BLOCK 2
LOGISTICS MANAGEMENT: COMPONENTS

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UNIT 5 PROCUREMENT OF MATERIAL AND INVENTORY CONTROL*

Structure

5.0 OBJECTIVES

After reading this Unit, you should be able to:

- Comprehend the concept and importance of procurement;
- Differentiate between procurement and purchase;
- Discuss the steps in a procurement cycle;
- Provide the conceptual framework of inventory control;
- Distinguish between inventory control and inventory management;
- Examine the inventory control techniques; and
- Assess the scope of automation in procurement and inventory control.

5.1 INTRODUCTION

The backbone of trade by getting goods delivered quickly on ordering is logistics or supply chain. The major components of logistics management are procurement, material handling, packaging, and transportation, with its related information that enables control of movement and supply of goods. Procurement and supply management involves buying the goods and services that allow an organisation to operate in a profitable and ethical manner. Procurement is often responsible for large chunk of companies' revenue, so small reductions in costs can have a huge impact on the profits. The processes employed to maximise a company's use of inventory is inventory control.

This Unit shall bring out the importance of procurement, make a distinction between procurement and purchase, discuss steps in procurement cycle, and examine the important inventory control techniques.

* Contributed by Col. (Dr.) Rajive Kohli, Management Consultant, New Delhi

5.2 UNDERSTANDING PROCUREMENT

All organisations lay great efforts to acquire raw materials, components, products, services, and other resources from suppliers for their operations. In a supply chain, each organisation buys materials from upstream suppliers, adds value, and sells them to downstream customers. As each organisation, in turn, buys and sells, the materials move through the whole supply chain. The trigger that initiates each move is a purchase which is a message that an organisation sends to a supplier, saying, 'we have agreed on terms, so send us materials and we will pay you'. In this process, procurement, purchasing, and sourcing are interchanging tasks having separate functions as follows:

- **Procurement**: It is the process of identifying and obtaining goods and services. It includes sourcing, purchasing and covers all activities from identifying potential suppliers through to delivery from supplier to the users or beneficiary.
- **Purchasing**: It is the specific function associated with the actual buying of goods and services from suppliers.
- **Sourcing**: It is simply identifying and working with appropriate suppliers. It is the process of acquiring goods, works and services.

Procurement vs. Purchasing

Procurement and purchasing are two processes that are done during the process of acquiring goods and services for an organisation.

Procurement is a strategic process of product or service sourcing, for example researching, negotiation and planning. It comprises the following activities:

- Identifying needs and requirements
- Sourcing and evaluating local, national, or international suppliers
- Negotiating terms, conditions, and contracts
- Building and managing supplier relationships
- Performing cost savings and profit margin analysis
- Receiving goods/services and warehouse management
- Processing and organising payment with supplier

Procurement has a vital role in an organisation involving a process of identifying, shortlisting, selecting, and acquiring suitable goods or services or works from a third-party vendor through a direct purchase, competitive bidding, or tendering process while ensuring timely delivery in the right quality and quantity. Proper procurement is essential to:

- Control spending as organisations can spend more than two thirds of revenue on procurement, so even small cost reductions can have a big impact.
- Prevent corruption as it is believed to add up to 25% of the cost of procurement contracts.
- Protect the brand of the product or service as accountability is ensured due

to information relating to inadequate supply chains now go right to the higher levels of organisation, with the company keeping a significant control on it.

The role of procurement in an organisation is to:

a) Ensure uninterrupted flow of raw materials at the lowest total cost.

b) Improve the quality of finished goods produced; and

c) Optimise customer satisfaction.

7 R's of Procurement. The goal of procurement as we have already discussed in Units 1 and 4 of this Course is to carry out its activities in such a way that the goods and services, so procured are of the:

1) Right Price
2) Right Quantity
3) Right Quality
4) Right Time
5) Right Place
6) Right Source
7) Right Service

The aim of procurement is to primarily have a reliable supply of materials. Other more immediate goals being:

- Organising a reliable and uninterrupted flow of materials into an organisation.
- Working closely with user departments, developing relationships, and understanding their needs.
- Identifying good suppliers, working closely with them, and developing beneficial relationships.
- Buying the right materials and making sure that they have acceptable quality, arrive at the time and place needed, and meet any other requirements.
- Negotiating good prices and conditions.
- Keeping stocks low, considering inventory policies, investment, standard and readily available materials.
- Moving materials quickly through the supply chain, expediting deliveries when necessary.
- Keeping abreast of conditions, including pending price increases, scarcities, new products, etc.

Purchasing

It includes the processes concerned with acquiring goods and services, including payment of invoices being a part of the wider procurement process. Purchasing is a function that focuses on how products and services are acquired and ordered, such as raising purchase orders and arranging payment. It has the following activities:

- Receiving purchase requisitions
- Evaluating quotes from suppliers
- Raising and processing the purchase orders

Purchasing contributes by:

- Actively seeking better materials and reliable suppliers.
- Working closely with strategic suppliers to improve the quality of materials; and
- Involving suppliers and purchasing personnel in new product design and development

5.3 PROCUREMENT METHODS

Procurement Process

The procurement process includes identifying a specific product or service requirement and the various steps on how a business finds new or existing suppliers, builds supplier relationships, measures cost savings, minimises risk and is predominately focused on value and return on investment.

A typical procurement process can involve the following steps:

a) Surveying the market
b) Identifying potential suppliers
c) Creating an approved list of vendors
d) Assessing internal needs
e) Preparing a purchase order
f) Requesting proposals and evaluating quotations
g) Selecting the right supplier and negotiating
h) Receiving goods and performing quality checks
i) Developing and managing contracts
j) Obtaining invoice approvals and fulfilling payment terms
k) Establishing a good supplier relationship

The purchasing process has the following steps:

a) Obtaining a purchase requisition
b) Requesting proposals and evaluating quotations
c) Dispatching official purchase orders
d) Receiving products and services
e) Checking the quality of delivered items
f) Providing payment to vendors

Procurement can be either of the following types:

a) Merchant buyers: These include wholesalers and retailers who purchase for resale.

b) **Industrial buyers:** These include those who purchase raw materials, capital equipment, or maintenance, repair, and operating (MRO) supplies.

Procurement activities are often split into two distinct categories:

a) **Direct spend:** It is production-related procurement that encompasses all items that are part of finished products, such as raw material, components, and parts. It focuses on supply chain management that directly affects the production process of manufacturing firms.

b) **Indirect procurement**: It is non-production-related acquisition by obtaining "operating resources" which a company purchases to enable its operations; comprises a wide variety of goods and services, from standardised items like office supplies and machine lubricants to complex and costly products and services such as heavy equipment, consulting services, and outsourcing services.

Procurement Cycle

A general approach to procurement has a series of common steps, which start with a user identifying a need for materials and end with its delivery. Procurement cycle may be considered as a process to include:

a) **Identification of need and requirements:** Based on business objectives, establish a short-term strategy of three to five years followed by defining the technical direction and requirements.

b) **External macro-level market analysis:** Based on its requirements, an organisation assesses the overall marketplace by understanding the competitiveness of the marketplace and trends that are likely to impact the organisation.

c) **Cost analysis:** Accumulation, examination, and manipulation of cost data for comparisons and projections to help in plan.

d) **Supplier identification:** Identifying suppliers who can provide the required product or services from different sources.

e) **Entering into Non-disclosure agreement (NDA):** Request vendors to sign an NDA prior to engaging with them to protect the organisation where sensitive information is shared with multiple potential vendors.

f) **Supplier communication:** Typically conduct competitive bidding processes using a variety of competitive bidding methods such as requests for quotation, proposals, information, tender, solution or partnership; making direct contact with the suppliers; samples examined or trials undertaken; and doing best value assessment.

g) **Negotiations and contracting:** To include price, availability, customisation, and delivery schedules which are outlined in purchase order or formal contract.

h) **Logistics and performance management:** To complete supply process based on contract terms, review their experience for reorder to consider continuing with same suppliers or continue with other suppliers.

i) **Supplier management and liaison:** Using supplier relationship management process for more strategic supplies within a formal governance process.

Check Your Progress Exercise 1

Note: 1) Use the space given below for your answers.

2) Check your answers with those given at the end of the Unit.

1) Differentiate between procurement and purchase.

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2) What are the components of procurement cycle?

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5.4 INVENTORY CONTROL: CONCEPTUAL FRAMEWORK

Inventory is defined as the sum of raw materials, fuels and lubricants, spare parts, maintenance consumables, semi- processed materials, and finished goods /stock at any given point of time. Since these resources are idle, when kept in stores, inventory is defined as a resource of any kind having an economic value.

Inventory control or stock control is regulating and maximising company's warehouse inventory by the activity of checking its stock. It is based on scientific methodical practice of verifying inventory and focusing on associated facets of inventory management, such as forecasting , within an organisation to meet the demands placed upon that business, including supply chain management, production control, financial flexibility, and customer satisfaction. The goal being to generate the maximum profit from the least amount of inventory investment without compromising customer satisfaction.

Inventory control is a system by which material of the right quantity and quality is made available to the users, at the right time, for a given production activity, maintenance, or repairs with the minimum of investment.

Inventory management is the process of efficiently overseeing the constant flow of material into and out of an existing inventory. This process usually involves

controlling the materials received to prevent the inventory from becoming too high or dwindling to levels that could put the operation of the company into jeopardy. A competent inventory management also seeks to control the costs associated with the inventory, both from the perspective of the total value of the goods included and the tax burden generated by the cumulative value of the inventory.

Inventory Control vs. Inventory Management

Inventory control and inventory management seem similar and some use it interchangeably. Both deal with different aspects of inventory optimisation, but both focus on the amount of stock to be ordered. Inventory control is the process of managing stock once it arrives at a warehouse, store, or other storage location; planning for sales and stock-outs, optimising inventory for maximum benefit and preventing the pile-up of dead stock. Inventory control is the managerial procedure for implementing an inventory policy. The accountability aspect of control takes stock of material held at a location and tracks any additions and deletions. Inventory control defines how often inventory levels are reviewed to determine when and how much to order. Accountability and tracking can be performed on a manual or computerised basis.

Inventory management involves tracking inventory throughout the supply chain, from sourcing to order fulfilment. It is a broader term that covers how to obtain, store, and profit from raw materials and finished goods alike. Inventory management is the process of ensuring the safe and efficient storage and control of stock, including the managing the demand and movement of materials.

Costs of Inventory

Inventory is costly and large amounts are generally undesirable. It can have a significant impact on the company's productivity and its delivery time. The heart of inventory decisions lies in the identification of inventory costs and optimising them relating to the operations of the organisation.

Holding (or Carrying) Costs. The cost in terms of money to hold inventory, that includes the costs for storage facilities, handling, insurance, pilferage, breakage, obsolescence, depreciation, taxes, etc. Clearly, high holding costs tend to favour low inventory levels and frequent replenishment.

a) **Fixed Costs**

- Capital costs of warehouse or store
- Costs of operating the warehouse or store
- Personnel costs

b) **Variable Costs**

- Cost of capital in inventory
- Insurance on inventory value
- Losses due to obsolescence, theft, spoilage
- Cost of renting warehouse or storage space

5.5 INVENTORY CONTROL TECHNIQUES

There are some important inventory control techniques. These include:

ABC Analysis

This technique is considered effective to exercise control over inventory. Here materials are classified into three categories in accordance with their values. Group 'A' constitutes high consumption items the value of which may be only 10 to 20 per cent of total items but account for about 50 per cent of the total value of the stores. A greater degree of control is exercised to ensure proper usage of these items. Group 'B' consists of medium consumption items that constitute 20 to 30 per cent of the inventory where a reasonable degree of control is needed. Group 'C' category has inventory that is of low consumption value. Though it covers 70 to 80 per cent of the inventory it costs about 20 per cent of total value. This technique helps in identifying key items and controls them.

Economic Order Quantity

It focuses on taking decisions regarding how much quantity of inventory should be ordered at any point of time and when it should be placed.

Just in Time

In this method of inventory control, the company keeps only as much inventory as it needs during the production process. It orders inventory when the current stock reaches the replenishment stage. This is considered a little risky method of inventory control as a little delay in ordering of new inventory can lead to out of stock situation.

Materials Requirements Planning Method

It is an inventory control method in which the manufacturers order the inventory after considering the sales forecast. Based on data and market demand, the inventory is reordered.

Vital Essential and Desirable (VED) Analysis

This technique is mainly used by companies for controlling spare parts of the inventory. Vital items are those without which the functions of the organisation are adversely affected. Essential items are those necessary for the long-term performance of organisational functions and the absence of which would not cause any interruption of activities. Desirable items are those which are necessary but do not cause any immediate loss to production and can be dispensed with.

Inventory control techniques often rely upon barcodes and radio-frequency identification (RFID) tags to provide automatic identification of inventory objects which can be processed with inventory management software. The items are labelled with a quick response (QR) Code, which can then be read with smart-phones to keep track of inventory count and movement. These systems are useful for field service operations, where an employee needs to record inventory transaction or look up inventory stock in the field, away from the computers and hand-held scanners.

Inventory control is a key activity. Excessive investment in inventories reduces profits due to cost of carrying inventories. This is more important in case of import of inventories. This needs proper scheduling of inventories.

5.6 AUTOMATION IN PROCUREMENT AND INVENTORY CONROL

There are several stakeholders involved in procurement processes, from internal members such as employees in different departments to external parties like vendors and contract negotiators, all demanding meticulous documentation comprising a complex web of procedures. A single purchasing cycle might last for weeks, whereas a whole procurement cycle can last for months or even repeated. If performed manually, these activities will be detrimental for efficiency, as the process of revising every document, evaluating every bid, and reviewing every invoice will cause too much delay. A comprehensive digital procure-to-pay solution, on the other hand, allows organisations to store all purchasing and procurement related files in one centralised database. While a shared network drive can fulfil this purpose, cloud-based procurement software can automate tasks at a level of convenience and efficiency that a manual system simply cannot match.

Most organisations use some form of e-procurement, advantages being:

a) Allowing instant access to suppliers anywhere in the world.

b) Creating a transparent market where products are readily available.

c) Automating procurement with standard procedures.

d) Reducing the time needed for transactions.

e) Lessening costs

f) Outsourcing some procurement activities to suppliers or third parties.

g) Integrating seamlessly with suppliers' information systems.

The impact of an e-procurement solution on procurement of material and inventory control is to streamline the process of acquisition by removing repetitive data entry, improving the workflow process, and enhancing report generation. The acquisition of products and services is a huge task as it involves several decision makers, departments, and a high level of paperwork: causing process bottlenecks, slowing decision making and complicating the procurement process. Automating key activities shall help in increasing the transparency of important information and aid decision making. Automated procurement systems also enable employees to concentrate on core activities to add further value within the business such as procurement strategy and improve supplier relationships.

To help maintain supplier management, and have an overview of negotiations and projects, many organisations utilise procurement software to hold and manage critical information. Typical procurement automation scenarios can include:

- Procurement software integration with accounting, Enterprise Resource Planning (ERP) and Warehouse Management System (WMS)

- Automating Request for Quotations (RFQs) when stock levels reach reorder points

- Automated stock reorder notifications through email or SMS
- Automatic creation and distribution of purchase orders
- Automated order confirmation emails
- Electronic Data Interchange (EDI) integration

Developments in technology shape the way the procurement teams interact with stakeholders and it benefits the organisation in the following manner:

- Integrating a digital transformation strategy
- Adopting artificial intelligence systems
- Installing cyber security systems and protection
- Making use of robotics for smart inventory management
- Using big data to drive decisions

Making organisation adapt to changing procurement trends can help in digital transformation, enhance supplier synergies and bring about cost savings.

Check Your Progress Exercise 2

Note: 1) Use the space below for your answers.

2) Check your answers with those given at the end of the Unit.

1) What is inventory control? List the techniques.

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2) What are the benefits of automation in the area of procurement?

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5.7 CONCLUSION

Inventory management is a critical concern of organisations as they help in planning their business future. Excess inventory, inventory record accuracy, and inventory velocity are still at the fore when discussing e-solutions implementation and technology developments. Inventory control focuses on the analysis that facilitates well-informed inventory decisions by presenting frameworks that assist in determining when inventory should be ordered, how much should be ordered, and ultimately how the inventory ordered should be managed and accounted for.

Modem information technology has created new possibilities for more sophisticated and efficient control of supply chains. Most organisations can reduce their material flow costs substantially. Inventory control techniques are particularly important components in this process.

5.8 GLOSSARY

Artificial Intelligence: It is the ability of a computer system to perform tasks normally requiring human intelligence. The systems work on their own without being encoded with commands. These tasks include visual perception, speech recognition, and translation between languages etc. In 1955, John McCarthy came up with the name 'artificial intelligence'.

Big Data: It involves computing and analysis from extremely large data sets to reveal patterns and trends especially relating to human behaviour and interactions.

Cyber Security: It is the protection of computer systems and networks from the theft of or damage to their hardware, software, or electronic data, as well as from the disruption, or misdirection of the services they provide.

Electronic Data Interchange (EDI): It is the transfer of data from one computer system to another by standardised message formatting, without the need for human intervention. It facilitates multiple companies in different countries to exchange documents electronically,

Enterprise Resource Planning (ERP): It is the integrated management of main business processes. In logistics management it relates to a computer system that analyses the current inventory forecast demand and expected delivery of new supplies to calculate demand and identify requirements from suppliers.

QR code: Short for "quick response" code is a type of barcode that contains a matrix of dots. It can be scanned using a QR scanner or a smartphone with built-in camera.

Request for Quotation: It is a business process in which a company of firm requests a quotation from a supplier for the purchase of specific products or services. It is generally call or invitation for bids.

Robotics: It is an interdisciplinary research area of computer science and engineering. It involves design, construction, operation and use of robots.

Warehouse Management System: It is a software application designed to support and optimise the functioning of warehouses and distribution centres.

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5.10 ANSWERS TO CHECK YOUR PROGRESS EXERCISES

Check Your Progress Exercise 1

1) Your answer should include the following points:

- Procurement is the process of identifying and obtaining goods and services. It covers all activities from identifying potential suppliers to delivery from suppliers to the users or beneficiaries.
- Purchasing is a transactional function that focuses on ordering and acquiring of products and services. This includes receiving purchase requisitions, evaluating quotations from suppliers, raising and processing of purchase orders.
- Procurement is the process of identifying and obtaining goods and services, while purchasing is associated with actual buying of goods and services from the suppliers.

2) Your answer should include the following points:

- Identification of needs and requirements
- External macro-level analysis
- Cost analysis
- Supplier identification
- Entering into Non-disclosure agreement
- Supplier communication
- Negotiations and contracting
- Logistics and performance management
- Supplier management and liaison

Check Your Progress Exercise 2

1) Your answer should include the following points:

- Inventory includes raw materials, fuels and lubricants, spare parts, maintenance consumables, semi-processed materials and finished goods/ stock at a given point of time.
- Inventory control is regulating and maximising the use of company's inventory.
- It attempts to generate maximum profit from the least amount of inventory investment without compromising customer satisfaction.
- It is the process of controlling inventory to ensure that material of right quantity and quality is made available to the user at the right time with minimum investment.
- The important inventory control techniques are a) ABC Analysis b) Economic Order Quantity c) Just In Time d) Materials Requirement Planning Method d) Vital Essential Desirable (VED) Analysis.

2) Your answer should include the following points:

- Integrating a digital transformation technology
- Adopting artificial intelligence system
- Installing cyber security systems and protection
- Making use of robotics for smart inventory management
- Using big data to drive decisions

UNIT 6 MATERIAL HANDLING AND PACKAGING*

Structure

6.0 OBJECTIVES

After reading this Unit, you should be able to:

- Explain the importance of material handling in logistics;
- Examine the objectives of material handling systems;
- Know the types of equipment for material handling;
- Discuss the significance of packaging; and
- Describe the various types of packaging.

6.1 INTRODUCTION

Logistics management aims at making customers satisfied with quality services. There are several products and commodities that are important for the day to day functioning of logistics cycle. Hence there is need for reliable material handling and packaging. Material handling and packaging is one of five interrelated functions of logistics. Material handling is concerned with the movement of material/goods within the storage space, and goods into and out of each facility. It is movement of right material to the right place, in right time, and in right condition. It includes the movement, storage, control, and protection of materials, products, and packaged goods throughout the process of manufacturing, distribution, and disposal. Packaging is an important aspect of materials handling that encompasses several aspects relating to the protection of materials and products for distribution and movement. It serves several purposes including protection, easing movement, and passing on product information. In this Unit, we shall discuss key aspects relating to material handling and packaging.

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6.2 SIGNIFICANCE OF MATERIAL HANDLING

Material handling is integral to the manufacturing industry. It is a human activity being performed since time immemorial but now an important specialised function of all industrial activities. Although every production worker's job involves this function, a large number of people work as dedicated "material moving machine operators". The material handling equipment transports various items in a variety of industrial settings such as moving construction materials around building sites or moving goods onto buses, trains, aircrafts, ships etc.

The basic function of material handling is to choose most appropriate material handling equipment which is safe and can meet material handling requirements. It aims towards:

- Improving the operational efficiency of the company;
- Ensuring better control of flow of material;
- Providing better response to customers through improved service delivery; and
- Promoting safety in material handling.

A manufacturing establishment receives the raw material, which passes through a series of handling processes before it reaches the ultimate customer. A modern manufacturing plant works on assembly line principles in which the material moves along the assembly line where different workers assemble different parts and the finished product emerges at the end of the process. For instance, the automobile manufacturing unit such as Maruti Udyog adopts this method.

Material handling also involves short distance movement within the confines of a building or between building and transportation vehicle.

Material handling is significant as it:

- Involves handling costs (can be 25% of the entire manufacturing costs).
- Requires frequent handling of subcomponents (can be 50 times in the manufacturing chain).
- Ensures increased safety.
- Decreases damages to parts and materials.

Material handling involves correct handling, sorting, moving of materials, equipment, and goods. Proper material handling results in shortening of delivery time, lowering overall costs of manufacturing, improving customer service, and reducing inventory.

Dimensions of Material Handling

- **Movement:** Efficient movement of goods into and out of storage facilities.
- **Time:** Readying goods for production or for customer order filling.
- **Quantity:** Due to varying usage and delivery rate of raw materials and finished goods, material-handling systems are designed to assure that the correct quantity of product meets the needs of production and customers.

- **Space:** Utilising effectively limited space by the material-handling equipment in the warehouse and plant.

6.3 MATERIAL HANDLING SYSTEMS

The handling of material is either manual or automated.

- Manual handling involves manual methods to move individual containers by lifting, lowering, filling, emptying, or carrying them. Ergonomic improvements can be used to modify manual handling tasks to reduce injuries by reconfiguring the tasks and using equipment such as lift/tilt/turn tables etc., to reduce reaching and bending. Manual handling can expose the workers to injuries especially handling heavy equipment.

- Automated handling equipment can be used to reduce and sometimes replace the need to manually handle material. Most of them require a human operator for tasks such as loading/unloading and driving. In a way it is semi-automated. Automated handling is increasing with advances in machine intelligence, and robotics.

All the material handling equipment in the facility is required to be a single unified system based on the following principles:

a) **Planning:** It encompasses a plan that includes suppliers, consultants, components of finance, engineering, management, and operations.

b) **Unitization:** Assembling of goods as one compact load.

c) **Systems:** Integration of handling and effective storage activities which is cost effective.

d) **Simplification:** Simplifying handling activities by reducing, eliminating, and combining unnecessary movement and equipments to maximise productivity.

e) **Ergonomics:** Recognising human limitations in human-mechanical systems.

f) **Standardisation:** Standardisation of material handling methods can enable the equipment and controls to perform various tasks than doing a specific one.

g) **Space Utilisation:** Ensuring effective utilisation of space and keeping the areas organised and clutter-free for the use of storage space within the facility.

h) **Automation:** Deploying automated technology in material handling, production, and storage.

i) **Environment:** Designing for ensuring reusability and recyclability along with environmental friendliness.

j) **Safety Principle:** Providing safe methods of handling equipment and following safety codes.

The primary objective of a material handling system is to reduce the unit cost of production; the others being:

a) Reducing manufacturing cycle time

b) Minimising delays and damage

c) Promoting safety and improving working conditions

d) Maintaining or improving product quality

e) Enhancing productivity through:

- Material flow in a straight line
- Material movement in as short a distance as possible
- Material movement at one time

f) Material handling automation

g) Controlling inventory

6.4 MATERIAL HANDLING EQUIPMENT

Industrial material handling equipment involves a diverse range of tools, vehicles, storage units, appliances and accessories involved in transporting, storing, controlling, enumerating, and protecting products at any stage of manufacturing, distribution, consumption, or disposal. These can be grouped into four categories: storage, engineered systems, industrial trucks, and bulk material handling.

1) **Storage Equipment.** These are usually non-automated used to hold or handle reserve materials (buffer). These include:

- **Racks**, such as pallet racks, push-back racks, and sliding racks, are a basic but important method of storage, saving floor space while keeping their contents accessible.
- **Stacking frames** are stackable like blocks, allowing inventory, such as containers of liquid, to be stacked to save space without damage.
- **Shelves** used with **bins** and **drawers**, to store and organise smaller and more difficult to manage materials and products.
- **Mezzanines**, which is an indoor platform to create more floor space.

2) **Engineered Systems.** These cover a variety of units that work cohesively to enable storage and transportation often being automated. These include:

- **Conveyors** are devices that move material (or people) horizontally or vertically between two fixed points.
- **Automatic Guided Vehicles** (AGVs) are independent computer-operated trucks that transport loads along a predetermined path, with sensors and detectors to avoid bumping into anything.
- **Automated Storage and Retrieval System** (AS/RS) is a large automated system for automatically placing and taking the loads/materials or commodities from the storage or place where they are stored. For example, the shuttle system is a mechanised cherry picker that can be used by a worker or can perform fully automated functions to quickly locate a storage item's location and quickly retrieve it for other uses.

3) **Industrial Trucks.** Trucks can also be manual or powered. A stack truck can be used to stack items, while a non-stack truck is typically used for transportation and not for loading. These include**:**

- Automated Guided Vehicle (AGV)
- Automated Electrified Monorail
- Storing Transfer Vehicle

4) **Bulk Handling Equipment.** These are conveyor belts or elevators that move large quantities of material such as food, liquid, or metals in loose bulk form, or in packaged form through drums and hoppers. These are:

- Conveyors of various types for different types of bulk material.
- Stackers are usually automated, pile bulk material onto stockpiles.
- Recliners retrieve materials from stockpiles, using bucket wheels, or scraper.
- Bucket elevators use buckets attached to a rotating chain or belt to carry material vertically.
- Grain elevators are tall buildings for storing grain, having equipment to convey the grain to the top of the elevator, where it is sent out for processing.
- Hoppers are funnel-shaped containers that allow material to be poured or dumped from one container to another.
- Silos are generally large storage structures for bulk materials, without any equipment to convey the material to the top like grain elevators.

Check Your Progress Exercise 1

Note: 1) Use the space given below for your answers.

2) Check your answers with those given at the end of the Unit.

1) What are the objectives of materials handling system?

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2) List the categories of material handling equipment.

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6.5 PACKAGING PERSPECTIVE

Packaging is the science, art and technology of enclosing or protecting products/ materials for distribution, storage, sale, and use. Packaging is typically viewed towards consumer with marketing focus, and for industrial purpose with logistics focus. Packaging refers to a container in which the product reaches the end user and is a part of the presentation of the product that stays right till the customer takes it from the retail store.

Packaging aims at:

- Product identification
- Product Protection
- Product Promotion
- Product Information
- Product Communication

For example, food packaging is done to ensure protection of food products from outside influences and damage, provide information to the consumers on its ingredients, nutritional information, cost, expiry date etc.

The functions of packaging are to:

a) Attract buyers' attention.

b) Protect goods inside the packaging.

c) Give description of contents.

d) Explain the benefits of the goods inside.

e) Provide warranty, warnings, and consumer information.

f) Indicate value, price, and uses.

Packaging is used as under to move materials throughout the various stages of logistics management process:

a) **Assembly:** Protecting and holding components delivered in production processes.

b) **Automation:** Automating systems require standardised trays or pans to function.

c) **Transportation:** Aggregating and protecting loads as they move through the supply chain.

d) **Warehousing:** Protecting products during storage.

e) **Holding Order :** Holding stored products prior to their delivery .

Packaging has following benefits:

a) **Containmen**t. It facilitates containment of products before they can be moved from one place to another. If the package breaks open, the item can be damaged or lost, or if it is a hazardous material it can contribute to environmental pollution

b) **Protection.** It ensures protection of the product. The contents of the package must be protected from damage or loss from outside environmental effects

such as shock, moisture, dust, insects, and contamination. This reduces the security risks of shipment.

c) **Apportionment.** Packaging needs proper apportionment or division of the product into appropriate quantities. The output must be reduced from industrial production to a manageable, desirable consumer size.

d) **Unitization.** Primary packages can be unitized into secondary packages (e.g., placed inside a corrugated case), which can then be unitized into a stretch wrapped pallet, and ultimately into a container loaded with several pallets. This reduces the number of times a product must be handled.

e) **Convenience.** Packaging allows products to be used conveniently, that is with little wasted effort by customers.

f) **Communication.** Packages and labels communicate how to use, transport, recycle, or dispose of the package or product.

g) **Marketing**. The packaging and labels can be used by marketers to encourage potential buyers to purchase the product. Package design is an important and constantly evolving feature.

h) **Sustainability**. It facilitates sustainability. Returnable and reusable packaging can be used repeatedly before it is recycled; some materials are engineered to be of biodegradable material.

There are usually three levels of packaging required in a distribution system. First is a primary package that holds the product. Next, for small packages, a shipping container such as a corrugated box is needed. There is a third level of packaging where several primary or secondary packages are assembled into a unit load. Typical applications include holding and protecting bulk materials, cases, loads or individual items for shipping and receiving, organising products in static or automated storage systems, and acting as a receptacle to hold picked items for a discrete order.

In general packaging is good if it fulfills the following requirements:

- Convenient
- Attractive
- Economical
- Protective; and
- Communicative

6.6 TYPES OF PACKAGING

Packaging may be described in relation to the type of product being packaged. It is sometimes convenient to categorise packages by layer or function primary (first envelops and holds), secondary (outside) or tertiary (transit). The four common types of packaging are:

1) C**ontainers:** Receptacles that hold, protect and organise products and materials during storage and transport. They come in a variety of forms, including bags, barrels, drums, cartons, cases. Common materials

include **corrugated cardboard**, welded wire mesh, metal (including steel and aluminum), corrugated plastic and high density polyethylene (HDPE) (most frequently used in the construction of reusable and returnable containers).

2) **Pallets:** These made of wood, plastic, or metal (steel or aluminum), provide a portable, horizontal, rigid platform that serves as a base for unit loads. Pallets are used as a returnable, reusable surface for assembling, storing, stacking, and handling and transporting of goods as a unit load.

3) **Dunnage:** These are materials or devices used in the securing and/or bracing of products during shipments. Since it is impractical for most facilities to stock multiple container sizes to accommodate shipping different product weights and sizes, most items get shipped in big boxes.

4) **Unitizers:** Materials that hold several items together to form a complete load.

Packaging Material

There are various types of materials available for packaging of the goods. These materials are paper, plastics, wood, cardboard etc. The selection of the packaging materials should be made keeping in view primarily the specifications required for consumer. The selection of the packaging materials would depend upon the following factors:

a) Product characteristics.

b) Transportation and storage methods.

c) Climate

d) Standards and environmental considerations.

e) Market position.

The type and quality of the packaging is specific to the given product. Certain products such as garments, shoes, textiles etc., are sold without any packaging at the retail stores. Such goods do not require expensive packaging to ensure that the products remain clean. These goods are often packaged in polyethylene bags. Cardboard boxes are used for the packaging glassware and delicate items to ensure that they are not damaged during handling and display. Expensive products and gift items such as jewellery need high quality and expensive packaging material.

Kinds of Packaging

Depending on the use of packaging materials, packaging is of the following categories:

1) **Plastic Packaging: T**he most common plastic materials are polyethylene (PE) and polypropylene (PP).

2) **Paper based Packaging:** These are used as wrapping, as paperboard cartons or corrugated fiberboard boxes.

3) **Paper Board Cans:** It is a form of paper-based retail packaging, is inexpensive and is used to pack different types of products. These can be

lined inside with aluminum foil or plastic films to provide additional protection against humidity.

4) **Combined Plastic and Cardboard Packaging:** These packages combine paperboard and plastic materials used mainly in retail packaging of pens and gift items.

5) **Plastic boxes:** Plastic box packaging has following advantages:

- Flexible, lightweight and can be applied with films or coating to enhance packaging appearance.
- Can be recycled.
- More durable than paperboard boxes.
- Airtight plastic packaging containers can help to preserve the quality of food and eliminate any contamination issues.
- Does not easily break and can be stored with food under extreme conditions.
- It has ability to showcase the product at any angle without necessarily opening the packaging.
- Recyclable and cost effective.

Several traditional materials, such as wood, leather, glass, and ceramic are being replaced by plastic.

6) **Sturdy boxes:** It is made from highly condensed paperboard that is four times thicker than the paperboard used in the construction of a standard folding carton and is more expensive.

7) **Foil sealed bags:** These are used for food such as nuts, cereals, smoked fish, cheese etc., and to prevent from spoilage, as well in coffee and tea packaging as it keeps the products dense to maintain the flavour. This protects it from bacteria thus increasing its shelf life. These can also be used to package bedding and clothing products by removing the oxygen from the bag to keep the fabric tight and secure to prevent the growth of fungi and bacteria.

8) **Other Materials:** Wood, textiles, straw, leaves or any other locally available materials can be used like specially made wooden boxes to package traditional ceramics, woodcarvings, various gift items, pieces of jewellery, etc. Gift packages are made with much care and cushion provided for preventing damage during transport.

Disposal of Packaging Waste

In many products there is a large amount of packaging with layers of wrapping. There are growing concerns about the amount of packaging, its cost and disposal. The empty packets form a large part of solid waste that the community generates. Conventionally, industrial packaging is more likely to be reused and recycled than consumer packaging, because it is more robust, and can be collected from a few locations. Discarded plastic waste litter the country's roads, rivers and form huge mounds in garbage dumps across India. Besides the stench, the site poses a major health hazard for the area's residents, exposing them to the mosquito-

borne and other diseases. Many times, the solid waste is put on fire, polluting the air. It can also be fatal for the stray animals, mainly cows and dogs that end up mistaking plastic for food. The packaging materials many a times comprise glass, plastic, tins etc., that get mixed up with other refuse creating disposal problem. The non-disposable nature of certain materials aggravates the problem further.

The issue of disposal of packaging waste can be tackled through the following ways:

- **Prevention**: Ways can be devised to avoid use of packaging material. It should be done only where it can be done away with. It is like carrying our own bag while shopping groceries and vegetables.

- **Minimisation:** Excessive layers of packing material can be done way with, through reduced packaging measures. Packaging should be resorted to only where required.

- **Reuse:** The reuse of packaging material should encouraged. The companies can devise the means of collecting back the packaging material from the customers. Many are resorting to this method.

- **Recycling**: The packaging materials wherever possible can be reprocessed for future use. Steel and aluminum cans, glass bottles/containers, paper, plastic can be recycled.

- **Disposal**: Certain packaging material must be disposed of. This can be through incineration, landfill, composting and so on. Only that type of packing material which is non-hazardous and non-toxic can be disposed by open dumping.

As per Tata Energy Research Institute (TERI), report of 2018 plastic accounts for 8% of the total solid waste generated in India. Of the 25,940 tons of plastic waste produced in India everyday according to Central Pollution Control Board (CPCB), 94% is thermoplastic, or recyclable materials such as PET (polyethylene terephthalate), and PVC (polyvinyl chloride). These materials can be recycled utmost around 7-9 times, after which they must be disposed of highlighting the key aspect of waste management system. It is estimated that 80% of plastic waste is recycled, mainly by the rag pickers who collect and segregate it. However, out of the non-recyclable waste, merely 28.4% could be treated before being disposed of, leaving the rest to pollute landfills or rivers and seas.

Currently, bio-degradable plastics are being developed. Most of the plastic produced is used by the packaging industry, nearly half of this is single-use plastic.

All packaging is ultimately discarded, hence the societal costs associated with waste disposal must be considered. Some companies have policies of reducing waste by reusable containers. The replacing cardboard containers by wood might seem expensive, but it can be used repeatedly and reduce overall costs – as well as contributing to a cleaner environment. In India, taking cognisance of the crisis, there is a nationwide movement to shun single-use plastic. Various state governments have enacted laws, with little success, to curb the menace. Awareness needs to be generated and innovative alternatives found.

Check Your Progress Exercise 2

Note: 1) Use the space given below for your answers.

2) Check your answers with those given at the end of the Unit.

1) What are the benefits of packaging?

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2) Describe the types of packaging.

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3) What are the ways of disposal of packaging waste?

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6.7 CONCLUSION

Material handling and packaging is a key component of logistics management. Generally, we see that any material or product when ordered is handled and packed to be sent to customer. Material handling is a key activity that ensures safety of the products as well as those dealing with the products. The package serves as a means of identifying the product in a way not possible from its outward appearance. In this Unit an attempt has been made to provide important aspects of these two activities.

6.8 GLOSSARY

Automated Electrified Monorail: It is an automated system that establishes a link between the areas of logistics centre –, production, storage, order preparation and shipping.

Ergonomics: It is the science of refining the design of products to optimise them for human use. It is an applied science concerned with designing and

arranging things people use so that they and things interact most efficiently and safely.

Mezzanine: It is a low storey or intermediate floor between main floors in a building and typically between ground and first floor.

Pallet: A platform used for storing and moving stock.

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6.10 ANSWERS TO CHECK YOUR PROGRESS EXERCISES

Check Your Progress Exercise 1

1) Your answer should include the following points:
   - Improving the operational efficiency of the company
   - Ensuring better control of flow of material
   - Providing better response to customers through improved service delivery
   - Promoting safety in material handling
   - Controlling inventory
2) Your answer should include details about the following four categories:
   - Storage

- Engineered systems
- Industrial trucks: and
- Bulk material handling.

Check Your Progress Exercise 2

1) Your answer should include the following points:
   - Containment
   - Protection
   - Apportionment
   - Unitization
   - Convenience
   - Communication
   - Sustainability
2) Your answer should include details about
   - Containers
   - Pallets
   - Dunnage; and
   - Unitizers.
3) Your answer should include the following points:
   - Prevention
   - Minimisation
   - Reuse
   - Recycling
   - Disposal

UNIT 7 TRANSPORTATION, WAREHOUSING AND STORAGE*

Structure

7.0 OBJECTIVES

After reading this Unit, you should be able to:

- Discuss the various modes of transportation that play a key role in logistics management;
- Provide an overview of transportation function;
- Examine the important aspects of warehousing and storage; and
- Describe the types of documents used in transportation and warehousing.

7.1 INTRODUCTION

In the domain of logistics management, physical distribution systems link manufacturers, wholesalers, and retailers into marketing channels making the products available. The major logistics function includes transportation in which certain decisions about the movement of goods and services are made in the interests of the organisation. Transportation function is important because it affects the delivery performance, pricing of product, and condition of the arrived goods which ultimately determine the satisfaction of the customers. There are five different transportation modes that can be adopted by an organisation in the delivery of their products to the dealers, warehouses, and customers.

It assumes importance in logistics management as all products are to go through the phase of warehouse and storage. Warehousing is the act of storing goods that will be sold or distributed later. While a small, home-based business might be warehousing products in a spare room, basement, or garage, larger businesses typically own or rent space that is specifically designed for storage.

This Unit orients you with the basic aspects of transportation, warehousing and distribution.

* Contributed by Col. (Dr.) Rajive Kohli, Management Consultant, New Delhi

7.2 TRANSPORTATION MODES

Logistics is the physical flow of materials and products which are commonly to be transported in the supply chain. The five basic transportation modes are road; rail, air, water, and pipeline which are described below.

Road (Trucks)

In India trucks are an important means of transportation of products than any another means. It is estimated that the Indian truck market reached a value of US$ 10,140 million in 2019 (IMARC). Shipping by truck is fast relative to other modes except by air. Trucks can reach several areas including rural, hilly terrains and in contrast to rail transport, trucks can accept products in small quantities. Within cities, trucks are considered as the largest transportation mode. The routing and timing schedules of trucks are highly flexible, and their service is much faster than railways. High value goods to be sent to short distances are effectively transported through trucks. Heavy or bulky goods require many trucks and hence uneconomical to use them over long distances. The amount of pollutants emitted by trucks is also high relative to some of the other transportation modes, so it is not an ecologically preferable solution. In India in 2017, the road transportation sector contributed to about 67 per cent of the freight traffic across the country.

Rail

Railways are the largest carrier of any nation delivering 26 per cent of total cargo. These can transport large amounts of bulk products to the distant locations such as sand, mineral, coal, agriculture, and forest items in a cost-effective way. In terms of speed and cost, shipping by rail falls somewhere between truck and water transportation. Businesses that need to ship heavy, bulky goods often try to locate their facilities nearer to railway lines.

Air

Air transportation is the least popular among the business organisations and only about 1 per cent of the total cargo is transported through air. The cost of air transportation is quite high due to expensive freight rates, but it is the fastest way of transporting goods, especially in case of perishable goods and smaller quantity of high value products.

Shipping (Water)

Shipping is the oldest mode of transporting goods from one region to another, but it is more time consuming than other modes. International trade is mostly conducted by cargo shipping. They transport "loose" cargo such as grain, coal, iron ore, petroleum, and other mined products; but also, consumer products. Waterway is inexpensive but slow, and many markets are also not directly accessible by water. Inland water transport is being developed wherever feasible.

Pipelines

Pipelines are generally used to transport oil, natural gas, and chemicals. Two-thirds of petroleum products are transported by pipeline. Pipelines are costly to be built, but once they are constructed, it is considered a cost-effective mode of transportation. The oil moves 5 to 12 km per hour and reaches the destination in two to three weeks depending on the size of the pipe, its pressure, and the density

of the liquid. The products shipped through pipelines often must be moved using two different transportation modes.

Inter-modal

Inter-modal transportation is shipping used together in combination with the other modes of transportation. Consumer goods are often shipped in inter-modal containers which are metal boxes. The largest containers are 53 feet long and 100 inches tall; the biggest cargo ships carry as many 15,000 containers. By contrast, a train can carry around 250 containers stacked on top of each other. A significant percentage of inter-modal containers offloaded from ships end up on railways bound for inland destinations. The containers are then trucked over shorter distances to distribution centres, warehouses, and storages.

7.3 TRANSPORTATION: AN OVERVIEW

India has a large and diverse transport sector. Transportation has been recognised for many years as being one of the most important activities in the physical distribution of materials and products. Companies face different trade-offs when choosing transportation methods. The choice of transportation method depends on the customers' needs, speed, cost, frequency of delivery, or flexibility to respond to different market conditions. Some of the functional issues related to transportation are:

a) Transport transactions are often influenced by five parties: the shipper (the original party), the consignee (destination party or receiver), the carrier, the government, and the public.

b) Transport economics and pricing are concerned with the factors and characteristics that determine transport costs and rates. In transportation, economy of distance is the tapering principle since rates or charges taper with distance i.e. transportation cost per unit of distance decreases as distance increases.

c) Economy of scale is the characteristic where transportation costs are proportional to the weight of the shipment. The cost per unit of weight decreases when the size of the shipment increases.

d) The freight transportation structure consists of vehicles, and carriers that operate within five basic transportation modes.

e) Transportation service is achieved by combining the capabilities of modes.

f) Government transportation regulations can be grouped into two categories: economic regulation and safety and social regulation.

Given a facility network and information capability, transportation is the operational area of logistics that geographically positions inventory. Because of its fundamental importance and visible cost, transportation has received considerable managerial attention over the years. The transportation managers are fundamentally responsible for:

a) Operations management

b) Freight consolidation

c) Rate negotiation

d) Freight control

e) Auditing and claims; and

f) Logistical integration.

Transportation requirements can be accomplished in three basic ways:

a) Private fleet of equipment

b) Contract with transport specialist; or

c) Common carriage where in the services of carriers that provide different wodes of transportation on an individual shipment basis are engaged.

The transportation requirements in the logistical network must ensure proper facility selection, total transportation cost within the freight bill, and ensuring the delivery service which is not sporadic or inconsistent.

Check Your Progress Exercise 1

Note: 1) Use the space below for your answers.

2) Check your answers with those given at the end of the Unit.

1) Identify functional issues relating to transportation.

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2) List the functions of transportation manager.

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7.4 WAREHOUSING AND STORAGE

Distribution Centre

The terms warehouse and distribution centre are often used interchangeably, however, a warehouse provides only storage; and a distribution centre not only stores the products but also executes the orders. In a distribution centre the emphasis is on processing and moving goods on to other parts of the supply chain. Modern supply chains equipped with better information can forecast product demand well in advance, plan accordingly and deliver the right product in the right place at the right time. Therefore, the static warehouses are evolved into distribution centres. The differences between a warehouse and a distribution centre are:

- A warehouse is used for storing products while a distribution centre, apart from storing products offers value-added services like product mixing, order fulfilment, cross docking, and packaging.
- A distribution centre stores products for relatively lesser periods compared to a warehouse. Hence, the flow velocity through the former is much greater than the latter.
- A distribution centre is customer-centric bridging the supplier and its customers. While the role of a warehouse is to store products efficiently, the role of distribution centre is to efficiently meet customer requirements.
- Typically retail and warehouse orders are shipped from a distribution centre and not from a warehouse. Basically, a warehouse generally does not serve external customers like a distribution centre.
- The operations at a distribution centre are much more complex than that at a warehouse. As a result, the distribution centres are equipped with latest technology for order processing, warehouse management and transportation management.
- Warehouses exist and serve a purpose. An example is when inventory is pre-built months in advance to meet the high seasonal demand and is stored in typical warehouses before being sent to a distribution centre for customer service. However, the importance of warehouses in supply chain has gone down and the distribution centres have now emerged as the nerve centres of the modern supply chains.

Warehousing Elements

The basic elements that help monitor inventory and store it safely in a warehouse, whether only storage or also order fulfilment, are:

a) Shelving and rack systems that offer maximum storage capacity and easy product access.

b) A climate control system for the product being stored. This is particularly important for frozen products or those requiring refrigeration.

c) Inventory control software giving details where all individual units are in the system.

d) Equipment for moving products within the warehouse.

e) Shipping supplies for order fulfilment.

f) Pickers or people who load products into a warehouse, others who fill orders in a true distribution centre, and those who manage the facility and operation.

g) Security to protect stored products.

h) Access to cost-effective transportation to bring products in or move them out as orders are fulfilled. That often means easy access to highways, railways, or airports.

Functions Performed by Warehouses

Warehouses usually perform the following functions:

a) **Procurement:** The first step in warehousing where goods are received unloaded and moved to pre-receipt inspection point and for accounting purpose.

b) **Sorting**: Items received in bulk are sorted out item-wise for better storage and easy identification. Heavy and big sized items are kept separate.

c) **Breaking (dividing**): Items received in bulk are broken down into smaller portions and packed separately to cater to the requirements of various retail outlets and customers.

d) **Storage**: After sorting and dividing, items are stored with proper identification and location to take them out as and when required. Big retailers also use computers and merchandise-based software packages to locate, identify and maintain accounting of the items.

e) **Making items available for consignment/shipment**: In warehouses, goods are stored for short period, and as per the orders from retail outlets or customers; goods are dispatched to the destinations.

f) **Material handling**: Material handling is a part of physical distribution system consisting of proper handling equipment used for loading, unloading, lifting, and moving goods from one place to another.

g) **Display**: To promote sales, some warehouses display products.

h) **Inventory control**: It includes procuring goods and keeping its proper records. Warehouses are also responsible for inspection, maintenance, and accounting of goods to prevent any thefts and unforeseen mishaps. Proper accounting results in avoiding large fluctuations in inventory levels.

i) **Processing**: Certain goods are not to be consumed in the form they are produced. It requires processing to make them consumable. For instance, ripening of fruits or juice extraction, seasoning of timber, crushing of wheat, polishing of paddy etc. Some warehouses also perform these activities as per the demand from the owners.

j) **Grading and branding**: Some warehouses perform the functions of grading and branding of goods on the behalf of the producers, wholesalers, or the importer of goods. Besides usual activities, some warehouses provide mixing, blending, and packaging assistance for the convenience of handling and sale.

k) **Transportatio**n: In a few cases, warehouses provide transportation facility. It collects goods from the factories and sends these goods to the place of delivery.

Types of Warehouses

The following are the types of warehouses.

a) **Private Warehouses**: Private warehouses are owned by the business enterprises to store their products. Because of heavy cost of construction and maintenance of these warehouses, their number is quite small. Only big business houses can afford to have such type of warehouses.

b) **Public Warehouses**: These are also known as duty paid warehouses and open for public at large. Most of the small and medium business organisations cannot afford to have their own warehouses on account of large financial investment in their construction and maintenance. They make use of these types of warehouses, which may be owned by an individual or some agency whose main object is to provide storage facilities to people for certain fees or charges. These warehouses operate within rules and regulations formed by the government. Public warehouses are especially useful to business houses, usually situated near railway lines or main roads, to provide quick transportation services. Goods lying in the warehouse can be hypothecated for getting loan and financial assistance. Public warehouses ensure greater security and handling of goods on account of latest mechanical devices used in handling and preserving the goods. Goods can be branded, graded, and packed in desired sizes in the warehouses.

c) **Bonded Warehouses**: Bonded warehouses situated near the port, are used for imported goods which are not granted clearance on account of non-payment of custom duty by the importer of these goods. Goods can only be removed after the custom duties are paid. Bonded warehouses may be run by the government or licensed private agencies having strict control and supervision imposed by custom authorities on their operation and functioning. The importer of the goods can inspect and check the goods. After making part payment of the custom duty, goods can be proportionately withdrawn from these warehouses. Goods kept in these warehouses can be branded, packed, graded, and labelled in the warehouse itself. Bank loans can be raised with the help of receipt issued by these warehouses as a collateral security. There is a least possibility of goods being exposed to any risk of theft, damage, and deterioration. The entrepôt trade i.e., re-export of imported goods is greatly facilitated as the importer can have the delivery of goods without paying any custom duty.

d) **Special Commodity Warehouses:** These warehouses are constituted for storing a particular type of commodity, e.g., tobacco, cotton, wheat etc. The nature of the commodity is important in selecting the type of warehouse. Storage tanks are needed for storing petrol, and godowns for storing agricultural products.

e) **Cold Storage or Refrigerated Warehouses**: These are the warehouses which are used for storing perishable commodities like eggs, butter, fruits, vegetables, fish, fresh meat etc. Goods stored in cold storages can be held for longer time making possible the regular supply of certain commodities throughout the year.

f) **Institutional Warehouses**: Different institutions and bodies have their own warehouses on account of the nature of their operations. Banks keep the

stock of the companies in these warehouses as security against the loans advanced. Railways maintain warehouses to store large quantity of goods to be dispatched to different parts of the country, or goods received for the purpose of delivery are kept till they are disbursed to the claimant. Various transport agencies also maintain warehouses for storing the goods which are to be dispatched and received. The Food Corporation of India has many big warehouses throughout the country for storing agricultural products.

7.5 TRANSPORTATION AND WAREHOUSING DOCUMENTATION

In transportation and warehousing, there are many types of documents and bills which are needed to transport goods from one place to another. Transport documents lie at the heart of trade transactions. These documents are issued by the shipping company, airline, trucking company, railway, freight forwarder or logistics company. They provide an accounting record of the transaction, instructions on where and how to ship the goods and a statement giving instructions for handling the shipment.

Lorry Receipt (L/R)

It is an acknowledgement of goods given by the transport companies to the persons who send goods. The consignor (sender) sends this receipt to the buyer with the invoice and other documents. The buyer can take delivery of the goods only on production of this receipt at the destination.

Railway Receipt (R/R)

When goods are sent through Railways, the railway authorities acknowledge receipt of goods which is called R/R. Like L/R, it is also a document of title to goods and the buyer must produce this to the railway authorities while taking delivery of goods.

Consignment Note

It is a form issued by railway companies to be signed up by all persons who intend to send goods by railways. It contains terms and conditions on which the railway company undertakes to carry the goods. This form is to be filled in and handed over to the Railways along with the goods.

Bill of Lading (B/L)

B/L is a document issued by the agent of a carrier to a shipper, signed by the captain, agent, or owner of a vessel, furnishing written evidence regarding receipt of the goods (cargo). It includes the conditions on which transportation is made (contract of carriage), and the engagement to deliver goods at the prescribed port of destination to the lawful holder of the bill of lading. It is, therefore, both a receipt for merchandise and a contract to deliver it as freight.

Although the term is used for shipment by sea, it may be used for any type of carriage of goods.

Airway Bill (AWB)

It is a bill of inventory or listing of cargo that is being transported by air. AWB is the most important document issued by an airline either directly or through its

authorised agent. It is a receipt issued by an international airline for goods and an evidence of the contract of carriage. It is a document of title to goods. It is a non-negotiable transport document that covers the transport of cargo from airport to airport. By accepting a shipment, a cargo agent acts on behalf of the carrier whose airway bill is issued.

CMR Document

CMR (*Convention Relative au Contrat de Transport International de Marchandises par la Route*) is an international agreement that contains the rights and obligations of parties involved in road transport, the shipper, carrier, and addressee. This is required when goods are transported internationally by road used by all parties. The carrier usually completes the form, but the sender or exporter is responsible for the accuracy of the information and must sign the form when the goods are collected. The consignee will also sign the form on delivery, which is essential for the carrier to be able to confirm the delivery of the goods and to justify the payment for its services.

Multi-modal Bill of Lading

This is for those goods carried in multi-modal transport units (mainly containers) covering two or more modes of transport , such as shipping by road and by sea. The responsibility for the management and processing of shipping document depends on the sale conditions (In coterms) agreed between the parties. Bill of lading is the title of ownership of the goods and can, therefore, be negotiated. Only authorised forwarders integrated into International Federation of Freight Forwarders Association (IFFFA) can issue this document. It is addressed to the exporter, multimodal transport operator in the destination country, and the importer.

Dock Warrant or Warehouse Warrant

It is a document of title to goods issued by dock authorities certifying that the goods are held by them. To take delivery of the goods, this certificate must be given back to the authorities. It is a transferable instrument and if properly assigned, even a third party can take delivery of the articles from the warehouse or dock.

Warehouse Keeper's Receipt

It is simply an acknowledgement of goods issued by a warehouse keeper to the owner of the goods. It is not a document of title to goods.

Delivery Order

It is an order issued by the owner of goods to the warehouse authorities when delivery in small lots is required from the warehouse. Such orders should accompany the warehouse warrant in which the authorities will enter the details of the goods delivered by the party. The delivery order is the document of title to goods.

Check Your Progress Exercise 2

Note: 1) Use the space given below for your answers.

2) Check your answers with those given at the end of the Unit.

1) State the functions of warehouses.

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2) List the various types of documents used in transportation.

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7.6 CONCLUSION

A supply chain is composed of a series of suppliers and customers linked together by a physical distribution system. The physical distribution system involves the transportation of goods through the various modes, the inventories that exist in transit and in distribution centres, along with the physical handling of goods. The efficient operation of the warehouse involves several processing activities. Freight transport and storage are crucial activities in logistics systems planning as they determine the logistics costs and affect the service level provided to customers. Each mode of transportation has different cost and service characteristics. These determine which method is appropriate for the types of goods to be moved.

All these logistics activities are linked to each other with detailed information about each. The monitoring of the plethora of information related to the diverse aspects of logistics is a crucial process. These would require integration of various technologies with the logistics data.

7.7 GLOSSARY

Consignees: In a contract of carriage, the consignee is the person to whom the shipment is to be delivered whether by land, sea, or air.

Entrepot Trade: It refers to a trade at one centre for the goods of other countries. In this merchandise can be imported and exported without paying import duties.

Freight Transport: Freight transport is the process of moving different types of goods from one point to another.

Shippers: Consignor, exporter, or seller (who may be the same or different parties) named in the shipping documents as the party responsible for initiating a shipment, and who may also bear the freight cost.

Cross docking: A logistics procedure where products from a supplier or manufacturing plant are distributed directly to a customer or retail chain with marginal to no handling or storage time.

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7.9 ANSWERS TO CHECK YOUR PROGRESS EXERCISES

Check Your Progress Exercise 1

1) Your answer should include the following points:

- Transport transactions are often influenced by five parties namely the shipper, consignee, carrier, government, and the public.
- Transport economics and pricing are concerned with the factors and characteristics that determine transport costs and rates.
- Economy of scale wherein transportation costs are proportional to the weight of shipment.
- Transportation service is achieved by combining the capabilities of modes.
- Government transportation regulation can be grouped into two categories economic regulation and safety and social regulation.

2) Your answer should include the following points:

The functions of transportation manager include:

- Operations management
- Freight consolidation
- Rate negotiation
- Freight control
- Auditing and claims; and
- Logistical integration

Check Your Progress Exercise 2

1) Your answer should include the following points:

The functions of warehouses encompass:

- Procurement
- Sorting
- Breaking
- Storage
- Making items available for shipment
- Material handling
- Display
- Inventory control
- Processing
- Grading and branding
- Transportation

2) Your answer should include the following points:

- Lorry Receipt (L/R)
- Railway Receipt (R/R)
- Consignment Note
- Bill of Lading
- Airway Bill
- CMR Document
- Multi-modal Bill of Lading
- Dock Warrant or Warehouse Warrant
- Warehouse Keeper's Receipt
- Delivery Order

UNIT 8 INFORMATION MONITORING*

Structure

8.0 OBJECTIVES

After reading this Unit, you should be able to:

- Comprehend the importance of information in logistics;
- Discuss the various components of information flow in logistics;
- Appreciate the usefulness of information technology in logistics; and
- Acquaint with various aspects of information processing in logistics.

8.1 INTRODUCTION

Logistics concerns the flow of material which is based on information about each aspect in the logistics cycle. Logisticians are realising the importance of information with in-depth understanding of improving logistical performance with the help of fast and accurate information. Logistics usually involves the integration of information flow with the other aspects of material handling, production, packaging, inventory, transportation, warehousing, and security. The logistics information management is related to the process of planning, implementing, and controlling procedures for the efficient and effective transportation and storage of goods. This information is from the point of origin to the point of consumption to conform to customer requirements and includes inbound, outbound, internal, and external movement of products.

8.2 LOGISTICS INFORMATION

Logistics requires a large amount of information on sales, inventory amounts, forecasts, ordering and procurement, transportation arrangements, and invoicing as well as various types of contracts, and terms of delivery. The information flow starts with customer demand forecast and moves along the chain to, raw material suppliers, warehouse, and to other service providers and subcontractors. All involved entities should receive adequate information to be able to do their part

* Contributed by Col. (Dr.) Rajive Kohli, Management Consultant, New Delhi

in promoting customer satisfaction in a timely manner so that the products are delivered in required amount and at the right time in the supply chain. These are important for decision making in logistics.

Principles of Logistics Information

a) **Availability:** Logistics information must be readily, rapidly, and consistently available to meet customer requirements and improve management uncertainties in operations and planning.

b) **Accuracy:** Logistics information must reflect the status of all the activities such as inventory levels, customer orders etc.

c) **Timeliness :** The logistics information must be timely to provide quick management feedback. Timeliness is measured in terms of time taken between the commencement and occurrence of an activity especially when the activity is visible in the logistical information system.

Elements of Logistics Information. It is essential that retrieval of information is without errors, fast and prompt and should be in a form useful to the user. Logistics information is related to:

a) **Sources:** They must be reliable, authentic, and easily available. In physical distribution, it is sales orders, accounting data etc.

b) **Collection of information : I**nformation is received from sales staff, periodicals, publications, information/ data from dealers, distributors, customers, and research organisations.

c) **Storage :** The data so collected from various sources in a manner convenient for storage and use. This data bank may be computerised and in form of registers, files, documents, etc.

d) **Retrieval :** The information so collected from data sources, processed, and stored must be retrieved for the purpose of decision making, and should be in a form which is useful in decision making.

e) **Reports :** The data collected, stored, and retrieved must be made accessible to the decision maker in specified forms such as reports.

Information management makes logistics operations efficient and effective in areas given below:

a) **Supply chain**: The simulation and optimisation of flows in the supply chain allows for stock reductions and preventing stockout.

b) **Price fixing**: It allows specifying the price levels that would bring maximum income or profit.

c) **Multi-dimensional segregation of clients**: Identification of groups of clients with tendency of buying similar products etc., which results in better understanding of the consumer behaviour enabling customisation and personalisation of customers' needs.

d) **Customer loyalty analysis**: This involves modelling the factors that might define customer groups, who are loyal to the company; retaining regular customers and developing loyalty programmes.

e) **Analysis of customer value** in terms of profitability, recognising the non-profitable and loss-making ones, to effectively plan and increase profitability.

f) **Analysis of customer satisfaction**: Assessing the level of customer satisfaction which helps to plan activities aimed at meeting their satisfaction with the provision of goods and services to meet their requirements.

g) **Control of logistics costs**: A continuous analysis of financial results, assisted by integrated IT software, allows to effectively manage the costs within the company.

h) **Quality of products and services**: Monitoring and early detection of quality problems and their minimisation to ensure customer satisfaction.

Logistics Information System

The core of an information system is to convert data to information, depicting it in a way useful for decision making, and interfacing the information with decision-assisting methods. Logistics information systems are a subset of the organisations' total information system, and it is directed to the logistics decision making. The three components in this are:

i) **Inputs:** The inputs are data needed for planning and operating logistics system obtained from sources like customers, company personnel, company records, and published data.

ii) **Database management:** The management of the database involves selection of the data to be stored and retrieved, choice of the methods of analysis and basic data-processing procedures.

iii) **Outputs :** The outputs of a logistics information system include:

- summary reports of cost or performance statistics;
- status reports of inventories or order in progress;
- exception reports that compare desired performance with actual performance; and reports that initiate action.

8.3 LOGISTICS INFORMATION FLOW

Logistics is about managing material and information flow. Within a logistics system, generally the flow of materials is from the suppliers to the processing and assembly plants, thereafter to the sales points and finally to the customers. The flow of materials is integrated with the information flow. The three main flows in logistics:

a) **Product flow** with movement of goods from the supplier to the customer along with returns and other service requirements.

b) **Information flow** by transmitting orders and updating the status of delivery.

c) **Finance flow** includes payment schedules, credit terms, consignment, and title ownership arrangements.

Information is the link connecting the physical flow of goods within all logistics activities given below:

- Movement and transport;
- Warehousing and storage;
- Industrial packaging;
- Stock control;
- Demand forecasting;
- Production planning;
- Material /Products purchase;
- Customer service at an appropriate professional level;
- Warehouses and plants location;
- Provision of spare parts and after-sales service;
- Collection and disposal of waste.

Information flow accompanies the flow of material, goods, and services in the production system. It plays a key role in organising and functioning of supply chains, linking all basic elements of the logistics system. The integration of information flow makes the system open, efficient, and enable to overcome obstacles arising in the process. The risk and competitiveness of a dynamic market impacts the environment of logistics requiring effective decision-making processes. This may take place when the decision-maker has information on the various parameters that characterise the company activities. Generally, no decision is taken spontaneously but based on basic information. At times it calls for a process of transforming basic information and this is always an integral part of decision-making.

Information is seen as the base for all the processes, as well as a treasured corporate asset. In a company managed in a traditional way, data analyses is done, and reports are prepared by many departments, based on different kinds of systems and IT tools which may lead to multiple versions of data. The analytical capability of a company becomes the most important element, resulting in creation of centralised data centres to enable information management. This is done by selecting information that is most important for managerial decisions, making the same sources accessible for use by different departments, preserving coherence when it comes to formats, and standards. In this knowledge-based economy, information systems provide:

- access to information in real time;
- facilitate the organisation of information collection and processing;
- ensure the exchange of information with business partners in digital form;
- help reduce communication costs;
- allow the managers, and logisticians to share databases and place orders through electronic means;
- facilitate management of several kinds of e-logistics.

8.4 INFORMATION TECHNOLOGY IN LOGISTICS

Information technology (IT) is an important enabler of effective logistics management.IT has potential to enhance the capabilities of a company for sustained innovation of its business processes. The purpose of Information Systems (IS) is to gather, categorise, store, and disseminate information that is needed to promote the growth of the organisation. Hence IT and IS have an important role in logistics management.

Computerised Information System

IT is essentially computer based. The benefits of computerised information system are:

a) Rapid, prompt and error free computerised data that gives a large volume of information for accurate analysis and decision making.

b) Enables analysis of information through mathematical and statistical modelling in a manner and speed which cannot otherwise be obtained manually.

c) Computerisation may be expensive, because of initial high cost but over long period it enables overall savings in terms of staff, space, and finances.

d) It helps in better coordination between supply of material and demand.

e) It is a decision assisting system.

f) Aids control systems such as inventory control, computerised material handling and storage system and order processing system.

g) Delegates the responsibility to lower levels under rules\regulations, which are made in advance, eliminating any departure from laid down rules.

Logistics Information System

This coordinates the function of supply of raw material and distribution of finished product, primarily the movement control and demand - supply coordination. For raw material it involves follow up of indents till its issue, purchase order follow up, receiving and warehousing of material, inventory control, etc. For finished product it involves sales orders follow up, processing, information flow, warehousing, scheduling, allocation of finished products. Logistics information system is mainly for flow of data from external sources, processing and storage of information within the organisation, use of data by the decision maker in the form of reports, and communication of decisions to customers and their feedback.

External Information. This relates to information about:

a) Order pattern of the customers relating to total number and volume of products ordered;

b) Material handling system available to ensure compatibility with customers' demands;

c) Re-order point of the customers where computerised order processing can reduce the reordering level;

d) Ordering procedure of customer for coordination and cooperation with the suppliers.

Internal Information. The information is required from internal departments as follows:

a) Purchasing : Information on logistic costs of purchasing from different suppliers and supply points; routing instructions and status for inbound materials; supplier preferences in meeting delivery schedules; supplier prices, discounts, names and addresses, delivery schedule; and alternate source of supply and process.

b) Production : Information on product preference and competitor product performance. and finished products; production quantities and scheduling; production capacity; alternate methods of production based on different production plans; production innovations; warehouse material handling systems; specific details of warehouse capacity for raw materials, alternate costs of logistics based on different schedules; delivery requirements from production to warehouse; logistic innovations; status of inbound movement of supplies or raw materials; and physical supply and delivery requirements.

c) Marketing : Sales structure and information on logistics costs for alternative types of customer service; ; potential changes in logistics affecting future sales; customer complaints; introduction of new products; sales costs; customer service norms; pricing; and any special customer service requirements.

d) Finance and control : Information to include budget for physical distribution costs; estimates of costs; projected capital investment requirements; order processing system; coordination with invoicing and amounts receivable;freight bill, auditing procedure; customer credit rating, credit procedure; corporate financial condition and performance; capital availability.

Check Your Progress Exercise 1

Note. 1) Use the space given below for your answers.

2) Check your answers with those given at the end of the Unit.

1) What are the elements of logistics information system?

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2) What are the components of external and internal types of logistics information system?

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8.5 INFORMATION PROCESSING

Information processing integrates all areas of the logistics system. The development of computers and software has put sophisticated management information systems within the reach of most organisations. Businesses are linking their internal logistics information systems with those of their vendors and customers as a means of adding more value to the entire chain, creating an open exchange of information for faster order placement, quick delivery, and greater accountability throughout the logistics process. A suitable software is the first requirement for this to fulfil all expectations.

The major logistic function remains same, but the information processing enhances the following areas.

1) **Order Processing:** Orders can be submitted by sales personnel through mail, telephone, electronic means, and generated by suppliers for their customers. On receiving an order, it should be quickly and accurately processed by the organisation. The use of sophisticated computerised order processing system speeds up the cycle of order, shipping, and billing.

2) **Warehousing :** Nearly every organisation must have facilities to store its products, so it must determine the number, types, and locations of warehouses. Highly automated warehousing is replacing the older warehousing system, where effective computerised material handling systems are used that are centralised, with fewer numbers of employees.

3) **Inventory Management :** Maintaining an effective level of inventory is having a balance between carrying less inventory and carry too much of it. New inventory management system techniques need to be adapted by the organisations. We have already discussed in detail in Unit 5 of this Course.

4) **Transportation :** This affects the delivery, pricing of product, and condition of the transported goods etc. The largest carrier is the railways that deal with large amounts of bulk product can be delivered. Trucks have a significant role in transportation of goods, within cities. Pipelines are used for shipment of petroleum, chemicals, and natural gas. The cost of air transportation is much higher, but it is the quickest mode of transporting, especially in case of perishable goods and smaller quantity of highly valuable products. Shipping is time consuming and used together with the other modes of transportation.

The sharing of information among logistics networks allows them to work together with the goal of integrated and coordinated logistics management. Information also enhances the performance and reduces the risks because it provides processes that facilitate the decision makers with the needed information. IT also plays an important role in integrating suppliers, manufactures, distributors and customers to ensure the proper quantity and quality of products. Organisations can gather vital information along the entire supply chain and react quickly to any predictable market changes, thereby gaining competitive advantage by effectively utilising logistics supply chains. Accessibility to information and transparency, enabling a single point of contact for data, allowing decisions based on total supply chain information and enabling collaboration with partners are the objectives of IT in logistics. The functional roles of IT in logistics encompass execution,

collaboration, coordination, and decision support.IT systems are expected to facilitate better matching of supply and demand between supply chain components and create an excellent backdrop for embarking on integration with external partners.

8.6 OPTIMISING LOGISTICS INFORMATION FLOW

The growth or decline of a company is indicated by five key dynamic flows in the logistics system, namely, information, materials, money, human resource, and capital. These flows need to be proactively managed by more effective, integrated flows across both internal and external chains. Information and communication technology (ICT) plays a crucial role in managing external customer and supplier relationships. The flow of materials or money is caused by related information movement, hence effective information flow directly affects the rest of the system and can significantly improve overall efficiency.

Sharing information effectively and accurately across an entire supply chain is a complex activity considering the number of access points, systems, and people at each location. The best systems in place should be capable of:

a) Managing massive amounts of data

b) Transforming data into information

c) Anticipating future needs through appropriate modelling scenarios

d) Understanding and planning replenishment cycles

e) Managing accounting functions

f) Tracking productivity

g) Fostering collaboration

To ensure complete customer accessibility, information technology in logistics integrates six key technologies given below:

a) **Intranet**: Internal sites utilised for project management, document sharing, brainstorming and generation of reports.

b) **Applications:** Applications are designed for one specific function and fully integrated with core transactional system, warehouse management system, financial consolidation and forecast/planning system, and product planning system. We shall be discussing these in detail in Unit 9 of this Course.

c) **Electronic Data Interchange: It is** a data transaction system that speeds up important logistics processes in the supply chain. It is a computer to computer exchange of business documents such as purchase orders and invoices in a standard electronic format between business partners.

d) **Partner Portals:** Easy-to-use portals fostering collaboration by providing information to business partners.

e) **Internet**: Leveraging the internet to add value along the supply chain.

The platform must allow for flexibility, transparency, and interoperability with a customer's own system. Effective logistics information flow eliminates

inefficiencies, particularly excessive inventory levels. By this integration, data visibility increases, and breakdowns are significantly reduced.

Check Your Progress Exercise 2

Note: 1) Use the space given below for your answers.

2) Check your answers with those given at the end of the Unit.

1) What are the areas that need information processing?

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2) Identify the key technologies that integrate the logistics processes.

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8.7 CONCLUSION

Logistics management involves the integration of information, transportation, inventory, warehousing, material handling, and packaging, and often security. Information is basic to decision making which is the essence of management function. A manager relies on an information system to make decisions pertaining to the function and level of the management. The information so collected is integrated into a system and may be in the form of computer, desk calculator, files etc. Information is a structure of machines and management technology enabling the manager to collect, receive, process, and analyse information.

There is need for systematically collecting information and setting up procedures to produce metrics that are used to evaluate performance to goals. Modern logistics does not only need data, information, but also knowledge, which is an intangible asset of the organisation, connected with human activity which, when applied, may be the source of competitive advantage. This knowledge, if effectively used in an enterprise, may not only bring about success, but also provide conditions for its further extension and sharing. The use of IT is considered a prerequisite for effective control of today's complex supply chains. The exponential growth of information technology in supply chain networks has significantly changed the paper-based communication to e-communication, which also faces the threat of cybercrime (e-risk) by unauthorised or illegal access by means of physical or/ and virtual intrusion to a computer system or computer network.

Using information more effectively is the single most important source of competitive advantage for business firms today. Logistics is an information-based process of material movement across the supply chain, and hence information is

a major factor for enhancing logistics competitiveness.

8.8 GLOSSARY

Electronic Data Interchange: It is the concept of businesses electronically communicating information that was traditionally communicated on paper, such as purchase orders and invoices. Business entities conducting business electronically are called trading partners.

Partner Portal: It is a web-based application that allows a company' s established distributors, service providers etc,. to obtain direct access to marketing resources, pricing, and sales information along with technical details to serve the customers.

Reorder level: It is the inventory level at which a company would place a new order for raw materials/products.

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8.10 ANSWERS TO CHECK YOUR PROGRESS EXERCISES

Check Your Progress Exercise 1

1) Your answer should include the following points:
   - Sources
   - Collection of information
   - Storage
   - Retrieval
   - Reports

2) Your answer should include the following points:

   The external types of logistics information include:
   - Product order pattern of customers
   - Material handling systems
   - Re-order point of customers
   - Ordering procedures

   The internal types of logistics information include:
   - Purchasing

- Production
- Marketing
- Finance and Control

Check Your Progress Exercise 2

Your answer should include the following points:

- Order Processing
- Warehousing
- Inventory Control
- Transportation

2) Your answer should include the following points:

The key technologies are

- Intranet
- Applications
- Electronic Data Interchange
- Partner Portals
- Internet

UNIT 9 LOGISTICS INFORMATION SYSTEM*

Structure

9.0 OBJECTIVES

After reading this Unit, you should be able to:

- Explain the concept and importance of Logistics Information System;
- Examine the role of Logistics Information System;
- Know its requirements and components; and
- Acquaint with the technologies and applications of Logistics Information System.

9.1 INTRODUCTION

Logistics concerns the flow of goods and services facilitated by information support. In present time machines and robots have to a large extent eliminated manual work. With advances in information technology, business-to-business (B2B) transactions or business-to-customer (B2C) deals are done through the internet. Presently logistics uses the information resources of the enterprise and creates a database specifically for its needs consisting of elements like data source, users, etc. Information Systems is an applied science for the processes of the creation and operation of systems that manage information.

Business Process Analysis methodologies are used for the modelling of logistic processes and their information flows that assist in understanding and clearly describing the information relationships between parties and authorities and in defining improvements to the logistic systems. Logistics Information System (LIS) is implementation of solutions for a system of records and reports which may be paper based or electronic. This is a specialised area in logistics that can handle location, work management, and data management in organisations. It mainly includes coordination of demand, supply, movement, and control of material or finished goods.

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This Unit acquaints the learners with the concept and role of LIS. It brings out the requirements and components of LIS. The technologies involved in it are analysed.

9.2 ROLE OF LOGISTICS INFORMATION SYSTEM

Logistics Information System (LIS) is a system of records and reports whether paper-based or electronic, used to aggregate, analyse, validate and display data from all levels of logistics system that can be used to make logistics decisions and manage the supply chain.

The role of LIS can be understood from the following:

a) LIS ensures the transformation of logistics functional operations into a process with the goal of pursuing customer satisfaction at the lowest cost. It facilitates planning and control of logistics activities related to order fulfilment.

b) LIS provides information on goods and tracks the delivery, by giving their status.

c) Logistics systems depend on outside information and international standards to comply with regulations and use laid down ways of sharing logistic information with others.

d) The manufacturers and traders monitor the actual products to know whether they will arrive on time and in proper condition at the delivery places, and to be able to take prompt action in case of any lapse.

e) Transporters focus on the progress and status of the means of transport. In case of any delays or exigencies, transporters can report these to their customers who can consider the impact.

f) Customs authorities and those responsible for ensuring the safety and security of goods during transportation are given details about the content of goods and their means of transport.

LIS is part of logistics management to manage, control and measure the logistical activities within the organisation and across the supply chain, achieving logistics efficiency and effectiveness. Within an organisation, LIS achieves the following:

a) Customer satisfaction at the lowest total cost.

b) Enables planning and control of the logistical activities related to order fulfilment.

c) Fosters better tactical and strategic decisions for the benefit of the firm and its customers.

d) Gives information to customers regarding product availability, order status, and delivery schedules.

e) Enables resource planning thereby reducing the requirements of inventory and human resources.

f) Provides information to top management to formulate strategic decisions by interface with marketing, financial, and manufacturing information systems.

g) Links the operations of the business, such as manufacturing and distribution, with the supplier's operations and the customers.

h) Facilitates 'virtual' inventory management or electronic inventory management by managing dispersed inventories through information technology. Inventory management becomes centralised and decisions on replenishment and other quantities are taken based on a single stock.

The benefits of implementing LIS are:

a) Improvement in customer service and satisfaction.

b) Establishing communication within the logistics chain.

c) Reduction in stock levels and costs particularly of transportation and storage.

d) Synchronising the processes of supply, production, and distribution.

e) Handling the problems caused by shortage of materials for production.

f) Improvement of delivery schedules and lessening probable orders errors.

g) Reduction of documentation required in supply chain management.

The main activities of LIS are:

a) Data flow from external sources.

b) Processing and storage of information within companies.

c) Transmission of data for storage\processing to the decision maker in form of reports.

d) Communication of decisions to customers and their feedback.

9.3 LOGISTICS INFORMATION SYSTEM: REQUIREMENTS AND COMPONENTS

There are three types of information systems that serve different organisational levels. These are operational level systems, management-level systems, and strategic level systems. Converting logistics data to information, representing it in a manner useful for decision making and interfacing the information with decision-assisting methods are at the core of LIS. There are certain requirements which are:

a) Organisation decisions: It relates to **t**he decisions to be made at each level of organisation. While designing information system, it must be ensured that the concerned person is entitled to get required information needed for decision making.

b) System requirement: After arriving at the decision on collecting information, next requirement is identification of source of information, the volume and quality of information. A suitable channel of communication will have to be designed to satisfy various requirements.

c) **Control requirements**. Based on guidelines given by the management, system should be able to aid in decision making, minimising delays, and increasing efficiency. Control is required to ensure that no errors are made.

d) **System input and output data**. To satisfy the demand of a customer, several activities are undertaken by organisation which need proper coordination. Action reports are made for the purpose of undertaking activities based on generated information.

Key Components of LIS

LIS is designed to manage the flow of materials and information within and between organisations and their business environment. Globally information technology is a critical enabler of the logistics supply chain networks that businesses use to acquire, produce, and deliver goods and services. The key components include:

a) Logistics Information Portal

b) Logistics Computing and Simulation

c) Decision Support System

d) Database

e) E-Logistics and E-Commerce

f) Software applications relating to Customer Relations Management (CRM), Enterprise Resource Planning (ERP), Radio Frequency Identification (RFID) Tags, Transport Management System (TMS), and Warehouse Management System (WMS)

Check Your Progress Exercise 1

Note: 1) Use the space below for your answers.

2) Check your answers with those given at the end of the Unit.

1) State the benefits of LIS.

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2) Describe the requirements of LIS and its components.

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9.4 LOGISTICS INFORMATION SYSTEM: CONCEPTS & TECHNOLOGIES

The effectiveness of LIS is based on real time accurate information enabling a reliable accurate forecast from the raw material suppliers to the ultimate consumer with a large geographical spread. Managing this information is possible only with the use of various systems continuously evolving which need ingenuity for adaption in the LIS.

Information Network: The traditional elements of logistics are integrated by a web of IT networks, and integrated management systems, with virtual and network companies within an information grid. This LIS incorporates all information relating to plans, implementation, and control, for efficient and effective flow and storage of goods and services.

Electronic Data Interchange (EDI): IT plays an important role in providing real time information for proper forecasting and planning of manufacture or for supply of finished products to the end users. EDI can link suppliers, manufacturers, customers, and intermediaries. IT as the key component facilitates speeding up delivery time by transmitting information to the warehouse directly triggering an order for immediate shipment. In global context, EDI links exporters with customs, ports, and transporters for quick processing of customs documents thus speeding up the deliveries.

Supply Chain Management Software (SCMS): These software modules complete supply chain transactions and manage supplier relationships for controlling the business processes. It can identify the activities that can reduce and eliminate non-value-added activities. It can deliver and market better quality products and services more quickly and cost-effectively to gain an advantage over less efficient competitors. Effective supply chain management systems help businesses to improve the entire supply chain network by reducing waste and shipping delays. SCMS reduces overhead expenses by enabling effective demand planning, improving inventory management, and relationships with vendors and distributors etc.

Enterprise Resource Planning (ERP): It encompasses software technologies in supply chain, bringing together the information from within the firm and from different geographical areas, integrating all businesses of the firm together for efficient use of resources. It is a process used by a company to manage and integrate important parts of its business. It refers to the software and systems to plan and manage all the supply chain, manufacturing, services, financial and other processes of the organisation.

Inventory Management Module: Inventory management being a key component of logistics, firms should manage their inventories efficiently as huge cost is involved in the inventories piling up. Therefore, an IT module for finished goods, semi-finished goods, raw materials, and work in progress inventories is convenient in ordering, based on suppliers or customers' demands.

Just-In-Time (JIT) System: JIT concept was introduced by Toyota in Japan and Maruti Suzuki in India. Generally, inventory carrying cost in terms of warehousing is extremely high due to large capital expenditure involved in

building and maintain warehouses. Thus, suppliers are required to supply components or raw material when the demand is just placed at 24-hour notice, saving cost of transportation and warehousing. The required components or raw material are supplied just-in-time when needed by the factory.

Transportation Management System: Transportation is a key element of logistics being an important dimension as third-party intermediaries, to link together the suppliers and manufacturers to final consumers. A range of services are available starting from factory door pick up, custom freight station, rail transportation using high speed wagons from container depot to ports and further movement if needed by sea to port of discharge and again hinterland transportation. In these activities, communication technologies, satellite tracking, bar coding applications, EDI, automated material handling systems etc., are employed.

Data Mining: Data mining is a process used of extracting usable data from a larger set of any raw data by companies to turn it into useful information through understanding a pattern and determine customers' behaviour for repeat sale. By using software to look for patterns in large batches of data, businesses can learn more about their customers to develop effective marketing strategies, increase sales and decrease costs. It implies analysing data patterns by using one or more software. Accordingly, based on the feed-back obtained from dissatisfied customers, services for such customers can be fine-tuned and customised to meet their requirement.

Data Warehousing: A data warehouse is built by integrating data from multiple sources that support analytical reporting, and decision making. Data warehousing is the process of constructing and using a data warehouse, being the electronic storage of a large amount of information by a business or organisation. These are solely intended to perform queries and analysis and often contain large amounts of historical data. It combines information from several sources into one comprehensive database. For example, in the corporate world, a data warehouse might incorporate customer information from a company's sales systems, website, mailing lists etc.

Customer Relations Management (CRM): It is a technology used to manage interactions with customers by merging practices, strategies and technologies used by companies. Data mining and data warehousing are two important elements of CRM technologies. CRM systems compile customer data across different channels, or points of contact, between the customer and the company, that include the company's website, telephone, live chat, direct mail, marketing tools and social networks. CRM systems can provide the staff dealing with the customers, a detailed information on customers' personal information, purchase history, buying preferences and concerns. CRM technology creates various value-added services for customers, making the interaction more accurate, timely, responsive, and reliable. The basic CRM system could be enhanced by automation of marketing, sales force, contact centre and workflow; location-based services, human resource management, etc.The usage of CRM depends on a company's business needs, resources and goals, as each has different costs associated with it as can be seen by the undermentioned examples:

a) **Contact Centre**. The sales and marketing teams procure data and update the system with information relating to customers and revise customer history records through service calls and technical support interactions.

b) **Social Customer Relations Management:** To add value to customer interactions on social media, businesses use various social CRM tools that monitor social media conversations, to determine their target audience. Other tools are designed to analyse social media feedback and address customer queries and issues. They capture customer sentiments, such as the likelihood of recommending products and overall customer satisfaction, to develop marketing and service strategies.

c) **Mobile Customer Relations Management:** Mobile CRM apps take advantage of features that are unique to mobile devices, such as GPS and voice recognition capabilities, to give sales and marketing employees access to customer information from anywhere.

9.5 LOGISTICS INFORMATION SYSTEM: TECHNOLOGY APPLICATIONS

The three types of important information in an inventory, which can be source of errors if not recorded accurately, are (i) part description/number, (ii) quantity and (iii) location. Identification systems are for the codification of packages inside the warehouse by means of codes that can be scanned by automatic devices and these are of fundamental importance for the computerised management of the warehouse. Some of the technology applications for LIS are described below.

Bar Codes

Bar codes are the optical conversion of a numerical or alphanumerical code which are used to identify a package. This optical conversion is represented by means of an alternating sequence of vertical bars and spaces. Bar codes are read using a laser light, which pick up the reflection from the bars and spaces on the label and is usually read from a short distance, although in present times the distance range is improving with new designs.

The codes are standardised by industry and usually printed on a paper label or tag. They generally contain a unique identifier, such as part number, which can be referred to a database for required information, such as price or description. The automotive industry requires labels designed to their specifications for layout and the type of code used and include, in addition to the product code, the manufacturer, date of manufacture, and so forth.

The use of bar codes improves the speed of data entry and the accuracy of the data retrieved. These can reduce errors as they are machine readable symbols and are widely used to gather information at all levels of retailing, distribution, and manufacturing. The error rate for this method is extremely low compared to human error, which is estimated to be as high as 3% for repetitive entries.

Technologically there are two kinds of bar code scanning devices:

a) **Optical scanners** use a light source that illuminates the surface of the code enabling a suitable sensor to record the variations of the reflected ray.

b) **Laser scanners** repeatedly explore the encoded surface at each passage, taking a series of pictures that allow a greater accuracy of scanning. This allows scanning at high intensity and on moving packages.

Radio Frequency Identification (RFID) Tags

Smart tags are automatic identification system based on radiofrequency technology that work in a way like bar codes. It uses reflected radio waves from a small device or tag to receive its information. It is activated by means of an electromagnetic field generated by the scanner (reader), which is the electronic device used for the exchange of information with the tag itself. The readers can be portable and are used by operators or are installed on vehicles, integrated with an antenna.

RFID tags are generally more expensive than printed bar codes, but the price is falling rapidly, promoting their wider applications. Hence major retailers are using this method of gathering information.

An RFID tag can be active or passive.

a) Active tags are provided with an internal battery that powers them and enables large transmission distance (over 400m in the open for some models). They are equipped with an overly complicated electric system that allows the application to be customised based on individual requirements.

b) Passive tags are more economical and widespread being made of an aluminium or copper antenna, a memory microchip, and a support for the protection of this chip. They do not have a battery and require no maintenance.

Logistic Labels

The logistic labels record information, both in legible format (characters, numbers, and graphic elements) and in the form of a bar code. With the help of the labels, a logistic unit can be traced throughout the supply chain. For example, a logistic label the SSCC (Serial Shipping Container Code) facilitates tracing of the physical path of the individual packages together with the information flow associated with it. The scanning of the SSCC, facilitates checking of the transport documents transmitted in electronic format, the shipping and delivery of the products.

The labels contain both human-readable text and scannable symbols giving supplier details, product description, carton quantity, batch no, etc.

QR Code

QR (Quick Response) code is a matrix or two-dimensional barcode which is a machine-readable optical label that contains information about the item to which it is attached. It consists of black squares arranged in a square grid on a white background containing data for a locator, identifier, or tracker that points to a website or application. A QR code uses four standardised encoding modes i.e. numeric, alphanumeric, byte/binary, and kanji (Chinese character) to store data efficiently. It has become popular due to its fast readability and greater storage capacity compared to standard barcodes.

FASTag

FASTag is an electronic toll collection system in India, operated by the National Highway Authority of India(NHAI) employing RFID technology for making toll payments directly from the prepaid or savings account linked to it or directly to the toll owner. It is affixed on the windscreen of the vehicle and enables to drive through toll plazas without stopping for transactions. With emphasis on implementing an effective and efficient electronic toll collection framework, FASTag has become popular enabling an efficient, fast, and cashless payment option for collection of toll charge. The integration of FASTags with the electronic way billing (E-way billing) system is an achievement toward a globally approved business and logistics hub. Connecting the electronic way bill (E-way bill) with FASTags can provide better operational efficiencies, making it simple to track the movements of goods by SMS alert especially at each toll plaza .

Check Your Progress Exercise 2

Note: 1) Use the space given below for your answers.

2) Check your answers with those given at the end of the Unit.

1) Elaborate on the technologies for adoption of LIS.

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2) Describe the technology applications for LIS.

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9.6 CONCLUSION

LIS caters to the specific information needs for decision making in the areas of logistics management. The appropriate software designed for the installed system makes it possible to generate reports for users in the required formats. Non value-added activities may be identified and taken out of the system to reduce investment cost. Integrating Logistics and Information Systems results in better awareness on various aspects of logistics. LIS is designed to provides the necessary skills to manage the flow of materials and information within and between organisations and their business environment. It focuses on the use of information technology as a critical enabler of the supply chain networks that businesses use to acquire, produce, and deliver goods and services all over the world.

9.7 GLOSSARY

Electronic Data Interchange: It is a standard way to electronically transfer data between software applications in logistics companies and their business partners. It speeds up important logistics processes in supply chain.

E-logistics: It is application of internet-based technologies to traditional logistics processes or web-based applications and services dealing with the efficient transport, distribution, and storage of products along the supply and demand chain.

E-way Bill: It is Electronic Waybill. It is a unique document/bill which is electronically generated for specific consignment/movement of the goods from one place to another, either inter-state or intra-state and for goods of value of more than INR 50000, required under current rules.

Serial Shipping Container Code (SSCC): It is an 18-digit number used to identify shipments/ cartons/ logistics units as they travel through the supply chain.

Warehouse Management System: It is a software application designed to support and optimise functioning of warehouse and management of distribution centre.

9.8 REFERENCES

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9.8 ANSWERS TO CHECK YOUR PROGRESS EXERCISES

Check Your Progress Exercise 1

1) Your answer should include the following points:
   - Customer service improvement
   - Increasing trust and confidence through communication within the

logistics chain

- Synchronisation of the processes of supply, production, and distribution
- Cost reduction particularly of transport and storage
- Reducing the documentation

2) Your answer should include the following points:

The requirements for LIS to be covered under:

- Organisation decision
- System requirement
- Control requirements
- System input and output data

The components of LIS include:

- Logistics information portal
- Logistics computing and simulation
- Decision support system
- Database and data mining
- E-logistics and e-commerce
- Software applications that include CRM, ERP, RFID, TMS, WMS

Check Your Progress Exercise 2

1) Your answer should include the following points:

- Information Network
- Electronic Data Interchange.
- Supply Chain Management Software
- Enterprise Resource Planning
- Inventory Management Module
- Just-In-Time Systems
- Transportation Network
- Data Mining
- Data Warehousing
- Customer Relations Management

2) Your answer should include the following points:

- Bar codes
- RFID tag
- Logistic labels
- QR code
- FASTag