refines the strategy until no additional improvement is likely. The obvious drawback of interactive approaches is the dependence on the skill and ability of the decision maker, particularly as the problem size and complexity increase.

Combinations of the three approaches have proven very effective. Two criteria are important when evaluating alternative solution approaches: generalizability and accuracy. Generalizability is the ability to efficiently incorporate extensions for special situations, such as pickups and deliveries, multiple depots, time windows, vehicle capacities, and legal driving times, in an actual setting. Accuracy refers to the ability to closely approximate performance characteristics and the results' proximity to an optimal solution.



*Did u know?* Accuracy determines the level of and credibility in the possible savings as a result of decreased vehicle operating expense, better customer service, and improved fleet productivity.

Notes

### Transportation Analysis Data Requirements

Transportation analysis requires three types of data network, pickup or delivery demand, and operating characteristics. The network defines all possible routes and is the backbone of any transportation system analysis. In some cases, a network is defined using street maps of the delivery area. Each intersection is a node, and the streets become links. The network contains the links between each node, the road distance, the transit time, and any special constraints such as weight limits or tolls. A Street-level network is very accurate and precise, particularly when there are constraints such as rivers and mountains. The deficiency of a street-level network is the high cost of development and maintenance. The other approach involves plotting customers on a grid and then computing the possible links between customers using the straight line distance. Latitude and longitude coordinates are often used. While a grid system is less costly to develop and maintain than a street-level network, it is less accurate and does not consider constraints as well.

Demand data defines periodic customer pickup and delivery requirements. For strategic or long-term analysis, demand is specified in terms of average periodic pick-ups or deliveries per customer. Routes are then created based on the average demand with a capacity allowance for extremely high demand periods. For tactical routing analysis, demand typically represents customer orders scheduled for delivery during the period being planned, such as daily. Tactical analysis allows the routes to be precisely designed for delivery requirements with no allowance for uncertainty.

Operating characteristics define the number of vehicles, vehicle limitations, driver constraints, and operating costs. Vehicle limitations include capacity and weight restrictions as well as unloading constraints such as dock requirements. Driver constraints include driving time and unloading restrictions. Operating costs include fixed and variable expenses associated with vehicles and drivers.

Transportation analysis for vehicle routing and scheduling is receiving increased interest because of the effectiveness and availability of low-cost software. Many firms involved in day-to-day transportation operations have reduced transportation expenses by 10 to 15 percent through the use of tactical or strategic transportation analysis. As customers continue to demand smaller orders, transportation analysis will become increasingly important to make effective routing, scheduling, and consolidation decisions.



*Task* At what point in the typical analysis does the technique give way to the managerial review and evaluation process?

## Self Assessment

State whether the following statements are true or false:

9. Dynamic simulation is used to investigate the dynamics of multiple-stage inventories.
10. Plant and distribution centre location is a common problem faced by logistics managers.
11. Mathematical programming methods, which are classified as optimization techniques, are one of the most widely used strategic and tactical logistics planning tools.
12. The traditional disadvantages of network optimization have been the cost of the problem that can be solved and the inclusion of fixed cost components.

Notes

13. Mixed-integer programming is the other optimization solution technique successfully applied to logistics problems.

14. The decomposition technique provides a procedure for dividing the multi-commodity situation into a series of single-commodity problems.

15. Location analysis requires that demand be classified or assigned to a geographic area.

16. Transportation Rates defines shipment volume to each geographic area identified as a market.



*Case Study*

## Simulate before You Restructure

Before launching a supply chain restructuring, Tesco Ltd., Great Britain's leading food retailer, used a state-of-the-art simulation tool to determine whether to revamp its frozen foods distribution network. This computer simulation validated corporate plans to restructure the network and build a separate facility specifically for frozen foods storage. Eight of Tesco's British distribution centres carry a mixture of ambient (general grocery and non-food items), chilled, and frozen products.

Two years ago, Tesco executives began weighing the idea of creating a stand-alone warehouse strictly for frozen food items, which account for about 10 percent of the company's grocery store sales. The rationale was that a separate facility would allow the retailer to expand its range of frozen food products and gain operational efficiencies. Before they approached the company's board of directors with the plan, Tesco's distribution executives decided to simulate the plan's impact on distribution with a computer model. They selected IBM's software simulation tool, The Supply Chain Analyzer. Because it can depict different hypothetical situations, the software gives companies a way to see the physical, financial, and informational impact of supply chain restructuring on a distribution network.

It took IBM consultants 6 weeks to set up and run the computer model with Tesco's help. Joe Galloway, Tesco's divisional director of supply chain information technology, reports that much of that time was spent gathering a year's worth of detail-laden data about its distribution centre operations to input into the model. "We were looking for data on the actual orders that went through our supply chain by (product) line and by store," he says. Once the data were fed into the application, it corroborated the soundness of the model.

When Tesco executives ran the same data through the computer model to simulate a restructured supply chain with a dedicated frozen food facility, the results supported their assumptions. The model indicated that the food retailer could achieve distribution savings in the range of 2 to 5 percent, depending on the actual mix of frozen food products stored in the dedicated facility. Transportation costs would drop because Tesco could eliminate trips between distribution centres and make more direct store deliveries. In addition to consolidating outbound trips, Tesco also determined that it could realize some savings on the inbound haul because it would only have to move products from suppliers to a single point rather than to two or three warehouses. Inventory carrying costs would decline. If all of the frozen food supplies were stored in a dedicated facility, the model showed Tesco could actually reduce its stock holdings or even expand its mix of frozen food products and increase store sales in this category. Tesco also would eliminate the need to construct more facilities in the future. Moving frozen foods out of the distribution centres would free up warehousing space for the expansion of chilled products, says Galloway.

*Contd...*

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The computer modelling demonstrated that using a single-point facility would not impair service to Tesco's stores. The simulation also indicated that the company might benefit by trying some alternative approaches. "We could see an advantage to not servicing all of the products through one central point, but having some kind of cross-docking through the other four [distribution centres] for stores not close to the central facility," Galloway recalls. Finally, the simulation gave Tesco some insights into its current operation that allowed it to make an immediate, money-saving change. The company discovered that it could cut back deliveries of certain slow-moving items to once a week and still maintain adequate stock for its stores. Although computer simulation helped persuade the board to approve the restructuring plan, it had another benefit as well. The simulation gave Tesco's logistics managers a deeper insight into their own supply chain's operation. "By the end of the exercise," says Galloway, "they had a better understanding of that area of the business. It got them thinking about costs and efficiencies of the supply chain."

**Question**

What do you infer from case? Provide some case facts in your own words.

***Source:*** James Aaron Cooke, "Simulate before You Act," Logistic Management and Distribution Report, September 1999, pp. 77–80.

## 13.3 Summary

- This unit provides a comprehensive review of the logistics planning process, decisions, and techniques.
- It is designed to guide the logistics manager through the overall process of situation analysis, alternative identification, data collection, quantitative evaluation, and development of viable recommendations.
- The methodology, which is generic enough for most logistics problem solving, includes three phases: problem definition and planning, data collection and analysis, and recommendations and implementation.
- The problem definition and planning phase is concerned with the feasibility assessment and project planning.
- Feasibility assessment includes situation analysis, supporting logic development, and cost/benefit estimation. Project planning requires statements of objectives and constraints, measurement standard definition, analysis technique specification, and project work plan development.
- The data collection and analysis phase develops assumptions, collects data, and completes the quantitative and qualitative analyses.
- Assumptions development and data collection include tasks to define the analysis approach, formalize assumptions, identify data sources, and collect data.
- The analysis step involves definition of analysis questions, completion of validation and baseline analyses, and completion of alternative and sensitivity analyses.
- The recommendations and implementation phase develops the final plan. The recommendation development step includes identification and evaluation of the best alternatives.
- The implementation step defines a recommended course of action, schedules development, defines acceptance criteria, and schedules final implementation.

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- Ad hoc tactical analyses such as freight lane balancing and ABC inventory analysis must be completed regularly to respond to changes in transportation rates, flows, and product demands.
- Regular supply chain planning and location analysis is becoming increasingly critical to respond to changes in global material availability, market demands, and production resource availability.
- More tactical tools such as dynamic simulation and routing and scheduling algorithms can be used to investigate and evaluate inventory and transportation alternatives.
- The importance of such comprehensive planning and analysis methods and tools is growing due to the possible alternatives to and complexity of global supply chains.

## 13.4 Keywords

***Appraisal***: Impartial analysis and evaluation conducted according to established criteria to determine the acceptability, merit, or worth of an item.

***Business Assumptions***: It defines the characteristics of the general business environment, including relevant market, consumer, and product trends and competitive actions.

***Linear Programming***: It is one of the most common techniques used for location analysis, selects the optimal supply chain design from a number of available options while considering specific constraints.

***Logistics***: The detailed coordination of a complex operation involving many people, facilities, or supplies.

***Logistics Design***: Design for logistics is a series of concepts in the field of supply chain management involving product and design approaches that help to control logistics costs and increase customer service levels.

***Management Assumptions***: It defines the physical and economic characteristics of the current or alternative logistics environment and is generally within the firm's ability to change or refine.

***Mathematical Programming Methods***: They are classified as optimization techniques and are one of the most widely used strategic and tactical logistics planning tools.

***Mixed-Integer Programming***: It is the other optimization solution technique successfully applied to logistics problems.

***Operational Planning***: Operational planning is the process of linking strategic goals and objectives to tactical goals and objectives.

***Planning***: Planning (also called forethought) is the process of thinking about and organizing the activities required to achieve a desired goal.

***Project Management***: Project management is the discipline of planning, organizing, motivating, and controlling resources to achieve specific goals.

***Project Planning***: Project planning is the development of tasks and a schedule to keep a project moving forward.

***Simulation***: It is the process of designing a model of a real system and conducting experiments with this model for the purpose of either understanding system behaviour or of evaluating various strategies within the limits imposed by a criterion or set of criteria for the operation of the system.

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***Situational Analysis***: It is the collection of performance measures and characteristics that describe the current logistics environment.

## 13.5 Review Questions

1. What is the basic objective in a logistics design and analysis study? Is it normally a one-time activity?
2. What is sensitivity analysis, and what is its role in systems design and analysis?
3. Why is it important to develop supporting logic to guide the logistical planning process?
4. Both internal and external review assessments must consider a number of measures. What are they and why are they important?
5. Why is a cost/benefit evaluation important to logistical systems design efforts?
6. What is the key objective in freight lane analysis?
7. In a general sense, what are the essential differences between analytic and simulation techniques?
8. What is the main advantage of the typical optimization technique in comparison to simulation?
9. Compare and contrast strategic and tactical transportation decisions.
10. "Transportation analyses focus on routing and scheduling of transportation equipment to optimize vehicle and driver utilization while meeting customer service requirements." Discuss.

### Answers: Self Assessment

| | | | |
|---|---|---|---|
| 1. | Phase I | 2. | Evaluation |
| 3. | Technology assessment | 4. | Availability, quality, or capability |
| 5. | Phase II | 6. | Analysis assumptions |
| 7. | Internal records | 8. | Phase III |
| 9. | True | 10. | True |
| 11. | True | 12. | False |
| 13. | True | 14. | True |
| 15. | True | 16. | False |

## 13.6 Further Readings



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*Online links*

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http://deliver.jsi.com/dlvr_content/resources/allpubs/guidelines/LMIS_Guid.pdf

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# Unit 14: Supply Chain Logistics Administration

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## Objectives

After studying this unit, you will be able to:

- Understand the Relationship Development Management
- Explain the Operational Performance
- Discuss the Financial Performance
- Describe the Social Performance

## Introduction

Logistics Function plays a very strategic role in achieving the twin objectives of any Firm i.e., Superior Customer Service and Cost Reduction. The aim of Logistics Strategy should be to play a proactive role for sustainable competitive advantage in a dynamic business environment. The new competitive framework of Logistics as a service function includes: Responsiveness, Reliability, Relationship and Rationalization. The basic driver of the Supply Chain is the concept that for a single company to successfully compete in a market where there is increasing demand from customers, escalating competition, etc. – it has to seek partners who are willing to share risks and rewards. It has to enter into collaborative activities and work, on a reciprocal basis, so that it may be able to show superior performance. Firms enter into inter-firm integrative and collaborative arrangements through the supply chain. The strategic role of the supply chain is in

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securing higher performance through the linkages that would not be possible by firms operating individually.

This means aligning the operational processes of a large number of firms into a single integrated supply chain system. It permits each of the firms to compensate for their individual weaknesses and/or resource constraints. They can do this by linking with other firms that have offsetting strengths. Collectively, this allows all firms to apply their resources toward areas that they see as important and where they can contribute the most. These types of processes are fostered through relationships management.

## 14.1 Relationship Development Management

Maruti Udyog, the leading manufacturer of cars in India, is a leader in supplier relationship management. Their turnover was ₹ 12,481 crores and profit before tax was ₹ 1,750 crores in 2005–06. Maruti sold 561,822 vehicles in 2005–06 and captured a market share of over 55 percent. Maruti deals with about 7,100 components for its eleven major models. 70 percent of its suppliers by number are located within 100 km radius of their Gurgaon plant. They meet more than 80 percent of Maruti's requirements by value, which was at a level of ₹ 7,150 crores in 2005–06.

Maruti has 220 approved vendors who supply the major components. The top 80 vendors supply 86 percent by value of the purchases. The rest of the vendors supply only 14 percent. Maruti has also signed joint ventures with a large number of its vendors. Of the 86 percent components supplied by vendors, joint ventures supply only 34 percent; the rest of the 52 percent by value is supplied by other vendors. These 80 vendors are considered strategic partners. Only 20 to 30 of them are Maruti joint ventures.

With strategic partners, Maruti has a number of programmes. Their emphasis is on vendor productivity and quality. Maruti takes on a major role in improving vendor productivity. They organize Junkai VA or cost workshops with their vendors on an ongoing basis. Junkai is a Japanese word which basically means 'visiting'. It has three components called three G – Gemba, Gembutsu, and Genjitsu.



*Notes* Gemba means taking a look to see what is happening at site. Gembutsu means examining the affected piece to understand what exactly the defect is. Genjitsu is discussing under what conditions this has happened – something like a brainstorming session. Typically a team from Maruti, along with the supplier team, visits the supplier's shop floor, has a look around, noting down points. They then have a brainstorming session at the Maruti office. At the end of brainstorming, they come out with various points relating to improvements in productivity, quality and cost.

Maruti has also constituted a group called Maruti Centre for Excellence. This is a team which continuously goes to suppliers to upgrade them. They audit the workings of their suppliers and chalk out a spider chart. The spider chart has 22 points. Each vendor is evaluated on these 22 points. They promise additional business on the next new model to vendors who score over 60 percent on the spider chart. Every vendor really tries to make sure that he goes above this mark.

They have also started the second tier improvement in a very big way. This is the latest initiative they have taken up a year ago. The result has been that the second tier vendor's quality has also gone up. They have also started 'green initiatives'. All packing has been converted into reusable packing. Maruti has recently introduced a practice to check the pollution levels of each trucks

Notes

getting into Maruti; if the pollution levels are not right then the truck is sent back. This makes their vendors understand that Maruti cares about the environment.

Maruti's Kaizen theme is to make its things smaller, fewer, lighter, shorter and beautiful. They follow it in their plant and have been continuously teaching their vendors this practice. It conserves the usage of material and yield improvement. They, along with CII and USAID, have started a programme to help their suppliers acquire ISO 14000 certification. They have also started a programme on ELV compliance. Though this is not required in India, the idea is that by the time the requirement will come to India, their vendors will all be sufficiently equipped to take care of that. They also have a vendor finance cost reduction programme. They line up with banks to see that loans of their suppliers can be transferred to lower interest rates etc. Through these initiatives, Maruti has become more agile and leaner.

As you can see, to excel in Supplier Relationship Management is complex. It takes much effort and work. You need to balance motivation with jeopardy. However, the results make it worthwhile. In 2005–06, Maruti trained around 16 vendors and ultimately the savings of man hours per day came to 1,580 man hours, which has resulted in a saving of over one crore rupees per annum. They were able to reduce component costs on the Alto alone, from 2001 to 2005, by 29 percent.

What is true for Supplier Relationship Management is true for all other relationships in a supply chain. Relationship management is a critical component of SCM. It creates reciprocal, interdependent, and long-term relationships. Its objective is to improve the quality of interaction of organizations (e.g. buyers and sellers), and take steps so that they can cooperate and communicate better, they can develop trust, and can mutually develop the types of governance structures that are necessary to contribute to the efficiency of the supply chain.

This is the strategic role of Supplier–Buyer Relationship. It describes the management of such relationships. It also discusses why firms enter into inter-firm collaborative arrangements through the supply chain and how do they share risks and rewards.

### 14.1.1 Relationship Management

Relationships have traditionally been considered as intangible. For more than half a century, there has been a debate about the value of tangible and intangible assets to organizations. Of late, many have come to believe that intangible assets play a very important part in today's competitive environment and can be sources of competitive advantage and above normal financial returns.

When we talk of intangible assets, we are principally talking of two related types of intangible assets:

- ***Relational:*** Relational market-based assets are outcomes of the relationship between a firm and key external stakeholders, including distributors, retailers, end-customers, other strategic partners, community groups, and even governmental agencies; and
- ***Intellectual:*** Intellectual market-based assets are the types of knowledge a firm possesses about the environment, such as the emerging and potential state of market conditions, and the entities in it such as competitors, customers, channels, suppliers and social and activist groups.



*Did u know?* Our discussion is limited to the former. Relational assets arise from the co-mingling of the firm with entities in its external environment i.e. with its stakeholders. It becomes an asset only when a company plays to its social strengths in a domain where its stakeholders (customers and interested parties) are evidently active.

Notes

Relational assets have become increasingly important to organizations as one of the impacts of the internet has been to move the market and its value drivers into the desires and ambitions of the stakeholders. Organizations have become increasingly aware that they have to make relationship management work, as it is a source of competitive advantage.

This important function has, to a large extent, become the responsibility of the supply chain. The supply chain is basically a customer focused, value maximizing function of an organization. In recent years, it has also become a strategic weapon for competitive advantage. The most difficult of all the activities supply chain managers perform now, is perhaps relationship management.

Relationship management focuses on improving operations and supply chain performance by eliciting the cooperation of other firms. Underlying the challenge is the question; how best can trust between buyer and supplier be institutionalized, especially as trust is most susceptible to break down.

Trust is developed by doing things jointly and in an aligned fashion over a period of time. There should be no major surprises. Surprises create a poor relationship. If this happens within any link of the supply chain, it can be disastrous for all other supply chain members. With the stakes so high, failure is unacceptable. This is reflected with the progressive increase in the number of companies putting an emphasis on relationship management.

In order to create an efficient and successful supply chain, organizations have to manage the relationships on all fronts – with their upstream suppliers, their internal suppliers, as well as their downstream customers. The buyer and seller, in each of these relationships, need to see each other as partners, each helping the other as much as possible.

The cooperative orientation of relationships means long-term commitment, joint work on quality, and support by the buyer of the supplier's managerial, technological, and capacity development and vice-versa. In India, it may not be easy to develop strong supply chain relationships like those found in Japan. However, in such environments, it becomes even more important to focus on these relationships.



*Caution* Within a firm, all supply chain activities can be related to one of three macro processes, the customer, the internal supply chain processes, and/or the supplier processes. This, in turn, can be translated into three types of 'focuses' – Customer focus, Internal Supply focus, and/or Supplier focus.

Based on the focus of the processes, the supply chain relationship management processes can be classified into the following:

1. ***Customer Relationship Management (CRM):*** All processes that focus on the interface between the firm and its customers.
2. ***Internal Supply Chain Management (ISCM):*** All processes that are internal to the firm.
3. ***Supplier Relationship Management (SRM):*** All processes that focus on the interface between the firm and its suppliers.

The three macro processes manage the flow of information, product, and funds required to generate, receive, and fulfill a customer request. Table 14.1 gives an overview of the three processes.

Notes

**Table 14.1: Supply Chain Macro Processes**

| SRM (Supplier Focus) | ISCM (Firm Focus) | CRM (Customer Focus) |
|---|---|---|
| Source | Strategic Planning | Market Trends |
| Negotiate | Demand Planning | Sales and Marketing |
| Buy | Supply Planning | Information on Customers |
| Design Collaboration | Fulfillment | Order Management |
| Supply Collaboration | Field Service | Call Centre Management |

***Source:*** Upendra Kachru, (2010), "Exploring the Supply Chain," Excel Books

### 14.1.2 Customer Relationship Management (CRM) Focus

CRM is a strategy used to learn more about customers' needs and behaviours in order to develop stronger relationships with them. The CRM process includes processes that will help bring together lots of pieces of information about customers, sales, marketing effectiveness, responsiveness, market trends, order management, and call centre management. Its basic aim is to generate customer demand and facilitate the placement and tracking of orders.

Supply chain relationships are not only limited to external suppliers. Supply chain relationships also extend to personnel of internal suppliers. In addition, systems and processes such as quality information, customer order information, or point-of-sale information, etc. also contribute to strengthening relationships. This type of information and data is collected or generated by personnel in different functional areas, who become a part of the supply chain network. In addition, you need to add any supply chain activity that requires the input and feedback of other functions within the firm, as well as suppliers and customers.



*Example:* In process selection, both engineering and IT help identify and develop the technologies needed. Personnel or human resources identify the people skills and training programs necessary to make the system "work." Marketing and customers provide information that the process meets the customers' needs. Finance can advise if the processes have improved or not. It can also help when processes require substantial investment in resources, by identifying ways and means of sourcing the funds.

### 14.1.3 Internal Supply Chain Management (ISCM) Focus

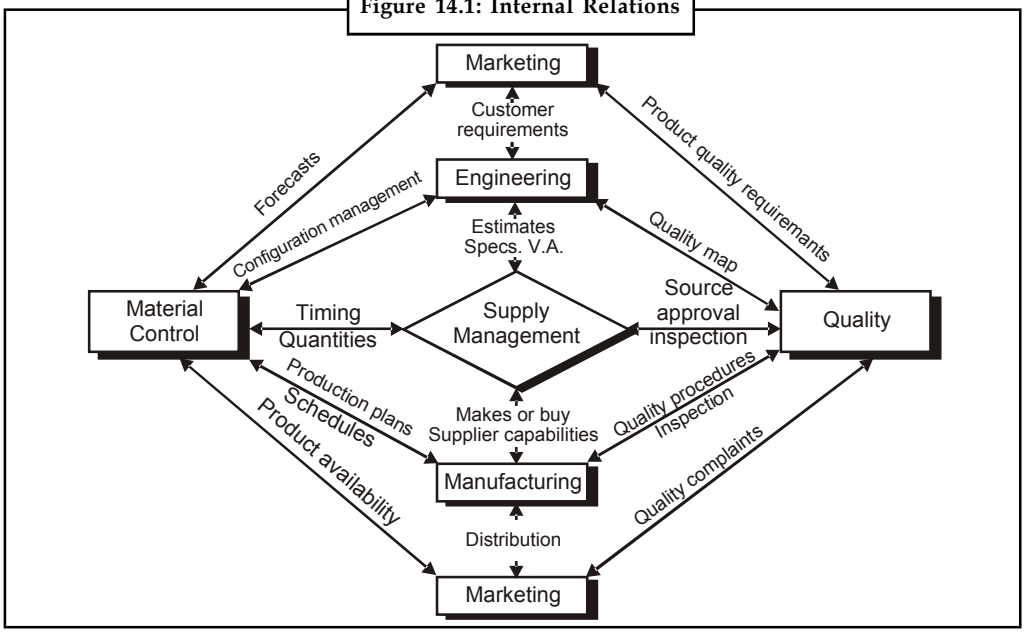
There is a complex web of relationships that are important within the organization. This is shown in Figure 14.1. The ISCM processes, though confined within a particular business unit, have to address these issues. Besides the coordination with different functional departments, the efforts should include the planning of internal production and storage capacity, preparation of demand and supply plans, and internal fulfilment of actual orders.

ISCM works on the internal supply chain with the objective of breaking down internal walls, and work on corporate integration. Its responsibility is to achieve company and supply chain-wide goals and objectives.

Organizational design has a strong influence on the success or failure of the ISCM integration effort. Organizational design refers to many different aspects of the organization. These include organizational structure, systems of communication, division of labour, coordination and control, and authority. Sometimes, modifications and changes are required for corporate integration.

Notes

**Figure 14.1: Internal Relations**




***Source:*** Upendra Kachru (2010). "Exploring the Supply Chain". Excel Books

Functional groups (engineering/R&D, manufacturing, and sales/marketing) are all instrumental in designing, building, and selling products most efficiently for the supply chain. This cooperation is desirable as it improves the supply chain's ability to match supply and demand effectively. However, many organizations find the different functional units to have very little communication between them. For example, marketing and manufacturing may have different forecasts when making their plans. The various parts of the company have to cooperate to align purchases, processing and logistics. ISCM is focused on internal improvement. The effort is to fulfil demand generated by the CRM processes in a timely manner and at the lowest possible cost by taking costs out of sourcing and logistics.

## 14.1.4 Supplier Relationship Management (SRM) Focus

The SRM macro process aims to arrange for and manage supply sources for various goods and services. Supplier relationship management is a comprehensive approach to managing an enterprise's interactions with suppliers. Its objective is to streamline and make more effective the processes between an enterprise and its suppliers. This is in a sense similar to customer relationship management (CRM) which streamlines and makes more effective the processes between the firm and its customers.

SRM reflects the need to integrate the entire supply chain – and to do so in a way that preserves flexibility, opens its enterprise infrastructure to the inventions, expertise and networks of others, and lets them shed the bits of the supply chain that can be better run by partners. SRM practices create a common frame of reference to enable effective communication between an enterprise and suppliers who may use quite different business practices and terminology. SRM processes include the evaluation and selection of suppliers, negotiation of supply terms, communication regarding new product and orders with suppliers and integration with the expertise of others.

All the three macro processes are aimed at serving the same customer. However, integration of the systems is to a large degree dependent on the organizational structure of the firm. In many firms, marketing is in charge of the CRM macro process, manufacturing handles the ISCM macro process and purchasing oversees the SRM.

Notes

*Tasks* Integration between the three macro processes is crucial for successful supply chain. Use of databases, communication systems, and foremost advanced computer software are crucial for the development of a modern cost-effective integrated SCM.

The collaboration and coordination costs of the supply chain increase with the speed of change in the marketplace. A proactive approach to manage customer demands is necessary to stay competitive. This requires flexibility in the supply chain while cutting hidden costs and reducing transaction costs.

*Example:* Speeding up sharing of information through electronic means, can help partners lower production cycle times and inventory can be viewed on a real-time basis so forecasting errors can be reduced. This will contribute to the objectives of satisfied customers and low costs.

*Caselet*

## TRW Steering Systems

TRW Steering Systems is a subsidiary of TRW, an American-owned multinational company. Mollart is a supplier of gun-drilling tools and services based in suburban Surrey, UK. These companies have forged a relationship based on trust and confidence that has brought Mollart to South Wales as the first tenant of TRW's new supplier park, which means that it is now a critical second-tier supplier to automotive assemblers in the UK and globally.

A key component of a steering system is the rack bar – a steel bar about a meter long with a rack at one end that engages with the steering column pinion. Along about three-quarters of the axis of this bar, a thin, deep, accurate hole has to be drilled. Mollart, a family firm founded in the 1920s, has long specialized in deep hole, or "gun," drilling. Its relationship with TRW Steering Systems began 10 years ago when it eased TRW's peak capacity problems. Initially at a rate of 100 per week, this built up to 7500 a week by 1997 – a significant proportion of TRW's weekly output of between 26,000 and 30,000 components.

But the material flow – from British Steel in Sheffield to TRW to Mollart in Chessington and then back to TRW – was not only wasteful but made fine control and rapid response impossible. So, Mollart moved to the Neath Vale Supplier Park and started production there in March 1998. It is machining bars for Honda, Rover, and Land Rover product, with plans to raise production to 13,000 units a week – half of TRW's total requirement. Mollart's intention is to do 60 percent of its business with TRW and 40 percent for other customers. Mollart has taken a big risk with no guarantees; it has no unique design or manufacturing capability to lock the customer in and is a minnow compared with its (currently) sole customer.

Why, then, does the relationship work so well! Largely, it is a tribute to TRW's attitude toward its suppliers. "We have a safety-critical product, so we have to select suppliers carefully," states Roger Llewellyn, TRW's group purchasing manager. "Moreover, external suppliers account for 52 percent of the product, so our own lean production, however good, can only address 48 percent of the problem."

*Contd...*

Notes

TRW has supplier development teams based on the principles of kaizen–continuous improvement – and the Toyota Production System. They teach suppliers about synchronous manufacturing, eliminating batch-and-queue and other techniques, and suppliers are included on TRW's internal courses, which emphasize features such as team working and single-piece flow. For Mollart and TRW's other 21 core suppliers whose product changes if the TRW platform changes and which account for 80 percent of spending, Llewellyn says, "We are totally transparent. We open our books in front of them and vice versa. I know their costs, cycle times. Everything and they know mine. Everyone has to be extremely ethical in a relationship based on trust, but information has never been abused. I want all my suppliers to be successful, to make a profit and to share in savings."

Llewellyn continues, "We market test all the time. I need to know that I am dealing with the right gun-driller on a total cost basis, but an existing supplier like Mollart will see the results of genuine quotations. I can't tell them how the other company does it, but we will help them with value engineering and so on. I want to see people looking at process and securing continuous improvement, not shaving margin to retain business."

***Source:*** Sam Tulip, "Marriage or Convenience," Supply Management, May 27, 1999, pp. 36–7

### Self Assessment

Fill in the blanks:

1. Relationships have traditionally been considered as ……
2. …… market-based assets are outcomes of the relationship between a firm and key external stakeholders.
3. …… market-based assets are the types of knowledge a firm possesses about the environment.
4. …… is developed by doing things jointly and in an aligned fashion over a period of time.

## 14.2 Operational Performance

Supply chain management views the operative dimensions such as purchasing/supply organization as the integrating mechanism in the internal and external exchanges of the firm. Operations managers have to respond creatively to internal customers' need on the one hand and maintain a mutually profitable relationship with suppliers on the other. The internal exchange function of purchasing emphasizes the interlocking relationship between input, throughput and output of an organization.

The external exchange relationship between purchasing and supplier organizations is interactive in nature. In business markets, both buyers and sellers are active in performing similar tasks such as:

- To prepare specifications to requirement,
- Locate counterparts,
- Negotiate, and
- Attempt to control transactions.

Marketing strategies of suppliers shape purchasing strategies of buyers and vice-versa. Within the context of interactive buyer – seller relationship, purchasing is more than buying as marketing is more than selling.

Notes



*Did u know?* From systems theory and total quality viewpoints, every purchase operation is a sale and a part of the value-creation process. Suppliers have the ability to enhance this value, because they can deliver technology, knowledge, products, or service quality that will beat competitors.

Operative activities involve management and integration of internal/external and upstream/ downstream supply chain. If the operational function is to contribute effectively to organizational goals and strategies, its practitioners will have to become fully integrated into the customer – employer – supplier chain, there are three primary operative dimensions of SCM:

- Strategic procurement, i.e. aligning procurement tasks and suppliers' performance with the corporate and business strategies of the firm.
- Supplier-base management, i.e. managing the structure and culture of supplier relationship that is denominated in strategic purchasing.
- Develop a lean supply organization by energizing organizational teams through flexible structures and responsive information systems.

Typically organizations operative dimensions include the following activities:

- ***Get the basics right:*** Getting the basics right reduces the time spent on intervening on an exception basis in day-to-day activities. It also defuses complaints about efficiency and responsiveness. If the everyday processes work well, purchasing will have the time to take a more strategic approach.
- ***Use short-term cross-functional project teams:*** These short-term initiatives can be effective in unfreezing existing attitudes about how activity is carried out. A cross-functional approach encourages thinking about issues further upstream, such as material specification, strategic make/buy analysis, etc.
- ***Develop the supporting organizational infrastructure:*** Companies usually focus on five elements of organizational support for strategic operations: leadership, organizational structure, people development, performance measurement, and information systems. Organizational changes typically include the establishment of a corporate-wide purchasing leadership group. The organizational structure and decision making are usually modified to permit them to build an effective network. Other changes include the upgrading of the skills of the organization, the establishment of relevant performance measures, and the development of a centre-led structure that includes regular cross-functional project teams.

## Self Assessment

State whether the following statements are true or false:

5. Supply chain management views the operative dimensions.
6. The internal exchange relationship between purchasing and supplier organizations is interactive in nature.
7. Marketing strategies of suppliers shape purchasing strategies of buyers and vice-versa.
8. Getting the basics right increases the time spent on intervening on an exception basis in day-to-day activities.

## 14.3 Financial Performance

Notes

Evaluation of the financial performance, including the creation of profit and loss statements, could be considered the overriding measure of the appropriateness of supply chain configuration. Financial evaluation should take into account the operational and dynamic aspects in order to capture the detailed financial drivers and take account of the real-world operation of the supply chain. Prominently the evaluation would be holistic rather than of partial performance

Financial evaluation by assessing the impact on the profit and loss account is far more influential as it captures the overall effect rather than immediate local effects. Measuring financial impacts can be difficult due to the need to capture a sufficient number of the financial drivers within an enterprise. Measurement of financial impact at an enterprise level is uncommon and those reported instances have been found of such measurement in a supply chain context are at a more abstract level.

A comprehensive supply chain design methodology needs the appropriate scope and detail to be meaningful for implementation across the supply chain as well as evaluation to assess the performance of the design. Even as there are a number of supply chain metrics that can be used, the financial performance is the most powerful; financial measures take a global, all inclusive view of the business rather than selective, localised measurement. Balanced scorecards can be employed to provide assessment through finance, customers, processes and learning and growth areas. However, taking a hierarchical perspective the finance is at the top resulting from market performance facilitated by the business processes and sustained by learning and growth. It is argued here that whilst operational/business process measures are vital they should be complemented by financial assessment.

***The financial perspective answers the question:*** "To succeed financially, how should we appear to our shareholders?" and is typically related to profitability. Some measures are, for example, the Return on Investment (ROI), Return on Capital Employed (ROCE), and Economic Value Added (EVA), etc.

### 14.3.1 Asset Utilization

Related to collaboration is the concept of asset utilization. With increasing financial, customer service and environmental demands, many transportation companies have started gathering equipment asset information through web portals, community systems and location-tracking technologies. This search, though at its early stages, is an effort to connect and run their equipment networks more effectively. This focus has validity and is now being practiced by some transportation companies.

The future seems to indicate the successful implementation of this concept. With increasing financial, customer service and environmental demands, this has the potential to become an enabler to manage the supply and demand of equipment. By interchanging equipment with any transportation provider, on demand, anywhere in the world, there will be optimization in the use of enterprise resources while improving customer satisfaction. As this fructifies, transport providers will offer higher value end-to-end services, increase their appeal to customers and enjoy the multi-fold economic benefits from greater asset utilization.



*Task* What is the basic inventory management techniques used in fast moving consumer goods (FMCG) industry firms in Indian economy?

Notes

### Self Assessment

Fill in the blanks:

9. …… of the financial performance could be considered the overriding measure of the appropriateness of supply chain configuration.
10. …… can be employed to provide assessment through finance, customers, processes and learning and growth areas.
11. Related to collaboration is the concept of …… utilization.
12. With increasing financial, customer service and environmental demands, this has the potential to become an enabler to manage the supply and demand of ……

## 14.4 Social Performance

Because of numerous instances of financial mismanagement by major corporations, in 2002 the U.S. Congress passed the Sattanes-Oxley Act (SOX). Although the focus of the law is on financial reporting by corporations to their shareholders, it became apparent soon after its enactment that it also has important implications for logistics and supply chain management, especially with respect to how performance is measured and reported.

### 14.4.1 Supply Chain Security

Supply chain security refers to efforts to enhance the security of the supply chain, the transport and logistics system for the world's cargo. It combines traditional practices of supply chain management with the security requirements driven by threats such as terrorism, piracy, and theft. Some analysts have raised concerns about supply chain security overreach.

Typical supply chain security activities include:

- Credentialing of participants in the supply chain
- Screening and validating of the contents of cargo being shipped
- Advance notification of the contents to the destination country
- Ensuring the security of cargo while in-transit via the use of locks and tamper-proof seals
- Inspecting cargo on entry

International trade is one of the key drivers of global economic growth. In today's globalised world, the cargo supply chains are complex and involve a great number and variety of parties. Unfortunately, these supply chains are also vulnerable to exploitations such as theft, pilferage and in the worst case scenario, exploitation by terrorists to further their own ends. Guarding against such scenarios is thus of vital importance as the global trading system cannot afford the consequences of a destructive attack.



*Caution* To guard against such exploitations, the supply chain has to be secured. Supply chain security can only be achieved by looking at supply chains in total, and not by focusing on individual nodes and links in isolation.

Notes

It is often said that a chain is only as strong as its weakest link. Securing the supply chain involves the securing of every node and link along the chain, creating a chain of responsibility that extends beyond that of each individual node and its links. The securing of the supply chain must start with the safe and secure packing of shipment and include measures that deter or provide alerts of any tampering of the shipment as it progressively moves from the point of packing to the final point of deconsolidation.

Several countries and international organisations have developed or are developing programmes that encompass guidelines and best practices for ensuring the security of the cargo, processes, and personnel involved in every movement through the supply chain. The following are some examples of supply chain security programmes:

- United States' Customs-Trade Partnership Against Terrorism (C-TPAT)
- European Union Authorised Economic Operator (AEO) programme
- New Zealand's Secure Exports Scheme
- WCO Framework of Standards to Secure and Facilitate Global Trade
- ISO/PAS 28000, 28001



*Did u know?* In July 2006, Singapore announced the implementation of a National Supply Chain Security Programme which has been named as the Secure Trade Partnership (STP).

## Self Assessment

Fill in the blanks:

13 …… refers to efforts to enhance the security of the supply chain, the transport and logistics system for the world's cargo.

14. …… is one of the key drivers of global economic growth.

15. …… the supply chain involves the securing of every node and link along the chain, creating a chain of responsibility that extends beyond that of each individual node and its links.

16. In today's globalised world, the …… supply chains are complex and involve a great number and variety of parties.



*Case Study*

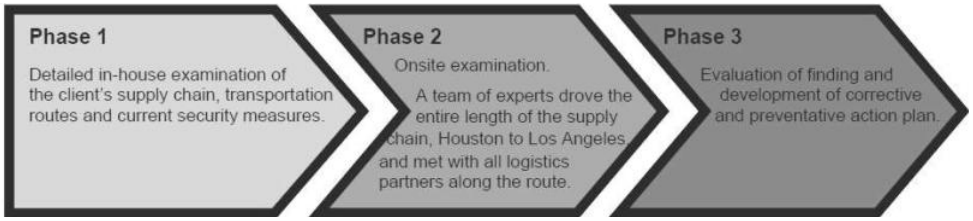
### TÜV Rheinland – Supply Chain Security Analysis

In April 2007, TÜV Rheinland began an intensive 2 week project for one of the worlds top 10 IT and computer peripheral manufacturers. In the US alone, the company was loosing 5 million dollars a year from stolen cargo, with the majority disappearing between the Port of Houston and the Port of Los Angeles. In order to take a proactive step towards controlling their supply chain, TÜV Rheinland was asked to conduct a thorough Supply Chain Security Analysis to help pinpoint weaknesses and suggest corrective and preventative actions.

*Contd...*

Notes

The analysis of the supply chain took place in three phases:




**Phase 1:**

**Aim: Identify where a majority of the reported losses were taking place**

The initial trigger for the outlined risk analysis project was the result of an investigation conducted by the rail operator. The operator reported that the majority of thefts were taking place between Houston and Los Angeles, and that a shipment of 2000 to 3000 containers would have 40 to 50 seals broken. Not all the goods would be missing however, indicating that criminals were looking for very specific products. Furthermore, when entire containers were stolen, they would usually be found discarded and empty within 24 hours of the event.

**Aim: Identify Major Players in the Supply Chain**

The client works with over 10 different logistics partners in the Houston – Los Angeles stretch alone. These partners are a mixture of multinational suppliers and local trucking companies. Each of the companies were identified and a detailed report was drafted on information including the scope of operation, management team etc. All of these parties were contacted and meetings were arranged for phase two. Based on the two aims, a detailed schedule and assessment plan was drafted to ensure the interviews and identified weak points in the supply chain would be investigated during the subsequent phase of the project.

**Phase 2:**

The TÜV Rheinland team met with all the logistics providers identified in phase one. The one-day meetings included an onsite tour and an overview of daily operations, with a special focus on the client's security objectives. Furthermore, all incident reports and response plans were analyzed for each of the 3PL companies. To ensure total analysis, the team also conducted unscheduled night visits to determine whether or not there were any significant weaknesses evident after hours.

**Outcome:**

Following the completion of the onsite analysis, the team evaluated the threat levels for each individual site. Several notable weaknesses were identified at all of the sites, including a lack of document control and weak information security. It became very clear that there were some consistent weakness between the companies. While the majority of the 3 PL's had good physical security, few of them had a monitoring system in place to ensure improvement. After completion of the onsite audits and interviews, the TÜV team embarked on a detailed risk analysis of the supply chain from Houston to Los Angeles. This part of the project involved 2 weeks of tracking trains along the route, looking at rail stations, fencing, urban areas, pit stops, and trucking routes. This part of the project allowed the team to identify clear risks in the supply route, which included for example;

- Breaks in fencing
- Long stops at night

*Contd...*

Notes

- Stops near residential areas
- Regular scheduled stops
- Unlocked containers
- Unmanned trains

**Phase 3:**

The team analyzed all the information that was collected in Phase 2, and provided a report outlining possible corrective actions. Using a combination of international security standards, industry best practice, regional legislative documentation and experience, the team provided solutions that would secure the supply chain, as well as provide increased visibility and efficiency, ultimately preventing/limiting the amount of cargo theft in the future. An example of a weakness discovered, was the failure to understand all the external processes. The client did not realize that once sealed containers are opened by customs, customs agents do not refit the container with a secure seal.

Customs inspections can take place at any point in the supply chain, meaning that in some cases containers travelled the length of the county with no seals.

Some of the other findings included;

- Adopting C-TPAT guidelines to reduce customs clearance times and therefore saving costs
- Provide all logistics partners with a set of minimum security requirements
- Seal containers with highly secure locks, at a cost of less than 5 USD per container
- Wrap all products with non-descriptive plastic in order to confuse potential criminals
- Implement some form of Information Security system to ensure that product information and transportation routes are not accessible to unauthorized personnel

Following the completion of the project, the company has now rolled out a detailed set of security standards for all suppliers. This security standard is part of all project tenders and is necessary for business. The client has also developed a stronger relationship with customs, ensuring that containers are resealed and has also resulted in the reduction of inspections at points of entry by almost 80 percent. The customer has also been successfully certified to the US Customs C-TPAT security scheme. The client has also invested in a new type of security seal for their containers. During our last communication with the customer they announced that theft had been reduced by over 90% since the implementation of the above security measures.

**Question**

Critically analyse the above case.

***Source:*** www.brm.tuv.com/brm/web/downloadcasestudies.xml?

## 14.5 Summary

- Relationships have traditionally been considered as intangible.
- Relational assets have become increasingly important to organizations as one of the impacts of the internet has been to move the market and its value drivers into the desires and ambitions of the stakeholders.

Notes

- The supply chain is basically a customer focused, value maximizing function of an organization.
- Relationship management focuses on improving operations and supply chain performance by eliciting the cooperation of other firms.
- In order to create an efficient and successful supply chain, organizations have to manage the relationships on all fronts - with their upstream suppliers, their internal suppliers, as well as their downstream customers.
- CRM is a strategy used to learn more about customers' needs and behaviours in order to develop stronger relationships with them.
- Functional groups (engineering/R&D, manufacturing, and sales/marketing) are all instrumental in designing, building, and selling products most efficiently for the supply chain.
- The SRM macro process aims to arrange for and manage supply sources for various goods and services.
- SRM reflects the need to integrate the entire supply chain – and to do so in a way that preserves flexibility, opens its enterprise infrastructure to the inventions, expertise and networks of others, and lets them shed the bits of the supply chain that can be better run by partners.
- Supply chain management views the operative dimensions such as purchasing/supply organization as the integrating mechanism in the internal and external exchanges of the firm.
- A comprehensive supply chain design methodology needs the appropriate scope and detail to be meaningful for implementation across the supply chain as well as evaluation to assess the performance of the design.
- Supply chain security refers to efforts to enhance the security of the supply chain, the transport and logistics system for the world's cargo.

## 14.6 Keywords

***Asset***: A resource with economic value that an individual, corporation or country owns or controls with the expectation that it will provide future benefit.

***Customer Relationship Management***: CRM is a strategy used to learn more about customers' needs and behaviours in order to develop stronger relationships with them.

***Financial evaluation:*** Financial evaluation mainly focuses into – Money aspects of the project, and – Rewards and financial profitability to the investors.

***Intellectual Market-Based Assets***: Intellectual market-based assets are the types of knowledge a firm possesses about the environment.

***Internal Supply Chain Management (ISCM):*** All processes that is internal to the firm.

***Organisation***: A social unit of people that is structured and managed to meet a need or to pursue collective goals.

***Relational Market-Based Assets***: Relational market-based assets are outcomes of the relationship between a firm and key external stakeholders.

***Relationship Management***: A strategy employed by an organization in which a continuous level of engagement is maintained between the organization and its audience.

Notes

***Supplier Relationship Management (SRM):*** The SRM macro process refers to arrange for and manage supply sources for various goods and services.

***Supply Chain Security***: It refers to efforts to enhance the security of the supply chain, the transport and logistics system for the world's cargo.

## 14.7 Review Questions

1. Explain Supplier Relationship Management with the help of example.
2. Discuss the two types of intangible assets.
3. "Trust is developed by doing things jointly and in an aligned fashion over a period of time." Elucidate.
4. Highlight the classification of supply chain relationship management processes which is based on the focus of the processes.
5. Describe Supply Chain Macro Processes.
6. Define CRM.
7. Write brief note on Internal Supply Chain Management (ISCM) Focus.
8. "The external exchange relationship between purchasing and supplier organizations is interactive in nature." Explain.
9. Discuss the operative dimensions of organisations.
10. Highlight the three primary operative dimensions of SCM.
11. Elucidate Asset Utilization.
12. What do you understand by supply chain security?

### Answers: Self Assessment

| | | | |
|---|---|---|---|
| 1. | Intangible | 2. | Relational |
| 3. | Intellectual | 4. | Trust |
| 5. | True | 6. | False |
| 7. | True | 8. | False |
| 9. | Evaluation | 10. | Balanced Scorecards |
| 11. | Asset | 12. | Equipment |
| 13. | Supply chain security | 14. | International trade |
| 15. | Securing | 16. | Cargo |

## 14.8 Further Readings



*Books*

Ballou, R.H. (1998). "*Business Logistics Management: Planning, Organizing, and Controlling the Supply Chain*." Prentice Hall

Bowersox, D.J. and D.J. Closs, (1996), "*Logistical Management: The Integrated Supply Chain Process.*" McGraw Hill

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Douglas M. Lambert, James R. Stock and Lisa M. Ellram. *"Fundamentals of Logistics Management"*. McGraw-Hill International Editions

H. Kaushal. *"Case Study Solutions – Materials Management"*. Macmillan India Ltd.

Vinod V. Sople . *"Logistics Management – The Supply Chain Imperative"*. Pearson Education

Tompkins, J.A. and D.A. Harmelink (Editors) (1993), "*The Distribution Management Handbook*." McGraw Hill



*Online links*

http://www.lean6sigma.vn/index2.php?option=com_docman&task=doc_view&gid=17&Itemid=43

http://www.palgrave.com/uploadedfiles/Business/Waters/waters_sample_chapter.pdf

http://quizlet.com/9526719/chapter-2-supply-chain-management-flash-cards/

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http://www.iibms.org/pdf/Ebooks/Logistics%20and%20Retail.pdf