Block

3

SUPPLY CHAIN PROCESSES

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BLOCK 3: SUPPLY CHAIN PROCESSES

For a long time, supply chain was considered as an essential aspect of materials management, leading to a feeling that both are synonymous. In view of the enlarging scope of supply management covering the entire product life cycle, all the involved processes play a vital role in operational efficiency. Therefore a need arises for the learner community to understand the relevant processes in the product life cycle, leading towards developing suitable strategies. All such topics are covered through the 8 units of this block. Following are the brief details of coverage in terms of why such a necessity and what are the offerings.

Unit 6 - *Purchasing and Supply Chain Management:* Purchasing activity is the core of supply chain management due to the strategies being followed for improving operational efficiency. Purchase strategies include outsourcing, co-creation etc. these emerging trends in purchasing call for understanding the role of purchasing in SCM.

This unit covers all essential elements of purchasing such as its evolution and activities, supplier management, regulatory and environmental framework, waste management; JIT management and goods and services tax (GST).

Unit 7 - *Manufacturing in a Supply Chain Context:* Manufacturing is the conversion process of inputs into desired outputs, explaining its importance in meeting the performance requirements of quality, cost, delivery and flexibility in a supply chain.

In line with the title of the unit, the topics covered include various types of production, flexible manufacturing systems (FMS), international technology transfer (ITT), and manufacturing postponement.

Unit 8 - *Inventory Management:* Inventory in a supply chain constitutes a lion's share of the manufacturing cost calling for understanding its various dimensions with a view to optimise its levels.

This unit describes the role of inventory in a supply chain, tools like decoupling, balancing supply and demand, radio-frequency identification (RFID), inventory management decisions, techniques like lean and agile supply chains, and vendor managed inventory (VMI).

Unit 9 - *Managing Transportation in a Supply Chain:* With globalization of operations, transportation has become an important aspect of logistics in supply chain management.

To understand and apply various tools and techniques, this unit examines the role of transportation in a supply chain, various acts and guidelines, functions, modes of transport; design of transportation network and associated trade-offs, and transportation analysis decisions.

Unit 10 - *Warehousing in a Supply Chain:* Warehousing is no longer a storage place in the corner of a building. With increasing retailing, warehousing is a major intervention in logistics management, deciding the efficiency of supply chains.

Accordingly, this unit addresses such topics as nature and importance of warehousing, its functions, activities, alternatives, factors for warehousing strategy and planning and managing a warehouse.

Unit 11 - *Returns Management and Supply Chain:* Product recalls used to be a practice of reputed organizations but steadily became a major aspect of customer relationship management in the supply chains.

To provide an insight into the various dimensions of returns management, this unit discusses reverse logistics and its need, associated processes; framework of performance metrics, operational returns process; disposition and challenges and use of information technology in returns management.

Unit 12 - *Customer Service in a Supply Chain:* Customer service, which used to be a separate function of marketing became an integral part of supply chain management, calling for a customer-centric focus.

This unit enables a learner to identify the elements of customer service and the approaches to develop customer service strategy and appreciate customer service as a performance outcome to create a differential advantage. This also covers topics such as impediments to implementing an effective customer service strategy, use of technology in customer service, quality of service delivery and customer satisfaction survey.

Unit 13 - *Order Fulfilment and Supply Chain:* Satisfactory fulfilment of a customer order is the ultimate goal and responsibility of supply chain management. This calls for understanding associated processes in detail.

This unit explains the order fulfilment process and helps in developing an e-fulfilment strategy; factors influencing the responsiveness of the order fulfilment process and various order fulfilment systems.

Unit 6

Purchasing and Supply Chain Management

Structures

"Intelligence is the ability to adapt to change."

- Stephen Hawking

6.1 Introduction

Knowing where the possible bottlenecks could be in the supply chain and adjusting dynamically is very critical compared to having great paper plans and expecting the plan will run without hitches of any kind.

In the previous unit, we discussed the factors that influence facility decisions. The framework for designing facility networks was examined next, followed by the models that are used for designing these networks

With intense global competition, efficient operations management became an unavoidable necessity, across the corporate world. Efficiency entails focusing on resources- both material and manpower, and managing all stakeholders. With the convenience of outsourcing, efficiency management in operations got a shot in the arm. Supply chain management became more dynamic, with a focus on the performance objectives of competitive advantage, through cost, quality, speed of delivery, and customer service. These are unthinkable, without the active support and participation of innumerable suppliers and subcontractors that a company has to depend upon. This leads us to the vital aspect of purchasing and its role in supply chain management.

This unit provides an insight into the evolution of this important supply chain function and other associated concepts.

6.2 Objectives

By the end of the unit, you will be able to:

- Discuss the evolution and activities of the purchase department
- Explain the process of selecting and managing suppliers
- Examine JIT (Just-in-Time) purchasing
- Explain the process of purchasing

6.3 Evolution and Activities of Purchasing Function

Purchase activity has been in vogue since very long. However, organized manufacturing activity called for a systematic approach to purchase management. Purchase manager has the responsibility to arrange right material at the right time and at least possible cost without compromising quality. Evolution of purchase function is discussed below.

6.3.1 Evolution of Purchasing Function

Traditionally, the purchasing function was restricted to vendor selection and price negotiation. The interaction of the purchase division with other departments was minimal and the work in the purchase department was largely clerical in nature. Competitive pressures in the market, coupled with increasing costs, have led to the introduction of a much wider role for purchase departments. The purchase department also has to interact with other departments, much more closely than it did earlier. The role of the purchasing professional extends from procurement to product design. Depending upon the nature of the business, in some organizations, the purchase head controls all other functions like manufacturing and delivery. In the context of JIT operations management, purchase plays a very vital role in ensuring convergence of all materials, as per operations plan and the delivery of the finished products to divergent destinations. The present concerns of climate change, carbon footprint management, and the need for green purchasing put additional responsibilities on the purchase department, to comply with regulatory and other requirements.

The changing role of the purchasing function, in supply chain management, can be understood through the five-stage purchasing developmental model presented by Keough (1993).

The five stages are:

- Transactional Stage
- Price Negotiation Stage
- Coordination Stage
- Cross-Functional Purchasing Stage
- External Integration Stage

Transactional Stage

In this stage, the purchase department acquires the raw material required by the organization. To ensure that the organization does not fall short of the raw material at any stage of the production process, the purchase department identifies suppliers, who can provide the required material at the right time. At this stage, the organization does not have a purchasing strategy in place. The organizational structure can be characterized by a decentralized sub-department at the plant level, mostly under the responsibility of a production or logistics manager. The purchasing function is strongly orientated towards operational and administrative activities. The performance of the department is judged by the number of complaints received. If there are very few complaints, it means that the purchase department's performance is satisfactory. The purchasing staff consists usually of operational and administrative buyers.

Price Negotiation Stage

In this stage, the purchasing manager negotiates with suppliers, to obtain the lowest prices. The purchasing manager should be well informed about prices and should have the ability to negotiate on price. At this stage, the purchasing strategy is focused on obtaining low prices.

The purchasing function has its own department at the plant level, reporting directly to the plant manager, who is interested in the savings the purchasing department adds, to ensure profitability. At this stage, the purchasing function becomes a specialist function. Specialist buyers are organized around different product groups. They enter into tough negotiations over price with many suppliers. The management of the company monitors the prices agreed and the savings achieved. The performance of the purchasing function is measured mainly based on the price and delivery performance of the suppliers. Cost savings are used as a prime performance indicator, for assessing the overall effectiveness of purchasing function.

Coordination Stage

At this stage, there is some kind of strategy formulation, aimed at capturing the benefits of internal coordination and synergy. Apart from price and costs, the purchasing function is seen as having an important influence on the quality of purchased products. The importance of the purchasing function is recognized by the top management. However, at this stage, the other departments of the organization do not involve themselves in the activities of the purchase department. At this stage, the purchasing function is centralized, and the formalization of the purchasing process and procedures takes place. The culture of the purchase department is characterized by great attention to communication and the intention to achieve better cooperation internally between business units. Computerized information systems are introduced, but the whole organization is not linked together. As a result, the departments are not sufficiently integrated.

A number of different purchasing jobs are in place. The purchasing staff receives training aimed at improving analytical and communication skills and achieving total quality management. At this stage, the central purchase department implements uniform purchase policies and systems and achieves cross-unit coordination and compliance with nationally negotiated contracts.

Cross -Functional Purchasing Stage

At this stage, the purchase department gives attention to cross-functional problem-solving. The aim is to reduce total systems cost, not just the unit cost of purchased components. Key suppliers are often involved as problem solvers. By involving them, the purchase department seeks to move from confrontational to partnership sourcing. Until this stage, the purchasing function was very functionally oriented. Now, it becomes process-oriented and tries to organize the purchasing function, around internal customers. The strategic importance of the purchasing function is realized at this stage. As a result, purchasing gets involved in strategic issues like core competencies and make-or-buy decisions. The structure, in this stage, is 'center-led' and operational buying becomes integrated with materials planning and scheduling. The culture of the purchase department is characterized by team-based management.

Cross-functional teams are also developed. The department takes measures to integrate the purchasing process of different divisions. At this stage, the focus is still on internal customers. The department's information systems are integrated with those of other departments and divisions but not yet with those of its important suppliers. The performance of the purchase department is measured through benchmarking and the use of internal customer satisfaction surveys. The people involved in the purchasing process have a broad business perspective and a high level of education.

External Integration Stage

In this stage, the organization involves the suppliers in product development and pre-production planning. Orders are placed through computer systems and external suppliers are coordinated using information systems. Suppliers are involved in product development and the process of supply chain management. The responsibility of the initial purchasing resides with the cross-functional teams. These teams consist of members from different disciplines, divisions, and organizations. Integration, with other disciplines, divisions, and suppliers, proceeds at full speed to make integrated supply chain management possible. Initial buying is no longer executed by a separate department instead, it is spread across the company. The management style is results-driven, though supportive and coaching at the same time. The culture is characterized by participation and consensus style decision-making. General managerial and leadership abilities are required at this stage. Information systems are integrated not only internally but also with those of partner suppliers.

Activities of the Purchasing Function

Purchase departments are structured to support four important activities of an organization. They are:

Sourcing and Negotiation: This sub-department of purchasing negotiates with suppliers and buys the required goods for the firm. Buyers negotiate between outside suppliers and the firm. Hence, they should be good at interaction and negotiation. The main objective of buyers, in this role, is to contact a number of suppliers for different materials and parts.

Purchasing research: This includes developing long-range material forecasts, conducting value analysis programs, assessing supplier capabilities, and analyzing the cost structure of the suppliers. Most organizations are beginning to recognize the importance of training purchasing personnel in this activity.

Operational support and order follow-up: This sub-department of the purchasing function deals with activities supporting the day-to-day operations of the firm. It involves checking whether the right materials are available at the right time in the right departments.

Administration and support: The purchase department is also responsible for various administration and support activities, with regard to the purchasing function. These include determining policies and procedures that purchasing personnel follow, developing department plans, organizing training sessions and seminars for buyers and developing performance measurement systems.

Example: Arkema follows responsible Supply Chain Purchasing Practice to Better Manage Supplier Risk

Arkema S.A. is a France based specialty chemicals and advanced materials company.

The company has adopted a responsible supply chain process. All vendors are screened for raw materials and packaging for their conformance to quality, safety, human rights, and sustainability. This will ensure better manage supplier risk for the company. This process also ensures sustainability objective of the company.

Source: https://www.arkema.com/usa/en/social-responsibility/doing-business-with-us/vendor-information/raw-material-energy-and-packagin/, 2022, Accessed on 24/08/2022

6.4 Selecting and Managing Suppliers

An important aspect of supply chain management is selecting and managing suppliers. Purchasing, which was earlier considered a purely clerical job, is now of strategic importance to an organization. Most companies today outsource a number of products and services, as a result, external suppliers have a major role in the company's success. Choosing and establishing a good relationship with

suppliers is important for a company. Most companies today have a reduced supplier base. Closer, longer-term relationships can be established with a few suppliers, who then play a critical role in contributing to new product design, reducing costs significantly, and constantly improving quality. This was certainly true in the case of automobile manufacturers like Ford and Toyota.

The steps involved in effective supplier management are:

- Discovering potential suppliers
- Evaluating potential suppliers
- Regulatory and Environmental Compliances
- Waste Management
- Selecting suppliers
- Managing suppliers

6.4.1 Discovering Potential Suppliers

Today, technology has made it is easy to find potential suppliers. There are a number of websites, by different suppliers, providing details about their products. Supplier catalogues are also useful, as they provide information about the products of various suppliers, with their prices and features.

Trade registers contain information about manufacturers and suppliers and also their locations and affiliates. Other possible sources of supplier information are advertisements in trade and industry journals. Managers can use these sources of information, to get in touch with suitable suppliers.

6.4.2 Evaluating Potential Suppliers

The next step after identifying potential suppliers is to evaluate each supplier individually. For such an evaluation, the purchase manager should be familiar with the supplier's performance and capability. The amount of care that has to be taken in assessing the supplier varies, depending on the nature, criticality, complexity and value of the purchase to be made. For example, Sun Microsystems works very closely with its supplier base, both the external manufacturers, as well as the suppliers of critical components. It has to be very careful in identifying suppliers. The five major questions it asks, to verify the quality of the supplier, are:

- Is the part we want to use standard or custom?
- What is the lead-time for the part?
- Is the part single-sourced?
- When will the part be no longer usable?
- Is the part used in other Sun platforms?

Firms use a number of methods to evaluate suppliers. These include surveys, financial condition analysis, third-party evaluators, evaluation conferences, plant visits and selected capability analyses. If the products being supplied play an important role in the company's success, then careful consideration is called for. The thoroughness of the evaluation can be reduced, if a short-term alternative supply is available at short notice or if the product being purchased is of low value.

Supplier surveys: These are undertaken to gain information about the supplier organizations and their functioning. A typical survey answers questions regarding the bank references of the suppliers, credit references, details of the sales and profits for the past five years, a referral list of customers, expansion plans, ratio of quality personnel to production personnel, percentage of defects, and quality assurance programs. The survey also verifies the tools and manufacturing equipment being used by the supplier firm in manufacturing the products.

Financial condition analysis: This is carried out to investigate the supplier's financial status. It involves a review of the supplier's financial statements and credit ratings. The analysis helps to judge the financial stability of the firm. This analysis is essential to have an idea of the likely continuity of the firm's performance, apart from its product quality. Until and unless a firm is financially stable, it will not be able to supply the required output and quality. If the buying firm is planning to establish a long-term relationship with its suppliers, it should conduct a financial analysis of its supplier's performance over the previous years.

Evaluators' conference: If the purchase is of great importance to the organization, then an evaluation conference is conducted at the purchase manager's department. These conferences help to analyze how well the supplier understands the complexity of the purchase and its importance to the purchaser. Depending on the interactions with the supplier, the purchaser can decide whether to drop the supplier or to consider the supplier for further evaluation.

Supplier facility visits: Visits to the suppliers' facilities give the purchase manager a feel of the supplier firm's technological capabilities, manufacturing or distribution capabilities, and the extent of the management's technical expertise. The composition of the team visiting the supplier's facility would depend on the nature of the product being purchased and the level of coordination the purchaser expects to build with the supplier. For example, if a car manufacturer is planning to buy a gearbox (high-value strategic component), the team would consist of top-level executives and technicians drawn from all the functional areas. On the other hand, if the purchase involves headlamps or radiator caps, the team visiting the suppliers' facility may be made up of a few product specialists.

Quality capability analysis: A company usually has certain quality standards. It should ensure that its suppliers maintain these quality standards. If the quality

standards of the supplier are lower than the firm's standards, then the supplier should not be considered. However, if no suitable supplier is found, then a supplier who is willing to upgrade quality in line with the buyer's requirements can be selected. Quality capability analysis should be based on the senior management's philosophy towards quality.

Capacity capability analysis: This analysis helps in identifying, whether the supplier will be able to provide the required quantity of supplies to the firm, as and when required. Since the operations of a firm depend on the timely arrival of inputs, any delay will halt the whole production process and result in huge losses for the firm. It is especially important for a firm sourcing component from different supplier firms, to receive all the components on time. Any delay from one supplier will stop the whole manufacturing process and this will have an adverse effect on the entire supply chain.

Management capability analysis: This analysis requires several visits to the firm. A quick analysis of a suppliers' capability can be conducted by evaluating their sales representatives. A good supplier will always have sales representatives, who know what the buying firm requires and make relevant suggestions to the purchase manager and his team. In addition, a well-maintained and managed firm will rarely have labor problems and inefficient performance.

Service capability analysis: A supplier can be termed as a good service provider if he takes every care to see that the buyer gets the right materials and service at the right time. He should ensure the smooth flow of materials and see that the work process in the buyer firm is not interrupted, because of any delays in supply. Apart from delivering on time, the supplier should also provide the buyer's information regarding any price changes, beforehand. If for any reason, the supplier is unable to provide the inputs on time, buyers should be informed well in advance, so that they can look for alternatives. To improve relations with buyers, the supplier may choose to stock spare materials for immediate delivery and extend suitable credit arrangements or special warranties on the quality and performance of items purchased, beyond the standard levels.

Flexibility capability analysis: An important issue in the supply chain management is Just-In-Time (JIT) purchasing. JIT purchasing evolved, to reduce costs associated with storing excess inventory. Under this method, based on the supplier's flexibility, production volumes are adjusted, and inventory is obtained within a short period. The advantages of the JIT system is that it results in reduced inventory, increased quality, reduced lead time, and reduced scrap and rework. When considering the JIT system, the buying firm should see whether its suppliers are also flexible enough to provide inputs at short notice. This system requires a high degree of integration between the operations of customers and suppliers.

Production scheduling and control systems: The purpose of evaluating the production control and delivery system is to check the availability of the required components, track the material and production cycle time, and compare with the performance objectives or standards. It also helps in identifying the history of supplier's on-time delivery performance. To sum up, the production scheduling and control process helps in identifying the degree of control the supplier has over the scheduling and control process.

E-commerce capability: The application of e-commerce to business is gaining importance. Electronic Data Interchange (EDI) is being replaced by web-based platforms as a method of establishing closer buyer-supplier relationships. The web-based platforms fall in the category of B2B (Business-to-Business) e-commerce. E-commerce systems help in exchanging all kinds of information for production, via the web.

In evaluating e-commerce capability, the buying firm may also need to find out whether the supplier uses Computer-Aided Design (CAD) and Computer-Aided Manufacturing (CAM) techniques. The ability of the suppliers to use bar-coding and the capacity of the supplier's employees to use e-commerce may also be important. Such analysis helps the buyer to judge whether the supplier is incorporating the latest technological developments. An analysis of the IT in use is also helpful, as the buyer and supplier firms can disseminate information in the supply chain more easily through compatible systems. Information sharing is particularly critical for JIT systems.

The analysis of all the factors listed above should be summarized so that a decision on the suitability of the supplier can be made. The most common approach used for summarizing is weighted factor analysis. Weighted factor analysis consists of two steps – first, choice of selection criteria, and second, assigning numerical ratings to these criteria. The first step is conducted by a committee of individuals, who have been evaluating suppliers. In the second step, the same committee assigns numerical ratings for these firms. A committee of evaluators is set up to conduct the weighted factor analysis.

6.4.3 Regulatory and Environmental Compliances

Depending upon the nature and application of the material, the buyer and the supplier have to comply with the applicable regulatory requirements. For example, there are certain items, which are banned for use like ROHS material (Restricted Hazardous Substances). Similarly, the use of radioactive materials like those used in x-ray machines call for special permissions for their procurement, use, and disposal. Both the parties need to know the applicable standards and regulations, and suitably incorporate them in the purchase data.

Another important requirement is environmental compliance of the materials. The intended material's environmental impacts should be understood, and necessary

environmental programs designed to address and contain the impact. For many materials, compliance is mandatory like the emission norms for automobiles and safety norms for chemicals, etc.

While ISO 9000 series of standards deals with quality management, ISO 14000 standards address the requirements of the environmental management. There are many regulations enacted from time to time, addressing various elements of the environment like water, soil, flora and fauna, pollution, etc.

6.4.4 Waste Management

Waste is wealth out of place. In view of the scarcity of resources and the compulsions to be cost-competitive, there is a need to ensure minimal waste in the purchased and processed material. The suppliers will have to be adequately trained to take necessary measures, for waste minimization through effective process management and quality assurance. Various methods available for waste management should be discussed and negotiated with the suppliers on a win-win basis, in the overall interests of the society at large.

Example: Volta Trucks selects Meritor as a Strategic Supplier

Volta Trucks selects Meritor as a strategic supplier for supplying the electric drivetrains for its electric commercial vehicles. Volta Trucks is a UK based auto company in the business of commercial vehicles. It is bringing the first all-electric trucks to the European market. The company uses cutting edge "supplier selections" processes to select vendors like Merit, for the vendor has the unique technical and production capabilities and shares the vision of Volta trucks for supplying world class electric commercial trucks. They enter a 3-year strategic partnership for supply of electric powertrains while ensuring highest level quality and delivery to meet the committed delivery schedules to the market.

Source: https://www.automotiveworld.com/news-releases/volta-trucks-selects-meritor-to-supply-the-innovative-electric-drivetrain-for-the-volta-zero/, February 3, 2021, Accessed on 24/08/2022

Activity 6.1

Evaluation of potential suppliers is a crucial stage in purchase management, which is an integral part of supply chain management. There are many types of analyses to be conducted for qualifying suppliers. In the present scenario of green supply chain management, organizational focus on Regulatory and Environmental compliances and Waste Management is very important.

You are required to:

- Identify various types of analyses to be conducted on potential suppliers.
- Identify various aspects related to regulatory and environmental compliances, as mandated across the world.

• Briefly describe the waste management initiatives to be taken up by the potential suppliers

Check Your Progress - 1

1 Which of the following is the exclusive activity of the Purchase department?

a. Sourcing and negotiation
b. Purchasing Research
c. Operational support and order follow up
d. Administration and support
e. Quality Management

2 Which of the following is not a stage according to the five-stage Purchase departmental model developed by Keogh?

a. Transactional stage
b. Price negotiation stage
c. Settlement stage
d. Cross-functional purchasing stage
e. External Integration stage

3. Identify the most important aspect of supplier management, in the context of 'Green Purchasing'.

a. Evaluating potential suppliers
b. Regulatory and Environmental compliances
c. Selecting suppliers
d. Forging relations with suppliers
e. Training suppliers

4. Which of the following is the most important aspect to be seen while evaluating potential suppliers?

a. Technical competence to supply the item
b. Financial management
c. Ability to meet delivery schedules
d. Relationship management
e. Outsourcing the responsibility

5. For the purchase department, which of the following is the most important standard/ regulation to comply with, from the environmental management point of view?

   a. ISO 9000

   b. ISO 14000

   c. ISO 18000

   d. ISO 27000

   e. ISO 31000

6.5 Selecting Suppliers

Using appropriate methods for the selection of suppliers is very important. After the evaluation process is complete, the next step is the selection process. The supply manager invites the suppliers to submit bids or proposals. The purchase manager should decide, whether competitive bidding or negotiation should be the basis of source selection.

6.5.1 Bidding vs. Negotiation

Based on the evaluation, the list of possible suppliers is narrowed down. The next step is the request for bids. The requests for bids are sent to three to eight potential suppliers. These bids ask the suppliers to quote their price, in accordance with the terms and conditions of the contract. There are five criteria to be considered for bidding, they are:

- The buyer should be confident that selecting the supplier concerned would give the company value for every rupee spent.
- The specifications of the purchase should be clear to the buying and selling firms. If the specifications are not clear and if there is any communication gap, there will be poor buyer-supplier relations. If the seller has had prior experience in dealing with similar buyer firms, it is an added advantage for the buyer, as the seller is likely to render the required service properly.
- There should be an adequate number of sellers in the market so that the buyer can evaluate and select the suppliers properly.
- Another advantage of having an adequate number of sellers is that it brings in competitive pricing and technically qualified sellers.
- Suppliers, who have been given large contracts, should be given adequate time to evaluate bids from subcontractors. Usually, thirty days is the time taken for bidding.

Firms should also keep in mind that it is better to avoid bidding in certain situations. These could be:

- Situations, where it is not possible to estimate costs with a high degree of certainty - costs cannot be predicted with certainty in high technology companies, where there are rapid changes in technical features. This is also true of firms, which take a long time to develop and produce products and the ones, which work under conditions of economic uncertainty.
- Situations, in which, apart from price, other aspects like quality, schedule, and service have to be considered.
- Competitive bidding cannot be applied, when the buying firm anticipates making changes in the specifications or some other aspects of the purchase contracts, at a future date.
- Situations, which involve special tooling or set up costs. These can be resolved through negotiation.

Excepting the above situations, competitive bidding usually results in the lowest price for inputs and is most suitable for selecting a supplier. In case competitive bidding is not appropriate, as in the situations mentioned above, negotiation should be used for selecting suppliers.

Several professionals consider negotiation better than bidding, for the following reasons:

- It helps in understanding all the issues of procurement. Thus, issues of quality and scheduling are made clear through negotiation.
- When companies go in for competitive bidding, the firm that offers the lowest bid is considered. The price aspect is given overwhelming importance, compared to issues like product quality and development efforts, which are often ignored. Negotiation is preferred to competitive bidding, in this regard.

6.5.2 Two-step Bidding or Negotiation

In the two-step process of bidding, suppliers are selected based on technical proposals. In the first step, bids are invited, asking suppliers to outline their technical proposals. These technical proposals should explain in detail how the supplier plans to produce the required inputs, without any mention of the price. The technical reports are analyzed and request for bids are sent to those suppliers, who meet the technical standards of the company. These shortlisted sellers participate in competitive bidding and the final suppliers may be selected, solely based on the lowest price, or after further negotiations on the quoted prices.

6.5.3 Solicitation and Responsibility for Selection

After a firm has decided to select its suppliers either through bidding or through negotiation, the next step that follows is the Request for Proposal (RFP) or the

Invitation for Bids (IFB). In practice, RFP is used for negotiated selection, and IFB is used for selection based on competitive bidding. The IFB or RFP contains information about the service required, the quantity required, delivery schedules, and special terms and conditions. The RFP should ask the supplier to provide the purchase manager with the required cost data in support of the price quoted in the proposal. This cost information helps the purchase managers, in negotiating with the suppliers.

6.5.4 Personnel Involved in Source Selection

The process of handling the selection of suppliers can be conducted in several different ways. It may be handled by a single purchase manager, who conducts the analysis and makes the selection. A second approach is through cross-functional teams from various departments like purchasing, process design, quality control, operations, finance, etc. The third method of selection is using commodity teams. They are a type of cross-functional teams, consisting of supply managers, material engineers, and production planners. Large commodity teams include a commodity manager and representatives from materials, design and manufacturing engineering, quality, and finance. The difference between commodity teams and cross-functional teams is that while the former are permanent, the latter are drawn together temporarily for a specific purpose.

Example: UT Health Houston's Selects Suppliers Via an Electronic Bid Process

UT Health Houston's selects suppliers by conducting sourcing events via an electronic bid process. The University of Texas Health Science Centre at Houston (UT Health) is a public health sciences centre in Houston, Texas.

The University Health Centre procured goods and services of various kinds running into several million dollars each year. The centre conducts sourcing events for goods and services through electronic bid process. The Centre uses Coupa eSourcing to facilitate the Sourcing process (bid creation to bid award). Suppliers interested in participating in a bid opportunity contact the purchase department through email. The supplier is added to the attendee list and the supplier gets an email. The Sourcing Event Information document and other Attachments to the bid are found on the Event Info tab.

Source: https://www.uth.edu/buy/bid-list.htm (2022), Accessed on 24/08/2022

6.6 Managing Suppliers

Not all firms will be in a position to get the best suppliers. In certain instances, the buying firm will not be in a position to identify the best suppliers. In such cases, the buying firm can select the best among the available suppliers, and train them to meet the firm's present and future requirements. The performance of the

suppliers should also be evaluated, on a periodic basis. The areas the buying firm should concentrate on, relating to the suppliers' growth plans, are future design capability in relevant areas, the role of the suppliers in the strategic growth of the organization, and their potential for future growth to support the organization. For example, Tata Motors introduced the Supplier Code of Conduct in order to increase the performance of its suppliers, specifically in the area of ethics in purchasing. If the firm realizes that the supplier is unable to meet its ethical code of conduct, it will help through orientation, training, and institutionalization of ethical practices. If the efforts are in vain, the supplier ceases to be a qualified supplier for Tata Motors.

6.6.1 JIT Purchasing

Just-in-Time (JIT) is a Japanese management concept that has been adopted by a number of companies all over the world, giving them numerous benefits. Japanese companies have been able to achieve a high rate of productivity and product quality, encouraging companies all over the world to study and adopt JIT practices. Traditionally, the primary functions of the purchase department of a firm were tasks such as preparation and processing of invoices and purchase orders, receiving items, and making payments. These tasks were mechanical in nature. However, with the changing business environment, most companies have realized that considering the purchase department as a profit center, rather than a unit for clerical operations, can help increase the company's profits. Japanese firms took the lead in looking upon the purchasing function as a quality and productivity center, through the implementation of the JIT purchasing concept. Firms worldwide have come to realize that purchasing activities are as important to the success of a firm as areas such as finance, marketing, engineering, production control, and quality control. The importance of JIT purchasing, in improving supply chain efficiency, can be analyzed by looking at the following aspects.

Purchase lot size: This is an important factor, in improving productivity and product quality. The smaller the lot size, the easier it is to inspect the lot and detect the defects or flaws. Parts purchased in small lot-sizes, with frequent deliveries, contribute to higher productivity, through lower levels of inventory and scrap, high quality, lower inspection costs for incoming parts, and early detection of defects. A common misconception is that JIT increases freight costs. Companies take care of this, in different ways. One approach used by companies such as Nissan, Kawasaki, and HP is to develop freight consolidation programs with suppliers. Here, the companies help the suppliers by sharing delivery trucks. The second approach that most companies follow is to select local suppliers, wherever possible. If there is no local source, then companies encourage their suppliers, to move their operations close to the company's plant to decrease the distance and improve their contact with the plant.

Number of suppliers: Most companies are realizing the importance of reducing the number of suppliers and establishing long-term relationships with suppliers. This is another important aspect of JIT purchasing. It becomes possible to build up trust between buyers and suppliers and they can work closely towards producing the required products. Suppliers become aware of the quality improvements required for the firm and provide inputs in line with the firm's quality standards. The other advantages are that when buyers deal with fewer suppliers, the buyer's resources such as time and travel, and engineering costs are conserved. Not much money needs to be spent on selecting, developing, and monitoring one or a few qualified sources.

Supplier selection and evaluation: The third important activity in JIT purchasing is a formal supplier selection and evaluation program, where suppliers are selected based on their ability to focus on product quality, long-term mutual relationships and cooperation, their delivery performance, geographical location, and price structure. At HP, the selection and evaluation of suppliers is done, based on the quality of the product, on-time delivery, frequent deliveries, deliveries of small quantities, and the exact quantity specified.

Quality control: The time required in the quality inspection can be reduced, by performing quality control at the source itself. All activities in the purchasing firm, related to the general inspection of materials and the quality of the product, should be eliminated. In other words, the supplier should assure the buyer of the high quality of the products. One method to ensure that the supplier is bringing in the right quality of products is through supplier certification. In these programs, suppliers take the responsibility of checking and sending the inputs, according to the requirements of the buyer. To ensure consistent quality, a periodic audit can be conducted at the suppliers' plants. Nissan follows this method. Six quality inspectors regularly audit their local supplier's plant. Moving the responsibility of the incoming parts to suppliers is an attempt to make the delivery of high-quality products an issue, over which there is absolute trust between buyers and suppliers. The suppliers also become keen to maintain quality, as they have to bear the cost of defective parts.

Involvement of suppliers in design specifications: JIT companies involve suppliers in the design of their products so that they become familiar with the production process. The suppliers can also alter the inputs as required when the buying firm brings out new designs or models of the product. Greater involvement also helps suppliers to get a precise idea of the specifications required by the buying firm. In this way, high product quality and productivity can be achieved, together with a reduction in the costs of tooling and bidding.

Bidding: In JIT purchasing, it is not the supplier who bids the lowest price, who gets the contract, but rather the supplier, who provides consistent quality. In JIT, there is a need for a long-term relationship between the buyer and supplier, with quality playing a prime role.

Reduction in the paperwork: By using long-term contracts, paperwork is reduced. The use of the Kanban system also does away with bureaucratic procedures. In addition, less time is spent on purchase orders, purchase requisitions, packing lists, shipping documents, invoices, etc., giving the buyers more time to audit supplier performance and cooperate in design and quality improvement.

JIT purchasing has become very important for many companies because of its characteristics, as explained above. In short, it helps in improving the efficiency of the entire supply chain, by delivering customized products to consumers at the right time. By effective utilization of the JIT, overall purchasing costs can be reduced considerably.

To summarize, the following are the benefits of JIT purchasing to the buyer and supplier.

6.6.2 Buyer Benefits

- Material costs can be reduced by reducing inventory carrying costs, transportation costs, and scrap costs, since defects are detected early.
- Administrative efficiency for the buyer can be increased by fewer requests for bids and fewer suppliers to contract with, reduced travel and telephone costs, simple accounting for parts received, and reliable identification of incoming orders.
- Quality can also be improved by fast detection and correction of defects, as purchase lots are small. The guaranteed high quality of parts purchased and the smooth production process also contribute to the quality of the product.
- Since suppliers are involved in the production process, there is a quick response to engineering changes and the supplier provides the required products, in accordance with changed technological requirements.
- Productivity also increases because of reduced rework in the production process, and fewer defective parts, which are identified in the early stages of production.

6.6.3 Supplier Benefits

- The material costs can be reduced, because of the lower finished and work-in-process inventory carrying costs.
- Administration efficiency can be increased because of close and ongoing communication with the buyer, which reduces the possibility of confusion. In addition, there is greater control over goods, because the outgoing shipments are steady and predictable.
- Quality improves because of coordination with the buyer, and the production of large defective lots is eliminated. Better coordination in engineering-related problems helps raise standards of quality.

- The production levels can be adjusted according to the requirements of the buyer because of ongoing interaction with the buyer. The supplier is able to retain the trust of the buyer.

Example: Mercedes-Benz Factory in Alabama Deploys JIT (Just in Time) Approach to Save on Inventory Costs

The manufacturing facility of Mercedes Benz in Alabama, manufactures the models GLE SUV, GL SUV, and the GLE Coupe.

Just-in-time (JIT) manufacturing method was used to build each model. JIT was based on the concept of not storing large amounts inventory. Large inventory increased costs and the operations become very inefficient. Any time, the assembly shop was planned to have only two hours' worth of inventory. About three hours was kept in store for the body shop for the production line. If extra inventory was needed, an automated system placed an order for replenishment and the company had well designed processes and arrangements with the suppliers who could supply the needed material almost immediately.

Source: https://mbusi.com/factory (2022), Accessed on 24/08/2022

6.7 Process of Purchasing

In addition to the traditional and established process of purchasing, globalization and its implications resulted in the need to know about certain new aspects related to the process of purchasing. These new aspects relate to eco-friendly procurement of materials, which ensure low-emissions, compliance to local and global regulations, integrity pact to ensure ethical practices in purchasing, etc.

Following paragraphs provide brief details.

Purchasing process involves the following steps:

Identify buying need - What, when, and how much to buy needs to be determined and needs to be approved.

***Identify potential suppliers* -** Identification can happen through supplier websites, catalogs, information files, yellow pages, trade journals, etc. Based on company policy, multiple, minority, or other categories need to be looked at, for potential sellers.

Evaluate suppliers - Where required, pre-qualification or empanelment needs to be done. Evaluation is done, based on the complexity of the supply market and the importance of procurement. Supplier surveys, quality capability analysis, third party survey, etc. provide insights into supplier capability.

Select suppliers - Selection is based on the ranking of suppliers, using a weighted average decision matrix or a balanced scorecard. Sub factors and their weightage need to be properly defined, for effective evaluation.

Develop suppliers - Based on the long-term and short-term needs of the company the suppliers need to be geared up, on performance and capability.

Manage suppliers - Building rapport and trust between the parties is important for effective management and achieving the goals of the function. Key performance indicators are defined and measured, which help in course correction and as a future reference. Purchase orders are raised, materials are received, they are assessed for quality and timeliness, and payments against the invoice are made.

6.7.1 International Contracts- Terms of Trade and INCOTERMS

The Incoterms or International Commercial Terms are a series of pre-defined commercial terms, published by the International Chamber of Commerce (ICC) relating to international commercial law. They are widely used in international commercial transactions or procurement processes and their use is encouraged by trade councils, courts, and international lawyers. The Incoterms® rules are the world's essential terms of trade for the sale of goods. Whether we are filing a purchase order, packaging and labeling a shipment for freight transport, or preparing a certificate of origin at a port, the Incoterms® rules are there to guide us. The Incoterms® rules provide specific guidance to individuals participating in the import and export of global trade on a daily basis. For example, terms like CFR (Cost and Freight) and CIF (Cost, Insurance, and Freight) are very popular in procurement terminology.

6.7.2 Green Procurement

Green Procurement is the process of purchasing materials and components, which are eco-friendly. The materials and components, while being used in production for making intermediate and final products, should not result in emissions causing pollution of the environment. It should also be ensured that such materials should not lead to depletion of critical resources, by locating alternative sources and suppliers. For example, Safexpress is a pioneer of green logistics and utilizes its proficiency in making the logistics greener and more sustainable, giving it an edge over other players in the industry. The company constantly focuses on ways to eradicate waste, retain more of the value that goes into its customer's products, and ultimately move toward a circular economy.

6.7.3 Life-Cycle Management

Life cycle management covers every aspect of the value chain, right from getting an order from the customer to retirement of the product from active use.

Thus, it covers design, development, engineering, manufacturing, testing, warehousing, packing, transporting, installation, commissioning, customer services, and retirement of the product. All these processes and associated activities need to be meticulously planned and efficiently executed. Apple's approach for Product design and deployment follows a life cycle approach. Only product design is done in the US and other processes are organized at different places around the world. For example, some I-phone models are manufactured in India. However, its life cycle approach is very robust and delivers the most sought-after models to the customers.

6.7.4 Goods and Services Tax (GST)

Goods and Services Tax (GST) is one of the greatest indirect tax reforms of India. Before leaping into the concept of GST, we need to first understand the Indian taxation framework and the underlying reasons that mandated the implementation of a single, unified tax.

Indian Tax Structure primarily consists of two types of taxes: 'Direct Tax' and 'Indirect Tax'. Direct Tax is a tax levied directly on the income, wealth, and profession of an individual. Income Tax and Corporation Tax are the major direct taxes. Indirect Tax, on the other hand, is not chargeable on the direct income of an individual. It is rather levied on the goods and services consumed by the ultimate consumer. Customs and GST are the major indirect taxes in India.

The previous indirect tax system comprised of separate Centre and State laws. Such a tax structure not only increased the cost of goods but also made the taxation system more complex. Therefore, to bring in simplicity and reduce the cascading effect, a single, unified tax in the form of GST was introduced. Such a tax system involves levy on the supply of goods or services or both, with concurrent jurisdiction of Centre and States.

GST is a single, destination-based indirect tax. It is levied on value-added to goods, as well as services at each stage of the supply chain. The main objective behind levying such a tax is to consolidate multiple indirect tax levies into a single tax. Thus, GST subsumes a host of taxes. It overcomes the limitations of the previous indirect tax structure. Furthermore, it brings efficiency to the administration of tax.

Principles that Define GST

To elucidate the above definition, we can say that GST is based on two principles: 'Destination Principle' and 'Value Added Principle'.

Destination Principle states that the supply of goods and services would be taxed at the point of consumption. This means that GST replaces a source-based tax system, with a destination-based tax regime.

Value Added Principle, on the other hand, underlines that the tax shall be collected on value-added to goods or services, at each stage of the supply chain. Right from the original producer or service provider to the ultimate consumer, GST will be collected on value-added at every stage of the supply chain.

Furthermore, GST paid on the purchase of goods and services can be set off against the output tax payable on the supply of goods and services. Thus, GST provides for comprehensive and continuous tax, throughout the supply chain. It does away with the cascading effect of taxes.

Just like the state-level Value Added Tax (VAT) levied on the sale of inter-state goods, GST is a national-level tax that incorporates the value-added principle. Therefore, we can say that GST is a well-designed VAT on goods and services. It eliminates the shortcomings such as the marginal benefit of input tax credit and the multiplicity of taxes that persisted in VAT.

Example: Tel Aviv University Adopts Initiatives including Green Purchasing to Create a Model for Carbon Neutrality

After the UN Climate Change Conference (Glasgow) "Tel Aviv University" had prepared a strategic plan to become carbon neutral by reducing "greenhouse emissions" resulting from its activities and there by promoting more efficient use of resources and renewable energy. The plan includes sustainable energy, recycling water and materials, reducing use of paper, introducing green purchasing procedures.

Source: https://english.tau.ac.il/news/tau-carbon-neutrality , November 2021, Accessed on 24/08/2022

Activity 6.2

GST (Goods and Services Tax), the most significant reform in post-independent India, has generated supporters as well as critics. Nevertheless, it has come to stay.

- You are required to go through the process of implementation and the institutional mechanism, for its monitoring, amendments, etc.
- Analyze its impact on various sectors of the Indian economy.

Check Your Progress - 2

6. Which of the following is the most important criterion to be considered for bidding?
   a. Value for money
   b. Clarity of specifications
   c. Limited number of suppliers
   d. Adequate time to bid
   e. IT capability
7. In the two-step bidding process, which of the following is the appropriate description of the process? The bids are evaluated …….
   a. At the worker and executive levels
   b. In technical and commercial angles
   c. By technical and commercial departments
   d. By the management and external experts
   e. By the management and customers
8. Which of the following is the primary objective of JIT Purchasing?
   a. Inventory control
   b. Quality control
   c. Cycle time control
   d. Supplier control
   e. Customer control
9. By whom/which of the following, the suppliers are decided?
   a. The CEO
   b. The Purchase-in-charge
   c. A cross-functional team
   d. Major stakeholders
   e. The customers
10 Which of the following is the best way to manage suppliers?
   a. Training and tuning suppliers to ensure supplies as required
   b. Evaluating and disqualifying unsuitable suppliers
   c. Forging partnerships to ensure smooth supply chains
   d. Financially supporting the suppliers
   e. Providing manpower to the suppliers

6.8 Summary

- Changes in the business environment have made it necessary for all departments of an organization to work cooperatively, to achieve the goals of the organization.
- The purchase department's role has also undergone major changes, and it has established itself as an important element in the supply chain management.
- The shift in the role of the purchasing function can be seen, by looking at the evolution of the purchasing function, over the last few decades.
- The five stages in the evolution of the purchasing function are transactional stage, price negotiation stage, coordination stage, cross-functional purchasing stage, and external integration stage.
- Before an organization decides on its suppliers, it should decide whether it should make or buy the required input.
- After this decision is taken, it must consider how it will select and manage its suppliers. Supplier selection is very important because, today, most companies aim to build long-term relationships with their suppliers.
- While discovering potential suppliers is not a difficult task given current technological advancements, evaluating them needs careful attention.
- Careful analysis of a number of indicators, such as financial capability analysis and quality analysis, is conducted to evaluate the performance of the suppliers.
- After evaluating suppliers, the selection can be done, either through bidding or through negotiation.
- Many companies today prefer negotiation to bidding.
- One concept that has gained great popularity over the last few decades is JIT purchasing. It is a Japanese concept that has been adopted by a number of US companies.
- Both buyers and suppliers can reap a number of benefits by adopting JIT purchasing.
- GST is a significant tax reform introduced in India.

6.9 Glossary

Bar-Coding: It is a method of automatic identification, using a series of light spaces and dark bars with differing densities, in standard formats, to enable a computer to read data and letters accurately, without keyboard entry.

CAD: Computer-Aided Design is the use of computer-based techniques like Numerical Control Systems, drafting aids, etc., for product engineering.

CAM: Computer-Aided Manufacturing refers to the deployment of automation, robotics, the Internet of Things, etc., in manufacturing operations.

Cross-Functional Teams: It is a generic term, representing a collective approach by different departments in an organization, to achieve operational efficiency.

EDI: Electronic Data Interchange refers to the exchange of data among different users, from a common source.

Green Purchasing: It refers to the procurement of materials, parts and other inputs by an organization, complying with regulations and practices related to environment-friendly supply chain management.

GST: Goods and Services Tax (GST) is a unified tax system operating in India.

INCOTERMS: They are the International contract terms introduced by the International Chamber of Commerce.

ISO 14000: It is a family of Environmental Management System standards adopted by all organizations across the world.

ISO 9000: It is a family of quality management standards, introduced by the International Organization for Standardization and is operational globally.

Just in Time (JIT): An inventory optimization technique pioneered by Toyota.

Kanban system: It is an inventory control system, used in Just-In-Time manufacturing. It was developed by Taiichi Ohno, an industrial engineer at Toyota.

RFP: It stands for Request for Proposal, a detailed specification of goods or services required by an organization, sent to potential contractors or suppliers.

6.10 Self-Assessment Test

1. Trace the evolution and activities of the Purchase Department.
2. What are the general principles for selecting and managing suppliers?
3. What is the process of selecting suppliers?
4. What are the levers for managing suppliers?
5. Describe in detail, the process of purchasing.

6.11 Suggested Reading / Reference Material

1. Ashley McDonough, Operations and Supply Chain Management Essentials You Always Wanted to Know: 15 (Self Learning Management Series) Paperback – 1 January 2020
2. Russel and Taylor, Operations and Supply Chain Management, 10ed, ISV Paperback – October 2019
3. Chopra and Kalra, Supply Chain Management 6/e Paperback – 17 June 2016

6.12 Answers to Check Your Progress

1. (a) Sourcing and negotiation

It is the most important function of purchase in an organization.

2. (c) Settlement stage

It is not a defined stage in the 5-stage purchase departmental model.

3. (b) Regulatory and Environmental compliance

It is the post important aspect of purchase function in the context of 'Green Purchase.'

4. (a) Technical competence to supply the product as per specifications

It is the most important aspect to be considered while evaluating potential suppliers.

5. (b) ISO 14000

ISO 14000 is the most important global standard to be followed for environmental compliance.

6. (b) Clarity of specifications

Clarity of specifications is the most important criterion for bidding.

7. (b) The bids are evaluated from technical and commercial angles

It is the most appropriate description for the process in a two-step bidding.

8. (a) Inventory control

JIT purchasing primarily focuses on inventory control.

9. (a) CEO decides the suppliers in small-scale industries

The Chief executive decides the suppliers in small scale industries

10. (c) Forging partnerships to ensure smooth supplies

It is the best way to manage suppliers as followed by established manufacturers.

Unit 7

Manufacturing in a Supply Chain Context

Structures

"Continuous improvement is better than delayed perfection."

- Mark Twain

7.1 Introduction

Manufacturing organizations continuously need to improve various processes rather than attempt perfection.

In the previous unit, we discussed purchasing and supply chain management covering the concepts such as evolution and activities of the purchasing function, selecting and managing suppliers, selecting suppliers, managing suppliers and process of purchasing.

Manufacturing is a key area in the supply chain, as it directly influences the capacity of the supply chain to meet customer demand. In the early 20th century, quality and customization of products was the prime focus of the production process. Many firms adopted craft production, as it enabled them to produce customized products. Later, the focus shifted from quality and customization to achieving cost efficiency. This led to a concept called mass production that was pioneered by Ford and GM. In the 1980s, quality at low prices became the critical factor and concepts of lean production and tiered production came into being. With the increased pace of globalization, competition, and advancements in technology, flexibility and speed became the differentiating factors and the 1990s saw the emergence of supply chain production.

In this unit, we discuss intra-firm and inter-firm production and their characteristics. Various supply chain production forms are also examined.

7.2 Objectives

By the end of the unit, you will be able to

- Discuss intra-firm production
- Explain flexible manufacturing system (FMS) and inter-firm production
- Describe supply chain production

7.3 Intra-firm Production

Intra-firm production refers to the production process, within a firm or single structure, i.e. where the entire product is manufactured within a firm. Common forms of intra-firm production are craft production, mass production, and JIT production. In a craft production system, a skilled worker or craftsman is involved in the entire manufacturing process of the product. With advancements in manufacturing technologies, the production process shifted to mass production, where a unit is produced in a series of steps, in an assembly line. In mass production, each worker is involved, in only a part of the production process. The contemporary production system introduced by the Toyota Production System is Just-in-Time (JIT) production. In this, production starts after getting the order and deliveries happen at the earliest. One of the most significant achievements of JIT production is inventory control to optimum levels. Now, with the increase in competition, firms have started employing what is called lean production, where the aim is to make the manufacturing process flexible and efficient. The three production processes are dealt with in detail below.

7.3.1 Craft Production

Craft production involves the manufacture of a wide range of customized products, using flexible and general-purpose machines, handled by adaptable and highly skilled workers. In craft production, an individual worker creates the entire product from start to finish, using simple tools. The production is highly flexible. The key characteristics of craft production are high demand due to the different product specifications of each customer. This increases variability in raw material requirements. The rate of production is slow. The costs involved in employing highly-skilled workers are high. Variable costs are also high due to variations in customer orders. Examples of this kind of production are jewellery, high-end luxury cars, and furniture.

7.3.2 Mass Production

With changing market conditions, high costs and limited growth opportunities available in craft production, firms turned to mass production, where large quantities of products are made at a time in a series of sequential steps on

inflexible assembly lines. The products are standardized so that huge quantities can be produced faster and at a lower cost. Mass production is function-focused i.e., work processes are standardized and workers are employed to perform these processes. The goods are usually produced in anticipation of customer demand and, hence, a large amount of inventory is held by the firm, to meet any variability in demand.

Mass production employs skilled workers to design the products, and for the actual production, unskilled workers are used. For this, the firm requires expensive equipment, which can be used for a single purpose. Mass production simplifies the production process by dividing large complex processes into small components, which can be performed by workers, who become specialized in a single process or function. In order to be profitable, the expensive machines employed in mass production must be operated at full capacity and for long production runs. Due to inflexible machines, and workers who are adept only in a particular function or process, mass production cannot handle variability in raw material supply, and cannot react quickly to changes in market conditions or customer preferences.

In mass production, the quality of the product is checked only at the end of the assembly line. Even if defects are identified during the manufacturing process, production is not halted and the defects are rectified only at the end of the production process. This leads to an increase in the cost of production. Familiar products for mass production are electronic goods like mobile phones, pharmaceutical products, food items, etc.

7.3.3 Lean Production

Lean production is more popularly known as the Toyota production system, as Toyota introduced this concept in the 1950s. Lean production was envisaged to counter the problems that exist in the mass production and craft production systems. Before the emergence of lean production, firms had two choices, either to adopt craft production or mass production. In craft production, the organizational structure is designed as a set of loosely defined jobs, each held by highly skilled craftsmen. The firm can produce highly customized products and operates in a niche segment. Costs are high in craft production. Mass production enables the firm to produce large quantities of standardized goods at a low cost. In mass production systems, firms maintain an arms-length relationship with suppliers. Firms also need to hold a large inventory and employ a large number of employees.

Both of these production systems have certain limitations. While craft production cannot produce products on a large scale, mass production cannot satisfy individual customer requirements. Volatility in the automobile market has increased to levels that never existed before. Firms employing mass production systems found it difficult to cope with this uncertainty. The ability of production

systems, to change according to market conditions, is limited in mass production systems. Because of production constraints, craft production cannot meet any increase in demand. Lean production can incorporate features of both craft production and mass production systems. Lean production can be flexible enough, to match supply with customer requirements, and at the same time, it can manufacture products in large quantities to cope with any rise in demand, and also achieve economies of scale. Lean production is about doing more with less, i.e., using fewer people and machines.

Quality is checked at every stage of the production process in lean production. As soon as a defect is discovered during production, it is rectified at that stage itself, unlike what happens in the mass production process. This reduces the rework that needs to be done at the end of the assembly line. Production costs are also substantially less, due to the increase in efficiency in the production systems.

One of the key components in lean production is JIT, which enables the firm to schedule the production process on a day-to-day basis.

7.3.4 JIT Production

The Just-In-Time (JIT) manufacturing concept is about delivering material and components to the next level of production, just before the parts are needed and in the precise quantity required. JIT is concerned with continuous improvement in material flow, within the factory or factories and the elimination of waste, in the production process. In some cases, JIT manufacturing is difficult to implement because inventories are reduced to almost zero. If a part does not reach the production floor, due to some disruption, then the entire production process comes to a halt. It took twenty years for Toyota, who developed this concept, to successfully implement JIT in its production system.

JIT techniques that are used to improve material flows can be categorized into:

- Revised layouts
- Reduced set-up times
- Pull system using Kanban controls
- JIT purchasing (discussed in the next section)

Revised layouts

Layouts of the production system can be revised so that there is continuous manufacturing flow. Continuous manufacturing flow aims to minimize material handling activities and corresponding transactions and provide quick quality feedback. Firms can revise their layouts either for assembly lines or manufacturing cells. Assembly lines are set up for the dedicated production of a particular product and can be used for multiple product models. Manufacturing cells are set up so that the resources required for making finished goods are assembled at one location. This is opposed to traditional manufacturing, which

consists of departmentalized layouts, where machines of the same type are grouped together. In manufacturing cells, the required machines are located together so that the assembly operations are completed within the cell.

Reduced set-up times

To reduce lot sizes and ease production flow, firms can reduce set-up times. Set-up time is the time taken for changeovers in equipment for producing a different product. Set up time does not add value to the production process and, therefore, firms try to keep set up times as short as possible. With reduced set-up times, firms can make products in smaller lots, in a cost-effective way. This also enables firms to produce a wide range of products and components on a daily basis.

Kanban controls

Pull systems refer to a process, where components are replenished only to the extent they are consumed. Pull systems are implemented using Kanban controls. In the Kanban system, a visual signal such as an empty container, open space, or flashing light is used to start the replenishment process. When the parts in the container are consumed, the container is sent back to the previous step, which indicates the requirement of more parts.

The key features of lean production that distinguish it from mass production are the flexibility to change according to the requirements of the firm and the market, and the use of reduced resources - workers, space, and equipment. In intra-firm JIT production, firms focus on improving and fine-tuning the processes and systems within the firm, to achieve just in time flow of components and products. But with all these measures, the firms were able to reduce costs only to some extent and beyond that, they have faced diminishing returns. This led firms to explore opportunities that exist outside the firm and the resultant inter-firm production process emerged. Inter-firm production talks about the coordination with the other members in the production process, mainly suppliers.

Example: Kormotech Deploys "Lean Production'' Method to Maximize the Focus on Customer

Kormotech (a Ukrainian pet food manufacturing company) deploys "Lean Production" method of manufacturing to maximize the focus on customer while motivating the staff. Lean-production methodology (an approach in Intra-firm Production) allows the company to address many daily operational challenges. The benefits are, achieving high quality with minimal costs, reducing the production time, avoiding overproduction, reducing inventory and improving customer satisfaction. Work safety and workplace comfort for employees is enhanced leading to employee involvement and motivation.

Source: https://www.petfoodindustry.com/articles/11482-kormotech-introduces-lean-management August 11, 2022, Accessed on 25/08/2022

7.4 Flexible Manufacturing System (FMS) and Inter-Firm Production

Globalization, volatile market requirements, and modern lifestyle trends have put up tremendous challenges to manufacturing industries. In the current business scenario, the competitiveness of any manufacturing industry is determined by its ability to respond quickly to the rapidly changing market and to produce high-quality products at low costs. However, the product cost is no longer the predominant factor, affecting the manufacturers' perception. Other competitive factors such as flexibility, quality, efficient delivery, and customer satisfaction are drawing equal attention.

Flexible manufacturing is a concept that allows manufacturing systems to be built under highly customized production requirements. The issues such as reduction of inventories and market-response time to meet customer demands, flexibility to adapt to changes in the market, reducing the cost of products and services to grab more market shares, etc. have made it almost obligatory for many firms, to switch over to Flexible Manufacturing Systems (FMSs) as a viable means, to accomplish the above requirements, while producing consistently good quality and cost-effective products. Companies have to adapt to the environment in which they operate, to be more flexible in their operations and to satisfy different market segments. Thus, the innovation of FMS is related to the effort of gaining a competitive advantage.

A Flexible Manufacturing System (FMS) is a manufacturing system, in which there is some amount of flexibility that allows the system to react in case of changes, whether predicted or unpredicted. It is a method for producing goods, which are readily adaptable to changes in the product being manufactured, in which machines can manufacture parts and handle varying levels of production. An FMS gives manufacturing firms agility, in a quickly changing manufacturing environment. While an FMS has many advantages, it may not always be the most cost-effective method of manufacturing, due to the high cost of developing the system and obtaining sophisticated machinery. An FMS may be able to make up for this high cost, with greater efficiency and less downtime. For example, a traditional manufacturing system may need to halt, if a key machine breaks down. An FMS may be able to adapt and keep production going during repairs.

There are three levels of manufacturing flexibility.

(a) Basic flexibilities

- *Machine flexibility* - the ease, with which a machine can process various operations
- *Material handling flexibility* - a measure of the ease, with which different part types can be transported and properly positioned at various machine tools in a system

- *Operation flexibility* - a measure of the ease, with which alternative operation sequences can be used for processing a part type

(b) System flexibilities

- *Volume flexibility* - a measure of a system's capability to be operated profitably, at different volumes of the existing part types
- *Expansion flexibility* - the ability to build a system and expand it incrementally
- *Routing flexibility* - a measure of the alternative paths that a part can effectively follow through a system, for a given process plan
- *Process flexibility* - a measure of the volume of the set of part types that a system can produce, without incurring any setup
- *Product flexibility* - the volume of the set of part types that can be manufactured in a system, with minor setup

(c) Aggregate flexibilities

- *Program flexibility* - the ability of a system to run for reasonably long periods, without external intervention
- *Production flexibility* - the volume of the set of part types that a system can produce, without major investment in capital equipment
- *Market flexibility* - the ability of a system to efficiently adapt to changing market conditions
- Actually, the need is for *flexible processes* to permit rapid low-cost switching from one product line to another. This is possible with *flexible workers*, whose multiple skills would develop the ability to switch easily from one kind of task to another.
- As main resources, flexible processes and flexible workers would create *flexible plants* as plants, which can adapt to changes in real-time, using movable equipment, knockdown walls, and easily accessible and re-routable utilities.

Different Flexible Manufacturing System Levels

A Flexible Manufacturing System (FMS) consists of several machine tools, along with part and tool handling devices such as robots, arranged such that it can handle any family of parts, for which it has been designed and developed.

Different FMS levels are:

- Flexible Manufacturing Module (FMM). Ex.: an NC machine, a pallet changer and a part buffer;
- Flexible Manufacturing (Assembly) Cell (F(M/A) C). Ex.: Four FMMs and an AGV (Automated Guided Vehicle);

- Flexible Manufacturing Group (FMG). Ex.: Two FMCs, an FMM and two AGVs which will transport parts from a Part Loading area, through machines, to a Part Unloading Area;
- Flexible Production Systems (FPS). Ex.: A FMG and a FAC, two AGVs, an Automated Tool Storage, and an Automated Part/assembly Storage;
- Flexible Manufacturing Line (FML). Ex.: multiple stations in a line layout and AGVs

7.4.1 Advantages and Disadvantages of FMS Implementation

Advantages

- Faster, lower-cost changes, from one part to another, which will improve capital utilization
- Lower direct labor cost, due to the reduction in the number of workers
- Reduced inventory, due to planning and programming precision
- Consistent and better quality, due to automated control
- Lower cost/ unit of output, due to greater productivity, using the same number of workers
- Savings from indirect labor, from reduced errors, rework, and repairs.

Disadvantages

- Limited ability to adapt to changes in product or product mix (e.g. machines are of limited capacity and the tooling necessary for products, even of the same family, is not always feasible in a given FMS)
- Substantial pre-planning activity
- Expensive, costing millions of dollars
- Technological problems of exact component positioning and precise timing, necessary to process a component
- Sophisticated manufacturing systems

7.4.2. Inter-firm Production

With the increasing trend of sourcing components from outside firms, the importance of suppliers has increased. The role of suppliers has shifted from merely providing raw materials to partnering in the production process. In craft production, the supplier's role is limited to the supply of raw material to the manufacturer. In mass production, suppliers provide not only raw materials but also sub-components and parts. In these systems, the suppliers' relationship with the manufacturer is transactional i.e. market-based and short-term. In mass manufacturing, the manufacturer designs and develops specifications for the parts

and components, and invites suppliers to bid for producing those parts. A mass manufacturer views suppliers in terms of cost, price, quality, delivery, and reliability. Since the relationship between a manufacturer and supplier is a distant one, cooperation and partnership between these two entities are not possible. This makes the manufacturer look for alternate suppliers, which increases the number of suppliers as well as inventory in the supply chain.

In contrast, in lean production, the manufacturer views the supplier not just from a cost and price angle, but also from a relationship point of view. By establishing a long-term relationship with a few suppliers, the firm can reduce the number of suppliers as well as inventory. In lean production, production costs are arrived at in the reverse order. For example, a firm decides the price at which the product has to be sold. Then, the suppliers and the firm decide how to produce the product within that price, so that they can make a profit. Ikea, a leading furniture manufacturer, widely uses this model, where it decides the target price for a furniture product and then plans the production process within the target price.

7.4.3 JIT Inter-firm Production

In JIT inter-firm production, firms maintain a long-term relationship with suppliers and even partner with them. In this production system, manufacturers and suppliers jointly decide upon cost reduction techniques. The manufacturer shares the profits that accrue in the cost reduction activities with the supplier. Unlike in mass production, where the manufacturer's relationship with the supplier exists for only as long as the supplier provides him with cheap raw materials, JIT production lays emphasis on a close and cooperative relationship, between the firm and the supplier for mutual benefit. By maintaining a long-term relationship with suppliers, firms can mitigate variability in supply. Because of the extended commitment, suppliers can provide material required by the firm in a timely manner, which will reduce the need to hold buffer stocks. Thus, the inter-firm partnership creates a win-win situation for both manufacturers and suppliers, where the manufacturer assures the supplier of sufficient orders and the supplier gives the firm a long-term commitment for the supply of quality material.

JIT inter-firm production is also concerned with quality. This is very important for a manufacturer who has to deal with multiple suppliers for multiple parts. Quality in JIT production demands early detection of errors in the production processes and defects in products when the firm is dealing with outside suppliers. By focusing on improvement internally, using business process engineering, TQM and other such measures, firms were able to improve productivity levels dramatically. But over a period of time, the gains from these internal measures diminished. Firms then shifted their focus to opportunities that exist outside the firm. This led firms to encourage suppliers to implement JIT manufacturing techniques and to even assist them to implement the JIT systems.

7.4.4 International Technology Transfer

International Technology Transfer (ITT) refers to the transfer of information across borders and its penetration into the economy of the recipient country. This involves a gamut of processes from innovation to international marketing, covering absorption and replication/ reverse-engineering/ imitation, etc. The participants in ITT can range from universities, R&D labs, NGOs to Multinational companies, including collaborators. Channels such as training, institutional programs, and procurement contracts are effective ways of technology transfer while licensing is less effective. Technology can also be transferred through the publication of journals, sale and purchase of equipment or transfer of personnel. ITT can be looked at both from the horizontal and vertical perspective, where three elements come into the picture- the host country, home country, and transaction.

Knowledge diffusion or spread happens in five stages: acquiring knowledge, persuasion, decision, implementation, and confirmation. The ease with which the knowledge gets diffused and absorbed in the receiving country is important in ITT effectiveness. It is a general perception that technology transfer happens only from developed countries to developing countries but it can happen between developed countries or from a developing country to a developed country. Instead of reinventing the wheel and developing the same product, organizations go for technology transfer to quickly capture the market, for new innovative products.

Companies need to review the receiving or buying the company's capability and formulate an appropriate contract, to ensure there is no violation when technology is transferred. Other aspects that a company has to focus are on the mode in which the foreign technology is acquired, resistance posed locally, and how to diffuse that knowledge and create internal capability. At the inter-firm level, technology transfer can happen as "on-site audit and troubleshooting", product design specifications, or sourcing of technical experts or a complete knowledge transfer for production.

In India, there have been many technology transfers, mostly in Indian Public Sector Units (PSUs), in the early days of independence and subsequently in the private sector as well. With a view to accelerate the growth of the Indian economy, the government started liberalization and is encouraging Foreign Direct Investment (FDI), even up to 100%. It has also insisted on manufacturing a certain percentage of the products within the country with a view to absorb technologies and also to generate employment. PSUs like BHEL, SAIL entered into collaborations with foreign companies and today became Maharatnas.

7.4.5 Tiered Production

Another form of production that enables the firm to deal with suppliers effectively is tiered production. In tiered production, a manufacturer deals with a limited

number of suppliers. In this type of production, the firm deals only with first-tier suppliers. The firm entrusts the responsibility of the design and production of a key part or component to this supplier. In turn, the first-tier suppliers deal with the second-tier suppliers to carry out some of the work. For example, Cisco systems entrust the production of some components, or even the entire product, to contract manufacturers like Celestica, Flextronics, and Solectron. These contract manufacturers are supported by suppliers, who provide the required components such as processor chips (Intel and Xilinx) and optical gear (JDS Uniphase and Corning). These companies are supported by another set of suppliers located around the world.

The tiered production model involves a number of steps (Stuart, Deckert & Paul, 2003). They include vendor certification, quality audits, rationalization of suppliers, joint problem solving, and buyer-seller collaboration in new product development. With the changing manufacturing environment, top-tier suppliers are even performing activities like inventory and procurement management, thus acting as an extended enterprise.

An advantage of the tiered supplier model is the effective involvement of primary suppliers in the design and development of new products. Firms can use the extensive knowledge and expertise of suppliers in new product development, for the prevention of errors or problems at the design stage itself, for faster product development, and provision of alternate designs for the production of the product, within the budgeted costs.

Premier Instruments and Control (Pricol), a major automotive instrument manufacturer, in India, adopted the tiered system of suppliers to increase efficiency, and improve quality in the supply chain. By 2019 the firm has 600 suppliers, who provide ₹ 150 Crore worth of products and services. Now, the company rationalized the supplier structure by reducing the number of suppliers and partner with component suppliers, who were capable of providing ₹ 1.2 Crore worth of products per annum. At the top or first tier, the firm wants to deal directly with 200 suppliers. These suppliers can in turn deal with other suppliers. Pricol tied-up with suppliers, who can offer their raw material and multi-component sub-assemblies, rather than just a few components.

Inter-firm production methods evolved due to the need for better quality and flexibility in the supply chain. But these methods did not address some of the problems, faced by firms. In inter-firm production systems, suppliers focus their efforts only on improving the operations of the focal organization. Due to this narrow focus, the ability of the members of the supply chain, to innovate or develop synergies with other members in the supply chain, is reduced. In addition, in such systems, the manufacturer's ability to deal with uncertainties in the market is also limited, due to its paired relationship with the supplier. Because of these

drawbacks, firms had to thoroughly analyze the supply chain to identify practices that would bring more effectiveness to the supply chain. This analysis led to the development of supply chain production methods.

Example: Honda Faces Challenges in its JIT (Just in Time) Inter-Firm, Tiered Production Approach Due to the Spread of Suppliers Across Japan and US

Honda deploys Flexible Manufacturing systems based on JIT and Tiered Production approaches to derive operational efficiencies and thereby offer highest quality products at competitive prices to its customers. The Honda philosophy is to hold as minimum inventory as possible. Due to this, it has a set of first tier suppliers who can supply just in time so that company can just have few hours of stocks in the store. While the first-tier suppliers can fully follow JIT, there are some products which they source from second tier suppliers who may not be geared up or not interested to supply small quantities. For examples Dupont is a second-tier supplier to one tier supplier of Honda. But Dupont does not want to supply small quantities OnDemand. This poses a challenge to first tier supplier and Honda also. So they need to increase stock levels in the store.

Source: https://gerpisa.org/ancien-gerpisa/actes/7/7-5.pdf (2022), Accessed on 25/08/2022

Activity 7.1

A small scale manufacturer of mechanical parts supplies to different organizations. Naturally, they will be of different specifications and sizes. The production manager observed that they are losing a lot of time in reorganizing machines and processes after the parts are manufactured for one customer. They want to make their manufacturing process more efficient by adopting a Flexible Manufacturing System (FMS).

- You are required to suggest an FMS, taking into consideration different mechanical parts the company is making.
- Provide a brief overview of FMS and the dos and don’ts while implementing FMS.

Check Your Progress - 1

1. Identify the type of production, which is not inter-firm production.
   a. Craft production
   b. Mass Production
   c. Lean production
   d. JIT production
   e. Extended-arm production
2. Which type of production does manufacture of customer-built high-end cars, come under?
   a. Craft production
   b. Mass production
   c. Lean production
   d. JIT production
   e. Specialized production
3. Which of the following is not a popular JIT technique?
   a. Revised layouts
   b. Reduced set-up times
   c. Pull system using Kanban controls
   d. JIT purchasing
   e. Six Sigma
4. Which is the most significant advantage of a Flexible Manufacturing System?
   a. Higher capacity utilization
   b. Quality improvement
   c. Inventory control
   d. Multi-skilling capabilities
   e. Lesser capital costs
5. Which of the following statements properly describes a tiered production system?
   a. The principal contractor, in turn, subcontracts to the next level of suppliers.
   b. The manufacturer designs, principal contractor engineers and the next level supplier produces the product.
   c. There will be many tiers of production for various items.
   d. It is the best way to ensure the best quality at the least cost.
   e. It is not suitable for mass production.

7.5 Supply Chain Production

The focus of firms has shifted from the cost and quality issues that existed in the early 1980s to innovation, flexibility and speed. They began to think of possible advantages that could accrue from influencing the entities outside the firm.

The competitive advantage of a firm is assessed in terms of its flexibility to shift from low-cost production strategies to faster product development in a short period of time and with lesser resources. Firms realized that in order to respond to the dynamically changing market conditions, the production process needs to be flexible. This made the firms examine their production process, from a supply chain perspective. A firm with a supply chain orientation not only considers the immediate supplier and customer but also the other levels of suppliers and customers. Some of the supply chain production methods widely used in industry are described below.

7.5.1 Dispersed Production

The dispersed production process involves the production of a component at a location, which is well suited for that particular job. For example, a US car manufacturer can produce critical parts like engines and gearboxes, at its main plants in the US and source the other components from suppliers and its other plants, in low-cost locations in China. The main function of the firm, in such a manufacturing environment, is to determine the overall production plan and allocate the tasks among the dispersed manufacturing partners. According to Ferdows (2003), there are three key factors responsible for the growing popularity of dispersed production. The first factor is the emergence of modern factories with global quality standards, in low-cost locations in Asian countries, especially China. These factories are able to supply components and even complex parts, at a low cost. The second factor is the reduction of trade barriers among nations, which enabled factories to cater to the needs of global customers. The liberalization of the Indian economy in 1991 and the setting up of Special Economic Zones (SEZ's) in China during the 1970s are examples of such developments. The third factor that allowed firms to employ dispersed production was the emergence of firms, which specialize in the production of certain components and technologies. Firms who are in need of these products/ technologies have no option but to source them from these specialist firms. Firms adopt dispersed production to take advantage of the low-cost facilities of these globally dispersed factories and, at the same time, to improve responsiveness, in the supply chain, to changes in the market place. To employ dispersed production successfully, firms need to work towards better coordination among supply chain members. The greater the extent of dispersed production, the greater is the need for better coordination. The absence of proper coordination in the supply chain will make it difficult for firms, to respond quickly to market changes.

According to Ferdows, firms face the following key challenges, in implementing dispersed production: balancing schedules and capacity utilization, maintaining just-in-time flow through the supply chain, and responding quickly to unforeseen changes.

Balancing schedules and capacity utilization

Since a number of firms are involved in the manufacture of a product, the coordination of production schedules is very important. Production schedules need to be planned in such a way that each production facility is allocated optimal production capacity. In a dispersed manufacturing environment, where the factories are spread across the globe and owned by different organizations, this is even more challenging. Apart from the production schedules and capacity utilization that needs to be planned, the supplies, shipment deliveries, and inventory should also be coordinated, to optimally utilize the other resources like warehouses and transportation vehicles.

Maintaining just-in-time flow through the supply chain

When a firm has to deal with a number of factories, holding inventory at each stage of the supply chain, to counter variability in the supply chain, is not the right approach. There are three key reasons for this They are:

- Lead time will increase, to the detriment of firms that are in the business of customized products.
- High inventory levels lock up valuable capital, resulting in increased costs. If the products the firms deal with have a short product life cycle and a high degree of obsolescence, then the build-up of inventory increases product risk.
- Such building up of inventory results in the initiation of the bullwhip effect, in the supply chain.

Thus, managing inventory, in a dispersed production environment, is a major task for the firm.

Responding quickly to unforeseen changes

The supply chain needs to be flexible enough to respond to unforeseen changes in the market place. Bringing in flexibility in the supply chain is another challenge for firms. Maintaining flexibility is difficult, even for firms that deal with production at one factory. Maintaining flexibility in the supply chain, where factories are dispersed across the world, and belong to different organizations and units, can be even more challenging.

Firms that implemented dispersed production successfully demonstrated three unique characteristics. These are:

They are organized around customers. Organizations, which have well-managed dispersed production systems are divided into multifunctional units, with the

capacity to plan and control various functions including marketing, procurement, and distribution. The units have been organized for better management of the supply chain to serve the needs of specific customers and are not organized on the basis of functions, productions, and geographical regions.

They focus on time more than cost. The underlying goal of firms that employ dispersed production is to reduce the costs of production but organizations that have superior dispersed manufacturing systems also focus on speed, flexibility, and timely and reliable delivery. If required, they even send shipments, through expensive transportation modes, such as by air. They make large investments in technologies that save time and costs. They ensure that suppliers and sub-contractors comply with their strict conditions of reliable delivery.

They monitor the flow of products in the entire supply chain. Organizations that successfully deployed the dispersed production monitor the flow of material not just in the firm and its immediate suppliers, but across the supply chain, even on which they don't have direct control like monitoring the sales at the retail outlets and the supply position at the suppliers, who are supporting the immediate suppliers, whom the firm is dealing with.

7.5.2 Build-to-Order Production

Build-to-order production is a system where products are made in response to customer orders, unlike in the traditional systems, where production is carried out in anticipation of customer demand. Such a production system is difficult to implement as companies need to balance what is available with the firm, with what the customer requires. Such a production system may not be suitable for all products. It is more appropriate for products where customers prefer differentiation. For example, commodity products do not require much differentiation, and build-to-order production is not suitable for such products. This production system is appropriate for products like PCs and fashion apparel. This production system requires a well-coordinated supply chain. The key factors that are involved in the implementation of build-to-order production are scalability, simplification of manufacturing processes and order management, flexible manufacturing, and optimum use of technology. The system needs to be scalable to meet any rise in demand. Simplification of manufacturing processes and order management enables the firm to cut the lead time and helps in executing customer orders quickly. A flexible management approach helps the firm to promptly respond to changes in the marketplace. Technology enables the automation of processes and better coordination in the supply chain.

7.5.3 Manufacturing Postponement

Manufacturing postponement is a form of a production process that takes advantage of supply chain orientation. In this form of manufacturing, production is divided into two phases, primary and secondary. In the primary phase, the base

product is manufactured in large quantities. In the secondary or final phase, modifications or addition of features like coloring, packing, or labeling the product are done, according to customer specifications. The separation of the manufacturing phases helps the firms in two ways. It enables the firm to produce the base product in large quantities thus achieving economies of scale. Modifying the product according to customer specifications improves efficiency and customer satisfaction.

This strategy is appropriate in situations, where inventories need to be kept near the customer, and the final production steps do not require manufacturing capabilities at large plants. For example, labeling and packaging of a product do not require any special manufacturing capabilities and these steps can be postponed, exemplifying a manufacturing postponement situation.

An example of manufacturing postponement, in the Indian context, is the launch of paint vending machines at retail outlets, which turn out customized paint as per customer requirements, by adding color to the base paint of major companies like Asian Paints, Nerolac, and Berger Paints. The paint companies manufacture the base paint in large quantities and send it to the retail stores, where the color is mixed as per the customers' requirement. This improves customer service and reduces the need to stock the premixed paint products at the store level, which increases efficiency in the supply chain.

The benefits of such a process are many. The need for holding a variety of products is reduced. As this base product is the same and can be served to a variety of customers, inventory management and planning are simplified. Since the production of the final product is postponed until the last moment, the possibilities of the product not matching the customer's requirements are reduced.

Such a production process does require proper coordination to manage the separated manufacturing processes.

7.5.4 Radio Frequency Identification (RFID) Technology

RFID (*Radio Frequency Identification*) is a technology that incorporates the use of electromagnetic or electrostatic coupling in the Radio Frequency (RF) portion of the electromagnetic spectrum to uniquely identify an object, animal, or person.

An RFID system consists of two components: an antenna and transceiver (often combined into one reader) and a transponder (the tag). The antenna uses radio frequency waves to transmit a signal that activates the transponder. When activated, the tag transmits data back to the antenna.

- **Tags:** Data is embedded in tags and consists of an Integrated Circuit (IC) and antenna. There are different types of tags and depending on the application, cost varies. An active tag can transmit over a longer range i.e., 100 ft or more, tracks expensive items and is equipped with a battery and cost is high (around

₹ 800 -1000). Passive tags cannot be kept far from the reader, as they receive power from the reader. Costs of passive tags are less i.e., ₹ 20 to ₹ 50. In retail, mostly passive tags are used for different applications like checkout counter, inventory control, tracking of items, etc. RFID tags support the Electronic Product Code (EPC) formats.

- **Readers:** Readers can talk with the tag, via Radio frequency (RF), the antenna on the tag and reader allows RF waves to connect. Reader's cost can vary from low prices to something very expensive, depending on the application it is built for and the type of tag, it is communicating with.

This technique is effectively deployed by Walmart with many benefits. Being a retail chain, inventory management, waste minimization, and tracking inventory are very important considerations. Tagging animals with RFID has been popular for long. At present, with the main focus on inventory management, it is being applied in the supply chain.

Example: WAZP (an Ireland based Digital Supply Chain Company) Successfully Deploys "Dispersed Production" Approach to Provide on Demand

WAZP is an Ireland based 3D digital supply chain company which follows "dispersed production" approach where the manufacturing cycle is systematically split between two or more locations based on proximity to the suppliers or customers. The company uses digital manufacturing techniques to cater to "on demand" orders from clients like Ikea. In fact they get the orders directly from a vendor and supply directly to the customer. This saves lots of time and money.

The plant produces 25 different types of products "on demand" every day. It is also planning plants in Europe and North America to benefit from local suppliers.

Source: https://www.independent.ie/business/technology/kerry-based-3d-printing-firm-wazp-hopes-on-demand-system-can-help-it-bypass-supply-crunch-41293970.html, January 31 ,2022, Accessed on 25/08/2022

Activity 7.2

Manufacturing has become an area of focus as most of the working capital of an organization is spent on supply chain operations and processes. The cost elements include materials, labor, machinery, inspection, waste, etc. Many organizations are resorting to automation and advanced process technologies to reduce labor costs. Inventory control remained a major area for focus, as materials take a lion's share of expenditure, in any manufacturing or service organization.

In this context, to ensure effective inventory control, you are required to suggest a suitable technique. • For this, consider the use of RFID technique and associated technologies to suggest a solution to inventory control. • Starting with explaining what is RFID and its components give examples from a few organizations, who successfully implemented RFID.

Check Your Progress - 2

6. Automobile manufacturers mostly prefer Dispersed Production, for achieving competitive operational management. Which, of the following is not a reason for their dispersed production?
   a. Local market focus
   b. Availability of better infrastructure outside
   c. Improved quality suppliers
   d. Availability of low-cost locations across the world
   e. Reduction of trade barriers
7. Which, of the following, is not a challenge in Dispersed Production?
   a. Balancing schedules
   b. Maintaining just-in-time flow through the supply chain
   c. Responding quickly to unforeseen changes
   d. Balancing capacity utilization
   e. Ensuring product quality
8. Which type of production system is suitable for fashion apparel?
   a. Dispersed production
   b. Build-to-order production
   c. Manufacturing postponement
   d. Batch production
   e. Just-in-Time production

9. Which, of the following, is the main feature of the Manufacturing Postponement process?
   a. Total manufacturing operations are suspended
   b. Operations are postponed to a specific future date
   c. Production is scheduled in a phased manner
   d. Modifications are identified before production planning
   e. Operations are initiated after firm orders are received
10. Which is the technique being used by progressive retailers for inventory management?
   a. Craft production
   b. Build-to-order production
   c. Manufacturing postponement
   d. Radio Frequency Identification (RFID)
   e. Batch production

7.6 Summary

- Manufacturing processes have been influenced, by changing business conditions.
- The three key forms of intra-firm production processes are - craft production, mass production, and lean production.
- Intra-firm lean production only helped firms to remove inefficiencies, within their internal operations. This led firms to explore opportunities outside the firm to increase efficiency, resulting in the emergence of inter-firm production systems.
- The focus of inter-firm production is to establish a long-term relationship with suppliers and distributors, and to make joint efforts, to achieve efficiency in the supply chain.
- The two main inter-firm productions systems are – inter-firm JIT production and tiered production.
- The increased pace of globalization, competition, need for better quality, flexibility, and speed in the manufacturing process, has led firms to think beyond their immediate suppliers and customers.
- Supply chain production considers the entire supply chain to achieve flexibility and efficiency in the production process.
- Three widely-used supply chain production systems are dispersed production, build-to-order production, and production postponement.
- Radio Frequency Identify (RFID) Technology is a widely used technique for inventory and warehouse management.

7.7 Glossary

Build-to-order production is a system, where products are made in response to customer orders.

Craft production involves the manufacture of a wide range of customized products, using flexible and general-purpose machines, handled by adaptable and highly skilled workers.

Dispersed production process involves the production of a component at a location, which is well suited for that particular job.

Just-In-Time (JIT) manufacturing concept is about delivering material and components to the next level of production, just before the parts are needed and in the precise quantity required.

Manufacturing postponement is a form of a production process that takes advantage of supply chain orientation.

Radio Frequency Identification (RFID). It is a technology, which is essentially an item identification system. It is used as an inventory management technique for inventory control and warehousing operations.

7.8 Self-Assessment Test

1. Explain in brief the types of production in intra-firm production.
2. Briefly describe the techniques used in JIT production.
3. Give a detailed account of Flexible Manufacturing Systems.
4. Describe the salient aspects of inter-firm production, including the advantages and disadvantages thereof.
5. Discuss various applications of RFID, in operations Management.

7.9 Suggested Reading / Reference Material

1. Ashley McDonough, Operations and Supply Chain Management Essentials You Always Wanted to Know: 15 (Self Learning Management Series) Paperback – 1 January 2020.
2. Russel and Taylor, Operations and Supply Chain Management, 10ed, ISV Paperback – October 2019.
3. Chopra and Kalra, Supply Chain Management 6/e Paperback – 17 June 2016.

7.10 Answers to Check Your Progress Questions

1. (e) Extended-arm production

Extended-arm production applies to the manufacture of customer-built high-end cars.

2. (a) Craft production

Craft production is the type of production used for manufacture of customer-built high-end cars.

3. (e) Six-sigma

Six-sigma is not a popular JIT technique

4. (a) Higher capacity utilization

Higher capacity utilization is the most significant advantage of FMS.

5. (a) The principal contractor, in turn, subcontracts to the next level of suppliers.

6. (a) Local market focus

Local market focus is not a reason for dispersed production.

7. (e) Ensuring product quality

Ensuring product quality is not a challenge in dispersed production as only qualified firms are used.

8. (b) Build-to-order

Build-to-order is the type suitable for apparel production.

9. (c) Production is scheduled in a phased manner

Production is scheduled in a phased manner in the manufacturing postponement process.

10. (d) Radio Frequency Identification (RFID)

RFID is used by progressive retailers like Walmart for inventory management.

Unit 8

Inventory Management

Structures

"The more inventory a company has, the less likely they will have what they need."

- Taiichi Ohno, a Japanese industrial engineer and businessman, considered to be the father of the Toyota Production System

8.1 Introduction

Without proper inventory management, the most needed items may not be available when actually needed in the manufacturing process.

In the previous unit, we discussed manufacturing in a supply chain covering intra-firm production, flexible manufacturing systems (FMS) and inter-firm production and supply chain production

One of the major objectives of supply chain management is the efficient "flow of materials" or "flow of goods" among supply chain members. The flow of materials and goods involves the use of inventories at various levels, in a supply chain. Inventory can be defined as a resource of any kind that is held to meet some future demand. The resource can be input materials, semi-finished goods, or finished goods.

Inventories exist because of a mismatch between supply and demand. If supply matches with demand, then there is no need to carry inventory. But, a mismatch between supply and demand always exists. As a result, inventories must be created to balance the mismatches. If supply exceeds demand, the level of inventory held increases. If demand exceeds supply, there will be a decrease in the inventory level.

Inventory is spread throughout the supply chain from raw materials and semi-finished goods to finished goods that suppliers, manufacturers, wholesalers, and retailers hold. Inventory constitutes a significant portion of the assets of any firm. Since inventory costs constitute a major portion of the costs of a firm, a reduction in inventory levels by even a few percentage points can lead to a remarkable improvement in the profitability of the firm. Thus, inventory management offers substantial opportunities for improving the profitability of firms.

Therefore, inventory management is one of the most important processes in supply chain management. It aims at maintaining optimal inventory level at minimum cost, without affecting customer service levels.

This unit explains the importance and functionality of inventory, in a supply chain. After examining the concept of inventory and its functionality, we discuss basic inventory management decisions. We then look at two key inventory decisions taken in a supply chain- cycle inventory decisions and safety inventory decisions.

8.2 Objectives

By the end of the unit, you will be able to

- Identify the role of inventory in a supply chain
- Describe basic inventory management decisions
- Explain inventory decisions in a supply chain

8.3 Role of Inventory in a Supply Chain

In make-to-order production, there is no need for holding inventory, as the product is being made only after the customer has placed an order. But this method of production is not always practical. Manufacturers generally must produce goods without precisely knowing the level of demand for the goods. Thus, holding inventory is necessary. Inventory serves the following purposes in a supply chain.

- Decoupling
- Balancing supply and demand
- Buffer uncertainties

8.3.1 Decoupling

Inventories are used to "decouple" various operations in the production-distribution system. The objective of decoupling is to reduce dependence among various operational units, by building up inventory at each level of the system. Inventory enables the firm to continue other production processes even when there is a machine breakdown, at one level of the production process. Inventory

may also protect the firm from raw material shortages, due to disruptions in supply. Similarly, finished goods inventory helps the marketing department to continue sales operations, during manufacturing disruptions.

8.3.2 Balancing Supply and Demand

Inventory can be used, to balance the mismatch between demand and supply from the manufacturing unit. Thus, inventory balances supply with demand. This is more important in seasonal supply/ demand situations. For example, the demand for air conditioners peaks in summer and starts to decline thereafter. Balancing the mismatch, between supply and demand, is a challenging task for firms. If the demand for products lasts for only a few months, firms can increase production, during the peak period. But the investment required for increasing production capacity to cope with the demand is substantial. Moreover, substantial idle capacity and volatility in workforce patterns (hiring, and firing) can take place, when a firm tries to satisfy the surge in demand. If a firm maintains a relatively stable workforce and produces at a constant level, throughout the year irrespective of seasonality, the firm will have to carry the excess units in inventory. This inventory can help the company, to meet demand during the peak period. Increasing inventory levels will cost the firm less than increasing production capacity.

Certain types of products are in demand throughout the year, but the supply of raw material is seasonal. While there is year-round demand for food products like jams and fruit juices, the supply of fruits is seasonal. In such cases, the company can manufacture finished products more than market demand and store them for future consumption.

8.3.3 Buffer Uncertainties

Another important function of inventory is to protect operating units from uncertainties. Usually, to protect firms against uncertainties, buffer stock or safety stock is maintained. Safety stock protects firms from two types of uncertainties. The first type of uncertainty occurs when actual demand exceeds forecasted demand. The second type of uncertainty occurs when there is a delay in delivery of goods, a delay in processing an order, etc. Safety stock gives firms access to the required goods, regardless of uncertainties in supply and demand.

Many mathematical models and statistical tools have been developed to ascertain the right level of safety stock that should be maintained. Advances in technology have made it easy, to accurately calculate the required safety stock levels.

8.3.4 Inventory Related Definitions

Some of the terms commonly used in inventory management are detailed in this section.

Inventory Policy: Inventory policy refers to the guidelines that a company must follow, to control inventory. It includes guidelines, regarding when to order, at what point to order, what quantity to order, etc. It also includes strategic decisions regarding the location of distribution centers, inventory positioning, etc. Thus, inventory policy guides inventory management in a firm.

Cycle Inventory: Cycle inventory refers to the stock that is held to satisfy the demand between two replenishment cycles. At the beginning of the replenishment cycle, the inventory will be at a maximum level. But gradually, as customer demand is met, the inventory level reaches zero. Before the inventory reaches zero level, the stock must be replenished to avoid stock out. The replenishment order should be placed, when the available inventory is greater than or equal to customer demand. The quantity ordered is known as the order quantity. The inventory held in the process is known as cycle inventory.

Transit Stock: Transit stock refers to the stock that is either moving or awaiting movement in transportation vehicles. It is also known as pipeline stock. It can be regarded as a portion of cycle stock, even though it is not usable or accessible until it arrives at its destination. With the increase in focus on small lots, JIT strategies, and frequent order cycles, transit inventory is occupying a major portion of total inventory.

Safety Inventory: Safety inventory refers to the stock held more than the cycle inventory, to cover the uncertainty of demand and replenishment cycles. The objective of holding safety inventory is to have a certain amount of inventory on hand, to cover the short-term variability in demand and lead time.

8.3.5 Cost of Carrying Inventory

Managers need to bring down inventory carrying costs, to lower supply chain costs. Inventory constitutes a major portion of total costs. Thus, a firm can save a considerable amount if it manages its inventory properly. The major costs associated with carrying inventory are capital costs, taxes, insurance, obsolescence, and storage.

Capital Cost: Capital cost is one of the major components of inventory carrying costs. It is also called opportunity cost because it refers to the return on investment that we can get from the "next best investment opportunity", which we cannot obtain now, as the funds are tied up in the inventory.

Insurance Costs: Insurance costs include the amount paid to the insurers, for insuring against the risks of holding inventory for a period. The amount charged depends on the nature of the product and the types of storage facilities used. For example, insurance charges may be high for perishable goods, and high-value goods.

Obsolescence Costs: The obsolescence cost estimates the rate, at which the value of the product being stored decreases either due to changes in technology, market conditions or deterioration in the quality of the products. The cost can range from 0% to 100%, depending on the nature of the product. Fashion garments may have as much as 100% obsolescence cost.

Storage Costs: Storage costs refer to storage facility expenses. The costs depend on the type of warehouse facility being used. Privately owned warehouse facilities charge, according to the space allocated for storage. Public warehouses charge according to the amount of inventory being stored.

Miscellaneous Costs: Firms also must deal with costs, associated with pilferage, damage, security, taxes, and relocation.

Example: Kohl's (an American Department Store Retail Chain) Embarks on a Major Inventory Clean Up to save Costs and Reduce Losses

The retailer is burdened with high levels of inventory costs due to sluggish demand for some products. Also, it has increased the inventories of some products after facing stock out situations in the previous year. In some cases, by the time the inventories arrived, the customer demand came down. To address the longer lead times, it went for higher transit inventory which added to the inventory cost. Immediately the retailer was cancelling orders and cutting prices to tide over and work on a long-term plan for inventory.

Source: https://www.supplychaindive.com/news/kohls-inventory-management-efforts-include-clearing-out-excess-inventory/630314/, 23/08/2022, Accessed on 25/08/2022

8.4 Basic Inventory Management Decisions

The objectives of inventory management are to increase the profitability of the company and to minimize its total costs. Inventory management aims at achieving an optimal inventory level, with minimum supply chain costs for a given customer service level.

The basic inventory management decisions are 'when to order?' and 'how much to order?'

8.4.1 Determining the Reorder Point (When to Order?)

The reorder point determines when an order should be initiated. When the lead time and demand are known, the following formula can be used to determine the reorder point:

$O = D \times T$

where O = reorder point in units

D = average daily demand

T = lead time

Suppose the demand is 15 units per day and the lead time is 15 days. Then the reorder point is

= 15 units/ day x 15 days = 225 units.

This approach can be used, only when demand and lead time are certain. Under conditions of uncertainty (i.e. either demand or lead time is uncertain), a buffer stock is necessary. A buffer or safety stock can handle an unexpected increase in demand or a delay in the arrival of a shipment. When a safety stock is used, the following formula is used to determine the reorder point:

O = D x T + SS

Where O = reorder point in units

D = average daily demand

T = lead time

SS = safety or buffer stock in units

8.4.2 Determining Lot size (How Much?)

The lot size balance is the cost of ordering, against the cost of carrying inventory. Since cycle inventory is proportional to the order quantity or lot size, the higher the order quantity, the higher the cycle inventory and the higher the carrying cost. Larger lot sizes reduce the frequency of orders, i.e., fewer orders are required for the period under consideration. As a result, the total ordering costs are reduced. The lot sizing decisions seek to identify the optimal lot sizes, at which the annual total cost, of ordering and carrying, is at a minimum, for a given sales volume.

The standard formula for EOQ is as follows

$$\text{EOQ, } Q^* = \sqrt{\left(\frac{2RS}{hC}\right)}$$

Where Q^* = economic order quantity (EOQ)

R = annual sales volume or demand, in units

S = cost per order

h = annual carrying cost as a fraction of inventory value

C = cost per unit.

Example: Walmart Adopts VizPick Technology to Predict Inventory Trends and Deliver the Right Quantity to the Stores when Needed

Walmart, the retail giant Adopted Augmented Reality Technology; VizPick and implemented in some 4500 stores. The system enables Walmart to predict inventory trends and supply the right quantity to each store at the right time. The technology accelerated the inventory management in stores where the staff can move products from the backroom to the shelfs more efficiently.

Source: https://www.supplychaindive.com/news/walmart-AR-adoption-vizpick/630003/, August 22, 2022, Accessed on 25/08/2022

8.5 Inventory Decisions in a Supply Chain

In the previous sections, we studied inventory concepts and basic inventory management principles. Let us now examine the key inventory decisions that are taken in supply chain management. The two-key inventory-related decisions taken in supply chain management are:

- Cycle inventory decisions
- Safety inventory decisions

8.5.1 Cycle Inventory Decisions

As already discussed, cycle inventory refers to the stock that is held to satisfy the demand, between two replenishment cycles. A lower cycle inventory is desirable, as it allows firms to reduce working capital and inventory carrying costs. Cycle stock is primarily held, to take advantage of economies of scale and reduce costs in the supply chain. Some of the factors that influence cycle inventory decisions are:

- Fixed costs
- Quantity discounts
- Trade promotions

The impact of each of these decisions is discussed below.

Impact of fixed costs on cycle inventory decisions

Fixed costs include ordering costs, inventory carrying costs, and transportation costs. These fixed costs are related to the quantity ordered (lot size). In this section, we identify the various cost trade-offs that need to be considered, when taking lot-sizing decisions and discuss some of the inventory strategies for reducing fixed costs.

Lot-sizing for a single product: When a company is procuring only one product and operates under conditions of certainty, lot-sizing decisions can be taken, using the EOQ model. The following example helps us to understand the complex nature of lot-sizing decisions.

Suppose the daily production requirement for a product (input) is 10 units and the lead time for procuring it is 10 days. Since the company knows the lead time and product requirement exactly, it can schedule the orders, to arrive just when the last unit of inventory is being used. Thus, inventory beyond cycle stock is not required. Let us assume a work year of 240 working days. Since the daily requirement is 10 units, the firm requires 2400 units per year. Assume that the ordering cost is ₹ 500 per order and that each unit costs ₹ 100.

Under these circumstances, what order size should the company choose?

To ensure uninterrupted production, the company should procure the product in lot sizes that at least cover the lead-time requirement i.e., it should order 100 units

every 10 days. But this quantity may not result in the lowest annual inventory cost (TC). Therefore, the company must choose an order quantity (lot size) that minimizes the total cost. To do so, the company should arbitrarily evaluate various lot sizes and select the one with the minimum cost.

Let us assume that the firm shortlists the following options:

Option I: 100 units; Option II: 200 units; Option III: 300 units.

Figure 8.1 shows the reorder points for each of the above three options (Fig. A – 100 units, Fig. B – 200 units and Fig. C – 300 units)

Figure 8.1(A) depicts the scenario when the reorder quantity is 100 units. The reorder point is 100 units i.e., as and when the inventory level falls below 100 units, the order needs to be placed. In this case, the order needs to be placed every 10 days since the reorder point is reached every 10 days. We also know that the average cycle stock equals half the order quantity (100/2). Over a period of one year, 100 units are purchased 24 times (total 2400 units).

Figure 8.1(B) shows the scenario when the reorder quantity is 200 units. In this case, an order is placed every 20 days. The cycle inventory is 100 units. 200 units are purchased 12 times in a year (total 2,400 units).

Figure 8.1(C) depicts the scenario when the reorder quantity is 300 units. In this case, an order is placed every 30 days. The cycle inventory is 150 units. Orders for 300 units are placed 8 times a year (total 2,400 units).

Though Option-I (100 units) reduces inventory carrying costs, it increases ordering costs. Instead of Option-I, management should choose an option, which minimizes total inventory costs. The total costs TC is given by the following formula:

TC = Annual material costs + Annual order cost + Annual inventory costs

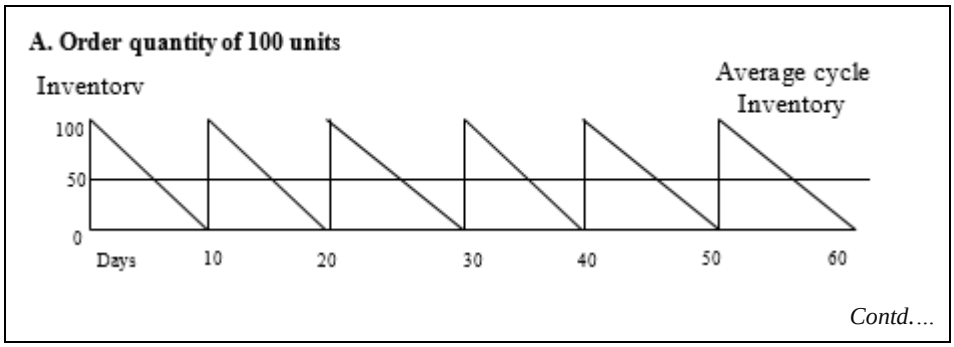
Where:

Annual material cost = $C \times R$ ---------- Equ. (8.1)

Where C is the cost per unit and R is the annual sales volume or demand.

Figure 8.1 Reorder Policy under constant demand and lead time.

Figure 8.1: Reorder Policy under Constant Demand and Lead Time



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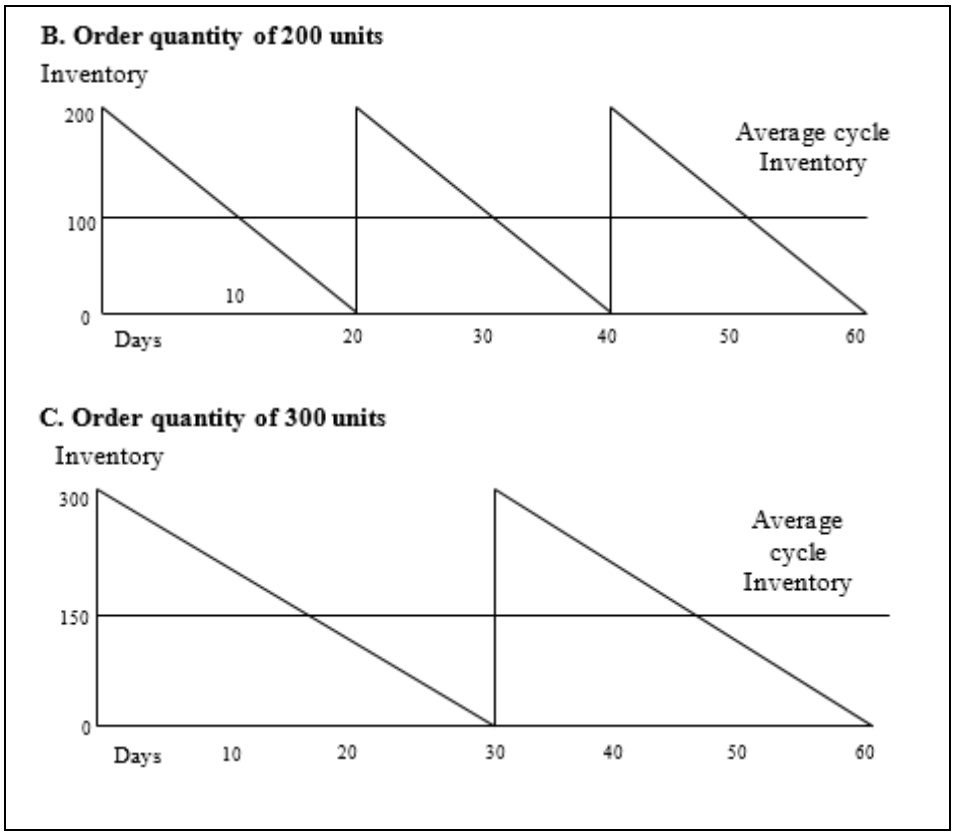
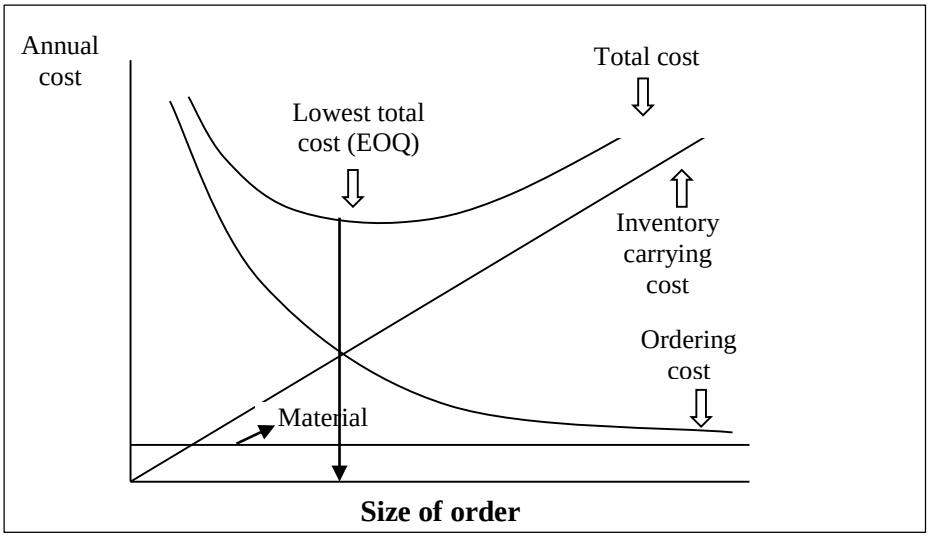


Source: ICFAI Research Center

Annual order cost = The number of orders per year × Ordering cost per lot = (R/Q) ×S ---------- Equ. (8.2)

Figure 8.2: EOQ Model



Source: ICFAI Research Center

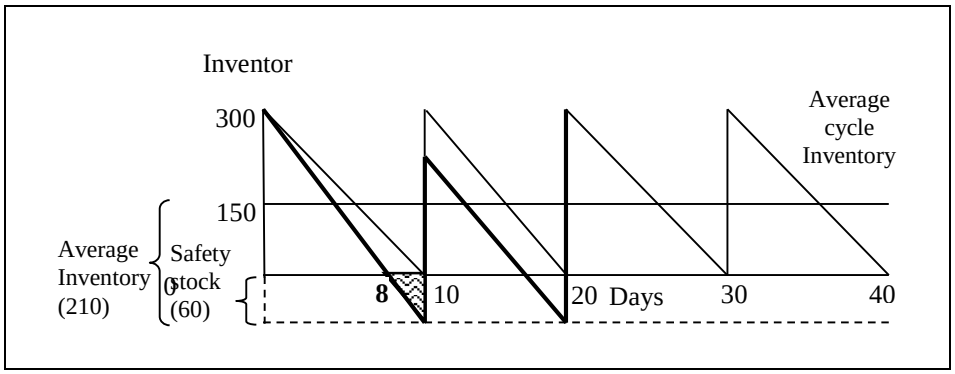
Where Q is the order quantity and S is the cost incurred for placing each order.

Annual inventory carrying cost = (Q/2) × hC ---------- Equ. (8.3)

Where h is the annual carrying cost as a fraction of the average inventory value.

Figure 8.3 shows average inventory under demand uncertainty.

Figure 8.3: Average Inventory under Conditions of Demand Uncertainty



Source: ICFAI Research Center

Therefore, the total annual cost, TC = CR+ (R/Q) × S + (Q/2) × hC --- Equ. (8.4)

The cost trade-offs, required to determine the most economic order quantity, are shown in Figure 8.2. Observe that the inventory carrying cost increases, with an increase in the order quantity. In contrast, the annual ordering cost decreases, with an increase in the order quantity. Material cost is independent of the lot size, as the price of the material is fixed. The optimal lot size is the one, which minimizes the total cost of inventory.

The standard formula for EOQ is as follows:

$$\text{EOQ, } Q^* = \sqrt{\left(\frac{2RS}{hC}\right)}$$

Where Q^* = economic order quantity (EOQ)

R = annual sales volume or demand, in units

S = cost per order

h = annual carrying cost as a fraction of inventory value

C = cost per unit.

Using the example in the previous section, let us determine the EOQ for the product. We assumed ₹ 500 as the fixed ordering cost, which includes order placement, transportation, and receiving costs. Each unit costs ₹ 100. Inventory holding cost is assumed to be 20% of the unit cost.

R = 2400 units

S = ₹ 500

h = 0.20

C = ₹ 100

$$Q^* = \sqrt{(2 \times 500 \times 2400) \div (0.20 \times 100)}$$

$$= 346$$

Total ordering cost = $(R/ Q^*) \times S$

$= (2400/346) \times 500$

= ₹ 3468.

Total inventory carrying cost = $(Q^*/2) \times (hC)$

$= (346/2) \times (0.20 \times 100)$

= ₹ 3460.

From the above calculations, we observe that at an EOQ of 346, the total ordering cost and total inventory cost are almost equal. Thus, we can achieve a balance between ordering costs and the inventory carrying costs by ordering in EOQ quantities. This, in turn, minimizes total inventory costs. To reduce total costs, the company should order in a lot size of 346 units, instead of 100, 200 or 300 units.

Thus, in a year, 7 orders would be placed, and the cycle inventory would be 173 units.

Lot sizing Decisions for Multiple Products: To reduce the lot size, firms need to review the fixed costs and try to identify the components, where savings can be obtained. The transportation costs and ordering costs are one of the major sources of fixed costs. These costs can be reduced by aggregating multiple products in a single order. Suppose that different divisions in a single company are sourcing different goods, from the same location independently. Then, the company can ask the divisions to coordinate the purchases so that the goods can be transported in a single vehicle, thereby reducing transportation costs. As ordering and transportation costs are spread, across multiple products, the firm can order the products in smaller lots more frequently. Thus, aggregating multiple products in a single order reduces the lot size, which in turn reduces the cycle inventory.

Multiple products, carried in a single vehicle, will keep transportation costs constant. But the ordering costs i.e., loading and receiving costs may increase with the increase in orders, for each new product. In such cases, a firm can take a different approach. As ordering costs increase with each order, the firm needs to identify the high-volume items and low volume items. Then, the low volume items should be ordered less frequently than the high-volume items, so that ordering costs are kept low. Such type of aggregation is known as tailored aggregation.

Activity 8.1

Inventory serves the following purposes in a supply chain.

i. Decoupling

ii. Balancing supply and demand

iii. Buffer uncertainties

Take the example of an automobile company and trace its inventory management to the above three purposes, with a detailed explanation.

Check Your Progress – 1

1. Ideally, under which, of the following situations, does an organization not need to hold inventory?
   a. In make-to-order situation
   b. Uncertainty in demand
   c. A recession
   d. Inflation
   e. Volatile interest rates
2. In the Air Conditioning industry, which operates on seasonal demand, which of the following is the best strategy to balance supply and demand?
   a. Produce more in summer.
   b. Produce uniformly throughout the year with fixed manpower and capacity.
   c. Outsource extra requirements during summer,
   d. Buy from other manufacturers, label, and supply.
   e. Increase capacity during peak seasons.
3. Cycle Inventory means
   a. The amount of inventory consumed during one production cycle.
   b. The stock held to satisfy the demand between two replenishment cycles.
   c. The inventory that is recycled repeatedly to reduce wastage.
   d. The disposal of surplus material left after meeting demand.
   e. Generating power from non-moving inventory.

4. Transit stock means
   a. Stock that is moving or ready for movement.
   b. Stock that is in a warehouse as finished goods.
   c. Stock that is changing hands among different users.
   d. Stock that is held up with the transporter due to some problems.
   e. Stock that is actively moving on the shop floor
5. Which of the following is not a component of 'Cost of carrying inventory'?
   a. Capital costs
   b. Insurance costs
   c. Obsolescence costs
   d. Storage costs
   e. Labor costs

Impact of Quantity Discounts on Cycle Inventory Decisions

In the previous discussions, we assumed that material cost (i.e. the price per unit cost) was constant, irrespective of the quantity purchased. However, price discounts are often offered, depending on the quantity purchased. A discount is generally offered in two ways: Lot size-based discount and volume-based discount. A lot size-based discount is offered, depending on the quantity ordered in each lot. A volume-based discount is offered, based on the volume ordered for a given period, irrespective of the lot size.

Lot size-based discounts

In lot size-based discounts, the unit price of the product decreases as the quantity ordered increases. The pricing schedule consists of certain breakpoints q_0, q_1, q_2,.....q_r. If an order quantity is greater than or equal to the price breakpoint, the discount price applies to all units. Under this scheme, ordering (q_i+1) units is less expensive than ordering $(q_i - 1)$ units.

To arrive at an optimal lot size, when using a quantity discount, we need to evaluate the EOQ for each price point C_i. Then we need to decide upon the lot size, which minimizes overall costs.

EOQ for each value of i, where $0 < i < r$, can be evaluated, using the following formula:

$$Q_i = \sqrt{\left(\frac{2RS}{hC_i}\right)}$$

There are three possible cases for Q_i

$q_i < Q_i < q_i+1$

$Q_i < q_i$

$Q_i > q_i+1$

Where, Q_i refers to the quantity.

When $q_i < Q_i < q_i+1$

In this case, quantity falls within the discounted price range, we can order in Q_i units and the cost per unit will be C_i. Then, the total annual cost would be:

Total annual cost, $TC_i = C_iR + (R/Q_i) \times S + [(Q_i)/2] \times hC_i$

When $Q_i < q_i$

A lot size of Q_i is not eligible for the discounted price in this case, as the quantity is less than the minimum quantity required for availing of the discount. Instead, the lot size should be raised to quantity q_i and ordering more than quantity q_i will increase the inventory carrying costs, without decreasing the material cost. Thus, we need to order q_i units, in this case. Then the total annual cost would be:

Total annual cost, $TC_i = C_iR + (R/q_i) \times S + [(q_i)/2] \times hC_i$

When $Q_i > q_i+1$

In this case, ordering q_i+1 units, it will allow us to avail of the discounted price, whereas ordering more than q_i+1 will not give us any additional discounts. As Q_i is more than qi+1, we need to order units in order q_i+1, to be eligible for a discounted price. The total annual cost in this case is:

Total annual cost, $TC_i = C_i+1R + (R/q_i+1) \times S + [(q_i+1)/2] \times hC_i+1$

Thus, we need to evaluate the appropriate case, at each price point and find the total cost and corresponding lot sizes. Finally, we need to choose the lot size, which has the least annual total cost in all cases.

To learn how to do this, examine the following problem.

A manufacturer of a confectionary product has given the following price schedule, for its popular chocolate bar:

Order quantity	Unit price
0 – 4000	₹ 6.00
4001 – 8000	₹ 5.00
Over 8000	₹ 4.00

The retailer has a demand for 30,000 bars per year. For each order placed, he is incurring a fixed ordering cost of ₹ 500. The retailer is also incurring a carrying cost of 20 percent of the average inventory value. Evaluate the optimal lot size.

Here,

$q_0 = 0$; $q_1 = 4000$; $q_2 = 8000$

$C_0 =$ ₹ 6; $C_1 =$ ₹ 5; $C_2 =$ ₹ 4

R = 30,000 units/year; S = ₹ 500; h = 0.20

Solution:

For i = 0, EOQ is

$$Q_0 = \sqrt{\left(\frac{2RS}{hC_0}\right)}$$

$$= \sqrt{((2 \times 30{,}000 \times 500) \div (0.2 \times 6))}$$

= 5000.

For i = 0, we take lot size $q_1 = 4000$, because from Case III, $5000 > q_1$ (or q_{0+1}) = 4000. Then, the total cost is

$$TC_0 = C_1R + (R/q_1) \text{ x } S + [(q_1)/2] \text{ x } hC_1$$

= (5 x 30,000) + (30,000/4000) x 500 + (4000/2) x 0.2 x 5

= 1, 50, 000 + 3750 + 2000

= ₹ 1, 55, 750.

For i = 1,

$$Q_1 = \sqrt{\left(\frac{2RS}{hC_1}\right)}$$

$$= \sqrt{((2 \times 30{,}000 \times 500) \div (0.2 \times 5))}$$

= 5477

For i = 1, we can order in the lot size of 5477. Because, from Case I, $4001 \leq 5477 < 8000$. Thus, we need to set the lot size at $Q_1 = 5477$. Hence, the total cost, in this case, is

Total annual cost, $TC_1 = C_1R + (R/Q_1) \times S + [(Q_1)/2] \times hC_1$

= (5 x 30,000) + (30,000/5477) x 500 + (5477/2) x 0.2 x 5

= ₹ 1,55,478

For i = 2

$$Q_2 = \sqrt{\left(\frac{2RS}{hC_2}\right)}$$

$$= \sqrt{((2 \times 30{,}000 \times 500) \div (0.2 \times 4))}$$

= 6124

For i = 2, we set the lot size at q_2 = 8000. Because, from Case II, 6124 < q_2 = 8000.

The total cost, in this case, is

Total annual cost, $TC_2 = C_2R + (R/q_2) \times S + [(q_2)/2] \times hC_2$

$= (4 \times 30,000) + (30,000/8000) \times 500 + (8000/2) \times 0.2 \times 4$

$= 1,20,000 + 1875 + 3200$

$= ₹ 1,25,075$

We observe that the minimum cost is for i = 2. Thus, the optimal quantity for the retailer is q_2 = 8000 units per lot. He can obtain these units, at a discounted price of ₹ 4.00 per unit.

If the manufacturer is selling all the units at a flat rate of ₹ 6.00, irrespective of the lot size, then the optimal lot size for the retailer is 5000 units. Since the manufacturer is offering lot size-based discounts, an optimal lot size of 8000 units will allow the retailer, to obtain the order at the lowest cost. However, the increase in lot size increases the cycle inventory from 2,500 units (5000/2) to 4000 units (8000/2).

Lot size-based discounts will encourage retailers, to buy bigger lots, to take advantage of price discounts and, hence, build up cycle inventory.

Quantity discounts as a lever for improving supply chain coordination

Quantity discounts can be utilized to improve coordination, between channel members and increase overall profits, in a supply chain. Effective coordination between channel members in a supply chain can make the supply chain efficient and responsive. Quantity discounts can be an effective coordination mechanism, if suppliers and buyers decide upon a joint inventory policy, which will benefit both parties. Let us see how this can be achieved

Quantity discounts for commodity products: In the commodity products market (like milk, salt, wheat flour, etc.), the market decides the price. In such cases, a retailer can maximize profits, by reducing costs. Suppose one of the products of a retailer is a popular low-priced soap (a commodity product). The retailer must determine the order quantity or lot size, depending on the costs he is incurring when he is ordering from the soap manufacturer.

When the demand for the product at the retailer is 2000 units per month, the retailer incurs a fixed ordering cost of ₹ 600, each time he places an order. The carrying cost is 20%. The manufacturer charges ₹ 3 for each unit purchased. Using the EOQ formula, the optimal size is

$$Q^* = \sqrt{\left(\frac{2RS}{hC}\right)}$$

Where, R = 24000 (12 x 2000)

S = ₹ 600

h = 0.20

C = ₹ 3 per unit

$Q^* = 6928$

Annual carrying cost = $(Q^*/2) \times hC = (6928/2) \times 0.20 \times 3 = ₹2078$

Annual ordering cost = $(R/Q^*) \times S = (24000/6928) \times 600 = ₹2078$

Total ordering and inventory carrying costs = ₹ 4156.

The manufacturer incurs a fixed cost for processing, packing, and shipping the product, each time the retailer places an order. The fixed cost is ₹ 1200. Each unit costs the manufacturer ₹ 1 and it incurs a holding cost of 20%. If the retailer's order quantity is 6928 units, the annual carrying and ordering costs for the manufacturer are

Annual ordering cost = (24,000/6928) × 1200 = ₹ 4157.

Annual holding cost for manufacturer @ 20% = (6928/2) × 0.2 × 1 = ₹ 693.

The total cost = ₹ 4849.

So, the total cost for the supply chain is ₹ 9005 (cost incurred by retailer plus cost incurred by the manufacturer).

If the retailer increases the order size to 10,000, then

At retailer:

Annual carrying cost = (10000/2) × 0.20 × 3 = ₹ 3000.

Annual ordering cost = (24000/10000) × 600 = ₹ 1440

Total cost incurred = ₹ 4440

At manufacturer:

Annual carrying cost = (10000/2) × 0.20× 1 = ₹ 1000

Annual ordering cost = (24000/10000) × 1200 = ₹ 2880

Total cost incurred = ₹ 3880

Therefore, total cost for the supply chain = 4440 + 3880 = ₹ 8320

If the retailer increases the order size to 10,000, then the total cost in the supply chain comes down. The total cost incurred falls to ₹ 8320. Thus, the savings achieved are ₹ 685. But the costs of the retailer have increased by ₹ 284 and the manufacturer's costs have decreased by ₹ 969. Thus, the manufacturer is saving ₹ 969.

If the manufacturer persuades the retailer to order 10,000 units, the profit of the manufacturer and the supply chain will increase. But the retailer may not show much interest in increasing the lot size, due to the accompanying increase in ordering and carrying costs. In such cases, offering a lot size-based discount is an appropriate option for the manufacturer. The manufacturer may set the price ₹ 3.00 for an order below 10,000 units and ₹ 2.97 for an order equal to or above 10,000 units. So, the manufacturer can return ₹ 300 (in the form of a discount) to offset the increase in the ordering costs of the retailer, an incentive for ordering lots above 10,000 units. Thus, a lot size-based discount can increase profits for the manufacturer and the retailer. However, lot sizing discount schemes also increase cycle inventory, across the supply chain.

Quantity discounts for the products, when the firm is a market leader: When a firm has a high market share, it should adopt a different approach. Assume that a company is the market leader, in the soft drink concentrate industry and that there are very few players in this industry. The company has launched a new product. Since there are very few players in the industry, the pricing of the product will influence its demand.

Suppose the demand for that product, at one of the retailers, is in the range of 1,50,000 – 20,000p, where p is the price, at which the retailer sells the product. The production cost for the manufacturer is ₹ 1.00 per unit. When the manufacturer and retailer act independently, the situation will be:

The profit figure for the retailer, if his cost price is ₹ 5.00 and the product is sold at ₹ 6.00 is calculated as follows

The demand = 1,50,000 - 20,000 × 6

= 30,000 units

The cost incurred for acquiring the product = 30,000 × 5 = ₹ 1,50,000

Sales = 30,000 × 6 = ₹ 1,80,000

Thus, the profit obtained = ₹ 30,000

If one rupee is the production cost and ₹ 5 is the selling price, the manufacturer's profit is as follows:

Production cost = 30,000 × 1 = ₹ 30,000

Sales = 30,000 × 5 = ₹ 1,50,000

Profit = ₹ 1,20,000

If the manufacturer and the retailer cooperate over the pricing of the product, then the profits in the supply chain can be increased substantially. If the manufacturer can supply the product to the retailer at ₹ 4 and persuade him to sell the product at ₹ 5, then the market demand will be 50,000 units. Then the total supply chain profit can be increased to ₹ 2,00,000 [50,000 × (₹ 5 – ₹ 1)].

Thus, due to retailer and manufacturer determining their prices independently, the supply chain is losing ₹ 50,000 in profit. In such cases, the manufacturer can offer volume-based discounts to increase his profits, as well as the retailer's profits.

Volume-based discounts

In this type of scheme, the discounts are based on quantity bought in a year, irrespective of the lot size. In the above case, the manufacturer can offer the product for ₹ 5, when the quantity purchased per year is below 50,000 units and ₹ 4, when the quantity purchased per year is above 50,000 units. It is advantageous for the retailer, to order the product in lot sizes of 50,000 units or more and sell the product to the customer at ₹ 5.

Then the demand for the product is [1,50,000 – (20,000×5)] = 50,000 units.

The total profit of the retailer is 50,000 × (₹ 5 – ₹ 4) = ₹ 50,000.

The total profit earned by the manufacturer is 50,000 × (₹ 4 - ₹ 1) = ₹ 1,50,000.

The total profit of the supply chain = 50,000 + 1,50,000 = ₹ 2,00,000.

As we can see from the above discussion, quantity discounts help firms to improve coordination and efficiency in the supply chain. Volume-based discounts are more helpful than the lot-sized-based discount schemes, in coordinating and maximizing profits. The key difference, between lot size-based discounts and volume-based discounts, is that lot size-based discounts are based on quantity purchased with each order, whereas, volume-based discounts are based on price or volume purchased, for a given period. Lot size-based discount schemes increase cycle inventory and, hence, increase total costs. This type of discount is more suitable for high-volume products. Volume-based discounts focus on improving profitability in the supply chain and can be suitable, even for products with small lot sizes.

Impact of trade promotions on cycle inventory decisions

Manufacturers offer trade promotions to retailers to stimulate sales. In a trade promotion, retailers are offered discounts on the quantity purchased. There are no restrictions on the number of units purchased. These schemes are offered for a temporary period. For example, to improve the sales of air-conditioners in the lean season, a company can offer a discount of 10% to retailers during that season. Trade promotions are common in the consumer goods industry, where different types of discount schemes are offered throughout the year.

The main objectives of trade promotions are

Promoting the brand through displays, price discounts (by retailers), and advertisements.

Improving the position in the market, by increasing market share.

Such deals will lead to forward buying, which will have a negative impact on the manufacturer. Forward buying refers to stocking up extra goods, by the retailer to take advantage of the temporary price discounts and holding them as inventory, to use it for future sale. Forward buying reduces the end-consumer demand after the promotional period. As the retailer buys larger quantities, during the promotional period, he places fewer orders in the subsequent periods, resulting in a decrease in revenues for the manufacturer.

If forward buying constitutes a major portion of sales during the promotional period, the manufacturer's profit margins will decrease.

Forward buying will also have a negative effect on cycle inventory, in the supply chain. Since the retailer will hold the goods for a long period, there will be an increase in demand variability and cycle inventory. Due to this increase in inventory, total profits across the supply chain will decrease.

Therefore, manufacturers must devise trade promotions, in such a way that forward buying can be minimized and the discounts are passed on to end consumers, by the retailer. To minimize forward buying, firms adopt two key strategies: Everyday Low pricing (EDLP) and scan back deals. In EDLP, the price is fixed, and temporary discounts are not allowed. In scan-back deals, manufacturers offer discounts only, on the sales that are made to the end-consumers rather than on the quantity purchased by the retailer. Such strategies reduce demand variability as well as inventory, in the supply chain.

8.5.2 Safety Inventory Decisions

Safety inventory is carried for the purpose of covering uncertainties in demand. There are two types of uncertainties that directly affect the inventory: demand uncertainty and lead time uncertainty.

Demand uncertainty arises, due to changes in consumer behavior, market conditions, and product life cycles. Lead-time uncertainty arises due to transportation delays, production problems, etc. Sometimes both demand and lead time uncertainty are present

Calculating safety inventory under demand uncertainty

Demand uncertainty makes the safety stock decisions complex. Although sales forecasts predict the approximate demand, the actual demand often exceeds or falls short of the predicted demand. Firms carry safety stock in addition to the cycle inventory to protect themselves from stock out situations arising from demand uncertainty. Thus, under conditions of uncertainty, average inventory or cycle inventory is one-half of the order quantity plus safety inventory. Figure 8.3 depicts average inventory, under conditions of demand uncertainty.

Suppose that the daily demand for a product is 30 units and the lead time is 10 days. The order quantity of 300 units can be replenished every 10 days. The cycle inventory of 150 units is sufficient, under conditions of constant demand and stable lead time. If there is a sudden increase in demand for the product- say the daily demand for the product increases to 37 units -then the stock will be sold out in 8 days. As the stock will be replenished every 10 days, the firm will face a stockout for 2 days, thus losing revenue and customers. In such situations, a buffer stock must be held to satisfy demand during periods of unexpected demand. In this case, as the stockout is occurring for two days, a buffer or safety stock sufficient for two days can cover the demand uncertainty. The safety stock in this case is 60 units. The order quantity should be increased to 360 units, and the average inventory rises to 210 units (150 + 60).

Using statistical techniques, we can identify the safety stock level under demand uncertainty. To simplify the process of calculating the safety stock level, we assume that demand is following a normal distribution, with a certain mean (X) and standard deviation (σ). Standard deviation measures the dispersion of events, within the areas under the normal distribution curve. In the case of inventory management, we regard daily sales as events. The dispersion refers to the variation in daily sales. Thus, the standard deviation measures the variation of daily sales. The standard deviation provides an estimate of the safety stock that must be maintained to protect the firm against uncertainty in demand.

The standard deviation can be calculated using the formula given below:

$$\sigma = \sqrt{\left(\sum F_i D_i^2\right) \div n}$$

where σ = standard deviation

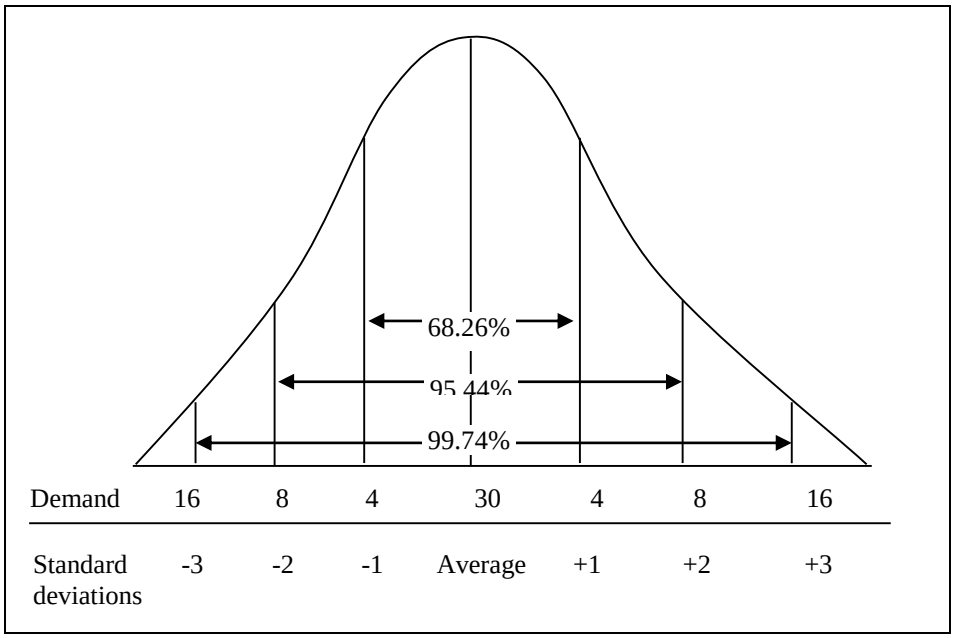
Fi = frequency of the event i

Di = deviation of event from mean for event i

n = number of events

Consider the previous example, where the daily demand is around 30 units and the lead time is 10 days. If the standard deviation value obtained is 4 units, then it indicates that the daily sales will range from 26 to 34 units (30 + 4). Thus, average inventory with 1 standard deviation (1 σ) of safety stock of 4 units will protect the firm against the stock-outs, during 68,26% of the replenishment cycles. If two standard deviations are considered, then the daily sales will vary from 22 to 38 (30 + 8). Thus, average inventory with two standard deviations of safety stock of 8 units (2 σ) will protect the firm against stockouts, during 95.44% of the replenishment cycles. Figure 8.4 shows the normal distribution curve.

Figure 8.4: Normal Distribution Curve



Source: ICFAI Research Center

In this way, statistical probability can help us determine the level of safety stock to be maintained, under conditions of demand uncertainty. The same procedure can be used to quantify lead time uncertainty, as discussed in the next section.

8.5.2.2 Calculating safety inventory, under lead time uncertainty

Lead time uncertainty is a result of inconsistent order replenishment by the supplier. Suppose in the previous example, the lead time is not consistent (the order is not delivered on time). In such cases, also firms need to maintain safety stock, to protect themselves from stock out situations, arising from lead time uncertainty. Suppose there is a delay in delivering the order by 2 days and, as a result, the order reaches the firm on the 12th day. In such a case, the firm will not have stocks for 2 days. Thus, the firm must hold buffer stock to manage the demand on those 2 days. The safety stock in this case is 60 units. The cycle inventory is 210 units.

Figure 8.5 depicts average inventory under conditions of lead time uncertainty

Standard deviation can be calculated using the formula given below:

$$\sigma = \sqrt{\left(\sum F_i D_i^2\right) \div n}$$

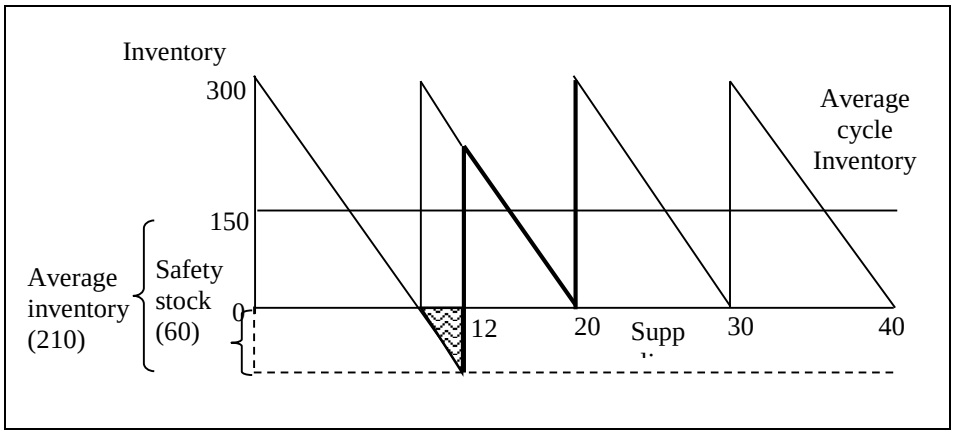
where σ = standard deviation

F_i = frequency of the event i

D_i = deviation of event from mean for event i

n = number of events

Figure 8.5: Average Inventory under Conditions of Lead Time Uncertainty

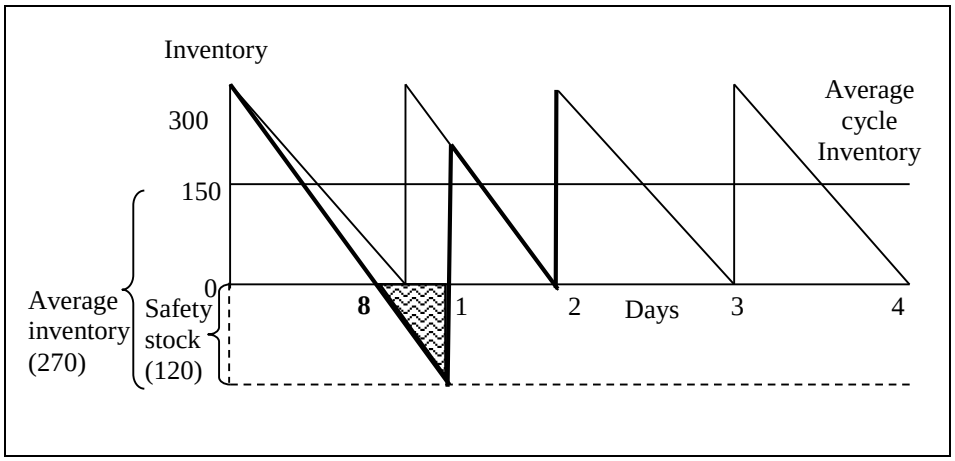


Source: ICFAI Research Center

If the standard deviation is 2 days, as in this case, then the lead time will vary.

Figure 8.6 shows joint impact of demand and lead time uncertainty on average inventory.

Figure 8.6: Joint Impact of Demand and Lead Time Uncertainty on Average Inventory



Source: ICFAI Research Center

8.5.3. Lean and Agile Supply Chains

Lean and agile are the two approaches used for developing supply chain management strategies. There are advantages and disadvantages to both, and therefore, the chosen approach should fit the firm's needs and objectives. There is no one-size-fits-all approach, even though there may be similarities among various activities in a supply chain such as procurement, production, and distribution. For some firms, a very lean system works best, whereas some others need the flexibility provided by an agile approach. As a via media, some firms resort to a hybrid approach to derive the benefits of both lean and agile strategies.

Lean supply chains

Lean supply chain management helps in reducing costs and waste, by focussing on efficient and streamlined operations. Vendors will have one point of contact across the entire company and one contract governing their relationship. In a lean approach, anything in the process that doesn't add value for customers is eliminated. When implementing a lean supply chain, focus is on looking for ways to remove layers of waste and initiate steps that add value to a product or service.

Lean strategies rely on reliable forecasting to decide inventory levels needed to meet demand. In some firms employing JIT (Just-in-Time) manufacturing, products are made on an as-needed basis and there's no unnecessary overproduction. The lean approach is best in markets that don't vary a whole lot. Toyota Production System is a classic example of a Lean supply chain.

Agile supply chains

Agile supply chain management focuses on adaptability. It is suitable for organizations that want to quickly adapt to changing situations. This method makes it easier to adjust sourcing, logistics, and sales, in response to factors including economic swings, technology changes, customer demand, and the overall business environment.

An agile supply chain looks at market demand before production. Short-term forecasts help firms stay responsive, but a key aspect of agile supply chains is that they respond to demand as it happens. This approach is useful when producing fast-changing and customizable items like fashion wear. An agile supply chain results in short order lead times and is quick to respond to customers. And when something unexpected happens, such as a regular supplier not being able to fill an order, the system enables flexibility. The firm can also respond more quickly to new market opportunities with an agile supply chain.

8.5.4 Vendor Managed Inventory (VMI)

Vendor managed inventory is necessary for improving multi-firm supply chain efficiency. The vendor monitors the inventory of the firm (buyer) and makes deliveries periodically, according to the operational requirements. The advantage of this is that the transactions that are usually initiated by the firm, like order processing and other activities are carried out by the vendor. The firm is, therefore, relieved of the burden of managing the inventory. Sometimes, financial aspects related to inventory are also transferred to the vendor. An organization having VMI agreements with its vendors will benefit in terms of improved services and reduced costs.

Reduced Costs: At times organizations are forced to maintain high inventory, because of uncertainty in demand, increasing costs for the firm. If the firm has VMI, it lessens the burden of uncertainty in inventory requirements, as the vendor tracks the inventory levels from time to time. It allows smaller buffers of capacity and inventory, thereby reducing the costs for a firm. With VMI, the frequency of

replenishment is usually increased from monthly to weekly or sometimes even daily. This is beneficial for both the firm and the vendor. The vendor can make replenishment decisions tuned to operating needs, and also have heightened awareness of trends in demand.

With VMI, there is greater coordination that supports the vendor's need for smoother production without sacrificing the firm's service and stock objectives. Transportation costs can also be reduced. The vendor is allowed to coordinate the resupply process instead of responding automatically to orders, as they are received.

Improved service: Customer service is an important differentiator for successful companies. From a retailer's perspective, product availability is an important measure of service. If the customer does not find a particular product, when he walks into the store, it means a loss for the firm in terms of sales and goodwill. With VMI, the coordination of replenishment orders and deliveries across multiple customers helps in improving service. A non-critical delivery for one customer can be diverted for a day or two, to enable a critical delivery to another customer. With the ability to balance the needs of all the partners, the vendor can improve the system's performance, without harming any individual customer. The vendor has a more accurate view of demand and can plan more effectively, which leads to better service.

Efficient technological support is needed, for successful implementation of the VMI. Electronic data interchange helps in enabling the process of VMI. Vendor managed inventory, combined with the right technology, can be beneficial to a firm.

Example: Nike uses "Lean Management" Approach to Manufacturing in Understanding and Catering to what the Customer Needs

Nike realized "lean supply chain" is the right approach to control its manufacturing process. Lean Supply chain is based on the predictions, which help to understand the future customer demand. So Nike can manufacture products what the customers need. The approach also helps Nike to decrease the wastage, and enhance the productivity.

Source: https://www.globaltrademag.com/supply-chain-methodology-lean-vs-agile-supply-chain/, March 03, 2021, Accessed on 25/08/2022

Activity 8.2

Inventory management decisions are of two types- Cycle inventory decisions and Safety inventory decisions.

- Identify the advantages and limitations of each one of them.
- Explain under what circumstances, each type of decision is taken.

Check Your Progress - 2

6. While describing the joint impact of demand and lead time uncertainty, which of the following is not true?
   a. The safety stock will be more.
   b. The order quantity will be more.
   c. The cycle inventory will be more.
   d. The safety stock level increases with the increase in protection level.
   e. One nullifies the impact of the other.
7. Which of the following is not the main reason for offering quantity discounts?
   a. To increase overall profits in a supply chain.
   b. To improve coordination between channel members.
   c. To make the supply chain more efficient and responsive.
   d. To reduce inventories.
   e. To assure quality.
8. Which of the following is the safest situation for offering discounts?
   a. When non-moving inventory is increasing.
   b. When the company has a dominant market share.
   c. When the future of the product in the market is doubtful.
   d. When new technology products enter the market.
   e. When the company is winding up its operations.
9. Which of the following is not a major impact in forward buying?
   a. Reduces the end-consumer demand after the promotional period
   b. Orders for the manufacturer come down after the discount period.
   c. Reduces profits for the manufacturer after the discount period.
   d. Affects cycle inventory.
   e. Both retailer and manufacturer incur losses.
10. Which of the following is the most significant joint impact of demand and lead-time uncertainty?
    a. Increase in the required levels of safety stock, order quantity and cycle inventory.
    b. Increase in only safety stock level.
    c. Increase in only order quantity level.
    d. Increase in cycle inventory level.
    e. No impact on any parameter cited above.

8.6 Summary

- Inventory forms a major part of a firm's assets.
- Proper inventory management helps a firm minimize inventory costs and maximize profits.
- Studied the concepts associated with inventory management and examined the costs involved in carrying inventory.
- The key inventory carrying cost components are capital cost, insurance, obsolescence, and storage.
- The two key decisions in inventory management are determining 'when to order' and 'how much to order'.
- The two key inventory decisions in supply chain management are cycle inventory decisions and safety inventory decisions.
- Three factors that affect the cycle inventory decisions are fixed ordering costs, quantity discounts, and trade promotions.
- Safety inventory is required to protect a firm under conditions of uncertainty of demand and lead time.
- Studied the impact of demand uncertainty and lead time uncertainty and the joint impact of these two variables on inventory policy.

8.7 Glossary

1. Balancing Inventory: Balancing Supply and Demand for materials
2. Cycle Inventory: It is the stock held to satisfy the demand between two replenishment cycles.
3. Decoupling: Making the processes independent of each other, to prevent bottlenecks.
4. Safety Inventory: It is the stock held in excess of cycle inventory to cover the uncertainty of demand and replenishment cycles.
5. Transit Stock: Stock that is either moving or ready for movement.

8.8 Self-Assessment Test

1. Discuss the role of Inventory in a Supply Chain.
2. Explain important Basic Inventory Management Decisions.
3. What are the Inventory Decisions in a Supply Chain?
4. Briefly describe the impact of demand uncertainty.
5. What are the impacts of lead time uncertainty?

8.9 Suggested Reading / Reference Material

1. Ashley McDonough, Operations and Supply Chain Management Essentials You Always Wanted to Know: 15 (Self Learning Management Series) Paperback – 1 January 2020.
2. Russel and Taylor, Operations and Supply Chain Management, 10ed, ISV Paperback – October 2019.
3. Chopra and Kalra, Supply Chain Management 6/e Paperback – 17 June 2016.

8.10 Answers to Check Your Progress Questions

1. (a) In make-to-order situation

In make-to-order situation, organizations need not hold inventory.

2. (b) Produce uniformly throughout the year with fixed manpower and capacity

Produce uniformly throughout the year with fixed manpower and capacity is the best strategy in the AC industry, operating on seasonal demand.

3. (b) The stock held to satisfy the demand between two replenishment cycles

The stock held to satisfy the demand between two replenishment cycles is called cycle inventory.

4. (a) Stock that is moving or ready for movement

Stock that is moving or ready for movement is called transit stock.

5. (e) Labor costs

It is not a component of the cost of carrying inventory.

6. (e) One multiplies the impact of the other

This is not true for describing the joint impact of demand and lead time uncertainty.

7. (e) To assure quality

It is not the main reason for offering quantity discounts.

8. (b) Where the company has a dominant marketplace

It is the safest situation for offering discounts.

9. (e) Both retailer and manufacturer incur losses

It is not a major impact in forward buying.

10. (e) No impact on any parameters

It is the most significant impact of demand and lead time uncertainty

Unit 9

Managing Transportation in a Supply Chain

Structure

"We want transportation as reliable as running water."

- Travis Kalanick, an American businessman and co-founder and former chief executive officer of Uber

9.1 Introduction

Efficient and reliable transportation infrastructure helps to make the supply chain efficient and responsive.

In the previous unit, we discussed the importance and functionality of inventory, in a supply chain, examined the concept of inventory and its functionality, basic inventory management decisions and looked at two key inventory decisions taken in a supply chain- cycle inventory decisions and safety inventory decisions.

Transportation is one of the important operations, in supply chain management. It is concerned with the movement of goods from one location to another. Transportation is also one of the major sources of cost, in the supply chain. With increasing competition and high customer expectations, timely and quick delivery

of the product has become the norm in the business environment. Efficient transportation infrastructure helps to make the supply chain efficient and responsive. With the availability of a wide range of transportation alternatives, choosing the right alternative is of vital importance. With the development of new concepts like cross-docking and the emergence of new service providers like third party logistics, transportation time and cost can be minimized.

In this unit, we first examine the functionality of transportation. Then we look at the factors affecting transportation decisions, various modes of transport and their characteristics, the transportation analysis decisions, and finally transportation techniques that are in current use.

9.2 Objectives

By the end of the unit, you will be able to:

- Discuss the role of transportation in a supply chain
- Describe the functions of transportation in a supply chain
- Identify participants in transportation decisions
- Explain the costs that influence transportation decisions
- Discuss the modes of transport
- Explain the design of transportation network
- Define trade-offs in transportation network design decisions
- Describe transportation analysis decisions and techniques

9.3 Role of Transportation in a Supply Chain

Transportation involves the movement of materials, component parts, and finished products, from one location to another. Since the customers (markets), manufacturing plants, and suppliers are widely scattered and products manufactured are rarely consumed locally, transportation plays a significant role in every supply chain.

It is one of the most vital economic activities for a business that links a company to its suppliers and customers, by providing material or products, when and where they need them. The distribution of raw materials for the purpose of production and the distribution of finished goods for consumption are completely dependent on transportation. Transportation provides the link that connects nodes in the supply chain, linking a company to its suppliers and customers.

A responsive transportation network enables businesses to set up production operations in the low-cost areas, without impacting customer service levels, because the network can be monitored and managed to keep inventory levels, as low as possible. An economical transportation network results in an economical supply chain.

Find below a brief overview of the relevant Government of India regulations.

9.3.1 Multimodal Transport of Goods Act, 1993

It is an Act to provide for the regulation of the multimodal transportation of goods, from any place in India to a place outside India, on the basis of a multimodal transport contract and for matters connected therewith or incidental thereto. The Act covers the requirements in a few chapters as follows:

Chapter 1: *Preliminary:* Short title, extent and commencement, and definitions

Chapter 2: *Regulation of Multimodal Transportation:* No person to carry on business without registration

Chapter 3: *Multimodal Transport Document*

Chapter 4: *Responsibilities and Liabilities of The Multimodal Transport Operator*

9.3.2 IATA Guidelines for Cargo Movements,

IATA (International Air Transport Association) issues guidelines to air cargo transporters, from time to time.

For example, it has issued guidance for Covid vaccine cargo handling, to ensure that the air cargo industry can support the large-scale handling, transport, and distribution of the COVID-19 vaccine.

IATA's Guidance for Vaccine and Pharmaceutical Logistics and Distribution provides recommendations for governments and the logistics supply chain in preparation for what will be the largest and most complex global logistics operation ever undertaken. "Delivering billions of doses of a vaccine that must be transported and stored in a deep-frozen state to the entire world efficiently will involve huge and complex logistical challenges across the supply chain," stressed IATA's Director General and CEO, Alexandre de Juniac. "While the immediate challenge is the implementation of COVID-19 testing measures to re-open borders without quarantine, we must be prepared for measures, when a vaccine is ready," he added. 'This guidance material is an important part of those preparations." the following are the Key challenges, addressed in IATA's Guidance for Vaccine and Pharmaceutical Logistics and Distribution, include:

- Availability of temperature-controlled storage facilities and contingencies, when such facilities are not available
- The roles and responsibilities of parties involved in the distribution of vaccines, particularly government authorities and NGOs, should also be defined.
- Industry preparedness for vaccine distribution includes capacity and connectivity:
- The global route network has been reduced dramatically from the pre-COVID 22,000 city pairs.

- Governments need to re-establish air connectivity to ensure adequate capacity is available for vaccine distribution.
- Facilities and infrastructure are emphasized as vital.
- The first vaccine manufacturer to apply for regulatory approval requires the vaccine to be shipped and stored in a deep-frozen state, making ultra-cold facilities, across the supply chain, essential.
- Some types of refrigerants are classified as dangerous goods and volumes are regulated, which adds a layer of complexity. Considerations include the availability of temperature-controlled facilities and equipment, and staff trained to handle time- and temperature-sensitive vaccines.
- Timely regulatory approvals storage and clearance by customs and health authorities will be essential.
- Priorities for border processes include introducing fast-track procedures for overflight and landing permits for operations carrying the COVID-19 vaccine and potential tariff relief, to facilitate the movement of the vaccine.
- Vaccines are highly valuable commodities. Arrangements must be in place to ensure that shipments remain secure, from tampering and theft.
- Processes are in place already, but the huge volume of vaccine shipments will require early planning, to ensure that they are scalable.

Reflecting the complexity of the challenge, the Guidance was produced with the support of a broad range of partners that include the International Civil Aviation Organization (ICAO), International Federation of Freight Forwarders Associations (FIATA), International Federation of Pharmaceutical Manufacturers and Associations (IFPMA), Pan American Health Organization (PAHO), UK Civil Aviation Authority, World Bank, World Customs Organization (WCO) and World Trade Organization (WTO).

9.3.3 Shipping Trade Practices Bill

It is a bill for obtaining clearance for exports from customers. For shipping export items by air, sea, or road, an exporter cannot load the goods, without filing an application as per the Shipping Bill. A Shipping Bill must be submitted electronically unless the Commissioner or Principal Commissioner makes an exception and allows it to be submitted physically. Shipping Bills are color-coded, depending on the export type.

Types of Shipping Bills

- Dutiable Shipping Bill: It is printed on yellow paper and is meant for goods that are to be exported on payment of export duty.
- Duty-Free Shipping Bill: It is printed on white paper and is for goods exported without duty payment. These are not eligible for duty drawback.

- Drawback Shipping Bill: It is printed on green paper, but once the drawback has been paid, it is printed on white paper.
- Shipping Bill for export of goods under the Duty Entitlement Passbook Scheme (DEPB): It is printed in blue; this is for goods exported under the government's DEPB export incentive scheme.

In a notification dated 25th March 2019, the Shipping Bill and Bill of Export (Forms) Amendment Regulations, 2019, was introduced. This defined the forms for various types of Shipping Bills.

Example: TCI (Transport Corporation of India) leverages Multi Modal to meet ESG (Environmental, Social and Governance)

The Gurugram headquartered TCI was able to meet its ESG compliances by leveraging multimodal Transportation. The demand for transportation of goods using sustainable options was growing in the industry. TCI had a strong multimodal network that included 2 AFTO Trains, 6 Coastal Cargo ships, 8000+ Marine Containers, and 650+ ISO Tank Containers servicing the remotest of corners of India and SAARC nations.

The multi modal transportation model of the company was attracting customer interest as they also wanted to reduce their transportation costs and carbon footprint. Sustainability was driven by efficient use of resources, improving transport infrastructure, and offering environmentally friendly transport choices.

Source: https://www.logisticsinsider.in/tci-leveraging-multimodal-transportation-to-meet-the-companys-esg-compliance/ April 8, 2022, Accessed on 27/08/2022

9.4 Functions of Transportation in a Supply Chain

Transportation performs two important functions- product movement and product storage.

9.4.1 Product Movement

Product movement is the primary function of transportation. Goods- whether they are the raw material from suppliers, work-in-progress goods from one manufacturing level to another or finished goods from manufacturer to warehouses and retailers or directly to customers -are required to be transported from one level of the supply chain to another. Transportation of goods consumes three types of resources- temporal, monetary, and environmental.

Temporal resources are the goods that are in transit. These goods are also called in-transit inventory. They are inaccessible to the firm during the period of travel.

Firms utilize the services of vehicles, personnel, and facilities, in the process of transporting goods to various destinations, within a supply chain. This requires a considerable amount of monetary resources to meet vehicle operating costs, personnel costs, and other administrative expenses.

Transportation consumes fuel, which is a non-renewable natural resource. Vehicles pollute the environment, through noise and air pollution, causing environmental degradation.

Therefore, transportation should concentrate on the movement of goods, between various facilities in a supply chain, in a manner that utilizes minimum resources, causes minimum environmental degradation and provides maximum satisfaction to customers.

9.4.2 Product Storage

A secondary function performed by transportation within a supply chain is temporary storage. Although using transportation vehicles for temporary storage is a costly option, firms resort to it, when their warehouse capacity is limited. In some cases, a temporary storage option in vehicles itself is advisable, when the costs of unloading and loading are more. Firms avail themselves of temporary storage facility by diverting shipments to other destinations.

While using this facility, firms change the regular direct route, through which the goods are transported, to a longer one, so that the goods take more time to reach their destination. The goods, thus stored during the transit time, arrive at the warehouse, when there is enough storage space, or when another truck is ready to ship them to the customers. This is one way of creating storage in transportation.

Another method to achieve temporary product storage is a diversion. Transportation vehicles provide the goods temporary storage facility when the shipment destination is changed during transit. Suppose a product is being exported by an Indian company from Mumbai to Singapore, but due to either an urgent need for that product or greater storage capacity in Hong Kong, the management may divert the shipment to Hong Kong. In such cases, transportation vehicles act as temporary storage facilities for goods.

Although such product storage is costly, the management can opt for it when restricted by warehouse capacity limitations or in case other costs like loading and unloading charges exceed the costs of storage of goods in transportation vehicles.

Example: Kohl's Q2 gross margins drop by around 3 percent due to higher transportation cost

Kohl has reported reduced gross margins in Q2 (2022). The drop was 2.9% compared to last year. It was attributed mainly to enhanced transport cost in addition to product cost inflation and higher spending on promotion. The sales were much lower than expected adding to the inventory costs, but the retailer had built huge in-transit inventory to meet customer demand.

Source: https://www.digitalcommerce360.com/2022/08/22/kohls-sales-in-q2-are-down-8-5-overall-compared-with-last-year-digital-sales-are-flat/ August 22, 2022, Accessed on 27/08/2022

9.5 Participants in Transportation Decisions

Understanding the role of four key participants, who are involved in the transportation transactions in a supply chain, will facilitate decision-making. They are:

- The shipper
- The carrier
- The receiver or consignee
- The government

9.5.1 The Shipper

The shipper and the consignee are concerned with the timely delivery of the goods from one point to another. Their objective is to deliver the goods at the destination quickly and at minimum cost. The shipper and consignee might be the same when the company delivers the goods from its manufacturing plant to its warehouses.

9.5.2 The Carrier

The carrier acts as an intermediary between the shipper and the consignee. He is responsible for the actual movement of goods. The primary motive of a carrier is to maximize the revenue from transportation transactions. To make profits, carriers try to quote maximum rates to a shipper and at the same time, deliver the goods at the lowest cost. They need to be good in planning, effective in utilizing the transportation modes, and on a constant lookout for avenues to reduce costs.

9.5.3 The Receiver or Consignee

In a contract of carriage, the consignee is the entity who is financially responsible for the receipt of a shipment. Generally, but not always, the consignee is the same as the receiver. If a sender dispatches an item to a receiver via a delivery service, the sender is the consignor, the recipient is the consignee, and the deliverer is the carrier. If the consignee is anybody other than the warehouse of the company, such as distributor, retailer or even the end-user, the consignee is outside the firm.

9.5.4 The Government

Transportation plays an important role in the economic growth of any country. Hence, the government has a vested interest in developing the transportation infrastructure, to ensure a proper transportation network that will enable an effective flow of goods. In India, the government holds a monopoly on rail transport. As a regulator, it monitors and controls the transportation network, in order to make the movement of goods faster and at a reasonable cost. Foreign companies cite India's poor transport infrastructure as one of the factors that deter them from setting up operations in the country. Responding to these concerns,

the Indian government has initiated road transport reforms in a big way (See Exhibit 9.1).

Exhibit 9.1: Road Infrastructure in India

The Government of India has allocated ₹ 111 lakh crore (US$ 13.14 billion) under the National Infrastructure Pipeline for FY 2019-25. The Roads sector is expected to account for 18% capital expenditure over FY 2019-25.

Robust Demand: Production of commercial vehicles increased to 752,022 in FY20, commanding a stronger road network in India

In November 2020, passenger vehicle wholesale expanded by 9%, compared with the same month last year.

Opportunities: The government aims to construct 65,000 kms of national highways at a cost of ₹ 5.35 lakh crore by 2022. Government of India allocated ₹ 111 lakh crore under National Infrastructure Pipeline for FY19-25. Road sector to account for 18% of capital expenditure over 19-25.

Investments: Transfer to National Investment Fund was estimated at ₹ 6,070 crore for 2019-20. In April 2020, the government set a target of constructing road worth ₹ 15 lakh crore over the next two years.

Policy Support: 100% FDI is allowed under the automatic route subject to applicable laws and regullations. In December 2020, the MoRTH proposed to develop additional 60,000 kms of national highways in the next five years. In January 2021, MoRTH announced that it has sought a budgetary allocation of ₹ 1,4 trillion for the year 2022

Source: India Brand Equity Foundation (IBEF), March 22, 2021

Example: Indian Government is Upgrading Transportation Infrastructure Aggressively to Fuel Economic Growth in a Sustainable Way

For sustainable economic growth, Government of India recognized the need for smart mobility solutions for the nation. Increasing fuel efficiency and avoiding congestion were the key objectives. In view of this, the Indian government was upgrading the transport infrastructure by investing heavily into multiple high-stake highway projects throughout the country. The road transportation was being coupled with the Internet of things (IoT) to achieve smart mobility. One of the initiatives was free flow toll system using Global Navigation Satellite System (GNSS).

Source: https://www.businessinsider.in/sustainability/news/soon-you-can-pay-your-highway-toll-on-the-move-nhai-brainstorms-satellite-based-free-flow-tolling-system-for-india/articleshow/93802052.cms August 26, 2022, Accessed on 27/08/2022

9.6 Costs that Influence Transportation Decisions

There are various costs that should be considered while making transportation decisions. The key parties in a transportation transaction are the shipper and the carrier. The costs that each of them has to take into consideration are different. First, let us look at transportation costs from the shipper's perspective.

9.6.1 Costs Affecting Shipper's Decisions

A shipper makes various decisions related to the design of the transportation network, mode of transport and selection of the transporter. These decisions are driven by the objective of minimizing transportation costs and maximizing customer responsiveness. Four key factors that influence the costs of the shipper are- distance, volume, density, and market factors.

Costs increase as distance increases. However, the rate of increase will decrease since the cost per mile reduces as distance increases. Distance also determines the mode of transportation. If the distances are smaller, the shipments can be sent through trucks, whereas, if the distances are longer, shipments can be sent through railways and waterways.

The volume of the consignment is another factor that influences the costs of the shipper. Transportation costs per unit will decrease, with an increase in consignment volume, since the costs can be spread over larger volumes. Thus, it is prudent for the shipper to send larger volumes in a single shipment to reduce costs.

Density refers to the quantity of the product that can be sent in a single truck. As space is limited in a truck, the product has to fill it up to the maximum, to achieve economy in transportation. If the product is lighter and fills up more space, a lesser quantity of goods is transported, implying that the space in the truck is not utilized fully. Thus, a firm has to maximize its utilization of space by taking measures like packing the product in space-saving containers, which will hold more of the product.

Market conditions like government restrictions on the movement of vehicles along a particular route, the peak demand season, weather conditions, strikes and other such instances, and tolls, also influence the transportation costs of the shipper.

Let us now look at various costs involved in the transportation of goods, which the shipper has to consider while making transportation decisions.

Transportation costs

Transportation costs have a major impact on the transportation decisions of a shipper. These costs include the amount paid to various carriers, for transporting goods. The amount paid to each carrier depends on the mode of transportation and the speed at which the goods are shipped to their destination. These costs are generally measured in cost per mile or unit weight.

Processing costs

These costs are incurred with every trip. These include loading, unloading, and other processing costs. Processing costs are fixed for each trip, regardless of the quantity of goods being shipped.

Facility costs

Facility costs are incurred for setting up various facilities, for example, warehouses in a supply chain. Though these costs do not affect transportation decisions directly, they have to be taken into consideration.

Inventory costs

Inventory holding costs, incurred by the shipper, also influence transportation decisions. Inventory costs are fixed for short-term transportation decisions, like in sending a shipment to a customer through a carrier. Inventory costs are considered variable, while making long-term decisions, like in designing a transportation network.

Customer service level costs

These costs arise due to non-conformity with the promised customer service levels i.e., in delivering the products to customers on time (say, within 48 hrs.). An organization should try to minimize these costs, by developing appropriate strategic and operational plans in transportation.

9.6.2 Costs Affecting Carriers' Decisions

The carrier also has to make several investments and operational decisions so as to maximize his return on every shipment. Some of the factors, a carrier has to consider while making a crucial investment and operational or pricing decisions, are distance, risk, and market conditions. Distance determines the price, the shipper would be charged. If the distance is longer, the shipper is charged a lower price per kilometer, and if the distance is shorter, he is charged a higher price per kilometer. Risk of the product getting damaged also influences the carrier's decisions. Perishable products have a higher risk of getting damaged, and therefore, command a higher price to transport them. Highly valuable products, being susceptible to theft, require more security and proper insurance. This increases the costs of the carrier. Delicate products that require special handling, may also contribute to an increase in the carrier's costs.

Market conditions also influence carrier decisions. Government restrictions on the movement of goods on a particular route can increase the costs of the carrier. For example, the closing of the airspace between India and Pakistan has forced Indian enterprises to take roundabout routes, to deliver the goods to other international destinations, resulting in greater costs and slower delivery, and, thus, increasing the carrier's costs.

Let us look at various costs, the carrier has to incur.

Fixed costs

Vehicles, purchased or taken on lease, constitute the largest portion of fixed costs. Fixed costs are also incurred in the purchase of equipment and information systems and acquisition of such other assets. Costs incurred due to the leasing of facilities like right-of-way, and airport cargo terminals, are considered as fixed. Carriers recover fixed costs by including a part of it in the shipping charges.

Variable costs

Variable costs are incurred for each trip a vehicle makes. This includes fuel costs, toll fees, personnel costs, etc. Service is priced in such a way that variable costs are fully recovered.

The carrier aims at covering fixed and variable costs in the price charged to the customer, at the same time, ensuring profits by minimizing variable costs.

Example: Yellow Corp (A logistics carrier major in the LTL expand segment) embarks on consolidating its operations to help shippers reduce costs

Yellow Corporation was a Kansas based transportation holding company with subsidiaries YRC Freight, (operates at national) New Penn Holland and Reddaway (operate at regional). The company had taken a major revamping under project "yellow one" to integrate its operations across the subsidiaries which were operating like separate companies. The project aimed to rationalize locations, staff, and storage facilities. This initiative, while it optimized the company's operations and profit, would benefit its current and prospective customers with low cost one point support for their shipping needs.

Source: https://www.logisticsmgmt.com/article/yellow_ceo_hawkins_predicts_great_year_as_it_transforms_into_super_regional March 10, 2022, Accessed on 27/08/2022

9.7 Modes of Transport

There are six basic transportation modes - road, rail, air, water, pipeline, and intermodal transportation. Exhibit 9.2 briefly provides the transportation statistics of India.

Exhibit 9.2: Transportation Statistics of India (2019)

Roadways

Total length of roads	–	5.23 million kms
Expressways	_	1642.5 kms
National Highways	_	142,126 kms

Contd….

No of vehicles	–	253 million (2019-growing @ 10% per year)
Freight vehicles	–	8.11 million
Freight traffic	–	2.2 trillion metric tons per km
Railways		
Total route length	–	65, 000 kms
Total freight traffic	–	668 million tons

Source: Ministry of Transport, Government of India

9.7.1 Road Transport

The flexibility and faster inter-city/ inter-state freight services offered by road transporters make them the favorite transportation option for many companies. India has one of the largest road networks (5.23 million kms) in the world. Compared to rail operators, truck operators have lower fixed costs, as they use highways owned/ maintained by the government. On the other hand, variable costs for each additional shipment or mile are higher, in the case of road transport, as it requires the utilization of additional trucks, drivers, and other personnel.

Road transport operators provide two types of services: Full Truck Load (TL) and Less than Truck Load (LTL). TL operators charge for the Full Truck Load, regardless of the quantity transported. LTL operators charge on the basis of the quantity shipped and the distance traveled. TL operations are suitable for the delivery of goods, having a larger lot size, like the shipping of finished goods from the manufacturing plant to the central distribution center. The LTL services can be used for sending goods, with a smaller lot size, like the delivering of goods to individual retail outlets from warehouses.

9.7.2 Rail Transport

Railways are another preferred mode of transport. Rail transport has high fixed costs and low variable costs. To cover these costs, the railways charge lower prices to transport large quantities over long distances. However, though the railways, with extensive coverage of cities, are ideal for the transportation of heavy goods over long distances, it takes a longer time than road transport. It can best be used to transport goods, which are not time-sensitive i.e., goods, which are not critical to the firms' manufacturing process and non-perishable goods, etc.

In recent times, the improvement in roadways and the increase in rail freight charges have been affecting the volumes of cargo being moved through railways. Indian Railways, one of the largest railway networks in the world, has started taking measures, to stop the decline in volumes and revenue. It is rationalizing the price structure for cargo services and is also trying to improve customer service. It is trying to provide innovative services, to attract and retain customers.

Indian Railways, in collaboration with Gati, a leading cargo management company, has started a joint venture, Millennium Parcel Express, to carry high-value express cargo. This train has a maximum capacity of 230 tons of cargo. Indian Railways gives its trains on lease to Gati, and Gati through its experience in cargo management and market promotion is expected to bring in business. This strategy is expected to improve the Railway's share in freight traffic. Though the trains under this project are currently running only on the Mumbai – Kolkata and Mumbai - Delhi routes, plans have been formulated, to extend them to other routes. Statistics are given below, only for the two dominant freight modes of Roadways and Railways, accounting for about 91% of freight traffic.

9.7.3 Water Transport

Water is one of the oldest modes of transport. Crude oil, ore, fertilizer, food grains, and chemicals are the preferred goods for transportation, through the sea route. Along the coastline, 11 major ports and 139 minor ones constitute India's shipping network. Though waterways facilitate the movement of large shipments at low variable costs, it takes a longer time to deliver the goods. The main disadvantage of water transport is its limited operations and its relatively slow speed. The starting and destination points have to be well connected with road or railways, for the movement of transported goods to the mainland. There is also the risk of the government, being the regulator of ports, imposing restrictions, which may hamper the growth of sea transport.

Water transport can be of two types - deepwater vessels that operate only in larger water bodies and that require deepwater ports for docking, and diesel-towed barges, which generally operate on rivers and canals, transporting smaller quantities for shorter distances.

9.7.4 Pipelines

Oil and natural gas pipelines form an important transportation network in the country. Pipelines are mainly used to transport crude oil, petroleum products, and natural gas. They can be operated 24 hours a day and 7 days a week, unlike the other modes of transport. Pipelines have high fixed costs and the lowest variable costs when compared to other modes of transport.

India has approximately 7,000 km of pipeline, generally used for the transportation of crude oil and its products. The country has recently completed one of its most ambitious projects, the 1700 km Hazira-Bijapur-Jagdishpur pipeline. Costing nearly ₹ 17 billion, the pipeline transports liquid gas from the South Basin offshore field off Mumbai to Jagdishpur and Aonla, deep in the mainland of Uttar Pradesh.

9.7.5 Air Transport

Major airlines across the world provide cargo services. But freight would be costlier, though faster. Thus, air transport is preferred only for those goods that require faster delivery, and are of high value like documents and jewelry. Air

India, Jet Airways, etc. offer air cargo services in India. Blue Dart India has its own fleet of aircraft for domestic freight.

9.7.6 Intermodal Transport

Intermodal transport uses a combination of different modes of transport. Common among the combinations is the truck/ rail mode. Owing to the inherent flexibility of this mode, and the increase in global trade, intermodal transport has gained popularity. In the truck/ rail mode, the goods container is transported in a truck to a rail terminal, from where a train carries to its destination. At the destination terminal, the container is again mounted on a truck to be delivered at the required place.

The advantage of this combination is that it offers a lower cost of transportation, compared to any single mode of transport. The disadvantage lies in the problem of proper communication between the operators in coordinating the movement of goods from one mode to another mode. Concor India is the leading player in intermodal transport, in India.

Example: J.B. Hunt (US based inter modal transport company) Enters Ocean Shipping to help its Customers Accelerate International Transportation from China and USA

J.B. Hunt was a US based inter modal transport company offering transport services to its customers with a good combination of Road, Train transport. Like other logistics companies, this company was also adding ship-based transport to its customers. This would help customers to accelerate their transportation from Chines ports to US ports. From the destination ports, the company delivered the goods to the destination with a mixture of road and rail as appropriate. Removing supply bottlenecks and reducing the transportation costs to the customers were the anticipated benefits.

Source: https://maritime-executive.com/article/intermodal-carrier-starts-shipping-service-with-chartered-swire-ships June 30, 2022, Accessed on 27/08/2022

Activity 9.1

Maruti Suzuki India has planned to transport vehicles through inland waterways and has inked a pact with the government for this, a move that will help the country's' largest carmaker reduce its logistic costs.

- Identify various modes of transporting vehicles and compare them for their advantages and disadvantages.
- Try to draw justification for Maruti Suzuki’s decision, to opt for inland waterways to transport its vehicles.
- Does the decision have to do with the cost of transportation or any other reasons?

Answer:

Check Your Progress - 1

1. Which, of the following, is the largest goods network in India?
    a. Waterways
    b. Airways
    c. Railways
    d. Roadways
    e. Manual
2. What is the percentage of Road Transportation (2015) in India?
    a. 30-40
    b. 40-50
    c. 50-60
    d. 60-70
    e. 20-30
3. What is the percentage of Rail Freight (2015) in India?
    a. 10-20
    b. 20-30
    c. 30-40
    d. 40-50
    e. 50-60
4. What is the approximate contribution of the transport sector to GDP in 2015?
    a. 3-4
    b. 4-5
    c. 5-6
    d. 6-7
    e. 7-8
5. Which of the following is not a key participant, in transportation decisions?
    a. Shipper
    b. Carrier
    c. Consignee/ receiver
    d. Government
    e. Public

9.8 Design of Transportation Network

The transportation network design plays a crucial role, in determining the ability of the supply chain to attain the required responsiveness, at the lowest cost. Firms are seen to adopt various transportation network design options, like:

- Direct Shipment Network
- Direct shipping with milk runs
- Shipments managed from a centralized distribution center
- Shipping via distribution center using milk runs
- Tailored networks

9.8.1 Direct Shipment Network

In the Direct Shipment Network, shipments from suppliers are directly delivered to the firm's retail outlets. For a retailer with a chain of stores, the route of the shipment is specific to each retail outlet. Figure 9.1 illustrates this arrangement. Since the transportation route is fixed (direct), the retailer has to decide only on the quantity to be shipped and the mode, through which it needs to be delivered. In this type of transportation network, the retailer has to make a trade-off between transportation costs and inventory costs. Transporting Larger quantities (TL) reduces transportation costs but builds up inventory at each retail outlet. Transporting Lesser quantities (LTL) results in increased delivery time and costs. Thus, the retailer has to decide upon the optimal quantity to be shipped, so that both transportation costs and inventory costs can be optimized.

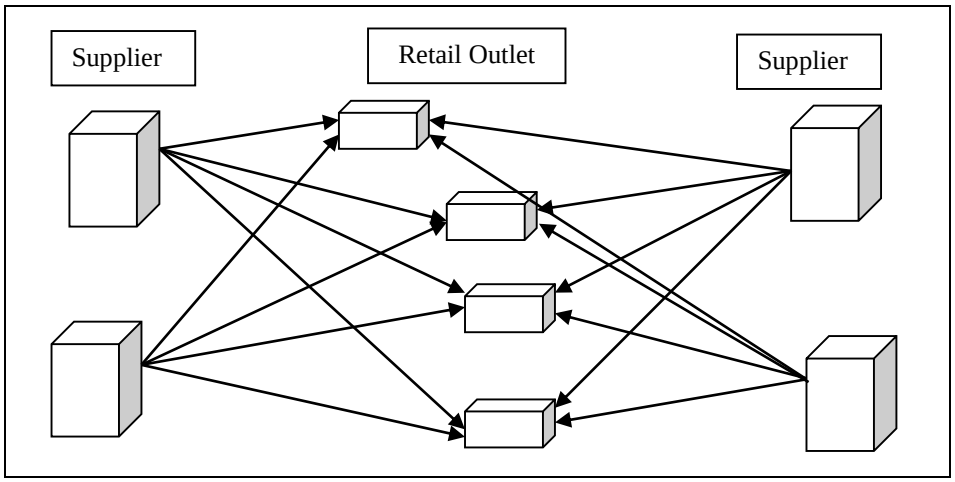
The main advantage of direct shipment is the elimination of intermediate facilities like warehouses. This type of network is advantageous for the firms having larger retail outlets, where sending larger quantities is economical. If the retail outlets are small in size, the quantity shipped will be smaller and transportation costs will be higher.

9.8.2 Direct Shipping with Milk Runs

A Milk Run is a route used by a single truck to collect material from various suppliers, to deliver them at a single destination (retail outlet) or to transport goods from a single supplier to various destinations (retail outlets). The concept of Milk Run is to fill the vehicle to its full capacity at the supplier’s end and make multiple deliveries in a particular region in a single trip. Figure 9.1 shows the graphical representation of Milk Run. The routing has to be optimal in this type of network so that the truck covers more suppliers/ customers at minimum cost. While direct shipment eliminates warehouses, Milk Runs lower the total costs by fulfilling many orders in a single trip. The other advantage is the maximum utilization of the vehicle’s space. The retail chains having smaller retail outlets can use Milk Runs to deliver goods to multiple outlets on a single truck and thus

gain transportation economies. Firms that require constant and frequent supply of goods in small lots, (for example, firms adopting a just-in-time strategy) can adopt Milk Run, as an economical option.

Figure 9.1: Direct Shipping Network

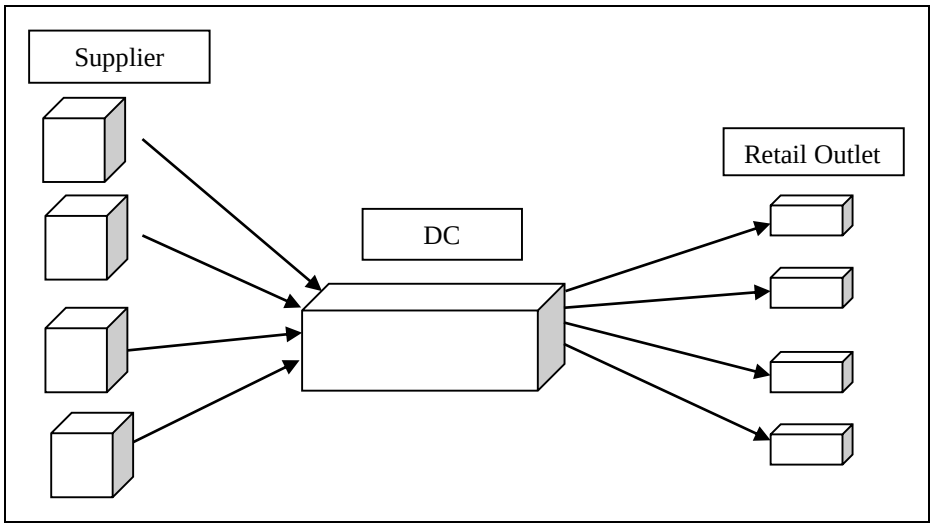


Source: ICFAI Research Center

9.8.3 Shipments Managed from a Centralized Distribution Center

Firms using this type of transportation network design, group their customers/ retailers, depending on their retail location, and set up a large Distribution Center (DC), to serve each of these customer groups. DC receives goods from different suppliers and distributes them to individual customers/ retailers in its region. Figure 9.2 shows the graphical representation of this design.

Figure 9.2: Shipments through Centralized Distribution Center (DC)



Source: ICFAI Research Center

When the aggregate demand for a particular supplier's product, from all the retailers in a particular region, may not be sufficient to achieve economies of

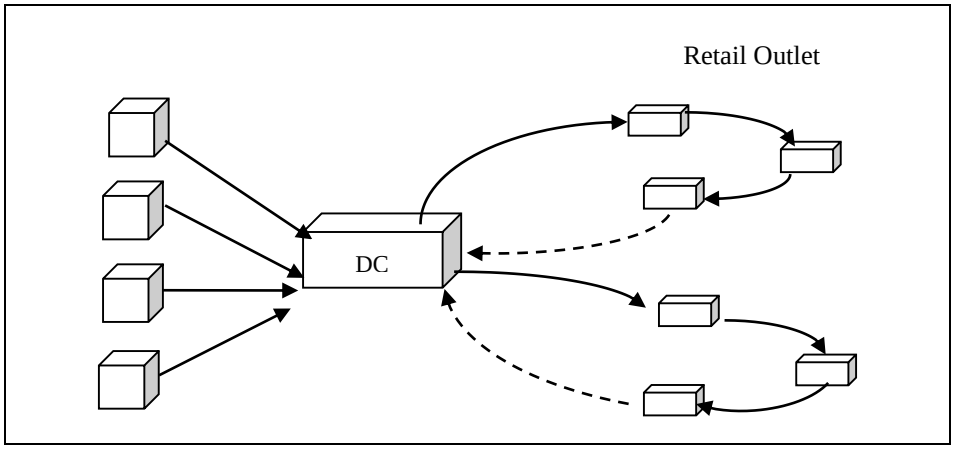
scale, the firm can order large shipments from the suppliers and store them in the DC. When the aggregate demand for a supplier's product, from all the retail outlets, is more or less matching with the supply, the products, instead of being stored in the DC, can be transferred to the retail outlets, by using the cross-docking technique. In cross-docking, shipments of various products procured from the suppliers, arrive at a DC in larger lot sizes, and simultaneously, these shipments are broken down into smaller lots and loaded for shipment to individual retail outlets, without storage in DC. Each inbound truck will contain the product from the supplier for multiple retail outlets, and each outbound truck heading for a retail outlet will contain products from multiple suppliers. This setup minimizes storage of inventory, resulting in the reduction of inventory costs and speeds up the product flow, through the supply chain. Cross-docking also reduces loading and unloading costs. Cross-docking is useful in conditions of predictable product demand and constant supply from the suppliers.

Walmart has effectively utilized cross-docking, to reduce inventory in its supply chain, without incurring excess transportation costs.

9.8.4 Shipping via Distribution Center Using Milk Runs

In this type of transportation network, both inbound and outbound transportation costs can be reduced. The goods from the suppliers are transported to a distribution center. Later, the goods are sent to multiple retail outlets using Milk Runs. The set-up is shown graphically in Figure 9.3. This type of network is suitable for firms having small retail outlets, demanding small lot sizes. Here the total shipment to a store does not fill the truck, and so shipments to multiple stores are consolidated and filled in a single truck, to minimize outbound transportation costs. However, this type of setup would require proper coordination, and the right routing and scheduling of Milk Runs. This transportation network is most commonly used by online retailers, where they are required to deliver small lots to individual customers (homes).

Figure 9.3: Shipping via Distribution Center Using Milk Runs



Source: Icfai Research Center

9.8.5 Tailored Networks

Tailored transportation networks are designed utilizing various other transportation network design options, based on organizational needs, customer characteristics, and requirements. For example, a car manufacturer delivers new cars to the dealers and spare parts to the service centers. The shipment of cars requires a different kind of transportation from that of spare parts. Thus, instead of having a common transportation network for all the needs of a company, its transportation network design could be tailored for each product or customer. But a tailored network requires high investment and proper information systems, to coordinate the operations.

Let us look at some of the common forms of tailored transportation networks, based on the product and customer characteristics.

Tailored transportation based on customer density and distance

Customer density and the distance between customers and the company warehouses are key factors while designing transportation networks.

If the customer density is high in a particular region and the warehouse is nearer to that region, the firm can use its own trucks to go on a Milk Run to deliver its goods. For example, FoodWorld has the highest number of outlets in Chennai, as compared to its presence in other cities of the country. FoodWorld outlets are located within 2 kms from one another, in Chennai. For these outlets, the stock replenishment from its distribution center can be completed with Milk Runs, using its own fleet of vehicles. If the customer density is high and the distance from the warehouse is long, using Milk Run is not the right option, since the trucks will travel empty on the return journey. In such cases, the firm can use public or third party transport services. For example, Mumbai and Delhi are the largest car markets in India. Hyundai Motors with its manufacturing plant located in Chennai can use public transportation like railways or private truck operator services, to transport its new car shipments to its warehouse in Bombay and Delhi, instead of using its own fleet for Chennai – Mumbai/ Delhi Milk Runs. From there, these shipments can be loaded into smaller trucks and delivered to individual dealers using Milk Runs. In the areas, where the customer density is low, the company can save on transportation costs by utilizing the services of LTL carriers or third-party logistics service providers, who are able to deliver the goods at a lower cost, as they combine the shipments for a region from various clients.

Tailored transportation according to the size of the customer

The size of the customer also influences the design of the transportation network. Firms can select a Full Truck Load or a Less than Truck Load operator, depending on the size of the customer.

There are two kinds of costs involved in it:

- Transportation cost incurred in delivering the goods, from the warehouse to the customers.
- Delivery costs, based on the number of trips or deliveries.

The transportation costs incurred by a firm in reaching a customer, remain the same irrespective of its size. But the delivery cost per unit would be comparatively higher for smaller customers. Transportation costs can be reduced by delivering goods to big and small customers on the same truck. But since it is not economical to visit every customer daily, the firms should design a delivery schedule, which includes a judicious mix of big, medium, and small customers. For example, Coca-Cola supplies mineral water in 20-liter packs under the Kinley brand, to large customers like corporate customers. It also supplies the Kinley water in 1-liter and 5-liter packs to retail outlets. Instead of delivering the mineral water packs for its corporate customers and retail outlets separately, the company can deliver to both of them in a single truck, using Milk Runs.

The frequency of visiting corporate customers and retail outlets could be decided based on the transportation and delivery costs. Since corporate customers and big retailers have bulk requirements, they can be visited almost daily by Milk Runs. Small retail outlets can be visited on alternate Milk Runs as their sales turnaround would be lower. This form of tailored transportation helps a firm utilize its truck to the optimum, as it can load the same quantity of goods, as it does on daily milk run.

Tailored transportation according to the product demand and value

Transportation network design is also influenced, by the demand for and the value of the product. The level of inventory aggregation and the mode of transport are decided, by evaluating the customer demand and the value of the product. If the product is in high demand and is of high value, the cycle inventory for such products should be placed near to the customers so that inexpensive modes of transport can be used, to replenish the cycle inventory. Since the safety inventory is required less frequently, the seller can aggregate them and faster modes of transport can be used, to ship this inventory to the customer, in case of emergencies.

When the product is in high demand and of low value, then the firm can disaggregate the inventory and keep it nearer to the customer area, to save on transportation costs. For products, which are in low demand and of high value, the inventory is aggregated and stored in fewer facilities, resulting in savings on inventory costs. For products with low-demand and low value, the inventory can be kept closer to the customers and the orders delivered through inexpensive modes of transport, to save on transportation costs.

Example: Swissport (Ground support provider at Schiphol Airport) deployed 'Milk Run' "direct shipping" (Transportation network) optimisation initiative to save 20,000 truck runs

Swissport provided airport ground services at Schiphol Airport. The services included warehouses and local transportation. Swissport along with some handlers and forwarders had come up with an idea of "milk run" shipping initiative. Earlier each handler or forwarder used to use their own vehicles and run multiple runs even though the vehicle was filled only to a small part of the volume. This increased congestion, wasted fuel, carbon footprint and overall wasted resources for all agencies. Using "milk supply" shipping network concept, all of them shared the same vehicle and loaded it full. Some 20,000 truck runs were saved.

Source: https://www.stattimes.com/logistics/swissport-celebrates-milk-run-initiative-at-schiphol-airport-1345496 24 May, 2022, Accessed on 27/08/2022

9.9 Trade-Offs in Transportation Network Design Decisions

While taking transportation decisions, a firm has to make many trade-offs. The firm should evaluate the impact of the decision on the costs associated with transportation, like inventory costs, facility costs, transportation costs, etc. The management has to make two important trade-offs.

- Transportation and inventory cost trade-offs
- Transportation cost and customer service level trade-off

9.9.1 Transportation and Inventory Cost Trade-Offs

Management has to make a trade-off between the transportation costs and inventory costs while making transportation decisions. If transportation costs are to be reduced, larger quantities have to be ordered to gain transportation economies. This will result in an increase in inventory, consequently increasing inventory costs. To bring down inventory costs, the inventory has to be reduced. This requires frequent ordering of smaller quantities, but this will, in turn, increase transportation costs. Thus, we need to make a trade-off between these two variables, based on the products being transported. The important decisions that affect trade-off are i. Choice of transportation mode, and ii. Inventory aggregation.

Choice of transportation mode

Choice of transportation mode is an important decision, which may have a long-term impact on the efficiency of a company's supply chain. There are two decisions involved in choosing a transportation mode - one at the strategic level, and the other at the operational level. At the strategic level, the firm has to make decisions regarding the carrier, with whom they need to tie up. Here, the firm

should look for a reliable carrier with a proven track record, who can offer services at reasonable prices. At the operational level, the firm needs to make decisions regarding the mode, through which a particular shipment should be sent. Though cheaper modes of transport reduce transportation costs, the time taken for the delivery of goods might be longer, and stipulations on the minimum lot size for shipment might not work, in favor of the firm. Thus, the cheaper alternative might increase inventory, as well as inventory costs. Modes that allow faster delivery and smaller lot size shipments are seen to be more expensive than the slower modes of transport.

To make a trade-off between transportation costs and inventory costs, a firm needs to study the products, which it wants to deliver. The products, which have a relatively high value compared to their weight, can be shipped in small lots via faster modes of transport. Such products include jewelry, electronic goods, medicines, etc. On the other hand, low-value bulk items like coal, iron ore, etc., can be shipped using slower modes of transport. Thus, a judicious selection of transportation mode will increase the efficiency of the supply chain, by decreasing the value of the inventory, held up at various stages of the supply chain.

Inventory aggregation

Inventory aggregation reduces inventory as multiple orders are aggregated in a single location. But in some cases, it increases transportation costs. For example, FabMall, a leading e-tailer in India, home delivers goods for those, who order through their website. For this, FabMall has to aggregate its inventory from the vendors and hold it in its warehouse. On the outbound side, FabMall has to send the groceries, in smaller lots to each customer. Though FabMall incurs lower inbound transportation costs due to inventory aggregation, it incurs more costs on the outbound side. In physical retail set up, the retailer incurs the inbound transportation costs, for replenishing the stock at the retail outlets. On the outbound side, customers buy the goods from the outlets, thus eliminating outbound transportation costs for the retailer. So, FabMall's transportation costs increase due to inventory aggregation, as the customer’s orders are small on the outbound side, which offsets the savings from inventory aggregation on the inbound side.

Inventory aggregation is a suitable option if the inventory costs and facility costs are high. In the food processing industry, inventory costs and facility costs are high, on account of the need for maintaining the freshness of the food products. Aggregating and storing them in a few facilities can reduce the inventory costs. Inventory aggregation is suitable for the transport of products, which have a 'high value to weight' ratio and high demand uncertainty. Inventory aggregation is also a right option, where the product demand on outbound side is large enough to achieve economies of scale.

9.9.2 Trade-Off Between Transportation Cost and Customer Service Level

The firm has to make trade-offs between its transportation costs and the customer service level. If a firm wants to maintain a high customer service level, the orders have to be processed faster and delivered quickly. However, this will increase transportation costs. On the other hand, if a firm wants to minimize its transportation costs, it has to accumulate the orders for some time and deliver the products in larger quantities. This not only reduces transportation costs but also achieves economies of scale. But delaying of orders reduces the firm's customer responsiveness.

Example: Chevron (the energy company) plans to use BayoTech's transport trailers to save "transportation costs" and increase driver productivity

Chevron, the energy company had to transport high pressure Hydrogen. The company would use BayoTech's transport trailers to distribute high-pressure hydrogen for power generation, transportation, and industrial applications. This would reduce transportation costs to Chevron while increasing driver productivity. By using BayoTech hydrogen transport trailers, Chevron could carry up to three times more compressed gaseous hydrogen per load than traditional steel tube trailers.

Source: https://hydrogen-central.com/bayotech-receives-inaugural-order-hyfill-hydrogen-transport-trailers-chevron/ August 26, 2022, Accessed on 28/08/2022

9.10 Transportation Analysis Decisions and Techniques

The most important transportation decision a firm needs to make is the routing and scheduling of shipments. These decisions focus on optimal utilization of the transportation system while meeting customer service level requirements. The routing and scheduling decisions can be categorized as strategic and operational. The strategic decisions are concerned with the fixed routes, to be used for delivering shipments over longer periods like a span of several months or years. Operational transportation decisions are concerned with the short term requirements, such as daily and weekly routes. The following questions need to be answered while taking on routing and scheduling decisions:

i What is the best delivery sequence for servicing customers?

ii How should orders be grouped for a particular route?

iii Which mode of transport should be used to deliver a particular order?

iv What is the best way (TL/ LTL) for servicing different customers?

9.10.1 Transportation Analysis Techniques

Several techniques are used while taking routing and scheduling decisions.

They can be classified as

- Heuristic approaches
- Exact approaches
- Interactive approaches
- Combination approaches

Heuristic approaches

Heuristic approach utilizes trial and error methods for routing and scheduling analysis. There are two key methods in the heuristic approach. a. Savings heuristics, and b. Insertion heuristics.

Savings heuristics tries to focus on lowering transportation costs by reducing the number of routes. In this method, the management determines, whether there are two routes having lot size less than the truck capacity. Then, the management analyzes, whether by merging these routes, time and costs can be reduced, without the lot size exceeding the capacity of the truck.

Insertion heuristics focuses on including more destinations in the existing set of routes. If a destination is not covered in the existing set of routes, this method tries to include it without affecting the route and transportation costs.

Exact approaches

Exact approaches use mathematical (linear) programming, to identify the best routes. These approaches are fast and reliable over a substantial range of problem sizes and applications. Complex mathematical calculations are involved in this method. The latest advances in information technology are capable of solving problems, with even large constraints and variables.

There are some disadvantages associated with this approach.

- Large number of constraints and variables to be considered while formulating the problem.
- More time and computational resources are required.

Interactive approaches

The interactive approach uses a combination of simulation, graphics, and cost calculator in an integrated system. The management gives the inputs to the system. The system determines the plots and routes and the associated time and costs. Then, the management evaluates the performance of each alternative and develops an optimal strategy. The drawback of this approach is the over-dependence on the management's ability and skill, to arrive at a decision.

Combination approaches

The combination approach is a combination of the above three approaches, to give a more accurate view when compared to each one of them in isolation.

Two main criteria- generalization and accuracy -have to be considered. Generalization represents the extent of special cases, like the inclusion of new destinations, multiple depots, and vehicle capacities, that can be incorporated into the method. Accuracy represents the extent of the calculated results, matching the optimal solution.

Example: Alberta Milk (Canadian Milk Cooperative) and Dairy Farmers of Manitoba Redefine Diary Transportation Using Technology

British Columbia Milk Marketing Board, Alberta Milk, and Dairy Farmers of Manitoba worked with the technology company Spiria to design and develop a new dairy "transportation data collection system". The new system was based on mobile and web technologies. Using the new system, the milk haulers were able to plan and transport milk faster than earlier in an easier way. The milk haulers just entered volume and sample data at the farm and drop-off data at the plants. The system provided data to the milk boards' transportation teams in real time. The transportation team had real-time visibility on milk routes and volumes, enabling them to make on-the-fly routing decisions and assuring quality compliance throughout the transportation process.

Source: https://www.newswire.ca/news-releases/key-players-of-canada-s-dairy-industry-redefine-dairy-transportation-830579890.html June 15, 2022, Accessed on 28/08/2022

Activity 9.2

Consider online retailers like Amazon. Amazon's shipping costs are only expected to climb, as more customers turn to the platform for general merchandise like martial arts gloves and barbeque pellets. The one-off shipments of random items are harder for the company to sell and lead to higher shipping costs. Transportation costs, in turn, help companies to decide plant locations, selection of modes of transport, outsourcing, etc.

You are required to analyze transportation costs for a retail major like Amazon, Flipkart, etc., by identifying various costs involved in computing total transportation costs.

Check Your Progress - 2

6. Which of the following is not a transportation network design?
   a. Direct Shipment Network
   b. Shipments managed from a centralized distribution center
   c. Shipments via distribution center using milk runs
   d. Tailored Networks
   e. Customer's designs
7. Which is the popular transportation option, to ship goods in a retail chain?
   a. Direct Shipment Network
   b. Shipments managed from a centralized distribution center
   c. Shipments via distribution center using milk runs
   d. Tailored Networks
   e. Customer's designs
8. In which of the following sectors are tailored transportation networks popular?
   a. Confectionary
   b. Automobiles
   c. Vegetables
   d. Stationary
   e. Food grains
9. Which of the following is not a technique used in Transportation Analysis?
   a. Heuristic approaches
   b. Exact approaches
   c. Interactive approaches
   d. Combination approaches
   e. Prior experience approach
10. Which technique uses detailed computational and IT resources?
    a. Heuristic approaches
    b. Exact approaches
    c. Interactive approaches
    d. Combination approaches
    e. Prior experience approach

9.11 Summary

- Transportation is one of the major items of cost, in a supply chain. A firm's ability to serve the customers depends on how efficiently and quickly the orders are delivered, and, hence, transportation management becomes one of the important operations, in a supply chain.
- There are two important functions performed by transportation: product movement and product storage. While product movement is the primary function of transportation, temporary product storage becomes its secondary function.
- There are five key participants in the transportation environment: the shipper, the carrier, the receiver or consignee, the government, and the customer.
- There are costs to be considered while making transportation decisions. From the shipper's perspective, transportation costs, facility costs, inventory costs, processing costs, and customer service level costs are to be evaluated before taking any transportation decisions. From the carrier's perspective, fixed costs like that for the terminal, information systems, equipment, vehicles, and variable costs like fuel costs, personnel costs, and toll fees need to be evaluated.
- There are certain design options for transportation networks. These are direct shipment to the retail outlets, direct shipping with Milk Runs, shipments managed from a centralized distribution center, shipping via distribution center using Milk Runs, and tailored transportation.
- There are two important trade-offs that a firm has to make: transportation and inventory cost trade-off, and transportation costs and customer service level trade-off.
- Various transportation analysis techniques used by the firms are the heuristic approach, the exact approach, the interactive approach, and the combination approach.

9.12 Glossary

1. Cross-docking: Shipments of various products from suppliers arrive at a distribution center in large sizes, which are broken into smaller lots and loaded into shipments to individual retail outlets, without any storage.
2. Customer Service-level Costs: These are the transportation costs, associated with non-conformity with promised customer service levels.
3. Exact approach: It is a transportation approach that uses Mathematical and Linear Programming, to identify the best routes.
4. Heuristic approach: It uses trial and error methods, for routing and scheduling analysis.

5. Interactive approach: It is a transportation approach that uses a combination of simulation, graphics, and cost calculator in an integrated manner, to decide the best routes.
6. Intermodal transport: It refers to the use of a combination of different modes of transportation.
7. Milk Run: A Milk Run is a route used by a single truck to collect material from various suppliers, to deliver them at a single destination (retail outlet) or to transport goods from a single supplier to various destinations (retail outlets).

9.13 Self-Assessment Test

1. Explain the Role of Transportation in a Supply Chain
2. What are the major Functions of Transportation in a Supply Chain?
3. Who are the Participants in Transportation Decisions?
4. What are all the Modes of Transportation and how do they compare?
5. Discuss various aspects in the Design of Transportation Network.

9.14 Suggested Reading / Reference Material

1. Ashley McDonough, Operations and Supply Chain Management Essentials You Always Wanted to Know: 15 (Self Learning Management Series) Paperback – 1 January 2020.
2. Russel and Taylor, Operations and Supply Chain Management, 10ed, ISV Paperback – October 2019.
3. Chopra and Kalra, Supply Chain Management 6/e Paperback – 17 June 2016.

9.15 Answers to Check Your Progress Questions

1. (d) Roadways

Roadways: Roadways is the largest goods network in India.

2. (d) 60-70

60 –70 is the percentage of road transportation (2015) in India.

3. (c) 30-40

30 –40 is the percentage of rail freight (2015) in India.

4. (d) 6-7

6 –7 is the approximate contribution of the transport sector to GDP in 2015.

5. (e) Public

Public is not a key participant, in transportation decisions.

6. (e) Customer's design

Customer's design is not a transportation network design.

7. (c) Shipping via distribution center using milk runs

Shipping via distribution center using milk runs is the popular transportation option, to ship goods in a retail chain.

8. (b) Automobiles

In automobile sectors, tailored transportation networks are popular.

9. (e) Prior experience

Price experience is not a technique used in transportation analysis.

10. (b) Exact technique

Exact technique uses detailed computational and IT resources.

Unit 10

Warehousing in a Supply Chain

Structure

"Trade isn't about goods. Trade is about information. Goods sit in the warehouse until information moves them."

- C. J. Cherryh, an American writer

10.1 Introduction

A warehouse as just a storage place is not much relevant to the business. Information system supporting the warehouse operations adds business value.

In the previous unit, we discussed the functionality of transportation, the factors affecting transportation decisions, various modes of transport and their characteristics, the transportation analysis decisions, and finally transportation techniques that are in current use.

Warehouses are facilities in the supply chain where goods are held or stored. Warehousing affects customer service levels, stock-out rates, and the success of a firm's sales and marketing efforts. The developments in supply chain initiatives, changing market dynamics and customer expectations have had an impact on the way warehouse functionality is viewed. The warehouse is emerging as a vital component of a firm's supply chain. Even in its traditional role, warehousing

involves the performance of the basic functions of transportation, storing and information transfer, which reflect its importance in the supply chain.

Warehouses perform four key roles in a supply chain. Warehouses provide flexibility to buyers and suppliers. This flexibility relates to space, labor, and information. Warehouses are also an important point of information in the supply chain. The information available at the warehouse includes the inventory level and movement, shipment requirements, customer requirements and transportation information. The warehouse personnel's knowledge regarding customers, carriers and geography can be a key asset for the company in formulating product and market strategies. Warehouses also act as a supply chain coordinator since they deal with upstream and downstream members of the supply chain. The upstream members include external suppliers and the company's manufacturing facilities, while downstream members include outbound carriers and customers.

Finally, warehouses provide essential marketing support. This is not just in terms of the supply of products, but also in terms of feedback on customers and markets.

In this unit, we first look at the benefits of warehousing. Then we examine the key activities that warehouses undertake. We then look at the different types of warehouses that are used for different purposes. The factors that should be considered for deciding on the number and type of warehouses are then discussed. Finally, we focus on the key elements in managing a warehouse.

10.2 Objectives

By the end of the unit, you will be able to:

- Explain the nature and importance of warehousing in a supply chain
- Define the functions of warehousing
- Identify warehousing activities
- Analyze warehousing alternatives
- Examine factors for warehousing strategy
- Explore planning warehouse
- Discuss managing a warehouse

10.3 Nature and Importance of Warehousing in a Supply Chain

The warehouse is a part and parcel of the supply chain’s logistic network. It is used for the storage of inventory at all stages of the supply chain, such as Raw Material, Semi-finished goods, and finished goods. It is used as an intermediate point, between the manufacturing plant and the customer. It is also used by some organizations, as a point of origin or sales headquarters.

With the advent of the e-business environment, directly fulfilling orders from the warehouse became a new business model. Companies like Amazon.com

aggressively engaged in e-retail business take orders directly through their websites and fulfill orders directly from their warehouses. The functions of a warehouse include:

- Maximizing the benefits of production and transportation economics
- Ensuring commitments to the customers
- Manage seasonal demand
- Provide space utilization and management

Thus, the warehouse becomes an important element of a supply chain. But it is expensive, as it accounts for 2 to 5 percent of the sales cost. Therefore, efficiently managing a warehouse by optimizing costs and utilizing space is a challenging aspect of supply chain management.

10.3.1 Free Trade and Warehousing Zones Act, 2005

Free Trade and Warehousing Zone was introduced in the Exim Policy, with the objective of facilitating import and export of goods and services. Basically, The Free Trade & Warehousing Zones (FTWZ) are a special category of Special Economic Zones, with a focus on trading and warehousing. Each Zone has ₹ 100 crores outlay and 5-lakh sq. mts built-up area. For the development and establishment of FTWZ, the Government of India has permitted 100% Foreign Direct Investment. Any new policy or amendment, related to the Free Trade and Warehousing Zone, is released, with the new Exim Policy 2008-2009, on or after 31st March 2008. The policy relating to Free Trade and Warehousing Zones is governed by the SEZ Act, 2005, and the Rules framed thereunder.

10.3.2 Warehousing (Development and Regulation) Act, 2007

Warehousing (Development and Regulation) Act, 2007 is an Act to make provisions for the development and regulation of warehouses in India. It has XI chapters, covering aspects like definitions, regulation of warehousing business, warehousemen, negotiability of warehouse receipts, the authority and powers of the central government, establishment of warehousing, appeals, offenses and penalties, etc.

Example: Zepto (A Major Player in the Q-Commerce Market in India) has set up a Network of "Micro Warehouses" to Ensure Promised Delivery in Less Than 10 Minutes

Zepto is an app based quick commerce (q-commerce) player in India promising to deliver groceries within a maximum of 10 minutes in major cities. It caters to new requirement of people who work from home and want ultra-quick deliveries to have instant gratification.

Contd….

Zepto delivers groceries, stationery items, medicines etc. within 10 minutes. The business model is based on establishing "micro warehouses" or also called dark stores which look like normal retail grocery stores in some inside streets but are only used for pickup and delivery. They are not accessible to public. These warehouses mostly store items which sell locally. They are closer to the customers also.

Source: Zepto - Humans of IT Companies, Zepto is set up in 2020-2021, Accessed on 30/08/2022

10.4 Functions of Warehousing

Warehousing serves many purposes in a supply chain. The functions of warehousing are classified into two major forms: economic benefits and service benefits.

10.4.1 Economic Benefits

Firms can gain many economic benefits through warehousing. These benefits are a result of the various uses, to which the warehouse can be put, such as for the consolidation of shipments, cross-docking, order processing postponement, and stockpiling. The decision to set up a warehouse usually depends on the economic benefits that can be derived through:

Consolidation

Consolidation involves using a warehouse as a point where the products are brought from various points, to be aggregated for later shipment to their eventual destination. Warehouses can be used to consolidate smaller shipments from several suppliers, which are to be sent to a particular customer. Consolidation of products has great significance in the retail industry. It is common for a retail organization to receive small shipments from suppliers, which are to be delivered to its many retail outlets. On the outbound side, instead of sending smaller shipments to retail outlets, products can be consolidated into a large order and can be delivered in a single shipment. Consolidation results in the reduction of transportation costs and inventory costs at retail outlets and manufacturing plants. The firm can derive maximum benefit from consolidation, by setting up a centralized warehouse and directing its manufacturing plants to use this centralized warehouse, instead of storing the goods at the individual plants.

Cross-docking

Cross-docking is the practice of unloading goods from inbound delivery vehicles and loading them directly onto outbound vehicles. By eliminating or minimizing warehouse storage costs, space requirements and inventory handling, cross-docking can streamline supply chains and help them move goods to market faster and more efficiently. Cross-docking is an important function of warehousing,

during which large shipments (consisting of orders of various customers) of the products are broken down to distribute them in smaller quantities to individual customers. The warehouse receives shipments from suppliers, and they are arranged in smaller shipments and delivered to individual customers/ retail outlets. It is like consolidation but without the storage of goods. Here, the warehouse acts as a transit facility. This process is called cross-docking. Thus,

Cross-docking too is widely used in the retail industry. Large shipments from various vendors arrive at the dock facility. These large shipments are broken down into smaller quantities, as required by the individual stores. Then these shipments are loaded onto the outbound trucks along with other products, which are to be delivered to the same destination/ retailer. The economic benefits of cross-docking are reduction in inventory costs because of negligible or zero inventory at the warehouse, and reduction in transportation costs due to consolidation, which ensures full-truckload deliveries to the retail stores.

Order Processing Postponement

Warehousing also facilitates the postponement of production. Warehouses make it possible to postpone or delay production, by manufacturing the product up to the penultimate stage at the manufacturing unit and then performing the final assembling/ process at the warehouse, according to the customer demand and requirements. Benetton, a leading clothing company, uses its warehouse facilities for postponement in its knit garments production. Using a unique technology, Benetton manufactures the knit garments but postpones the dyeing of the garment. Depending on the demand for a particular color, the company dyes the garments at the warehouse. Postponement is also used by contract manufacturers. Contract manufacturers make products for other labels. They postpone final packing and labeling until customer orders are received. When the customer order is received, the packing and labeling are completed, as per the customer requirements. The main benefit of postponement is improved matching of supply and demand. This reduces the risk of product obsolescence, as the product is made exactly in line with the demand. The second benefit is a reduction in inventory levels, leading to a reduction in total costs. Since the final processing is undertaken at the warehouse, instead of at the manufacturing facility, additional costs may be incurred. Thus, postponement is viable only, when the benefits outweigh the additional costs.

Stockpiling

Another economic benefit of warehousing is the possibility of stockpiling. Stockpiling is required for products with

i. Seasonal production-steady demand

ii. Seasonal demand-steady production

Seasonal production-steady demand occurs in cases, where the supply of raw material is seasonal, and demand is steady, throughout the year. This is very evident in the food processing industry, where the availability of raw materials like fruits is seasonal, but the demand for finished products exists, throughout the year. The raw material is stockpiled in the warehouse to be able to satisfy year-long demand. Seasonal demand-steady production occurs, when demand occurs for a short period in the year, while production is year-long. For example, demand for air conditioners peaks in summer and thereafter the demand remains low. However, the production of air conditioners goes on uniformly throughout the year and excess production is stored in warehouses, for sale in the peak demand period.

10.4.2 Service Benefits

Service benefits refer to the benefits derived from the improved customer servicing capability of the company, through warehousing. These benefits may not always result in reduced costs. For example, setting up smaller warehouses nearer to retail outlets, instead of a centralized warehousing facility may increase costs. But such warehouses may create increased value, through improved customer service in the marketing process, by making goods available, whenever they are required by consumers. Warehousing facilities can provide four specific service benefits. These are stock spotting, product mixing, product support, and market presence.

Stock Spotting

Stock spotting is used chiefly in physical distribution. It is used particularly by manufacturers, whose products are subject to seasonal demand. Instead of storing the inventory in a central warehouse throughout the year or shipping the goods directly from manufacturing plants, some amount of product is "spot stocked" in warehouses, close to key market areas, much before the anticipated demand period. This reduces the time to market the products, resulting in improved customer service.

Product Mixing

Warehousing facilities also act as product mixing sites. When a customer orders several different products, the warehouse assures that the products are picked up according to the requirements of the customer and delivered in a single shipment. The Distribution Centers (DCs) of retailers act as product mixing sites. The DC receives the supplies from various vendors. It then delivers shipments to individual retail outlets as a customized mix of products according to the requirements of each retail outlet. Stock mixing can help reduce the overall product storage in a supply chain. It also helps increase the efficiency of order filling and order delivery.

Production Support

Warehouses also provide production support through a steady supply of raw materials to the production facility. It ensures that the production process is smooth, even if there are supplier stock-outs, or transportation delays, by storing extra stock, known as safety or buffer stock. Thus, warehouses help in the timely and steady availability of raw material to the manufacturing plant.

Market Presence

Warehouses also support the marketing activities of the firm. For example, if a firm plans to launch a new product, then the product is stored in warehouses to meet the high initial demand. The existence of local warehouses, rather than a few distant large warehouses, supports the marketing department. Stock can be replenished quickly from local warehouses so that stockouts are avoided. This makes the firm more responsive to customer needs. Thus, the presence of local warehouses may help in increasing the market share, and consequently, it may improve the profitability of the firm.

Example: Benetton Group, (One of the Best-known Fashion Companies in the World) Deploys Automation Solutions in its Warehouse to Optimize Storage and Order Processing

Benetton Group is one of the best-known fashion companies in the world with around 4000 stores. It is well known for its iconic brands, United Colors of Benetton and Sisley. The company has chosen Dematic to automate its warehouse to optimize storage and "order processing". The company has been looking for solutions to make its picking process more efficient, flexible, and agile by reducing required space, and reduce picking times.

The new system will be implemented with 60,000 bins and orders will be picked by 53 "mobile robots" that go up to the top of the storage units and descend into the units to access the bins with the necessary items. The robots then transport the items to one of its 12 picking stations where the items are put together for further processing in production. The staff earlier had to travel long distances to pick individual items.

Source: Benetton Group Entrusts Dematic with Automation for Key Logistics Facilities in Italy | Dematic 28/09/2021, Accessed on 10/10/2022

10.5 Warehousing Activities

The product is usually reorganized at the warehousing facility. It arrives in bulk and is repackaged into smaller packs, for delivery to downstream customers. A large lot of the product arrives from the manufacturing plant at the regional Distribution Center (DC). This large lot is broken down into smaller lots and sent to different destinations. The size of the lot decreases as it moves down the supply

chain. The manufacturing plant may send the product in pallet loads to the DC. The DC may send the product in cases to local warehouses. And the local warehouses may send the inner packs to retail outlets. Thus, in a typical warehouse set-up, the activity flow is as follows: the warehouse receives the bulk shipments; stores them in an organized manner for efficient retrieval; retrieves and sorts the product as per customer requirements; and, ships them to the ordered locations. These activities can be clubbed under three broad heads- product movement, product storage, and information transfer.

10.5.1 Product Movement

Product movement takes place in four distinct phases:

Receiving inbound shipments: This activity starts with the dispatch of an advance intimation, regarding the arrival of goods at the warehouse, so that the personnel there can plan the activities that follow the arrival of a shipment. On arrival of the shipment, it is unloaded, and the contents are scanned so that the arrival information is logged into the warehouse management system. The shipment documents are verified. The quantity and quality of the goods are also checked for damage, wrong dispatch, incorrect quantity, etc. Normally receiving costs constitute 10% of the operating costs of the warehouse.

Transfer of goods: Before deciding to store the product, an appropriate location for it should be determined. Determination of the location is important to achieve speed and efficiency, at the order-picking stage. The appropriate location can be determined, either by physical checking or through computer-based systems. After the product is stored, its location must be entered into the warehouse information system. This helps the order pickers to locate the product, at the retrieving stage.

Order picking of goods: Order picking of goods is done when the customer order is received. The product is retrieved from storage and assembled and packed according to the specifications of the customer and the order is made ready for outbound delivery to the customer location. Order picking costs form a major component of warehouse operating costs. Typically, 55% of the operating costs are incurred, during the order picking process. It also consumes more time than any other warehousing activity. This is largely due to the time required for searching for the product and retrieving it from the warehouse.

An order-line states the quantity of a single article, to be picked from a particular location. Several order-lines together make up a pick order. The entire order picking process consists of scheduling the customer orders, releasing them to the floor, picking the articles from storage (usually racks), and disposal of the picked articles.

Shipping of orders to the customer using a suitable mode of transportation: This also includes the preparation of the necessary shipping documents.

10.5.2 Product Storage

Product storage is the prime activity of a warehouse. Products may be stored temporarily or semi-permanently. Temporary storage refers to the storing of a product required to replenish immediate/ daily inventory needs. Semi-permanent storage is used to store the extra stock for emergency needs. This is also known as safety stock. The excess of the product, produced over and above normal demand levels, to serve anticipated peak demand, is also stored in warehouses.

10.5.3 Information Transfer

Information transfer occurs simultaneously with the two activities mentioned above. Information regarding product quantity and quality, space utilization, inventory levels, inventory location, and other information is stored in a system. This is used by management to assess the performance of the warehouse. This information is also used for formulating strategic and operational plans.

Example: Amazon is Testing a Robot Which Will Automate Functions of its Warehouses (Fulfilment Centres)

Amazon maintains huge warehouses to fulfil customer orders. The company continuously tries to automate the operations to achieve better efficiencies and customer satisfaction. It has been testing autonomous robot Proteus. This robot brings materials to the staff doing the order fulfilment job. It also brings materials to the machines which are involved in packing customer orders. The company is evaluating ways in which this technology can be operationalized in warehouses in a safe manner.

Source: https://www.vision-systems.com/factory/robotics/article/14281485/amazon-is-testing-an-autonomous-and-collaborative-robot Date: August 29,2022, Accessed on 30/08/2022

10.6 Warehousing Alternatives

A key decision in warehousing is to choose the type of warehouse or the combination of different types of warehouses to be used. There are three main warehousing alternatives - Private warehousing, public warehousing, and contract warehousing.

10.6.1 Private Warehousing

Private warehouses are owned/ leased and operated by private companies, which are warehouse-keepers. The warehouse-keepers use the warehouses to store their merchandise.

The facilities are either owned or leased. The decision, to own or lease the warehouse facility, depends on the firm's requirements. There are times, when the warehouses, which are already owned or leased by the firm, are not suitable for its warehousing needs. In such cases, the firm may use the services of real estate developers, who can develop and lease warehouses according to the firm’s

specifications. These arrangements are flexible as developers are usually willing to lease warehouses, even for five years.

The major benefits of private warehousing are

- Benefit of economies of scale
- Greater control regarding the operations of the warehouse
- Physical control over warehouses helps the firm to integrate the warehousing operations, with other processes of the supply chain.
- Control over costs. For the private warehouse to be cost-effective, the facility should have high throughput so that the company can achieve economies of scale. Fixed costs can be spread over a larger number of transactions. The facility needs a steady demand, to justify the maintenance of such a set-up.

10.6.2 Public Warehousing

A public warehouse is a storage facility operated by an independent warehouse company on its premises. Here a shipper can pay the warehouse company to avail of its storage and handling facilities. The primary difference between a private warehouse and a public warehouse is that a private warehouse handles the goods of a single manufacturer, while a public warehouse has multiple users. The public warehouse offers a wide range of services, including packaging, labeling, inventory management, and information transfer. In general, public warehouse fees are a combination of storage fees (per pallet or actual sq. footage) and transaction fees (inbound and outbound). Public warehouses fall into different categories depending on their operations.

A general merchandise warehouse is used to store goods that are readily handled, are packaged, and do not require a controlled environment. They are designed to handle general goods like household supplies, small appliances, etc. A refrigerated warehouse is used to store perishable items, requiring controlled temperatures. These warehouses handle food products, medicines, chemicals, etc. Commodity warehouses are used to carry bulk shipments, which require special handling considerations. Bonded warehouses are government-controlled warehouses, which allow firms to store goods before payment of taxes and duties. Companies can use these warehouses to place goods in storage, without paying taxes or tariffs. Here the warehouse manager bonds himself to the tax or tariff collecting agency to ensure payment of the taxes, before the warehouse releases the goods. Thus, a company can reduce the value of inventory stored, as they can postpone the payment of taxes for the stored inventory.

Specialty warehouses are designed to store and handle products that require unique types of facilities. For example, handling grain requires elevators, liquids require tanks, and tobacco requires barns.

There are many reasons, why a firm may opt for a public warehouse. First, using a public warehouse does not require the capital investment, required for setting

up private warehouses. Public warehouses also have lower variable costs than private warehouses, because of their higher productivity, lower personnel costs, and economies of scale. The reduction of variable costs can be passed on to customers, in terms of lower prices. Using lease space in public warehouses may also offer tax benefits.

The use of public warehouses offers the firm flexibility in changing the location, size, and the number of facilities. This gives the firm the ability to respond quickly to changes in customer demand, competitors' strategies, and other market conditions. Public warehousing also makes possible certain economies of scale. As the warehouse is used to store the products of several clients, it is generally a high-volume operation. Fixed costs can be spread over many users and hence the facility can be managed efficiently. Public warehouses also provide transportation economies. Since they handle the shipments of several vendors, the shipments, which are heading for the same destinations, can be clubbed together and delivered in a single shipment.

10.6.3 Contract Warehousing

Contract warehousing is a specialized form of public warehousing. Apart from offering lease space, the contract warehouse operators provide customized solutions, for an extended period. The risks associated with storage are also shared between the warehouse operator and the company. The shared risk and long-term relationship result in a lower cost to the firm than public warehouses. Contract warehouses are also beginning to expand the services they provide. The services include transportation, inventory control, order processing, etc. Thus, in essence, contract warehouse operators are third party logistic service providers, who offer high-quality services at lower costs than public warehouses. Fees for contract warehouses maybe transaction and storage-based, fixed cost plus, or a combination of the two.

Example: GXO Logistics (An American Global Contract Logistics Company) Adds $1 Billion Contract Value for its "Contract Warehousing" and "Contract Order Fulfilling" Service in One Quarter

GXO Logistics (trade name **GXO**) is an American global contract logistics company that manages contracted warehousing and supply chain services for clients like H&M. This is the largest pure play "contract logistics provider" with 869 warehouses (totalling 208 million square feet).

The company offers its customers, 'on demand warehousing' based on changing needs and the company does it with ease. The company also handles other services like order fulfilment on contract basis. In Q3 of 2021, it added $1 Billion contract value. The contract periods are from 2 to five years.

Source: https://talkmarkets.com/content/stocks--equities/gxo-logistics-the-makings-of-a-winner?post=337574 date: December 12, 2021, Accessed on 30/08/2022

Activity 10.1

Warehousing serves many purposes in a supply chain. The functions of warehousing are classified into two major forms: economic benefits and service benefits.

Identify the service benefits of warehousing and analyze each one of them, keeping in view a supermarket chain.

Also try to capture the sources of dissatisfaction, for customers visiting a supermarket in your neighbourhood and suggest a few improvements for making its warehousing processes more efficient.

Check Your Progress - 1

1. Which, of the following, is not a major function of a warehouse?
   a. Providing flexibility to the buyers and sellers in space.
   b. Serving as a point of information in the supply chain.
   c. Acting as a supply chain coordinator.
   d. Providing market support.
   e. Performing quality control checks.
2. What does Cross-docking mean?
   a. Breaking down large shipments and distributing them in smaller lots to individual customers.
   b. Safely storing material.
   c. Coordinating transfer of materials between warehouses.
   d. Accepting customer orders and executing them.
   e. Providing various customer services.
3. Which, of the following, does not happen in product movement from a warehouse?
   a. Receiving inbound shipments.
   b. Transfer of goods.
   c. Order picking of goods.
   d. Replacing goods damaged in transportation.
   e. Shipping of orders to the customers.

4. Which, of the following, is the most used form of a warehouse?
    a. Private warehouse
    b. Public warehouse
    c. Contract warehouse
    d. Joint warehouse
    e. Specialty warehouse
5. Which is the best advantage of a contract warehouse?
    a. Providing lease space
    b. Providing centralized services
    c. Risk-sharing
    d. Service basket
    e. Quality of services

10.7 Factors for Warehousing Strategy

Firms aim to adopt a warehousing strategy that enables them to serve customers effectively. A firm may use a private warehouse or a contract warehouse as a central distribution center and use public warehouses near its target markets as field warehouses. In general, central warehouses are used to meet the routine storage/ distribution needs of the firm as forecasted, while public warehouses are used to meet additional demand in the peak seasons. A company should formulate an integrated warehousing strategy for optimal utilization of its warehousing facilities. The two issues, on which decisions are required, are- i. the number of warehouses required, and ii. the type of warehouses that should be used.

A larger number of warehouses, close to the market areas, help in establishing a high level of customer service. But costs such as transportation costs, operating costs, and inventory costs, are high under such a strategy. A smaller number of warehouses reduce transportation costs and inventory costs for the firm. But this option is likely to reduce customer service levels and increase stock-out costs. Thus, the firm must make trade-offs based on its organizational requirements and market conditions. Some of the factors that need to be considered in deciding the number of warehouses required are listed below.

- The level of customer service desired,
- Stability of customer demand and location of customers and their buying behavior,
- The amount of information transfer between manufacturers and consumers.

If the firm wants to maintain a high level of customer service, it should have more warehouses located near the markets. The nature of customer demand also influences the number of warehouses required. If customer demand is stable and continuous, then a few large warehouse facilities are required. On the other hand, if customer demand is uncertain, then a larger number of smaller facilities are required to manage the uncertainty. The amount of information transfer between manufacturers and customers also impacts warehousing decisions. If accurate information on the consumer reaches the firm, then the firm can forecast demand correctly, and undertake improved order- processing and delivery to its customers. This can help in deciding the optimal number of warehouses.

A firm considers various factors before selecting a particular type or a combination of various types of warehouses. Some of the qualitative factors that influence a firm's decision on whether to select a private, a contract or a public warehousing facility are:

- Presence synergies
- Industry synergies
- Operating flexibility
- Location flexibility
- Scale economies

10.7.1 Presence Synergies

Presence synergies refer to the benefits that are derived from warehouses, being in locations close to the firm's customers/ suppliers. A manufacturer may feel more comfortable if his suppliers have their warehouses close to his plants. This may require them to set up their own warehouses rather than use public warehouses. Similarly, some customers prefer local warehouses for certain kinds of products. The customer will be looking only at availability in the retail outlet and is not concerned about, which warehouse it comes from. In such cases, the firm may use private and/ or contract warehouses, to provide better customer service, through better distribution of products.

10.7.2 Industry Synergies

Companies benefit from a location that is close to other firms catering to the needs of the same or similar industries. For example, firms that supply spares to automobile manufacturers can share a public warehouse with suppliers of other automotive spares to the same set of manufacturers, so that they can benefit from lower transportation costs, through consolidation of shipments sent to the final customers (automobile manufacturers). Thus, when a firm is situated near other firms servicing the same industry, it can select public warehouses and/ or contract warehouses, to derive benefits from industry synergies.

10.7.3 Operating Flexibility

Some warehouse operators are more willing than others do to alter their operating procedures and policies and offer customized services to their clients. This is another factor that determines a firm's selection of a warehousing facility. Changing the policies and procedures of warehouses according to market needs is not possible in public warehouses. Policies and procedures in public warehouses cater to the common needs of the warehouses' major clients. Moreover, they prefer to maintain consistent policies and procedures when dealing with different clients. Therefore, if a firm requires a customized warehousing service, private warehouses are the best options. The firm can establish full operational control over private warehouses. Depending on organizational and customer needs, policies and procedures in a private warehouse can be changed. Contract warehousing also offers some degree of operational flexibility.

10.7.4 Locational Flexibility

The ability of a warehousing company to provide a warehousing facility near the firm's customers and to increase its warehouse facilities also influences the decision of the firm to use its services. This factor plays a major role in the warehousing decisions of firms, which experience seasonal demand for their products. During the peak season, such firms may want the warehousing company to provide more warehousing facilities near its market with a corresponding reduction of facilities during the off-season. Such flexibility is offered by public and contract warehouses.

10.7.5 Scale Economies

Scale economies are achieved when material handling costs and storage costs are reduced. This happens if the warehouses have a large storage capacity and can handle high volumes of materials and finished goods. Not all companies can establish warehouses for their own use that can achieve scale economies. Multi-user public warehouses and contract warehouses, on the other hand, are designed to handle high volumes and employ advanced technologies to manage the volumes, resulting in better scale economies.

Many public and contract warehouses now offer the customization and convenience that was previously associated, only with private warehousing. Due to competition and the high expectations of customers, public and contract warehouses offer customized solutions to their customers and provide a host of other value-added services such as packaging, inventory control, order processing, billing, etc. Some public warehouses offer integrated logistics services, where all the functions that a firm must carry out in the process of fulfilling the customer orders are taken over by the warehouse operator. Thus, the warehouse operator takes responsibility for the total order processing and delivery process. This gives the firm more options to choose from.

Another important consideration is the willingness of the company to outsource its operations. If the company thinks that outsourcing warehousing operations reduces its control over operations and its ability to serve customers well, then private warehousing is a better option for the company. But if it feels that outsourcing certain services can bring in more efficiency in its business operations and allow it to focus on its core operations, then public or contract warehousing is the right option.

Example: Maersk (The global warehousing and logistics company) is chosen by Pure Electric (A UK Based retailer for electric vehicles) for integrated factory to front door logistics support

Maersk is a Danish shipping warehousing and supply chain services company. The company provides customized warehouse operations as per customer requirements. It also provides end to end supply chain integrated service to its customers. The customers find in Maersk, a long-term strategic partner for warehousing and other supply chain services.

Pure Electric is a UK based electric vehicle retailer which is the fastest growing retailer in UK. Its two-wheeler and four-wheeler electric vehicles are sought after by growing client base. The company has growing warehousing requirements for its growing orders. It cannot allocate resources to manage this. So, the company chose Maersk which has entered a long-term contract to provide on demand warehouse requirements and handle the entre supply chain from factory to front door. So, the company can focus on its core business of designing and improving its electric vehicles portfolio

Source: https://www.maersk.com/news/articles/2021/05/13/if-you-want-to-go-fast-go-together 13th May, 2021, Accessed on 30/08/2022

10.8 Planning a Warehouse

The following points should be kept in mind when setting up a warehouse:

- Site analysis
- Product mix considerations
- Material handling equipment
- Warehouse design

10.8.1 Site Analysis

The first step, when planning a warehouse, is the selection of the site for the warehouse. The key factors in selecting a site are the cost and service factors. The transportation costs, set-up costs, operating expenses, taxes, insurance rates, etc. need to be evaluated. Service factors including proximity to markets, infrastructure, location of competitors, etc. need to be examined. It should also be ensured that there is sufficient room for expansion. There are several techniques

to help in choosing an appropriate site. These can be classified as gravity location models, optimization or linear programming models, heuristic models, and simulation. These models are covered in Unit 5.

10.8.2 Product Mix Considerations

Another factor, which needs consideration, is the product mix. The warehouse design depends on the product mix it is handling. Each product's annual demand, volume, weight, type of packaging required, etc. needs to be evaluated. This data helps in determining the warehouse layout, operational policies and procedures, material handling equipment, etc. If the product is delicate and of high value, then sophisticated material handling equipment needs to be used. If the product is heavy and occupies a lot of space, then the space utilization should be optimized.

10.8.3 Material Handling Equipment

The selection of material handling equipment is of great importance in setting up a warehouse. The type of material handling equipment used has a bearing on the warehouse design. The equipment selected should contribute to the smooth flow of items in and out of the warehouse and within the warehouse. The characteristics of the product determine the selection of equipment. Heavy-duty equipment is required for large and heavy goods. If the product is delicate, e.g. electronic items, then sophisticated and buffered equipment may be needed. Special equipment is required for products like fluids and gases. Examples of material handling equipment are fork-lift trucks, walkie-rider pallet trucks, towlines, tractor-trailer devices, conveyors, and carousels. Among the more recent developments is the use of robotics and information-directed equipment, where the movement of the equipment is directed remotely, without being directly operated by humans.

10.8.4 Warehouse Design

The three important elements of warehouse design are - design criteria, material handling technology, and storage plan.

Design Criteria

Design criteria determine the physical characteristics of the facility and the product movement requirements in the facility. They include the number of levels the facility should have, the height of the facility, and the product flow. An ideal warehouse should have a single level. A single level allows the horizontal flow of goods, without the need for them to be moved up and down. The height of the ceiling determines the utilization of space, with a higher height making possible better space utilization. Normally warehouses have 20-30 feet-high ceilings. Some warehouses have a height of up to 100 feet. But for the effective utilization of such great height, the material handling equipment installed should have the capacity to lift and place products at such heights, without damaging them and without causing accidents.

The warehouse design should enable the easy and smooth flow of products through the warehouse. The most efficient product flow is a straight-line product flow, where the product arrives at one end, is stored in the middle, and is shipped out at the other end. A straight-line product flow reduces congestion.

Material Handling Technology

The appropriate material handling technology can help in the effective and efficient utilization of the warehousing facility. There are two aspects, which need to be considered here: movement continuity and movement scale economies.

Movement continuity refers to the smooth utilization of material handlers. For example, it is preferable for a single material handler to make a single longer move, than for the product to be handled by several handlers to achieve the same result. In other words, the transfer of goods from one handler to another should be minimized. This saves time and reduces product damage in transit.

Movement scale economies are achieved when larger quantities of the product are handled by the material handlers. A warehouse should be designed in such a way that the shipments can be moved in groups of cases or pallets, rather than as individual units. This implies that the material handler is dealing with multiple orders at a given time. This reduces the number of activities to be performed but increases the complexity of the activity, as multiple orders are to be considered in a single activity.

Storage Plan

Flexibility in the storage of products is the key feature of a good warehouse design. The storage of the product depends on product characteristics like volume and weight.

If the product volume is high or the product is in high demand, then the product is stored in locations that minimize the distance to be covered, in reaching the dispatch area. The locations of such products may be primary aisles or low storage racks. Low-volume products are stored in locations (e.g. high storage racks), where they do not disrupt the movement of fast-moving goods.

The weight of the product should also be considered when designing storage in the warehouse. Heavy items need to be allocated to locations, where they can be retrieved without damage to the product or accidents to workers. Heavy items may be stored in open spaces or low storage racks. Lighter items may be stored in higher racks.

The other considerations, when designing a warehouse are:

- Whether the slot locations should be fixed or variable
- The degree of automation that must be employed in warehousing operations
- Protection for the product stored
- The scope for future expansion

Following Exhibit 10.1 illustrates the factors considered by organizations to prefer Coimbatore as a potential warehousing hub.

Exhibit 10.1: Coimbatore – The Cynosure for Warehousing

Coimbatore, an industrial city with a population of 1.7 million (2020), well-known as South India's Manchester, is fast emerging as a warehousing hub in India. It has become a place of attraction for e-commerce majors, third party logistics players, FMCG companies and manufacturers of consumer durables to prefer it as their warehousing hub.

The major factors that qualify a place as a warehousing hub are:

- Well-developed road infrastructure,
- Ability to cover a wide base of consumption demand and the quick access it provides to various regions through connectivity,
- Ease of distribution and
- Affordable land prices.

Factors Favouring Coimbatore

- Strategic advantage of being well connected to various regions within and outside Tamil Nadu by rail, road and air.
- Proximity to Kerala - Port of Kochi to cover the missing link for transportation.
- Land prices are relatively low when compared to Chennai and Bangalore.
- Established 5-6 warehousing corridors around the city meeting the requirements of auto, auto-ancillaries and spare parts manufacturing activity, third-party logistics players, FMCG companies, consumer durable makers and e-commerce majors.
- It is one of the major manufacturers of industrial components in India.
- Very hospitable city with ample manpower supply due to a host of educational institutions.
- Provides equal opportunities for warehousing and manufacturing which makes it an interesting geography because they are interdependent.
- The average range of warehousing transactions in tier-II locations vary between 10000 to 30000 sft. Coimbatore recorded an outlier last year with Amazon setting up a six-lakh sft warehousing facility.
- Coimbatore saw warehousing transactions to the tune of 5 lakh sft in 2018-19, which doubled in 2019-20 and is estimated to be 13 lakh sft for the year 2020-21.

Contd….

Major warehousing players operating from Coimbatore include IndoSpace, TVS Industrial Park and NDR Warehousing, Future Supply Chain, Alstom, Scheneider Electric, Safexpress and LG Electronics, Amazon, Flipkart and Reliance, Godrej, Hindustan Unilever, Philips and LG Electronics and B2B startup Udaan.

Source: South India's Manchester to Warehousing Hub: What Lures Flipkart, Amazon and Reliance, The Economic Times, E-Paper; https://economictimes.indiatimes.com/prime/economy-and-policy/south-indias-manchester-to-warehousing-hub-what-lures-flipkart-amazon-and-reliance-to-coimbatore/primearticleshow/83178043.cms, June 3, 2021 (Accessed on October, 10 2022).

Example: Auchan Retail France Plans to Deploy Robots for "Material Handling" in its Warehouse to Achieve Operational Efficiencies and Customer Delight

Auchan is one of the world's largest retailers with a direct presence in France, Spain, Portugal, Luxembourg, Poland, Romania, Hungary, Ukraine, Russia, Taiwan, and Senegal. It is based in France.

The company has warehouses designed and developed in many locations globally to support its operations. It has designed energy efficient warehouses to reduce its carbon footprint. The company also wanted to enhance its operational efficiencies while increasing customer satisfaction.

The company has been upgrading its material handling in its warehouses. Recently, it partnered with Balyo to deploy robots. Balyo will provide autonomous storage and retrieval of 2,000 high-rack pallets in Auchan warehouses.

Source: https://www.businesswire.com/news/home/20220524005852/en/BALYO-Signs-a-Commercial-Agreement-With-Auchan-for-the-Management-of-2000-Pallets-Within-Its-Fulfillment-Logistics-Platform date: May 24, 2022, Accessed on 30/08/2022

10.9 Managing a Warehouse

Good management of the warehouse is critical to the flow of products in the supply chain. If there is a disruption in warehousing activities, it could affect product flow to other members of the supply chain. For example, if there was a disruption in activities at the cross-dock facility, the products that have arrived at the dock may not reach the retail outlets on time, resulting in stock-outs. As the cross-dock facility may not have enough storage capacity to store the supplies, this will lead to serious storage problems. Thus, proper planning and coordination are required for the smooth functioning of warehouse operations.

To manage a warehouse efficiently, the following elements have to be properly executed.

10.9.1 Stocking the Warehouse

The warehouse has to be stocked efficiently so that space utilization is optimal. There are two common methods of stocking inventory in slots- the fixed-slot placement system and the variable-slot placement system (also called the dynamic slot placement system) they are:

- In the fixed-slot system, the product is assigned a permanent position, and this position is not changed, as long as the product movement and volume do not change.
- In the variable-slot system, the product position is changed, whenever a new shipment arrives, to accommodate the new shipment. This is done in order to utilize space effectively.

If the product volume changes then the product is reassigned to another position. Finding the product in a fixed-slot system is easier since the product is assigned a permanent position, unlike in the variable-slot system. But with advanced computer systems in use, a product can be located easily under either placement system.

10.9.2 Training Personnel

Human resources are important for the proper functioning of warehouses. Choosing the right personnel and training them well is of prime importance. Most personnel in warehouses are unskilled or semi-skilled and they have limited awareness regarding information systems and other technologies. Thus, as newer technologies are deployed in warehousing operations, training unskilled and semi-skilled workers becomes very important. Newly-employed personnel should be familiarized with the policies and procedures of the warehouse. Then, they should be given specific training according to their job responsibilities. Warehouse personnel can be categorized as administrators, supervisors, material handlers, laborers, etc. The firm should simulate situations to give them practice before they execute real orders. For example, material handlers can be asked to retrieve products for some simulated orders, so that they get hands-on experience, before undertaking actual work. Periodic training workshops should be conducted to keep personnel, abreast of new developments in warehousing.

10.9.3 Developing Standard Operating Procedures (SOPs)

For the smooth functioning of the warehouse, proper work procedures should be laid down. The management has to make sure that all the employees understand and apply these procedures.

Procedures regarding material handling need to be laid down clearly, as incorrect handling may lead to serious mishaps in some cases, and damage to material in others.

For order picking, two types of work procedures are followed, namely, individual selection and area selection. In individual selection, a single handler completes the total order, i.e. one handler picks all the products that are specified in the customer order. This results in the expenditure of more time and resources. In the area selection system, previously demarcated areas of the warehouse are handled by different employees, so several handlers, working cooperatively, complete the order in full. This saves time and resources because each handler is restricted to a specific area, and knows where all the items in that area are located, so retrieval is much more efficient.

There should also be specific procedures regarding the receiving and shipping of items. The inventory system needs updating, whenever merchandise is added to or taken from the inventory. The personnel involved in shipping operations should use the required loading procedures so that the shipments reach the right place at the right time. Well-laid out policies and procedures reduce shipment errors and make the management of inventory, such as the location of inventory, maximum space utilization, proper storage, etc., more streamlined and straight-forward.

It may be necessary to draw up procedures not only for the floor personnel in the warehouse but also for outside personnel, who interact with the warehouse personnel. Such outside personnel could include procurement personnel and marketing personnel. If the procurement personnel, for example, buy large quantities of an item in order to get a good price but fail to find out, whether there is sufficient space to stock it, the low price may not translate into low costs for the company. So, procurement personnel need to follow a set procedure of checking with the warehouse manager for space availability, before making large purchases. Similarly, the marketing personnel need to check with distribution center managers, regarding the immediate availability of the product, before making any commitments.

10.9.4 Security Arrangements at the Warehouse

A security system is required to protect the warehouse from pilferage and product deterioration. Pilferage can be reduced by enforcing proper security guidelines, regarding the movement of personnel in the warehouse. The personnel need to be checked thoroughly, before entering or leaving the facility. Only persons with valid permission should be allowed in. Unauthorized people should be allowed in, only after thorough checking. Computerized order processing systems and inventory control systems help in monitoring product movement. Radio frequency technologies are also being used to enhance security in warehouses. Radio Frequency Identification (RFID) is a technology, where a chip containing identification information of the product is embedded in the product. With this technology, the product is auto-identified and can be easily tracked and located. Using this technology, it is possible to be absolutely certain about the product movement. The items that are physically present are compared with the list of

items in the system. If any item is missing, the system alerts the manager. Security systems can also be programmed to sound an alarm when the product is lifted without authorization. In some cases, thefts are organized by warehouse employees in collusion with outsiders. Periodic checks and employee rotation can help in reducing such incidents.

10.9.5 Product Deterioration

Product deterioration occurs either, due to careless handling of the material or due to an improper storage environment, which is not compatible with the characteristics of the product.

Damage, due to careless handling, can be prevented by proper supervision of loading and unloading operations and proper training of the staff, handling the products.

Damage due to improper storage environment can be reduced, by studying the product characteristics and using an appropriate storage environment. The warehousing facility should have the required controlled environment, for the products to be stored in it and these should be properly maintained. If the correct storage environment is absent, the firm should look for alternative warehousing facilities.

10.9.6 Billing and Inventory Control

Managing billing and inventory is another important operation of the warehouse. There should be proper billing procedures, for shipments moving in and out of the warehouse. Many firms use computerized inventory control systems for the efficient management of inventory. When the order is received, it is recorded in the system. Then the products required are listed out, according to their placement in the warehouse. Periodic checks of the computer inventory against the physical inventory need to be made to identify discrepancies if any.

Example: GXO Logistics (World's Largest Contract Warehouse Company) Deploys Air and Ground Based Security Systems Across its Chain of Public Warehouses to Meet Customer Expectations on the Security Front

GXO logistics is the world's largest contract warehousing service provider. The company uses Air and Ground robotic technology to detect potential security issues in real time to make the warehouse safer for team members and secure the customer's products. GXO has already used these robots to conduct around 12,000 patrols or first-responder missions. In those missions, the teams investigated and cleared alarms, as well as completed video-verified security audits, saving miles of walk time for team members.

Source: https://www.stocktitan.net/news/GXO/gxo-enhances-security-and-safety-with-high-tech-drone-dog-and-aerial-jtod856no274.html date June 8, 2022, Accessed on 30/08/2022

Activity 10.2

Good management of the warehouse is critical to the flow of products in the supply chain. If there is a disruption in warehousing activities, it could affect product flow to other members of the supply chain. The importance of managing a warehouse is gaining more impetus, in view of intense global operations. In this context:

You are required to identify the activities involved in managing a warehouse.

In your response, specifically identify the precautions to be taken for the safety and shelf-life of items stored.

Check Your Progress - 2

6. Which is the most important factor for deciding the number of warehouses required for an organization?
   a. Level of customer services planned
   b. Location of customers
   c. Financial resources
   d. Availability of manpower
   e. Demand forecast
7. Which of the following is not a factor while setting up a warehouse?
   a. Site analysis
   b. Product mix considerations
   c. Political climate
   d. Material handling equipment
   e. Warehouse design
8. Which of the following is not an essential element for managing a warehouse?
   a. Stocking a warehouse
   b. ISO 9000 certification
   c. Personnel training
   d. Developing work procedures
   e. Security arrangements

9. Which is the most effective security arrangement in a warehouse?
    a. Deploying an adequate number of security personnel.
    b. Stationing the in-charge of supply chain management in the warehouse.
    c. Using Radio Frequency Identification (RFID).
    d. Keeping the warehouse, under the control of the marketing department.
    e. Keeping the warehouse, under the vigilance department.
10. Which is the main reason for the loss of food grains in warehouses?
    a. Rodents
    b. Pilferage
    c. Political interference
    d. Aging of inventory
    e. Poor maintenance of infrastructure

10.10 Summary

- Warehouses are facilities in the supply chain, where goods are held or stored. Warehousing affects customer service levels, stock-out rates, and sales and marketing success.
- Warehouses act as a bridge between the upstream members of the supply chain and the downstream members of the supply chain.
- The functions of warehousing are categorized into economic benefits and service benefits.
- The economic benefits include consolidation, cross-docking, processing/ postponement, and stockpiling.
- The service benefits that can be achieved through warehousing are stock spotting, stock mixing, production support, and market presence.
- There are three types of warehousing facilities that exist in the market- public warehouses, private warehouses, and contract warehouses.
- There are five important factors to be considered while developing an integrated warehousing strategy. They are- presence synergies, industry synergies, operating flexibility, location flexibility, and scale economies.
- The elements that go into planning a warehouse are- site selection, product-mix considerations, material handling equipment, and warehousing design.
- Various aspects of managing a warehouse include stocking the warehouse, training personnel, developing work procedures, security arrangements in the warehouse, preventing product deterioration, and billing and inventory control.

10.11 Glossary

Bonded Warehouse: A bonded warehouse is a secure warehouse, in which goods are stored until customs duty is paid or the goods are cleared for export.

Contract warehousing: It is a specialized form of public warehousing. Apart from offering lease space, the contract warehouse operators provide customized solutions, for an extended period.

Cross-docking: This is breaking down large shipments (consisting of orders of various customers) of the products, and distributing them in smaller quantities, to individual customers.

Industries synergies: Synergy, or the potential financial benefit, achieved through the combining of companies, is called industry synergy.

Presence synergies: Refers to the benefits that are derived from warehouses being in locations close to the firm's customers/ suppliers.

Throughput: It is a term used to describe the rate at which a company produces or processes its products or services. The goal behind measuring the throughput concept is often to identify and minimize wastage

Warehouse: Warehouses are facilities in the supply chain, where goods are held or stored.

10.12 Self-Assessment Test

1. Describe the nature and importance of warehousing in a supply chain.
2. Briefly explain the Functions of Warehousing.
3. What are the important Warehousing Activities?
4. Identify the Factors for Warehousing Strategy.
5. How is a Warehouse planned and managed?

10.13 Suggested Reading / Reference Material

1. Ashley McDonough, Operations and Supply Chain Management Essentials You Always Wanted to Know: 15 (Self Learning Management Series) Paperback – 1 January 2020.
2. Russel and Taylor, Operations and Supply Chain Management, 10ed, ISV Paperback – October 2019.
3. Chopra and Kalra, Supply Chain Management 6/e Paperback – 17 June 2016.

10.14 Answers to Check Your Progress Questions

1. (e) Providing quality control services

It is not a major function of a warehouse

2. (a) Breaking down large shipments into smaller lots for delivery

This is the meaning of cross-docking.

3. (c) Replacing goods damaged in transportation

It does not happen in product movement from a warehouse.

4. (b) Public warehouse

It is the most popular choice for a warehouse.

5. (c) Risk sharing

It is the best advantage of a contract warehouse.

6. (a) Level of customer services planned

It is the most important factor for deciding the number of warehouses required for an organization

7. (c) Political climate

It is not a factor for setting up a warehouse.

8. (b) ISO 9000 certification

This certification is not an essential element for managing a warehouse.

9. (c) Using RFID

It is the most effective security arrangement in a warehouse.

10. (e) Poor maintenance of infrastructure

It is the main reason for the loss of food grains in a warehouse.

Unit 11

Returns Management and Supply Chain

Structures

"To Maximize Bottom Line, Drive Every Return to its Highest and Best Use"

- Dan Gilbert, Vice President of Reverse Logistics for Cisco

11.1 Introduction

Any return will affect the bottom line of the company. So, the companies need to have processes in place to extract maximum value from returned items to maximize profits.

In the previous unit, we discussed the topic, Warehousing in a Supply Chain. The concepts covered included the benefits of warehousing, key activities that warehouses undertake, different types of warehouses, the factors that should be considered for deciding on the number and type of warehouses and finally, the key elements in managing a warehouse.

Returns management is a neglected area in supply chain management. It has received less importance compared to other functions like manufacturing, purchasing, etc., as firms are of the opinion that their prime responsibility is to put the product in the hands of the customer. With the rise in product offerings by companies, increased competition, and change in customer preferences, firms are burdened with a large volume of returns. This has led companies to think about post-sales activities, resulting in an increased focus on returns management. Returns management has also become a profit-generating avenue for many

retailers and manufacturers. Returns management can be defined as the physical handling and disposition of returns.

In this unit, we first discuss the need for returns management. Later, we discuss the strategic and operational processes of returns. Then, we examine different challenges that are involved in implementing an effective returns management process. Finally, we discuss how information technology can be used to improve the returns management process.

11.2 Objectives

By the end of the unit, you will be able to:

- Define reverse logistics
- Establish the need for returns management
- Explain the return management processes
- Discuss the options for disposition
- Identify the challenges in returns management
- Describe the role of information technology in returns management

11.3 Reverse Logistics

In simple terms, one can define reverse logistics as the reverse process of logistics. Generally, businesses viewed reverse logistics as a process that deals with recycling or disposing of products. But reverse logistics is defined in various ways, by different players in the supply chain. For example, a retailer defines reverse logistics as "a way to get the product that has been returned by a consumer, back to the vendor." (Buxbaum, 1998). Manufacturers view it as "a way of receiving defective products or reusable containers, back from the user." Council of Logistics Management defines reverse logistics as “the process of planning, implementing, and controlling the efficient, cost-effective flow of raw materials, in-process inventory, finished goods and related information, from the point of consumption to the point of origin, for the purpose of recapturing value or proper disposal” (Rogers and Tibben-Lembke, 1998). Reverse logistics can be discussed under three heads, they are:

- Packaging return and reuse
- Product recall
- Returns management

11.3.1 Packaging Return and Reuse

Packaging can be of two types. One is packaging that is used to display the product and to show product information to the consumers and the other is packaging used to transport the product consignments from manufacturers to the distributors and retailers or from suppliers to manufacturers. Packaging waste is

generated in about equal measure from the consumer`s front and the transport packaging. With the governments tightening the rules and regulations of packaging waste disposal, firms have taken steps to reduce packaging waste through a 'reuse and reduce' approach. Since firms have less control over consumer packaging, there is less scope for reuse. On the transport packaging front, as firms are in control, reuse is more prevalent. Transport reusable packaging consists of boxes, pallets, totes, and containers that are used to ship products from one place to another. These are designed in such a way that they can be reused over a long period and the waste generated from them is minimal. Another way of minimizing transport packaging is pallet pooling, which is a pallet renting service provided by a third party. Firms ship palletized products to the supply chain partners like distributors or retailers. The service provider collects the empty pallets from the partners and checks them for reusability. They are repaired if required and made ready for the next usage.

There are many benefits of transport packaging reuse. Savings can be achieved due to reduced purchase and disposal costs. The high quality of the returnable packaging ensures that products are transported in a more protected manner. This is important for sensitive products like sophisticated medical equipment, and PCs. Reusable packaging is suitable for firms that have the network to collect empty containers and have them returned to their facilities in a short time and with low costs.

Reusable packaging containers are suitable for firms that constantly move products in large volumes. The savings from transporting large volumes of products compensate for the costs incurred, in having the empty containers returned. A constant flow of goods suits the standardized containers that are reused, which would otherwise need to be changed if the volumes fluctuate.

Reusable containers are suitable for firms that practice milk runs to distribute goods to customers or to collect components from suppliers. Since transportation costs are less and there is frequent movement of goods, using reusable containers helps the firm to save costs.

11.3.2 Product Recall

Product recall is another important element in the reverse logistics process. This is important for automobile companies, where the recall of vehicles for repair or replacement is a common feature. A firm recalls a product for various reasons:

a) The product may be defective;

b) It may have design flaws;

c) Due to investigation or findings by government/ other agencies, or by the firm itself that reveal dangers and flaws in the product; and

d) Due to product tampering by outside firms.

Product recall is generally done when products have defects or design flaws on a large scale. Recalls by Toyota and Volkswagen in recent years is global news, because of their size and safety/environment-related violations. Invariably, all automobile manufacturers liberally practice this, one time or the other.

Product recall is prevalent in other areas like foods and beverages.

If the product recall is not managed properly, it may have long-term implications for the firm.

Product recall needs to be handled properly and completed quickly so that the damage or potential damage can be contained, in a short period, thus restoring the product's as well as the firm's image. In some cases, effective handling of the product recall can boost the public image of the company.

Product recall involves the following process:

- The firm first constitutes a dedicated cross-functional team, to deal with the product recall and oversee the smooth functioning of the process.
- The firm then decides upon the course of action, depending upon the impact of the defect or contamination of the product on the consumer.
- If the defect poses a risk to consumer safety or health, then the process is expedited. A decision is taken to replace the defective part or replace the product itself.
- The next step is to transmit the recall information to the retailers, service centers, and end consumers. This comprises product information, i.e. name of the product, model and year of manufacture, problem that is associated with the product, degree of risk or danger to the consumer, and how to proceed with the product recall process.
- The final step is the actual recovery of the product. The product needs to be completely removed from circulation in the market place.

The product recovery needs to be done in collaboration with the supply chain partners. While the product can be recovered fully from a distributor and to a larger extent from the retail outlets, the product that is in the hands of the consumer cannot be recovered completely. For this, the firm has to offer incentives like discounts on other products, extended warranty, freebies, etc. The dealers play a key role in the product recall process as they are the ones, who are in contact with the customers. So, the firm has to closely interact with the dealers and provide them with reimbursements and commissions, for carrying out the product recall operations.

11.3.3 Returns Management

Returns management deals with the efficient handling and disposition of returns. It is a broad concept, which includes informational support for the entire process

in the supply chain. It can be defined as the management of returns across the supply chain that includes return approval, transportation coordination, tracking the returns, receipt and disposition of the return, and crediting money to the customer account.

Of all the above processes in reverse logistics, returns management is the more complex and key process from the supply chain point of view. Product recall is one time or a short-term process. Packaging returns can be managed more easily, as they are limited and can be tracked and controlled. Returns management is a continuous and more complex process, as it involves many steps and players in a supply chain. Complexity of the process is due to volumes and volatility in the returns from customers and supply chain partners. The returns cannot be tracked easily as the firm is not in full control of the process. Returns can originate from customers as well as supply chain partners and can be of various types.

What are the returns?

Returns can be defined as those goods, which are unwanted or damaged and are sent back to the manufacturer or retailer for repair/ replacement, or a refund. Returns originate from two sources- from the end consumers or the supply chain partners.

Returns can be categorized in the following manner:

Close-Outs: Second quality products that the retailer wants to stop carrying in its stores. These goods are sold at reduced prices to outside firms.

Buy-Outs: To gain shelf space, a supplier or manufacturer may buy-out a competitor’s products from the retailer's shelves. This is also beneficial for the retailer when it wants to dispose of slow-moving products and stock fast-moving goods.

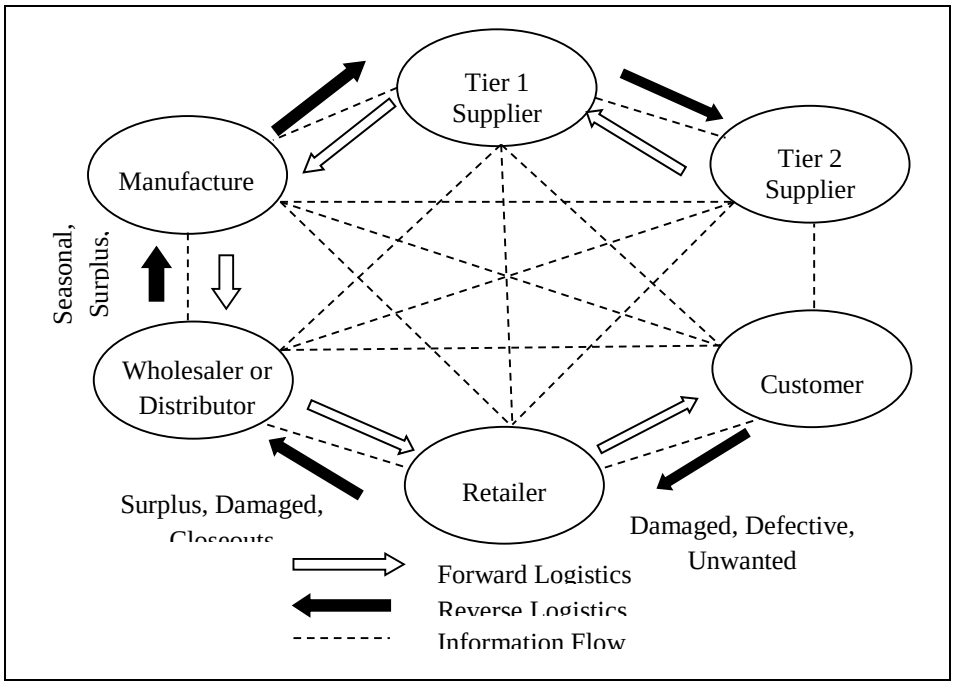
Seasonal items: These are leftover items at the end of the season. For example, woolen clothes those are unsold at the end of winter. These products are either returned to the manufacturer or sold to firms specialized in dealing with such products.

Surplus: These are items of first quality, which exist due to an inaccurate sales forecast or because the retailer has bought a product in excess, to take advantage of special promotions.

Defectives: These are items, which customers or retailers detect as defective. They are replaced with new items or compensated for, by the manufacturer.

Salvage: These are items that are used or damaged either in transit or at retailer/ customer location. This category of returns is disposed to salvage the value of a product. Figure 11.1 shows flow of returns in a supply chain.

Figure 11.1: Flow of Returns in a Supply Chain



Source: ICFAI Research Center

Example: Ikea Recalls "Made in India" Troligtvis Travel Mugs from 400 Stores Globally

Ikea India recalled "Made in India" Troligtvis travel mugs from 400 stores globally. The decision was based on test reports that the mugs might contain some chemicals beyond the prescribed limits. The company did not promise any compensation. They said, they are doing it as only a precaution and that they are no health hazards involved. They wanted the buyers to go to the nearest store and deposit the mug. Most of the customers did not take the trouble to return a low value item (some $2) as the cost of returning is more. The company also arranged for safe disposal and additional cost of handling the returns. The more serious issue is pinpointing "Made in India". This observation will affect future growth of its business in India.

Source: https://scroll.in/article/953429/ikeas-decision-to-recall-troligtvis-travel-mugs-casts-a-shadow-over-its-future-in-indian-markets February 20, 2020, Accessed on 31/08/2022

11.4 Need for Returns Management

Returns management is practiced by firms for three reasons-legislative, economic, and competitive.

Legislative factors: For the past several years, concern for environmental matters and sustainable development has been on the rise among consumers, bureaucrats, and corporates. Governments have passed stringent legislation regarding the disposal of residual products and discarded products. Governments are putting

the onus on manufacturers and suppliers for the proper disposal of products generated from post-consumer activity. This has prompted corporates to evolve returns management programs that would comply with the rules formulated by the government.

Economic factors: The economic benefits that a firm can obtain also led companies to focus on returns management. Companies are realizing that proper returns management not only reduces costs but also helps the firm, in recovering investment and generating revenue. Firms can recover the investment, through proper recycling and reuse of the returned products. Automotive companies are recycling and remanufacturing parts and using them in their production process or selling them at a lower price, with the same warranty as new parts

Competitive factors: Proper returns management can also give the firm a competitive edge, in the marketplace. A customer-friendly returns policy, with faster and easy returns processing, increases customer satisfaction, thus, giving it a competitive advantage. The liberal returns policy of Sear's, an American Departmental Stores, was one of its key success factors. Effective returns management is especially important, for online retailers. Online buyers have often cited a customer-friendly returns policy, as a motivating factor for purchasing a product.

Example: Marks and Spencer's Extends Return Policy During Christmas as a Customer Friendly Gesture

Marks & Spencer has returns policy where customers get 35 days to return or exchange an item with a receipt. The company made an exception to this policy during Christmas as many customers get gifts which they may want to return or exchange. This is only to be customer friendly and considered as part of customer loyalty strategy. Even if 35 days are over, customers can return up to Jan 9, 2022. If the item is not faulty, the customer pays for delivery costs for return.

Source: https://www.chroniclelive.co.uk/news/uk-news/christmas-present-unwanted-return-receipt-22504200 25th December 2021, Accessed on 31/08/2022

Activity 11.1

Returning a wrong or bad product has been in practice, since long. But, with increased economic activity, online shopping, etc., returns management attracted management attention.

One very familiar item, where returns management has become a focused area, is cars. Large scale call back of cars by Toyota, Volkswagen exposed many deficiencies, in supply chain management.

You are required to analyze various reasons for returns management, across various industrial sectors.

With a specific focus on the automobile industry, take either Toyota or Volkswagen and analyze the reasons for their large-scale recalls. Classify the reasons as design defects, manufacturing faults, and supplier-related problems.

Check Your Progress - 1

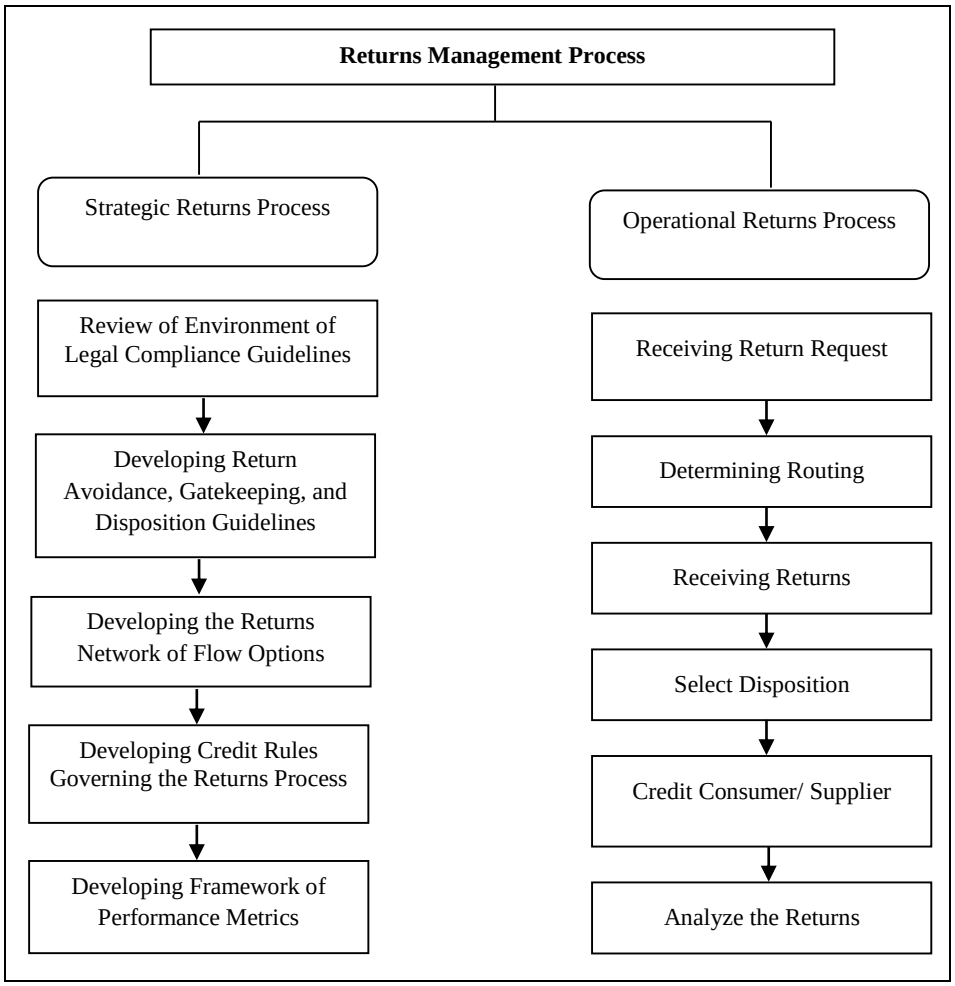
1. Which of the following statements best suits the meaning of Reverse Logistics?
   a. Cancellation of all previous transactions with the customers.
   b. Following all the processes performed, while delivering products to customers in the reverse order.
   c. Doing what the customer wants the supplier to do, at the end of the life of a product.
   d. Changing the suppliers of all services previously provided.
   e. Taking back supplied products and salvaging useful items.
2. Why are products usually recalled?
   a. When deficiencies are noticed, after supply
   b. When customers complain
   c. When the company is closed
   d. When the product support is missing
   e. When a new model of the product is ready for release
3. Product recall is very frequent, in the Automobile industry. What could be the main reason?
   a. Fuel efficiency
   b. Review of Design
   c. Safety
   d. Profitability
   e. Reverse Engineering
4. Which is the most important advantage of efficient Returns Management?
   a. Enhancement of company image
   b. Ensuring customer loyalty
   c. Efficient waste management, to generate wealth from waste
   d. Helping local municipal administration in the garbage disposal
   e. Salvaging materials

5. Which, of the following, is the best option in returns management?
   a. Recall
   b. Disposal from the customer site
   c. Bringing to the origin of supply and managing suitably
   d. Retrofitting and supplying as seconds
   e. Selling scrap to the highest bidder

11.5 Returns Management Processes

Returns management involves various processes. These processes can be classified under two heads- strategic returns process and operational returns process. The strategic returns process deals with developing an overall framework so that returns management can be performed smoothly and cost-effectively. The operational returns process deals with the actual management of returns. Figure 11.2 summarizes the returns management process.

Figure 11.2: Returns Management Process



Source: ICFAI Research Center

11.5.1 Strategic Returns Process

Proper systems and procedures to manage the returns process can help the firm to cut costs, improve customer service, and bring in profitability for the firm. These guidelines and procedures are followed by the personnel, who actually deal with returns management.

The following steps are involved in the strategic returns process.

Review of environmental and legal compliance guidelines

The first step in the strategic returns process is to review the environmental and legal compliance guidelines. Due to increased emphasis on a clean environment and sustainable development, governments have enforced stringent legislation and tightened the regulatory environment, in dealing with the processing and disposition of returned and discarded products. This has made it necessary for firms to periodically review the environmental and legal guidelines, to check, whether their returns management process is in conformance with government guidelines.

Developing return avoidance, gate keeping, and disposition guidelines

The next step is to formulate the guidelines for returns avoidance, gate keeping and disposition of the returned products.

Returns avoidance

Returns avoidance aims to reduce returns through manufacturing and selling the product in a better way. For this, the firm needs to identify the root causes behind the returns and develop corrective action plans. The firm may take steps, to improve product quality, which would result in the reduction of returns. Another way of avoiding returns is to educate the salespersons and customers, on how to handle the products. This is important for products, which are highly sophisticated. If the salespersons are trained, they can in turn educate the customers. This would enable the customers to understand better the features and the limitations of the products, and reduce the returns that are generated, due to improper handling.

Another option to avoid returns is to adopt a zero returns policy, so that returns are handled and disposed of, by the distributors and retailers.

Zero returns is a process, where the manufacturer tries to pass on the responsibility of dealing with returns, to the downstream members of the supply chain. To support this, the firm offers incentives to the distributors or retailers to handle and dispose of the returns.

Before adopting such a policy, the firm has to thoroughly evaluate the pros and cons and implications to the firm. A zero returns policy eliminates control over the returned products. Such a policy may also affect revenues, as the firm has to

pay some commission to the retailers and distributors, for bearing this responsibility. The firm may even lose some lucrative business opportunities. For example, many apparel firms get substantial revenue from seconds and overstock sales, through their outlet stores. Adopting a zero returns policy, in such cases, is not advisable.

Gatekeeping

Proper gatekeeping guidelines can help firms save on time and costs like transportation for unwanted returns. Gatekeeping is necessary for various reasons. With a liberal returns policy, some customers abuse the policy and return products, which do not qualify for a return. Improper knowledge and lack of training of salespersons is another reason, for having proper gate keeping guidelines. Because of ignorance and lack of knowledge, products, which do not qualify for a return, are sometimes accepted by sales personnel, at retail outlets. Such errors add costs to the retailer and also the manufacturer. These can be eliminated, by following proper gatekeeping practices.

Disposition guidelines

Developing proper disposition guidelines not only expedites the returns management process but also helps the firm to obtain revenues. To develop proper disposition guidelines the firm needs to take a number of steps.

First, the firm needs to collect essential information on the following:

i. Composition of the products: The materials that are involved, the quantity, the value and the proportion of hazardous material in the products, etc. are evaluated.
ii. Nature of returns flows: The channels, from which the returns are more and from which they are less are identified. This helps in routing the returns quickly and efficiently.
iii. Demand for the remanufactured, refurbished, and recycled products within the company itself or the supply chain, or outside the supply chain.
iv. Product recovery options and their cost-benefit analysis. The technical feasibility and environmental impact, of these product recovery options, are also evaluated.

For this information gathering, coordination with the supply chain members is necessary. A firm-wise or supply chain-wise IT system can also help in obtaining faster and accurate information.

Various product recovery options can be employed in a firm. The firm needs to analyze, which options can be performed within the firm and which options need to be outsourced. Generally, remanufacturing is done in-house, while recycling is outsourced to third parties. As these options are interrelated, proper coordination among the supply chain partners is necessary.

Based on the above analysis, the firm has to set specific disposition guidelines.

Developing returns network and flow options

After determining proper guidelines for the disposition of the products that are be returned, the firm needs to decide upon the transportation and facility network, required to support the returns flow. The firm needs to decide, whether to set up dedicated facilities for handling returns or to use the existing distribution centers. The firm also needs to decide, whether returns handling should be decentralized or routed to a central returns center.

The firm needs to develop optimal transportation plans, by which the returns can reach their final destination quickly and, in a cost-effective manner. The transportation plan must consider the number of customers, their locations, the frequency and timing of pickups, and the value and importance of the returned products to the firm. Instead of accepting the returns from the customers through multiple carriers, firms can negotiate with the customers to route their returns through a few preferred carriers, who provide services at pre-determined rates, thereby saving on transportation costs. Firms may also consolidate the returned product shipments, to save on transportation costs.

Better coordination of return shipment deliveries, within the firm or the supply chain, improves the effectiveness of returns flow.

Developing credit rules governing the returns process

The firm needs to develop credit issuance guidelines for customers and suppliers, depending upon the status of the returned products. If the products are defective, the firm has to bear the shipping costs, but if the customer has changed his mind and wants to return the product, then the shipping costs need to be borne by the customer. Some firms provide a replacement for the product but not refund, and some firms give a partial refund. So, the firm has to set rules for the refund process.

A manufacturing firm has to credit the distributors and retailers, for the returned products. Manufacturing firms either replace the returned products or adjust the amount in payment transactions.

Another element of credit rules is the commission that needs to be paid to the retailer. If the firm is adopting a zero returns policy, then the firm sets a limit for the returns and compensates to that extent for the returns. So, if an FMCG company adopts a zero returns policy and sets a limit of 3% on returns for the retailer, the retailer can deduct 3% from the amount that is to be paid to the firm, in lieu of taking responsibility for returns disposition. The firm has to set rules governing those transactions. For this, the firm needs to establish credit policies and credit authorization guidelines. Proper information systems are needed to track and monitor the flow of returns, in a supply chain. Customers and retailers require timely and accurate credit for the returned products. Delay in the issuance of credit or discrepancy in determining the value of the returned products may

result in customer dissatisfaction. Errors like double crediting also need to be avoided.

Developing the framework of performance metrics

The final step in the strategic returns process is to develop performance metrics to measure the returns management performance. The firm needs to include indicators on how effectively the value is recovered from the returned products, costs of transportation, costs of returns processing, and cycle times.

11.5.2 Operational Returns Process

The operational returns process deals with the actual implementation of the returns management process. It starts with the customer placing a request to return the product and ends with the proper disposition of the returned item. The following steps are involved in the operational returns process.

Receiving return request

The first step in the operational returns process is to receive the return request. When a customer wants to return a product, he is either directed to return the product to the retail outlet or requested to contact the firm's customer service center through phone, fax, or the Internet. The customer service center then issues a Return Material Authorization (RMA), based on the business rules that are set by the firm for acceptance of the returned items, along with a mailing label, which is sent to the customer, either through post or online. RMA is an identification number given to the returned product, to track the product movement in the supply chain. After receiving the mailing label with RMA, the customer packs the returned product, attaches the mailing label to the top of the pack, and ships the package to the firm through a carrier. If the products are defective, the firm bears the shipping costs; if the product is non-defective and the customer wants to return the product, then the shipping charges need to be borne by the customer. In some cases, the firm provides a prepaid shipping label, which a customer can attach to the returned product and either wait for the logistics partner of the firm to pick up the product or drop it off at the nearest receiving center of the logistics partner.

Determining routing

Once the return request is accepted, the returned product needs to be routed to the right warehouse or the central returns center. The decision is based on the status of the returned product. The returned product is then sent to the determined destination and advance shipping notices are sent to the receiving center.

Receiving returns

At the warehouses and the central returns center, the returned products are received and verified with the original returns-notification information. The returns are then inspected and processed.

Selecting the disposition option

A proper disposition option is then selected, by evaluating the returned products. The decision is based on the guidelines that are developed in the strategic returns process.

Crediting consumer/ supplier

The next step is to credit the customers as per the guidelines developed in the strategic returns process. In some cases, the supplier takes back the returns. In such cases, the supplier has to credit the firm. So, the firm needs to track such transactions also.

Analyzing returns and measuring performance

The performance of the returns management is measured using the performance metrics developed in the strategic returns process. The root causes for the returns and return rates are evaluated. This helps the firm, in taking steps to minimize returns in the future.

Example: Amazon's "Operational Returns Policy" has Strict Gate Keeping Process

Amazon has a well-designed "returns policy" which has both strategic and operational elements taken care of. The policy tries to ensure the interests of sellers, buyer, and marketplace (Amazon).

When a product is received back under "Try before buy", the product is thoroughly checked for its condition by trained staff. The staff checks if the returned product is eligible for return as per company Return Policy. If returned products are not in acceptable condition, they will ship back to the customer and charge full price and delivery charges. If they are in good condition, the refund is paid to the customer and the item is returned to the shelves.

Some of them are sold to second hand discount sellers to save on inventory costs. Some of the items may be given to charities as per company policy.

Source: https://www.sunjournal.com/2022/08/24/lewiston-senior-citizens-brings-back-cribbage-league-on-sept-1/ August 24, 2022, Accessed on 31/08/2022

11.6 Options for Disposition

Disposition is the heart of the returns management process. Proper disposition, of the returned products, not only helps the firm to route the product to the right destination but also provides revenue-generating opportunities. The returned products are either resold or reused directly, or remanufactured or refurbished and then reused. Let us examine various disposition options that are used in the industry.

Disposition options can be discussed under three heads:

- Direct reuse
- Product recovery management
- Waste management

11.6.1 Direct Reuse

In this case, the products are reused or resold directly. This implies that the firm wants to sell the product, in an as-is condition or with minor modifications. This option does not require much effort and the firm can dispose of the product, in a short period.

The options under this head are return to the supplier; sell as new; sell through outlet or discount stores; and sell in secondary markets.

Return to supplier

A supplier takes back returned goods for various reasons. He may take back surplus items, at the end of the promotion period. He may also take back items, as an incentive for the retailer to provide better service to customers. By returning the unsold items, the retailer can avoid product obsolescence and stock new products. The supplier also takes back defective items and replaces them with new products. There are two reasons for the supplier taking back defective products. One is that by taking back the defective items the supplier can analyze the defects and rectify them. The second reason is that the supplier does not want the defective items to enter the secondary markets or other stores and reduce the demand for new products.

Sell as new

When the returned products arrive unopened or unused then these products can be resold as new. Care needs to be taken by the retailer or manufacturer to see that the products appear new and the customers are not able to detect that the products are being resold.

Sell through outlet or discount stores

Returned products are sold through the retailer's or supplier's own outlet stores or discount stores. This practice is more prevalent in the apparel industry, because of the unwillingness of customers to accept the returned products as new products. The products are sold at prices, which are much lower than the regular prices. By selling through outlet stores, the firm has control over the sale of returned products. By selling through its own stores, the firm can also protect its brand reputation, which may otherwise be affected when the products are channelized, to lesser known stores. Top clothing companies like Raymond, Arvind Mills, and Madura Coats have their own outlet store chains to dispose of overstock, returned items, and factory seconds.

Sell in secondary markets

Another option for the firm is to sell the products in secondary markets. Secondary markets consist of liquidators, wholesalers, and exporters, who buy the returned products, which the firm could not sell through outlet stores. The secondary market players either sell these items in their own stores or to other discount stores, which deal with such items. Websites and internet auctions are another source of secondary markets. Websites like overstock.com sell the surplus stock of various companies on their sites. Surplus goods are also sold, through auction sites such as eBay.

11.6.2 Product Recovery Management

If the items cannot be directly reused or resold, then they are reprocessed or reconditioned so that the firm can recapture value from the products. The aim of product recovery management is to extract the maximum possible value, from the returned products. The following are some options for product recovery☹ i) repair (ii) refurbish (iii) remanufacture (iv) cannibalize (v) recycle

Repair

This process involves repairing or replacing the defective parts so as to restore the product to working condition. The focus is on bringing the product into working condition rather than on making the product meet specific quality standards.

Refurbish

Refurbishing refers to the process of reconditioning the returned products to match the specified quality standards. The key parts are inspected and the defective ones are repaired or replaced. The quality standards for refurbished products are lower than those for new products. Refurbishing aims at enhancing the service life of the product. Maruti Udyog Ltd., India's largest car manufacturer, is looking at the used cars business, as one of its growth areas. Under the brand name TrueValue, Maruti buys used cars from customers, whose vehicles are less than four years old and have travelled not more than 60,000 km. The engineers at the TrueValue ascertain the value of the car based on 120 checkpoints. The veracity of the documents is also checked. These cars are then refurbished and sold to other customers.

Remanufacture

Remanufacturing refers to the process of upgrading the returned product, to match the standards of a new product. The returned products are disassembled and thoroughly inspected. The worn-out or defective parts are removed. New parts are fixed and the product is reassembled. For example, the used toner cartridges of computer printers are remanufactured by companies. Firms collect empty cartridges from customers at no cost. The cartridges are disassembled and thoroughly cleaned and inspected. The worn-out parts, if any are removed and new parts are fixed. Then toner is filled. These cartridges are made to the quality standards of the new cartridges but are sold at a lower price.

Cannibalize

Unlike remanufacturing, where the whole product is reused, cannibalization uses only a few parts of the product. The aim of cannibalization is to recover key parts of the product. Other parts are either recycled or disposed of. The parts that are removed are used in the remanufacturing, repair, and refurbishing processes.

Recycle

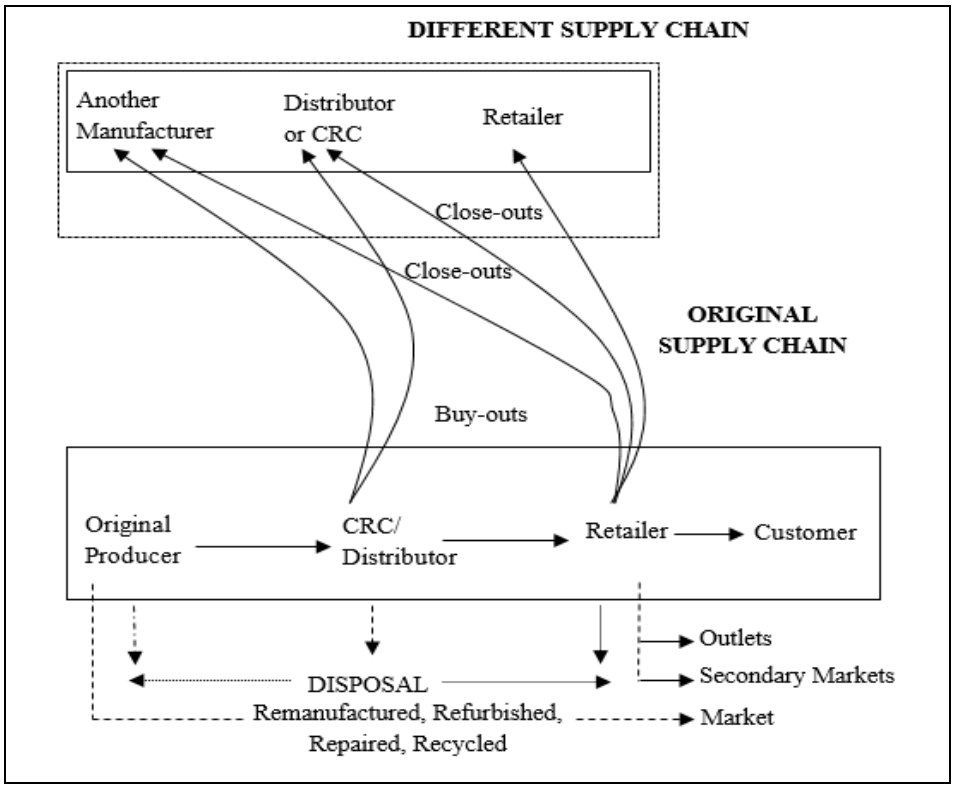
Recycling is used, when the parts and components cannot be repaired, refurbished, or remanufactured. The material in the returned products is reused. An example is the recycling of plastic and metal sheets from a returned car.

11.6.3 Waste Management

If no value can be recovered from the returned products or components, then the parts or products are either incinerated or sent to a landfill. There are costs involved in these processes. Stringent regulations often exist and heavy penalties are levied by governments for landfilling or incinerating products. Therefore, the firm has to evaluate the cost and benefits before making a decision. Any salvageable items can be recovered, before sending the returned components or products to the landfill.

Figure 11.3 provides the process of disposition of returned products in a supply chain.

Figure 11.3: Disposition of Returned Products in a Supply Chain



Source: ICFAI Research Center

From the above figure, the recycling process of returned goods is evidently different between the original supply chain and the revised one. Recyclers, like new manufacturers, have surfaced because of the increasing market potential. These manufacturers will have advanced infrastructure which is fully eco-friendly to create wealth out of waste.

Example: Green Wave Electronics recycled 23 Million Pounds of e-Scrap for its Customers and is Expecting to Increase by 25%

Green Wave Electronics is an Atlanta based electronics recycling and reuse company. It has opened new collection centres across US to meet increasing demand for its disposal services.

Green Wave's facilities are a 100,000-square-foot plant in Atlanta and a 200,000-square-foot facility in Indianapolis.

The company primarily collects IT equipment from client organizations but also offers a public drop-off and run public collection events in partnership with local governments. It shreds drives and dismantles/sorts e-scrap for recycling, and it refurbishes and resells used electronics through retail e-commerce channels and via wholesale to markets around the world.

Green Wave recycled 23 million pounds of e-scrap last year and is on pace to beat that number by at least 25% this year.

Source: https://resource-recycling.com/e-scrap/2022/07/21/logistics-factors-drive-processors-expansion/ July 21, 2022, Accessed on 31/08/2022

11.7 Challenges in Returns Management

The challenges, which the firm may have to overcome in the returns process, include:

11.7.1 Retailer-Manufacturer Conflict

Conflicts that arise between the manufacturer and the retailers over the condition, size, value, and response time, often, impede the smooth functioning of returns management. The retailer believes that if the products, which are returned in good condition, are found defective on arrival, it would be because of damage in transit or a manufacturing defect. The manufacturer suspects that the retailer is returning products that do not qualify for a return and abusing the returns policy. The value of the returns is also often an issue of contention, between the manufacturer and the retailer. The retailer expects a full refund for the returned products, whereas the manufacturer feels that the returned products are not eligible for a full refund. The issuance of credit is another reason for conflict. The manufacturer tries to postpone the credit for the retailer, until the next accounting period, to avoid the deduction of the value from the sales in the current accounting period.

Since manufacturers and retailers depend on each other for their growth, it is in their mutual interest to maintain cordial relationships. Through the formulation of proper gate keeping and credit rules, conflicts can be minimized.

11.7.2 Lack of Information

Another challenge for firms is the lack of information. Timely and accurate information regarding returns helps the firm to improve the handling and processing of returns. Information also helps the firm to identify the causes for the returns, which help in reducing the returns in the future.

11.7.3 Not Understanding the Importance of Returns Management

Companies consider adequate returns management to be less important than other processes and often do not commit time and investment, for its effective implementation. Many firms practice returns management only to comply with government regulations and, thus, adopt a reactive strategy. These firms are not looking at returns management as a tool to achieve a strategic advantage, customer satisfaction, and economic benefits. Further, by not adopting a proactive strategy towards returns management, firms are also losing revenue-generating opportunities and competitive edge in the market place.

Example: Booktopia (Australia's Largest Online Book Retailer) is to Pay Huge Fines for Misleading "Return Policy"

Booktopia is Australia's largest online book retailer. The company was not careful about its "return policy". It had to pay a huge price for that. The consumer regulator found that the company stipulation that the customers are eligible for returns only if they notify within 48 hours after purchase, was found to be not as per law. Also, some statements made by company representatives to some customers about "return policy" was not applicable for some products which were found to be faulty.

Source: https://www.channelnews.com.au/booktopia-earnings-hampered-by-fines-failed-mergers-restructuring/ 29th August, 2022, Accessed on 31/08/2022

11.8 Use of Information Technology in the Returns Management Process

Use of IT solutions, for automating the returns management processes, can reduce costs, and improve effectiveness.

Use of information can help the firm in four areas: product design, manufacturing operations, inventory management and product allocation, and customer negotiations.

Collecting information, regarding the returns process, helps the firm in identifying defects in its products; this can be communicated to the product design department so that the defects can be eliminated. By gathering feedback from

customers, the products can be fine-tuned to their needs and preferences, thus minimizing returns.

The returns information can be passed on to the upstream entities of the supply chain (the supplier or to the manufacturing department) so that errors in the manufacturing process can be identified and rectified.

Inventory management and product allocation can be done efficiently if a firm gets timely and accurate returns information. This is important, when the returns are good enough, to be sold as new. This enables a firm to decide how many additional units need to be sent to the retail outlet.

If accurate returns information is available and communicated across the supply chain, conflicts between the manufacturer and the retailer can be reduced. Because of the increase in transparency in return dealings, trust between both parties will improve. They can also analyze how the returns policies are used by the customers and identify opportunities for cost reduction.

Communicating the returns information in advance to logistics partners can enable them to make optimal plans for routing and shipping returns.

According to Daugherty and Meyers, the information systems support needs to be viewed, from three key dimensions- capability, compatibility, and technologies.

11.8.1 Capability

Information systems have to be capable enough to respond to the needs and changes in customer or organizational demands. In other words, information regarding returns needs to be easily and continuously shared, among members of the supply chain. This is important as product returns are highly uncertain and the information system needs to provide continuous support to the firm. This may also improve the relationship between the buyer and the seller. For example, if a firm has access to the customer order information stored in the retailer's system, it can provide prompt service to the customer, who wants to return the product. A manufacturing firm can take the right disposition decision if it has timely and accurate information.

11.8.2 Compatibility

Information systems should be compatible with the systems of the supply chain partners. As returns handling and processing involves interaction with various supply chain partners, compatibility with their systems enables the firm to take coordinated action. This results in an increase in the efficiency of the supply chain.

11.8.3 Technologies

Information systems also need to keep pace with the present technologies. The systems need to be upgraded with relevant and latest technologies, which possess more features and provide better service than the existing technologies.

Example: DHL Supply Chain Deploys ReverseLogix (Information System) for Returns Management Solution for Ecommerce Customers

DHS supply Chain is a global logistics provider and is part of the famous DHL group. The company's customers in the ecommerce sector are increasing manifold and DHL Supply Chain services to its customers also includes returns management. The company was looking for an integrated information system to support returns management for its customers. It found ReverseLogix platform.

With ReverseLogix, DHL Supply Chain can deliver on its mission to provide customers with a best-in-class suite of e-commerce solutions which include an end-to-end, purpose-built Returns Management System. The system connects and enhances the returns cycle and enables companies to streamline return requests, logistics, inventory, and processing.

Returns have become a critical factor in customer satisfaction for ecommerce customers. ReverseLogix can be accessed from a variety of devices and automated workflows enable to process returns more quickly following consistent rules. A 360-degree view of returns will help logistics teams identify issues fast, track key metrics, report results to customers and ensure high service levels.

Source: https://www.mmh.com/article/dhl_supply_chain_taps_reverselogix_for_returns_management_solution_for_ecom February 22, 2022, Accessed on 31/08/2022

Activity 11.2

Retail business by companies like Amazon made Returns Management an important area of sales promotion, ensuring customer satisfaction. While the return management processes are very cumbersome for the seller, it remains a confidence giver for the customers.

An interesting aspect for study is the way retail companies are ensuring profitability in spite of liberal returns management policies. Conduct a detailed study of what happens, after the products are returned by the customers.

- Identify major processes, which returned materials generally undergo, because such items can never be fully scrapped, or stockpiled, as waste material.
- Examine the environmental impact of returns and recalls.

Check Your Progress - 2

6. Which of the following is the most important issue in Returns Management?
   a. Environmental and Legal guidelines and their compliance
   b. Returns avoidance
   c. Compensation to the customers
   d. Savings/penalties from returns
   e. Disposal actions
7. Who issues Returns Material Authorization (RMA)?
   a. Regional Pollution Control Board
   b. State Excise Department
   c. Customer
   d. Customer service department of the supplier
   e. Quality Control department of the customer
8. Which of the following is the best approach for handling used computers, through Returns Management?
   a. Directly disposing of two dispensers from customer premises
   b. Product Recovery
   c. Waste Management process
   d. Return to the customer after retrofitting
   e. Direct reuse
9. Which of the following is the best option for Product Recovery in Refrigerators?
   a. Repair and return to the customer
   b. Refurbish and sell in the secondary market
   c. Remanufacture
   d. Cannibalize
   e. Recycle
10. Why do you think that Returns Management has become very important in recent times? (give the most important concern)
   a. Faster services demanded by customers
   b. Profitability goals of the manufacturers
   c. Technological obsolescence
   d. Depleting resources
   e. Government regulations

11.9 Summary

- Returns management or reverse logistics is a long-neglected area in supply chain management, as the focus of firms has been, only on how to move the products to the customers effectively.
- With increasing competition, changing customer preferences, and more stringent government regulations, firms are also focusing on the management of discarded and returned products.
- Returns management refers to the physical handling and disposition of returns.
- The strategic returns process involves devising returns avoidance, gatekeeping, and disposition guidelines, planning transportation and facility networks to support the returns flow, developing credit processing guidelines, and setting up performance metrics.
- The operational returns process involves receiving the return request, determining the routing of the product, choosing the right disposition option, credit processing and analyzing the returns, and returns management performance.
- The key challenges, faced by firms in the implementation of the returns management process, are retailer-manufacturer conflict, lack of information regarding returns flow, and insufficient focus on the returns management process.
- Information technology is playing an increasing role, in the efficient returns management process.

11.10 Glossary

Cannibalization- The process of pulling out useful components/ parts, from returned products for reuse.

Disposition- It is the process of disposing of the returned product, in the most efficient manner.

Product Recall- Taking back the product from the market/ customers, usually based on some deficiency found in the product.

Recycle: It is the process of creating the product or another product from the item which cannot be repaired or reused**.**

Refurbish. Refurbishing refers to the process of reconditioning the returned products to match the specified quality standards.

Remanufacture- Remanufacturing refers to the process of upgrading the returned product, to match the standards of a new product

Reverse Logistics- The process of managing product returns from customers.

RMA- Returns Material Authorization.

11.11 Self-Assessment Test

1. Explain in brief what is Reverse Logistics.
2. Establish the need for Returns Management.
3. List and briefly describe various returns management processes.
4. What are the options for disposition?
5. What are the challenges in Returns Management and what are the repercussions, if they are not effectively addressed?
6. Explain how Information Technology can be used, for more efficient Returns Management.

11.12 Suggested Reading / Reference Material

1. Ashley McDonough, Operations and Supply Chain Management Essentials You Always Wanted to Know: 15 (Self Learning Management Series) Paperback – 1 January 2020.
2. Russel and Taylor, Operations and Supply Chain Management, 10ed, ISV Paperback – October 2019.
3. Chopra and Kalra, Supply Chain Management 6/e Paperback – 17 June 2016.

11.13 Answers to Check Your Progress Questions

1. (b) Following all the processes

All the processes should be followed while delivering the product to the customer in the reverse order.

2. (a) When deficiencies are found/reported after delivery of the product

Products are usually recalled when deficiencies are found in the product delivered to the customers.

3. (c) Safety

It should be the most important concern.

4. (c) Efficient waste Management

It is the process of disposing off the waste material through recycle, reuse, refurbish etc. to create wealth from waste.

5. (c) Bringing to the origin and managing

It is the best option.

6. (a) Environmental and Legal guidelines

Their compliance is the most important aspect of returns management.

7. (d) Customer Service Department

It usually issues RMA after coordinating with all concerned.

8. (b) Product Recovery

It is the process of getting back a rejected product through repair, refurbishment, recycling etc.

9. (b) Refurbishing and selling in the secondary market

It is the best approach for consumer durables like refrigerators.

10. (d) Depleting Resources

Even though there are many reasons, Depleting Resources is the main reason for Returns Management.

Unit 12

Customer Service in a Supply Chain

Structure

"There is only one boss. The customer. And he can fire everybody in the company from the chairman on down, simply by spending his money somewhere else."

- Sam Walton

12.1 Introduction

For an organization to survive and grow, the customer is the fulcrum. If he is dissatisfied, the survival could be at stake.

In the previous unit, we discussed the topic of returns management and supply chain management. The concepts covered include the need for returns management, strategic and operational returns processes, various challenges that are involved in implementing an effective returns management process and how information technology can be used to improve the returns management process.

The ultimate aim of the supply chain management process is to satisfy the needs of customers, which determines all activities in the supply chain. This implies that every participant in a supply chain has a role to play, in ensuring customer satisfaction. The two key reasons, for the increasing importance of customer service in supply chain management, are- decreased significance of product

differentiation as a tool to gain competitive advantage, and increased expectations of the customers. Product differentiation is the marketing of similar products, with minor variations that are demanded by consumers when making a choice.

Advancement in technology and adoption of best practices by companies have reduced the effectiveness of product differentiation as a tool, for gaining an edge over competitors. If products of competing firms possess similar features, it is difficult to gain a competitive advantage based on product differentiation. This is evident in the PC industry, where the PCs offered by different companies are similar. Realizing this, Dell computers focused on making customer service the major differentiator. It adopted the strategy of offering customized products, and selling them directly to customers, without any intermediaries. The customers can customize Dell's product through the company's web site and buy them at the click of the mouse. Thus, by using customer service as a differentiator, Dell has done better than its competitors. The other reason for the focus on customer service is the increase in customer expectations. The market has become transformed from a seller's market to a buyer's market. Due to a variety of options, awareness, and globalization, expectations of the end consumers are increasing. To meet the increased expectations, firms are forced to adopt best practices and innovative strategies like JIT manufacturing, to avoid obsolete inventory of products. To support such strategies, firms in turn demand higher customer service levels from the suppliers. Dell computers, for example, uses JIT strategies in its manufacturing processes. It demands a higher level of customer service from suppliers to support its strategies. This has allowed Dell to maintain a low level of inventory of only 4 days. In other words, customer service is being viewed by firms, as a competitive advantage.

In this unit, we shall first examine the elements of customer service and discuss different methods of developing customer service strategies. Then, we shall look into the process of setting customer service standards. Further, we shall identify impediments to the implementation of effective customer service strategies.

12.2 Objectives

By the end of the unit, you will be able to:

- Identify the elements of customer service
- Examine the approaches to develop customer service strategy
- Explain customer service as a performance outcome to create a differential advantage
- Identify impediments to implementing an effective customer service strategy
- Discuss the use of technology in customer service, quality of service delivery, customer satisfaction survey

12.3 Elements of Customer Service

Customer service includes all activities that occur at the interface, between the customer and the company. The International Customer Service Association (ICSA) defines customer service as those functions within a business that have customer satisfaction as a responsibility and provide that satisfaction, through the fulfillment of sales, order, demand, and/ or information needs.

Customer service consists of:

- Pre-transaction elements
- Transaction elements
- Post-transaction elements

12.3.1 Pre-Transaction Elements

Pre-transaction elements focus on the readiness of the members of the supply chain to provide service to the customers. These elements help in establishing a good environment for customer service. They include written customer service policy, accessibility, organizational structure, and system flexibility.

Written customer service policy

A customer service policy is formulated based on an evaluation of the needs of the customer, the firm's capabilities and competitor's offerings. The policy is formulated after taking into consideration all the members of the supply chain. The policy should be unambiguous and specific. It should be communicated internally among the employees of the firm and also across the members of the supply chain. Table 12.1 gives the customer service policy standards of few supply chain members.

Table 12.1: Customer Service Standards

Supplier	Lead time, not more than 5 days
Retailer	Home delivery of goods within 12 hours. Returns accepted within 30 days.
Manufacturer	Order fill rate 98%. Lead time not more than 3 days.
Carrier	Delivery in 48 hours. Damage claims not more than 1%.
Restaurant	Order served within 10 minutes.
Airlines	Flights on-time 99%.

Source: ICFAI Research Center

Accessibility

Another pre-transaction element of customer service is accessibility. The company has to analyze, whether it is accessible to the customer. Does the customer find it easy and convenient to contact the firm?

Organizational structure

The organizational structure of a firm and the structure of its supply chain, as a whole, determine how effectively the firm or supply chain can provide service to the customers. The firm has to evaluate whether appropriate systems are in place, to deal with the customer service process. For example, if a company specifies that the product will be delivered to the customer within 5 days, the supplier, the manufacturing department, the warehousing facility, and the logistics provider have to collaborate, to deliver the product within 5 days. Thus the supply chain design should support the company's customer service policy.

System flexibility

A firm's flexibility, in meeting customer needs, determines its customer service capability. The firm has to examine, whether its systems are flexible enough, to deal with fluctuations in demand, supply disruptions, or specific customer needs.

12.3.2 Transaction Elements

Transaction elements are directly related to the delivery of goods or services. Customer perception of the company's service offerings depends on how actually the company is delivering the goods or services. The future relationship of the customer with the firm depends on how effectively the firm meets its customer needs in the present transaction. Thus, these elements help firms build profitable relationships with customers. Transaction elements include lead time, product availability, order fill rate, and order status information.

Lead time

Lead time refers to the time elapsed between the placement and delivery of an order. It has to be based on customer requirements. The company has to consider, whether the existing lead time is acceptable to the customers, whether the lead time can be reduced, and whether the company can provide consistent service to customers (as per the committed schedule).

Product availability

The availability of the product is another important transaction element that affects the company's ability to serve customers. The company has to determine how much demand it can satisfy with the products available at its facilities and arrange for replenishment on time to avoid stockouts. A high level of product availability enhances the level of customer service, as it allows the company to meet customer requirements effectively.

Order fill rate

The order fill rate refers to the proportion of the customer orders, filled within the committed lead time schedule. If the customer ordered 100 units and the firm could fill only 90 units, then the order fill rate is 90%. The fill rate varies with the

level of customer service and the type of customer being served. If the components are critical to the customers' operations, then the firm has to maintain a higher-order fill rate. If the components are not critical products, then the firm can maintain a lower order fill rate, which is acceptable to the customers.

Order status information

The firm should provide accurate order status information to the customers.

Dell computers, because of its best practices and state of art systems, can provide the customer with instant feedback regarding the order. When the customer places an online order, he can track the status of his order by using Dell's website.

12.3.3 Post-Transaction Elements

Post-transaction elements help in retaining the customers and maintaining long-term relationships with them. The post-transaction elements include the availability of spares, product tracing/ warranty, and customer complaints and claims management. These post-transaction elements become all the more important in the Indian context, where the life span of the product with the customers is very high. The average life span of a car in the hands of the customer in India is 7 years. This signifies the importance of post-transaction support in building long-term relationships with customers..

With the latest advances in information systems and forecasting tools, a firm can forecast the requirements of customers, with a reasonable level of accuracy.

This helps in identifying any problems beforehand.

Warranties positively influence the perceptions of customers about the firm's product or service capabilities. Intel Corporation offers a three-year warranty on its processors and motherboards, unlike its competitors, who offer a one-year warranty. The longer warranty makes the product more acceptable to the customers. The management of customer complaints and claims is another important area, in the post-transaction phase of customer service. Prompt redressal of complaints and claims increases the level of customer satisfaction. Many firms are now focusing on 24-hour customer care, through various channels of communication like service centers, call centers, and through the Internet.

The importance of the elements described above varies from company to company, and also from situation to situation. Some companies consider pre-transaction elements like accessibility, organization structure, flexibility, etc. more important. For example, a company preparing for a new product launch gives more importance to pre-transaction elements. The firms dealing with IT enabled systems see the post-transaction elements as key differentiators, since customers generally look for good after-sales support, when buying the IT enabled systems.

Example: ASSSA (Spain based Health Insurer) Provides Top Class "Customer Service" Through High Quality Trained Multi-Lingual Customer Support Team

ASSSA is an 80-year-old health insurer operating in Spain especially serving expatriates. The customer profile consists of people speaking multiple languages. The company believes providing top quality customer service is key to customer retention and there by ensure growth. The company has highly trained human resources who can handle customer issues in multiple languages on all aspects of services. The insured need to trust the company to take care when he feels ill. He needs staff who can talk with the needed sensitivity and address all concerns. The company provides lifelong coverage with best of doctors and hospitals to serve the patients.

Source: https://spanishnewstoday.com/the-importance-of-quality-service-from-a-health-insurer_1752699-a.html March 25, 2022, Accessed on 31/08/2022

12.4 Approaches to Develop a Customer Service Strategy

The firm has to follow an appropriate approach in identifying customer needs and developing strategies based on them, to maintain higher levels of customer satisfaction. In this section, we discuss six prominent approaches to customer service that help the firms in formulating customer service strategies. They are:

- Understanding customer reactions to product or service failures and stockouts
- Analyzing cost-revenue trade-off
- Activity-based costing (ABC analysis)
- Product-customer matrix
- Internal and external customer service audits
- Competitive position matrix

12.4.1 Understanding Customer Reactions to Product or Service Failures and stock outs

Customer reaction to a product/ service failure or its non-availability is an important factor to be considered while formulating a customer service strategy. The level of negative reaction of a customer (manufacturer), due to a product or service failure, depends on the impact of this failure on his ability to serve his customers. The greater the impact, the higher the level of the negative reaction. Hence, vendors supplying products/ spares critical to the production processes of their customers (manufacturers) should adopt a hyper-responsive customer service strategy, for their supply chains. The firm's guarantee of replacement or repair of the product free of cost will be an appropriate option.

Customer response to stock-outs also determines the firm's customer service strategy. A customer may respond to a stock-out, by shifting to a competitor's product/ service either temporarily or permanently. The firm should ensure the availability of the products to avoid the customers' shifting permanently to competitors' products.

While using the response approach, for developing a supply chain service strategy, a firm should analyze the costs that are incurred in providing service and the costs that arise due to service failures, at various levels of a supply chain. Based on the analysis, a firm can determine the optimal customer service strategy, which is cost-effective for the supply chain as a whole.

12.4.2 Analyzing Cost-Revenue Trade-Off

Another approach towards developing a customer service strategy is based on the cost-revenue analysis. It identifies the additional cost that it incurs on the additional services that are provided to the customers and the revenues that it receives on those services. The firm should understand the cost-benefits trade-offs, for various supply chain partners for the service delivered to the end customer in a supply chain.

12.4.3 Activity Based Costing (ABC analysis)

Another approach to develop the customer service strategy is activity-based costing analysis. It is used to identify the most important or profitable product or customer segments and provide higher levels of customer service to those segments, to retain them. Using this approach, the firm can identify strategic partners in a supply chain. Then it can jointly work with these partners to identify customer needs and cluster the customers, who have similar needs into groups. Later, the firm can determine the profitable products or customer segments. Joint efforts of the firm and its supply chain partners are focused on providing higher customer service to the customers in the target segment. Generally, firms set the same customer service level for all customers without understanding the needs of individual customers. Instead, if the firm identifies customer needs, and clusters customers having similar needs, it can provide different customer service levels, tailored to each cluster.

12.4.4 Product – Customer Matrix

A firm can set its customer service levels using a product-customer matrix. The matrix identifies various product-customer relationships. According to this matrix, there are two types of products: core and non-core products. The core products are of high value and are important to customer operations. Non-core products are not as important to customers as the core products. Customers are segregated into two categories: core and non-core customers. Core customers are the regular and bulk buyers of the company, while non-core customers are

one-time or occasional buyers. We now examine, how a supplier can determine customer service levels, depending on the needs of the customers and that of the firm. Table 12.2 summarizes the product-customer relationship.

Table 12.2: Product Customer Matrix

Products	Customers: Core	Customers: Non-core
Core	**1** Core customers Core products lead time 2 days	**2** Core customers Non-core products lead time 4 days
Non-core	**3** Non-core customers Core products lead time 5 days	**4** Non-core customers Non-core products lead time 7 days

Source: ICFAI Research Center

There are four quadrants in the matrix shown in Table 12.2.

i. Core customer/ core products

ii. Non-core customers/ core products

iii. Core customers/ non-core products

iv. Non-core customer/ non-core products

Core customers/ core products

The core customers, who regularly order the core products in bulk, constitute the first quadrant of the product/ customer matrix. Since the core products are key to the customer's operations and they are of high value, customers hold minimal inventory of the product and expect faster processing of their orders. Stockouts of these products can affect the customer, as well as the supplier adversely. The firm can cut short the lead time by keeping the inventory of products in local warehouses, closer to customers. Generally, a lead time of 2 days is acceptable to these customers.

Non-core customers/ core products

The second quadrant consists of small, one-time customers, who order core products in smaller quantities. This is where the firm faces difficulty, in determining the appropriate service levels. As the ordered products are core products, by meeting these orders, the firm may not be able to satisfy the needs of core customers in the first quadrant, who are key customers and offer a steady demand to the firm. The solution for this problem is to negotiate with the

non-core customers for a longer but reasonable lead time, so that the firm may have ample time to serve both non-core and core customers, in a satisfactory manner. As seen in the matrix, the company sets the lead time for this segment at 4 days. But the core customers in the first quadrant are set a lesser lead time of 2 days. By doing so, the company can have a time gap of 2 days between serving the core customers and non-core customers. During this time the firm can order extra safety stock from the manufacturing plant and store it in the warehouse, to cater to the unexpected demand, from the non-core customers.

Core customers/ non-core products

The third quadrant consists of core customers, who order non-core products. Improper distribution of non-core products increases costs and also disrupts the core product distribution flow. They accept longer lead times for non-core products since they hold the required safety stock and the products are not critical for their operations. Thus, the company can negotiate with the core customers for a longer lead time, say 5 days. This helps the company in keeping most of the stock in the distribution center and bringing it to the local warehouses, from where it is shipped to the customers as and when the demand arises.

Non-core customer/non-core products

The fourth quadrant is not so critical for the company, since the products and customers are not so important. Thus, the company can set the lead time for a longer period say 7 days **so** that it can bring in the goods from the distribution center to the local warehouse or ship them directly to the customers. Setting longer lead times also helps in giving priority to the flow of core product distribution.

Thus, the company can provide a high level of customer service by understanding the customer needs and differentiating the customer service for each group of customers, who have similar needs.

12.4.5 Internal and External Customer Service Audits

Customer Service Audit is another approach, by which the customer service strategy can be determined. Firms using this approach conduct both external and internal audits to determine the appropriate levels of customer service that a supply chain should provide. An external audit aims at identifying elements of customer service that affect the customer directly. It includes examining the required customer service level that satisfies the customer needs and implementing policies through which customer satisfaction can be enhanced. Internal audit aims at measuring the readiness and the capabilities of the members of the supply chain to provide service to the end customers, as per their requirements.

12.4.6 Competitive Position Matrix

Competitive position matrix compares the performance of the firm with that of the competitors, with reference to customer service and also studies customer perceptions about the service. Apart from identifying the services that are important to customers, the strength of the firm's service vis-à-vis competitors is also ascertained. Using this approach the firm can achieve both customer satisfaction and competitive advantage in the market. Table 12.3 exemplifies a generic competitive position matrix.

Table 12.3: Competitive Position Matrix

	Feature-1	Feature-2	Feature-3
Competitor 1	✓		✓
Competitor 2		✓	✓
Competitor 3	✓	✓	
Competitor 4			✓
US	✓	✓	

Source: ICFAI Research Center

Example: TELUS International (Telecom Company) Plans to Invest in Digital to Enhance "Customer Service" as a Strategy

TELUS, the telecom company is known for its high-level customer services compared to its competitors. It has been winning awards for its customer service. The company through an international survey has recognized that most of its customers want to avail services in digital channels so that it is available 24x7 and, they did not want to wait in queue for getting across to a human to get simple things like change of password. This feedback is driving the company to enhance its digital channels for customer service. Another finding is that customers are more concerned about their experience with the customer service team rather than bad product experience.

Source: https://www.forbes.com/sites/forbestechcouncil/2022/08/02/achieving-customer-loyalty-requires-an-investment-in-digital/?sh=31b08ef448e8 accessed on August 2, 2022

Activity 12.1

"You want to buy a car and after going through the pre-transaction elements of customer service of various brands, you have identified a particular make and go along with your family to the showroom of the company. How do you decide to buy, based on transaction and post-transaction elements of the customer service? You are required to identify other types of customer service and the elements thereof.

- You have decided to buy a car and go along with your family to a showroom.
  What are the aspects you will be discussing after deciding upon a model?
- Is the information gathered adequate to make a decision?

Answer:

Check Your Progress - 1

1. Which of the following is a Pre-transaction element of customer service?
   a. Lead Time
   b. Written Customer Service Policy
   c. Product availability
   d. Availability of spares
   e. Claims management
2. Which of the following is a transaction element of customer service?
   a. Accessibility
   b. Organization structure
   c. Order Status Information
   d. Customer complaints
   e. System flexibility
3. Which of the following is a post-transaction element of customer service?
   a. Accessibility
   b. Order fill-rate
   c. Order Status Information
   d. Warranty
   e. Lead Time
4. Which of the following is not important for developing a customer service strategy?
   a. Understanding customer reactions to product/ service failures
   b. Analyzing cost-revenue trade-offs
   c. Internal and External Audits
   d. Product-customer matrix
   e. Technology used for product/ service

5. What is the advantage of a competitive position matrix?
   a. To enhance customer satisfaction and competitive advantage
   b. To know the company's competitive position
   c. Just to identify how intense is the competition
   d. To find strategies to kill competition
   e. To develop better products and services

12.5 Customer Service as a Performance Outcome to Create Differential Advantage

Many firms concentrate on the activities or processes through which customer satisfaction is achieved and neglect the customer service outcomes that are required to create a competitive advantage. According to Bowersox and Closs (1996), different levels of customer service provide different types of outcomes, in terms of efficiency and effectiveness in the supply chain. Efficiency in a supply chain depends on factors like product availability, operational performance, and reliability. Effectiveness depends on services provided by the seller that aim at market access, market extension, and market creation. All these factors are discussed below.

12.5.1 Product availability

Availability refers to the firm's capacity to hold inventory when it is required by a customer. The availability of the product can be based on three performance measures: stock out frequency, fill rate, orders shipped complete. These three measures represent the firm's ability to meet customer requirements. *Stock out frequency* refers to the likelihood of situations, where the stock outs occur when demand outstrips supply. *Fill rate* refers to the percentage of units that can be filled from inventory when requested by a customer. For example, if the order is for 100 units and the firm has 95 units, then the fill rate is 95%. *Orders shipped complete* refers to a more stringent measure, as it considers the full availability of the product, as the measure of performance. If the product is available as and when the customer needs it, then the stock out costs can be minimized, resulting in efficiency in supply chain operations. Exhibit 12.1 shows Domino's dominant presence in India.

Exhibit 12.1: How Dominos conquered a large pizza market in India?

The operating model of Domino's in India: Domino's Pizza is an international pizza restaurant chain and the largest one globally based on retail sales. The company operates 16,528 stores globally as of the third quarter of fiscal 2019. Domino's has expanded fast internationally. It is a US-based pizza brand whose second-largest market is in India.

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In the Indian subcontinent, Jubilant Foodworks Limited operates the Domino's franchise. As of quarter 3, 2019, the number of Domino's Pizza stores in India was 1,259. Unlike its core market, the United States, its 30 minutes guarantee has remained operational in India. This guarantee was not just a promotional gimmick but a basic proposition around which the entire operational model of Domino's pizza in India is built. The enormous growth that Domino's is enjoying in India was based on its 30 minutes or free guarantee. Jubilant introduced Domino's in India in 1996 when the country had started opening itself to the outside world. Not many people were familiar with pizza and most believed it was just a snack. There were several challenges to introducing pizza in such a country and finding success. The CEO of Jubilant Foodworks limited also attributed the resounding success of Domino's Pizza in India to some cultural factors. At the time, the company introduced pizza, the market was not as ready and success was not really guaranteed. The concept of food delivery was not mainstream either at that time and in this way Domino's literally ended up creating an entire food delivery market. Due to the low disposable income, the Indian consumers were both highly demanding and price-conscious. When Jubilant introduced the thirty minutes or free promise, it seemed a risky proposition because the infrastructure and the traffic conditions would have made the company go bankrupt. Jubilant introduced it in 2004 and Domino's had already abandoned the promise in the US. However, Jubilant's gamble was a success which turned Domino's into India's largest Pizza player. According to the then CEO of Jubilant, people loved freebies in India and the kind of noise the 30 minutes or free guarantee created in India would not have been possible in any other culture. The promise helped Jubilant achieve two things: It encouraged the Indian consumers to try ordering food. Food delivery was not still a mainstream idea in India. Since there was the thirty minutes or free guarantee, Indians were assured that the food was going to be delivered really quickly. If food delivery was delayed for any reason, the Indian consumers were more than forgiving since they were getting the food for free. The thirty minutes guarantee really did wonders for Domino's and quickly India rose to become the restaurant chain's second-largest market.

Domino's Business Model in India: Domino's Pizza India catered to the needs of the Indian consumers for quality and reliable food delivered to their homes quickly. Compared to the other Pizza brands in India, Domino's charges a premium price. Apart from good quality food, the company also promises in time delivery for a premium price. This is something no other brand was able to achieve before Domino's. Domino's also offers premium dine-in services at domino's outlets. However, their business is built mainly around the home delivery model. Home delivery also constitutes the larger part of Domino's revenue from the Indian market.

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Operating Model of Domino's Pizza in India: The entire operating model of Domino's Pizza in India was designed around the promise of 30 minutes delivery. However, despite a lack of infrastructure and serious traffic issues in India, the way they were able to pull it off was no less than surprising. How they achieved it was through process standardization and by designing a system that made quick delivery possible at key locations in the leading cities of India. Apart from selecting the right locations for outlets, the company also designed its operations inside the stores in a manner that Pizza could be prepared and delivered within 20 to 30 minutes to the customers' address. Once an order is placed, it flashes on the screen and the team gets into action. It takes around 15 minutes to get the pizza ready and packed inside boxes. That leaves an estimated 15 minutes for delivery. However, due to the location of outlets, delivery can mostly be completed within 8 minutes of packing and it leaves 7 minutes extra for unexpected traffic congestions. Domino's has still ensured that more than 99% of the pizza orders are delivered on time.

Source: https://notesmatic.com/2020/02/how-dominos-conquered-a-large-pizza-market-in-india/

12.5.2 Operational performance

The ability of a company to provide effective customer service depends on the performance of its operations. Operational performance, in turn, depends on the objectives of the firm, the type of customer it handles, and the level of variance or unexpected disruptions in the operations, the firm experiences. There are three important measures of operational performance - lead time, operational flexibility, and consistency. *Lead time* is the time taken between order placement and order delivery. *Operational flexibility* refers to the firm's ability to respond to unexpected customer requests. If a manufacturer has shorter lead times and higher operational flexibility, the retailer's inventory costs come down. This enables the retailer to provide better services to the ultimate customer. This brings efficiency to supply chain operations. *Consistency* refers to the firm's ability to carry out the delivery of shipments on time, for most of the customer orders. Not performing consistently results in the customer holding more safety stock, to cover against the lead time delays.

12.5.3 Reliability

Reliability refers to the firm's ability to provide customer service dependably, accurately, and to the extent of the customers' expectations and gives a differential advantage in the market. If the firm provides reliable service, then the customer organization can plan its operations effectively and utilize its resources efficiently. This also reduces inventory required to counter uncertainties, resulting in a lowering of total costs. For example, if the supplier informs the manufacturer in advance, about any delays in delivering shipments, the manufacturer can look out for alternate solutions to tackle shortages.

Another aspect of reliability is a continuous improvement by the firms. Firms come across many errors and malfunctions in their operations. The aim of the firm is to provide a service with fewer errors and malfunctions. For this the firm has to analyze the occurrence of errors and malfunctions and incorporate changes accordingly, to prevent their recurrence.

12.5.4 Market access

The first step towards achieving service effectiveness is to provide better market access to potential supply chain participants (customers, suppliers, etc.), by sharing information with them. Firms try to achieve this by providing a higher level of customer service to those customers, who cooperate with them in fulfilling joint objectives and share information with them, for effective and efficient functioning of both the firms. For example, P&G offers a higher level of customer service to Wal-Mart, as Wal-Mart cooperates with P&G, to achieve their joint objectives, and shares information on customer characteristics and the movement of P&G products.

12.5.5 Market extension

Market extension services involve providing value-added services that attract new customers and enhance the firm's relationship, with the existing customers. A supplier may provide a higher level of customer service and more value-added services, to win more business from the customer. For example, a third-party logistics firm may provide not just logistics support but also inventory management and other value-added services, to retain and get more business from its customers. Such services are more important in the SCM context since it helps in achieving supply chain integration. If the supplier can perform a particular operation effectively and at a lower cost than that incurred by the customer, entrusting that particular service to the supplier results in lowering of total costs and establishing an efficient supply chain.

12.5.6 Market creation

Market creation level services are aimed at creating new markets, by working along with other supply chain partners. Some suppliers are so committed to the customer that the supplier virtually acts, as a part of the customer’s setup. The automotive industry is a typical example of such relationships. Some suppliers working for Toyota Motors virtually function as subsidiaries. They cooperate with Toyota for implementing joint productivity improvement measures. The personnel of both firms are exchanged. The suppliers are part of new product development initiatives. Toyota often has equity stakes of more than 20% in these companies. Thus, the firm jointly works with the other firms in the supply chain, to provide a higher level of service to the end-customer.

Example: Acutrack (Leading Book Printer and Order Fulfilment Service) Offers Publishers and Author-Publishers Value-Added Services to Improve Profits and Customer Services

Leading book printer and order fulfilment service Acutrack is a leading book printing and order fulfilling service provider. The company offers free ecommerce integration services to its members. Acutrack's technology-driven platform is one of the most efficient and cost-effective ways of printing and fulfilling book orders.

Acutrack allows authors and publishers to send collateral or other materials with book orders. The option of customizing packages is also there. These value-added services can improve both profits and customer service.

Source: https://www.prweb.com/releases/2022/8/prweb18866809.htm August 31, 2022 Accessed on 31/08/2022

12.6 Impediments to Implementing an Effective Customer Service Strategy

Impediments to implementing effective customer service strategy always exist. Firms should strive to overcome these impediments as they decrease the effectiveness and efficiency of the supply chain. Let us examine some common impediments firms face while implementing a customer service strategy.

12.6.1 Metrics not well Defined

One common obstacle to implementing an effective customer service strategy is poorly defined performance measures i.e. Metrics. It is important that the metrics are clearly defined and departments, within the firm as well as the members of the supply chain, agree upon those metrics and their measurement. Metrics need to reflect the entire process, rather than individual components that make up the process. Devising metrics, which focus on the entire supply chain can provide a clearer picture of the effectiveness of a process. When a company sets the order fill rate of a distribution center at 98%, as a metric to measure the customer service level, it can meet this metric either by expediting manufacturing orders or by holding large inventories. By focusing on this performance measure, the firm may neglect other issues, which are of greater importance to customers, like issues concerned with orders reaching the customer’s place at the required time, cost to fill the order, the quality and accuracy of the order, etc. Here the company fails to think, in terms of integrated supply chain perspective, rather it focuses on individual components of the process. Instead, the company can set the performance measure as 95% and perfect order fulfillment in 5 days. This measure addresses the issue of delivery of the shipment, by setting it for 5 days. Too many measures will make the total performance measurement process confusing and ineffective. So, the firm has to identify and measure those processes, which are important for improving supply chain operations, as well as implementing business strategy.

12.6.2 Conflicting Metrics

Choosing the service performance metrics can become difficult when those metrics conflict with departmental goals within the company. To provide a higher customer service, based on the marketing department's recommendation, the company management may set the order delivery time as 3 days. But the logistics partner may not be in a position, to deliver the goods in 3 days. Thus, there arises a mismatch between the requirement of the marketing department and the logistics partners' ability. So, the firm has to consider the needs and ability of all the participants of the supply chain, while developing performance metrics. The firm can discuss with the logistics partner the shortest time, within which he can deliver the goods to the customer, and with the marketing department, the variance in the delivery time, the customer can accept. Based on this, the firm can set the delivery time, which is acceptable to both the parties and which meets customer expectations.

12.6.3 Not Understanding the Trade-Off Issues

The company has to make many trade-offs while deciding upon providing a particular level of customer service. For example, if the retailer wants to provide high product availability, by holding higher inventory at the stores, it increases inventory costs. So the firm has to arrive at a trade-off between its objectives of offering high product availability and reducing inventory costs. If such trade-offs are not properly understood, it may result in either an increase in costs or a decrease in customer service levels. In the above case, if the benefits of high product availability outweigh the costs involved in maintaining higher inventory levels, then the firm can increase the availability of products to its customers, by holding higher inventory at the retail level.

12.6.4 Failure to watch Industry Shifts and Changes in the Competitive Environment

Another important barrier to implementing an effective customer service strategy is the company's failure to keep abreast, with the changing market environment. The firm has to keep track of customer needs and also the competitors' service offerings so that it can change its customer service strategy, in accordance with the changing market conditions.

Example: A multi-state Regional Bell company had the problem of "conflicting metrics"

A multi-state regional bell company had the problem of "conflicting metrics" in providing an innovative broadband solution to its customers. A multi-state regional bell company in Southern USA faced an inter departmental conflict in introducing a path breaking innovative Broadband service to its customers.

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The marketing team first conducted a market survey which said the customers wanted the service, but they were not willing to pay the full cost charges. The innovation team came with an alternative. The idea is to conduct a limited test project by connecting small upscale communities.

This strategic customer service innovation could have given a major competitive advantage to Bell. But the proposal failed to enthuse other departmental heads as they did not see the benefit to meet their immediate operational metrics. They wanted the resources for tactical customer service projects. The finance team also killed quoting non-viability.

Source: https://hbr.org/2022/05/are-you-tracking-the-customer-service-metrics-that-really-count May 11, 2022, Accessed on 31/08/2022

12.7 Use of Technology in Customer Service

Advancements in technology and the reduction of prices of those technologies are encouraging companies to adopt technology to improve customer service levels. Customer Relationship Management (CRM) applications are among the technologies used by the firms, to increase their customer service levels. CRM applications are used to gather information regarding the existing customers and also potential customers. Standard components of most CRM packages are customer support, field sales support, order management, and marketing automation. While the *customer support component* deals with monitoring customer requests, verifying customer order status, getting shipment details, etc., *field sales support* deals with the sales force automation process. *Order management* helps the company in automating order processing activities. *Marketing automation component* deals with collecting information regarding the customers, at every point of contact between the customer and the firm. CRM applications help the company by providing access to accurate and up-to-date information about customers, by automating various customer transactions.

There are other applications, which are used to improve customer service levels. They include Electronic Data Interchange (EDI), intranet applications, extranet applications, and internet applications. EDI applications facilitate information exchange, between two parties. Intranet applications are used for automating information flow, within the firm and extranet applications are used for automating information flow, between the firm and other members of the supply chain. These technologies are dealt with in detail in unit 17. The key benefits, a firm enjoys by adopting technology for serving its customers, are the automation of some of the routine customer transactions and real time access to customer information. Technology also facilitates easy dissemination of information about the customers, within the firm and among the members of the supply chain. This information sharing results in the improvement of supply chain performance. For example, Saturn Corporation is taking the help of technology in managing the after-sales supply chain activities, so that it can provide a higher level of customer service.

12.7.1 Quality of Service Delivery

ISO 9001:2015 defines quality as "The totality of characteristics of an entity that bears on its ability to satisfy the stated and implied needs of the customer'. Service quality characteristics, which promote customer delight include Timeliness, Completeness, Courtesy, Consistency, Accessibility, Responsiveness, Accuracy, Competence, Ambiance, Reliability and Dependability, Credibility, Security, and Safety.

Customer Perception of Quality - Customer-driven Excellence

What the customer feels about the product/ service that is perceived or felt is quality. In general, the customer decides based on how he/ she feels about the overall quality/ performance/ superiority, about the product/ service and how it compares with similar alternatives. In addition, the parameters, which the customer focuses on while buying a product or service, are also not constant. Hence, they can vary from customer to customer and from time to time. The components that contribute to the perception of quality are:

- How good a product/ /service is in terms of features and functionality
- Brand image and company reputation
- Customer experience
- Packaging of product/ service

Factors affecting the purchase of a product/ service, based on a survey conducted by the American Society for Quality (ASQ) are:

- **Performance:** Determines, whether the product/ service delivers, what it is intended to when needed, and can be maintained easily.
- **Features:** The attributes of a product. For example, for a mobile phone, the function is communication on the go, while the extra attributes could be- listen to music, watch videos, etc.
- **Service:** The way the company responds, in terms of queries, support, training, additional value, etc.
- **Warranty:** Displays the confidence the company has on its quality and the focus on customer satisfaction.
- **Price:** If a higher value is obtained, customers are willing to pay a higher price. e.g. Apple iPhone, though priced higher, people are willing to pay, to get a higher quality, as per their perception.
- **Reputation:** The image, the company has, in terms of the brand value, commitment, etc. e.g. Apple has a brand value for personalized products and it has a certain aura created around it, which is also a reason for its popularity.

Customers are the driving force, for improving the quality continuously, by focusing on their inputs and observing the feedback, from various touch points of the customer interface. Many of us have come across the words: “If satisfied tell others, if not tell us”, in many businesses. It is a known fact that word of mouth is the best publicity and it can be good or bad and that will make or break a company’s products and services. Excellence is not only producing defect-free products but also earning the trust, loyalty, and respect of the customers, which makes them satisfied and remain as loyal customers. Excellence also involves building competitor-proof features that differentiate itself, by innovative offerings, prompt service/ response and long-term relationships. Some of the banks have transformed themselves into a one-stop financial service provider by bringing banking, insurance, stock broking, and loans under one roof and providing services at the doorstep of the customer. This is the way, in which they can create excellence, considering the inputs of the customers. For this, organizations need to constantly be gauging the markets and emerging needs of customers, to be ahead of the race and retain customers, with innovative and value-added services and product features.

12.7.2 Customer Satisfaction Survey

Customer satisfaction is one of the measures of quality and is generally considered a key performance indicator. Quality is a perception and one of the factors that satisfy customers, while there are other aspects of the overall customer experience that create satisfaction. Hence, customer satisfaction is also not an objective measure. The customer has two levels of expectations from the product/ service. What the customer really wants is called the desired level and there is a certain level below the desired level, which is acceptable but below which, the customer gets dissatisfied and if it is above the desired level, the customer may be delighted. Customer satisfaction is also a key component on which organizations are measured when considered for the International Quality Awards. To measure customer satisfaction, organizations need to identify indicators that lead to satisfaction, along with collecting data about the customer’s perception of delivered quality. Customer satisfaction for products is measured in terms of reliability, aesthetics, functionality, usability, etc., while courteousness of employees, responsiveness, speed of processing, approachability, the ambiance of facilities, honesty in service, and clarity in communication are a few parameters for service. The key benefit is customer retention and building a loyal base of customers. Customer satisfaction surveys are not a one-time activity or taken up when problems occur. They need to be administered at regular intervals or when changes in the market or competitors are growing.

Surveys are a common tool for understanding the satisfaction of the customer. They can be administered through email, telephone, web, or personally. Most surveys are used to get feedback on various parameters that impact the quality of the product or service, using certain questions with a rating scale, numeric (1-5)

or qualitative (poor-excellent). Some of the aspects to be considered, when designing the questionnaire and conducting surveys are:

- What and how you ask what you get
- The more focused the question, the better use of the answer
- Time limit for the survey
- Determine the target audience for the survey
- Determine the data that need to be collected and the technique to be used
- Surveys raise the expectations and, hence, the focus should be on achievable parameters.

For a survey, a mix of potential, current, past, and competitor's customers can be included. The focus of a questionnaire should be on understanding, what the customer wants to convey and not what the organization wants to know.

Example: Starling Bank (A Pure Digital Bank) Ranks Top in "Customer Satisfaction" Survey

Starling Bank is a digital challenger bank based in the United Kingdom, which focuses on current and business account products. In a "customer satisfaction" survey conducted by an independent agency; all digital banks ranked top along with another all-digital bank Monzo.

85% of Starling Bank have indicate they would recommend the bank to others based on their own personal experience. Surprisingly Royal Bank of Scotland ranked very low in the survey.

The bank helps customers better manage their money and provides them with customer support 24/7. The charges are very reasonable. The bank identifies the customer needs and works back to devise service strategies.

Source: https://thefintechtimes.com/starling-and-monzo-top-customer-satisfaction-survey/ August 15, 2022, Accessed on 31/08/2022

Activity 12.2

In India, during the prevalence of Covid-19, there is general dissatisfaction among people, on the cost and quality of service, provided by corporate hospitals.

Healthcare, being an area where service quality cannot be compromised and must be affordable, you are required to conduct a customer satisfaction survey, among those, who visited the hospital for services.

- Describe the procedure followed by you and the parameters covered.
- What are the results of the survey and the conclusions?

Check Your Progress - 2

6. Identify the most important factor from the following that provides a clear market differentiation in the service industry.
   a. Product availability
   b. Operational performance
   c. Environmental concern
   d. Quality and Reliability
   e. Market access
7. Which of the following is not an impediment for developing an effective customer service strategy?
   a. Performance Metrics not defined properly
   b. Inadequate understanding of trade-off issues
   c. Failure to understand the business environment
   d. Prevailing political climate in the operating regions
   e. Improper understanding of emerging market requirements
8. Which of the following packages is the most popular in customer service management?
   a. Electronic Data Interchange
   b. Customer Relationship Management
   c. Internet applications
   d. Intranet applications
   e. Social media
9. Which of the following is not a major characteristic of customer service quality?
   a. Competence/ skills of the servicing personnel
   b. Level of the service person in the organizational hierarchy
   c. Responsiveness
   d. Courtesy
   e. Accessibility
10. Who, among the following, should conduct customer satisfaction surveys, to be effective and useful for formulating quality improvement strategies?
    a. Internal Employees
    b. Quality Management Team
    c. Committee of Directors of the organization
    d. External agencies
    e. Groups of major customers

12.8 Summary

- The ultimate aim of supply chain management is to satisfy the needs of the end-consumers.
- Companies are now realizing that they can distinguish themselves from their competitors, based on the responsiveness, accuracy, ease of interaction, and similar attributes collectively referred to as customer service.
- Various aspects of customer service, from the perspective of supply chain management, have been discussed, starting with the definition of customer service.
- Customer service can be defined as activities, aimed at enhancing the product offer or facilitating the exchange process, between a company and the customer.
- The three elements of customer service are pre-transaction elements, transaction elements, and post-transaction elements.
- Different approaches for designing customer service strategies have been discussed. These are the understanding of customer reactions to product or service failures (customer's response to stock outs), analyzing cost-revenue trade-offs, Activity-Based Costing (ABC analysis), internal and external customer service audits, and competitive position matrix.
- The unit then focused on the factors that influence the efficiency and effectiveness, in a supply chain. They are product availability, operational performance, and reliability.
- Effectiveness depends on services provided by the seller that aim at market access, market extension, and market creation.
- Impediments to implementing effective customer service strategy always exist.
- Firms should strive to overcome these impediments, by clearly defining the metrics, as they decrease the effectiveness and efficiency of the supply chain.
- One way to improve customer service is through the use of technology.
- Technology facilitates easy dissemination of information about the customers, within the firm and among the members of the supply chain.

12.9 Glossary

CRM- Customer Relationship Management

Customer Satisfaction Survey- an indicator of customer satisfaction, found by using some tools and techniques.

Post-transaction elements- aspects like customer complaints, warranty issues, and after-sales service come under this category.

Pre-transaction elements- those elements of customer service, which need to be taken care of, ahead of real operations. These include policies, organization, etc.

Transaction elements- elements, which are relevant during actual service operations- availability of inventory, information on customer service status, etc.

12.10 Self-Assessment Test

1. What are the elements of Customer Service? List them category wise.
2. Briefly explain different approaches to Developing the Customer Service Strategy.
3. How do you justify Customer Service as a performance outcome for Creating a Differential Advantage?
4. What are the impediments to implementing an effective Customer Service Strategy?
5. Explain the use of technology in Customer Service, Quality of Service Delivery, and Customer Satisfaction Survey.

12.11 Suggested Reading / Reference Material

1. Ashley McDonough, Operations and Supply Chain Management Essentials You Always Wanted to Know: 15 (Self Learning Management Series) Paperback – 1 January 2020.
2. Russel and Taylor, Operations and Supply Chain Management, 10ed, ISV Paperback – October 2019.
3. Chopra and Kalra, Supply Chain Management 6/e Paperback – 17 June 2016.

12.12 Answers to Check Your Progress Questions

1. (b) Written Customer Service Policy

It is a pre-transaction element of customer service.

2. (c) Order Status Information

It is a transaction element of customer service.

3. (d) Warranty

Warranty is a post-transaction element of customer service.

4. (e) Technology used for product/service

It is not an important element for developing a customer service strategy.

5. (a) To enhance customer satisfaction and competitive advantage

It is the advantage of a competitive position matrix.

6. (d) Quality and Reliability of the product/service

This aspect provides a clear market differentiation in the service industry.

7. (d) Prevailing political climate in the operating regions

It is not an impediment for dev eloping an effective customer service strategy.

8. (b) Customer Relationship Management (CRM)

CRM is the most popular package in customer service management.

9. (b) Level of the service person in the organization

It is not a major characteristic of customer service quality.

10. (d) Independent external agencies

They should conduct customer satisfaction surveys.

Unit 13

Order Fulfillment and Supply Chain

Structures

"85% of the reasons for failure to meet customer expectations are related to deficiencies in system and processes...rather than the employee."

- W. Edward Deming

13.1 Introduction

To meet customer expectations, systems and well-defined processes are important. The best employees without system and process are no good.

In the previous unit, we examined the elements of customer service and discussed different methods of developing customer service strategies. Then, we looked into the process of setting customer service standards. In addition, we identified impediments to the implementation of effective customer service strategies.

Order fulfillment is a key process for any company. It is even more important for off-line and online companies, which are engaged in e-commerce because it is one of the key elements, through which they can differentiate themselves in the e-commerce marketplace. Part of the success of Amazon and Cisco (See Exhibit 13.1) can be attributed to their efficient and effective order fulfillment process. The process of order fulfillment encompasses all the activities that take place, between the placement of an order by a customer and the delivery of the product to the customer. From an organizational point of view, order fulfillment refers to the optimization of supply chain processes of a firm, to fulfill customer demand in a profitable way so that the firm can differentiate itself from its competitors.

In this unit, we discuss the order fulfillment process and its role and importance in e-commerce businesses. Then, we examine the factors and components involved in designing responsive order fulfillment processes. The unit concludes with a study of the features of order fulfillment systems that are currently being used in the industry.

13.2 Objectives

By the end of the unit, you will be able to:

- Explain the order fulfillment process
- Discuss e-fulfillment vs. traditional process
- Examine responsive order fulfillment process
- Identify order fulfillment systems

13.3 The Order Fulfillment Process

The effectiveness of a supply chain is determined by its ability to fill customer orders on time. Achieving a high order fulfillment rate and low costs requires coordination between various organizations across the supply chain as well as coordination between their internal functions like manufacturing, distribution and transportation. Since order fulfillment requires the coordination of different firms, spread across the supply chain, the firm must take various strategic and operational decisions for filling customer orders effectively. At the strategic level, the firm must determine the requirements and capabilities of its functional departments and design a proper distribution network, for effective order fulfillment. At the operational level, the firm must determine how the order placed by the customer will be filled. The different strategic and operational level processes involved in filling a customer order are discussed below.

13.3.1 Strategic Order Fulfillment Processes

The strategic order fulfillment process provides organizations the knowledge, required for making optimal utilization of the existing resources and tools for effective and efficient order fulfillment. The strategic order fulfillment process consists of a series of sub-processes, which are described below.

Review of channel relationships, marketing strategy, and customer service goals by the top management

The first step in the strategic order fulfillment process involves a review of a firm's marketing strategy and customer service goals. The role of customer service, in the firm's marketing strategy, influences the process of order fulfillment. If customer service is a key differentiator for the firm's products and services, then the order fulfillment process is made more responsive to customer needs. Firms dealing in life-saving drugs know that their customers expect timely

and quick delivery of products. In such cases, customer service becomes a key differentiating factor and order fulfillment strategies of these firms need to be responsive.

If customer service is not such a critical differentiator in a firm's marketing strategy, then the order fulfillment strategy should focus on achieving cost-effectiveness. Exhibit 13.1 shows order fulfilment process at Cisco.

Exhibit 13.1: Order Fulfilment Process at Cisco

Cisco Prime™ Order Fulfillment offers a modular and automated approach for bringing together the people, processes, and products required to accelerate the discovery, assembly, launch, and orchestration of new services across multiple domains.

Cisco Prime Order Fulfillment utilizes service creation tools to formally define processes and handoffs, and automates tasks wherever possible. It reviews service orders involved and automates their separation so that suborders are automatically generated and sent to each of the technology domains involved for processing. Additionally, services are assembled quickly and efficiently through reusable building blocks from discovered resource capabilities. The result is a flexible service creation, assembly, and delivery model that efficiently coordinates and analyzes the end-to-end fulfillment process to increase revenue, reduce operating expenses, and improve customer satisfaction.

Established on a standards-based, catalog-driven service delivery model, Cisco Prime Order Fulfillment accelerates the design and fulfillment of services. Services are composed of components available from multiple suppliers and provided "on demand" and "at scale" in a multitenant, elastic environment.

Design: Provides entire lifecycle management of technical service products that utilize the full value of the underlying multitechnology, multivendor network. Using the TM Forum's Product and Service Assembly (PSA) standard (TMF287), the solution discovers and catalogs resource-facing capabilities from participating technology domains, assembles them into viable product bundles, and exposes these products to customer-facing ordering systems.

Fulfillment: Receives and dismantles technical service orders into their constituent parts and orchestrates delivery of each constituent to the appropriate technology domains. The solution manages cross-domain order fulfillment processes. It also tracks and analyzes relevant network, service, and customer information to help ensure end-to-end service quality and customer satisfaction to both residential and business consumers.

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Benefits

Cisco Prime Order Fulfillment:

- Increases revenues by accelerating the design, assembly, and launch of new products
- Extends the service provider product portfolio to expand market penetration, increase service revenue, and help enable products to be easily improved throughout their full lifecycle
- Synchronizes network capabilities with customer needs to avoid disjointed service offerings
- Reduces cost by automatically breaking down orders into constituent parts and orchestrating the fulfillment of these parts across multiple technology domains
- Minimizes order processing overhead to reduce operational expenses
- Increases profit and service value through analysis of product and service performance
- Improves customer experience through automated monitoring and control of delivered services
- Increases customer satisfaction through the ability to offer a more comprehensive product portfolio
- Matches front office promises to back office capabilities to better meet customer expectations

Source: Cisco Prime Order Fulfillment Data Sheet, August,2014

For example, order fulfillment strategies of hypermarkets should be cost-effective, in order to control costs and provide goods to customers, at low prices.

The customer service goals set by an organization also determine its order fulfillment strategy. If an organization's customer service policy sets a specific time for the delivery of an order, then the order fulfillment strategy must be developed based on customer service goals. The supply chain structure should also be examined, to ensure that it is suitable for the order fulfillment requirements of the organization.

Determining order fulfillment requirements

The next step in the strategic process is determining order fulfillment requirements. During this process, the capabilities, which are required for effective fulfillment of the order, are determined. The level of manufacturing capacity, lead-time, and customer service requirements are decided. This helps the organization identify the processes, through which service differentiation can be achieved in the marketplace. During this stage, the order fulfillment team interacts with the customer service and manufacturing teams, to identify the differentiating variables that can be built into the order fulfillment strategy.

Evaluating the supply chain network

At this stage, the supply chain network design is analyzed and designed according to the order fulfillment requirements. The optimal design of the supply chain network can lead to the maximum utilization of resources, resulting in substantial savings and an increase in productivity for the organization. The strategic issues that are dealt with at this stage include the amount of capacity allocation to each manufacturing unit; the level of inventory to be held at the warehouses; the location of plants, warehouses, and supplier's facilities; and the transportation strategy to be adopted. At this stage, decisions are taken after consulting the demand management team. These decisions are later communicated to the manufacturing department and the supply chain partners, who handle the logistics part of order fulfillment.

Developing an order fulfillment plan

The next step in the strategic order fulfillment process is to develop an order fulfillment plan. During this stage, the order fulfillment plan for each group of customers is determined. Customers, who have similar requirements are clustered so that their orders can be fulfilled in an effective and efficient manner. The final order fulfillment plan is developed in consultation with the customer service team.

Setting performance metrics

In this step of the strategic order fulfillment process, performance metrics are developed to measure and control the order fulfillment process. The metrics that are usually employed are on-time delivery, order fill rate, orders completed, and order-cash cycle time.

13.3.2 Operational Order Fulfillment Process

The operational order fulfillment process includes the activities required for the actual fulfillment of customer orders. The operational process consists of the following sequence of processes:

- Order generation
- Order processing
- Order preparation
- Order shipment
- Post-delivery activities

Order generation

The order fulfillment process starts with order generation. Order generation includes order placing and order communication. Orders are generated, either by sales representatives on behalf of the customers or are placed directly by customers through various channels like phone, fax, Internet, and email.

They are also placed through channels like the intranet, extranet, and EDI (Electronic Data Interchange) routes.

Order processing

The next step in the operational order fulfillment process is order processing. Order processing involves activities like order entry, order selection, order prioritization and order scheduling. The order request is received and entered into the system. Then the firm decides whether to accept the order or to reject it or to put it on hold. The firm checks the credit limit of the customer and if he wants to purchase the products on credit. Then, the inventory is checked to ensure that the quantity specified by the customer is available.

If the product is not available, then the order information is transmitted to the firm's manufacturing facilities. In some cases, the order is communicated to third party vendors, who assemble or produce the products for the firm. Then, the firm prioritizes the orders it has decided to accept. Order prioritization helps a firm identify the orders that need to be expedited and those that need to be closely monitored. This increases responsiveness, as well as profitability, in the supply chain.

Order preparation

Order preparation includes activities like order picking and document handling. The order preparation activity starts, when the warehouse receives the order information and ends when the consignment is ready for shipping. The warehouse manager prepares an order pick list (which identifies the list of items to be picked and their location in the warehouse) and gives it to the order picker. The order picker picks the items specified in the pick list. The order picking activity consumes a major portion of the time, in the order preparation process. After the items have been picked, they are assembled, packed, and readied for shipment, according to the specifications of the customer. Then the firm prepares all the documents related to the customer order. These include the order invoice and the packing list. The packing list specifies the items that are in the package and the personnel, who prepared the order.

Order shipment

Order shipment is done at this stage, in coordination with a logistics service provider. Depending on the type of consignment it is delivering, a firm must choose a logistics provider and a shipment route. If the shipment is urgently required by the customer, then the firm must send it, by a speedy mode of transportation. Such delivery may be expensive but necessary from a customer service point of view. If the shipment is not required urgently, it can be delivered through inexpensive and slower transportation modes. The order shipment process also involves load planning, which specifies how the goods should be placed, within a vehicle or container, to facilitate cross-docking.

In the order shipment process, firms have to prepare the required shipping documents and deliver the package to the destination, specified by the customer. If the package is to be exported, then the necessary export shipping documents have to be prepared. The delivery information has to be provided to the customer, as well as the customer service department.

Post-delivery activities

The post-delivery activities of the operational order fulfillment process are dealing with the customer payment processes and measuring the performance of the order fulfillment process. During this stage, the firm settles all issues pertaining to customer payment. The performance of the order fulfillment process is measured as per the metrics, identified during the strategic order fulfillment process.

Example: Blackline Safety Redesigns its "Order Fulfilment Strategy"

Blackline Safety (industrial safety products and service company) redesigns its "order fulfilment strategy" to reduce inventory costs without affecting customer satisfaction. Blackline Safety supplies safety equipment and provides safety services for organizations in different sectors so that the customers need not worry about safety and concentrate on their core business. When it started, the company "had a strategic order fulfilment" approach just to penetrate the market. So, they started with next day delivery promise. The inventory was kept, and other logistics were accordingly tuned. While the customers were delighted, the inventory costs were heavy and that meant more expenses and less profits. Recently inventory costs increased as the company increased levels to meet the challenge of longer procurement times due to covid. An extra inventory cost of $7 million was reported.

So, the company has redesigned its "order fulfilment" strategy and is shifting to up- to -30-day order fulfilling time. The company is sure customers will not mind this change.

Source: Blackline Safety Provides Business Update, Positioning for Improved Financial Strength | Financial Post August 8, 2022, Accessed on 01/09/2022

Activity 13.1

The performance of a supply chain is determined, by its ability to fill customer orders on time. Achieving a high order fulfillment rate and low costs requires coordination between various organizations, across the supply chain as well as coordination between their internal functions like manufacturing, distribution, and transportation. Since order fulfillment requires the coordination of different firms, spread across the supply chain, the firm must take various strategic and operational decisions, for filling customer orders effectively.

You are required to identify the levels, at which supply chain decisions are taken, to formulate strategies and implement them. Assume yourself as an entrepreneur manufacturing solar power inverters. To fulfill orders of customers, you need to depend upon a few suppliers also for materials and logistics. Identify the strategic and operational elements for the supply chain process involved. Formulate an order fulfillment flow chart for your supply chain.

Check Your Progress - 1

1. Which of the following is the most important goal in the customer service supply chain?
   a. Formulating a strategy
   b. Delivery of order on time
   c. Fixing vendors
   d. Operations strategy
   e. Returns management policy
2. Which aspect influences the customer order fulfillment process most?
   a. Corporate long-term strategy
   b. Operations Strategy
   c. Marketing Strategy
   d. HR Strategy
   e. Quality Management strategy
3. Which of the following is not relevant to formulate the Order Fulfillment Strategy?
   a. Defining customer requirements
   b. Supply Chain Structure
   c. Customer service goals
   d. Order fulfillment plan
   e. Order Shipment

4. Which of the following is not a part of the order fulfillment process?
   a. Operations Goals
   b. Operations Plan
   c. Operations Processes
   d. Operations Strategy
   e. Customer Satisfaction Strategy
5. Which, of the following, is not a post-delivery activity?
   a. Customer payment processes
   b. Performance measurement of order fulfillment
   c. Attending to customer complaints
   d. Installation and operationalization
   e. Closing the order

13.4 E-Fulfillment vs Traditional Order Fulfillment Process

The requirements of the *e-fulfillment* process are different from those of the traditional order fulfillment process. Let us examine, how the *e-fulfillment* process differs from the traditional order fulfillment process. In the e-fulfillment process, orders are delivered in single order shipments, directly to the customer's doorstep. As a result, the transportation costs in an e-fulfillment process are higher than those in the traditional order fulfillment process. In the traditional order fulfillment process, the goods are consolidated and sent in truckloads, to the nearest field warehouse or to retail stores.

The expectations of online customers are higher than those of the customers, who shop at physical outlets. Online customers expect a high level of customer service, like instant order processing, real-time communication about the status of their orders, and faster order delivery. These customers are also fickle in their shopping behavior. If they do not get what they want, then they switch to the competitor's websites, which is just a click away (unlike physical outlets).

Another important difference between e-tailing and traditional retailing is the volatility in demand. In the traditional retailing setup, the retailer has a certain number of outlets covering a particular geographical region. These outlets can provide information to the retailer regarding past sales history, consumer behavior, etc. Based on this data, the retailer can plan for future demand. This helps the retailer tackle the volatility in demand. In e-tailing, forecasting demand is a difficult task. As e-tailing is a relatively new concept, customer demand is more volatile than in traditional retailing. In addition, a new e-tailer will not have any past demand history to determine future demand. E-tailers also need to

manage a high percentage of returns. In a traditional setup, returns can be handled easily, but in an e-tailing setup, returns management is difficult, due to the non-existence of physical outlets.

Apart from understanding the differences between the e-fulfillment process and the traditional order fulfillment process, firms that are dealing with online customers should also evaluate other issues like customer service and pricing. For example, Barnes & Noble leverages the power of its brand, to offer online customers the Web's premier destination for books, eBooks, magazines, toys & games, music, DVD and Blu-ray, and related products and services. It was confronted with some situations such as,

- Should they treat the customers, who shop at physical stores and the customers, who order through their website, the same way?
- Should its pricing and product return policy, at its stores and on its web site, be the same or different?

It has utilized the power of the internet to define its processes and maintain its global leadership.

Providing the same customer service to different types of customers can be advantageous. It helps a firm achieve economies of scale, gives a common interface to the customers, and allows sourcing at cheaper rates (through consolidation of orders). However, providing a common customer experience for both online and offline customers can be difficult, as many firms do not have proper systems in place, to provide a common interface to all their customers. Therefore, firms can initially run online units separately and integrate gradually all the channels.

13.4.1 Developing an E-Fulfillment Strategy

After evaluating various factors, online retailers need to formulate a fulfillment strategy, which matches their needs and customer expectations. The fulfillment strategy must be based on the nature of the retailer’s operations and its level of outsourcing. Operations can be either centralized or distributed. In a centralized setup, the order fulfillment process is run from a single or centralized site. In a distributed setup, the different operations of the order fulfillment process are located at different places, i.e. warehousing of goods at one location and order packaging and shipping at another location. Firms should determine the level of outsourcing required for their order fulfillment processes. They can either manage all their operations themselves or outsource them completely or in part.

Most e-commerce organizations use one of the following order fulfillment strategies:

- Distributed delivery centers
- Partner fulfillment operations
- Dedicated fulfillment centers

- Third-party fulfillment centers
- Build-to-order

Distributed delivery centers

In this strategy, the firm accepts the orders online and customers are asked to pick the orders at the nearest distribution center or its own stores. This strategy is suitable for companies, which have a number of physical stores across the region and for new online companies, which have tie-ups with physical retailers. By adopting this strategy, firms can save on shipping costs.

But there are some disadvantages to this strategy. Firms using this strategy will have to maintain additional inventory at each distribution center or retail outlet, which will lead to an increase in inventory costs.

In addition, the employees would not only have to process online orders but also have to deal with customers, who visit the physical stores. In this strategy firms can adopt processes, which enable the customers to order online and pick the goods at their nearest company outlet. Ford Motors accepts orders for its automobiles online and routes these orders to the nearest dealer (from where the customer is supposed to pick the vehicle), who processes the order. Exhibit 13.2 describes Tesco's online order fulfillment strategy.

Exhibit 13.2: How Tesco Adjusted its Online Retail Strategy?

Tesco CEO Dave Lewis explains how his firm has responded to the uptick in demand for online ordering through the Coronavirus crisis - and what lies beyond lockdown for the UK's largest supermarket chain.

The Coronavirus crisis has driven a boom in consumers engaging with online ordering and delivery services from supermarkets, but also resulted in the supply chain and fulfilment capacity of those retailers coming under horrendous pressure. Tesco became the first of the major supermarket chains in the UK to ‘open the kimono’ on how it has put in place a Coronavirus survival plan and what it believes the short-to-mid term prospects for the omni-channel retail sector. The way Tesco operates its online operation has had to change since the onset of the health crisis in order to meet the firm’s mission to, as Lewis puts it, feed the nation:

“Our capacity and our ongoing normal rate, excluding Christmas, was around 660,000 weekly slots going into this process. Initially that capacity went south. It declined because of two things. Very strong traffic in store meant meant that our picking capability was affected, but also the number of items that people were ordering was also significant. All of last year, the average items per order would be about 44 or 45. At the time of those two weeks, it rose to about 130 items per order, so the orders were significantly larger.

Contd….

We introduced, so that we could spread and keep capacity for all, a limit of 80, but actually, in the last week the average orders are more like 61,62 items per order. So, [we've been] managing that and increasing the amount of picking time. In some of our 345 dot com stores we're picking from 2am. We've increased the weekly slots to 805,000 and we'll continue to increase that capacity so that we can serve more people". In common with other grocery retailers, Tesco has also sought to segment its customer base and identify the most vulnerable shoppers.

Life after lockdown

While the crisis goes on with the number of UK deaths has yet to peak, Tesco is looking ahead to life after lockdown in an attempt model future planning, says Lewis:

"We have a team within Tesco which is looking at the demand curve for the medium and long term. We have a team in Tesco looking at the supply strategy for the medium and the long term. We're trying to model what might happen. The one thing I have to say as a caveat here is the one thing that we know is that none of the forecasts we have are going to be accurate. As one of my colleagues said, it's all precisely wrong. We have to we have to recognise that nobody knows…as things unfold we'll see how those assumptions, actually play out.

We'll hear similar war stories from the retail frontline in the coming weeks and months. Tesco's response to the Coronavirus crisis has been impressive and responsible which is encouraging given its status as the UK's largest supermarket chain." CEO Lewis boasts:

COVID-19 has shown how critical the food supply chain is to the UK and I'm very proud of the way Tesco, as indeed the whole UK food industry, has stepped forward.

That said, the current situation has demonstrated how limited the online fulfilment capacity really is. While Tesco has done well to revamp its online operations, the reality is that that it can only service around 10% of potential shoppers. Life after lockdown is likely to include a long term re-evaluation of the omni-channel balance in operating strategy moving forward.

Source: How Tesco has adjusted its online retail strategy to cope with Coronavirus and life after lockdown, Stuart Lauchlan, April 8, 2020, Diginomica

Partner fulfillment operations

In this strategy, the firm holds no inventory. Instead, the order fulfillment process is completely done by partners or suppliers. The retailer passes the order to the manufacturer or supplier, who ships the order directly to the customer. This process is also known as drop-shipping.

This type of arrangement has many advantages. Since firms do not hold any inventory, they make substantial savings on inventory carrying costs. And since order fulfillment is done by the supplier, the firm also saves on fulfillment costs. As the retailer has access to the supplier's wide product range, it can offer a wide selection of products to the customer. Moreover, product availability is high, since the supplier provides the goods to multiple retailers. The retailer can get the products at lower costs for the customer since the supplier deals in larger quantities of products than the retailer can. The transportation costs are also saved in this setup, due to the direct shipment of the goods to the customer by the supplier.

Certain disadvantages are associated with this type of strategy. The retailer loses the product margins that accrue if the retailer himself sources the product. Since the product is directly shipped to the customer by the supplier, the supplier retains a substantial portion of the product margin. As the retailer does not oversee the order fulfillment process, customer service quality, as well as product quality, may be negatively affected, when using this strategy. The product quality is affected if the supplier delivers low-quality products. The service quality is affected if the supplier delivers the wrong product or is unable to deliver it on time. By providing the order information to the supplier, the retailer is at risk of the supplier directly dealing with the customer.

Dedicated fulfillment centers

In this strategy, retailers set up their own dedicated fulfillment centers, to provide better order fulfillment services to their customers. Amazon.com and Dell follow this type of strategy. Amazon has 110 dedicated hi-tech warehouses in the US and 185 globally to fulfill orders in a fast and efficient manner. Dedicated fulfillment centers facilitate prompt delivery and allow the retailer control over operations and product quality. However, since these centers are owned by the firm, the firm’s inventory carrying costs increase. In addition, a substantial investment is required to set up these centers. Flexibility in dealing with unexpected demand depends on the capacity and capability of these centers. The scalability of the retailer’s operations can be difficult if these centers are not suitable for further expansion.

Third-party fulfillment centers

In this strategy, a firm uses the services of third party fulfillment service providers, to manage its fulfillment process. This strategy gives the firm flexibility in managing order fulfillment, by allowing the firm to change its capacity according to market demand. Firms may outsource all their fulfillment activities or only a select few activities like returns management and warehousing. For example, Flipkart warehouse or Flipkart Fulfilment Center is a

third-party service by Flipkart, which provides services of warehousing and shipping to the sellers. The sellers can store their inventory across fulfillment centers of Flipkart and they will take care of the rest. Flipkart has its own logistics arm– Ekart, which delivers the products to customers. Ekart is said to be the biggest logistics partner, which delivers across 3800+ zip codes.

Build-to-order

In this strategy, products are built, according to customer specifications. This type of strategy is widely used by Dell Computers. In this strategy, firms have to manage the entire flow of goods in the supply chain, instead of just managing inventory at its warehouses. This requires not just intra-firm coordination but also inter-firm coordination. To reap the benefits of this strategy, the firm should aim at faster inventory turnover and adopt a proactive approach to the sourcing of components from suppliers, as the demand pattern changes (instead of just reacting to demand changes).

The selection of an optimal strategy depends on various factors. If the sales of a firm are high, then investing in its own facilities is the right strategy. Amazon has a high sales volume, so investing in its own fulfillment facilities is worth the effort and money involved. If the demand volatility of the products is high, the retailer can outsource the fulfillment services to save on inventory and warehousing costs. Since third party service providers deal with multiple retailers, they can manage demand volatility more effectively than individual retailers. If the product variety is high and managing the range of products is difficult for the retailer, outsourcing would be the right option.

The use of hybrid strategies is gaining popularity. In such strategies, some orders are filled in-house, while some are outsourced. For example, Amazon.com fills orders for products like books and CDs in-house, because it can provide customers with a high level of customer experience in a profitable way; but it uses drop shipping for products, which can be delivered effectively and efficiently to customers by third-party service providers. Amazon outsources orders for mainly three kinds of products, cell phones, computers, and books which are not the bestsellers. Amazon is also thinking of drop shipping other types of products like electronics, tools, and kitchen gadgets.

Example: Byrd raised $56 Million In Funding to Let E-Commerce Retailers Deliver the Next Day to Consumers Anywhere in Europe

Byrd is a Vienna based start-up company providing third party order fulfilment services to ecommerce companies including the big ones like Amazon. The company runs a virtual network to provide order fulfilment services to online retailers across Europe.

Contd….

The software technology is used by warehouse partners and integrate seamlessly with e-commerce platforms such as Amazon. With a new funding of $56 million, the company is expanding facilities and is assuring next delivery across Europe. The company has a robust technology platform (owned by him) which enables cost effective, efficient services to its customers.

Source: Vienna's Byrd flies away with $56 million to enable next-day e-commerce delivery - Tech.eu 10th May, 2022, Accessed on 01/09/2022

13.5 Responsive Order Fulfillment Process

Since the order fulfillment process is a responsive function, it is one of the key differentiators for gaining a competitive advantage in the market. Responsiveness can be defined, as the ability to react within a certain timeframe to key events, opportunities, and threats, so as to gain or maintain a competitive advantage. By implementing a responsive order fulfillment process, a firm can improve its customer service. This would lead to customer loyalty, which would enable differentiation and create a positive perception of the firm in the market. A responsive order fulfillment process can give the firm the ability to price its services or products, at a premium and also enable it to gain a larger market share. In this section, we first discuss the factors that influence the responsiveness of the order fulfillment process. Later, we discuss the elements of the responsive order fulfillment process.

13.5.1 Factors Influencing the Responsiveness of the Order Fulfillment Process

Key factors that influence the responsiveness of the order fulfillment process are:

- Nature of the product
- Nature of customer demand
- Production triggering
- Meeting customer demand

Nature of the product

'Nature of the product' refers to product characteristics, volume, product range, and the level of customization that is required. These factors may influence the responsiveness of the order fulfillment process. If the products have to be customized or built-to-order, the firm must specify the date of delivery of the product. Customers expect such products to meet their specifications and to be delivered according to schedule.

Nature of customer demand

The nature of customer demand also influences the responsiveness of the order fulfillment process. The key component of this factor that influences the

responsiveness of the order fulfillment process is the volatility of customer demand. Volatility can be of various types. The volatility can be in volumes, or within the product range, or across the product range. The nature of the product and the industry in which the firm operates also influence the level of demand fluctuations. For example, firms that manufacture built-to-order products tend to face high demand fluctuations in product design. Companies, which manufacture standardized products face demand fluctuations in volume and product variety.

Production triggering

Production triggering refers to the means, by which the demand is met. In firms, which manufacture highly customized products, production is triggered by actual customer orders. At Dell Computers (which manufactures products according to customer specifications), production starts after the receipt of customer orders. In some cases, production is triggered by forecasts. In firms that manufacture consumer products and other standardized products, a combination of actual customer orders and forecasting triggers production.

Meeting customer demand

Meeting customer demand is another factor that influences the responsiveness of the order fulfillment process. The way in which customer demand is met depends on how production has been triggered. If production is triggered by forecasts, customer demand is met immediately off-the-shelf. If production is triggered by actual customer orders, then the customer has to wait for the fulfillment of the order. In such cases, the firm has to specify the date on which the product will be delivered.

13.5.2 Elements of Responsive Order Fulfillment Process

There are four elements that guide the responsive order fulfillment process:

- Stimuli
- Awareness
- Capabilities
- Goals

Stimuli

Stimuli that influence the responsiveness of a firm's order fulfillment process include the uncertainties and changes that firms face, due to operational problems (like machine breakdowns, shortage of raw material, and shortage of labor) and external changes in competitors' activities, suppliers' activities, market conditions, and legislation. They form the basis for developing responsive capabilities. The stimuli depend on the environment, in which the firm is operating, the industry to which it belongs, the products the firm makes, and the operational characteristics of the firm.

Awareness

Awareness refers to the firm's understanding of the stimuli and their source (whether they originated from customer needs, demand uncertainties or market conditions). The awareness of the company can be judged by its preparedness to face the stimuli, like holding safety stock, using forecasting techniques, etc.

Capabilities

Capabilities refer to the activities that are performed in response to these stimuli. Such capabilities are: adjusting the manufacturing flow according to variations in demand; making alternate arrangements in case of shortage of the raw material inventory; or changing the demand pattern to suit the requirements and abilities of the firm. Through the use of information technology and innovative processes, Dell computers is capable of changing the demand pattern of customers, when it cannot meet their needs. If there is a sudden rise in customer demand for 15-inch monitors, and neither the firm nor its suppliers are in a position to meet this demand, Dell might offer a higher range monitor (like a 17-inch monitor) at the same price or for a nominal increase in price to its customers. The whole process is done in real-time, using state-of-the-art information systems. Such response helps the company in three ways: (1) the firm does not lose customers because of the stockout (which offsets the loss incurred due to offering a higher range of products, at a price of lower range products); (2) the firm creates a shift in demand pattern to suit its needs and requirements; (3) customer satisfaction increases because the customer is getting a higher range product, at the same price or at a nominal increase in price.

Goals

Goals refer to those organizational goals and policies, which are designed according to an organization’s capabilities and requirements. The goal of any firm is to satisfy customer demand. But the approach adopted to satisfy the demand differs. For example, consumer product firms may try to satisfy customer demand, by making available a wide range of products in appropriate quantities. So, the goal of these firms is to make the product available to customers and avoid stock-outs. But firms, which build custom-made products try to deliver products, which exactly match the specifications of their customers, on the agreed delivery date. The responsiveness of the order fulfillment process depends on such goals.

Thus, a responsive order fulfillment strategy must be based on stimuli, awareness, capabilities, and goals. The strategy can be formulated at two levels, at the strategic level and at the operational level. At the strategic level, the firm decides on the responsive approach and the level of responsiveness required, depending on the nature of the industry in which it is operating, the product range it is offering, and other market conditions. At the operational level, the activities that must be undertaken to achieve the responsiveness decided at the strategic level are determined.

Following are the basic steps for developing a responsive order fulfillment strategy:

- Evaluate the stimuli that exist in the business environment
- Examine the impact of stimuli on goals
- Build capabilities, in order to design appropriate responses to those stimuli.

Example: SLM Solutions (Metal 3D Printer Manufacturing Company) Overcomes "Order Fulfilment" Challenges to see a 7 Percent Growth in Margins in Q1 of 2022

SLM Solutions manufactures and supplies metal 3D printers to its customers across US. The company had problems with supply chain delays, which led to not able to meet "order fulfilments "for a backlog of orders received. Since it suffered order fulfilment problems due to supply disruptions, it reduced production which led to more delays in order fulfilling.

It sensed the problem well in advance and took steps to mitigate the problem in 3 ways viz. expanding supplier base, increase inhouse production and enhance 'safety stock' levels.

Source: SLM Solutions overcomes "ongoing supply chain disruptions" to deliver revenue growth of 7% in Q1 2022 - 3D Printing Industry May 12, 2022, Accessed on 01/09/2022

13.6 Order Fulfillment Systems

Order fulfillment systems can be used to implement the order fulfillment process effectively. These systems automate order fulfillment processes and help improve coordination among the various members of the supply chain. i2, Manugistics, Oracle, SAP, and Yantra have developed many such systems.

These systems handle orders in four phases:

- Order capture
- Order management
- Order fulfillment
- Reverse logistics

Order Capture: During the order capture phase, these systems provide necessary information to customers and enable them to enter their order details and close the order. The information includes details about products, pricing, warranties, shipping, and availability. If the firm is dealing with B2B transactions, the information provided will include additional details about products, billing, and payment.

Order Management: In this phase, the orders received are processed and channeled to relevant departments, according to predetermined rules and regulations, about sending order details to the manufacturing plant or supplier, sending information to the demand management system, and sending order quantity details to the warehouse.

Order Fulfillment: In this phase, the system takes care of actual order fulfillment. The system coordinates the activities of order picking, packing, and shipping. It updates and tracks the order and provides the necessary information, to each department involved in the process.

Reverse Logistics: In this phase, the system handles post-sales problems, like product mismatches, wrong deliveries, payment settlement, returns, repairs, etc.

13.6.1 Characteristics of an Ideal Order Fulfillment System

An ideal order fulfillment system should be able to accept multiple order formats, provide real-time and complete information to the customers, handle orders across multiple channels, and track and manage outsourced operations.

Accept multiple order formats. Orders are received from customers in multiple formats like email, EDI, fax, and phone. The order management fulfillment system must be able to interpret these formats and convert the order information into the firm specified format.

Provide real-time and complete information to the customers. The order fulfillment system should be able to provide complete and real-time information about products to customers. Such information should include details on product specifications, product availability and price, and likely shipping date. This will help customers place orders easily and quickly. After placing the order, customers should be able to track the order status in real-time.

Handle orders across multiple channels. Firms sell goods through many channels: physical stores, sales representatives, website, franchises, etc. Therefore, an order fulfillment system should be able to handle orders from all these channels. Thus, instead of maintaining a different order management system for each channel, the firm can use a system that handles multiple channels.

Track and manage outsourced operations. As mentioned earlier, many firms are outsourcing their order fulfillment operations. So, the order fulfillment system should be able to track and manage outsourced operations. To enable their systems to do so, firms should integrate order fulfillment systems, with the systems of the outsourcing partners.

Example: Vooki sees a whopping 8233% Increase in Order Volume

Vooki, (Chennai-based sanitisers and disinfectants manufacturer) sees a whopping 8233% increase in order volume due to partnership with third party order fulfilment company Pickrr. Vooki is a Chennai-based manufacturer of sanitisers and disinfectants. Before 2020, the shipments were around 60 per month... But the demand increased manifold during Covid, and on-time delivery became a major challenge.

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To address the supply issues and ensure high-speed order fulfilment, Vooki partnered with the logistics provider start-up Pickrr. This resulted in 7% fall in logistics cost, while its delivery turnaround time improved by 20%. The streamlined order fulfilment process saw the monthly order volume peak to more than 5,000, an 8,233% increase from its pre-pandemic days.

Source: https://inc42.com/startups/how-pickrr-is-opening-up-a-growth-trajectory-for-ecommerce-businesses/ 1st December, 2021, Accessed on 01/09/2022

Activity 13.2

The requirements of the e-fulfillment process are different from those of the traditional order fulfillment process.

You are required to do the following:

- Identify the differences between the two processes.
- Establish the relevance of the e-fulfillment process in the current business scenario.
- Identify strategies followed by e-commerce organizations.

You are requested to suggest an order fulfillment strategy for a proposed supermarket in your locality.

- Formulate a strategy for the same.

Check Your Progress - 2

6. Which of the following is the most important factor influencing the Responsiveness of the Order Fulfillment Process?
   a. Nature of the product
   b. Nature of customer demand
   c. Production triggering
   d. Meeting customer demand
   e. Supplier response
7. Which of the following is not an element of the Responsive Order Fulfillment Process?
   a. Stimuli
   b. Resources
   c. Awareness

d. Capabilities
e. Goals

8. Identify the option that is not a part of the order fulfillment system.
   a. Order Capture
   b. Order Management
   c. Order fulfillment
   d. Order negotiation
   e. Reverse Logistics
9. Which of the following is not a characteristic of an Ideal Order Fulfillment Process?
   a. Accept Multiple Order Formats.
   b. Provide real-time and complete information to customers.
   c. Handle orders across multiple channels.
   d. Track and manage outsourced operations.
   e. Realize customer dues immediately after delivery.
10. Which is the most critical problem that irritates customers. when the product is delivered?
   a. Product mismatch
   b. Damage during transportation
   c. Payment settlement
   d. Poor quality packing
   e. Wrong delivery

13.7 Summary

- Order fulfillment is a key process in any product or services company.
- The process of order fulfillment encompasses all the activities that take place between the placement of an order by a customer and to the delivery of the order to the customer.
- The order fulfillment process can be viewed, from two perspectives: strategic and operational.
- The strategic order fulfillment process determines the requirements and systems that need to be in place, to fill customer orders.
- The operational order fulfillment process deals with the activities that have to be performed to fill the order.
- The e-fulfillment process is different. from the physical order fulfillment process.

- Most e-commerce organizations use one or more of the following order fulfillment strategies: distributed delivery centers; partner fulfillment operations; dedicated fulfillment centers; third-party fulfillment centers; and build-to-order.
- The key factors that influence the responsiveness of the order fulfillment process are the nature of the product, the nature of product demand, production triggering, and meeting customer demand.
- Four components are involved in the responsive order fulfillment process: stimuli, awareness, capabilities, and goals.
- Technologically advanced order management systems can help firms develop an accurate and efficient order fulfillment process.

13.8 Glossary

CRM: Customer Relationship Management. CRM refers to the principles, practices, and guidelines that an organization follows when interacting with its customers.

EDI: Electronic Data Interchange. EDI is the concept of businesses electronically communicating information that was traditionally communicated on paper, such as purchase orders and invoices.

E-Fulfillment: refers to online order processing and delivery.

Responsive Order Fulfillment: It is the process that can give the firm the ability to price its services or products at a premium and also enable it to gain a larger market share.

Reverse Logistics: It is the management of returns from customers.

13.9 Self-Assessment Test

1. Briefly explain the elements of the Customer Service Supply Chain.
2. What are the major aspects of the Customer Order Fulfillment Process?
3. What are the essential requirements of an Order Fulfillment Strategy?
4. List and briefly explain the elements of the Responsive Order Fulfillment Process.
5. What are the major differences between Traditional and E-Fulfillment processes?

13.10 Suggested Reading / Reference Material

1. Ashley McDonough, Operations and Supply Chain Management Essentials You Always Wanted to Know: 15 (Self Learning Management Series) Paperback – 1 January 2020
2. Russel and Taylor, Operations and Supply Chain Management, 10ed, ISV Paperback – October 2019
3. Chopra and Kalra, Supply Chain Management 6/e Paperback – 17 June 2016

13.11 Answers to Check Your Progress Questions

1. (b) Delivery of the order on time

It is the most important goal in the customer service supply chain

2. (c) Marketing strategy

It influences the customer order fulfilment process most.

3. (e) Order Shipment

It is not relevant to formulate order fulfilment strategy

4. (e) Customer Satisfaction Strategy

It is not a part of the order fulfilment process.

5. (e) Closing the Order

It is not a part of post-delivery activity.

6. (b). Nature of customer demand

It is the most important factor influencing the responsiveness of the order fulfilment process.

7. (b) Resources

'Resources' is not an element of the responsive order fulfilment process.

8. (d) Order Negotiation

It is not a part of the order fulfilment system.

9. (e) Realize customer dues immediately after delivery

It is not a characteristic of an ideas order fulfilment process.

10. (a) Product Mismatch

Product mismatch is the most critical problem that irritates customers after the product is delivered.

Supply Chain Management

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