

MATERIALS MANAGEMENT MODULE

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Table of Contents

Preface	7
Learning objectives.....	8
CHAPTER ONE.....	1
INTRODUCTION TO MATERIALS MANAGEMENT.....	1
1. Introduction.....	1
1.1. Overview of Materials Management.....	2
1.2. Meaning of Materials Management.....	2
1.3. Significance of Materials Management.....	3
1.4. Function of Material Management	4
1.5. Origin and Transition of Materials Management	5
1.6. Objectives of Materials Management	6
1.7. Materials management and its Environment.....	7
1.7.1 External factors	7
1.7.2 Internal factors.....	9
1.8. The Concept and Need for Integrated Materials Management.....	10
1.8.1. Basic objectives of integrated material management	11
1.8.2. Benefits of integrated materials management approach:	12
1.9. Organization for Materials Management.....	13
1.10. Problems of Materials Management	14
Chapter summary	15
CHAPTER TWO	18
FORECASTING	18
1. Introduction	18

2.1.	What forecasting is?	18
2.2.	Why Forecasting?	19
2.3.	Features of Good Forecasting	21
2.4.	Steps in Forecasting Process	22
2.5.	Types of Forecasting/Forecasting Techniques	22
2.5.1.	Qualitative Forecasting	22
2.5.2.	Quantitative Forecasting	23
	Chapter Summary.....	37
	CHAPTER THREE.....	42
	PURCHASING	42
1.	Introduction	42
3.1.	Meaning and Role of Purchasing	42
3.1.1.	Meaning or definitions of purchasing	42
3.1.2.	Role of Purchasing in Business	43
3.2.	Purchasing Objectives	45
3.3.	Relationship between Purchasing and Other Functional Units	49
3.4.	Purchasing Policies	51
3.5.	Purchasing Procedure	54
3.6.	Types of Buying	67
3.6.1	Hand to mouth	67
3.6.2	Forward purchasing	68
3.6.3	Speculative purchase	68
3.7.	Make or Buy Decision	69
3.8.	Sourcing	71
3.9.	Identifying and evaluating suppliers	72
3.9.1.	Identifying Suppliers	72
3.9.2.	Factors in selecting suppliers	73

3.9.3. Supplier's selection	75
3.10. Value Analysis	83
Chapter Summary.....	84
CHAPTER FOUR.....	89
INVENTORY MANAGEMENT	89
1. Introduction	89
4.1. Definition of Inventory	90
4.2. Purposes of Inventory	90
4.3. Forms of Inventories	92
4.4. Nature of Demand in Inventories	93
4.5. Inventory Costs	94
4.6. Economic Order Quantity (EOQ).....	96
4.7. Economic Production Quantity (EPQ)	103
4.8. Materials Requirements Planning (MRP)	107
4.8.1. Objectives of MRP	108
4.8.2. Input of MRP	108
4.9. Just in Time (JIT) management	109
4.10. Inventory Control System	110
Chapter Summery.....	115
CHAPTER FIVE.....	119
STORE MANAGEMENT	119
1. Introduction	119
5.1. Definition and Nature of Stores	120
5.2. Storage functions and responsibilities	120
5.3. Location and layout	124
5.4. Organizational Structure of Stores Division	127

5.5. Stores System and Procedures	128
5.5.1. Storage Procedures.....	128
5.5.2. Storage Systems.....	128
5.6. Stock receipt, issue and dispatch.....	130
5.7. Stores Accounting and Stock Verification	133
5.7.1. Stores Accounting	133
5.7.2. Stock verification.....	134
5.8. Stores security	135
5.9 Codification	137
5.9.1 Methods of codification.....	138
5.9.2 Elements of Good Codification System.....	140
Chapter Summary	140
CHAPTER SIX.....	143
MATERIALS HANDLING.....	143
6. Introduction.....	143
6.1 Definition of Material Handling	144
6.2 Traditional and Modern View of Materials Handling.....	145
6.3 Objective of Material Handling	145
6.4 Principles of Material Handling.....	146
6.5. Minimizing Material Handling	147
6.6 Factors affecting materials Handling System	148
6.7 Analysis of Material Handling.....	150
6.8 Material Handling Equipment's	151
6.8.1 Evaluation of Material Handling Problems.....	157
Chapter summary	159
CHAPTER SEVEN.....	162

LOGISTICS	162
1. Introduction.....	162
7.1. Origin of Logistics.....	163
7.2. Transportation Overview.....	164
7.2.2 Method of selection.....	169
7.2.3. Components of Transport Systems.....	176
7.3. Transport Providers.....	176
7.4. Transport Documents	179
Chapter summary	181
References	183

Preface

Materials management is common to every organization. Materials management is essential not only to manufacturing but also to service industries and it exists not only in profit making enterprises but also in private non-profit sectors of the economy.

Materials management problems often are not identified by that name, instead of that management tend to relate them as specialized materials management sub-functions viz. Purchasing, Inventory control, Production control, Traffic, Warehousing, Receiving Shipping, Materials handling and related activities. The basic reason for this is that the formal materials management organization is much younger than all its components. The concept of materials management as an integrated activity is of recent origin. But now materials management has won many and converts and it is now a conventional practice to group together organizational activities that are concerned with purchase, Movement and storage of materials.

In this module seven chapters are included. Each of these chapters contain an introduction to the chapters at the beginning followed by chapter objectives. Next topics and subtopics are discussed in detail. Finally, a chapter summary is provided to help the reader capture important concepts of the chapters for review. After completing each chapter and section, different exercises and self-test questions are included to help you understand and check your progress with the subject matter under discuss.

Learning objectives

At the end of this module, you will be able to:

Explain the basic concepts, definitions, functions, and objectives of the subject matter of materials management.

State and explain the objectives of materials management and illustrate the concept of an integrated materials management function.

Explain the what forecasting, why forecasting, steps in forecasting and Forecasting Techniques.

Understand and describe procedures, policies and objectives of purchasing function. Define the term inventory and inventory management.

Identify different types of inventory, inventory management and types of inventory models.

Describe the meaning of storage management and state warehouse/storage functions and responsibilities.

Explain the concept of material handling and its devices/equipment's

Understand the meanings of plant lay out and process lay out.

Describe the principles and guidelines for effective materials

handling Describe logistic management concept & practice

CHAPTER ONE

INTRODUCTION TO MATERIALS MANAGEMENT

Learning Objectives

After going through this chapter, you should be able to:

Describe the meaning, importance and functions of materials management.

Explain origin and transition of materials management

State and explain the objectives of materials management.

Illustrate the concept of an integrated materials management

function. Explain the major functions of materials management.

Introduction

Dear learner! Materials management is an indispensable core activity of all organizations. All organizations are continuously involved in procurement, storage, and stock replenishment of different types of materials. In some of the industries the cost of materials put ranges from 45% to 85 % of the product cost. Thus, the slightest efficiency in the materials management releases substantial gains to the organization in terms of cost and capital requirement. Due to such strategic role materials management has assumed greater importance in the modern management. In fact, along with other areas of management like production, marketing, finance and personnel, materials management has been recognized as the fifth key area of management of the organizations. Materials management is therefore, covers efficient management of materials-planning and programming, purchasing, inventory control, receiving, warehousing and store-keeping, materials handling and disposal of scraps and surpluses. **Dear learner!** In this chapter we will discuss operating environment of a business firms to achieve their organizational objectives. In addition, we will be discussing the meaning, significance, origin and functions of materials management and the concept of integrated materials management function. The last section of this chapter will discuss the types of materials, materials management process and structure of materials management in an organization.

1.1. Overview of Materials Management

Dear learner! Do you know how to measure the wealth of a given nation? The wealth of a country is measured by its gross national product- the outputs of goods and services produced by the nation in a given time. Goods are physical objects, something we can touch, feel, or see. Services are the performance of some useful function such as banking, medical care, restaurants, clothing stores or social services.

But what is the source of wealth? It is measured by the amount of goods and services produced, but where does it come from? Although we may have reach natural resources in our economy such as mineral deposits, farm land and forests, these are potential sources of wealth. It is obvious that some sort of production function is needed to change our resources into useful goods and services. And production takes place in all forms of transformation-extracting minerals from the earth, farming lumbering, fishing, and using these resources to manufacture useful products.

There are many stages between the extraction of material resource and the final consumer product. At each stage in the development of the final product, value is added, thus creating more wealth. If ore is extracted from the earth and sold, wealth is gained from our efforts, but those who continue to transform the raw material will gain more and far greater wealth. Japan is a prime example of this. It has very few natural resources and buys most of the raw materials it needs. Managing the operation means planning for and controlling the resources used in the process: labor, capital and material. All are important, but the major way in which management plans and controls is through the flow of materials. The flow of materials controls the performance of the process. If the right materials in the right quantities are not available at the right time, the process cannot produce what it should. Labor and machinery will be utilized poorly. The profitability, and even the existence, of the company would be threatened.

1.2. Meaning of Materials Management

What Are Materials?

Dear student! Materials refer to inputs into the production process, most of which are embodied in the finished goods being manufactured. It may be raw materials, work-in-progress, finished goods, spare parts and components, operating supplies such as lubricating oil, cleaning materials, and others, required for maintenance and repairs.

What is materials management?

Materials management is defined by different authors in different ways but for the same concept. Some of these definitions of materials management are:

It is defined as the integrated function of purchasing and allied activities so as to achieve the maximum coordination and optimum expenditure in the area of materials.

It is a process of management which coordinates, supervises and executes the tasks associated with the flow of materials to, through and out of an organization in an integrated fashion.

It is a confederacy of traditional material activities bound by a common idea-the idea of an integrated management approach to planning, acquisition, conversion, flow and distribution of production materials from the raw material state to the finished product state.

Materials management is a total concept having its definite organization to plan and control all types of materials, its supply, and its flow from raw stage to finished stage so as to deliver the product to customer as per his requirements in time. This involves materials planning, purchasing, receiving, storing, inventory control, scheduling, production, physical distribution and marketing. It also controls the materials handling and its traffic. The materials manager has to manage all these functions with proper authority and responsibility in the material management department. The historical background about the materials management is as follows.

Dear learner! When we sum up these definitions, Materials management can be defined as an organizational concept designed to enhance coordination and control of the various materials activities including an activity to plan, purchase, store, handle, distribute, use and control of materials in order to contribute to organizational success and profitability.

1.3. Significance of Materials Management

Every organization uses, transforms, distributes or sells materials of one kind or another. Materials are one of the vital resources of an organization. If an organization is to function and operate successfully, it must have proper and sufficient supply of necessary materials. These materials may take different forms, such as raw materials, machinery, tools, equipment, vehicles, furniture, stationary, fuel, oil and lubricants, accessories etc.

Lack of availability of adequate materials disturbs the normal operation or production causing unnecessary delay of production or work stoppage. The dalliance or stoppage of work in turn causes additional cost such as cost of depreciation of fixed assets, salary of permanent employees, opportunity costs, loss of sales, dissatisfaction of customers, etc. Thus, effective management of materials is crucial to the performance of many organizations.

Traditionally, materials were thought to be cheap, readily available and abundant. Today, however, the realities of the market proved that materials are scared and costly. In many organizations, materials form the largest single expenditure item. Studies indicate that materials account about 60-80 percent of the total annual expenditure of organizations. Besides, materials management has a tremendous influence on the ultimate cost of a product and efficiency of an organization, because it is concerned with the total flow of materials in the organization. The total flow can extend from suppliers to production and subsequently through distribution to required place at the required time and by ensuring that these resources are properly handled and utilized. Thus, the importance of materials management lies in the fact that any significant contribution made by the materials manager in reducing material cost will help to improve the profitability and rate of return on investment.

Dear learner,

Please mention basic functions you have observed from the definition of materials management.....

1.4. Function of Material Management

Irrespective of the type of the organization, the basic material related functions performed at the organization are:

- | | |
|--|-----------------------------------|
| 1. Purchasing | 6. In plant storage |
| 2. Inbound traffic from suppliers to company | 7. Material handling |
| 3. Receiving | 8. Packaging and shipping |
| 4. Inventory Control | 9. Outbound traffic |
| 5. Production control | 10. Warehousing and distribution. |

1.5. Origin and Transition of Materials Management

The scarcity of materials, which was felt during World War I in USA to a very large extent and it, has become difficult for production managers to supply the War goods. This has created it necessary to organize the Materials Management department for managing large inventories in stores and to analyze the problems arising to control and economize inventory cost problems and shortage elimination. The materials management was included as an important function of the management. With the development of principles of scientific management by F.W. Taylor in 20th century, the economic use of materials in all the organizations was critically felt to reduce the cost of production.

The early years of developments in the field of materials purchase and supply systematically begins from 1850. Charles Babbage's book on the economy of machinery and manufacturing published in 1832 refers to the importance of purchasing function. Babbage is also known as "Materials Man". The growth of Rail Road industries by 1866 started in America. The Book on 'The Handling of Railway Supplies and their Purchase and Disposition' in 1887 discussed the purchasing issues. Purchasing gained importance during World War I. Howard T. Lewis was a purchasing professional from 1905 to 1945. He developed importance of sound procurement to company operation.

The concept of materials management was widely spread during World War II. Professor Howard T. Lewis of the Harvard Business School made the extensive studies in Industrial Purchasing Practice. W.N. Michelle, N.F. Harriman, L.F. Buffy, Donald G. Clark, Edward T. Gushee, Russell Forbes, Stuart F. Hewritz and George A. Reward had contributed largely to purchasing and materials management in procuring, receiving, inventory control and supply. World War II introduced a new period in purchasing history. The emphasis on obtaining required and scarce materials influenced a growth in purchasing interest. In 1933, nine colleges offered courses related to purchasing which was increased to forty-nine colleges in 1945 in America. The membership of the National Association of Purchasing Agents increased from 3400 in 1934 to 5500 in 1940. The post-war period saw the development of the value analysis technique, pioneered by General Electric Company in 1947 on the evaluation of which materials or changes in the specification and design would reduce overall product cost. From 1947 to 1960 were 13 years on further developments in materials management.

Firms initiated dramatic growth of the materials management during 1960-1970. The Vietnam War resulted in upward price and materials availability pressure. During 1970 Firms experienced widespread materials problems related to 'oil shortages and embargos. Widespread agreement between countries taken place with the overall objective to solve materials problems including materials planning, inventory control, purchasing, quality control, stores control, materials movement and surplus disposal. The purchasing strategies and behaviors that evolved over in 1980 gave rise to foreign global competition. The global era of trading in between 1970 and 1999 for materials management increased. Purchasing approaches beyond 2000 reflects a changing emphasis towards the improvement of quality of materials, supplier relationship, more co-operative approach, long-term strategies of cost management and database materials management systems for materials planning and utilization in industries to bring about overall improvement in production systems, in-cost reduction through economy and increased sales. In order to serve the corporate goals and perform materials activities efficiently, a functional organization of the materials management must be established to fulfill the objectives of materials program, elimination of materials wastages and duplication of efforts to do so in every organization. Then only the above-mentioned goals of materials management can be achieved.

1.6. Objectives of Materials Management

The basic objectives of materials management are given below:

Making materials and services available in time and ensuring the balanced flow of materials all the time.

To have the correct quantity and right materials on hand at the time required with minimum investment expenditure; that is, ensuring proper control over inventories in order to minimize investment and wastage of funds.

Continuity of supply by issuing and delivering of materials at the right time and place because idle time of employees and machine push up overall costs of operation or production of goods or services.

Ensuring quality materials in consultation with concerned units.

Ensuring good supplier relations: Materials management aims at studying and selecting reliable suppliers and providing them fair treatment; that is, stimulating the suppliers for better performance-so as to ensure continuous supply.

To buy competitively: To buy competitively the buyer needs:

- To consider the effect of the balance and supply in the market
- Understanding of the supplier's cost structure

- The ability to negotiate price and service arrangements that are fair relative to the supplier's actual cost.

Departmental efficiency: involves the development of personnel, and the creation of operating policies and procedures, that contribute to the accomplishment of departmental objectives in the most cost-efficient manner.

Counseling service to management: This involves keeping top management aware of costs involved in the organization's procurements and any market changes that could affect the organizations output or growth potential-cost-benefit analysis

Price and demand forecasting: By analyzing and interpreting data of past purchase, seasonal variations in prices, and availability for materials, materials management forecasts future trends and plan material requirements

To achieve maximum integration with the other departments of the organization. This includes understanding the needs of using departments and translates these needs into materials support action.

1.7. Materials management and its Environment

Dear learner! Materials management works in a complex environment affected by many factors (both the internal and external factors).

1.7.1 External factors

Among the most important external factor that affect materials management are government regulation, the economy, competition, customer expectations, and quality.

Government: Regulation of business by the various levels of government is extensive. Regulation applies to such areas as the environment, safety, product liability, and taxation. Government, or the lack of it, affects the way business is conducted.

Economy: General economic conditions influence the demand for a company's products or services and the availability of inputs. During economic recession the demand for many products decreases while others may increase. Materials and labor shortages or surpluses influence the decisions management makes. Shifts in the age of the population, needs of ethnic groups, low population growth, free trade between countries, and increased global competition all contribute to changes in the market place.

Competition: Competition is severe today.

Manufacturing companies today completion from throughout the world. They find foreign competitors selling in their markets even though they themselves may not be selling in foreign markets. Companies also are resorting more too worldwide sourcing.

Transportation and the movement of materials are relatively less costly that they used to be. Worldwide communications are fast, effective, and cheap. Information and data can be moved almost instantly halfway around the globe.

Customers: Both consumers and industrial customers have become much more demanding, and suppliers are responded by improving the range of characteristics they offer. Some of the characteristics and selection of customers expect in the products and services they buy are:

A fair price

Higher/right quality products and services

Delivery lead time

Better pre-sale and after-sale services

Product and volume flexibility

Quality: Since completion is international and aggressive successful companies provide quality that not only meets customers' high expectations, but exceeds them.

1.7.2 Internal factors

Within an organization, the material management function is influenced by other functional areas such as:

Material management and finance; The finance department is responsible for maintaining cash flow and providing advice in preparing operating budgets. It also supplies finance to buy the materials and controls how well the money is used. To have smooth relationship between finance and material management, the later should spend only reasonable costs for ordering, handling and maintaining materials.

Material management and manufacturing; In this case the material management section supplies all the necessary materials to manufacturing section. So, there is a need to have smooth relationship between them. The material management section should supply the right quantity material /parts with the right quality at the right time and at reasonable price. The material management section fails to accomplish its tasks the overall production of the organization will be collapsed. So this section should develop its plan based on the plan of the manufacturing section plan.

Materials management and marketing; The marketing section is the key section for the overall operation of the organization. In order to meet the customer need/wants we should have close cooperation between them. The base for the manufacturing section to work the sales forecast.

Dear learner! Would you answer the following questions?

What is the contribution of materials management to the wealth of a nation?

2. List down major activities of materials management.

1.8. The Concept and Need for Integrated Materials Management

What is a system? A system is asset of elements, which are interrelated and integrated in order to achieve a certain objective.

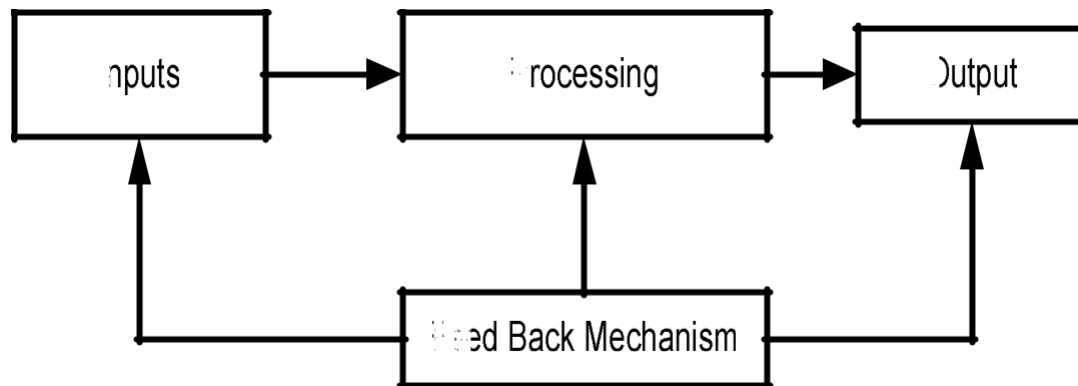
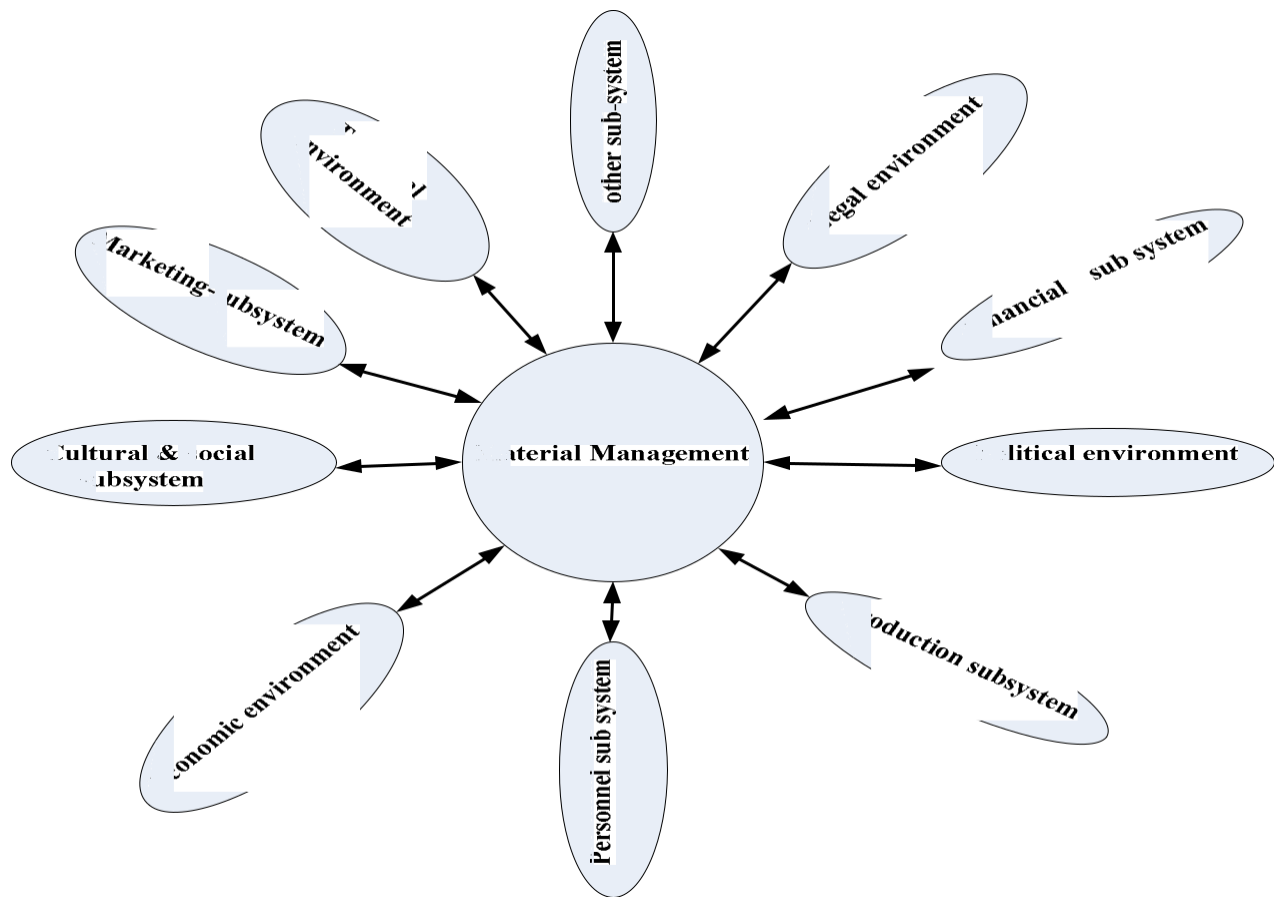


Figure1. Product flow

Materials required for production purpose are normally procured and stored in the plant and issued to manufacturing when there is a requisition. Materials are to be purchased in advance and stored to ensure uninterrupted supply. There should be a proper co-ordination and co-operation among different functional heads of materials department to optimize the operations of materials management. The materials function to be effective, the objective must be to maximize materials productivity. An integrated approach to materials management i.e. materials planning and control must look in to the problem areas in a co- coordinated manner in order to maximize the effectiveness of materials management. Materials management is a system approach towards the management of materials as it advocates the management of purchasing, receiving, storage, inventing control, and other material activities under one division in an integrated manner. This approach considers the interrelation and interdependence of materials management with other internal functional /departmental activities and in the elements in the external environment.

Figure 2. The Integrated materials management functions



When organizations were small almost all functions were performed by the chief responsible to handle materials management and other functions. As organizations grew, specializations or diversification of materials management activities will be used (e.g. Materials planning, purchasing, receiving, stores, distribution, inventory control, and surplus, scrap & waste disposal. However, these functions are assigned to different managers performing other activities such as production, engineering, marketing, etc. This means that, the responsibility for different, but interrelated materials management functions were widely dispersed throughout the organization structure, creating problem of coordination and communication. Thus, the integrated material management concept and its related form of organization have evolved in response of this problem.

1.8.1. Basic objectives of integrated material management

Optimizing organizational performance

Enhancing better communication system

Greater coordination and better control

Materials management is, therefore, the systematic integration of the following activities.

Materials forecasting, budgeting, planning and
programming Scheduling, purchasing and procurement
Receiving and inspection as to quantity and quality
Inventory control, storage and ware housing

Materials handling, movement, control and traffic etc.

Dispatch, shipping and disposals including wastes, scraps and surplus products.

When organizations were small almost all functions were performed by the chief responsible to handle materials management and other functions. As organizations grew, specialization and diversification of activities materials management increased (e.g. materials planning, purchasing, receiving, stores, distribution, inventory control and surplus, scrap and waste disposal). However, these functions are assigned to different managers performing other activities such as production, engineering, marketing, etc. This means that, the responsibility for different, but interrelated materials management functions were widely dispersed throughout the organizational structure, creating problem of coordination and communication. Thus, the integrated materials management concept and its related form of organization have evolved in response of this problem.

1.8.2. Benefits of integrated materials management approach:

Integration of organization; Establishing the entire materials functions together under one department, Reducing conflict and encourage complementary groups to work together as a team, Increased awareness and improved communications, Provide an integrated systems approach to the coordination of materials activities and the control of all material costs and Minimizes confusion, Advocates for the need of assigning all major materials management activities to a single unit

Integration of individual manager objectives; A materials manager becomes the sole decision-maker for materials as they flow through the organization.

Improvement of the credibility of the materials management organization to help to reduce costs and minimize confusion and to create an atmosphere of mutual trust and cooperation.

Improved materials control; The responsibility of control of materials rests upon one specific department.

Reduction of duplicated efforts; One department will perform materials management activities.

Better communication between the various materials sub-functions and other company functions

1.9. Organization for Materials Management

The primary objective of any materials management organization is to help maximize company profits by optimizing total costs associated with materials while maintaining a high level of customer service. The materials management organization structure should include all functions related to materials activities. The design of the structure must provide a room for both immediate and future needs. The following is an example of the ideal type of organization for materials management.

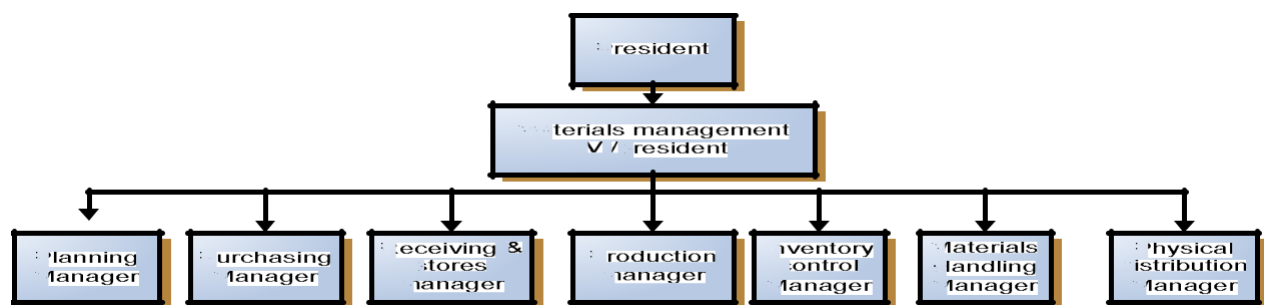


Figure 3. Position of materials management function in a company's organizational structure

Whether materials management is a top-level function or low or middle level function depends on the importance of the materials management activity to the total company functions. Generally, the importance and level of materials management for many organizations is largely determined by:

Availability of materials: Major materials required can be readily available in a competitive market or key materials can be bought in a volatile market subject to periodic shortages and price instability. In the latter case, top management involvement may be necessary.

Absolute dollar volume of purchase: If a company spends a large amount of money on materials it needs top management decision.

Percent of product cost represented by materials: If the percentage of product cost represented by materials by materials is significant it needs top management decision.

Dear learner! Would you answer the following questions?

Explain the types of functions that need to be incorporated in designing the structure of materials management.

State the basic objectives of integrated materials management functions.

1.10. Problems of Materials Management

Dear students! Materials management problems are common to every organization. Materials management problems are often identified by the specialized materials management sub-functions viz. purchasing, inventory control, production control; Traffic management; warehousing; materials handling and other related activities.

Some of the main problems of materials management are discussed here under as follows:

Lack of qualified managers: Lack of capable managers with broad experience and knowledge of various sub-functions of materials management is a basic problem in many organizations. This problem can be alleviated through improved education and cross training of personnel within the materials organization.

Insufficient upper management support: The success of an integrated materials management program is dependent upon upper management's understanding and continuous support.

Improper planning and implementation: Ineffective planning and implementation can destroy programs. To alleviate this management should understand the full requirements of instituting a total materials program.

Lack of credibility: Due to inadequate service or information, delay of delivery and shortage of materials occurs.

Chapter summary

In this chapter, we have been discussing about the meaning and significance of materials management, its contribution to the wealth of a nation, the concept of an integrated materials management approach, and issues associated with pitfalls and problems of materials management.

To improve productivity and wealth, a company must first design efficient and effective systems for manufacturing. It must then manage these systems to make the best use of labor, capital, and material. One of the most effective ways of doing this is through planning and control of the flow of materials into, through and out of manufacturing.

In this chapter we have also discussed issues related to materials management.

“Materials management can be defined as an organizational concept designed to enhance coordination and control of the various materials activities including an activity to plan, purchase, store, handle, distribute, use and control of materials in order to contribute to organizational success and profitability”.

The importance of materials management lies in the fact that any significant contribution made by the materials manager in reducing material cost will go long way in improving profitability and rate of return on investment. The functions of materials management are forecasting and planning of material requirement, Purchasing, Receiving, Storing and warehousing, Inventory control, value analysis and materials handling.

Also, the objectives of materials management can be stated as: provide an uninterrupted flow of material supplies, and services, keep inventory investment and loss at a minimum, maintain adequate quality standards, achieve harmonious, productive working relations with other departments within the organization and etc.

In the last section of this chapter we have also discussed how to design the structure of materials management. In order to design the structure, one should learn the relationships between materials management and the different functional areas in an organization. Generally, the question under

which unit shall we structure material management depends on: the size of the organization, management philosophy of the organization and the type of business the organization intends to perform.

Self-check Exercise 1

PART ONE: Multiple Choice Questions:

1. Which one of the following is **not** the factor that affects operations management?

- | | |
|--------------------------|--------------|
| A. Economy | D. Customers |
| B. Government regulation | E. None |
| Competition | |

One of the following is the objective of materials management:

- Ensuring proper flow of materials at their need
- Reducing the inventory carrying costs
- Preventing all types of wastage
- Avoiding “no stock” condition
- All

The question under which the materials management department should be structured have no a clear-cut answer. This depends on:

- The size of the organization
- Management philosophy of the organization
- Type of business
- All
- All except C

Which of the following is not a problem of materials management?

- Lack of qualified managers:

Lack of upper management support
Lack of credibility.
Proper planning and implementation

5. Materials management is the systematic integration of the following activities **except**

- | | |
|-----------------------|---------------|
| A. Materials handling | D. Scheduling |
| B. Storage | E. None |
| C. Auditing | |

PART TWO: Discuss the following questions using your own words

1. What is material?

2. What is materials management?

Discuss the basic functions of materials management and the benefits that can be achieved through effective materials management.

4. Name and describe four major external factors affecting operations management.

5. What are the major problems of material management?

Answer Key

1. E

4. D

2. E

5. C

3. D

CHAPTER TWO

FORECASTING

After completing this unit, students will be able to:

Know Why Forecasting?

Identify Features of Good Forecasting

Discuss Steps in Forecasting Process

Discuss Types of Forecasting

1. Introduction

The success of an organization depends on how well the organization sees the future environment which is full of risks and uncertainties. In order to make prediction about the future, we must use the past and present data. These data help in minimizing risk and/or uncertainties about the future. Forecasting is a prelude to planning. Before making plans, an estimate must be made of what conditions will exist over some future period. How estimates are made, and with what accuracy, is another matter, but little can be done without some form of estimation. Every day managers make decisions without knowing what will happen in the future. They order inventory without knowing what sales will be, purchase new equipment's despite uncertainty about demands for product, and make investments without knowing what profit will be. The organizational forecast serves as bases for all other business decisions. The quality of this business decisions can only be as good as the forecast on which they are based. Forecasts are used to set production schedule, budget capital, and allocate resources to programs.

2.1. What forecasting is?

Forecasting is the art and science of predicting future events. It involves estimation of the occurrence, timing, and magnitude of uncertain future events or levels of activities. Forecasting may involves taking historical data and projecting them into the future with some sort of

mathematical model. It may be a subjective or intuitive prediction. In some conditions it may involve the combination of both mathematical data and manager's perception.

Successful forecasting requires blending art and science. Experience, judgment, and technical expertise will all play a role in a successful forecasting. The purpose of forecasting activities is to make use of the best available present information to guide future activities towards systems goal.

2.2. Why Forecasting?

Forecasts are the basis for budgeting, planning capacity, sales, production and inventory, personnel, purchasing, and more. Forecasts play an important role in the planning process because they enable managers to anticipate the future so they can plan accordingly.

Forecasts affect decisions and activities throughout an organization, in accounting, finance, human resources, marketing, and management information systems (MIS), as well as in operations and other parts of an organization. Here are some examples of uses of forecasts in business organizations:

Accounting. New product/process cost estimates, profit projections, cash management.

Finance. Equipment/equipment replacement needs, timing and amount of funding/borrowing needs.

Human resources. Hiring activities, including recruitment, interviewing, and training; layoff planning, including outplacement counseling.

Marketing. Pricing and promotion, e-business strategies, global competition strategies. **MIS.** New/revised information systems, Internet services.

Operations. Schedules, capacity planning, work assignments and workloads, inventory planning, make-or-buy decisions, outsourcing, project management.

Product/service design. Revision of current features, design of new products or services.

In most of these uses of forecasts, decisions in one area have consequences in other areas. Therefore, it is very important for all affected areas to agree on a common forecast. However, this may not be easy to accomplish. Different departments often have very different perspectives on a forecast, making a consensus forecast difficult to achieve. For example, salespeople, by their very nature, may be overly optimistic with their forecasts, and may want to "reserve" capacity for their customers. This can result in excess costs for operations and inventory storage.

Conversely, if demand exceeds forecasts, operations and the supply chain may not be able to meet demand, which would mean lost business and dissatisfied customers.

There are two uses for forecasts. One is to help managers plan the system, and the other is to help them plan the use of the system. Planning the system generally involves long-range plans about the types of products and services to offer, what facilities and equipment to have, where to locate, and so on. Planning the use of the system refers to short-range and intermediate-range planning, which involve tasks such as planning inventory and workforce levels, planning purchasing and production, budgeting, and scheduling.

Business forecasting pertains to more than predicting demand. Forecasts are also used to predict profits, revenues, costs, productivity changes, prices and availability of energy and raw materials, interest rates, movements of key economic indicators (e.g., gross domestic product, inflation, government borrowing), and prices of stocks and bonds. For the sake of simplicity, this chapter will focus on the forecasting of demand. Keep in mind, however, that the concepts and techniques apply equally well to the other variables.

In spite of its use of computers and sophisticated mathematical models, forecasting is not an exact science. Instead, successful forecasting often requires a skillful blending of science and intuition. Experience, judgment, and technical expertise all play a role in developing useful forecasts. Along with these, a certain amount of luck and a dash of humility can be helpful, because the worst forecasters occasionally produce a very good forecast, and even the best forecasters sometimes miss completely. Current forecasting techniques range from the mundane to the exotic. Some work better than others, but no single technique works all the time.

Dear learner! Would you answer the following questions?

1. What we mean forecast?

2. Why we need to forecast?

2.3. Features of Good Forecasting

A properly prepared forecast should fulfill certain requirements:

The forecast should be timely. Usually, a certain amount of time is needed to respond to the information contained in a forecast. For example, capacity cannot be expanded overnight, nor can inventory levels be changed immediately. Hence, the forecasting horizon must cover the time necessary to implement possible changes.

The forecast should be accurate, and the degree of accuracy should be stated. This will enable users to plan for possible errors and will provide a basis for comparing alternative forecasts.

The forecast should be reliable; it should work consistently. A technique that sometimes provides a good forecast and sometimes a poor one will leave users with the uneasy feeling that they may get burned every time a new forecast is issued.

IV. **The forecast should be expressed in meaningful units.** Financial planners need to know how many dollars will be needed, production planners need to know how many units will be needed, and schedulers need to know what machines and skills will be required. The choice of units depends on user needs.

The forecast should be in writing. Although this will not guarantee that all concerned are using the same information, it will at least increase the likelihood of it. In addition, a written forecast will permit an objective basis for evaluating the forecast once actual results are in.

VI. **The forecasting technique should be simple to understand and use.** Users often lack confidence in forecasts based on sophisticated techniques; they do not understand either the circumstances in which the techniques are appropriate or the limitations of the techniques. Misuse of techniques is an obvious consequence. Not surprisingly, fairly simple forecasting techniques enjoy widespread popularity because users are more comfortable working with them.

VII. **The forecast should be cost-effective:** The benefits should outweigh the costs.

2.4. Steps in Forecasting Process

There are six steps in forecasting process

Determine the purpose of forecast; What is its purpose and when will it be needed? This will provide an indication of the level of detail required in the forecast, the amount of resource (personnel, completion time, dollar) that can be justified and the level of accuracy necessary

Establish a time horizon; The forecast must indicate a time limit, keeping in mind that accuracy decreases as the time horizon increases

Select a forecasting technique

Gather and analyze relevant data; Before a forecast can be prepared, data must be gathered and analyzed. Identify any assumptions that are made in conjunction with preparing and using forecast.

Prepare a forecast: use an appropriate technique

Monitor the forecast; A forecast has to be monitored to determine whether it is performed in satisfactory manner. If it is not, reexamine the method, assumption, validity of data and so on; modify as needed and prepare a revised forecast

2.5. Types of Forecasting/Forecasting Techniques

There are many forecasting methods, but they can usually be classified into two categories:

a. Qualitative

b. Quantitative

2.5.1. Qualitative Forecasting

In some situation, forecasts rely solely on judgment and opinion to make forecasts. If management must have a forecast quickly; there may not be enough time to gather and analyze quantitative data. At other times, especially when political and economic conditions are changing, available data may be obsolete and more up to date information might not yet be available. Some of the common qualitative methods of forecasting are:

Executive Opinion

A small group of upper level managers may meet and collectively develop a forecast. This approach is often used as a part of long-range planning and new product development. It has the advantage of bringing together the considerable knowledge and talents of various managers. However, there is a risk that the view of one person will prevail and the possibility that diffusing

responsibility for the forecast over the entire group may result in less pressure to produce a good result.

Delphi method

This method involves judgment. It is an interactive group process and employs a group of experts, not an oracle to obtain forecasts. The experts are usually not known to each other and their interaction takes place through a coordinator. The other participants in the Delphi process are the staffs who are involved in collecting and analyzing data. The respondents are the subjects whose judgment is being sought.

□ $\bar{A} \bar{A} \bar{A}$ $\bar{A} \bar{A}$ □ $\bar{A}$ □
ales force composite

In this method sales force members will be asked to estimate the likely sales in their respective areas. The estimates are then received to ensure that they are realistic. Finally, the estimates are combined at the district, regional and national level to obtain the overall forecast.

IV. Consumer Panel Survey

Under this method consumers are questioned about their purchase plan in a consumer panel. The aim of this method is to forecast product and service demand on the basis of subjective judgment of consumer purchase. These are typically used to forecast long range and new product sales. It can help not only in preparing a forecast but also in improving the design and planning for new product. There is one basic assumption to this model. i.e. the consumer in the panel are the representatives of the ultimate/final purchasers.

2.5.2. Quantitative Forecasting

In opposite to qualitative approach, quantitative models are objective in their very nature and they employ numerical information. This model includes time series model and causal models.

Time series models.

The time series models attempt to predict the future values using the historical data. Here the demand forecast is done on the basis of the past demand value. This prediction is based on the premise that the future is a function of what has happen in the past. In other words, they look at what has happened over a period of time and use a series of past data to make a forecast. If we are

predicting weekly sales of an automobile, we use the past weekly sales for automobile in making forecast.

Decomposition of time series

Time series analysis involves decomposing the past data into components and then projecting them forward. A time series has four components.

Trend: - Over a long period, time series will have an overall tendency either to move upwards or downwards, though the actual movement will not be regular.

Seasonality: - The fluctuation occurs periodically, the movements recurring within a definite period may be every month or every Week

Cyclical movement: - The cyclic variations as an index in decomposition method occur as short-period changes and periodic variations. These variations may be regular or irregular. They are caused by business cycles. For example, the sales of company may be high because the level of economic performance may be high.

Random Variation: - These variations are erratic and irregular and are usually caused by some unpredictable reason. They follow no discernible pattern, so they cannot be predictable.

Dear learner! Would you answer the following questions?

1. Would you explain the difference between qualitative and quantitative forecast?

2. When we can say forecasting system is good?

The most commonly used time series models are:

A) Naive forecast:

The simplest forecasting technique is the naïve method. A naïve forecast for any period equals the previous period's actual value.

For example, if demand of last week was 50 , the forecast for the upcoming week is 50 . Similarly demand in the upcoming week turns out to be 54 , the forecast for the following would be 54 .

Consider the advantage: it has virtually no cost, it is quick and easy to appear as forecast because data analysis is nonexistent, and it is easy for the users to understand. The main objection to this method is its inability to provide highly accurate forecasts.

Simple Moving Averages

The simple moving average method uses the average of the most recent n data values in the time series as the forecast for the next period. Mathematically, the simple moving average is expressed as:

$$\text{Simple Moving Average} = \frac{\sum}{n}$$

Example: The demand for product A is observed for 10 months & it is given below:

<u>Month</u>	<u>Demand (in unit)</u>
1	420
2	380
3	456
4	412
5	429
6	366
7	392
8	440
9	452

10	396
----	-----

Question:

What is the forecast for month 11 using a 3-month moving average & 4-month moving average methods?

Solution:

A three-month moving average can be obtained by adding the demand during the past three months dividing the sum by three, with each passing month the recent month data is added by dropping the old to get new forecast.

By using three months moving average, the demand in month 11 will be;

$$\frac{396 + 452 + 440}{3} = 429 \text{ units}$$

When four months moving average is used, the forecast of month 11 will be 420 units.

Which can be obtained as follows:

$$\frac{392 + 440 + 452 + 396}{4} = 420 \text{ units}$$

Note that in a moving average as each new actual value becomes available, the forecast is updated by adding the newest value and dropping the oldest and, then, computing the average. Consequently, the forecast “moves” by reflecting only the most recent value.

The advantages of moving average forecast are that it is easy to compute and easy to understand. A disadvantage is that data storage requirements can be significant, especially if large numbers of moving average forecasts are being made. This is because individual values that comprise the average must be separately identified so that with each new forecast the oldest value can be discarded. A more serious consideration is that all values in the average are weighted equally. Hence, in a ten-period moving average, each value is given a weight of 1/10; the oldest value is

given the same weight as the most recent value. Decreasing the number of values in the average will increase the weight of more recent values, but this will be at the expense of losing potential information from less recent values.

C) Weighted moving average

In the simple moving average method, each observation in the time series receives the same weight. When detectable trend or pattern is present, weight can be used to place more emphasis on recent values. One possible variation known as ***weighted moving average***; involves selecting different weights for each data value and then computing a weighted mean as the forecast. In most cases, the most recent observation receives the greater weight, and the weight decreases for the older data values. This practice makes forecasting technique more responsive to changes because most recent period may be more heavily weighted.

Mathematically it can be expressed as:

$$\text{Weighted Moving Average} = \frac{\sum (w_t \cdot D_t)}{\sum w_t}$$

Example: given the following demand data

Period	Demand
1	42
2	40
3	43
4	40
5	41

Compute a weighted average forecast using a weight of 0.40 for the most recent period, 0.30 for the next recent, 0.20 for the next and 0.1 for the next

If the actual demand for period 6 is 39, forecast demand for period 7 using the same weight as in part (A)

Solution:

$$F6=0.4(41) +0.3(40) +0.20(43) +0.1(40) =41$$

$$F7=0.40(39) +0.3(41) +0.20(40) +0.1(43) =40.2$$

Note that if four weights are used, only the four most recent demand are used to prepare

The advantage of a weighted average over a simple moving average is that the weighted average is more reflective of the most recent occurrences. However, the choice of weight is somewhat arbitrary and generally involves the use of trial and error to find a suitable weighting scheme

Exponential Smoothing

It is not necessary to keep months of history to get a moving average because the previously calculated forecast has already allowed for this history. Therefore, the forecast can be based on the old calculated forecast and the new data. Suppose an average of the demand of the last six months (80 units) is used to forecast January demand. If at the end of January, actual demand is 90 units, we must drop July's demand and pick up January's demand to determine the new forecast. However, if an average of the old forecast (80) and the actual demand for January (90) is taken, the new forecast for February is 85 units. This formula puts as much weight on the most recent month as on the old forecast (all previous months). If this does not seem suitable, less weight could be put on the latest actual demand and more weight on the old forecast. Perhaps putting only 10% of the weight on the latest month's demand and 90% of the weight on the old forecast would be better. In that case,

$$\text{February forecast} = 0.1(90) + 0.9(80) = 81$$

Notice that this forecast did not rise as much as our previous calculation in which the old forecast and the latest actual demand were given the same weight. One advantage to exponential smoothing is that *the new data can be given any weight wanted*. The weight given to latest actual demand is called a smoothing constant and is represented by the Greek letter alpha (α). *It is always expressed as a decimal from 0 to 1.0*. In general, the formula for calculating the new forecast is:

$$\text{New forecast} = (\alpha) (\text{latest demand}) + (1 - \alpha) (\text{previous forecast}).$$

The old forecast for May was 220, and the actual demand for May was 190. If alpha is 0.15, calculate the forecast for June. If June demand turns out to be 218, calculate the forecast for July.

Solutions

$$\text{June forecast} = (0.15) (190) + (1-0.15) (220) = 215.5$$

$$\text{July forecast} = (0.15) (218) + (0.85) (215.5) = 215.9$$

Exponential smoothing provides a routine method for regularly updating item forecasts. It works quite well when dealing with stable items. Generally, it has been found satisfactory for short-range forecasting. It is not satisfactory where the demand is low or intermittent. Exponential smoothing will detect trends, although the forecast will lag actual demand if a definite trend exists. If a trend exists, it is possible to use a slightly more complex formula called double exponential smoothing. This technique uses the same principles but notes whether each successive value of the forecast is moving up or down on a trend line. A problem exists in selecting the “best” alpha factor. If a low factor such as 0.1 is used, the old forecast will be heavily weighted, and changing trends will not be picked up as quickly as might be desired. If a larger factor such as 0.4 is used, the forecast will react sharply to changes in demand and will be erratic if there is a sizable random fluctuation.

A good way to get the best alpha factor is to use computer simulation. Using past actual demand, forecasts are made with different alpha factors to see which one best suit the historical demand pattern for particular products. The sensitivity of forecast adjustment to error is determined by the smoothing constant, alpha. The closer its value is to zero, the slower the forecast will be to adjust a forecast error (i.e. the greater the smoothing). Conversely, the closer the value of alpha is to 1.00, the greater the sensitivity and the less the smoothing. Selecting the smoothing constant is, basically, a matter of judgment or trial and error. The goal is to select a smoothing constant that will balance the benefits of smoothing random variations with the benefits of responding to real changes if, and when, they occur. Commonly used values range from .05 to .50

Trend Projections

In this method, a trend line is fitted to the given time series data and then projections are made in to the future by using this line. The trend line may be linear or curvilinear in nature. In-order to obtain the trend line, the historical data are plotted on the graph, representing time scales on X-axis. Then a line is drawn through these points in such a way that the sum of deviations above & below the line are equal.

The sum of the squares of these vertical deviations is minimum. In essence the trend line is drawn based on the principle of least square. Such a line is represented by;

$$y = bx + a$$

where:

y = is the trend line to be predicted

a – the y intercept

b = the slope of the trend line

x – independent variable (in this case time)

So far, the trend lines the value of b & a can be obtained as follows

$$b = \frac{\sum x_i y_i - n(\bar{x})(\bar{y})}{\sum x_i^2 - n(\bar{x})^2}$$

$$a = \bar{y} - b(\bar{x})$$

Example:

Consider the following demand pattern of ABC Company for iron ore.

Year	Demand for iron sheet in '000 tons
1999	13
2000	17
2001	16
2002	16
2003	21
2004	20
2005	20
2006	23

2007	25
2008	24
2009	25

Required:

- A. Forecast the demand of the iron sheet for the year 2010 for ABC Company. Using 2004 as base year.
- B. Forecast the demand of the iron sheet for the year 2010 for ABC Company. Using 2007 as base year.

Solution:

- A. When we use 2004 as a base year.

Year	Xi	Yi	Xi (Yi)	Xi ²
1999	-5	13	-65	25
2000	-4	17	-68	16
2001	-3	16	-48	19
2002	-2	16	-32	4
2003	-1	21	-21	1
2004	0	20	0	0
2005	1	20	20	1
2006	2	23	46	4
2007	3	25	75	9

2008	4	24	96	16
2009	5	25	125	25
	$\Sigma Y_i = 0$	$\Sigma Y_i = 220$	$\Sigma X_i (Y_i) = 128$	$\Sigma X_i^2 = 110$

The equation of the estimating line,

When the base year is 2004 $x = 0$. The value of b & a for trend line can be obtained as follows:

$$b = \frac{128 - 11(0)(20)}{110 - 11(0)^2} = \frac{128}{110} = 1.1636$$

$$a = y - b(x)$$

$$20 - 1.1636(0) = 20$$

The trend linear equation will be; $y = bx + a \dots y = 1.1636(X) + 20$

Therefore, the forecast for the year 2010 will be as follows; $X = 6$ (because it is six years after the base year 2004)

$$y = 1.1636(6) + 20 = 26.9816 \text{ tons of iron sheet}$$

B) If we take 2007 as a base year

Year	X_i	Y_i	$X_i (Y_i)$	X_i^2
1999	-8	13	-104	64
2000	-7	17	-119	49
2001	-6	16	-96	36
2002	-5	16	-80	25
2003	-4	21	-84	16
2004	-3	20	-60	9
2005	-2	20	-40	4

2006	-1	23	-23	2
2007	0	25	0	0
2008	1	24	24	1
2009	2	25	50	4
	$\Sigma X_i = -33$	$\Sigma Y_i = 220$	$\Sigma X_i (Y_i) = -532$	$\Sigma X_i^2 = 209$

$$x = \frac{\Sigma X_i}{n} = \frac{-33}{11} = -3$$

$$y = \frac{\Sigma Y_i}{n} = \frac{220}{11} = 20$$

$$b = \frac{-532 - (11)(-3)(20)}{209 - 11(-3)^2} = \frac{-128}{110} = \underline{\underline{1.1636}}$$

$$a = y - b(x)$$

$$20 - 1.1636(-3)$$

$$\underline{\underline{23.4908}}$$

Then the equation will be

$$Y = 1.1636X + 23.4908$$

the forecast for the year 2010 will be;

$$X = 3 \text{ (because it is 3 yrs. after the base year 2007)}$$

$$y = 1.1636(3) + 23.4908$$

$$y = \underline{\underline{26.9816}} \text{ tons of iron sheet.}$$

N.B. The forecast for the year 2000 will be the same even if the base year is changed i.e. irrespective of the base year the forecast will be the same.

Example:

$y = 20 + 1.1636x$ when the middle year is used as a base year, when the base year is changed by adding /subtracting from the value of x i.e. from 1994 to 1997 there is a 3 yrs. time gap. So the value of x will be $x + 3$. The trend equation by using 1997 as a base year is

$$y = 20 + 1.1636 (x+3)$$

$$y = 20 + 3.4908 + 1.1636x$$

$$y = 23.4908 + 1.1636x$$

B. Causal Models of Forecasting

The causal model considers two types of variables the dependent and independent variables. E.g., the sales of a company are depending on & are related to the price changed. By using regression analysis, it is possible to develop a statistical relationship b/n the dependent and independent variables.

Simple regression analysis;

It is used when there is one independent variable/ explanatory variable. Here an estimate of the dependent variable is made corresponding to a given value of the independent variable by putting their relationship in the form of regression line. The regression line is then represented by the following equation.

$$y = a + bx \quad \text{where,}$$

a - intersects of the regression line

b - slope of the regression line

x - the independent variable

y - the predicted value of the dependent variable

$$b = \frac{\sum xy - n \bar{x} \bar{y}}{\sum x^2 - n \bar{x}^2}$$

$$\sum x^2 - n \bar{x}^2$$

$$a = \bar{y} - b \bar{x}$$

Here parameter b is also called the regression coefficient. Parameter a and b of the trend line drawn on the principle of vast square are obtained using the following pairs of normal equations.

$$\sum y = na + b\sum x$$

$$\sum xy = a\sum x + b\sum x^2$$

$$b = \frac{\sum xy - n\bar{x}\bar{y}}{\sum x^2 - n\bar{x}^2}$$

$$\sum x^2 - n\bar{x}^2$$

$$a = \bar{y} - b\bar{x}$$

Here $\sum y$ – Summation of the value of the dependent variable

$\sum x$ – Summation of the value of the independent variable

$\sum xy$ – Summation of moderate of x and corresponding y value

$\sum x^2$ – Sum of the square of the value of the independent variable

n- Number of date points

Illustration on Regression analysis;

Consider a large firm organization engaged in producing barely. The organization feels that the demand for its product (barely) is dependent or related to the number. of cans of beer of 1 liter consumed every year in a certain locality. To establish the demand forecast for its product, the organization has collected the following historical data of hectares of land that had been sown & the number. of quintals of barely harvested.

<u>Year</u>	<u>Consumption of beer in ‘000 of liters</u>	<u>Demand for barely in ‘000 of quintals</u>
2000	36	54
2001	26	30
2002	12	28
2003	40	48

2004	24	36
2005	18	30
2006	30	38
2007	30	46
2008	14	16
2009	34	42

Required:

If the numbers of liters of beer to be consumed in the coming period is 48000 liters (orders already received from clients). Forecast the number of quintals of barely that could be demanded in the year 2010.

Solution:

The first step in regression analysis is to identify the dependent and independent variables usually denoted by x and y respectively. In this illustration the dependent variable is barely and the independent variable is beer.

<u>Bear (x)</u>	<u>Barely (y)</u>	<u>x^2</u>	<u>xy</u>
36	54	1296	1944
26	30	676	780
12	28	144	336
40	48	1600	1120
24	36	576	864
18	30	324	540

30	38	900	1140
30	46	900	1380
14	16	196	224
<u>34</u>	<u>42</u>	<u>1156</u>	<u>1424</u>
$\sum x_i = 264$	$\sum y_i = 368$	$\sum x_i^2 = 7768$	$\sum y_i^2 = 10556$

$$\bar{x} = \frac{\sum x}{n} = \frac{264}{10} = 26.4$$

$$\bar{y} = \frac{\sum y}{n} = \frac{368}{10} = 36.8$$

$$b = \frac{10556 - 10(26.4)(36.8)}{7768 - 10(26.4)^2} = \frac{840.8}{798.4} = \underline{\underline{1.05}}$$

$$a = 36.8 - (1.05)(26.4) = \underline{\underline{9.08}}$$

$y = 1.05x + 9.08$ The demand for barely is in the year 2000 $= 1.05(48000) + 9.08 = 50.4$ tons of quintals.

Chapter Summary

Forecasting is the art and science of predicting future events and it involves taking historical data and projecting them into the future. Organizations forecast materials demand in order to minimize production interruption and to meet customer demand. Forecasting techniques can be either a qualitative or quantitative. **Qualitative techniques** are projections based on judgment, intuition, and informed opinions. By their nature, they are subjective. On the other hand, **quantitative models** are objective in their very nature. Qualitative method can be conducted through the

following alternatives; such as Delphi method, sales force composite, customer panel survey...etc.

For quantitative method there are two basic options; time series method & causal method

Self-check Exercise 2

Multiple chooses

Among the following which statement is correct?

In forecasting process, selecting forecasting technique precedes determining the purpose of the forecast;

Forecasting activity is neither a science nor an art;

Forecasting accuracy decrease as the time horizon decrease;

None of the above

One of the following is not a feature of good forecasting:

A. Timely

D. Reliable

B. Complex

E. Expressed in a meaningful term

Accurate

The forecast for any period equals the previous period's actual value is called

A. Moving average

D. Naïve

B. Exponential smoothing

E. None

Regression

On which of following demand is increasing in a steady pattern from year to year?

A. Trend

D. Cyclic

B. Seasonality

E. None

Random

What is the forecast for May based on a weighted moving average applied to the following past demand data and using the weights: 4, 3, and 2 (largest weight is for most recent data)?

Nov	Dec	Jan	Feb	Mar	April
-----	-----	-----	-----	-----	-------

37	36	40	42	47	43
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- A. 44.1
- B. 39.7
- C. 44.0
- D. 44.5
- E. 43.1

Quantitative forecasting techniques include:

- Consumer survey
- Exponential smoothing
- Managers opinion
- Delphi method
- None of the above

Which one of the following is true about exponential smoothing?

- Low values of α is used when the underlying average tends to be unstable; higher values are used when the underlying average is not susceptible to change
- the closer the value of α is to 0, the greater the responsiveness and the less the smoothing
- The smoothing constant α represents a percentage of the forecast error.
- The closer the value of constant to its zero, the faster the forecast adjust to forecast error
- All of the above

Given last period's forecast of 65, and last period's demand of 62, what is the simple exponential smoothing forecast with an alpha of 0.4 for the next period?

- 63.2
- 62
- 63.8
- 65
- None of the above

II. Short answer.

Write forecasting procedure.

Explain the difference between qualitative and quantitative methods of materials demand forecast.

The demand for cotton in ABC Textile Company observed for the last ten year and it is given below:

Required:

What is the forecast for year 2004 using a 3-month simple moving average method?

Assume that the weight of the three months forecast given above is 3:2:1 then, forecast for year 2004 using weighted moving average method.

Forecast the demand for cotton for the year 2004 using trend projection method (assume that year 1998 is a base year).

Year	Demand quintals (000)
1994	13
1995	16
1996	15
1997	18
1998	20
1999	20
2000	22
2001	24
2002	26
2003	27
2004	?

Answer key

1. C
2. B
3. D

4. E
5. A
6. B

7. C
8. A

CHAPTER THREE

PURCHASING

Chapter objective

At the end of this chapter you should be able to:

- Define what purchasing mean

- Define the rights of purchasing

- Identify the role of purchasing in business

- Describe the relationship between purchasing and other functional departments

- Explain about purchasing policies and purchasing procedures

- List types of purchasing

- List criteria to select supplier

- Describe about value analysis

1. Introduction

Purchasing is a managerial activity that goes beyond the simple act of buying, and it includes the planning and policy activities covering a wide range of related and complementary activities. Included in such activities are the research and development required for the proper selection of materials and sources; the follow-up to ensure proper delivery; the inspection of incoming shipments to ensure both quantity and quality compliance with order; the development of proper procedures, methods, and forms to enable the purchasing department to carry out established policies; the co-ordination of the activities of the purchasing department with such other external divisions of the concern such as traffic, receiving, storekeeping, and accounting, so as to facilitate smooth operations; and the development of a technique of effective communication with top management of the company so that a true picture of the performance of the purchasing function is presented.

3.1. Meaning and Role of Purchasing

3.1.1. Meaning or definitions of purchasing

Many authors have defined purchasing in different ways and there is no single definition accepted by everyone. Some of these definitions are:

Purchasing is the process of acquiring goods or services in exchange for funds.

Purchasing is obtaining from external sources all goods, services, capabilities and knowledge which are necessary for running, maintaining and managing the company's primary and support activities at the most favorable conditions

The purchasing function comprises the essential activities associated with the acquisition of materials, services, and equipment used in the operation of an organization.

Purchasing is the function of buying machinery, tools, general supplies, raw materials etc required by an organization.

From the above definitions it can be concluded that purchasing is the process of obtaining material input, machineries, tools, supplies and services for the smooth running of any organization be it business, non-for-profit, large or small from outside sources. In other words, purchasing is a common function in almost all organizations.

Activity: Define the term purchasing?

3.1.2. Role of Purchasing in Business

To see the role of purchasing, the function will be observed from three points of view.

Purchasing as a function of business

Purchasing as one of the basic elements required to accomplish productive work

Purchasing as a key department responsible for outside manufacturing

I.As a Function of Business

Purchasing is one of the basic functions common to all type of business enterprise. These functions are basic because no business can operate without them. All businesses are managed by coordinating and integrating six functions namely:

Creation: the idea or design function usually based on research

Finance: the capital acquisition and financial planning and control function

Personnel: the human resource and labor relation function

Purchasing: the acquisition of required materials, service and equipment

Conversion: the transformation of material in to economic goods and services

Distribution: the marketing and selling of goods and services produced

Depending on the company's size, these six basic functions may be supervised by a single manager or individual managers for each function. By its very nature, purchasing is a basic and integral part of business management. For a business to be successful, all its individual parts must be successful.

As Elements Required for Productive Work

The basic goal of any individual activity is the development and manufacturer of products that can be marketed at a profit. This goal is accomplished by the appropriate blending of what management authorities historically have called the five M'S:

Machine

Money and

Manpower

Management

Materials

Materials today are the life blood of industry. Materials of the appropriate quality must be available at the right time, in the proper quantity, at the needed location and at an acceptable total cost. Failure to fulfill any of these responsibilities concerning materials management adds to company's cost and decrease company profit just as surely do out mode production methods, inefficient personnel and ineffective marketing activity.

Purchasing as a key department responsible for outside manufacturing

The materials that go in to a typical company's product can originate from either of two sources. The company's production department is the first source. This department converts raw material in to processed parts; the company's purchasing department is the second source. This department not only purchase raw material which the production department converts in to processed parts but also purchases finished parts and components. The parts made by the production department are combined in assembly with the items bought by the purchasing department to make the company's final product.

Activity: What are three roles of purchasing?

3.2. Purchasing Objectives

The objectives of purchasing can be viewed from two levels:

a very general managerial level,

a more specific functional or operational level, and

□ **A** □

A □

A □

A □

From a top managerial perspective, the general objectives has traditionally been expressed as the ***five rights*** which management expects the department to achieve the acquisition of materials:

- | | |
|-------------------------|---------------------------|
| - Of the right quality | - From the right supplier |
| - In the right quantity | - At the right price |
| At the right time | |

Activity: What are the three levels based up on which objectives of purchasing can be identified?

Right quality

Quality may define in various ways like fitness, excellence, and merit but in materials management quality has different meaning: The right quality is the suitability of an item for a given purpose. The best quality need not be the right quality. The quality is the dimensional limits: Composition, performance, durability and etc., of materials.

Therefore, quality refers to suitability of an item for its intended purpose, no more no less just enough for its purpose. Quality deals with suitability and cost factors rather than the fitness or excellence. A quality material is a material that is suitable for the purpose and at the same time with low cost.

Activity: What is quality?

Right quantity

It is a quantity which is ***not too much or too few***. Large quantity leads to costs such as holding, obsolescence and deterioration, tied up capital etc. And also, too low materials will also lead to shortage cost which results loss of customers, persons and machines are at down time, interruption of production, productivity decreases etc.

Thus, there is a need to keep balance between large quantity and low quantity this is called right quantity. This optimum quantity is determined by economic order quantity (EOQ) – The quantity at which (carrying cost + ordering cost + purchase cost) is the lowest. (To be discussed in the next chapter)

Right price

The right price is the one which being the best ultimate value. It need not be the lowest price. Price should be determining in combination with other factors such as quality, ultimate life, delivery time, after sales service etc. In short, the ‘right price’ will be the lowest price available, consistent with ensuring the right quality, quantity, timing and delivery. Therefore, right price is the price that must be paid to the supplier to obtain the goods of the right quality at the right time.

Right supplier

This is the one that meets the requirement of the organization like quality, quantity, service, price, and delivery performance. The right source should possess the necessary financial resources, technical ability (including inspection and quality control methods) to supply the required quantity and quality of goods at satisfactory price. As far as, possible the firms should be located within a few distance of the buyer’s plant. This will avoid delivery delays and high transportation charge, facilitates personal contact between the buyer and the supplier, enable better after sales services etc. The firms should be also free from strikes and shut down. Middlemen and brokers should be allowed as far as possible. Only the right source can give goods of the right quality, in the right quantities, at the right price and at the right time.

Right source aspect requires decisions regarding the classification items to be purchased directly from the manufacturers, items to be brought from dealers and items to be purchased in the open market. Right source also requires the analysis of transportation costs, along with the basic price, to make the choice between a distant supplier and local supplier.

Right time

This is when materials are made available when they are required. Materials that have purchased before the required delivery time are not efficient procurement. Because they are exposed to deterioration, obsolescence and handling costs. Likewise, materials bought after the time they were required is also not efficient purchasing because they incur additional cost, which is termed as stock out cost.

From an operating or functional perspective, then, it is necessary to probe more deeply to develop a set of statements that provide practical and useful targets for decision-making purposes.

To support company operations with an uninterrupted flow of materials and services. This is the most fundamental of all purchasing and materials management objectives. In a logistical sense this is a key reason for the existence of the department. Responsibility for performance of the function is located in a single operating unit, there by facilitating co-ordination and control of the supply activities.

To buy competitively. Buying competitively involves keeping abreast of the forces of supply and demand that regulate prices and availability of materials in the market place. At times; it also involves an understanding of a supplier's cost structure, coupled with ability to minimize the supplier's costs within reason-then to negotiate price and service arrangements that are fair relative to the supplier's costs. *A buyer who pays significantly more than his or her competitor does for a given material or service generally is not buying competitively.*

To buy wisely. Buying wisely involves a continual search for better values that yield the best combination of price, quality, and service, relative to the buyer's needs. This frequently involves coordination with users in defining the need. It may also involve co-coordinating and reconciling users' needs with suppliers' capabilities to achieve optimal value considering both issues. A firm that purchases a silver-plated part when a copper plated part could perform the function just as well usually is not buying wisely. It is the combination of buying competitively and buying wisely that typically contributes most to the profitability of the firm.

To keep inventory investment and inventory losses at a practical minimum. Although maintaining a large inventory is one way to achieve objective number one, it is also costly. Generally, speaking, most firms today pay in indirect costs between 25 and 35 percent of the average inventory value per year for the convenience of having the inventory available. Hence, the materials management job is to achieve a reasonable balance between the level of inventory required to support operation and the cost of carrying the inventory. Through proper packaging, and storing, it is also the department's objective to minimize losses that occur as a result of deterioration, obsolescence, theft, and so on.

To develop reliable and effective sources of supply. Cooperative suppliers that are willing to work with a buyer to help solve the buying firm are problems and to minimize its materials-related costs are an invaluable resource. Progressive buyers today tend increasingly to "buy suppliers", as opposed simply "buying products". The identification, investigation, selection, and in some cases development of competent and responsive suppliers is a buyer's paramount responsibility. It is difficult indeed for a firm to perform optimally if it cannot depend on the planned performance of a reliable contingent of suppliers.

To develop good relationships with the vendor community and good continuing relationships with suppliers. *Good relationships with suppliers are imperative, and good relationships with potential suppliers are invaluable.* The achievement of the preceding objective on a continuing basis is virtually impossible if mutually satisfactory continuing relationships are not maintained. Potential suppliers are much more interested and eager to acquire a firm's business if the buying firm is likely to be a "good customer".

To achieve maximum integration with the other departments of the firm. It is essential for buyers to understand the major needs of their using departments, so that these needs can be translated into materials support actions. While these actions vary from firm to firm, they normally require the purchasing and materials operation to support a using department in one or more of its major responsibilities. The most common types of support involve actions such as developing materials standardization programs (in Co-ordination with ongoing design programs), forecasting future prices and general business conditions, performing economic make-or buy analyses, and serving as a repository of information and data from suppliers regarding new materials, processes, prices, and materials availability.

To administer the purchasing and materials management function in a professional, & cost-effective manner. Management should expect the preceding seven objectives to be achieved in a professional manner at a cost that is commensurate with their value to the total organization. This involves the acquisition and development of highly competent personnel who are motivated to perform their responsibilities effectively, with the overall goal of helping the firm maintain a competitive position in its industry. Such personnel also serve as a reservoir of talent from which future executives of the firm can be drawn.

To sum up, all these objectives apply in principle to all categories of industrial buying activities: manufacturing concern, governmental units, schools, hospitals, and all other types of buying units that buy for consumption or conversion. A nonprofit activity, of course, cannot seek to “maximize its profit”. It can, however, seek to maximize the benefits the organization receives from its appropriated or endowed birr. A principle common to all types of purchasing activities is to obtain the greatest value from each birr the purchasing department spends.

3.3. Relationship between Purchasing and Other Functional Units

A purchasing department is the center of a large part of company’s business activity. By its very nature, purchasing has continuing relationship with all other departments in the firm as well as with the firm’s suppliers. Purchasing operations cut across all departments (production, engineering, marketing, and finance) often view common problems differently.

A. With Engineering Department

Its relation with engineering department is the widest of all. When making new designs, discussion takes place between engineering department (product design) and purchasing department regarding availability of various materials. Similarly, when developing source of supply for components to be sub contracted, consultation between purchasing and engineering will be necessary. Also, when selecting of suppliers of capital equipment, the engineering department comes to the picture.

In many organizations the inspection of the incoming materials is also done by the engineering (staff or inspection). Further the materials management department (store) is the custodian of tools, operational suppliers, raw materials, finished components etc and the engineering department (production and maintenance) is the user.

B. With Sales Department

The relationship with sales depends on the types of the set up. If the dispatch section comes under the materials management department, the relation will be greater. The sales can also be of assistance to materials management department (purchase) in expediting suppliers from certain supplier because of the spread-out nature of the sales department of the organization.

C. With Accounting and Finance Department

The area of contact with accounting and finance include preparation of budget, programming delivery of expensive raw materials, and capital equipment's in such a way as to avoid strain on company's finance, selection of suppliers and price determination through tender committees, opening of letter of credit, payment of suppliers, bills often involving clarification from purchase or stores, accounting of petty cash, expenditure by purchase or traffic, verification of stocks in stores, preparation of annual inventory, etc. It is also essential that the various forms used in the materials department (purchase order requirements, delivery note etc.) correspond to the accounting to the accounting requirements so that essential accounting data can be collected without difficulty.

D. With Personnel Department

The relationship with personnel department hardly needs mention. Everything concerned with staff matters like recruitment, selection, disciplinary action etc has to be handled through this department. Generally, the efficiency of a company's overall operation depends to a great extent on the amount of cooperation and understanding among various departments. The purchasing department must therefore maintain good relation with other departments. Without their cooperation or without cooperating with them the department can't function efficiently.

Activity: describe the area that purchasing has relation with another department?

3.4. Purchasing Policies

Policies are developed to serve as general guidelines in making operating decision that channel action towards achievement of objectives. They are one of the administrative tools of the executing unit and reflection of top management philosophy. They can be used by auditors who check purchasing adherence to corporate policies.

Activity: What is policy?

Types of Purchasing Policy: Centralized Vs Decentralized

Policy A. Centralized Purchasing Policy

It means that the requirements of all departments of a plant or different units of the same company or of associated companies of the same group will be purchased by a single purchase department. Or when purchase decision making authority and power is concentrated at one center.

Advantage of centralized purchasing policy

When functioning properly, centralized purchasing produces the following benefits:

Responsibility for performance of purchasing function is fixed with a single department head, there by facilitating management control.

Duplication of effort and haphazard purchasing practices are minimized by the central coordination of all company purchases

Quantity discount are made possible by consolidating all company orders for the same and similar materials. In addition, a firm is able to develop and implement a uniform procurement policy.

Transportation savings are realized by the consolidation of orders and delivery schedules

Suppliers are able to offer better prices and better services because their expenses are reduced. Centralization develops purchase specialists whose primary concern is purchasing

Fewer orders are processed for the same quantity of goods purchased, thus reduce purchasing, receiving, inspection, and accounts payable expense.

Record keeping is reduced and at the same time made significantly more effective.

Disadvantages of centralized purchasing policy

The specific requirements of the individual items may not be attended successfully. At times, it may result in absence of matching of mind between the needy section and the buying section resulting in wrong buying.

The centralized standard procedure may result in delays in receiving the materials.

It is likely that the centralized buying staff may not be expert in buying varied types of items.

In case of multi-plant units located at distant places and receiving their requirements from centralized storing, it may not be possible to tap the local resources. However, this situation can be handled effectively authorizing the regional purchase agent to make local purchases if they involve cost advantage.

B. Decentralized purchasing policy

Despite the general advantages of centralization, complete centralized purchasing is neither always possible nor always desirable. Three types of situations justify some decentralization.

Companies that process single natural raw materials. Many such firms separate the purchase of the key raw material from the purchase of other materials. Firms in the tobacco, textile, and leather industries are good examples.

Technically oriented firms that are heavily involved in research. Operations of multi plant manufacturing firms

Decentralized purchasing policy exists when authority and power of purchasing decision making is delegated and given to lower level is called decentralized purchasing.

Advantage of decentralized purchasing policy

Fast and quick decision making
purchase is made closer to using department

It helps to satisfy the differing local needs. It has advantages to aware of purchasing depending up on the local need.

Helps to spread risk

Disadvantage of decentralized purchasing policy

Difficult to control

Weak negotiation power

Absence of quantity discount

Inefficient utilization of resources

Combination; Organization usually uses combination method to get the advantage of centralized and decentralized purchasing.

Activity; describe the difference between centralized and decentralized purchasing policy?

What Are the Advantages and Disadvantages of Policies?

Advantages: -

Having written and implied policies is an opportunity to define and clarify top management objectives.

Policy statements are a means for executive management to communicate its leadership and views. Executive management should develop a series of high-level policy statements that provide guidance to employees at all levels.

Policies provide a framework for consistent decision making and action. In fact, one of the primary objectives of a policy is to ensure that personnel act in a manner consistent with executive or functional management's expectations.

Finally, an effective policy provides an additional advantage by defining the rules and procedures that apply to all employees.

Disadvantages: -

A policy is often difficult to communicate throughout large organizations.

Employees might view policies as a substitute for effective management. Policy statements are guidelines that outline management's belief or position on a topic. They are not a set of how-to instructions designed to provide specific answers for every business decision.

Policy development can also restrict innovation and flexibility. Too many policies accompanied by cumbersome procedures can become an organization's worst enemy.

What Makes for an Effective Policy?

Several characteristics of a policy render it effective.

Effective policies are action-oriented guidelines that provide guidance. They provide enough detail to direct behavior toward a specific goal or objective but are not so detailed that they discourage personnel from following the policy.

An effective policy is relevant (avoiding trivial or unimportant issues) and concise (stating a position with a minimum number of words).

An effective policy is unambiguous, allowing personnel little doubt as to how to interpret the policy's intent and direction.

Another characteristic of effective policies is that they are timely and current, which assumes that they are periodically reviewed for clarity and conformance. A policy is ineffective or counterproductive if it is confusing, ignored, or outdated. Policy formation and review should be a dynamic activity undertaken at least once every year or so.

3.5. Purchasing Procedure

A purchasing department buys many different types of materials and service and the procedures used in completing a total transaction normally vary among the different types of purchasing. However, the general procedures followed in a sound purchasing system are:

Recognition of need	Follow up and expediting of the order
Description of the need	Receipt and inspection of the material
Flow of purchasing requisition	Clearance of the invoice and payment
Determination and analysis of possible source of supply	for supplier
Preparation and placement of purchase order	Maintenance of purchase records

Recognition of needs: - any purchase originates with the recognition of a need by someone /department/ in the organization. The recognitions of needs refer to the means by which the needed materials are formally accepted by requesting individual/ department. The person who is responsible for a particular activity of need recognitions should know what, how much when materials are needed for the unit. The purchasing department is responsible for helping to anticipate the needs of using department.

Description of needs: No purchase can be expected to buy without knowing exactly what the using department wants. For this reason, it is essential to have an accurate description of requested goods and service.

Inaccurate description may result in some loss of time, serious financial loss consequences and loss of supplier's respect and trust. The basic document on which needing department can describe their need is **purchase requisition**. Purchase requisition is an internal document which is prepared by needing department and sent to purchasing department. Or Purchase requisition is a document generated by using department that authorizes materials purchase department to make purchases. It is the written authority for the purchase department to make purchase. The origin of the purchase requisition depends up on the policy of the organization. It can be originated from the user units (for non-stock items) and from store department (for stock items).

3. Flow of purchase requisition/ need transition

Purchase requisition should have prepared in two copies; the original to be sent for purchasing department and the duplicate retained by requester. Purchase requisition (PR) formats vary widely because each company design its own format to simplify its own particular communication problems. Under no circumstance should the purchasing department accept requisition from anyone other than those specifically authorized and all requisitions should be checked carefully before any action is taken.

The requested quantity should be based on the anticipated needs and should be compared to economic purchasing quantity. The delivery date should allow sufficient time to secure quotation and sample, if necessary, and to execute the purchaser order and obtain delivery. The information that should be include in purchase requisition are date, Identification number, originating department, account to be charged, complete description of materials and quantity, date at which materials needed, any special shipping instruction, signature of authorized requisitioner.

Verification of purchase requisition

The purchasing units have to verify or check whether the requesting department has the authority to do so. Whether the request is within budget time and whether purchase requisition form contains all the relevant information.

XYZ COMPANY LTD.

Purchase requisition

Please supply the following materials to the -----dept No. _____

Classification of Goods Date: _____

Consumable _____ Spare parts _____ S.R. No. _____

Fixed assets _____

SR. No.	Item No.	Description	Unit of Measure	Quantity		Unit Price	Total Price	Remark
				Ordered	Received			

Prepared by _____ Checked & Received by _____ Approved by _____

Activity: list information's that should be included in purchase requisition form?

4. Determination and analysis of possible source of supply

Supplier selection constitutes an important part of the purchasing function, and involves the location of qualified vendors and assessing the probability that a purchase agreement would result in one-time delivery of satisfactory product and needed service before and after the sales. Selecting the source is the process of narrowing down a large list of potential suppliers to a relatively a few and the final choice is made from this short list. The purchase of a new or high value item may require a length investigation of potential suppliers. After selecting a preliminary group of potential sources, the buyer may employ the technique of competitive bidding or negotiation. Bidding is one of the basic methods by which price can be determined. It is more often used by government organizations. Under competitive bidding, industrial buyers, but not always, give the order to the lowest bidder. By law, government buyers are routinely required to give the order to the lowest bidder.

The proper use of competitive bidding, as the best method, is subject to the following five basic criteria:

The money value of specific purchase is large enough to justify the expense

The market consists of an adequate number of sellers

The market consists of sellers that are technically qualified and actively want the contract

The time available is sufficient for using this method of pricing i.e. the time required for preparing mailing, opening, and evaluating bids and obtaining the best price

The specification of the materials or services to be purchased is explicitly clear to both buyer and seller so that the seller knows the cost of producing the items or rendering the service

Type of supplier evaluation method

The type of evaluation needed required determining supplier capability varies with the nature, criticality, complexity and birr value of the purchase to be made. It also varies with the buyer's or buying team's knowledge of the firms being considered for the order.

A. Preliminary Surveys

If an examination of existing data indicates that a firm appears to be an attractive supplier for existing or anticipated requirements, a telephone or mail survey should be conducted to obtain additional information. Such a survey should provide sufficient knowledge of the supplier to make a decision to include or exclude the firm from further consideration. Clearly, this sound precedes any plant visits. The survey is based on a series of questions, which cover the following areas:

The principal officers and titles

Bank reference

Credit references

The annual history of sales and profit for the past five years

A referral list of customers

The number of employees

The space currently occupied

Expansion plans (including sources of funds)

The current production defect rate for similar products

The number of inspections used

The date when statistical process control was adapted

A list of all equipment and tools, which would be used to manufacture, test, and inspect the purchase in question.

B. Financial Condition

Preliminary investigation of a potential supplier's financial conditions often can avoid the expense of further study. A qualified buyer or professional from the finance department conducts these investigations. *A review of financial statements and credit ratings can reveal whether a supplier is clearly incapable of performing satisfactorily. Financial stability is essential for suppliers to assure continuity of supply and reliability of product quality.*

Imagine the difficulty of getting

A financially weak supplier to maintain quality;

A supplier who does not have sufficient working capital to settle an expensive claim;

or A financially unsound supplier to work overtime to meet a promised delivery date.

In addition to informing a buyer or the sourcing team about a supplier's capability to perform a contract, financial information can be useful in other ways as well. Financially, strong firms are usually managerially strong. Hence, they generally make good suppliers. An analysis of a firm's balance sheet and operating statement is helpful in numerous ways i.e. on discovering that a firm's financial conditions has started to deteriorate a buyer should tighten quality monitoring and consider either searching for a new supplier or reducing the size of the orders given to the distressed firms.

C. Quality capability

A critical factor to examine is the firm's quality capability. If the prospective supplier's process capability is less than the buying firm's incoming quality requirements, the supplier typically is not worthy of further investigation. An obvious exception is the case in which no supplier possesses the required capability.

D. Plant visit

By visiting a supplier's plant or distribution facility, the sourcing team can obtain firsthand information concerning the adequacy of the firm's technological capabilities, manufacturing or distribution capabilities and its management's technical know-how and orientation.

Depending on the importance of the visit, the company may send representatives from only purchasing and engineering or it may also include some combination of representation from finance, operations, quality assurance, marketing and industrial relations.

In planning plant visits only a few outstanding potentials suppliers' plants should be chosen for observation due to the time and costs involved. The buying firm wants suppliers whose management is committed to excellence. To make such a determination properly requires an overall appraisal.

Among the factors to be addressed during plant visit are: -

Attitude and stability of the top and middle management teams

Research and Development capability

Appropriateness of equipment

Effective of the production control, quality assurance and cost control systems

Competence of the technical and managerial staffs.

Other important factors include

Morale of personnel at all levels

Industrial relations

Willingness of the potential supplier to work with the buying firm

Quantity of back orders

Effectiveness of purchasing and supply management and materials management operations and past performance

Past major customers

General reputation

Letters of reference

The plant visit should be planned carefully to provide the required level of knowledge and insight into the potential supplier's operations, capacity and orientation. The efficiency with which the plant visit is planned and conducted reflects on the buying organization. The prospective supplier usually is requested to provide additional information on the company's history, current customers, sales volume and financial stability. In the quality area, the buyer and his or her sourcing teammates should attempt to understand.

Activity3.9: - explain different type of supplier evaluation methods

5. Preparation and placement of purchase order

The placing of an order usually involves preparation of a purchase order form and it is done after selection of the right supplier.

Purchase order becomes a legal binding contract once accepted by the seller, it become a legal contract for the delivery of the goods according to the terms and conditions specified in a purchase agreement

The order should include all data required to ensure a satisfactory contract and it should be worded in a manner which minimize the miss interpretation by either party

Quantity requirement, price, delivery requirement and quality specifications must be described accurately in the purchase order. It is prepared from the purchase requisition or quotation and from any other additional information needed

The minimum number of copies most commonly used is five

Original copy is sent to the supplier

Second copy inform the accounting department for use in checking and issuing payment for the seller invoices

The third copy advice the receiving department that can expect receipt of shipment at a particular date

The fourth copy informs the user department of the details of the order so it can plan its work and budget accordingly

The fifth copy remains in the purchasing department open order file and it is often used for the purpose of order follow up and expediting.

PURCHASE ORDER

XYZ CO.

To: ABC Co.

Your quotation No. ABC / 01/ 04 Dtd

Address:

Dear Sir,

Ref: Our Tender NO XYZ/ 10/ 04 Dtd

We kindly request you to supply the following items as per the following terms and conditions:

SR NO.	Item code	Item description	Unit of measurement	Unit price	Total price	Remark

Thank you, Yours faithfully,

Summary of information contained in purchase order

❖ Buying firms and document	
identification	Shipping instructions
Internal identification	Summary totals
Purchase order identification	Purchase order item number
Supplier identification	Item identification number
Specific shipping destination	Item description
Internal information	Delivery quantity
Accounting change	Shipping / delivery dates
Payment terms	Unit price and measures
Additional contract inclusions	Extended price x quantity
Point of title transfer	Buyer identification and date

6. Follow up and expediting

After purchase order has been prepared and issued to a winner supplier, the responsibility of purchasing does not terminate with making a satisfactory contract. Purchasing bears full responsibility for an order until the material is received, inspected and accepted.

Follow up: - is the routine tracking of an order to assure that the vendor will be able to meet delivery promises. Or it is process of remind the sellers about date of delivery in order to get materials at normal garment time.

Expediting: - is the application of pressure on vendors to get materials on the original delivery promise or delivery ahead of the schedule. It may involve the threat of order cancellation or withdrawal of future business, if the supplier cannot meet the agreement. At the time order is placed, an appropriate follow up date is often specified simultaneously with the help of the follow up cope up the purchase order. In some firms, purchasing has full time follow up and expediting personnel is assigned.

Follow up and expediting can be implemented through;

Writing letter / Fax

Email

Calling the phone

Physical supervision

Activity3.10: what is the difference between follow up and expediting?

7. Receipt and inspection of goods

The next step in the traditional purchasing cycle is receipt and inspection of the order. When a supplier ships material, it includes in the shipping container a packing slip, which itemizes and describes the contents of the shipment. The receiving clerk uses this packing slip in conjunction with his or her copy of the purchase order to verify that the correct material has been received. After a shipment has been inspected for quality and for general condition of the material, the receiving clerk issues a receiving report. In some cases, the report is prepared on separate receiving department forms. However, the trend in most companies today is to reduce the clerical work by using an online computer-based system, coupled with bar code order identification or by preparing a receiving report form during the same typing or printing operation that prepares the purchase order.

ABC COMPANY LTD.

INSPECTION NOTE

Supplier Name: _____ No. _____

Invoice No.: _____ Date: _____

P.O. No. _____

SR. No.	Item No.	Description	Unit of Measure	Quantity		Reasons
				Received	Rejected	

Distribution: -

Original - General Accounts	3 rd copy - Stores recording and control
1 st copy - Costs & stock Accounts	4 th copy – Storekeeper
2 nd copy - Purchasing	5 th -copy-Pad

Activity: explain the difference between purchase order & purchase requisition.

8. The invoice audit and completion of the order

Payment for purchase can be made on the bases of the contract agreement like cash beforehand, cash on delivery etc. to ensure proper payment for materials actually received, review of the purchase order, the receiving report and the invoice is necessary. By checking the receiving report against the purchase order, the purchase determines whether the quantity and type of material required was received. Then by comparing the invoice with the purchase order, and receiving report, the firm verifies that supplier's bill is priced correctly and that it covers the proper quantity of acceptable material. Finally, by verifying the arithmetic accuracy of the invoice, the correctness of the total invoice figure is determined.

9. Maintaining Purchasing related Records

In the purchasing process, large number of files and documents are produced to facilitate the purchasing activity. This documents and files contain a large volume of data that flows among the participants in the purchasing process. Despite its huge volume, much of this information can be useless in daily operations unless it is organized in a manner which makes it readily accessible. Although the unique needs of each purchasing department dictate the specific structure of its records system, the following basic records are essential for the effective operation of most purchasing departments:

A record of open orders	Supplier record
A record of closed orders	Contract record
Purchase log	Special tool record
Commodity record	

a) Record of Open Orders

All buyers need immediate access to information concerning the status of their outstanding orders. The record system can be maintained on a computer, in hard-copy form, or as a combination of the two. Because reference to these orders most frequently requires identification by supplier's name, the record system customarily is indexed alphabetically by suppliers' names. Within each supplier's sub file, orders are arranged in ascending numerical sequence.

Although practice varies widely, each order commonly contains the purchase requisition, the working copy of the order, the returned acknowledgment information, follow-up data, and all notes and correspondence that pertain to the order. Some companies also include competitive bids in the order file. Others prefer to keep bids in a separate price file or with the commodity record. When the bid is not included in the order file, the order record must contain a cross-indexing reference. Some firms also maintain a separate numerical file or log of all completed purchases. It frequently serves as a useful reference when questions arise concerning past orders and when certain historical data are needed to guide future decisions. Specific inclusions of the file were discussed previously. It is difficult to generalize about the length of time such records should be kept.

While government contract records should be kept indefinitely, most firms retain their other closed orders from three to seven years. Normally, any order files kept longer than this should be retained only on a high selective basis. In a large firm, record retention is costly. Therefore, if commodity and supplier records are properly maintained, only unique and high-value orders are generally worth keeping longer than the four-year period required for legal purposes.

b) Purchase Log

Every purchasing department should maintain an ongoing record, in numerical sequence, of all purchase orders issued. The record need not be elaborate, but it should contain the purchase order number, the status of the order, the supplier's name a brief description of the material purchased, and the total value of the order. Such a record summarizes the commitments for which the purchasing executive is responsible. In the event that the working copy of an order is lost, basic data concerning the purchase can be in the log. The log further serves as a convenient record from which summary administrative data can be extracted concerning such matters as the number of small orders, rush orders, and total orders issued; the volume of purchases from various suppliers; the value of outstanding commitments; and so forth. The purchase logs of some firms consist of a sequential list of purchase orders recorded in journal or in the computer data base. Other firms accomplish the same objective simply by filing in numerical sequence, the follow-up copy or an additional copy of the order.

c) Commodity Record

The file of commodity records constitutes a vast reservoir of materials data that makes efficient "mass production purchasing" possible. A commodity record card or computer file should be maintained for each major material and service that is purchased repetitively. Typically included in the record is a complete description of the material or service, with full reference to necessary engineering drawings and specifications which might be field elsewhere. Also included should be a list of approved suppliers and their price schedules. Competitive quotations may be included in the file, although it is more common to summarize bid data in the record, note a cross reference to the original quotation, and place all quotations in a separate file. The preceding data provide a buyer with the basic information initially required in a repetitive purchase investigation. In making the purchase decision, the buyer supplements this information with numerous qualitative considerations concerning individual suppliers, such as their current workloads, internal problems, quality

performance, and so on. Some companies, however, also include in the record a complete purchase history for the item. For every purchase, the purchase order number, purchase quantity, price, delivery performance, and quality performance are recoded. In deciding how much detailed information to keep in its commodity record, each firm must weigh the value of the information against the cost of transcribing it.

d) Supplier Record

To provide quick access to information about suppliers, most companies centralize such information in a single record file. A separate card or computer record is maintained for each major supplier. In this record is recorded the address, telephone number, and the names of personnel to contact on specific matters of inquiry. Selling terms and routing instructions for shipping purpose also usually are included. Although the practice varies, many firms additionally summarize in this record the supplier's delivery and quality performance, as well as the annual volume of materials purchased from the supplier. In a matter of seconds, these records enable a buyer to obtain a wealth of summary information about any important supplier.

e) Contract Record

Today most firms are purchasing in increasing number of items on a long-term contractual basis. In such cases, it is usually convenient to consolidate all contracts in a separate file. In addition to providing immediate access to all contract documents, this file also appraises all buying personnel of the materials that are purchased in this manner. If the number of contracts is large, it is desirable also to list them in summary form to provide a bird's-eye view of all contract purchases and their expiration dates.

f) Special Tool Record

Many companies have no need for this record. However, such a record is essential to those firms that purchase many items requiring special tooling for their manufacture. On some orders the suppliers own them. By maintaining a record of special tools, the buyer can summarize for quick reference the special tools owned, the age and location of each, and the essential mounting and operating characteristics of each.

The above-mentioned records along with all the other records that are believed to be useful in making purchase related decisions are to be kept systematically so that they can be accessible easily and

quickly. Through following the above-mentioned procedures, the purchasing department tries to provide the service required by all functional units in the organization. However, these procedures may not be rigidly employed in every type of purchases. They involve the number of steps used during purchasing. Of course, the procedure may vary from organization to organization.

3.6. Types of Buying

We may have three types of buying activity:

Hand to mouth buying,

Forward buying,

Speculative buying

3.6.1 Hand to mouth

It is a practice of buying materials to satisfy current operating requirements in quantities smaller than those normally considered economical. As this term indicates, the production operation literally exists on hand to mouth supply of materials.

In the case of some high value materials, it is difficult indeed to draw the line between a hand to mouth purchase and a purchase made to satisfy current operating requirements. In general, however, many firms consider a purchase quantity that provides from one to three months coverage as one which normally satisfies current operating requirements. Correspondingly, a hand to mouth purchase can then be defined as one which provides operating coverage from a bare minimum up to approximately three or four months.

There are three basic reasons for using a hand to mouth purchasing policy:

If material is purchased in an unstable market

In the event that a firm plans an engineering design change which renders some materials obsolete.

Occasionally, firms require additional cash for operation purpose.

The placement of numerous small orders is more costly in terms of buying and administrative expenses.

There is a danger of running out of stock if any one of the activities in the supply chain fails to perform exactly as scheduled.

3.6.2 Forward purchasing

It is the practice of buying materials in a quantity exceeding current requirements, but not beyond actual foreseeable requirements. The distinction between speculative buying and forward buying is that in the former case a definite production need for the material exists, while in the latter case it does not. The forward purchaser assumes a risk regarding future price fluctuations of the material. There are three major objectives which justify a policy of forward buying:

It has done in unstable market is designed to take advantage of what the buyer believes to be favorable price situation. It also permits a buyer to purchase in quantities sufficiently large to obtain quantity discount or volume freight rate which reduce unit costs.

Occasionally, when a material is purchased in an unstable market.

It reduces the risk of inadequate delivery in the event of an impending materials shortage, possible transportation difficulties, or possibility of unreliable performance by a supplier.

Is the obvious price risk involved?

Added inventory carrying charge and attendant tie-up of working capital

3.6.3 Speculative purchase

A speculator is a person who buys an item at one price with the intension of profiting on the transaction by selling it at a higher price. A speculator adds no value to the purchased item and provides no service to customers, beyond that intrinsic in supplying the item itself.

Speculative buying involves the purchase of material in excess of foreseeable requirements. In anticipation that need arises for the material; and that the firm will profit by making the purchase at current price.

Activity: Name and describe three types of purchasing?

3.7. Make or Buy Decision

This refers to whether a company should start making or should it stop making and buy it from outside suppliers. The decision maker should have to look at different options from different point of angles. To arrive at either of the two, the company should analyze the merits and demerits of the two. For decision making, we have general and economic considerations.

A. General considerations

Favor of making

When cost to make is less than cost to buy

When the company has enough capital to buy plant assets

When companies manufacturing technology, knowledge and experience etc. are related with the production of a product in question.

When the company has idle resource such as human, material, equipment, that can be used to manufacture the materials

When the suppliers are unable to meet the specification and standard of the company

When the company achieve research break through i.e. producing a better quality product in efficient way than the suppliers

Favor of buying

When cost to buy is less than cost to make

When the company does not have sufficient finance for investment of fixed capital required to produce the product in question

When the company manufacturing experience/technology is not related to the material in question

When the company can use money for other better purpose

When the supplier meets better than the company itself

When the quantity of material to be purchased is small

When other companies have patents, trade secret etc.

B. Economic consideration

It is considered to add objectivity in our decision making. We use quantitative tools called break even analysis.

$\text{Cost to buy} < \text{Cost to make} = \text{Buy}$ $\text{Cost to make} < \text{Cost to buy} = \text{Make}$ $\text{Cost to make} = \text{Cost to buy}$
 $\text{buy} = \text{Break even} = \text{indifference point}$ $\text{Cost to buy} = \text{Unit price} \times \text{Quantity purchased}$
 $\text{Cost to make} = \text{Fixed cost} + \text{Variable cost}$
 $\text{Breakeven point} = \text{Cost to make} = \text{Cost to buy}$

Example:

ABC Company produces item X, it wants to produce packing box for the items, which is currently buying from the suppliers at 0.7 cents each. The annual demand for packaging is 37,500 units. If the company produces the package itself, it requires a molding machine which will result in annual fixed cost of \$8,000. Variable cost for labor, materials, and overhead are estimated at 0.5 cents per box

Required:

Should the company make or but the box?
 If not at what quantity level it produces?

Solution:

Given:

Annual demand (Q) = 37,500 units

Variable cost (V) = .5 cent per box

Price = .7 cent per unit

Fixed cost = \$8000

$$\begin{aligned}
 &= \quad \times \quad + \quad \\
 &= \quad \$ \quad .5(37,500) + 8000 \\
 &= \quad \$ \quad .7 \times 37,500 \times
 \end{aligned}$$

At this point buying is better.

b. At breakeven point

$$\begin{aligned}
 & \Rightarrow \\
 & \quad = \\
 & \quad \times + = \times \\
 & \quad = (\times) - (\times) \\
 & \quad = (-) \\
 & \quad = \frac{\quad}{\quad} \\
 & \quad = \frac{\quad}{.70 - .50} \\
 & \quad = \frac{10000}{.20}
 \end{aligned}$$

The breakeven quantity is 40,000 units

Activity14: The following data indicates the expected cost per unit of producing and buying 100 units of computers next year.

<u>Relevant cost</u>	<u>relevant cost/ unit</u>
Outside purchase of parts	\$ 160
Direct material	\$ 80
Direct manufacturing labor	\$ 10
Variable manufacturing overhead	\$ 40

Expected total fixed manufacturing overhead costs of materials handling and setups is \$2000

\$30,000 fixed manufacturing overhead costs of plant lease, insurance, and administration could be including under both alternatives.

Required: what do you advice to make or to buy the computer? Shaw your calculation

Feedback: if buying = **\$46,000**

If making = \$45,000, so making is better.

3.8. Sourcing

A procurement strategy in which a business seeks to find the most cost efficient location for manufacturing a product.

There are three types of sourcing: ***sole, multiple, and single***

Sole sourcing implies that only one supplier is available because of patent, technical specifications, and so forth

Multiple sourcing is the use of more than one supplier for an item. The potential advantages for multiple sourcing are that competition will result in lower price, better service and that there will be a continuity of supply. In practice there is a tendency toward an adversarial relationship between supplier and customer.

Single sourcing is a planned decision by the organization to select one supplier for an item when several sources are available. It is intended to produce a long-term

partnership. Activity: Name and describe three types of sourcing?

3.9. Identifying and evaluating suppliers

3.9.1. Identifying Suppliers

One major responsibility of the purchasing department is to continue to search all available sources of supply. Some aids for identifying sources of supply are listed below:

Business Directory: is a publication that lists and classifies suppliers according to the products they produce or distribute. The directory may indicate the financial status, methods of distribution and location of suppliers. In many places, chamber of commerce publish directives that contain a list of firms, products/services and their addresses.

Catalogues: The Supplier Item Catalog provides a simple mechanism for locating items and their source information for the purpose of creating purchase order and requisition lines. You can open the catalog from an existing requisition or purchase order and add lines to that document. Alternatively, you can open the catalog from the menu and create new requisitions.

Trade Journals: are mostly used as a general source of information on new products, economic and technological developments and methods as described in the editorial and advertising pages.

Trade exhibits: the use of exhibit as a means of sales presentations is greatly increasing. They provide an excellent opportunity for buyer to see various new products and modifications of old products. They also offer buyers an opportunity to compare concurrently similar products of different manufacturers.

Sales personnel: they are excellent sources for supply and material information. Not only are they usually well informed about the capabilities and features of their own products, but they are also familiar with similar and competitive products as well. By the very nature of their specialized knowledge, sales people can often suggest new applications for their products which will eliminate the search for new suppliers.

Supplier purchasing information file: purchasing department should keep supplier information files on past and present suppliers which include: the name of each supplier, a list of material he can supply, his delivery history, his quantity rejection record, his overall desirability as a supplier, and general information concerning his plant and management.

The yellow page: another commonly known directory is the classified yellow page section of telephone directories. This source of information is frequently of limited value to industrial buyers because local telephone books list only local companies.

Filing of mailing pieces: many mail advertisements are worth saving. This should be given a file number, dated, and indexed by the name and number of each publication. When buyer seeks a new source, they can then refer to the index and review the appropriate brochures and booklets.

Activity: - mention sources for supplier information.

3.9.2. Factors in selecting suppliers

The previous section discussed the importance of function, quantity, service, quality, and price specifications. These are what the supplier is expected to provide and are the basis for selection and evaluation. Considering this, there are several factors in selecting suppliers.

Technical ability:

Does the supplier have the technical ability to make or supply the product wanted? Does the supplier have a program of product development? Can the supplier assist in improving the product? These questions are important since, often, the buyer will depend up on the supplier to provide product improvements that will enhance or reduce the cost of the buyer's product. Sometimes the supplier can suggest changes in product specification that will improve the product and reduce cost.

Manufacturing capability:

Manufacturing must be able to meet the specification for the product consistently while producing as few defects as possible. This means that the supplier's manufacturing facilities must be able to supply the quantity and quality of the products wanted. The supplier must have a good quality control program, competent and capable manufacturing personnel, and good manufacturing planning and control systems to ensure timely delivery. These are important in ensuring that the supplier can supply the quantity and quality wanted.

Reliability:

In selecting a supplier, it is desirable to pick one that is reputable, stable, and financially strong supplier. If the relationship is to continue, there must be an atmosphere of mutual thrust and assurance that the supplier is financially strong enough to stay in the business.

After sales service:

If the product have a technical nature or likely to need replacement parts or technical support, the supplier must have a good after sales service. This should include a good service organization and inventory of service parts.

Supplier location:

Sometimes it is desirable that the supplier be located near to buyer, or at least maintains an inventory locally. A close location helps shorten delivery times and means emergency shortages can be delivered quickly.

Price:

The supplier should be able to provide competitive prices. This does not necessarily mean the lowest price. It is one that considers the ability of the supplier to provide the necessary goods in the quantity and quality wanted, at the right time, as well as any other service needed.

Other considerations:

Sometimes other factors such as credit terms, reciprocal business, and willingness of supplier to hold inventory for the buyer should be considered.

3.9.3. Supplier's selection

The objective of purchasing is to get all the right things together: quality, quantity, delivery, and price. Once the decision is made about what to buy, the selection of the right supplier is the next most important purchasing decision. A good supplier is one that has the technology to make the product to the required quality, has a capacity to make the quantities needed, and can run the business well enough to make a profit and still sell a product competitively.

To select suppliers, we have to set criteria for selection and details of the criteria and assign weight for the criteria. Criteria's those are most common include quality, delivery, service and price. The two methods of evaluating and selecting criteria include the weighted point method and cost ratio method.

Quality: we have already said that quality refers to the suitability to the desired purposes. It indicates conformance with specifications. Purchasing the best quality is not necessarily the highest quality.

Delivery: this refers to the schedule requirements and related costs such as telephone, fax, transportation, follow up activities

Price: it is the measure of the value of goods and services. It must be considered quality, quantity and usefulness.

Service: it is a factor that should be considered in addition to the purchased goods.

Organizations buy only not materials, but also additional facilities, performance and other services with the materials. For example, with the purchased computer hardware, maintenance, software and training services may be provided. Services as evaluation factor can be affected by several conditions.

A. The categorical method

This method makes use of information from the materials record and supplier record. All the concerned departments are involved in the evaluation process. They may measure informal evaluation records. A list of performance factors which is important to each department can be prepared for each major supplier. These factors can be used as a criterion, and be distributed to each department involved in the evaluation. After the factors are identified for relative importance, each supplier is then rated in simple categorical terms, such as excellent, very good, good, fair, and low. Although the method is less expensive it is highly subjective. See the following example:

Table 1. List of factors which are used to judge supplier's performance

Name of supplier _____					
Factors	Excellent	Very good	Good	Fair	Low
Delivery on time					
Has competitive price					
After sales service					
Fair treatment					
Keeps promise					
Replaces rejections promptly					
Has credit facility					
Has good packaging facility					
Has technical ability					
Invoice correctly					

Note: we give each weight according to the company's policy

B. The weighted point method

The weighted point method uses numerical terms and gives the weight for each evaluation factor based on the relative importance of the factors. It is more of the objective method than the categorical method. According to this method, any type of evaluation factor is included in the criteria and their relative weight is determined in numerical terms. Based on the past experience, the percentage performance point is assigned to each factor for each supplier. Then the composite weight is calculated for each supplier.

Criterion which is the most important for an organization will be assigned the highest weight and criterion that is less important is assigned the least weight. The weight assigned to each factor varies from one purchase to another.

Example:

A medium size manufacturing enterprise determined quality, delivery and price as the best evaluation criteria. Of these three criteria the enterprise, gain, believes that quality has the highest relative importance and should be weighted the highest point. Therefore, the enterprise assigned 40, 30, 30 point for quality, delivery and price respectively. The last performance of the three suppliers A, B, and C in percentage was as follows.

Table 2. Last performance of the suppliers

Suppliers	Quality (%)	Delivery (%)	Price quoted (\$)
A	90	80	40
B	80	90	50
C	70	100	60

Required: rank the suppliers on the bases of their performance?

Solution: -

Table 3. Computation of supplier's performance

Factors	Weight	A rating	B rating	C rating
Quality	40	$40 \times 0.90 = 36$	$40 \times 0.80 = 32$	$40 \times 0.70 = 28$
Delivery	30	$30 \times 0.80 = 24$	$30 \times 0.90 = 27$	$30 \times 1.00 = 30$
Price	30	$30 \times 1.00 = 30$	$30 \times 0.80 = 24$	$30 \times 0.66 = 19.8$
Total Rating		90	83	77.8

The price rating is calculated as:

$$= \frac{\text{Price rating}}{\text{Total Price weight}} \times 100\%$$

Therefore, according to the calculations of the composite rating, the ranking will

be 1st = supplier A

2nd = supplier B

3rd = supplier C

C. Cost ratio method

This method is also more objective. It makes use of standard cost analysis. The total cost related to purchasing is adjusted to the total value of purchase price. The longer the ratio of cost, the lower is the rating, and the lower is the chance of accepting the supplier. Quality, delivery, service, and prices are the common categories of criteria. Cost ratio method computes the costs and adds the cost to price. A supplier with the lowest cost after all the costs are added to the price becomes the best supplier to be selected. To evaluate quality, the procedure is that we compute the quality percentage cost against the total amount of purchase or shipment to each supplier.

$$= \frac{\text{Quality percentage cost}}{h} \times 100\%$$

To evaluate delivery, we compute the percentage of total delivery cast against the total purchase or shipment.

$$= \frac{\text{Total delivery cast}}{h} \times 100\%$$

To evaluate service, we need additional information on maximum value of service in terms of percentage and acceptable service level in terms of points.

To evaluate price all costs that have been computed will be added to the price, and the supplier with the lowest cost after all costs are considered is the best supplier for selection.

When calculating the cost ratio for quality it includes cost of visit to the supplier, cost of inspection, cost of sample, cost of rework, value of rejected parts, etc. information on cost of quality can be obtained from different departments. Every department may be required to report excess costs due to defective products.

Delivery costs may include cost of telephone calls, telegrams, expediting shipments, and other miscellaneous costs associated with delivery of the items.

When calculating the cost ratio for services we should consider all the factors related to service.

Determining the cost ratio for service is not an easy task. Some authors suggest the use of some sort of procedures like:

- Identify the subjective service factors used to evaluate the performance. This may include financial stability, location, reserve and development facility, the flexibilities in providing short lead time, labor relation, expansion, etc.

- Assign numerical value to each factor according to its importance to the buying organization.

Determine a premium over quoted price that the total subjective service factor is worth.

Determine acceptable norm. For example, out of 100 services offered 60 point can be taken as acceptable norm.

Rate the supplier according to the service factors.

Determine the percentage by which the supplier is rated as over or under the acceptable norm

Apply this percentage to the total service package which is valued at 20% of price and total possible points are 100, with 60 points as acceptable.

Example:

Suppose that you are a purchasing officer of an organization. You need to select among suppliers of A, B, C, and D on the bases of their past performance. You are required to use cost ratio method and the factors used are quality, delivery, service, and price. The following data have been made available to you.

Table 4. Quality cost (in \$)

Factors	Suppliers			
	A	B	C	D
Visit to suppliers	300	500	400	200
Sample	400	700	800	600
Incoming inspection	100	275	250	225
Rework	0	425	450	400
Value of rejected parts	200	1500	975	675
Others	0	200	325	700
Total quality cost (\$)	1000	3600	3200	2800

Table 5. Data related to delivery

Factors	Suppliers			
	A	B	C	D
Telephone calls	400	100	200	300
Telegrams	475	275	425	200
Expediting	875	300	975	750
Shipments	750	225	900	950
Miscellaneous	500	300	700	600
Total delivery cost (\$)	3000	1200	3200	2800

Table 6. Data related to service

Factors	Maximum point value	Suppliers			
		A	B	C	D
Financial stability	20	20	8	15	15
Location	15	10	15	6	0
Research & dev. Facilities	5	5	3	5	3
Flexibility in providing short lead time	5	5	5	3	5
Labor relations	10	8	10	10	8
Expansion	10	10	8	7	9
Repair facility	20	15	18	10	9
Warranty	10	8	10	0	0
Miscellaneous	5	3	4	0	0
Total points	100	84	81	56	49

N.B: Maximum value of service point is 20%

Acceptable service rating is 60 points.

Table 7. Additional information

Supplier	Total value of purchase	Price per unit (\$)
A	100,000	85
B	120,000	86
C	80,000	82
D	140,000	83

Required: given the above information, which supplier is the best based on cost ratio method?

Solution: -

1.
$$= \frac{\text{Total value of purchase}}{\text{Price per unit}} \times 100\%$$

Computation of quality cost ratio

A	B	C	D
$\frac{100 \times 100\%}{100,000} = 1\%$	$\frac{3600 \times 100\%}{120,000} = 3\%$	$\frac{3200 \times 100\%}{80,000} = 4\%$	$\frac{2800 \times 100\%}{140,000} = 2\%$

2.
$$= \frac{\text{Total value of purchase}}{\text{Price per unit}} \times 100\%$$

Computation of delivery cost ratio

A	B	C	D
$\frac{3000 \times 100\%}{100,000} = 3\%$	$\frac{1200 \times 100\%}{120,000} = 1\%$	$\frac{3200 \times 100\%}{80,000} = 4\%$	$\frac{2800 \times 100\%}{140,000} = 2\%$

3.
$$= \frac{\text{Total value of purchase}}{\text{Price per unit}} \times 100\% - 100\%$$

.

Table 8. Computation of service cost ratio

A	$\frac{84}{60} \times 100\%$	$- 100 \times .20 = 8\%$
B	$\frac{91}{160} \times 100\%$	$- 100 \times .20 = 10.33\%$
C	$\frac{56}{60} \times 100\%$	$- 100 \times .20 = -1.33\%$
D	$\frac{49}{60} \times 100\%$	$- 100 \times .20 = -3.67\%$

Positive signs reduce quoted price because they indicate performance above the norm, while negative signs increase the price.

Finally, combine quality cost ratio (QCR), delivery cost ratio (DCR), and service cost ratio (SCR) with the quoted price to determine the vendor's net cost.

4. Table 9. Total

Suppliers	cost adjustment		% =	% +	% +	%
	QCR%	DCR%			SCR%	TCA%
A	1	3			-8	-4
B	3	1			-10.33	-6.33
C	4	4			1.33	9.33
D	2	2			3.67	7.67

5.
$$= - (\times . \%)$$

Table 10. Ranks of suppliers according to their cost

Suppliers	Quoted price	Net adjustment	Rank
A	85	$85 - (85 \times 4\%) = 81.6$	2 nd
B	86	$86 - (86 \times 6.33\%) = .$	1 st
C	82	$82 + (82 \times 9.33\%) = 89.65$	4 th
D	83	$83 + (83 \times 7.67\%) = 89.37$	3 rd

3.10. Value Analysis

Value analysis or value engineering is a study of cost factors of an item such as size, quality, design, etc. in relation to its function or end use to identify and eliminate unnecessary expenditure if any in respect of that item. It is a technique to effect cost reduction. The term value means the relationship between function and cost. This can be done through substitution, elimination, simplification, consolidation and standardization.

Some of the points which may be considered when carrying out value analysis are:

Whether the item can be eliminated

Whether it needs all its features

Whether a standard part can be used

Whether the component can be made by a low-cost method

Whether cheaper quality materials will serve the purpose

Whether a slightly more expensive materials having longer life can be used
What alternative materials can be used in making the item

How could the item be simplified?

Answer to such question lead to substantial cost saving. Answer to the above questions could be found by analyzing the specifications of the product and these require consulting engineers both within and outside the organization and professional suppliers both from the supplier and purchaser side. Such analysis will need to improved product test performs the intended function with lower cost

Chapter Summary

Purchasing is one of the most important functional areas of materials management. It is the field of study and activities concerned with procurement of goods and services from some external agencies. The basic objectives of purchasing can best describe in terms of the five rights of purchasing. They are also called the basic principles used as parameters by which the performances of purchasing can be measured. The five rights are the right quality, the right quantity, the right place, the right price, and the right time.

The purchasing function will be observed from three viewpoints; first, as a function of business; second, as one of the basic elements required to accomplish productive work; and, third, as the department responsible for outside manufacturing.

A purchasing department is the center of a large part of company's business activity. Purchasing operations cut across all departments (production, engineering, marketing, and finance) often view common problems differently.

Purchasing policy is largely determined by the finances available, but every organization has its own policy, whether they are put into writing or not. However, an established policy eliminates the necessity of making a fresh decision every time when comparable situation arises.

Procedure means the manner in which a purchase proposal is carried into effect. Therefore, it involves the functions to be performed by purchasing people from inception to the conclusion of the deal.

The objective of make or buy decision is to utilize full productive capacity of the undertaking. Any decision as to make or buy must be taken based on the joint efforts of many departments.

After sources of supply are selected, their performance must be evaluated. Evaluation provides the buyer with objective information to use in subsequent negotiations and in making future source selection

Value analysis/value engineering is an effective cost saving technique. It focuses on the cost side of the quality problem. It seeks to achieve the proper relationship among price, cost, and functional value received. It constantly strives to reduce cost by better integrating the technical and economic factors of quality.

Self-check Exercise 3

Part I: choose the best answer.

Which of the following is not an objective of purchasing?

- To select proper source of supply
- To procure material at necessarily low cost
- To coordinate with other functional departments
- To ensure desired quality of materials are supplied
- None

Which one of the following is wrong about the five rights of purchasing?

- The best quality need not be the right quality
- Right quantity is a quantity which is too much
- Right sources is a source which possess necessary financial resources
- Right time mean making materials available when they are required
- None

The acquisition of required materials, service and equipment is the responsibility of

- A. Purchasing D. Production B. Personnel E. None

Finance

Among the following one is not advantage of centralized purchasing policy?

- Minimize duplication of effort
- Transportation cost saving
- Development of purchase specialists
- Local interest is not satisfied
- None

which one of the following is **not** benefit of centralized purchasing?

- Develops a purchase specialist
- Enhances duplication of efforts in purchasing
- Encourages company wise uniform application of policies
- Minimizes ordering costs
- A and B
- None of the above

The first step in purchasing procedure is

- Preparing of purchase requisition form
- Supplier selection
- Placing of an order
- Follow up and expediting
- Maintaining purchasing related record
- None of the above

purchase requisition form

- Contains description of materials and quantity
- Formats uniforms in every type of organizations
- Is external document prepared by suppliers
- A and B
- All of the above
- None of the above

When production department does not allow sufficient time to carry out the purchase of a material the firm may experience which of the following

- Blanket order
- Rush order
- Small order
- Purchase order
- None

Part II. Write T for true statements and F for false statements

- _____ 1. Single sourcing implies that only one supplier is available because of patent, technical specifications, and other factors.
- _____ 2. In the case of service cost ratio positive signs increase quoted price
- _____ 3. Technical ability means that the supplier's manufacturing facilities must be able to supply the quantity and quality of the products wanted
- _____ 4. The weighted point method uses numerical terms and gives the weight for each evaluation factor based on the relative importance of the factors
- _____ 5. When the company does not have sufficient finance for investment of fixed capital required to produce the product in question buying is better.

Part III. Solve the following problems

1. Given the following selected figures from company financial reports (in millions of dollars)

Total sales			\$10
Total costs			\$9.0
	Fixed	Variables	
Direct labor		\$2.0	
Direct materials		3.0	
Factory overhead	\$1.0	0.5	
Sales	0.6	0.9	
General and administrative	0.9	0.1	
Total	\$2.5	\$6.5	
Net profit (before tax)			\$1.0

Required: find sales at breakeven point?

Assume that the purchasing department has decided to weight and measure performance as follows:

Weight	Factor	Measurement formula
50	Quality performance	= 100% - percent of rejects
25	Service performance	= 100% - 7% of each failure
25	Price performance	= _____

Assume further that supplier A performed as follows during the past month. Five percent of its items were rejected for quality reasons; three unsatisfactory split shipments were received; and A's price was \$100/unit, compared with the lowest offer of \$90/unit. **Required:** calculate the total performance evaluation for supplier A?

Assume that for one supplier the quality cost ratio is 2%, the delivery cost ratio is 2%, the service cost ratio is 1%, and the bid price \$72.25.

Required: calculate cost ratio for a given supplier?

Chapter Three

PART I

1. E

2. B

3. A

4. D

5. B

F

A

B

PART II

1. T

2. F

3. T

4. T

5. T

Part Three

\$2.5 million fixed costs = 0.35 sales at breakeven point

$$2. \quad \text{_____} = \$2.5 \quad \text{_____} \quad 0.35 = \$ \text{_____}$$

Supplier A performance evaluation

Factor	Weight	Actual performance	Performance evaluation		
Service Quality	25	3 failures	50% ×	(1.00 - .05)	= 47.5
	50	5% rejects			
			25 × 1.00 - (.07 × 3)		= 19.75
Price	25	\$100	25 × \$90	\$100	= 22.5
Over all evaluation					= 89.75

The sum of all cost ratios is 3%; hence, the adjusted price for the supplier is

$$[\$72.25 + (.03 \times 72.25)] = \$74.42$$

CHAPTER FOUR

INVENTORY MANAGEMENT

Chapter objective

At the end of this chapter you should be able to:

- Explain inventory and inventory management
- Identify functions and types of inventory
- know independent vs. dependent demand
- Compute inventory costs, economic order quantity (EOQ), economic production quantity (EPQ)
- Discuss materials requirements planning (MRP), inventory systems, and just in time (JIT)

Introduction

Dear learner in this chapter you will understand inventory management techniques. Inventories are materials and supplies that a business or institution carries either for sale or to provide inputs or supplies to the production process. All businesses and institutions require inventories. Often, they are a substantial part of total assets. Financially, inventories are very important to manufacturing companies. On the balance sheet, they usually represent from 20% to 60% of total assets. As inventories are used, their value is converted into cash, which improves cash flow and return on investment. There is a cost for carrying inventories, which increases operating costs and decreases profits.

Good inventory management is essential. Inventory management is responsible for planning and controlling inventory from the raw material stage to the customer. The fundamental problem of inventory management can be briefly described by the two questions: When should an order be placed? And How much should be ordered? In general, the model that we discuss can be used interchangeably to describe either replenishment from an outside vendor or internal production. This means that from the point of view of the model, inventory control and production planning are often synonymous.

4.1. Definition of Inventory

Activity 4.1: Can you define the term inventory?

Inventories are stock of materials of any kind stored for future use. They are materials or resources of any kind having some economic values, either awaiting conversion or use in the futures. They include semi-finished goods awaiting release for sale, many indirect materials such as maintenance materials, fuels and lubricants, etc.

Inventory is the stock of any item or resource used in an organization and an **inventory system** is the set of policies and controls that monitor levels of inventory and determine what levels should be maintained, when stock should be replenished, and how large orders should be.

By convention, manufacturing inventory generally refers to items that contribute to or become part of a firm's product output. Manufacturing inventory is typically classified into raw materials, finished products, component parts, supplies, and work-in-process. In distribution, inventory is classified as in-transit, meaning that it is being moved in the system, and warehouse, which is inventory in a warehouse or distribution center. Retail sites carry inventory for immediate sale to customers. In services, inventory generally refers to the tangible goods to be sold and the supplies necessary to administer the service.

4.2. Purposes of Inventory

All firms keep a supply of inventory for the following reasons:

To maintain independence of operations. A supply of materials at a work center allows that center flexibility in operations. For example, because there are costs for making each new production setup, this inventory allows management to reduce the number of setups. Independence of workstations is desirable on assembly lines as well. The time that it takes to do identical operations will naturally vary from one unit to the next. Therefore, it is desirable to have a cushion of several parts within the workstation so that shorter performance times can compensate for longer performance times. This way the average output can be fairly stable.

To meet variation in product demand. If the demand for the product is known precisely, it may be possible (though not necessarily economical) to produce the product to exactly meet the demand. Usually, however, demand is not completely known, and a safety or buffer stock must be maintained to absorb variation.

To allow flexibility in production scheduling. A stock of inventory relieves the pressure on the production system to get the goods out. This causes longer lead times, which permit production planning for smoother flow and lower-cost operation through larger lot-size production. High setup costs, for example, favor producing a larger number of units once the setup has been made.

To provide a safeguard for variation in raw material delivery time. When material is ordered from a vendor, delays can occur for a variety of reasons: a normal variation in shipping time, a shortage of material at the vendor's plant causing backlogs, an unexpected strike at the vendor's plant or at one of the shipping companies, a lost order, or a shipment of incorrect or defective material.

To take advantage of economic purchase order size. There are costs to place an order: labor, phone calls, typing, postage, and so on. Therefore, the larger each order is, the fewer the orders that need be written. Also, shipping costs favor larger orders—the larger the shipment, the lower the per-unit cost.

Many other domain-specific reasons. Depending on the situation, inventory may need to be carried. For example, in-transit inventory is material being moved from the suppliers to customers and depends on the order quantity and the transit lead time. Another example is inventory that is bought in anticipation of price changes such as fuel for jet planes or semiconductors for computers. There are many other examples.

Activity 4.2: what is the purpose of inventories?

4.3. Forms of Inventories

There are many types of inventories, such as raw materials and production inventories, components and service parts, as well as work in process and finished goods inventories. They may also be functionally classified as movement inventories, lot-size inventories, anticipation inventories, fluctuation inventories, etc.

Thus, broadly, inventories may be classified **based on flow of material**.

Raw materials and production inventories: These are raw materials and supplies, parts and components, which enter into the product during the production process and generally form part of the product.

Work in process inventories: These are semi-finished, work-in-progress and partly finished products formed at various stage of production.

MRO inventories: maintenance, repairs and operating supplies which are consumed during the production process and generally do not form part of the product itself example oil and lubricants etc.... They are items that simply support production and administrate the operation without becoming part of final product.

Finished goods inventories: These are complete finished products ready for sale. In order to run the operation smoothly and keep the cost of inventory lower, inventory control management is an escapable step in any organization regardless of the types of organization and irrespective of the activities involved.

Based on the function they perform inventories can be classified as follows;

Anticipation Inventory; Anticipation inventories are built up in anticipation of future demand. For example, they are created ahead of a peak selling season, a promotion program, vacation shutdown, or possibly the threat of a strike. They are built up to help level production and to reduce the costs of changing production rates.

Fluctuation Inventory (Safety Stock); Fluctuation inventory is held to cover random unpredictable fluctuations in supply and demand or lead time. If demand or lead time is greater than forecast, a stock out will occur. Safety stock is carried to protect against this possibility. Its purpose is to prevent disruptions in manufacturing or deliveries to customers. Safety stock is also called buffer stock or reserve stock.

Lot-Size Inventory; Items purchased or manufactured in quantities greater than needed immediately create lot-size inventories. This is to take advantage of quantity discounts; to reduce shipping, clerical, and setup costs; and in cases where it is impossible to make or purchase items at the same rate that they will be used or sold. Lot-size inventory is sometimes called cycle stock. It is the portion of inventory that depletes gradually as customers' orders come in and is replenished cyclically when suppliers' orders are received.

Transportation Inventory; Transportation inventories exist because of the time needed to move goods from one location to another such as from a plant to a distribution center or a customer. They are sometimes called pipeline or movement inventories.

Hedge Inventory; Some products such as minerals and commodities—for example, grains or animal products—are traded on a worldwide market. The price for these products fluctuates according to world supply and demand. If buyers expect prices to rise, they can purchase hedge inventory when prices are low. etc....

Activity 4.3: according to the flow of material, what are the four classifications of inventories?

4.4. Nature of Demand in Inventories

In order to establish an efficient inventory planning and control, we have to identify whether the demand is dependent or independent for the products. The demand for inventory may be dependent or independent.

Dependent Demand Items: - are those items where their demand is related to the demand for another item. This demand is also known as Derived Demand. Example, if a motor cycle require two tires and if you decide to produce ten motor cycles, then the demand for the tire is 20. This is because the demand for the tire is dependent up on the demand of motor cycle. For determining the right quantity for dependent demand materials, we use *materials requirement planning (MRP)* (to be discussed later).

Independent Demand Items: - are those items that are not influenced by production operation but by the market forces. For stocking decisions of independent demand item forecasting and Economic Order Quantity model is required (to be discussed later).

Activity 4.4: describe the difference between dependent and independent demand?

4.5. Inventory Costs

In making any decision that affects inventory size, the following costs must be considered:

1) Holding (or carrying) costs

The holding cost, also known as the carrying cost or the inventory cost, is the sum of all costs that are proportional to the amount of inventory physically on hand at any point in time. The components of the holding cost include a variety of seemingly unrelated items. Some of these are:

Cost of providing the physical space to store the items

Taxes and insurances

Breakage, spoilage, deterioration, and obsolescence

Opportunity cost of alternative investments

The salaries and wages of storing, receiving and issue of material personnel.

Stationary and other consumables use by the stores.

2) Ordering Costs

The holding cost includes all of those costs that are proportional to the amount of inventory on hand, whereas, the order cost depends on the amount of inventory that is ordered or produced. Placement of purchase order for a material is associated with certain obvious cost due to advertising, consumption of stationery and postage, telephone charges etc....

In fact, all the annual expenditure of the purchasing department of a company can be considered to be on the purchase order it places during the year. The cost associated with ordering would, therefore, consists of;

Salaries of the staffs in the purchasing department

Negotiating purchases, placing orders and follow up.

Rent for the space used by the purchasing department.

The postage, telegram, telephone bills, and Traveling expense.

Entertainment charges for vendors, inspecting shipment & moving goods to storage.

Lawyers and court fees due to any legal matters arising out of purchase.

When more order placed in a period, the more would be the stationery and postage consumed, more staff and officers will be required for handling the work, the more will be the space required for accommodating them and soon.

Penalty Costs

When the stock of an item is depleted, an order for that item must either wait until the stock is replenished or be canceled. When the demand is not met and the order is canceled, this is referred to as a stock out. A backorder is when the order is held and filled at a later date when the inventory for the item is replenished. There is a trade-off between carrying stock to satisfy demand and the costs resulting from stock outs and backorders. This balance is sometimes difficult to obtain because it may not be possible to estimate lost profits, the effects of lost customers, or lateness penalties. Frequently, the assumed shortage cost is little more than a guess, although it is usually possible to specify a range of such costs.

4) Setup (or production change) costs

To make each different product involves obtaining the necessary materials, arranging specific equipment setups, filling out the required papers, appropriately charging time and materials, and moving out the previous stock of material. If there were no costs or loss of time in changing from one product to another, many small lots would be produced. This would reduce inventory levels, with a resulting savings in cost. One challenge today is to try to reduce these setup costs to permit smaller lot sizes.

Purchase Cost

The purchase cost is the price paid to supplier for purchasing materials. The nature of purchasing cost is that it is constant i.e. purchase price per unit is constant unless otherwise discount is offered.

Activity 4.5: Discuss the major inventory costs?

4.6. Economic Order Quantity (EOQ)

The EOQ (Economic Order Quantity) model is one method of determining the adequate (optimum) inventory level for independent demand materials. This model is one of the mathematical models and it results in an inventory level which is not too large or too small. i.e. It is the economical level of inventory.

The economic order quantity or EOQ is the certain amount to be ordered at specific intervals. It gives the perfect saw tooth pattern in a graph of inventory versus time. EOQ is simple to understand and use but it has several restrictive assumptions. Even with these weaknesses, EOQ is a good place to start to understand inventory systems. EOQ assumes:

Assumptions:

Annual usage requirements are known and denoted by (D).

Usage spread evenly throughout the year so that usage rate is reasonably constant i.e. demand rate per period is constant.

Lead time (placing and receiving time) does not vary.

Each order is received in a single delivery. Order is received at the movement inventory moves to zero or replenishment is instantaneous. This assumption implies the following things.

There is no safety stock i.e. no safety stock is utilized. The average inventory at hand =

EOQ is an order size that balances the annual carrying cost & annual ordering cost. At EOQ the annual carrying cost is equivalent to the annual ordering cost. Now in order to calculate the annual carrying cost (ACC) let us look at the concept of average inventory. The concept of average inventory is based on the following assumption;

Purchase is made at the beginning.

Usage rate is constant and

The last item is used on the last date

As the order quantity increases, the average inventory and the annual cost of carrying inventory increase, but the number of orders per year and the ordering cost decrease. It is a bit like a seesaw where one cost can be reduced only at the expense of increasing the other. The trick is to find the particular order quantity in which the total cost of carrying inventory and the cost of ordering will be a minimum. Ideally, the total cost will be a minimum at a point where an order quantity in which the ordering costs equals the carrying costs. If these two costs are equal, the following formula can be derived:

Carrying costs = ordering costs

The annual carrying cost (ACC) is calculated as follows;

The $ACC = Q/2 \times CC$

Where $CC =$ unit carrying cost per year

$Q =$ Order quantity in unit

The annual ordering cost (AOC) is also calculated as follows;

$AOC = D/Q \times OC$

Where $D =$ Annual Demand

$OC =$ Ordering Cost per order

$$\begin{array}{ccccc}
 \text{At EOQ} & ACC & = & AOC & \\
 & \downarrow & & \downarrow & \\
 & Q/2 \times CC & = & D/Q \times OC &
 \end{array}$$

If we multiply both sides by Q, the result will be

$$\begin{aligned}\frac{Q^2}{2} \times CC &= D \times OC \\ \frac{Q^2}{2} &= \frac{D \times OC}{CC} \\ Q^2 &= 2 \times \frac{D \times OC}{CC} \\ Q &= \sqrt{\frac{2DOC}{CC}}\end{aligned}$$

Where

Q = economic order quantity

D = Annual demand

OC = Ordering Cost/order

CC = Carrying Cost per unit per year.

The above analysis can be summarized as follow.

$$\text{Minimum Inventory Cost} = ACC + AOC$$

$$\text{Minimum Total Annual Cost} = ACC + AOC + \text{Purchase cost}$$

Example

A local distributor for Addis Tire Company expects to sale approximately 9600 steal bested tires of a certain size next year. Annual carrying cost is \$16 /tier and ordering cost is \$75 /order. The distributor operates 288 days a year. Required:

Determine EOQ

What is the ordering cost per year and annual carrying cost at EOQ?

What is minimum inventory (incremental) cost at EOQ

If the purchase price per unit is \$80 what is the total inventory cost at EOQ

How many times per year does the store reorder?

Determine the length of an order cycle

Determine ordering, carrying, total inventory costs, if the order quantities are 100,

150,200,250,300,350 and 400 units. What do you understand from this?

Solution:

Given

D = 9600 tires

Cc = \$16 /year

Co = \$75/order

$$1. \quad \text{EOQ:} = \frac{\frac{\text{_____}}{\text{_____}} \times \frac{\text{_____}}{\text{_____}}}{\text{_____}}$$

$$= \frac{\text{_____} \times \text{_____}}{\text{_____}}$$

$$= \frac{\text{_____}}{\text{_____}}$$

$$= \sqrt{90000}$$

$$= \mathbf{300 \text{ tires}}$$

$$2. \quad \text{a. Cc per year} = \frac{\text{_____} \times \text{_____}}{\text{_____}}$$

$$= \mathbf{\$2400}$$

$$\text{b. Co per year} = \frac{\text{_____} \times \text{_____}}{\text{_____}}$$

$$= \mathbf{\$2400}$$

Incremental cost = Annual carrying cost + Annual ordering cost

$$\$2400 + \$2400$$

$$\mathbf{\$4800}$$

Total cost = purchase cost + Annual carrying cost + Annual ordering cost

$$\$80 (9600 \text{ tires}) + \$2400 + \$2400$$

$$\mathbf{\$772800}$$

$$5. \quad \text{Number of orders per year} = \frac{\text{_____}}{\text{_____}} = \frac{\text{_____}}{\text{_____}} = \text{_____}$$

$$6. \quad \text{Length of order cycle} = \frac{\text{_____}}{\text{_____}} \times \text{_____} = \frac{\text{_____}}{\text{_____}} \times \text{_____} = \text{_____}$$

7. Table 4.1

Order given	No. of orders	ACC	ACO	AIC	TIC
100	96	800	7200	8000	776000
150	64	1200	4800	6000	774000
200	48	1600	3600	5200	773200
300	32	2400	2400	4800	772800
350	27.5	2800	2057	4857	772857
400	24	3200	1800	5000	773000
450	21.3	3600	1600	5200	773200

In the previous part of the EOQ model, the supplies of materials were assumed to be immediate in Order but in practice this is not so. From the time the requisition for an item is raised, it may take several Weeks or months before the supplies are received, inspected and taken in to the stock. This time is called **Lead-Time** and involves the time for the completion of all or some of the following activities.

Raising purchase requisition.

Inquires, quotations and approval, (import license procedure for imported items).

Placement of an order on supplier(s).

Suppliers time to make the goods ready.

Transportation or clearing.

Receipt of goods at the company.

Inspection of received items.

Taking the items in to the store.

Obviously, in order to receive supplies before the stock reaches zero level, it is necessary to order the materials much in advance. i.e. when the stock available is sufficient to last during the lead time. Suppose an item has lead time of 15 days and the monthly consumption (assuming 30 days per month) of the item is 600 units, then the reorder must be placed when the stock available is sufficient to last 15 days is 300 units.

EOQ with Quantity Discounts & Price Breaks

The optimum quantity when there is quantity discount is the one that makes the savings from the purchase cost equal to the total inventory cost. EOQ model is not the best method to determine the optimum level when there is quantity discount.

Example: A factory required 1,500 units of an item per month, each costing 27.00 Birr. The cost per order is 150.00 Birr & inventory carrying charge is 20% of price.

Required: 1. Find the EOQ & the total material cost.

2. Would you accept a 2% discount on a minimum supply of quantity of 1,200 units?

Given

Monthly demand = 1,500 unit So Annual demand will be $1,500 \times 12 = 18000$

Price = 27.00 Birr

CC = $0.2(P)$ $0.2(27) = 5.4$ Birr /year /unit

OC = 150/Order

Solution

$$1. \quad \text{EOQ} = \sqrt{\frac{2 \times 18000 \times 150}{5.4}} = \underline{1000} \text{ units}$$

The total cost without discount is

$$\begin{aligned} \text{TOC} &= D/Q \times \text{OC} \\ &= 18000/1000 \times 150 = \underline{2,700} \text{ Birr} \end{aligned}$$

$$\begin{aligned} \text{TCC} &= Q/2 \times \text{CC} \\ &= 18000/2 \times 5.4 = \underline{2,700} \text{ Birr} \end{aligned}$$

$$\text{Total Purchasing Cost} = 27 \times 18000 = \underline{486,000} \text{ Birr}$$

$$\begin{aligned} \text{Total Material Cost} &= 2491,400 \\ &= \underline{491,400} \text{ birrs} \end{aligned}$$

The minimum supply is 1,200 units.

The unit cost will be decreased by 2%. i.e.

$$= 27 - (0.02(27)) = \underline{26.46\text{Birr}}$$

The total material cost with quantity discount of 2% can be obtained as follows (N.B. Q=1,200)

$$\text{TOC} = 18000/1200 \times 150 = \underline{2,250 \text{ Birr}}$$

$$\text{TCC} = 1,200/2 \times (26.46 \times 0.2) = \underline{3,175.20 \text{ Birr}}$$

(CC is 20% of Price)

$$\text{TPC} = 18000 \times 26.46 = \underline{476,280 \text{ Birr}}$$

Total material cost is 481,705.20 Birr with a discount of 2% for an order size of 1,200 units.

Illustration on Price Breaks

Determine the order quantity that will minimize total annual inventory cost for the price schedule below. Annual demand is 1200 units, ordering cost is 41 br., and holding cost is birr 2 per unit per year.

<u>Quantity in Unit</u>	<u>Unit price (birr)</u>
1 to 199	27
200 to 299	26
300 to 399	25
400 or more	24

Solution:

The first step is to calculate EOQ, then to identify the price break that it falls.

$$\text{EOQ} = \sqrt{\frac{2 D OC}{CC}}$$

$$\text{EOQ} = \sqrt{\frac{2 \times 1,200 \times 41}{2}} = \underline{222 \text{ units}}$$

The EOQ is in the range of 200 to 299 which is not optimal because of the price breaks.

The second step is to calculate the total cost at EOQ and the price breaks of 300 to 399 and 400 or more. The calculation is as follow:

$$TC = AIC + AOC + \text{Purchase Cost}$$

$$TC_{222} = 222/2 \times (\text{br.2}) + 1200/222(\text{br.41}) + 1200(\text{br.26}) = \text{Birr } \underline{\underline{31,644}}$$

$$TC_{300} = 300/2 \times (\text{br.2}) + 1200/300(\text{br.41}) + 1200(\text{br.25}) = \text{Birr } \underline{\underline{30,464}}$$

$$TC_{400} = 400/2 \times (\text{br.2}) + 1200/400(\text{br.41}) + 1200(\text{br.24}) = \text{Birr } \underline{\underline{29,323}}$$

Therefore, the fourth range's value is optimal because it has the lowest total cost.

4.7. Economic Production Quantity (EPQ)

We have seen the application of the EOQ model in determining the optimum order quantity of items purchased/ordered from external suppliers. But when the company is the producer and user of its items, the run size is the economic production quantity (EPQ). In other words the company is the supplier for itself.

In the determination of the EPQ the carrying cost remains the same but the ordering cost is replaced by set-up-cost which is the cost of preparing production for operations.

Let us now derive the formula of EPQ;

Let d == Daily demand rate for the products.

P == Daily production rate for the product

T == Number of days for a production run (In order to produce the Specified quantity).

When $p > d$;

Daily rate of inventory build-up = $p - d$

Level of inventory by the end of t -day = $(p - d) \times t$

Run size $\Rightarrow Q = pt$

Run time $= \frac{Q}{p}$ Stated as days.

p

The maximum inventory is given above as $= (p-d) \times t$

Since $t = \frac{Q}{p}$ it can also be stated as $= (p-d) \times \frac{Q}{p}$

p

$= (1 - d/p) \times Q$

And the average inventory will be $= \frac{\text{Maximum inventory}}{2}$

2

$= Q/2 (1-d/p)$

Consequently, the annual carrying cost is $= Q/2 (1-d/p) \times CC$

The annual set-up cost (ASC) can be obtained as follows:

$ASC = (\text{No. of production run / year}) \times (\text{set-up cost / year})$

$= \left(\frac{D}{Q_0} \right) \times Sc$ Where :

Q_0

$Q_0 = \text{run Size} = EPQ$

$Sc = \text{Set-up cost/year.}$

The Total Annual $= \frac{Q}{2} \left(1 - \frac{d}{p} \right) CC + \frac{D}{Q_0} Sc$

The Optimum production size will also be determined as follows;

$EPQ \Rightarrow Q_0 = \sqrt{\frac{2 \times D \times Sc \times p}{(1 - d/p) \times CC}}$

Where D	=	Annual demand
Sc	=	Set-up cost/run
CC	=	Annual carrying cost/unit
d/p	=	Part of production that is not inventoried
1 - d/p	=	Part of production that is carried in inventory

Example

A toy manufacturer uses 48,000 rubber wheels per year for its popular dump-truck series. The firm makes its own wheel, which it can produce at a rate of 800 per day. The toy trucks are assembled uniformly over the entire year. Carrying cost is Br 1.00 per wheel a year. Set up cost for a production and change over from the previous production is Br. 45.00. The firm operates 240 days per year. Determine each of the following.

- A) The optimum Size (EPQ)
- B) The minimum total inventory cost.
- C) The cycle time for the optimal size.
- D) The run times.
- E) The number of production runs in a year.
- F) Maximum level of inventory.

Solution:

Given: D = 48,000

 P = 800/day

 CC = Br. 1/unit /year

 Sc = Br. 45/production/ Run

Working Days = 240 days

$$\text{Daily demand} = \frac{48000}{240} = 200/\text{day}$$

A) The optimum Size

$$\begin{aligned} = \text{EPQ} &= \sqrt{\frac{2 \times D \times S_c}{(1 - d/p) \times c_c}} \\ &= \sqrt{\frac{2 \times 48,000 \times 45}{(1 - 200/800) \times 1}} = 2400 \text{ Wheels} \end{aligned}$$

Here one run will last for 3 days = $\frac{2400}{800}$ and from this quantity level 600

wheels will be consumed (3 x 200) and the remaining 1,800 units will be kept in the store.

B) The minimum Total inventory cost is = ASC + ACC

$$\begin{aligned} \therefore \text{The Total Annual} &= \left(\frac{D}{Q_0} \right) S_c + \frac{Q}{2} \left(1 - \frac{d}{p} \right) C C \\ &= \left(\frac{48,000}{2,400} \right) 45 + \frac{2,400}{2} \left(1 - \frac{200}{800} \right) \times 1 \\ &= 900 + 900 \\ &= \text{Birr } 1,800 \end{aligned}$$

C) The cycle time for the optimal run size:

$$\begin{aligned} \frac{\text{Optimum Quantity}}{\text{Daily Demand}} &= \frac{2,400}{200} = 12 \text{ Working days} \end{aligned}$$

The optimal run size covers 12 working days. i.e. 3 days for production & usage time & 9 days will be idle time.

D) The Run time:

$$t = \frac{Q_0}{p} = \frac{2,400}{800} = 3 \text{ days}$$

E) The number of production runs in a year:

$$= \frac{\text{Annual demand}}{\text{Optimal Quantity}} = \frac{4,800}{2,400} = 20 \text{ runs.}$$

The 20 runs cover 60 production days. i.e. $20 \times 3 = 60$ days and in this period, there is production and consumption simultaneously. The remaining 180 days are idle time between runs & during these periods there is only consumption.

F) Maximum inventory level:

$$= Q_0 \times (1 - d/p)$$

$$= 2,400(1 - 200/800) = 1800$$

Activity 4.6; explain the difference between EOQ & EPQ.

4.8. Materials Requirements Planning (MRP)

The material requirements plan (MRP) is a plan for the production and purchase of the components used in making the items in the master production schedule. It shows the quantities needed and when manufacturing intends to make or use them. Purchasing and production activity control use the MRP to decide the purchase or manufacture of specific items. The level of detail is high. The material requirements plan establishes when the components and parts are needed to make each end item.

The planning horizon is at least as long as the combined purchase and manufacturing lead times. As with the master production schedule, it usually extends from 3 to 18 months. Material requirements planning (MRP) plans the material flow based on the bill of material, lead times, and available inventory. Just-in-time practices will modify this approach.

4.8.1. Objectives of MRP

Material requirements planning has two major objectives: *determine requirements* and *keep priorities current*.

Determine requirements. The main objective of any manufacturing planning and control system is to have the right materials in the right quantities available at the right time to meet the demand for the firm's products. The material requirements plan's objective is to determine what components are needed to meet the master production. Material Requirements Planning schedule and, based on lead time, to calculate the periods when the components must be available. It must determine the following:

- | | | |
|--|---|----------------------------|
|  What to order. | : | When to order. |
|  How much to order. | : | When to schedule delivery. |

Keep priorities current. The demand for, and supply of, components changes daily. Customers enter or change orders. Components get used up, suppliers are late with delivery, scrap occurs, orders are completed, and machines break down. In this ever-changing world, a material requirements plan must be able to reorganize priorities to keep plans current. It must be able to add and delete, expedite, delay, and change orders

4.8.2. Input of MRP

The use of MRP requires three basic information inputs.

Master production schedule; The master production schedule is a statement of which end items are to be produced, the quantity of each, and the dates they are to be completed. It drives the MRP system by providing the initial input for the items needed.

Inventory records. A major input to the MRP system is inventory. When a calculation is made to find out how many are needed, the quantities available must be considered. There are two kinds of information needed. The first is called planning factors and includes information such as order quantities, lead times, safety stock, and scrap.

This information does not change often; however, it is needed to plan what quantities to order and when to order for timely deliveries. The second kind of information necessary is on the status of each item. The MRP system needs to know how much is available, how much is allocated, and how much is available for future demand. This type of information is dynamic and changes with every transaction that takes place. These data are maintained in an inventory record file, also called a part master file or item master file. Each item has a record, and all the records together form the file.

Bills of material. The bill of material is one of the most important documents in a manufacturing company. It is defined as “a listing of all the subassemblies, intermediates, parts, and raw materials that go into making the parent assembly showing the quantities of each required to make an assembly.” The bill of material shows the components that go into making the parent. It does not show the steps or process used to make the parent or the components.

4.9. Just in Time (JIT) management

Just in time is a U.S term coined to describe the Toyota production system widely recognized today as one of the most efficient manufacturing operations in the world. In its simplest, JIT requires only necessary units be provided in necessary quantities at necessary time. Producing one unit extra is as bad as being finishing one day late. Items are supplied only when needed. Stock exists because items have been bought before they are required. It is normally uncertainty or over caution that causes stock. The principle of just in time (JIT) is simple that we have items when they are needed and none when they are not needed.

The idea may be simple but the application of just in time has given the opportunity to decimate stock holding without affecting customers. Companies which are considering how JIT can work in their business, or avoiding it, should realize that JIT is an outcome of other techniques, not a technique of its own. It is a logical aim of tight inventory control, effective progress planning and plant design, work force motivation, cost reduction, logistics and even material requirement planning (MRP). The optimization of these together inevitably leads to the JIT approach. The elements of JIT are the techniques to be developed, for example:

Supply what is required

Organize effectiveness

Supply the quality required

Use all the expertise available

Reduce lead times

Benefits of JIT

A study of the average benefit accrued to us manufacturers over a five-year period from implementing JIT is impressive: 90% reduction in manufacturing cycle time, 70% reduction in inventory, 50% reduction in labor cost, and 80% reduction in space requirements. While not every company can achieve results at this level, JIT does provide a wide range of benefits including;

reduced inventory

improved quality

lower costs

reduced space requirements

shorter lead time

increase productivity

greater flexibility

better relations with suppliers

simplified scheduling and control activity

increased capacity

4.10. Inventory Control System

The ABC Classification (ABC = always better control) This is based on cost criteria. It helps to exercise selective control when confronted with large number of items. It rationalizes the number of orders, number of items and reduces the inventory.

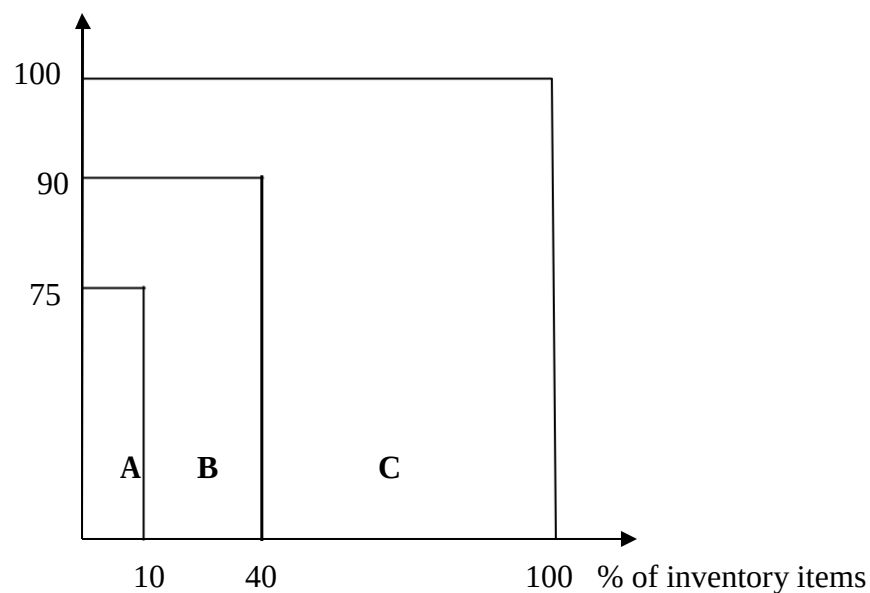


Figure 1. ABC classification chart

In general

A item (5-15 % of all inventory items that account for 70-80% of annual inventory value) B items (30% of total inventory items that account for 15% of annual inventory value)

C items (50-60 % of total inventory items that account for 5-10 % of annual inventory value)

This classification will not be exact but they have been found to be close to the actual occurrences in firms with remarkable frequency. ABC analysis does not stress on items those are less costly but may be vital. Different systems of control are used for the three categories of stock. As the A items carry the most value, accurate systems are required to control them. On the other hand, the C items are low value but form bulk of the inventory. For this the main requirement is to ensure that stock is available to meet demand. The control requirements for each category are shown in the above table.

Table 2. Descriptions of ABC classification.

Characteristics	Policy	Method
A item Few items Most inventory value	Tight control Rigid estimate of requirements Strict and closer to watch Low safety stock Managed by top management	Frequent monitoring Accurate records Sophisticated forecasting Service level policy
B items Important Items Significant inventory value	Moderate control Purchased based on rigid requirements Reasonably strict watch and control Moderate safety stock level Managed by middle level management	Rely on sophisticated system Calculated safety stock Limit order value Computerize management and exception reporting
C items Many items Low inventory value	Ordinary control measures Purchased based on usage estimates high safety stock policy	Simple system Avoid stock outs and excess, infrequent ordering Automatic system

Category A items have a disproportionate amount of time and effort used on them and have to be controlled tightly using systems in conjunction with market expertise and product knowledge to maintain stock at the least appropriate level.

For category B item computerized techniques are most appropriate. The number of items involved and the lower values make it a waste of item to use specialist skill which could be working on category A. the computer can maintain control through statistics and deal with the complex calculations using the computer forecasting models which are most important for B items.

The use of management by exception is also important for B items. The minor sales items, category C, should be controlled by a simple system which enables supply to be obtained with a minimum of administration. However, the control of C items must be reliable and not result in stock outs or large excesses.

An investment in extra stock of C class items is inexpensive but can greatly simplify the problem of controlling large number of stock lines. This is appropriate policy for the faster moving C class items. For the very slow moving, higher value C class items a purchase to order policy should be adopted where possible, or if there is only one customer, they can hold the stock themselves and be responsible for reordering as required.

The first step in ABC analysis is to classify all inventory items as either A, B or C. each item is assigned a dollar value which is computed by multiplying the dollar cost of one unit by the annual demand for the item.

$$\text{Annual inventory value} = \text{Annual usage} \times \text{Unit cost}$$

All items are then ranked according to their annual inventory value.

Example ABC classification

Table 3. ABC classification:

Part	Unit cost	Annual usage
1	\$60	90
2	350	40
3	30	130
4	80	60
5	30	100
6	20	180

7	10	170
8	320	50
9	510	60
10	20	120

Solution: First rank the items according to their total value and compute each item's percentage of total value and quantity.

Table 4. Classification by usage value

Part	Total Value	%of total value	% of total quantity	% of cumulative	
9	\$30,600	35.9	6.0	6.0	A
8	16,000	18.7	5.0	11.0	
2	14,000	16.4	4.0	15.0	
1	5,400	6.3	9.0	24.0	B
4	4,800	5.6	6.0	30.0	
3	3,900	4.6	10.0	40.0	
6	3,600	4.2	18.0	58.0	C
5	3,000	3.5	13.0	71.0	
10	2,400	2.8	12.0	83.0	
7	1,700	2.0	17.0	100.0	
\$85,400					

Table 4 shows a number of different stock items, their unit costs and annual usage in terms of quantity. Items are then ranked in order of size of annual inventory value. This is displayed in table 4 with the items in descending order. The cumulative annual usage value and percentage of annual inventory value are also calculated. Items are then classified into A, B, and C by assessing the number of items in each category and their percentage of annual inventory value. In table xx class A, B, and C are compared as percentage of number of items and total value. The table shows

that the four items in class C have an annual inventory value of \$10,700, whereas three items in class A have an annual inventory value of \$60,600.

Table 5. Summary of ABC Analysis

Class	Items	% of total value	% of total Quantity
A	9,8,2	71.0	15.0
B	1,4,3	16.5	25.0
C	6, 5, 10, 7	12.5	60.0

2. FSN Analysis

This classification is made on the bases of utilization.

F - Stands for fast moving.

S - Stands for slow moving.

N - Stands for non-moving materials. Non-moving items must be periodically reviewed to prevent expiry and obsolescence.

3. VED Analysis

It is based on critical value and shortage cost of an item. It is a subjective analysis.

V – Class items: are vital items without them production will immediately stop. Shortages cannot be tolerated.

E – Class items: are essential items where the non-availability of them would affect only performance or efficiency in the system. Shortages can be tolerated for a short period.

D – Class items: are desirable items in the absence of them production will not be affected. Shortages will not adversely affect, but may be using more resources. These must be strictly scrutinized.

This type of classification is appropriate for some special raw materials like spare parts that are difficult when the non-availability of them affects the smooth flow of operation.

4. HML Analysis

It is based on cost per unit, **H**ighest **M**edium and **L**ow

This is used to keep control over consumption at departmental level for deciding the frequency of physical verification.

5. SED Analysis

Based on availability

Scarce items or imported materials: Those are always in a short supply. They are managed by top level management. Maintain big safety stock.

Easy to obtain items are items that are easily available in the market. Maintain minimum safety stock.

Difficult to obtain items are already available in the market but difficult to obtain them. Maintain sufficient safety stock.

Chapter Summery

The development of inventory management is a dynamic activity, with new approaches being made, techniques being refined and new challenges being met. Successful inventory management is a balance between the use of basic techniques which are easy to use and give reasonable results and sophisticated techniques which can be better control if they are used properly. Modern inventory management has the opportunity to use better and more effective controls.

It is imperative that the challenges are met, since continuing competitiveness is based on ever-improving customer service and ever – reducing inventory costs. The approaches discussed in this chapter give companies major improvements in their efficiency across all type of business. Understanding the full implications and applications is a gradual process, but worth the effort because of the tremendous benefits.

Self-check Exercise 4

Part I: choose the best answer.

Which one of the following is a correct statement about types of inventory?

Raw materials are semi-processed items

Work-in-process inventory are finished products and ready for consumption

Supplies are items which are used as input for production process and it will be a part of final product.

The end products of one organization can be considered as component for another organization

Neither of the above is correct

Among the following, one is true statement:

If there is a speculation of future price decrease for materials, it will lead the current inventory amount to be increase.

Production economies of scale are due to, the distribution of constant variable cost over large amount of out-put.

The amount of direct demand items can be determined by observing the other items demand

A & B

All of the above

Which one of the following is odd?

Cost of providing the physical space to store the items

Breakage, spoilage, deterioration, and obsolescence

Negotiating purchases, placing orders and follow up.

The salaries and wages of storing, receiving and issue of material personnel.

Stationary and other consumables used by the stores.

On the absence of those items production will immediately stop

- A. Vital
- B. Essential
- C. Desirable
- D. All

Among the following one is not true about JIT principles?

- A. Increase inventory
- B. Reduce lead time
- C. Greater flexibility
- D. None
- E. None

Increase productivity

Which of the following specifies the anticipated production of finished products week by week in to the future?

- A. Master production schedule
- B. Bill of material
- C. Inventory status file
- D. None

Among the following, which one is false about the assumptions of EOQ?

- A. Annual demand is unknown
- B. Lead-time fluctuate from time-to-time
- C. Varying consumption rate
- D. There is high amount of reserve stock
- E. All are false
- F. B and C

Part II: solve the following problems

A company is using a carrier to deliver goods to a major customer. The annual demand is \$2,000,000, and the average transit time is 10 days. Another carrier promises to deliver in 8 days. What is the reduction in transit inventory?

The annual demand is 10,000 units, the ordering cost \$30 per order, the carrying cost 20% and the unit cost \$15. The order quantity is 600 units. Calculate:

Annual ordering cost

Annual carrying cost

Total incremental cost

A company manufactures a line of ten items. Their usage and unit cost are shown in the following table.

Required:

Calculate the annual dollar usage for each item

List the item according to their annual dollar usage

Calculate the cumulative annual dollar usage and the cumulative percent of items

Group items in to an A, B, C classification.

Part no.	Unit usage	Unit cost \$
1	1100	2
2	600	40
3	100	4
4	1300	1
5	100	60
6	10	25
7	100	2
8	1500	2
9	200	2
10	500	1

Answer Key

1. D
2. A
3. C
4. A

5. A
6. A
7. E

CHAPTER FIVE

STORE MANAGEMENT

Chapter Contents:

- 5.1. Definition and nature of store
- 5.2. Storage functions and responsibilities
- 5.3. Location and layout
- 5.4. Stores system and procedures
- 5.5. Stock receipt, issue and dispatch
- 5.6. Stores accounting and stock verification
- 5.7. Stores security

Learning objectives

At the end of this chapter, you are expected to:

- Describe the meaning of storage management.
- State warehouse/storage functions and responsibilities.
- Describe codification and standardization.
- Describe stock receipt, issue and dispatch of stock. Explain store location and layout.
- Explain warehouse activities

Introduction

Dear Learner! In chapter three we have tried to discuss about how organizations implement different techniques and models to avoid inventory problems. Here in this chapter, we will discuss issues related to storage management. The first part of our discussion will focus on topics such as: warehouse/storage functions and responsibilities, codification and standardization, how stock receipt, issue and dispatch of stock will be done, and concepts related to store location, layout, and security. Store keeping is a function of receiving, storing and issuing of materials. In almost all industries, the materials represent a very large investment.

5.1. Definition and Nature of Stores

Dear learner! Dictionary defines stores as a building where goods are kept. Stores are defined as supplies of goods and storage is defined as the act of storing the goods. Some people use the term store keeping which means storage.

The term stores, storehouse or warehouse refer to a building or room or place where materials are kept. In popular usage, the term stores are used to cover all aspects of preservation of goods that is building suppliers, and the act of storing. Stores or storage is the function of receiving storing and issuing material. In short it is connected with the physical handling and wellbeing of stocks. An organization can have various types of stores like raw materials stores, processed or semi-finished materials stores, finished goods stores, yard stores and so on.

Since inventory is stored in warehouses, the physical management of inventory and warehousing are intimately connected. In some cases, inventory may be stored for an expected time. In other situations, inventory is turned over rapidly, and the warehouse functions as a distribution center.

Basically, the function of stores management is to be a custodian, looking after the items and controlling their flow. The efficiency of manufacturing operation largely depends on the efficient functioning of receiving and stores operation. Efficiency in stores starts with planning the need for materials and this presupposes that the need itself has been forecasted with a considerable degree of accuracy. The forecast also must be subject to periodic review. The art of store keeping is largely that of optimizing the use of resources to meet actual needs in an efficient manner. One of the indicators of efficiency in stores is the number of times the stocks have turned over. Money is a scarce resource and once it is converted in to material, it is use full only when the materials have been converted back to money. This is the significance of stock turn over.

5.2. Storage functions and responsibilities

An important component of materials management is the storage of materials. Basically, the function of storage management is to be a custodian, looking after the items and controlling their flow. This is the component of the materials management with production department relates directly on a day –to- day or perhaps hour-to-hour basis. In this custodial and controlling function, the important issue is to have good information and record system on the: Incoming, Outgoing, and Remaining item of material.

A good information system is the heart of stores management. The cost of operating a warehouse can be broken down into capital and operating costs. Capital costs are those of space and materials handling equipment. The space needed depends on the peak quantities that must be stored, the methods of storage, and the need for ancillary space for aisles, docks, offices, and so on.

The major operating cost is labor, and the measure of labor productivity is the number of units (for example, pallets) that an operator can move in a day. This depends on the type of material handling equipment used, the location and accessibility of stock, warehouse layout, stock location system, and the order-picking system used.

As with other elements in a distribution system, the objective of a warehouse is to minimize cost and maximize customer service. To do this, efficient warehouse operations perform the following:

- Provide timely customer service.

- Keep track of items so they can be found readily and correctly.

- Minimize the total physical effort and thus the cost of moving goods into and out of storage.

- Provide communication links with customers.

The different activities related to storage are to:

Receive goods. The warehouse accepts goods from outside transportation or an attached factory and accepts responsibility for them. This means the warehouse must:

- Check the goods against an order and the bill of lading.

- Check the quantities.

- Check for damage and fill out damage reports if necessary.

- Inspect goods if necessary.

Identify the goods. Items are identified with the appropriate stock-keeping unit (SKU) number (part number) and the quantity received recorded.

Dispatch goods to storage. Goods are sorted and put away.

Hold goods. Goods are kept in storage and under proper protection until needed.

Pick goods. Items required from stock must be selected from storage and brought to a marshaling area.

Marshall the shipment. Goods making up a single order are brought together and checked for omissions or errors. Order records are updated.

Dispatch the shipment. Orders are packed, shipping documents prepared, and goods loaded on the right vehicle.

Operate an information system. A record must be maintained for each item in stock showing the quantity on hand, quantity received quantity issued, and location in the warehouse. The system can be very simple, depending on a minimum of written information and human memory, or it may be a sophisticated computer-based system.

Warehouse/storage is an essential limb or an industrial unit. It is the depository of all materials required by the industrial unit and supplies materials as and when required by users. Different kinds of materials are required for different operation in a production unit. Some examples are given below:

Table 5.1. Type of materials and their functions

S. No.	Materials	Purpose/Function
1	Raw material	Production of the product
2	Spare and consumables	Repairs and maintenance works
3	Packing materials	Packaging
4	Chemicals	Quality control
5	Electrical items	Installation and maintenance of electric
6	Electronic items	Repair and maintenance of electronic items
7	Kitchen items	For requirements of restaurant
8	Stationary items	Office work
9	Tyres and tubes	Transport Vehicles
10	Lubricants and oils	Lubrication works
11	Tools and tackles	Repair and maintenance works

Activity: -

Define what we mean store

2. What are the basic functions in store operation?

The variety of items stored is so large that a planned system is required to keep them safely and orderly. The stored items should be identified and issued with minimum efforts and in minimum time. This call for the following:

An organizational structure suitable to carry on various activities efficiently and productively.

Defining the functions and duties of each focal official.

Developing operational systems for standardization in operations and uniformity in action in various situations.

To develop systems and ensure safety of men and materials.

To decide on authority for decision making on various issues.

To develop and maintain records for proper accounting, management information and analysis for improving the procedures and policies.

The functions of stores may be listed as follows:

Receiving and Inspection: to receive and inspect raw materials.

Issue and dispatch-to meet the demands of the customer (user department) by proper issuing.

Stock records-to know the balance and assist in verification and providing supporting information for effective purchase items.

Stock accounting.

Stock taking and checking- to highlight stock accumulation discrepancy, and abnormal consumption and effect control measures.

Stores preservation-to provide adequate and proper storage and preservation to various items.

To minimize obsolescence –surplus and scrap through proper codification preservation and handling.

Stores arrangement-to ensure good housekeeping, so that materials handling, preservation, stocking receipt and issue can be done efficiently

In some companies, the store keeping function include salvage and retrieval of materials, disposal of scrap, and surplus. In smaller companies, the stores department may be vested with the additional responsibility of inventory control and even purchasing.

5.3. Location and layout

All materials shall be stocked in a systematic way so that minimum time is spent in picking out the materials for day-to-day issues. Thus, each rack and bin in the Stores will be identified with a location number, which shall be indicated on the respective stock cards/Bin cards.

When dealing with the store's layout, there are two basic aspects to be considered. One is the layout of storage areas or store-rooms and the other is the layout of bins and racks in each store.

Layout of storage area

The following factors should be considered when stockroom layout is being planned:

Commodity factors – the characteristics of the items to be stored.

Capacity factors – the characteristics of the available storage area. Activity factors – the activities that must be accommodated.

Commodity Factors

a. Nature of the Material

Items subject to deterioration need to be properly protected from extremes of temperature, dampness, rodents, insect infestation, and the like. Security items should be stored in vaults, safes, or caged areas; sensitive items must be properly safeguarded.

Hazardous commodities including ammunition, flammable material, and oxidizing items need to be segregated from each other and from other types of supplies and stored in appropriate containers as applicable according to Occupational Safety and Health Administration (OSHA) standards and require the proper Material Safety Data Sheet (MSDS) to be on file.

b. Size, Weight, and Shape

Extremes of size, weight, or shape need to be considered. Large awkward containers and unusually heavy items must generally be stored near shipping doors. Light and fragile items should not be stacked to a height that would cause crushing or other damage to the containers and their contents.

c. Turnover

Fast-moving items must be stored in readily accessible areas, where they can be handled quickly and efficiently. Slow-moving items must be stored in less accessible or less desirable areas, where structural conditions make stacking or handling operations difficult. In supply rooms with issue counters, items issued most frequently should be located as close to the counter as possible. The decision as to where to place items is called *positioning*.

d. Quantity

Large quantities of uniform packages are conducive to simple layouts. In contrast, small quantities of various-sized items require special storage planning: small lots must be stored in short rows, racks, or bins to provide proper segregation of supplies, maximum utilization of space, and accessibility for issue.

Capacity Factors

Floor Loads

Floor load capacity is the maximum weight of stored material that the floor can safely support, expressed in pounds per square foot of storage space. In multistory buildings, floor load capacities have been established and are indicated on the building plan. When floor load capacity is unknown, consult an engineer. If floor load capacity is not exceeded, lightweight and bulky items may be stacked as high as ceiling clearances allow, considering crushability and other characteristics of the items.

b) Doors

The number of doors available will influence the number of main cross-aisles that can be laid out and maintained for access to loading docks or areas. Doors should be high and wide enough to permit the easy passage of material handling equipment. Doors that are not required for access to loading areas, access by firefighting equipment, or as safety exits may be closed and sealed, with the additional space used for storage.

c) Loading Facilities

Aisle space leading to loading docks must be ample.

d) Upright Columns

The layout of aisles and storage bays will be affected by the location, size, and number of any upright columns and the distance between them. The bays should be laid out so that, when the supplies are safely stored, the amount of unused space will be minimal.

e) Stack-Clearance Safety Regulations

Standard stack-clearance regulations will be established. They will allow both for the safekeeping of supplies and for fire protection. A certain amount of clearance below fire protection sprinkler systems is required in accordance with OSHA standards.

3. Activity Factors

When stockroom or warehouse layout is planned, the activities that the space must accommodate need to be considered. Those activities include storing, receiving, picking, packing, shipping, over-the-counter issuing and handling of material, maintaining equipment, filing records, and so on. In a space in which ceiling height varies, areas with lower ceilings must be used for receiving and issuing, whereas areas with higher ceilings must be used for actually storing supplies.

Activity: -

Mention at least five basic factors which determine store location & layout.

Layout of bins and ranks

A uniform rule cannot be applied to the layout of bins and ranks. It will vary from store to store and should take in to account the following;

- The size and shape of the stores and the position of the main entrance door,
- Kind of material to be stored,
- The type of bins and ranks proposed to be used
- The type of material- handling equipment proposed to be used
- Convenience for taking materials in and out of the bin
- Maximum utilization of floor and overhead space etc.....

5.4. Organizational Structure of Stores Division

Dear learners! Effective organizational structure of ware house/stores division is necessary to carry out various activities. A typical organizational structure of stores division adopted by a larger plant is shown in the following figure. The number of staff in the store's division depends upon the number of stores and their distribution in the plant area.

The important functions of stores division are: Store Manager, Engineer, Inventory Control, Warehouse Officer, Inspection Controller, Store Keeper(s) and Supervisor, Stock Records Section



Figure. 5.1. Organizational structure of a store's division

5.5. Stores System and Procedures

5.5.1. Storage Procedures

The procedures' document defines step by step how the activities in the warehouse should be carried out and clearly defines the processes to be adopted. These can be adopted as 'best practice'. The procedures provide visibility of the operations for managers and donors.

However, in creating such procedures, care must be taken to avoid constraining the use of local initiative which might be required to deal with local conditions. Procedures should be considered as streamlining the business processes and providing checks and balances. They provide guidance to warehouse managers and must have some level of flexibility to cater for unique situations, then to be rigidly adhered to. This can be achieved by limiting the level of detail that the procedures document defines, allowing more flexibility and/or by arranging 'dispensations' to allow departure from the procedures in order to optimize local performance, especially in emergencies.

receiving and issuing of supplies;	how to detect and deal with stock losses;
quality control or verification;	how rejected material will be managed;
storage of goods;	and
how to control stock movement (stock control);	how to deal with unwanted material, obsolete and scrap, disposal.
documentation flow;	

5.5.2. Storage Systems

The two main storage systems are; Centralized and Decentralized Stores.

In small privatizations, one store will be sufficient to store all the materials which can be supplied by this centralized place to the other places or requirements. But, in large industrial organization since the production shop floors or workshops are lying at different place and sometimes located far away. So, the decentralization of stores is necessary in such organizations.

Advantages of centralized store

The Variety of goods can be supplied to all users from one small locations

Minimum inventory will be there as store will have limited capacity specially the tools, fixtures, large parts and spare parts.

Less manpower will be required

Better control of materials is possible

Materials located in small available space ensures economy in storage

Receipt and inspection of materials can be efficiently organized

Materials handling will be easy

Disadvantage of centralized storing

It may not be suitable for large manufacturing concerns

More staff will be required for shifting and transportation of the materials to various
production unit

Wastage and shortage of materials may be there

Safety and maintenance of large amount of materials is difficult in large stores

Record keeping is difficult

Note: - the disadvantages of centralized storing are advantage of decentralized storing and vice-versa.

Decentralized storing needs efficient planning of materials as well as location of storing them. However, it is the convenience of the organization to select any one type of storing system. But, the type of materials like small parts as nut, bolts, screw, fixtures, chemicals, paints, etc... have to be stored at separate places, whose requirements may be at many place. The type of store will be definitely depending up on the type of materials stored. Such as;

Consumable materials

Raw materials entering the production

Chemicals, acids etc...

Inflammable and toxic materials like kerosene, petrol, diesel, lubricants,
flammable liquid and gases

Small parts like nut, bolts, screws, nails, fixture

Hand tools and tools used for cutting machine

Machinery and equipment's

Furniture and Office materials and stationery etc.

Activity:

Explain the difference between centralized & decentralized storage system.

5.6. Stock receipt, issue and dispatch

A. Receiving: is the process of identifying, visually inspecting, counting and recording the receipt of all incoming materials. Goods may be received from outside suppliers, from production department or from other sources within the organization. They must be properly looked after when they arrive. Goods receiving should be arranged as economical as possible to avoid unnecessary delay or expense.

Receipts from outside supplier- when goods are received the following information and documents should be made available and necessary arrangements should be made.

The consigner should be giving clear information about the place where goods are to be delivered.

Hazardous materials should be clearly identified and marked. Unloading of this item should not take place until the necessary safety and other equipment is in place.

If goods are urgently required and need priority of unloading, information of their arrival should be communicated to the receiver

Suppliers should be informed of the days and items during which facilities will be available to accept deliveries.

The receiver should be informed of deliveries through the following documents:

Copy of the purchase order- when orders are placed the store keeper must be informed what he/she is expected to receive and when it is likely to arrive. This is usually done by sending a copy of the order form to him/her.

Supplier's advice notes- gives description, the quantity involved, the method of transport, and the date of the dispatch. But it may not be required for small values.

Carrier's consignment note-this document is used if an independent transport organization is used to transport the goods. It is sent in addition to the supplier's advice note. It shows the name and the address of the consigner, the description of the goods identification marks if any, the weight detail of the delivery vehicle and the name and address of the carrier.

Supplier's packing note-when materials are supplied carted or packaged, the supplier sends packing note, which is either included in or securely fixed to the package. This not gives much more detail about the contents than the corresponding advice note.

Then before delivery, the receiver compares the above documents to see that there is no discrepancy.

Once the documents are verified, the receiver proceeds with the following procedure:

Unloading and checking the shipment –the number of containers (goods) unloaded from carriers is checked against the carrier's manifest (freight bill) or the above documents to make certain the full consignment have been delivered. All containers are also inspected for external damage: any damage found is inspected by the carrier representative and noted on the receipt which the receiving clerk signs. Failure to do so before accepting can relieve the carrier from all liabilities except liability for concealed damage not evident until container is unpacked.

Unpacking and inspecting the material-the receiving clerk is responsible to verify &check:

The general condition of the material

The materials received against the seller's packing slip and against copy of the firm's purchase order

The type, quantity, and item

Recording overage, shortage or damage to the material-

Paying and processing freight bills provided that the freight bill is to be settled by the buyer

Completion of the receiving report-while goods are received goods receiving note is prepared

Notifying user of the material receipt

Delivery of the material – the more stock material should be directly delivered to the user department

Inspection: Goods received should be checked for type, quality, and quantity. To ensure the quantity of the incoming goods is up to standard, it is necessary to inspect every item of the incoming delivery. However, in all cases inspecting every incoming item may be difficult. Thus, sampling inspection can be appropriate when:

Inspection involves destructive testing

The cost of accepting defective item is

possible Materials arrive in large batches

It is possible to take a truly random sampling

Sampling can predict the quality of the parent batch consistently

Disposition of Surplus, Obsolete, Scrap and Waste

A final objective of stock control is the detection of inactive stock item that increase the inventory investment without contributing any corresponding service or utility. Surplus may arise from any one of the following reasons:

Over questioning, over buying or over delivering

Abandonment of projects or cancellation of sale order

Undetected errors in materials accounting or materials stored in wrong location and consequently lost and

Error in record keeping

Reasons for Disposal

Obsolescence

Deterioration in value

Irrevocable damage

Surplus

Alternative possibilities for disposal:

Utilization as a substitute for currently standard material or some other product Utilization by transfer to another department

Utilization by remanufacture

Return to original manufacturer

Sale as surplus material

Sale as scrap

Dispose as a waste material

Issue and Dispatch

Authorization of issues- before goods are withdrawn from a storehouse, they have to be duly authorized by a person nominated to authorize the issue.

Timing of the issue- there should be regular issue of materials to avoid delay and to insure smooth and even flow of work. Depending on the nature of demand, issue can be made on daily, weekly or monthly basis. The store keeper should try to meet the convenience of users.

Record system- the operation of the store function and control of stores require collecting and storing information and facilities for the analysis and use of this information. Stock records are expected to preserve particulars of receipts, issues and balances remaining in stock for each individual item held in the store house from day to day.

Reason for maintaining records

To indicate the amount of stock at any time without making physical

count To establish a line between the physical stock and the store account

5.7. Stores Accounting and Stock Verification

5.7.1. Stores Accounting

Store accounts play an important role in estimating the cost of the product for pricing decision. Materials costing are very crucial in terms of the valuation of the cost of materials assumed by the production department, as well as in terms of the estimation of the value of materials held in stock. Materials costing can be discussed under classification of;

the receipt of material

the issue of materials to production

the stocks held at the end of the accounting period

1. costing of the receipt of materials

The actual cost of materials received is worked out by taking price quoted by suppliers as the base, subtracting the discount and adding any other expense not covered. There for we can say that cost of materials received is equal to the price quoted less discounts, less freight, insurance duties, taxes and package charges.

Costing of issue of materials to production

First-In-First –Out (FIFO), Last-In-Last-Out (LIFO), average cost, standard cost, base stock method, and market price at the time of issue are some of the methods used to calculate the cost of issue to production.

Costing the closing stock

Generally guide lines used here is that closing stock is value at either at the market price or at actual cost of the stock whichever is less. The main factors that determine the cost of closing stock are price levels, obsolescence and deterioration. Provisions have to be made to account for under valuation or over valuation of stock due to price fluctuations, obsolescence of stock on the basis of past experience (usually worked as a percentage of total stock value) and deterioration of stock with time due to limited shelf life or inadequate precaution while storage

5.7.2. Stock verification

Store verification means, testing or checking the stores record with the actual items stoked in the store. The store record at any time should show the exact physical quantity of raw materials and parts which are available for use. Store verification also referred as to stock taking is meant to ascertain any discrepancy of actual store when comparing with record. Store verification or stocktaking is also sometimes called internal audit of store. Discrepancy revealed by physical verification may be one of the two types:

Store materials (stores) short of what the record shows

They are in excess of what the record shows

Store verification revels if there is any discrepancy of stored materials with the stores record; discrepancy may arise due to:

Clerical error

Wrong description
Incorrect counting
Omission in issue of material
Omission in recording issued material
Loss due to damage, breakage or deterioration and Small thefts etc

5.8. Sores security

Preservation of Materials and Protection of Stores

The various types of materials stored will be affected by atmosphere and environment. These types of materials must be preserved by keeping them in proper environment which will not affect them. The materials will be affected and deteriorate in the following ways:

Fruits, vegetables and some of the agricultural products deteriorate with time and they have short life. They can be stored and preserved for only few days. These types of materials must be carefully stored and the quantity to be stored should be such that it will be consumed before spoilage. Some chemicals can be preserved for few months.

Cement is affected by dampness. Steel plates and other iron products are corroded. Some of the materials are affected by dust particularly electronic devices. These types of materials must be protected from the things which deteriorate them.

Stationery, cloth, paper, wood and plywood are affected by dampness, white ants and moths. Anti-treatment against white ants must be done where ever these types of materials are stored.

Rats, insects etc. eat away the food grains, wheat, rice, cereals, clothes etc. Bamboos, timber and wood are affected by *ghuns*.

Drugs and chemicals are spoiled by light, air, heat etc. They must be preserved against them. Rubber goods are also affected by these things and they become hard after some time without use, therefore they must be consumed before their expiry periods.

Some types of liquids give out fumes and gases which may be toxic or flammable. The great precautions must be taken for preserving and use of such materials. They may be fertilizers, insecticides and other chemicals used. Battery cells are also deteriorating. If they are kept with other materials, they may spoil them. Battery cells must be stored in dry place and preserved properly.

Many a gas like petroleum gas, chlorine, Sulphur dioxide, oxygen, hydrogen are preserved in gas cylinders. The proper types of cylinders are used and they are kept separately after checking for leakages etc. Inflammable liquids are stored very carefully away from fire places and hot atmosphere.

Since most of the materials as discussed above deteriorate because of the atmospheric conditions and seasonal changes, therefore, these materials must be preserved in such a way that these effects are as less as possible and they must be protected. Some of the important protection methods necessary in every store are as follows:

Protection of store against fire: The stores must be located in fire-proof rooms. The fire-fighting equipment like fire distinguishers, water and chemical sprinklers and inert gases are used against fire. The fire alarms and other safety devices should be used in the stores against fire. While doing welding in the store, precautions must be taken so that it will not be the cause of fire or burning any other material.

Dust protection: Closed and dust-free enclosures should be used in the stores. Cleaning and good housekeeping is necessary in the stores. Air conditioners prevent dust to enter in the stores. Wherever ventilation is necessary specific type of ventilators are used so that dust should not enter in the storerooms.

Maintaining proper environment: Proper air conditioning in the storerooms avoids dampness. Dehumidifier maintains dryness in the stores. When the materials are kept outside, in the store yards and sheds they must be protected against excessive exposure to light, heat and rains by building proper type of sheds.

Protection against corrosion: Those materials which are corroded by atmospheric moisture should be protected against corrosion by painting, coating or greasing by anti-corrosive chemicals particularly machine parts, bearings and gears etc.

Fast-deteriorating materials should be used immediately and their storage should be limited. Overstocking of deteriorating materials should be avoided. Proper type of containers and storage places are necessary to keep deteriorating items. Their expiry time is to be mentioned on these containers. These items should be handled carefully.

Prevention of theft is very necessary in every stores department. Unauthorized persons should be prevented from entering in to the stores. The guards should check all the persons going out of the stores.

The stores are assets of the company. The use of proper preservation methods and protection of stores avoids lot of wastages of materials and goods. While planning the stores layout and location one of the important criteria is preservation of inventory and protection of all types of materials against atmosphere.

Activity;

1. What we mean stock receipt & issue?

2. What are the possible hazardous to stock materials

3. How we can minimize possible problems/hazardous?

5.9 Codification

Dear Learner! Codification is used to describe an item which is short thus; avoiding the necessity of a long statement every time they need to describe the item arises. Codes are very useful for the following reasons.

Every one finds a similar mining in identifying an item with the help of a code.

The same item may be available under different names. A code eliminates the possibility of duplication in names.

Item with different features but for the same purpose can be differentiated easily. For example, a ball pen with ordinary refill will have a code different from that of a ball pen with jotter refill.

A code helps avoid long description in purchase requisitions.

Entries in bin cards, stock control cards, and account records are made easily with codes. Moreover, a code helps in uniform method of entry.

Entries in receipt and issue documents are made easily with accuracy in the appropriate records.

Codes are necessary for mechanization or records through computerization of activities.

5.9.1 Methods of codification

Dear learner! One can adopt different methods of codification. Let us see the methods of codification:

- | | |
|--------------------|-----------------------|
| 1. Numerical codes | 3. Consonant code |
| 2. Mnemonic code | 4. Alpha-numeric code |

Let's see each method in detail:

Numerical code: Different systems have been used for codification with numerical. A seven-digit system or ten-digit system (Kodak System) have been widely used for codification. All numerical methods of codification seek to describe the item by using groups of numerical to describe the general class to which a part might belong, such as electrical, plumbing, pipes, and fitting etc. The next two characters may describe some groups such as switches in electrical, valves, in plumbing, and steel pipes and fittings under pipes and fittings. The next two characters may narrow down to the unique description of the part it describes.

Example1

A seven-digit codification system is used as follows:

XX	X	XX	X	X
Class	Sub-class	Description of material	Size	Minor Variations

Example2

In the ten digits Kodak system, the structure of the code is as follows:

XX	X	XX	XX	XX	X
Class	Sub-class	Kinds	Types	Size	Minor Variation

Numerical codification systems focus on the material and ignore the purpose for which the item is used. Quite often, the same part is known by several names depending on its use. Codification eliminates such duplication of names which may arise because of various uses of the same materials.

Mnemonic code: A mnemonic code uses alphabets to describe the items. Since there are only 26 alphabets, there is a limitation in giving codes to classes/subclasses more than 26 in number. A combination of alphabets is used to describe items, but very soon over lapping meanings is represented by these codes. For this reason, mnemonic codes are not well adapted to machine data processing methods. Mnemonic codes are normally used for identifying relatively short lists of items coded for manual processing where it is desired that the items are recognized by their codes from memory.

Consonant codes: Consonant codes also use alphabets, either singularly or in combination. In this system, abbreviations are used, which are selected in such a way that sounds like the item to be described. In this system initial letter is retained, but all subsequent vowels (including W and Y) are dropped. Codes developed in this way are unique to the item. While consonant codes can be used for any type of data item. This type of coding is more commonly used for coding long names and addresses. The main advantage of this coding system is the easiest way with which the new items could be coded. Anybody with a little practice can code it's by consonant code. Some of the examples of the consonant codes are:

TPT	Transport	EB	Electrical Circuit Breakers
MAT	Materials	ED	Electric Power Distribution
PLN	Planning	UPS	Uninterrupted Power supply
MNTC	Maintenance		

This coding is used where the number of items to be coded is less. However, as the number of items increases, it becomes difficult to differentiate between items, as the same code is likely to be having two different items as they may sound similar. This may result in mistake in identification of items.

Alpha-Numeric code: This system uses a combination of alphabet with numerical for codification. Alpha-numerical codes are used to maintain the lists of individuals or company names usually their account names. This coding system can have a suitable number of characteristics say seven or nine or any other number is required.

5.9.2 Elements of Good Codification System

The codification system should meet the requirements of the organization. Each organization is different from other in many ways such as the prevailing system, extent of modernization, automation/computerization, and further plans.

A good communication system should search the needs of purchasing, warehousing, computerization of inventory levels and financial analysis, and should help in controlling procurement delays; stock out situations, repetitive small orders, wrong sourcing of enquiries, and order quantities.

Chapter Summary

Dear learners! In this chapter, we have discussed different concepts and theories related to storage management, its functions and responsibilities. The term stores, storehouse or warehouse refer to a building or room or place where materials are kept. In popular usage, the term stores are used to cover all aspects of preservation of goods that is building suppliers, and the act of storing. Stores or storage is the function of receiving storing and issuing material. In short it is connected with the physical handling and wellbeing of stocks. An organization can have various types of stores like raw materials stores, processed or semi-finished materials stores, finished goods stores, yard stores and so on. The function of stores management is to be a custodian, looking after the items and controlling their flow. The art of store keeping is largely that of optimizing the use of resources to meet actual needs in an efficient manner. One of the indicators of efficiency in stores is the number of times the stocks have turned over. Money is a scarce resource and once it is converted in to material, it is useful only when the materials have been converted back to money.

Self-check Exercise 5

Part one: Multiple type questions

Choose the best answer for the following multiple type questions.

1. Which of the following is not a function of stores?

- | | |
|--------------------|---------------------|
| A. Issue | D. Stock accounting |
| B. Dispatch | E. None |
| C. stock recording | |

Which one of the following is the advantage of codification?

Every one finds a similar meaning in identifying an item with the help of a code.

A code eliminates the possibility of duplication in names.

Items with different features but for same purpose can be differentiated easily.

A code helps avoid long description in purchase Requisitions

none

_____ gives description, the quantity involved, the method of transport, and the date of the dispatch.

- | | |
|---------------------------|----------|
| A. Supplier's advice note | D. A & B |
| B. Packing slip | E. none |
| C. purchase requisition | |

Which one of the following is false about Random location?

items can be stored in any location

space is under utilized

is used when large number of product lines is recorded

A&C

none

5. The layout of the store house helps to:

- | | |
|--|----------------------------|
| A. develops an efficient work flow. | D. ensures timely dispatch |
| B. minimizes the transportation problem. | E. All of the above |
| C. minimizes handling time of materials | |

PART two

Explain and elaborate the following discussion type questions.

1. Discuss the meaning and significance of storage management.

2. Outline and discuss briefly a typical receiving procedure.

3. Explain how a numerical and a mnemonic material identification system work.

4. Discuss briefly the responsibilities of a typical stores department?

What are the objectives of good store room layout? Explain.

Answer key

- | | |
|------|------|
| 1. E | 4. B |
| 2. E | 5. E |
| 3. A | |

CHAPTER SIX

MATERIALS HANDLING

Chapter Contents

- 6.1. Definition and scope
- 6.2. Benefits of proper materials handling
- 6.3. Influencing factors and control
- 6.4. Materials handling codes and specifications
- 6.5. Materials handling equipment and guidelines
- 6.6. Evaluation of materials handling
- 6.7. Materials disposal

Chapter Objectives:

After going through this chapter, you should be able to:

- Define what we mean materials handling
- Describe benefits of proper material handling
 - Explain factors which influencing materials handling process
 - Differentiate different type of materials handling equipment
- Mention evolution of materials handling and materials disposal techniques

6. Introduction

Dear learner! In chapter five we have tried to discuss about an important component of materials management i.e. storage management. We hope that you have obtained a good insight about the functions and responsibilities of storage management and about the concept of receipt, issue and dispatch of stock. Here in this chapter we will discuss issues related with the concept of material handling and its devices/equipment's, the principles and guide lines for effective materials handling. And explain factors affecting materials handling decisions. Material handling is the art and science of moving, storing, protecting, and controlling material. We will see in detail the basic techniques, principles and problems related with material handling.

Dear learners! Is there any materials handling activity taking place at your organization? If there is any, please list down some of them, well done student! Firstly, we will define what materials handling is about. Hence, it has been observed that no value is added to the end product through material handling. Materials handling can be defined as the function dealing with the preparation, placing and positioning of materials to facilitate their movement or storage.

Materials handling includes every consideration of the product except the actual processing operation. Many organizations have used industrial engineering techniques such as “flow process charts” to design effective integrated internal material handling systems. When layout and handling are designed in an integrated manner valuable insight can be developed on the selection of handling equipment’s, number of equipment’s and maximum utilization of floor space. In the two-basic layout, viz product layout and process layout, it has been found that material handling is kept at a minimum in the case of product layout.

A good plant layout and material handling system improves the economics of production by reducing wastage in materials and improving utilization of man and material. It also results in reduced accidents; good housekeeping and increased, employee morale. Material handling is an important area of study with a view to effect cost reduction by suitable material handling. Material handling has now become a specialized function. In the pre scientific management period the material handling was only manhandling and handling was done in most uneconomical way by human labor only. It is important that material handling should have no congestion of materials, in process inventory and bottlenecks and this could be achieved by the study of layout and material handling systems.

6.1 Definition of Material Handling

Material handling has been rightly defined as an Art and Science involving the moving, packing and storing of substance in any form. Material handling is the preparation placing and positioning of materials to facilitate their movement or storage. The total cost of material handling formed is indicated in the following diagram.

Material handling is the moving of material from the raw material storage through production to ultimate consumer with the least expenditure of time and effort, so as to produce maximum productive efficiency at the lowest material handling cost.

6.2 Traditional and Modern View of Materials Handling

The traditional view of materials handling see material handling as non-value adding and only contributing to the cost of the product. As such, material handling should be avoided and minimized as much as possible. Since material handling operations often involve a substantial amount of direct labor and labor is expensive, many material handling design engineers were very supportive of automation. This trend is even more pronounced in Japan and west Europe where labor is very expensive.

The modern view recognizes the space and time utility of material handling operations, i.e., a product is worth more if it is at the right place and at the right time. The modern goals in material handling system design are to create a flexible system that can be used for a variety of products and processes and to integrate the currently designed material handling system in the overall material handling plan.

6.3 Objective of Material Handling

Reduction in wastage of machine time. Proper material handling system would ensure regular supply and distribution of raw material and finished product. This will not create the problem of idling of machine and eliminate problem wastage of machine time.

Reduction in manufacturing cycle time. Keeping the loading and unloading time of machine at minimum enable the completion of manufacturing cycle at reasonably short time.

Avoid disruption in production schedule. In mass production system, all parts or materials must come in the assembly line in correct quantity and at precisely the right time to avoid risk of shut down.

Safety and safe working conditions. Correctly designed material handling system enables utilization of proper material handling device and training workers in safe material handling practice it is tangible saving in reduced insurance rates, payment of compensation and boost to worker's moral.

Customer satisfaction. Regular market supplies, by avoiding disruption in production schedule, shortening manufacturing cycle time, timely deliveries lead to customer satisfaction a key to business success.

Enhances productivity and avoids high cost. Efficient material handling system results in reduction in cost through various steps which results in higher productivity.

Activity: -

Define what we mean material handling.

Explain objectives of good material handling.

6.4 Principles of Material Handling

The various objectives listed above can be achieved by following certain principles. It will be good to remember that these are the general principles only and in practice the individual industrial problems affect the evolution of material handling system. Factors like the production system, types of building and cost of various devices largely affect the system in a particular industry. General principles are:

Materials should be moved over the shortest distance possible. Short movements require less time and cost less money than long movements.

Do not retrace your path. The aim of material handling system should be to move in forward direction or clock wise direction.

Terminal time should be kept as short as possible. It is time taken for picking up the finished product.

Loads should be carried both ways on material handling trips whenever possible.

Partial loads and manual handling should be avoided.

Utilize gravity as moving force as far as possible.

Utilize containers and unit loads. The unit load means the product to be moved should be grouped into units of a large and constant size.

Materials should be already marked to help save time in sorting and avoiding mixing up.

6.5. Minimizing Material Handling

The material should travel from the one machine to the other as little as possible; especially the heavy components should flow in line only because excess flow of material requires manpower as well as equipment for lifting and carrying the material. Following are factors minimizing material handling.

Flexible layout. The layout should be flexible for the following causes:

Design Change

b.) Increased production

c.) Adding a new product

d.) Maintaining high turnover i.e. the storage time of the material inside the line need to be minimum.

Economical use of Area. Each square foot area costs money. Unaccepted waste or idle floor is burden on rest of the plant spacing between machines after necessary spacing required for movement of men and material.

Effective use of labor. Labor may be wasted through poor layout. Following factors should be considered for effective use of labor utilization:

Reduce manual handling

Minimize walking

Balance machine cycles so that man and machine are not idle

Laying the machine in such a way that supervision is simplified

Employees comfort. The layout should be such that the worker is not affected by heat, moisture or dirt. Direction of light should also be considered for laying the machines. Equipment causing more noise should be isolated as far as it is possible. Equipment which vibrates should be cushioned or specially mounted to prevent transmission of vibrations to floor or surrounding areas.

6.6 Factors affecting materials Handling System

Dear learners! Materials handling cannot be viewed in isolation. Many factors like plant layout, processes, and nature of raw materials and products influence the material handling system. Therefore, an integrated approach will have to be taken in the case of materials handling.

It needs to be appreciated that material handling operations encompass suppliers, store, inspection, manufacturing, warehousing and transport to consumer. The objective therefore, must be to obtain maximum overall effectiveness of the material handling system. We will discuss some of the important decisions that are relevant for materials handling function.

Lay out decisions are normally taken on technological considerations. Very rarely are such decisions taken in consultation with materials management and materials handling departments. Such a consultative process could result in savings in terms of reduction in handling costs, reduction investment on handling equipment's and a reduction in production cycle time. In such a consultative process, movement of materials could be studied right at the outset from the receipt of raw materials stage to that of dispatch of finished goods to warehouses. Many organizations have used industrial engineering techniques such as flow process charts and string diagrams to design effective integrated materials handling systems. When lay out and handling are designed in an integrated manner, valuable insights can be developed on the selection of handling equipment's, number of equipment's and maximum utilization of floor space. In the two basic lay outs, viz, product layout and process layout, it has been found that material handling is kept at a minimum in the case of product layout. This is because product lay out is designed as per the sequence of operations leading to smooth flow of materials. Also, machineries are so located as to minimize the handling between successive processes. However, process lay out results in lower investment in capital equipment and better utilization.

The following four factors affect material handling system.

Production system. There are two basic types of production systems. One is intermittent or job-lot production; the other is continuous-production. Intermittent systems are used where a variety of jobs are being done at the same time on a variety of machines and in a variety of places. Since a great deal of flexibility is necessary it is likely that variable path equipment will be used more than fixed-path equipment.

In terms of materials-handling devices lift trucks, pallets, hand trucks and trolleys would be more useful in intermittent production system in continuous production systems. These materials-handling devices would not be so commonly used in continuous-process systems, one would find extensive use of conveyors, cranes, hoists, pipelines and in modern plants, automatic of transfer machines and tape-controlled indexing machines.

Type of products to be handled. The type of products being handled greatly affects materials handling decisions. Powders, liquids and gases are well suited to transport by pipelines. Automatic transfer machines should be used in automatic processes where a sufficiently high volume of production is available to offset the high cost of the equipment. Cranes and hoists are best suited to very heavy lifting jobs, where the material to be used cannot be easily lifted from below. Conveyors should be used where high volumes of products move from one fixed point to another. Trucks should be used where flexible destinations are required and where the volume of material to be moved may be low.

The characteristics of the products, including weight, size, shape, perishability and whether it is a solid, liquid or gas have significant bearing on the selection of the type of device which should be chosen to move them.

Types of building. The number of floors has a direct effect on the devices which should be used. Single- store building, the most common type being built today lends themselves to the use of lift trucks and conveyors. They also eliminate the need for elevators, which often prove to be a bottleneck in materials-handling. Multi-stored building, however, finds themselves to the use of gravity flow with pipelines and shutters which is the most economical method of materials handling.

Cost of Material Handling. The last major factor is the cost of various devices which are available for use. Cost comparisons among various alternatives are often difficult to make. The initial costs of alternative devices should be considered. The usual life of equipment will also affect the decision. Resale or scrap value is the other factor. Perhaps most important are operating costs which include fuel maintenance, repair, insurance and labor costs. These costs must be determined for the alternatives before estimates of the value of one device versus another can be determined. The graphical representation given in Fig shows the relation between cost per unit of load moved and distance moved.

6.7 Analysis of Material Handling

Materials handling problems vary from situation to situation. The gravity of the problem varies according to whether production is continuous or intermittent. This in effect means only that a detailed analysis of various aspects of materials movement is necessary.

What to Move. Data is collected on what materials are to be moved. The bill of materials coupled with the production schedule would give this information. Additionally, all information regarding weight, size, shape, quantity etc., of the materials to be transported is to be collected. The following form could be used.

ITEM SPECIFICATION LIST

ITEM			UNIT				HOW MOVED				
Description	Size	Wt.	Qty .	Qty .	Size per unit	Wt .	No .	From units required	To	Deist.	Equipment.

Where to move. Once the data is available as to what to move, the details of where to move are to be collected. It is necessary that information is collected in the form of distance weight since this is the most pertinent information. The information could be collected in the form given below:

To From	A	B	C
A			
B			
C			

How to Move. The data required to be collected is (i) the equipment used for movement, (ii) whether material is moved individually or in units like tray, pallets, bundles etc. and (iii) the time taken for the movement. Details of equipment's used are to be collected, viz. (i) capacity, speed, (iii) flexibility and (iv) maneuverability. Hence the factors affecting material handling can be summarized as follows:

What to move: Materials – form, characteristics, quantity

In what: Containers

Where: Routing

How often: Frequency and duration

How far: Distance

How fast: speed

On what: Paved gangway curves

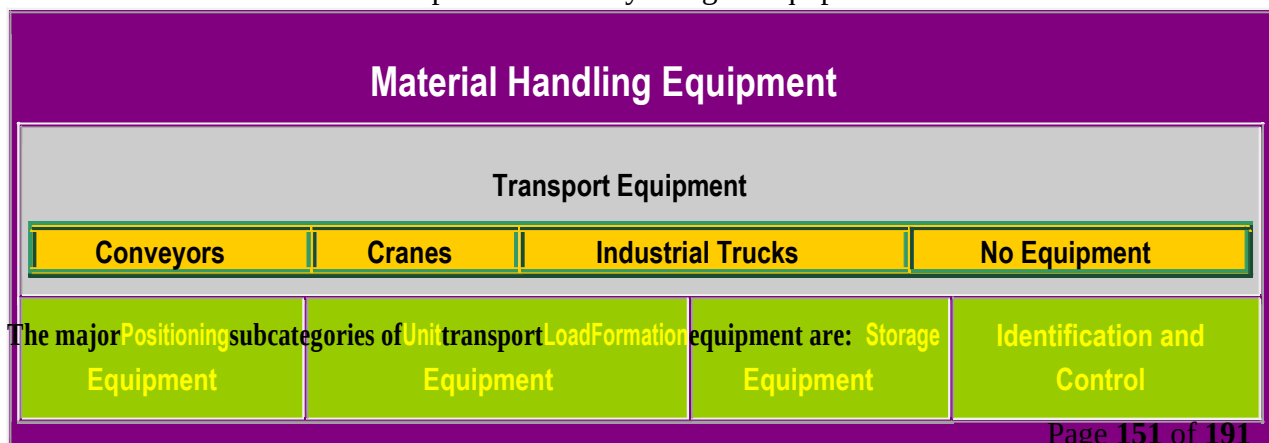
By whom: Type of labor

By what: Equipment

6.8 Material Handling Equipment's

Material handling equipment (MHE) is used for the movement and storage of material within a facility or at a site. MHE can be classified into the following five major categories:

Transport Equipment: Equipment used to move material from one location to another (e.g., between workplaces, between a loading dock and a storage area, etc.). The major subcategories of transport equipment are conveyors, cranes, and industrial trucks. Material can also be transported manually using no equipment.



Conveyors: - equipment used to move materials over a fixed path between specific points.

Conveyors are used:

When material is to be moved frequently between specific points

To move materials over a fixed path

When there is a sufficient flow volume to justify the fixed conveyor investment

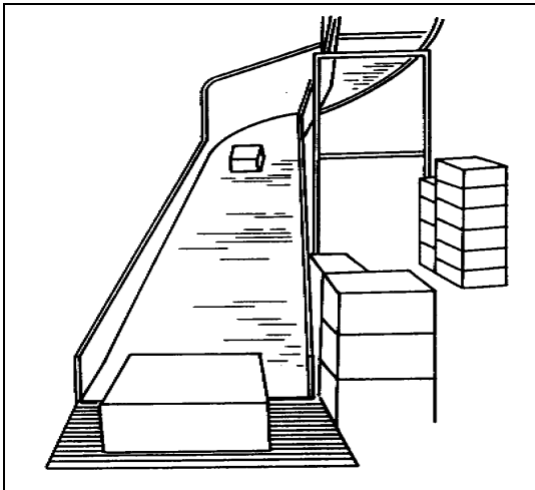
Conveyors can be classified in different ways:

Type of product being handled: *unit* load or *bulk* load

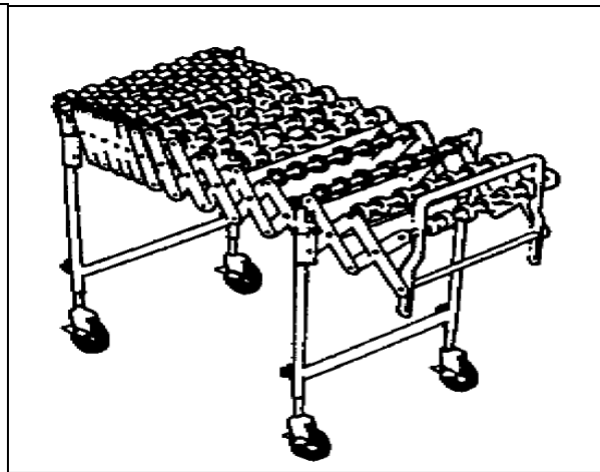
Location of the conveyor: *overhead*, *on-floor*, or *in-floor*

Whether or not loads can *accumulate* on the conveyor

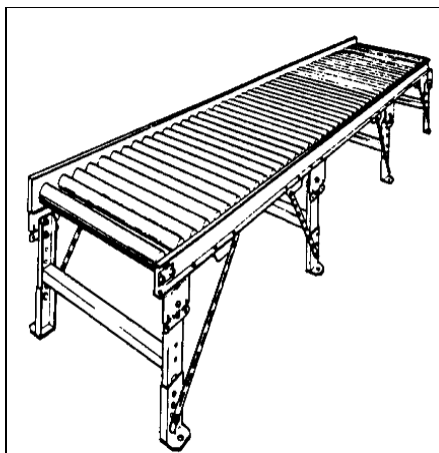
Chute Conveyor



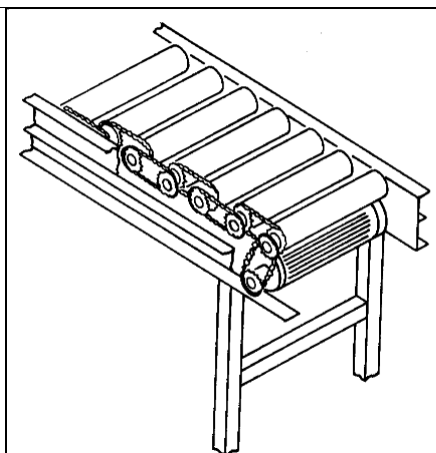
Wheel Conveyor



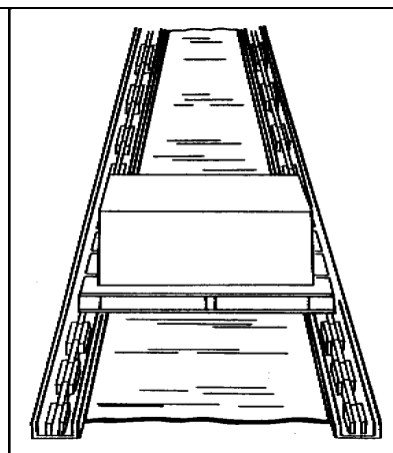
Gravity Roller Conveyor



Live (Powered) Roller Conveyor



Chain Conveyor



Cranes: - equipment used to move materials over variable paths within a restricted area.

General characteristics of cranes:

Used to move loads over variable (horizontal and vertical) paths within a restricted area

Used when there is insufficient (or intermittent) flow volume such that the use of a conveyor cannot be justified

Provide more flexibility in movement than conveyors

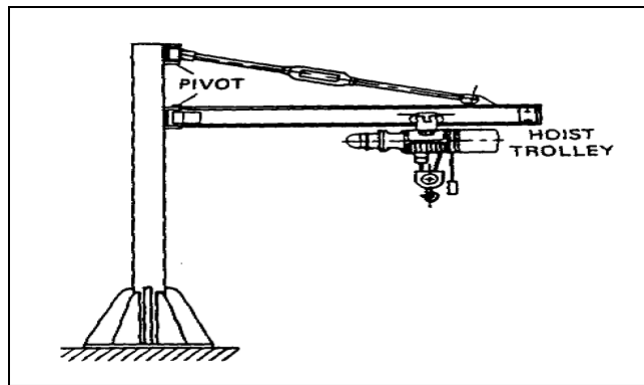
Provide less flexibility in movement than industrial trucks

Loads handled are more varied with respect to their shape and weight than those handled by a conveyor

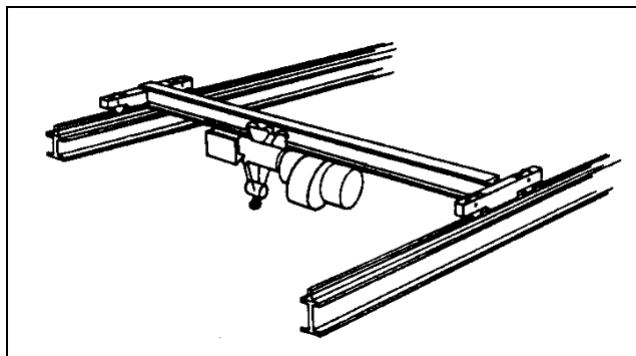
Most cranes utilize hoists for vertical movement, although manipulators can be used if precise positioning of the load is required

The major types of cranes are:

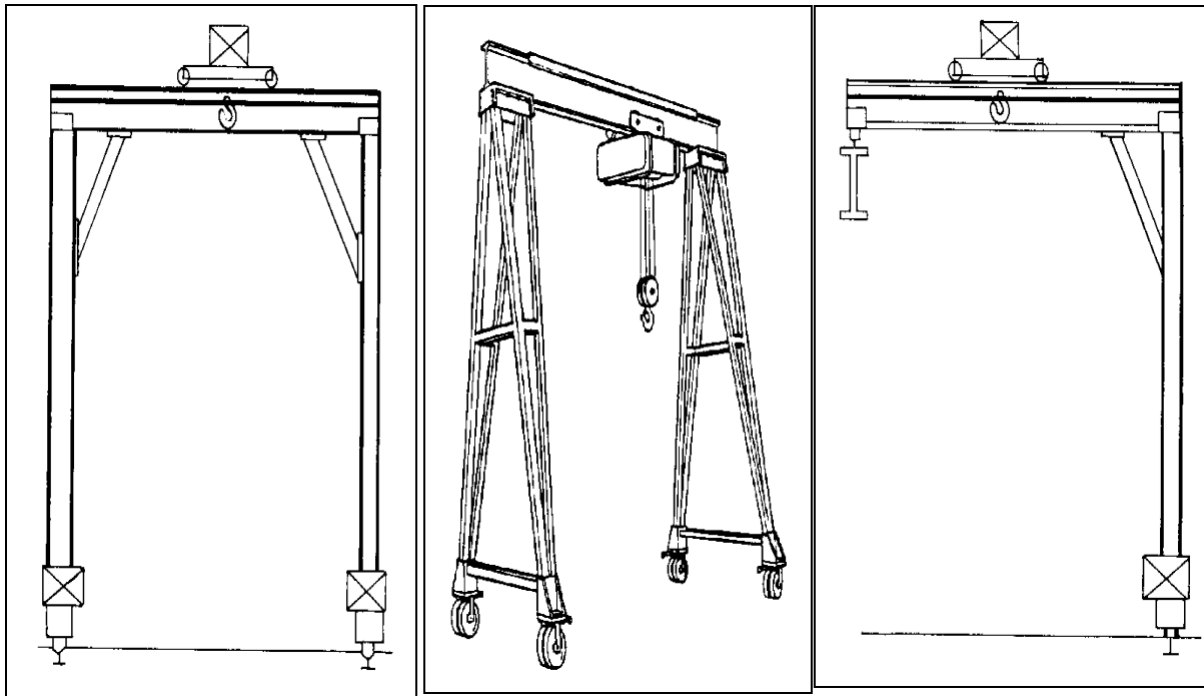
A. Jib crane



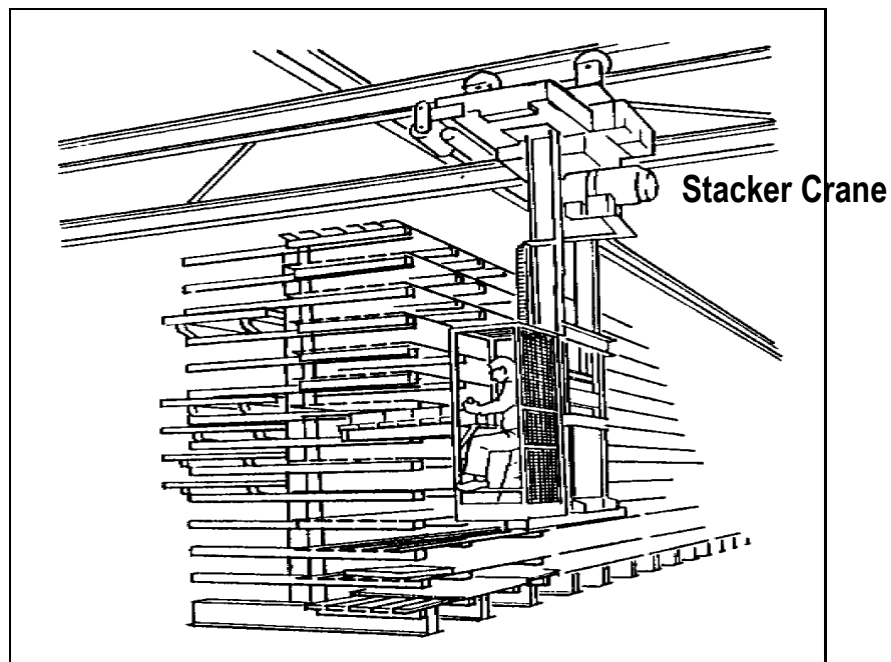
B. Bridge crane



C. Gantry crane



D. Stacker crane



Industrial Trucks; -equipment used to move materials over variable paths, with no restrictions on the area covered by the movement (i.e., unrestricted area).

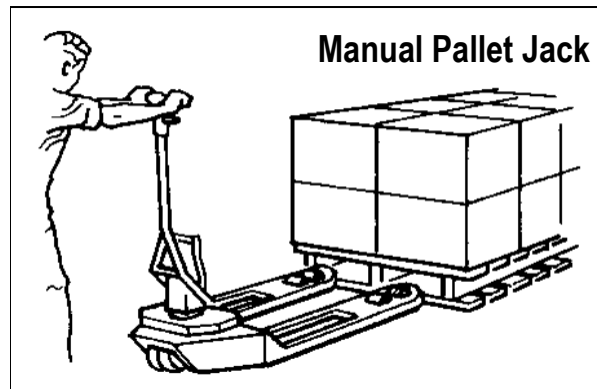
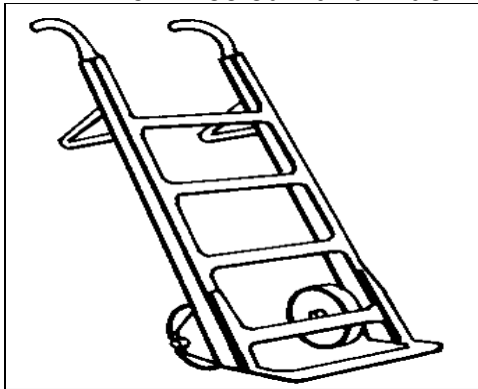
Used to move materials over variable (horizontal) paths with no restrictions on the area covered and Provide vertical movement if the truck has lifting capabilities

Used when there is insufficient (or intermittent) flow volume such that the use of a conveyor cannot be justified

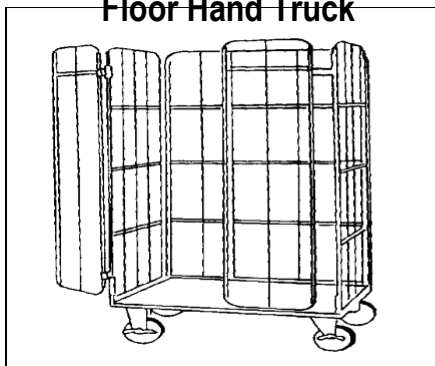
Provide more flexibility in movement than conveyors and cranes

Not licensed to travel on public roads—"commercial trucks" are licensed to travel on public roads

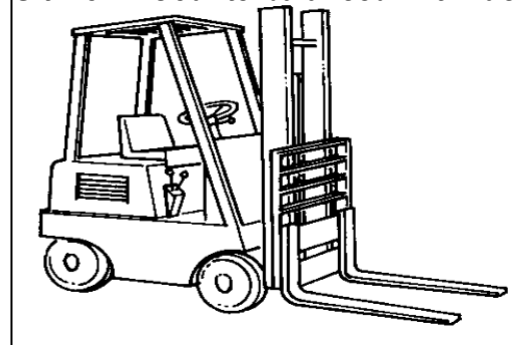
Two-Wheeled Hand Truck



Floor Hand Truck



Sit-Down Counterbalanced Lift Truck



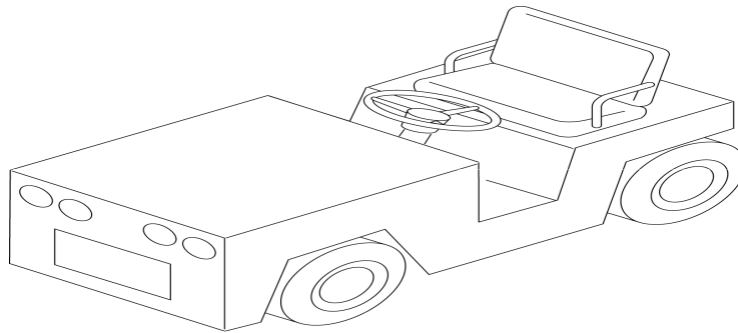
The powered industrial trucks

The powered industrial trucks are used for moving either mixed or uniform loads intermittently over various paths. While these paths can be somewhat random at the discretion of the driver, the paths are restricted to suitable indoor or outdoor surfaces.

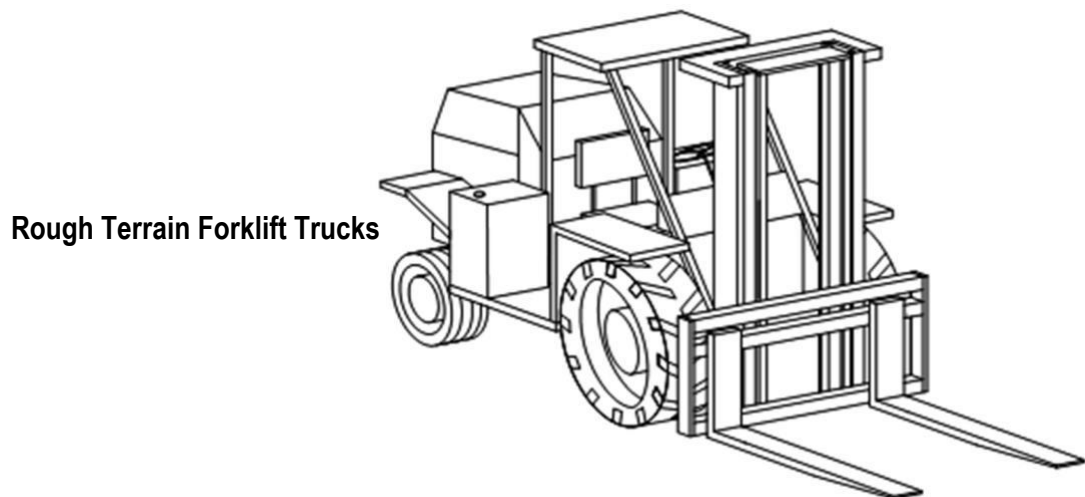
These trucks are used for moving either mixed or uniform loads intermittently over various paths. While these paths can be somewhat random at the discretion of the driver, the paths are restricted to suitable indoor or outdoor surfaces.

Industrial trucks provide not only a means of transporting materials, but also provide a means of accurate lifting and stacking.

Appropriate tooling for the truck permits users to lift not only pallets, but a wide array of specialized loads. For example, rolls of carpet are easily moved via industrial truck by replacing standard forks with a single tube. The following are some of powered industrial trucks.



Electric and Internal Combustion Engine Tractors



Rough Terrain Forklift Trucks

No Equipment: -material can also be transported manually using no equipment.

Positioning Equipment. Equipment used to handle material at a single location so that it is in the correct position for subsequent handling, machining, transport, or storage. Unlike transport equipment, positioning equipment is usually used for handling at a single workplace. Material can also be positioned manually using no equipment.

As compared to manual handling, the use of positioning equipment can provide the following benefits;

raise the productivity of each worker when the frequency of handling is high,

improve product quality and limit damage to materials and equipment when the item handled is heavy or awkward to hold and damage is likely through human error or inattention, and

reduce fatigue and injuries when the environment is hazardous or inaccessible.

Unit Load Formation Equipment. Equipment used to restrict materials so that they maintain their integrity when handled as a single load during transport and for storage. If materials are self-restraining (e.g., a single part or interlocking parts), then they can be formed into a unit load with no equipment.

IV. **Storage Equipment.** Equipment used for holding or buffering materials over a period of time. Some storage equipment may include the transport of materials (e.g., the S/R machines of an AS/RS, or storage carousels). If materials are block stacked directly on the floor, then no storage equipment is required.

Identification and Control Equipment. Equipment used to collect and communicate the information that is used to coordinate the flow of materials within a facility and between a facility and its suppliers and customers. The identification of materials and associated control can be performed manually with no specialized equipment.

6.8.1 Evaluation of Material Handling Problems

Normally in a plant there are a lot of problems with which an employee is bombarded but, with passage of time he develops a habit to tolerate the inconveniences at that place and accept the problem as inevitable. However, a survey of plant would bring out several facts which need a systematic study. Certain points will show us the need of a study of the Material Handling problem.

In Receipts and Stores:

Does the area where materials are received give a look of bad housekeeping? Are materials being dumped all over the space?

Are materials piled up in the receiving yard to be moved?

Are the members of group, handling materials are uniformly loaded? How many men are engaged?

Are the materials moved twice in the receiving yard before they are finally sent into the plant?

Has the storage area been divided into sections for storing different materials?

Are the records of materials stored maintained properly so as to locate them properly?

Are floor loading capacity and ceiling height use properly displayed?

Are the items of more frequent use kept near the gate?

Is the floor properly leveled so that the movement can be made without the danger of accident or obstruction?

Does the distance of the store from the production department ensure shortest distance moved?

Are the packages ready in time to avoid demurrage of wagons?

Are there any damages to the materials during handling?

In Production Areas:

Do skilled workers handle material or heavy object?

Are there proper demarcation lines for material movement's areas?

Is the production area clustered with parts and materials for use rejects?

Are in process material kept on floor?

Has the storage area been divided into sections for storing different materials?

Chapter summary

Dear learners'! we have defined material handling is the moving of material from the raw material storage through production to ultimate consumer with the least expenditure of time and effort, so as to produce maximum productive efficiency at the lowest material handling cost.

The layout of a factory, workshop or working area means the position of the departments or shops in the factory and of the machines, work places and storage points in the working areas, including offices and staff facilities relative to one another. A bad layout can add a good deal of time to the total work.

A good plant layout and material handling system improves the economics of production by reducing wastage in materials and improving utilization of man and material. It also results in reduced accidents; good housekeeping and increased, employee morale.

Material handling is an important area of study with a view to effect cost reduction by suitable material handling. Material handling has now become a specialized function.

Materials handling cannot be viewed in isolation. Many factors like plant layout, processes, and nature of raw materials and products influence the material handling system. Therefore, an integrated approach will have to be taken in the case of materials handling.

It needs to be appreciated that material handling operations encompass suppliers, store, inspection, manufacturing, warehousing and transport to consumer. The objective therefore, must be to obtain maximum overall effectiveness of the material handling system.

Materials should be handled by the right equipment in order to minimize materials damage, unnecessary cost, and employee fatigue.

Self-check Exercise 6

Part I:- Multiple Choose

Which of the following cannot add value to an item?

- Moving materials from one place to another using handling equipment
- Receiving, storing and issuing of materials
- Movement of goods from space and time from departure to the destiny.
- Processing of the item from raw materials to finished good through production
- All, except D

One of the following is a factor for selection of materials handling equipment:

- The nature of the material to be handled
- Quantity involved and distance to be covered,
- Facilities available for the use of equipment and its frequency of movement.
- All
- None

Among the following, which one of the following is objective of material handling:

- Reduction in manufacture cycle time
- Enhances productivity and avoid high costs
- Reduction in wastage of machine time
- Bring safety to workers and provide safer working conditions
- All of the above
- None of the above

Which one of the following is not among transport material handling equipment?

- | | |
|----------------------|----------------------|
| A. Conveyors | D. Bin |
| B. Cranes | E. None of the above |
| C. Industrial Trucks | |

Part II. Short answer

5. Elaborate what we mean material handling.

6. Write at least four basic principles of material handling

7. Explain at least three general characteristics of cranes.

Answer key

1. E

2. D

3. E

4. D

CHAPTER SEVEN

LOGISTICS

1. Introduction

Logistics is the art and science of strategically managing and controlling the flow of goods, energy, information and other resources like [products](#), [services](#), and people, from the source of production to the marketplace. It is difficult to accomplish any [marketing](#) or [manufacturing](#) without logistical support. It involves the integration of information, [transportation](#), [inventory](#), [warehousing](#), material handling, and [packaging](#). The operating responsibility of logistics is the geographical repositioning of [raw materials](#), work in process, and finished inventories where required at the lowest cost possible.

The word of logistics is origin from the ancient [Greek logos](#), what means “ratio, word, calculation, reason, speech, and oration”. Logistics as a concept is considered to evolve from the military's need to supply themselves as they moved from their base to a forward position. In ancient Greek, Roman and Byzantine empires, there were military officers with the title ‘Logistikas’ who were responsible for financial and supply distribution matters.

The Oxford English dictionary defines logistics as: “The branch of [military science](#) having to do with procuring, maintaining and transporting material, personnel and facilities.” Another dictionary definition is: "The time related positioning of resources." As such, logistics is commonly seen as a branch of [engineering](#) which creates "people systems" rather than "machine systems". Logistics as a business concept evolved only in the 1950s. This was mainly due to the increasing complexity of supplying one's business with materials and shipping out products in an increasingly globalize supply chain, calling for experts in the field who are called Supply Chain Logisticians. This can be defined as **having the right item in the right quantity at the right time for the right price** and is the science of process and incorporates all industry sectors. The goal of logistic work is to manage the fruition of [project life cycles](#), [supply chains](#) and resultant efficiencies.

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

Activity: -

Define what we mean logistic & logistic management in general.

Explain the implication of logistic management in business organization.

7.1. Origin of Logistics

The concept of “Logistics” started many years before Christ and was used by Greek generals (Leon the Wise, Alexander the Great) in order to describe all the procedures for the army’s procurement on food, clothing, ammunition, etc.

Alexander the Great was a big fan of the mobility of his troops and he didn’t want his troops to stay in one place waiting for supplies from Macedonia. Thus, he tried to resolve the issues of supplies by using supplies from the local resources of his defeated enemies. For many years, logistics were always an issue in war affairs. Kingdoms and generals with strategic planning on logistics were those who won the war.

World War II was the major motivation of logistics to increase recognition and emphasis, following the clear importance of their contribution toward the Allied victory.

Starting from the early ‘60s, many factors, such as deregulation, competitive pressures, information technology, globalization, profit leverage, etc., contributed to the increase of logistics science in the form we know it today.

The Scope of Logistics in Business

Logistics / Supply Chain in a business aim to the following contributions:

- Achieve maximum customer service level

- Ensure high product quality

- Achieve minimum (possible) cost

- Be flexible in the constant market changes

Logistics management tries to have the “right product”, in the “right quantity”, at the “right place”, at the “right time”, with the “right cost”

Logistics management must balance two basic targets:

Quality of Service

Low Cost

Logistics Strategy

Selecting a good logistics strategy may yield a competitive advantage. It must not be seen as a less creative process than developing the corporate strategy. It is suggested that a logistics strategy has three objectives:

Strategy	Description	Sample Issues
Cost Reduction	☐ Minimizing the variable costs associated with movement and storage.	Evaluate alternative courses of action: ☐ choosing among different warehouse locations, or ☐ evaluate alternative transport modes
Capital Reduction	☐ Minimizing the level of investment in the logistics system. ☐ Maximizing the return on logistics assets	☐ Shipping direct to customers to avoid warehousing, ☐ choosing public warehouses over privately owned, ☐ selecting a just-in-time supply approach rather than stocking to inventory
Service Improvement	☐ Recognizing that revenues depend on the level of logistics services provided	☐ Provide different and better services than the competition

7.2. Transportation Overview

Transportation provides the flow of materials, products and persons between production facilities, warehouses, distribution centers, terminals and customer locations.

Transportation Planning targets to:

Customer Satisfaction (quality of service)

On-time delivery

Minimum delays, damage or

losses Productivity Efficiency

Transit time reduction

Lower variability of transit time

Cost minimization

Vehicle acquisition/ fuel consumption minimization

Minimization of overtime and excess personnel costs

7.2.1. Types of Transport Modes

Road Transport

Includes the different means of transport such as motor cars, trucks, tankers, tramways, annuals and carts and is the most important mode of transport in the industry.

Advantages of Road Transport

Door-to-door service-Road transport provides door-to-door service. Goods can be collected from the centers of production and carried directly to the destination, if it is full truck/lorry load. This is perhaps the most important reason for its popularity. *Loading and unloading charges are reduced in road transport if there is direct transportation of goods to the final destination.*

Suitable for short distance-Road transport generally proves to be quicker and cheaper than railway transport, when the distance involved is small. This is the reason why perishable goods like vegetables, fish, fruits and flowers are generally sent by road transport.

Multiple use of roads-Road transport is convenient for carrying goods to the interiors and remote parts of the country, where other means of transport cannot reach easily and quickly.

Flexibility-Road transport is a flexible means of transport as changes can be made easily, quickly and with limited expenditure. There is no fixed schedule or time table for road transport. Vehicles can move at any time according to the need. Like airways, it is not tied down to fixed routes and time schedules.

Safety-Road transport is reasonably safe and secure, particularly when goods are door delivered without any break and loading and unloading in transit. The possibility of loss due to thefts and breakages is limited.

Disadvantages of Road Transport:

Less reliable -Road transport is less reliable than railways. Breakdowns, road congestions, delays due to road accidents, floods, heavy rainfall etc. make road transport less dependable. It is also affected by weather conditions.

Absence of uniform rates-Road transport is managed by the private sector. The transport charges are not uniform and subject to frequent changes.

Not suitable for long distances-Road transport is inconvenient and uneconomical for transporting heavy, bulky and low value goods over long distance.

Not suitable for bulky goods- Road transport has limited carrying capacity. It is not suitable for carrying heavy and bulky goods, costly and low grade goods.

Railway Transport

Railway transport is the most important and popular means of transport. It is most suitable for long distances and for bulky goods.

Advantages of Railway Transport

High speed- Railways has considerable speed because of the use of electricity and automation, straight railway lines and absence of disturbances on railway tracks. Due to high speed, a lot of time in transportation is saved. Goods can be taken quickly to faraway places.

High carrying capacity- railways have very large carrying capacity and, therefore, bulky goods can be taken economically from one place to another like food grains, fertilizers, petrol etc.

Regularity of service-railways offers regular, reliable and dependable service. Railway is a public utility. It has a fixed time table from which it does not deviate.

Transport charges-railways are owned and managed by the state. Naturally railway freight rates are low and also uniform in all parts of the country.

Dependable- railway network operates regularly and continuously, as per fixed schedule. Railway is less affected by weather conditions and is a dependable mode of transport.

Disadvantage of Railway Transport

Absence of flexibility-railway transport is rigid and lacks flexibility. Railway provides transport facilities only between certain fixed points. It carries goods from one railway station to another only.

3. Water Transport

Ninety per cent of the world's international trade is transported by sea. The customs and practice associated with this form of transport have been refined over centuries of worldwide trade.

Sending cargo by sea is ideal for high-volume cargoes that are not necessarily time sensitive or have long lead times for delivery. However, this mode of transport is slow and fraught with possibilities for delay.

Water transport (rivers, canals, sea and creek) is the oldest, cheapest and the most natural means of transport. Water transport is suitable for carrying bulky and low cost goods. There are two kinds of water transport: Inland water transport and Ocean transport

a. Inland water transport-

It includes river transport and canal transport and useful for internal transportation of goods. **In river transport**, rivers are used for internal transport of passengers and goods. Small boats and steamers are used for this purpose. This transport is cheap and convenient. **Canals** are the artificial waterways specially constructed for navigation and irrigation. The well-known Suez Canal in Egypt is the finest example of the use of canal for transportation. This type of transportation is mainly useful for local transportation. Like river transport, it is cheap and safe.

b. Ocean transport

Ocean transport refers to the transport facilities in the open sea. Big passenger ships, cargo ships, tankers and tramps are used in ocean transport.

Ocean transport is classified into two categories, namely ***coastal shipping*** and ***overseas shipping***. ***Coastal shipping*** is possible in the case of countries where borders touch the sea shores and is carried by big ships and boats. It is an economical means of transport and generally restricted to the national shipping companies.

Overseas shipping is the transportation between different countries.

Advantages Ocean Transport

Cheapness-ocean transport is the cheapest mode of transport. It is the only means of transport available for transportation between different countries which are separated by sea. Ocean transport is economical, as it is a natural means of transport.

Suitability-it is very suitable for carrying bulky goods over a long distance. It is convenient for transportation of goods between different countries.

Disadvantages of Ocean Transport

Cargo carried by sea is subject to deterioration in quality because sea water is corrosive.

Sea transport requires strong and much better packing of goods.

Sea transport runs the risk of losses due to inclement, weather choppy seas and possibly of shipwreck.

Air Transport

Air transport has made a revolution in the field of transport. It has made the world smaller.

Merits of Air Transport

High speed: - Air transport is the speediest of all means of transport. A lot of time is saved due to air transport.

Suitable for light/valuable articles-Air transport is particularly suitable for movement of delicate and perishable goods.

Low packaging cost- Air transport entails low packaging cost, which partially offsets the higher freight cost.

Lower lead time- Being the fastest mode of transport, it reduces lead time and therefore enables the firm to operate with smaller inventories.

Demerits of Air Transport

High cost of operation- freight rates are very high due to high operational cost.

Unreliable-Air transport is also uncertain and unreliable. Flights are cancelled very often due to unfavorable weather conditions. Cancellation of flights is very common during the rainy season and in winter due to heavy rainfall, snow, fog etc.

Lacks flexibility- Air transport lacks flexibility. It provides service from one airport to the other. As a result, air transport needs the support of other means of transport.

Pipeline

Used to transport Liquids and Gases (i.e. Oil, Natural Gas)

Although transportation is slow (3-4 miles per hour), the ability to operate 24 hours a day makes it an efficient transportation mode of these product types.

Weather conditions do not influence pipeline operations and limited technical problems may occur.

Activity: -

Mention advantage & disadvantage for each of the transport modes.

7.2.2 Method of selection

Correct selection of the mode of transport requires a comparative study of all mode's vis-a-vis to merits and demerits. The broad approach is split into four key stages, covering operational factors, transport mode characteristics, consignment factors, and cost and service requirements.

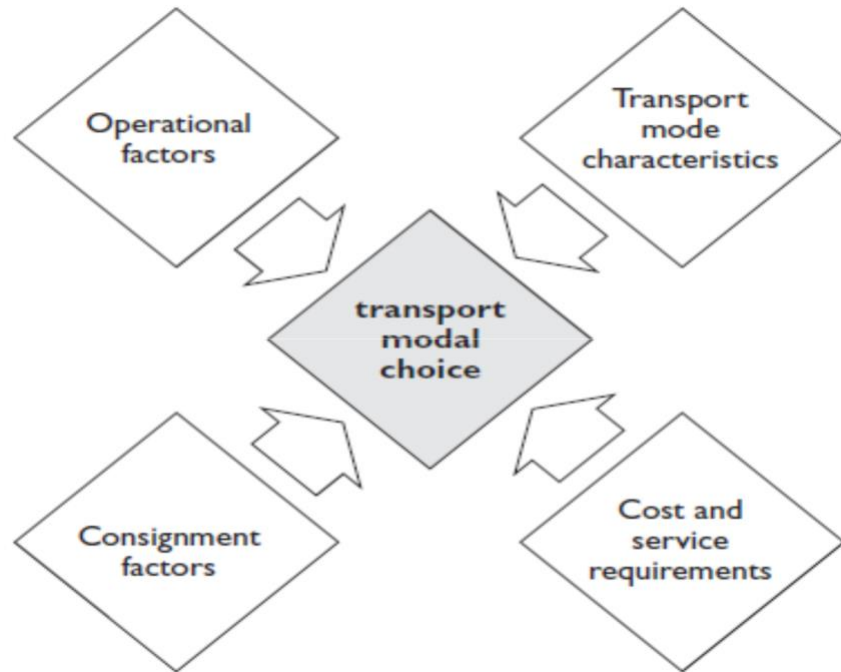


Fig. 7.1: - factors which affects modes selection

1. Operational Factors

External factors

Encompassing the many operational factors that may need to be considered are those that are external to direct distribution-related factors. These are particularly relevant when contemplating the international context of modal choice because from country to country these factors can vary significantly. They include:

The basic infrastructure in the country. In particular, the transport infrastructure is likely to be important. For example, opportunities to use rail will be significantly affected by the rail network that exists within a country. Many countries have limited track availability, whilst others may have mainline track but an insufficient number of railheads or railheads in inappropriate locations for industrial or commercial use.

Trade barriers. These might include, for example, customs duty, import tariffs or quota payments. These can have a big impact on the overall cost of a product, and this may affect the decision concerning the most appropriate mode of transport for cost reasons.

Export controls and licenses. With these, there may be implications for the quantity of product that can be shipped in given periods of time.

Law and taxation. Clearly, legal requirements in both a general and a specific context are likely to differ from one country to another.

Financial institutions and services, and economic conditions. Elements such as exchange rate stability and inflation, for example, can influence modal choice. Where financial changes occur at a dramatic rate in a country then speed of delivery may be important.

Communications systems. These can have an impact, for example, on the supporting processes and paperwork of freight movements. Delays can be more likely with some modes of transport. For example, sea freight can have particularly lengthy and onerous procedures.

Culture. Differing cultural aspects may influence how trade and commerce are undertaken. For example, the choice of transport mode may rest on ownership rather than cost- effectiveness.

Climate. Extremes of weather, temperature and humidity can have a major impact on some products. Thus, modes of transport must be selected carefully to ensure that prevailing climatic conditions do not badly affect freight whilst it is in transit. Suitable protection must be guaranteed.

Customer Characteristics

The main customer characteristics to take into account are:

Service level requirements. Some service level requirements can have a significant impact on choice of transport mode. Delivery time constraints can mean that certain relatively unreliable modes cannot be considered. This may occur when there is a need for delivery to be at a certain time or on a certain date, or when a specific time delivery window is stipulated. It is very common in retail delivery operations.

Delivery point constraints. This factor is a very important one. It refers particularly to the physical aspects of delivery, including the location of the delivery point, any access constraints concerning the size of vehicle that can make the delivery and any equipment requirements for unloading. Once again, these are common problems in retail delivery.

Credit rating. The credit rating of a customer may help to impose a limit on route selection and modal choice. New customers and existing customers with a poor credit rating mean that a company will want to be sure that payment is confirmed before delivery is made. Thus, commercial arrangements may override any logistical preference for a particular transport method.

Terms of sale preference. There are a number of different terms of sale that can be used, ranging from ex works (at the supplier factory) to delivered duty paid (at the customer's delivery point). The terms of sale preferred by a customer therefore have a very large implication for the choice of transport mode – and of course who makes that choice, the supplier or the customer. The different terms of sale (Incoterms) are outlined later in this chapter.

Order size preference. The physical size of an order clearly has an impact on modal choice, as some modes are more suitable for small orders and others for large ones. There may be significant cost implications here.

Product knowledge. Some products or orders may necessitate some knowledge transfer to the customer at the time of delivery. This may relate to the need to assemble the product in some way, or how to use the product. It is not likely to be an element that affects many orders, but would be important to route and modal choice where it does.

C. Physical nature of the product

The main factors that need to be considered include:

Volume to weight ratio – which concerns the relative amount of cubic capacity taken up by a given weight of product. For example, 1 ton of paper tissues take up far more space than 1 ton of bricks. This is relevant when considering the different charging structures of the different transport modes – whether charged by weight or by cubic volume. For example, 1 ton is normally charged the same as 1 cubic meter for sea freight, but the same as 6 cubic meters for air freight. Heavy goods are thus relatively more expensive by air freight.

Value to weight ratio – which takes into account the value of the product to be transported. The relative transport cost of a high-value, low-weight product is likely to be so insignificant to the overall value of the product that the choice of mode from a cost perspective is irrelevant (eg jewelry or computer chips).

Substitutability (product alternatives) – whereby, if a product can be substituted by an alternative from another source, it may be worthwhile using a fast but expensive mode of transport to ensure the order is accepted by the customer. Where no substitute is possible, a slower and less expensive mode can be used.

Special characteristics (hazard, fragility, perishability, time constraints, security). A hazardous product may be restricted in how it is allowed to be transported (eg some chemicals), and a time-constrained product may have to be moved on a fast and expensive mode of transport to ensure it does not miss its time deadline (eg newspapers and promotional products).

Transport mode characteristics

Speed of transport- Air transport is the speediest among the modes of transport. Railways ranks next for speed where long distances (over 500 km) are involved, followed by road transport. However, over short distances, road transport is faster than the rail transport.

Cost of service- Inland waterways is the cheapest method of transport and air transport is the costliest. If the freight cost of inland waterways is taken as base, then the freight cost is almost twice the cost of inland waterways and Rail transport is two times costlier than inland waterways, road transport is two times costlier than rail transport and four times costlier than Waterways, Air transport is 40 times costlier than water transport, 20 times costlier than rail transport and 10 times costlier than road transport.

Flexibility of service- Road transport provides the maximum flexibility of service compared to any other mode of transport. Its route and times can be adjusted to the needs of the customers. It offers door-to-door service, which reduces carting expenses and loading and unloading charges.

Regularity of service- Railways ranks the first among all modes of transport in terms of regularity of service. Railway transport is a public utility. It has a fixed time schedule, from which it does not deviate. Air transport may be placed second (next to railways), road transport third and water transport fourth, considering regularity of service.

Activity: mention

Basic external factors which affects transport modes selection and Characteristics transport modes which affects modes selection.

3. Consignment Factors

There are important consignment or route factors that may have an impact on the final decision concerning the best mode of transport for each individual shipment. These are specific elements related to the order or load that may influence the choice of transport mode. The main factors include those that are noted below:

Routing and through transit responsibility:

Is a direct route stipulated by the customer?

Are there countries through which the shipment may not travel?

Who is responsible for the through transit?

Who is paying for the freight costs?

Distance:

What is the distance to be moved?

Does distance restrict the options that are available?

Type of cargo:

If it is bulk or general cargo, will a certain specific route be preferable?

If it is bulk or general cargo, are certain routes cheaper?

Does the cargo have specific features that make certain routes more attractive (perishable, high value)?

If hazardous, are all routes available?

Quantity:

full load;

part load;

Small size, etc.

Unit load:

Will unitization help?

Is it a small or large unit load?

Is containerization feasible?

Is group age an alternative?

Priority:

How soon must the goods reach their destination?

Does 'Urgent!' really mean 'Urgent!'?

Who pays the freight costs for an urgent order?

Commodity value:

How important is the transport cost element?

If it is import/export, how is the commodity rated?

Will a fast, expensive mode enable reduced inventory holding and associated cost savings?

Regular shipments:

How often will these shipments be made?

Should a contract be negotiated or is 'spot hire' adequate?

An Indicative Comparison of Transport Modes

Selecting which modes to combine and how a decision that is based on the following parameters is:

Modes	Parameters				
	Cost (Price)	Delivery Time	Time Variability	Geographical Coverage	Loss & Damage
Rail	3	3	4	2	5
Road	4	2	3	4	4
Sea	1	5	5	1	2
Air	5	1	1	3	3
Pipeline	2	4	2	5	1
Legend	1= cheap 5= expensive	1= fast 5= slow	1= small 5= large	1= good 5= poor	1= safest 5= least safe

7.2.3. Components of Transport Systems

The components of a transportation network can be separated into 3 categories;

Facilities: - facilities are the fixed components of a transportation network. They include:

- User-specific Facilities: Warehouses, Terminals, Distribution Centers, Hubs, Docks, etc.
- Common Facilities: Roadways, Rail tracks, Waterways

Equipment: - Consists of the various parts of a transportation network. Usually equipment belongs and is maintained by the shippers or the carriers and includes: Containers, Trailers, Vehicles (trucks, scooters), Rail (Cars, locomotives), aircrafts, and vessels.

People: - People that are involved in transportation-related or transportation supportive functions are one of the crucial components of transportation networks. Related working positions are Operating Personnel (Drivers, Pilots, etc), Supportive Personnel (Maintenance, Loading/ unloading, etc) and Managerial Personnel (Logistics Directors, Dispatchers, Administration)

7.3. Transport Providers

Warehousing and Transportation of Products / Commodities consist of one of the core procedures in Business Operations. These procedures can be performed by own resources or by external partners:

Common & Private Carriers (distribution)

Freight Forwarders (distribution & storage)

Third Party Logistics Providers (3PL) (integrated distribution & storage)

Each company selects (based on their needs) the types of services to outsource to an external partner.

Common Carriers

A common carrier is a business that transports people and/ or goods, offers its services to the general public under license or authority provided by a regulatory body. Common carriers typically transport persons or goods according to defined and published routes, time schedules and rate tables upon the approval of regulators. Public airlines, railroads, bus lines, cruise ships, motor

carriers (i.e., trucking companies) and other freight companies generally operate as common carriers.

Private carrier

In contrast, private carriers are not licensed to offer a service to the public. Private carriers generally provide transport on an irregular or ad hoc basis for their owners.

It should be mentioned that the carrier refers only to the person (legal or physical) that enters into a contract of carriage with the shipper. The carrier does not necessarily have to own or even be in the possession of a means of transport.

Unless otherwise agreed upon in the contract, the carrier may use whatever means of transport approved in its operating authority, as long as it is the most favorable from the cargo interests' point of view. The carriers' duty is to get the goods to the agreed destination within the agreed time or within reasonable time.

Freight Forwarders

Freight Forwarders are not the classic common carriers. Their business is to:

- Hire “transport space” from transportation means (carriers, ships, etc.)

- Group and integrate loads and shipments

The advantages of the existence of freight forwarders and their provided services can be summarized in the following:

- They succeed in better transport means' capacity utilization (due to consolidation of shipments)

- Consolidation of shipments and the handling of larger integrated loads/ shipments lead to efficient material handling (loading, unloading, transshipment, etc.)

- Due to the consolidation and the transshipment of larger shipments, freight forwarders succeed in lower transport prices with the transport means' operators, leading to minimized cost in comparison with sending smaller shipments by each shipper.

Third Party Logistics (3PL) Providers

A 3PL firm provides outsourced services to companies for part, or sometimes all of their supply chain management function. Typically specialize in integrated operation, warehousing and

transportation services that can be scaled and customized to customer's needs based on market conditions and the demands and delivery service requirements for their products and materials.

Apart from the usual operations (warehousing, collection, distribution, picking, fleet management, etc.) 3PLs also undertake other operations that are related to the transport of goods. The following are some of other services provided by third party;

Assembly service; e.g. PC manufacturers sent the components (monitors, hard drives, etc) of computers to 3PL companies, where the final assembly (and software installation) is taking place and forwarded to the final destination.

Packing; 3PL companies undertake the packing operations of several products to be transported. Additionally, repacking operations (such as containerization, pallets or blister-packing) are performed

Reverse logistic & packing materials return; Due to legislations, packing some packing materials may have to be returned in order to be re-used. Containers may have to be returned to their starting locations (empty or loaded). In addition, Damaged or malfunctioned products should be returned to the shipper.

Issues in Transport Management

Transport Managers / Dispatchers are facing operational issues daily regarding the organization of the transportation network, the management of the fleet and the management of shipments. Some of the problems that should be confronted either in the planning phase of a transportation network or during daily operations is summarized below:

Mode Selection; - Which transport mode to select and how to combine them (intermodal) in order to achieve lower transport costs and better customer satisfaction?

Route Selection: - Route selection determines:

The sequence of customers to visit

The shortest path to follow in order to minimize travel costs and times.

Vehicles may return to starting location or not, multiple origins / destinations may exist, intermediate may exist or not.

Fleet Sizing: - Fleet sizing deals with the tradeoffs between fleet size and customer needs satisfaction. The larger the fleet, response time to demands increases but vehicles utilization decreases. In contrast a limited number of vehicles may not be able to cope with the total demand. Homogeneous or heterogeneous, fleets exist, with different capacities and different capabilities and characteristics.

Vehicle Scheduling: - Vehicle Scheduling deals with time-related options / decisions in routing problems. Main decisions to be answered are what time to send shipments, how many vehicles and when to dispatch them, when to serve customers with specific time-windows, etc.

Shipment Consolidation: - Answers to questions regarding when, where and how to group shipments with same or similar characteristics (i.e. can be loaded to the same vehicle) in order to achieve in minimized transport costs. Shipments can be grouped by time (serve similar customers in same day), inventory (increase order sizes and achieve order discounts) or hub-resource (use an intermediate station - warehouse in order to consolidate shipments and use larger vehicles to their final destinations)

7.4. Transport Documents

Transport documents are the receipts issued by the transport organization to the consigners (or sender of goods) in acknowledgement of the receipt of goods by them and acceptance of responsibility for carrying the goods to the destinations, in return for specified charges which are called freight.

Transport documents contain:

Consignor's and consignee's names and addresses.	Information as to goods carried at Carrier's risk or Owner's risk.
Names of the places of departure and destination.	Details in respect of freight (paid/to-pay).
Details in respect of the goods such as number of packages, their weight, value and nature,	Date on which the document is issued.

The main transport documents used by trade are:

A. Railway Receipt (RR)

is the acknowledgement of receipt of goods by the Railways authorities and acceptance of the responsibility to carry goods to the railway station of the receiver of the goods (consignee). The railway receipt is received by the consigner (sender of the goods). The consignee takes the delivery of goods from the station against the railway receipt. Alternatively, the consigner can route the RR to the consignee through the bank. The bank hands it over to the consignee against the payment of amount stipulated in the invoice. The consigner (i.e. the seller) thus is guaranteed of the payments of the goods sold. The RR is transferable by endorsement.

B. Lorry Receipt (LR)

LR is the acknowledgement of the receipt of goods by the transport organization and acceptance of its responsibility to transport the goods to the consignee (i.e. the buyer). The consignee obtains the delivery of the goods from the transport company against the lorry receipt. The consigner can send the lorry receipt to the consignee through the bank and collect payment for the goods sent.

C. Bill of Lading

A bill of lading is a contract for the carriage of goods from the port of dispatch to the port of destination. It is either signed by the captain of the ship or by the ship owners. It is prepared on the basis of the *Mate's Receipt*, which is given by the ship-owners to the consigner, when the former hands over the goods on the ship. Then the consigner or the shipper gets the bill of lading from the ship-owners, against the submission of the Mate's Receipt. It is issued in triplicate, is transferable by endorsement and delivery can be sent through a bank to collect payment of goods. A bill of lading may be qualified or clean. A *qualified bill* means that the ship-owners have found the packing unsatisfactory. A clean bill indicates that the packing of goods is properly done.

D. The Air Consignment Note or Airway Bill

It is an acknowledgement of receipt of the cargo and acceptance of the responsibility, by the airlines for carriage of the goods under the specific conditions of the carriage. The airway bill is issued in triplicate. One copy is retained by the carrier, one copy signed by both the carrier and the consigner accompanies the goods and the third copy is to be kept by the consigner. The airway bill has the following particulars.

The place and date of issue

The places of departure, destination and stoppages

- The names and addresses of the consigner and the consignee
- The particulars of goods
- The numbers of packages, their weight, quantity, volume, dimensions etc.
- The apparent conditions of the goods
- The amount of freight and person liable to pay

Chapter summary

Logistics is the art and science of strategically managing and controlling the flow of goods, energy, information and other resources like [products](#), [services](#), and people, from the source of production to the marketplace. Logistics is the “process of planning, implementing, and controlling the efficient, effective flow and storage of goods, services, and related information from point of origin to point of consumption for the purpose of conforming to customer requirements.” Among the logistic activities, the major component is materials movement. Materials movement can be implemented through by one of the following modes of transport; road transport, water transport, railway transport, air transport, & pipe line.

Self-check Exercise 7

Part I: - Multiple Choose

_____ is a mode of transport which provides door-to-door service and suitable for its flexibility.

A. Road transport

C. Airway transport

B. Railway transport

D. Inland water transport

2. Among the following, which one does not determine transportation cost:

A. Value of the product

D. Special services required

B. Volume of goods moved

E. All of the above F. None

C. The place of goods transported

of the above

3. Transportation Planning should target on:

A. Cost minimization

C. Productivity Efficiency

B. Customer Satisfaction

D. All of the above

All are advantages of Air transportation except;

High speed

Less damage & theft possibility

Capacity to carry bulky shipment

None of the above

Low packaging cost

Which one of the following is among the transport modes characteristic that affects modes selection;

A. Cost of modes service

D. Regularity of service

B. Speed of transport

E. All

Flexibility of service

All are classified under components of a transportation facilities except;

A. Vehicles

C. Distribution Centers

B. Warehouses

D. Rail tracks

Part II. Short answer & discuss

7. Discuss the difference between common private carriers.

8. What we mean third party logistic & what are the services they provide?

9. Why transport documents required?

Answer key

1. A

4. B

2. F

5. E

3. D

6. A

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