MATERIALS MANAGEMENT

Unit I

Introduction to integrated materials management – organisation for materials Management, Materials – planning – Budgeting – Applications of Forecasting Techniques – exponential Smoothing – Time Series Analysis – Materials Management – Purchase Policies, Purchase procedures, Development of Source. Import Substitution for rating.

Unit II

Price trends – make or by decision. Capital equipment purchases. International buying and Import procedure. Legal aspects of Purchase DGS & D Organisation, Policies and Procedure Purchase ethics, value analysis, codification and Standardisation.

Unit III

Introduction to Inventory Control – Inventory costs – Selective Control (ABC analysis, VED analysis etc.) Inventory models – EOQ Model – Modification of EOQ under different conditions (Price discounts, working capital restriction, Space restrictions, no.of. orders restrictions).

Unit IV

Dynamic inventory models Q system, P – Systems, Z bin systems, concept of safety stock. Determination of safety stock for variation in consumption during lead time. Variation in lead time. Determination of service level based on cost optimization. Application of simulation in inventory control. Spares planning and control.

Unit V

Storage and preservation stores accounting, verification, valuation, disposal of surplus and scrap material, performance evaluation of material management.

Suggested Readings:

1. Material Management – An integrated Approval Gopalakrishnan and Sundaresan.
2. Stores Management and Logistics – Gopalakrishnan and M.Sandiya
3. Integrated Materials Management – Gather
4. Scientific Inventory Management – Buchan and Kolnigsbar
5. Purchasing and materials management, Text and cases – lamer lie and Donald W. Dubber.

UNIT I

1. Definition of Materials:

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.

Definition on Material Management: Material management deals with controlling and regulating the flow of materials in relation to changes in variables like demand, prices, availability, quality, delivery schedules etc.

Objects of materials management:

1. Minimization of materials costs

2. To reduce inventory for use in production process and to develop high inventory turnover ratios.

3. To procure materials of desired quality when required, at lowest possible overall cost of the country. 4. To reduce paper work procedure in order to minimize delays in procuring materials.

5. To note changes in market conditions and other factors affecting the concern.

6. The purchase, receive, transport, store materials efficiently

7. To reduce cost, through simplification, standardization, value analysis etc.

8. To conduct studies in new areas e.g., equality consumption and cost of materials so as to minimize cost of production.

Function of Materials Management:

1. Materials planning and programming

2. Purchasing materials inspection of materials

3. Inspection of Materials

4. Classification, codification and standardization in stores

5. Storage of materials

6. Issuing of materials

7. Maintence of proper inventory records

8. Materials receiving

1.1 Material management:

Materials management can deal with campus planning and building design for the movement of materials, or with logistics that deal with the tangible components of a supply chain. Specifically, this covers the acquisition of spare parts and replacements, quality control of purchasing and ordering such parts, and the standards involved in ordering, shipping, and warehousing the said parts.

Some Definitions of Materials Management:

(i) 'Materials Management' is a term used to connote "controlling the kind, amount, location, movement and timing of various commodities used in production by industrial enterprises".

(ii) Materials Management is the planning, directing, controlling and coordinating those activities which are concerned with materials and inventory requirements, from the point of their inception to their introduction into the manufacturing process.

It begins with the determination of materials quality and quantity and ends with its issuance to production to meet customer's demand as per schedule and at the lowest cost.

(iii) Materials Management is a basic function of the business that adds value directly to the product itself

(iv) Materials Management embraces all activities concerned with materials except those directly concerned with designing or manufacturing the product.

(v) Materials Management deals with controlling and regulating the flow of material in relation to changes in variables like demand, prices, availability, quality, delivery schedules etc.

Thus, material management is an important function of an organisation covering various aspects of input process, i.e., it deals with raw materials, procurement of machines and other

equipment's necessary for the production process and spare parts for the maintenance of the plant. Thus in a production process materials management can be considered as an preliminary to transformation process.

It involves planning and programming for the procurement of material and capital goods of desired quality and specification at reasonable price and at the required time.

It is also concerned with market exploration for the items to be purchased to have up to date information, stores and stock control, inspection of the material received in the enterprise, transportation and material handling operations related to materials and many other functions. In the words of Bethel, "Its responsibility end when the correct finished product in proper condition and quantity passes to the consumer."

(i) Planning and programming for materials purchase.

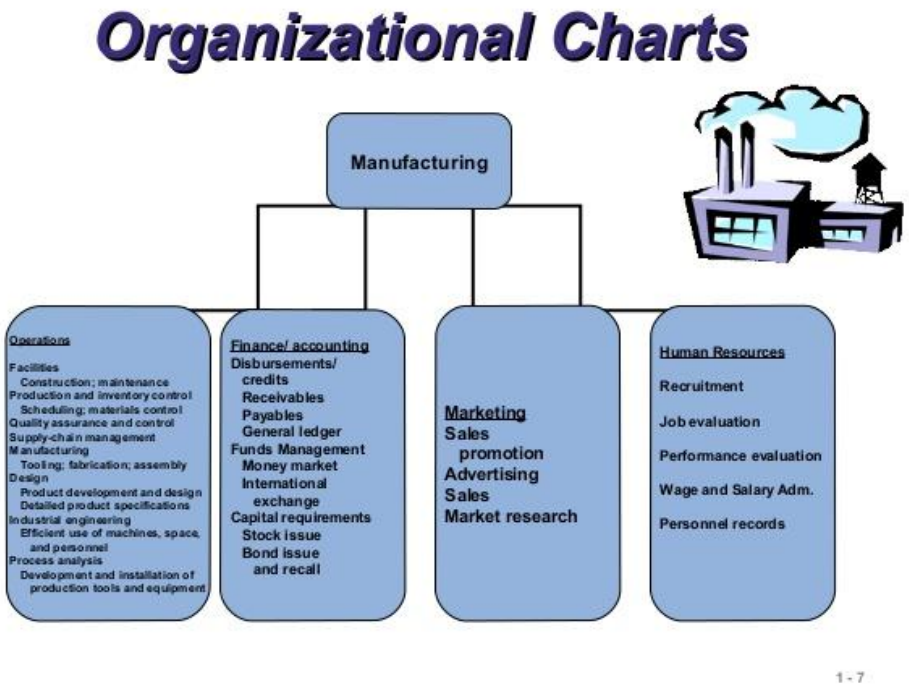
(ii) Stores and Stock control.

(iii) Receiving and issue of the material.

(iv) Transportation and material handling of the material.

(v) Value engineering and value analysis.

(vi) Disposal of scrap and surplus materials.



❖ ***Objectives of Materials Management:***

Materials management contributes to survival and profits of an enterprise by providing adequate supply of materials at the lowest possible costs.

The fundamental objectives of materials management activities can be:

(i) Material Selection:

Correct specification of material and components is determined. Also the material requirement in agreement with sales programme are assessed. This can be done by analysing the requisition order of the buying department. With this standardisation one may have lower cost and the task of procurement, replacement etc. may be easier.

(ii) Low operating costs:

It should endeavor to keep the operating costs low and increase the profits without making any concessions in quality.

(iii) Receiving and controlling material safely and in good condition.

(iv) Issue material upon receipt of appropriate authority.

(v) Identification of surplus stocks and taking appropriate measures to produce it.

The outcome of all these objectives can be listed as given below:

(i) Regular uninterrupted supply of raw-materials to ensure continuity of production.

(ii) By providing economy in purchasing and minimising waste it leads to higher productivity.

(iii) To minimise storage and stock control costs.

(iv) By minimising cost of production to increase profits.

(v) To purchase items of best quality at the most competitive price.

The Integrated Materials Management evolved as a rationale for bringing all the materials related activities under one common head. The Materials Manager to permit uninterrupted flow of raw materials, components & parts from the suppliers to the corporation, to all consumer points in the organization & distribution of finished goods at minimum cost.

The areas which come under the framework of Integrated Materials Management are:

- Materials Planning/Materials Requirement Planning
- Purchasing
- Receiving & Inspection
- Storekeeping & Warehousing
- Inventory Control

- Materials Handling and Transportation, including Logistics & Physical Distribution Management
- Scrap & Surplus Control and Disposal
- Cost Reduction Techniques like Value Analysis, Standardisation, Variety Reduction etc.
- Forecasting & Market Analysis

Integrated MM also encompasses Production Planning on one hand & Distribution of finished goods to customers on the other. Companies which have these activities transferred under the Integrated MM set-up, have found encouraging results by the way of improved coordination & reduced inventories.

Functions Integrated Materials Management:

Various functions served by materials management include the material planning, purchasing, receiving, stores, inventory control, scrap and surplus disposal. All these functions can have separate working norms including the one for performance.

Efficient management of input materials is of utmost importance in a business organization for maximizing materials productivity, which ultimately adds to the profitability of the organization.

This requires well co-ordinated approach towards various issues involving decision making with respect to materials. All the materials related activities such as material planning & indenting, purchase systems & procedure, variety reduction through standardization & rationalization, reducing uncertainties in demand & supply.

Handling & transportation, inspection, proper storage & issue of materials to the internal customers, inventory management, vendor management & finally disposal of obsolete, surplus & scrap materials etc. taken together is termed as **Integrated Materials Management.**

For example, **while inventory manager** would like to have minimum level of inventory to show of his performance, Purchasing manager would like to place bulk orders in order to lessen his work load and show discounts as reductions. Both of these acts may be little contradictory from the organisational point of view. That is if some of the functions were to be handled separately, a conflict of interests may occur.

Therefore, the conflicting objectives need to be balanced and intertwined from a total organisational viewpoint so as to achieve optimum results for the organisation as a whole.

In an integrated set up, one materials manager (usually the chief) is responsible for all such inter related functions and he is in a position to exercise control and coordinate all the activities with a view to ensure proper balance of the conflicting objectives of the individual functions.

Integration also attains the synergetic advantage in terms of eliminating water tight compartments that set in in a disjointed environment of working. The resulting benefits can be seen in terms of rapid transfer of data, through effective and informal communication channels.

Integrated Material management

It is well co ordinated approach towards v arious issues such as material planning, reducing uncertainties in demand and supply transportation, inspection, proper storage & manage issue of materials and finally disposal of obsolete, surplus & scrap materials etc.,

Sequence in Material Management

- Forecasting the requirements
- Making stocking policies
- Vendor evaluation
- Release of order
- Receipt of materials
- Handling issue of maintainence
- Inventory control

Integrated Materials Management

All the materials related activities such as material planning & indenting, purchase systems & procedure, variety reduction through standardization & rationalization, reducing uncertainties in demand & supply, handling & transportation, inspection, proper storage & issue of materials to the internal customers, inventory management, vendor management & finally disposal of obsolete, surplus & scrap materials etc. taken together is termed as Integrated Materials Management.

Tangible Advantages:

- Better accountability
- Better coordination
- Better performance
- Better adaptability to EDP

Intangible Advantages:

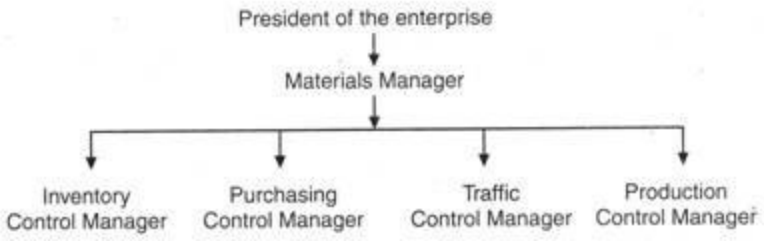
- Noticeable team spirit
- Morale and cooperation

Logical sequence in Materials management:

- Forecasting the requirements
- Deciding stocking policies
- Vendor evaluation/source selection
- Release of orders
- Follow up of orders
- Receipt of materials
- Issue/stock of maintenance
- Stock accounting
- Inventory control

1.2 Organization of Materials Management:

To facilitate planning, direction, control and co-ordination of various activities related to material in an enterprise there should be a separate department of materials management. The organisational structure of the department can be.



There can be more sub-sections of the department but in general, materials manager controls the four major sections and is responsible for reporting to the president of the organisation.

Goal

The goal of materials management is to provide an unbroken chain of components for production to manufacture goods on time for the customer base. The materials department is charged with releasing materials to a supply base, ensuring that the materials are delivered on time to the

company using the correct carrier. Materials is generally measured by accomplishing on time delivery to the customer, on time delivery from the supply base, attaining a freight, budget, inventory shrink management, and inventory accuracy. The materials department is also charged with the responsibility of managing new launches.

In some companies materials management is also charged with the procurement of materials by establishing and managing a supply base. In other companies the procurement and management of the supply base is the responsibility of a separate purchasing department. The purchasing department is then responsible for the purchased price variances from the supply base.

In large companies with multitudes of customer changes to the final product over the course of a year, there may be a separate logistics department that is responsible for all new acquisition launches and customer changes. This logistics department ensures that the launch materials are procured for production and then transfers the responsibility to the plant materials management

Materials management is not a science and depending upon the relevance and importance that company officials place upon controlling material flow, the level of expertise changes. Some companies place materials management on a level whereby there is a logistics director, other companies see the importance level as managing at the plant level by hiring an inventory manager or materials manager, and still other companies employ the concept that the supervisors in the plant are responsible accompanied by a planners.

The major challenge that materials managers face is maintaining a consistent flow of materials for production. There are many factors that inhibit the accuracy of inventory which results in production shortages, premium freight, and often inventory adjustments. The major issues that all materials managers face are incorrect bills of materials, inaccurate cycle counts, un-reported scrap, shipping errors, receiving errors, and production reporting errors. Materials managers have striven to determine how to manage these issues in the business sectors of manufacturing since the beginning of the industrial revolution. Although there are no known methods that eliminate therefore mentioned inventory accuracy inhibitors, there are best methods available to eliminate the impact upon maintaining an interrupted flow of materials for production.

MATERIAL MANAGEMENT PLAN AND DESIGN

Materials management plans and designs for the delivery, distribution, storage, collection, and removal of occupant-generated streams of materials and services. It is usually an

additional service that is offered as part of a campus planning process or a building design project. It is most beneficial for university, health care, and corporate environments. Materials management looks at the planning and design considerations needed to support the efficient delivery and removal of goods and services that support occupant activity. The streams of occupant-generated materials and activity include mail, office supplies, lab supplies, food, special deliveries, custodial services, building supplies, waste and recycling, and service calls.

A materials management plan may include planning guidelines or full design for the following:

- Truck delivery and service vehicle routes, to reduce vehicle / pedestrian conflict
- Loading docks and delivery points, to increase accommodation and reduce queuing and vehicle idling
- Recycling, trash, and hazardous waste collection and removal, to increase waste diversion and reduce costs
- Service equipment and utility infrastructure relocation or concealment, to improve aesthetics and realize landscaping goals
- Regulatory and operation planning

Benefits

The effective materials management plan builds from and enhances an institutional master plan by filling in the gaps and producing an environmentally responsible and efficient outcome. An institutional campus, office, or housing complex can expect a myriad of benefits from an effective materials management plan. For starters,there are long-term cost savings, as consolidating, re-configuring, and better managing a campus' core infrastructure reduces annual operating costs. An institutional campus, office, or housing complex will also get the highest and best use out of campus real estate.

An effective materials management plan also means a more holistic approach to managing vehicle use and emissions, solid waste, hazardous waste, recycling, and utility services. As a result, this means a "greener," more sustainable environment and a manifestation of the many demands today for institutions to become more environmentally friendly. In fact, thanks to such environmental advantages, creative materials management plans may qualify for LEAD Innovation in Design credits.

And finally, an effective materials management plan can improve aesthetics. Removing unsafe and unsightly conditions, placing core services out of sight, and creating a more pedestrian-

friendly environment will improve the visual and physical sense of place for those who live and work there.

1.3 MATERIALS PLANNING AND BUDGETING

Material planning

Material requirements **planning** (**MRP**) is a very useful technique and it is used by all kinds of production and manufacturing industries for **materials planning and budgeting**. ... production and manufacturing.

Material Management:

The objective of materials management is to have the right material required for manufacturing, or production, in the right amount, at the right place, and at the right time, and, as we have already noted, this implies that the what, how much, and when of material requirements must be determined first. This is the basic objective of planning and budgeting function. The questions that must be answered are the following:

1) Which material inputs must we get?

Note: The inputs required are dependent on the outputs/end products planned to be manufactured.

2) How much of each of these inputs do we need, and based on how much is available in stores and/or has already been ordered (inventory on hand and or order), how much of each of these should be ordered? The gross requirements of each of the required material inputs is calculated first and the net requirements are derived by subtracting from it the on hand and on order inventory.

3) When should the orders for each of these material be placed?

Note: This decision is dependent on

(i) where in the manufacturing process for the end product is the particular material required, namely, the crankshaft forging for the machining of the crankshaft prior to its assembly with the piston, cylinder etc. for the engine subassembly of the automobile, and

(ii) the lead times for procurement and manufacturing, namely procurement lead times for raw materials (including for sand castings) and purchased, or bought-out, components

and subassemblies, and manufacturing lead times for the in-house manufactured components and assembly operations, both subassemblies and final assembly. Materials requirement planning (MRP) is a computational technique that converts the master schedule for the end products (MPS) into a detailed schedule for the raw materials and components used in the end products. The detailed schedule identifies each raw material and component item required for a particular end product. It also determines when each of these items must be ordered by the factory and delivered by the vendor/supplier to the factory so as to meet the planned completion date for the end product as per the MPS. The underlying concepts for the techniques collected and unified by Orlicky under MRP in the early 1960's had been known for many years, but they could not be fully exploited without the data processing power of the modern computers. Its early application, in the 1960's, was a bill of material explosion technique (desegregation of the end product) for determining the time-phased requirement of the components and subassemblies (for the quantity of end product given in the MPS) and a method of releasing manufacturing and purchase order to the shop and vendors/suppliers. Orlicky called the technique 'time-phased material requirements planning'. Before we take up the discussion the MRP technique, we must note the distinction between independent and dependent demand inventory item. This is necessary since this distinction is basic to the MRP technique.

Production and manufacturing are terms used to describe a set of processes used for converting raw materials into finished products. These raw materials, or inputs, under number of stages of conversion, with each stage using a particular production, or manufacturing, process, and at each stage, the material(s) undergoes conversion and assumes a different form. The effective management of production and manufacturing must provide finished, or end, products of the required quality, and in appropriate quantities to satisfy the demand for the products, at the desired times and at a reasonable cost. Thus production and manufacturing planning and control functions are concerned primarily with the aspects of quantity or volume, delivery or timing, quality and cost.

Production and manufacturing, Technically, manufacturing and production are the same, but whereas the term manufacturing can be used for any kind of production, it is generally used in cases where discrete products are produced. Such products are usually engineered products like automobiles, aircraft's, refrigerators, machine tools, heavy, medium and light machines, televisions, radios and appliances, and manufacturing is the process of transformation of raw materials into these discrete engineered

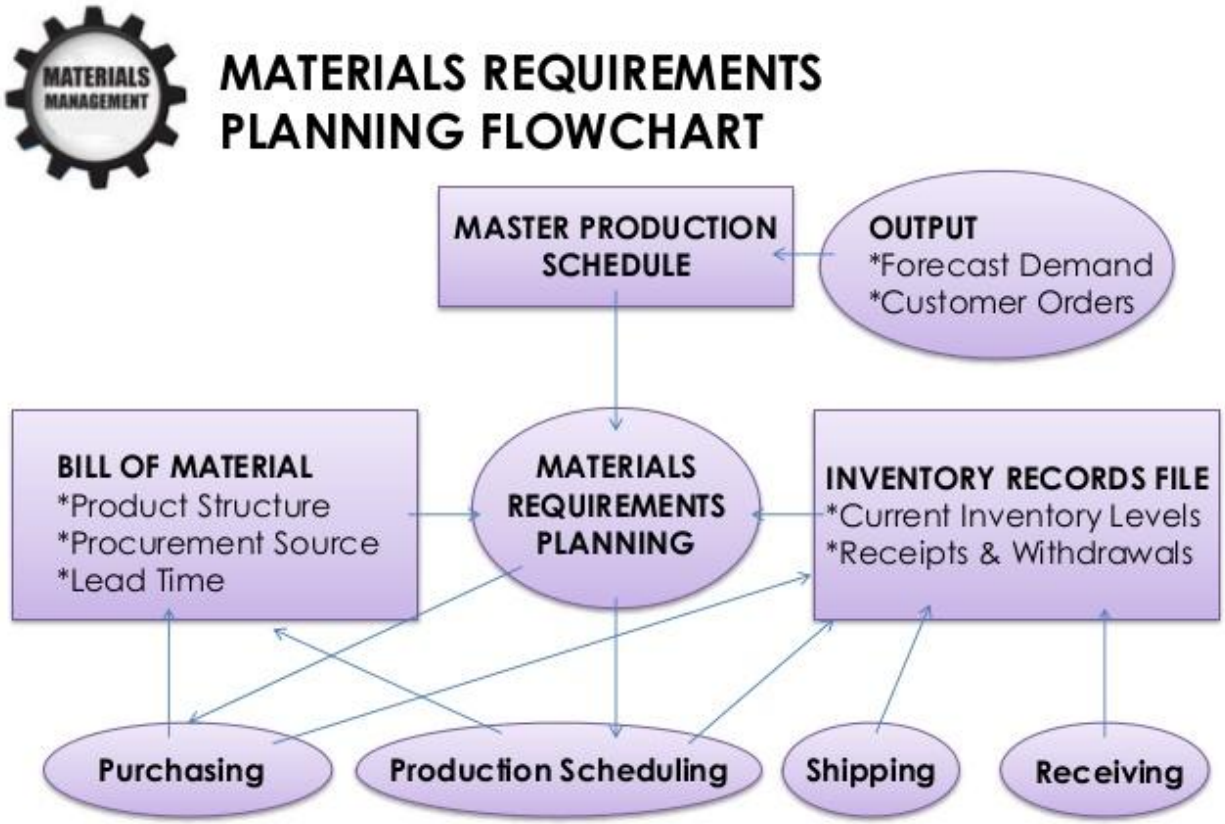
products. These products are distinctly different from bulk materials and products such as steel, fertilizer, chemicals, cement and pharmaceuticals. The important there is that material in various forms, such as ores, raw stock, raw materials in the form of bars, plates, sheets, angles etc., purchased components and sub assemblies, and in-house manufactured component and subassembly, is the essential input, and production of bulk materials and manufacturing of discrete products can only be carried out effectively if, and only if, the requirements of various materials are adequately planned, budgeted and controlled. Material planning and budgeting is the starting point and the most important activity of materials management. If the planning of the requirements of various material inputs is either wrong or untimely, then the functions of manufacturing planning and control are most adversely affected. Materials planning deals with a number of critical questions, which include the following:

i) whether to make a component/subassembly or an intermediate product, in house, or buy from an external vendor/supplier?

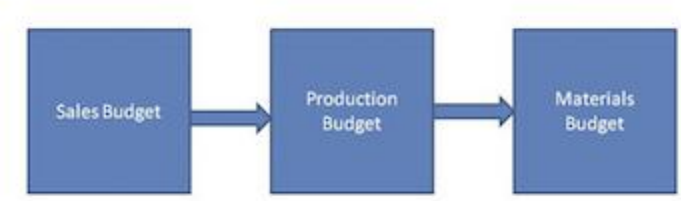
ii) How much to order? or how much to order every time an order is placed?

iii) When to order? or how frequently to place orders for that material? Moreover, the amount of order will depend on the stock, or inventory, in hand and on order.

The elements of the task of materials planning and budgeting for production of bulk materials and products differ (and at times quite significantly) from that for the manufacture of discrete products. The procedures and algorithms used for planning, budgeting and control are also somewhat different. In this unit, we will discuss the various aspects of materials planning and budgeting in manufacturing and production. However, before we can take up the details of materials planning and budgeting in manufacturing industries, and in continuous process industries engaged in the production of bulk materials and products, we must briefly discuss the management of production and manufacturing. We must also identify the links and interfaces of materials planning and budgeting with purchasing and stores, one hand, and materials control, on the other. The material requirements planning algorithm will be discussed in detail in this unit.



Material Budget:



The make-or-buy decision is the act of making a strategic choice between producing an item internally (in-house) or buying it externally (from an outside supplier). The buy side of the decision also is referred to as outsourcing. Make-or-buy decisions usually arise when a firm that has developed a product or part—or significantly modified a product or part—is having trouble with current suppliers, or has diminishing capacity or changing demand.

Make-or-buy analysis is conducted at the strategic and operational level. Obviously, the strategic level is the more long-range of the two. Variables considered at the strategic level include analysis of the future, as well as the current environment. Issues like government regulation, competing firms, and market trends all have a strategic impact on the make-or-buy decision. Of course, firms should make items that reinforce or are in-line with their core competencies. These are areas in which the firm is strongest and which give the firm a competitive advantage.

Make-or-buy decisions also occur at the operational level. Analysis in separate texts by Burt, Dobler, and Starling, as well as Joel Wisner, G. Keong Leong, and Keah-Choon Tan, suggest these considerations that favor making a part in-house:

- Cost considerations (less expensive to make the part)
- Desire to integrate plant operations
- Productive use of excess plant capacity to help absorb fixed overhead (using existing idle capacity)
- Need to exert direct control over production and/or quality
- Better quality control
- Design secrecy is required to protect proprietary technology
- Unreliable suppliers
- No competent suppliers
- Desire to maintain a stable workforce (in periods of declining sales)
- Quantity too small to interest a supplier
- Control of lead time, transportation, and warehousing costs
- Greater assurance of continual supply
- Provision of a second source
- Political, social or environmental reasons (union pressure)
- Emotion (e.g., pride)

Factors that may influence firms to buy a part externally include:

- Lack of expertise
- Suppliers' research and specialized know-how exceeds that of the buyer
- cost considerations (less expensive to buy the item)
- Small-volume requirements
- Limited production facilities or insufficient capacity

- Desire to maintain a multiple-source policy
- Indirect managerial control considerations
- Procurement and inventory considerations
- Brand preference
- Item not essential to the firm's strategy

The two most important factors to consider in a make-or-buy decision are cost and the availability of production capacity. Burt, Dobler, and Starling warn that "no other factor is subject to more varied interpretation and to greater misunderstanding" Cost considerations should include all relevant costs and be long-term in nature. Obviously, the buying firm will compare production and purchase costs. Burt, Dobler, and Starling provide the major elements included in this comparison. Elements of the "make" analysis include:

- Incremental inventory-carrying costs
- Direct labor costs
- Incremental factory overhead costs
- Delivered purchased material costs
- Incremental managerial costs
- Any follow-on costs stemming from quality and related problems
- Incremental purchasing costs
- Incremental capital costs

Cost considerations for the "buy" analysis include:

- Purchase price of the part
- Transportation costs
- Receiving and inspection costs
- Incremental purchasing costs
- Any follow-on costs related to quality or service

Capital equipment refers to long-lasting goods a firm acquires and owns that are not consumed in the normal course of business. These may include assets such as machines, trucks, large computers, and office furniture.

Owners expect capital equipment to produce operating benefits over a long period of time, usually several years or more. Accountants normally classify these items as capital assets. And,

they track asset earning performance year-to-year with financial metrics such as return on total assets (ROA) and Total Asset Turnover.

Most firms establish criteria for deciding which items they acquire are capital items, and which are not. These criteria result partly from local tax laws, but they also reflect accounting policy choices by the firm's managers. Such criteria typically specify that an item qualifies as a capital item if it meets at least 3 conditions: The item must:

- Have a minimum useful service life or economic life (e.g., one year or more).
- Have an acquisition cost above a certain threshold (e.g., $1,000 or more).
- Contribute value to the firm's business.

1.4 Forecasting:

Organizations use forecasting methods of production and operations management to implement production strategies. Forecasting involves using several different methods of estimating to determine possible future outcomes for the business. Planning for these possible outcomes is the job of operations management. Additionally, operations management involves the managing of the processes required to manufacture and distribute products. Important aspects of operations management include creating, developing, producing and distributing products for the organization.

Techniques of forecasting:

Forecasting techniques help organizations plan for the future. Some are based on subjective criteria and often amount to little more than wild guesses or wishful thinking. Others are based on measurable, historical quantitative data and are given more credence by outside parties, such as analysts and potential investors. While no forecasting tool can predict the future with complete certainty, they remain essential in estimating an organization's forward prospects.

1. **Delphi Technique**

The RAND Corporation developed the Delphi Technique in the late 1960s. In the Delphi Technique, a group of experts responds to a series of questionnaires. The experts are kept apart and unaware of each other. The results of the first questionnaire are compiled, and a second questionnaire based on the results of the first is presented to the experts, who are asked to reevaluate their responses to the first questionnaire. This questioning, compilation and requestioning continues until the researchers have a narrow range of opinions.

2. **Scenario Writing**

In Scenario Writing, the forecaster generates different outcomes based on different starting criteria. The decision-maker then decides on the most likely outcome from the numerous scenarios presented. Scenario writing typically yields best, worst and middle options.

3. Subjective Approach

Subjective forecasting allows forecasters to predict outcomes based on their subjective thoughts and feelings. Subjective forecasting uses brainstorming sessions to generate ideas and to solve problems casually, free from criticism and peer pressure. They are often used when time constraints prohibit objective forecasts. Subjective forecasts are subject to biases and should be viewed skeptically by decision-makers.

4. Time-Series Forecasting

Time-series forecasting is a quantitative forecasting technique. It measures data gathered over time to identify trends. The data may be taken over any interval: hourly; daily; weekly; monthly; yearly; or longer. Trend, cyclical, seasonal and irregular components make up the time series. The trend component refers to the data's gradual shifting over time. It is often shown as an upward- or downward-sloping line to represent increasing or decreasing trends, respectively. Cyclical components lie above or below the trend line and repeat for a year or longer. The business cycle illustrates a cyclical component. Seasonal components are similar to cyclicals in their repetitive nature, but they occur in one-year periods. The annual increase in gas prices during the summer driving season and the corresponding decrease during the winter months is an example of a seasonal event. Irregular components happen randomly and cannot be predicted

1.5 Exponential smoothing

The simplest of the exponentially **smoothing** methods is naturally called "simple **exponential smoothing**" (SES). (In some books, it is called "single **exponential smoothing**".) This method is suitable for **forecasting**data with no trend or seasonal pattern. In **exponential smoothing** (as opposed to in moving averages **smoothing**) older data is given progressively-less relative weight (importance) whereas newer data is given progressively-greater weight. Also called averaging, it is employed in making short-term forecasts. Statistical technique for detecting significant changes in data by ignoring the fluctuations irrelevant to the purpose at hand. In exponential smoothing (as opposed to in moving averages smoothing) older data is given progressively-less relative weight (importance)

whereas newer data is given progressively-greater weight. Also called averaging, it is employed in making short-term forecasts.

Exponential smoothing is a rule of thumb technique for **smoothing** time series data, particularly for recursively applying as many as three low-pass filters with **exponential** window functions. Such techniques have broad application that is not intended to be strictly accurate or reliable for every situation.

There exist methods for reducing of canceling the effect due to random variation. Widely **used** techniques are "**smoothing**". ... Whereas in Moving Averages the past observations are weighted equally, **Exponential Smoothing** assigns **exponentially**decreasing weights as the observation get older.

1.6 Time series

The biggest advantage of using **time series analysis** is that it can be used to understand the past as well as predict the future. ... Business managers use **time series analysis** on a regular basis for sales forecasting, budgetary **analysis**, inventory **management** and quality control.

Time series analysis comprises methods for analyzing **time series** data in order to extract meaningful statistics and other characteristics of the data. **Time series**forecasting is the use of a model to predict future values based on previously observed values.

Time series patterns

There are three types of time series patterns.

Trend

A trend exists when there is a long-term increase or decrease in the data. It does not have to be linear. Sometimes we will refer to a trend “changing direction” when it might go from an increasing trend to a decreasing trend.

Seasonal

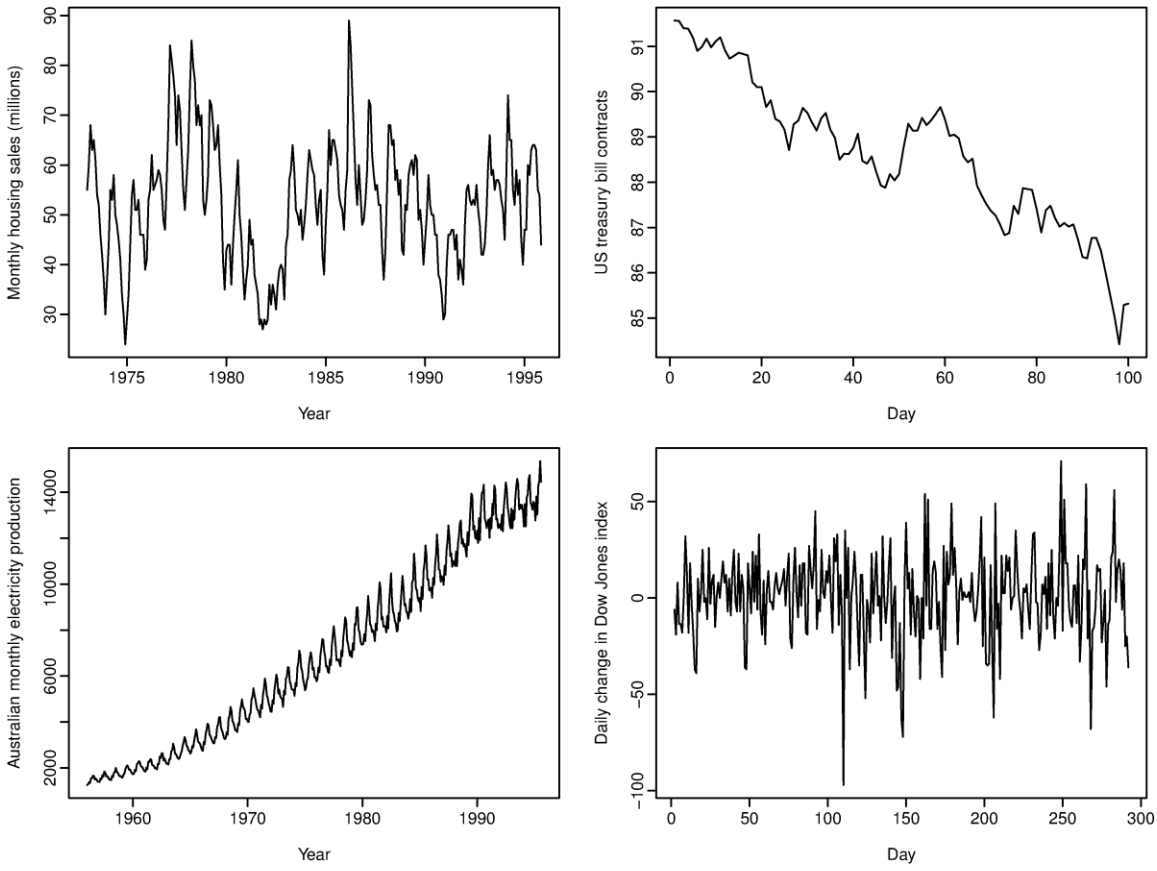
A seasonal pattern exists when a series is influenced by seasonal factors (e.g., the quarter of the year, the month, or day of the week). Seasonality is always of a fixed and known period.

Cyclic

A cyclic pattern exists when data exhibit rises and falls that are *not of fixed period*. The duration of these fluctuations is usually of at least 2 years.

Many people confuse cyclic behaviour with seasonal behaviour, but they are really quite different. If the fluctuations are not of fixed period then they are cyclic; if the period is unchanging and associated with some aspect of the calendar, then the pattern is seasonal. In general, the average length of cycles is longer than the length of a seasonal pattern, and the magnitude of cycles tends to be more variable than the magnitude of seasonal patterns.

The following four examples shows different combinations of the above components.



1.7 Purchase

Purchasing is the most important function of materials management. The material planning functions determines the requirements of rawmaterial, parts, components etc. needed for production and takes decision recording,

- what to buy?
- How much to buy?
- When to buy?

  All these decisions in the preparation of material requisition which are then passed on to purchase the department for the further action towards procurement of materials listed in

material requisition, "purchasing" refers to the function of procuring of materials, supplies, machines, tools, spareparts and service required for meeting the needs of production department and maintainence department.

Purchasing:

Meaning and Definition: -

Purchasing is the first phase of Materials Management. Purchasing means procurement of goods and services from some external agencies. The object of purchase department is to arrange the supply of materials, spare parts and services or semi-finished goods, required by the organisation to produce the desired product, from some agency or source outside the organisation.

Importance of Purchasing:

1. Purchasing function provides materials to the factory without which wheels of machines cannot move.
2. A 1% saving in materials cost is equivalent to a 10% increase in turnover. Efficient buying can achieve this.
3. Purchasing manager is the custodian of his firm's is purse as he spends more than 50% of his company's earnings on purchases.
4. Increasing proportion of one's requirements is now bought instead of being made as was the practice in the earlier days. Buying, therefore, assumes significance.
5. Purchasing can contribute to import substitution and save foreign exchange.
6. Purchasing is the main factor in timely execution of industrial projects.
7. Materials management organisations that exist now have evolved out or purchasing departments.
8. Other factors like: (i) Post-war shortages,(ii) Cyclical swings of surpluses and shortages and the fast rising materials costs, (iii) Heavy competition, and (iv)Growing worldwide markets have contributed to the importance of purchasing.

Objectives of Purchasing:

1. To pay reasonably low prices for the best values obtainable, negotiating and executing all company commitments.
2. To keep inventories as low as is consistent with maintaining production.
3. To develop satisfactory sources of supply and maintain good relations with them.

4. To secure good vendor performance including prompt deliveries and acceptable quality.

5. To locate new materials or products as required.

6. To develop good procedures, together with adequate controls and purchasing policy.

7. To implement such programmes as value analysis, cost analysis, and make-or-buy to reduce cost of purchases.

8. To secure high caliber personnel and allow each to develop to his maximum ability.

9. To maintain as economical a department as is possible, commensurate with good performance.

10. To keep top management informed of material development which could affect company profit or performance.

11. To achieve a high degree of co-operation and co-ordination with other departments in the organisation.

PRINCIPLES OF**PURCHASING:**

6 Major Principles of Purchasing Some of the major principles of purchasing are: 1. Right Quality 2. Right Quantity 3.Right Time 4.Right Source 5.Right Price and 6. Right Place.

Types of Purchasing Systems

1.Purchase made as per requirement:

2.Contract Purchasing:

3.Market Purchase:

4.Schedule Purchasing:

Centralized purchasing means buying and managing purchases from one location for all locations within an organization. This can also be run by a central location buying in to a distribution warehouse that feeds smaller warehouses. This is called a hub and spoke system. The responsibility and authority to purchase, lease, or rent materials, supplies, goods, equipment, or services are placed with the Division of Finance and Operations, Purchasing and Stores Department.

Purchasing is centralized to:

- realize economy, efficiency, and effectiveness in the procurement function;
- pursue quality assurance and standardization;
- maintain the highest standards of ethics;

Advantages of Centralized Purchasing

1.Volume purchasing

2.Warehouse

3.Save time in researching products

Disadvantages of Centralized Purchasing

1.Good processes are not without their shortcomings.

2.Extended procurement time

Decentralized purchasing is the opposite where each plant or office buys what it needs. This operation allows any employee to buy what he needs. You can also run this operation with a designated buyer assigned to the site to do the buying. The more decentralized an operation is, the less control the home office has. You have a duplication of effort in buying and less buyer specialization. You lose discounts on quantity buys. You lose freight options based on dollars or weight. Also some support is lost from the supplier as there is no single contact for the supplier to deal with. Volume buying may not be calculated for all your sites.

Purchasing Process

1. Market survey

2.Requisitioning

3.Approving

4.Studying Market

5.Making Purchase Decision

6.Placing Orders

7.Receipting Goods and Services Received

8.Accounting Goods and Services

9.Receiving Invoices and Making Payment

1o.Credit note in case of material defect

Purchasing Management Process

1. Purchasing Planning
2. Purchasing Tracking
3. Purchasing Reporting
4. Negotiate

Purchasing Cycle / System OR Steps in Purchasing

- Get requirement from user department with proper specification.
- Send the inquiry to the vendors(suppliers). (request quotation)

- Get the quotations from vendors.
- Make comparative statement.
- Negotiate, fix the price and terms & conditions.
- Place the order to the right vendor.
- Follow up with vendor.
- Receipt & inspection. (grn)
- Storage & record- keeping. (batching)
- Invoice & payment.

Components of purchasing

- Needs assessment
- Source identification
- Contract negotiation
- Supplier selection
- PO issuance
- Expediting / follow-up
- Performance evaluation

Purchasing objectives:

- Right quality
- Right quantity
- Right time
- Right source
- Right price

Purchasing management cycle

- Analysis
- Planning – make or buy, domestic vs. overseas, national vs. local, distributor vs. Manufacturer, purchasing timing
- Implementation

- Control
- Organisation

Purchasing role in corporate planning

- Quantity
- Time
- Purchasing Procedures

Purchasing Policy:

The Purchasing Department is responsible for the procurement of all goods and services and applying best practices for optimizing cost savings, quality products and services, and for assuring proper inventory control and inspections as required by the College in accordance with State, City and CUNY regulations. All purchases made using tax levy (State and City funds) are subject to Finance and Education Law of the State of New York, the rules and regulations promulgated by the Office of the State and City Comptroller, and the official policies mandated by the Board of Trustees of The City University of New York. Pursuant to College Policy, employees who order and receive goods and services without an approved purchase order may be held personally liable for payment. Likewise, vendors who provide goods and services without an official approved College Purchase Order, issued only by the Purchasing Department, and may be subject to non-payment.

General Procedures

PURCHASE REQUISITION 1. Split 2.Purchase Order

Supplier Management: Six Steps to Selecting the Right Supplier Selecting the right supplier may seem like an onerous process for your supply chain. While having a more simplistic supplier selection process may be helpful for some smaller supply chains, a more involved process of selecting the right suppliers can help many food and nutrition companies meet or exceed regulatory standards, drive customer demand and build a strong brand reputation of quality products.

1.Identifying a Supplier

2. Measuring Supply Performance

3. Gaining Supplier Feedback

4. Achieving Certification
5. Developing Partnerships
6. Ensuring Quality for Consumers

Supplier Selection Process

Selecting the right supplier can help you meet the consumer demand for higher-quality ingredients—while also meeting high regulatory standards. When selecting the right supplier, manufacturers should remember to:

• Include all key internal stakeholders in the process to agree on important criteria that the supplier should meet.

• Require strong communication between the manufacturer and the supplier. Good communication might not necessarily confirm a successful relationship, but poor communication can almost guarantee a failed relationship.

• Perform audits for the selected supplier, and work with them to address any deficiencies. If the deficiencies are too great, move on to another supplier. Implement adequate monitoring to drive improvement in supplier performance.

• Assess performance through useful metrics and provide the necessary feedback to the supplier.

• Establish an effective certification program and utilize it when the supplier has met its standards. • Motivate your suppliers to develop strategic partnerships to ensure the greatest opportunity for success for both parties.

• Invest sufficient time, effort and energy early in the relationship to set up for success.

SUPPLIER SELECTION PROCESS

1.Thinking strategically when selecting suppliers
2.What you should look for in a supplier
3.Identifying potential suppliers
4.Drawing up a shortlist of suppliers
5.Choosing a supplier
6.Getting the right supplier for your business

Purchase Order - A purchase order, or PO, is a document that a company issues to a vendor to place an order for products. It outlines all of the details of the sale, including quantity of product, sales price, delivery date, terms, and requirements for the order to be fulfilled. For instance, a giant grocery store might place an order for bananas from a fruit company. The purchase order would detail how many bananas are being purchased, when they would be delivered, etc.

PURCHASING ORDER TERMS AND CONDITIONS

1. Definitions. 2.Acceptance of Purchase Order. 3. Data. 4. Packing and Shipping. 5. Taxes and Duties. 6. Payment and Prices. 7.Set-off. 8.Warranty. 9. Inspection. 10. Default. 11. Change Orders and Deliverable Substitution. 12 Title. 13.Intellectual Property and Proprietary Rights. 14. Confidential Information. 15.Termination. 16. Compliance with Law. 17.Delays. 18 Assignment and Subcontract. 19.Advertising. 20. Personal Injury and Property Damage Indemnification. 21 Hazardous Chemicals and Hazardous Materials. 22.Relationship of Parties. 23.Waiver. 24. Entire Agreement. 25. Governing Law and Venue. 26. Survival. 27.Limitation of Liability.

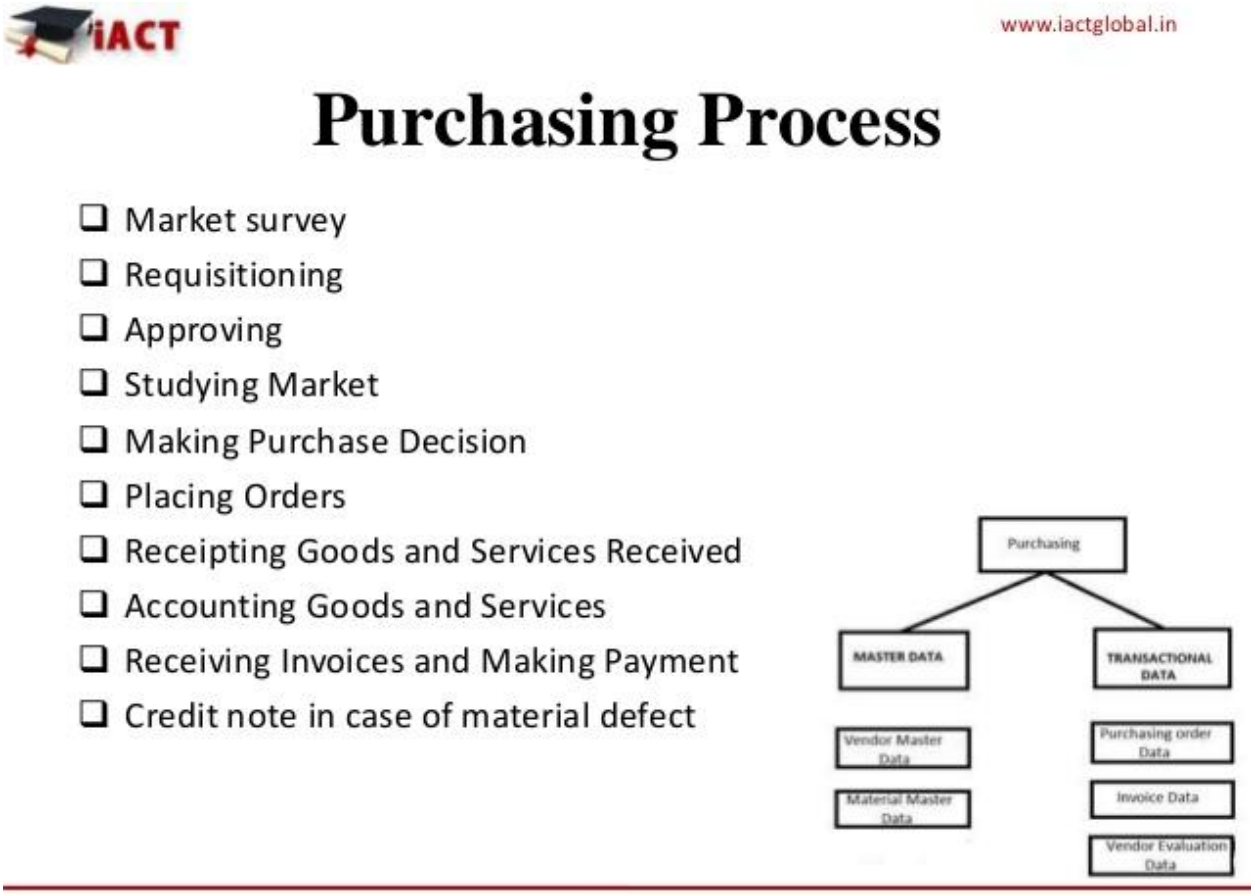
NON-DISCRIMINATION IN EMPLOYMENT –

TERMS AND CONDITIONS 1.acceptance: 2. changes: 3. handicap accessibility 4. assignment of purchase: 5. termination: 6. taxes: 7. warranty: 8. health & safety: 9. delivery/f.o.b. destination: 10. inemnification and hold harmless: 11. venue: 12. insurance: 13. invoices and payment: 14. licenses and permits: 15. vendor: 16. anti-discrimination:

1.8PURCHASING PROCESS

The purchase of goods and services from outside vendors is to begin with the initiation of a purchase order through the district's financial system or a paper form requesting a purchase order submitted to the district office (allow three working days for paper form). This shall occur at the time the product or service needs to be ordered, not when it is time to pay for the product or service. A fully approved and budget checked Requisition is then automatically sourced into a Purchase Order. The official Purchase Order is ready to be sent to the vendor. The system provides an appropriate audit trail since all transactions are captured in the system specific to each individual purchase, putting the District in the best position to pay for purchases in a timely

manner. Starting with a Requisition ensures that an approved and official Purchase Order is issued. An official Purchase Order is the legal document that governs the transaction and properly protects the department/school and District. Verbal purchases (without an approved purchase order) (i.e. phone orders) are not considered valid by the District, nor are purchase orders generated through internal department/school systems or means other than the district's accounting system. Departments/schools that use these means to initiate purchases with outside vendors assume responsibility for such purchases at

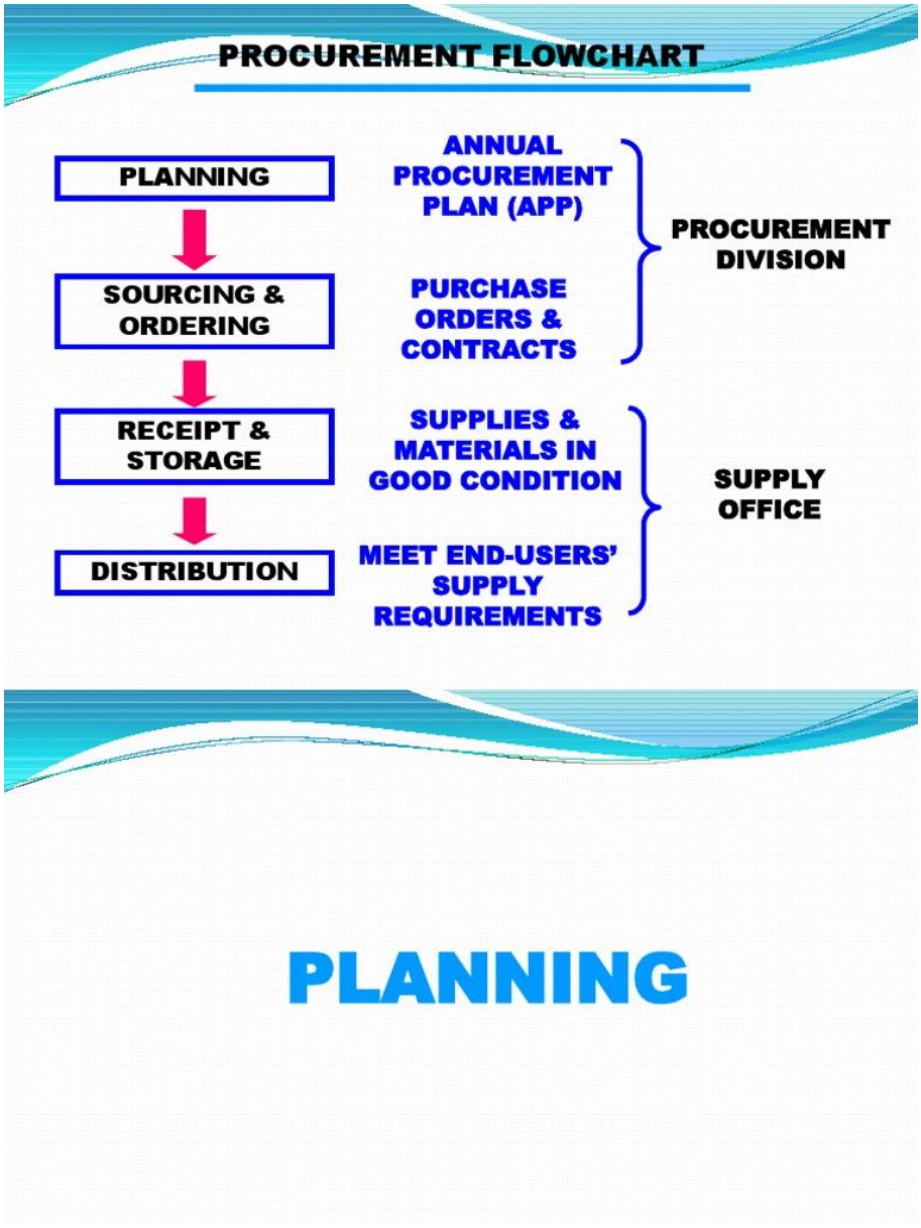


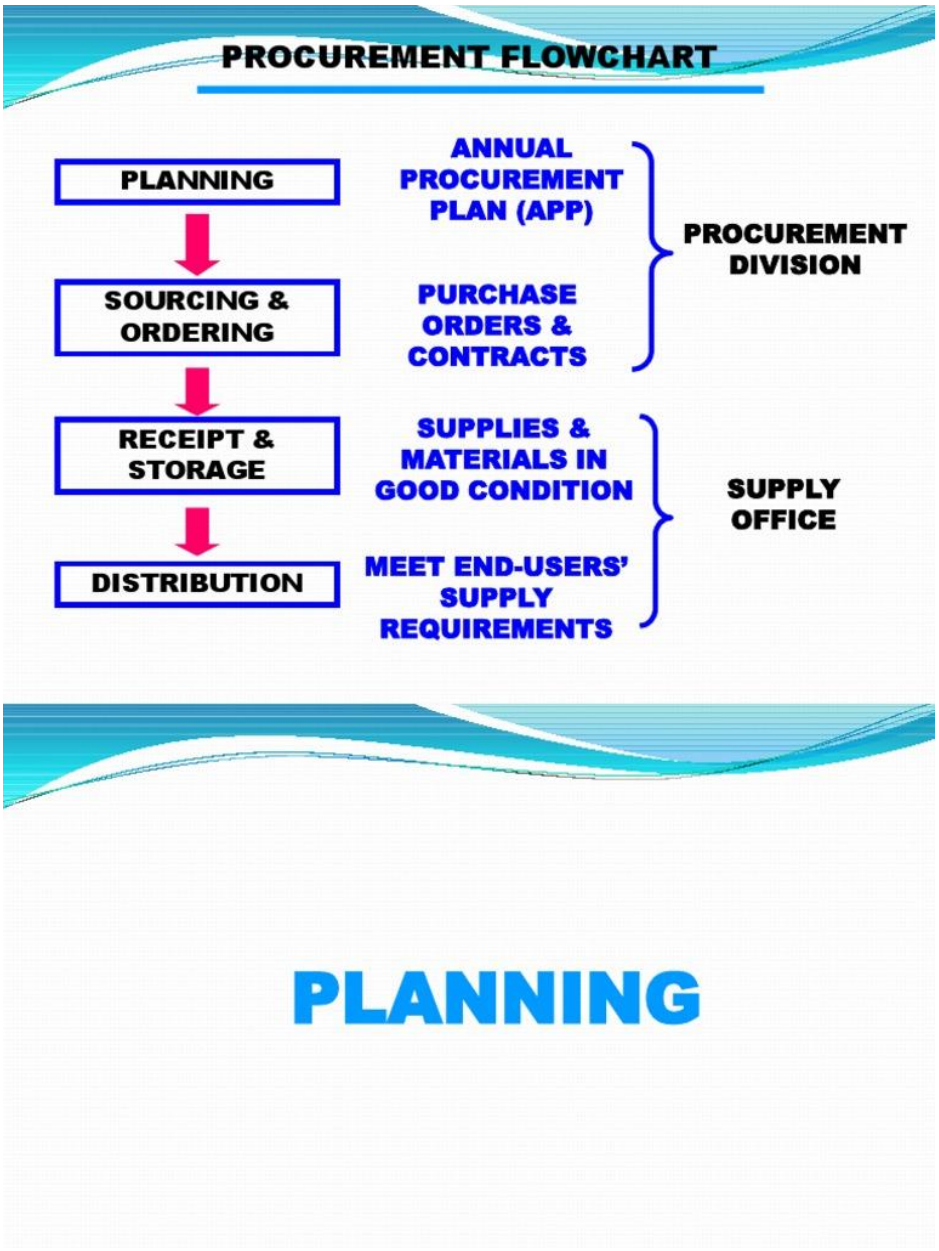
1.9 Purchase policy

Every organisation needs purchasing guidelines with in which purchasing decisions and may day to day activities of buyers and carried out. Well established purchasing policy reduce the number and complexity of the purchasing decisions that must be made by the buyers and ensure the responsible the uniformity of action. Purchasing policy statements:

1. A definition of authority and responsibility of purchasing
2. Relationship with vendors and suppliers

3. Treatment of sales representatives of vendor or supplier firms
4. Proper handling of competitive bidding
5. Proper handling of vendor technical service and design work
6. Reciprocity
7. Employee purchases
8. Ethical practices in purchasing





1.10 Purchase procedure

- A typical purchase department is usually engaged in purchasing a number of materials and services falling in different categories. The activities are performed regularly by purchase professionals with the objective of fulfilling organisation's materials and services needs.
- Naturally, depending upon the nature of procurement, environmental practices etc the purchasing systems and procedures may also vary substantially. However , purchase procedure can be seen to have a bit of standardisation across the globe and therefore a

professional purchasing system does show following steps that eventually constitute a purchasing cycle.:

- Recognition and description of need
- Transmission of need
- Selection of Source to satisfy the need
- Contracting with the accepted source
- Following up with the source
- Receiving and inspecting material
- Payment and closure of the case

1.11 Import substitution:

Import substitution, economic policy adopted in most developing countries from the 1930s to the 1980s to promote industrialization by protecting domestic producers from the competition of imports. Protection in the form of high tariffs or the restriction of imports through quotas—was applied indiscriminately, often to inherently high-cost industries that had no hope of ever becoming internationally competitive. After the early stages of import substitution, protected new industries tended to be very intensive in the use of capital and especially of imported capital goods—i.e., tangible items such as buildings, machinery, and equipment produced and used in the production of other goods and services.

With high levels of protection for domestic industry, and with exchange rates that were often maintained at unrealistic levels (usually in an effort to make imported capital goods “cheap”), the experience of most countries practicing import substitution was that export earnings grew relatively slowly. The simultaneous sharp increase in demand for imported capital goods (and for raw materials and replacement parts as well) led to critical foreign-exchange shortages, eventually forcing most countries to reduce imports. The cutbacks in imports in turn reduced growth rates, leading in many cases to recessions.

This result led to the view that economic stagnation was caused primarily by a shortage of foreign exchange with which to buy essential industrial inputs. However, contrasting the experience of countries that persisted in policies of import substitution with those that followed alternative policies subsequently demonstrated that a foreign-exchange shortage was a

barrier to growth only within the context of the protectionist policies adopted and was not inherently a barrier to the development process itself.

ADVANTAGES AND DISADVANTAGES

Advocates of neo-liberal economics argue that while import substitution policies might create jobs in the short run, as domestic producers replace foreign producers, neoliberal theory believes that in the long run output and growth will be lower than it would otherwise have been. This is because import substitution denies the country the benefits to be gained from specialisation and foreign imports. The theory of comparative advantage shows how countries will gain from trade. Moreover, protectionism leads to dynamic inefficiency: Domestic producers have no incentive from foreign competitors to reduce costs or improve products. Import substitution can impede growth through poor allocation of resources, and its effect on exchange rates harms exports.

Despite some apparent gains, import substitution was "both unsustainable over time and produced high economic and social costs." Given import substitution's dependence upon its developed and isolated markets within Latin America, it relied upon the growth of a market that was limited in size. In most cases, the lack of experience in manufacturing, plus lack of competition, reduced innovation and efficiency, which restrained the quality of Latin American produced goods, while protectionist policies kept prices high. In addition, power concentrated in the hands of a few decreased the incentive for entrepreneurial development.

UNIT 2

2.1 Pricing is the process whereby a business sets the price at which it will sell its products and services, and may be part of the business's marketing plan. In setting prices, the business will take into account the price at which it could acquire the goods, the manufacturing cost, the market place, competition, market condition, brand, and quality of product.

Pricing is a fundamental aspect of financial modeling and is one of the four Ps of the marketing mix. (The other three aspects are product, promotion, and place.) Price is the only revenue generating element amongst the four Ps, the rest being cost centers. However, the other Ps of marketing will contribute to decreasing price elasticity and so enable price increases to drive greater revenue and profits.

Pricing can be a manual or automatic process of applying prices to purchase and sales orders, based on factors such as: a fixed amount, quantity break, promotion or sales campaign, specific vendor quote, price prevailing on entry, shipment or invoice date, combination of multiple orders or lines, and many others. Automated systems require more setup and maintenance but may prevent pricing errors. The needs of the consumer can be converted into demand only if the consumer has the willingness and capacity to buy the product. Thus, pricing is the most important concept in the field of marketing, it is used as a tactical decision in response to comparing market situations.

2.2 MAKE OR BUY DESICION

The make-or-buy decision is the act of making a strategic choice between producing an item internally (in-house) or buying it externally (from an outside supplier). The buy side of the decision also is referred to as outsourcing. Make-or-buy decisions usually arise when a firm that has developed a product or part—or significantly modified a product or part—is having trouble with current suppliers, or has diminishing capacity or changing demand.

Make-or-buy analysis is conducted at the strategic and operational level. Obviously, the strategic level is the more long-range of the two. Variables considered at the strategic level include analysis of the future, as well as the current environment. Issues like government regulation, competing firms, and market trends all have a strategic impact on the make-or-buy decision. Of course, firms should make items that reinforce or are in-line with their core competencies. These are areas in which the firm is strongest and which give the firm a competitive advantage.

The increased existence of firms that utilize the concept of lean manufacturing has prompted an increase in outsourcing. Manufacturers are tending to purchase subassemblies rather than piece parts, and are outsourcing activities ranging from logistics to administrative services. It prescribes that a firm outsource all items that do not fit one of the following three categories:
(1) the item is critical to the success of the product, including customer perception of important product attributes;
(2) the item requires specialized design and manufacturing skills or equipment, and the number of capable and reliable suppliers is extremely limited; and
(3) the item fits well within the firm's core competencies, or within those the firm must develop to fulfill future plans. Items that fit under one of these three categories are considered strategic in nature and should be produced internally if at all possible.
Make-or-buy decisions also occur at the operational level. Analysis in separate texts by Burt, Dobler, and Starling, as well as Joel Wisner, G. Keong Leong, and Keah-Choon Tan, suggest these considerations that favor making a part in-house:

- Cost considerations (less expensive to make the part)
- Desire to integrate plant operations
- Productive use of excess plant capacity to help absorb fixed overhead (using existing idle capacity)
- Need to exert direct control over production and/or quality
- Better quality control
- Design secrecy is required to protect proprietary technology
- Unreliable suppliers
- No competent suppliers
- Desire to maintain a stable workforce (in periods of declining sales)
- Quantity too small to interest a supplier
- Control of lead time, transportation, and warehousing costs
- Greater assurance of continual supply
- Provision of a second source
- Political, social or environmental reasons (union pressure)
- Emotion (e.g., pride)

Factors that may influence firms to buy a part externally include:

- Lack of expertise
- Suppliers' research and specialized know-how exceeds that of the buyer
- cost considerations (less expensive to buy the item)
- Small-volume requirements
- Limited production facilities or insufficient capacity
- Desire to maintain a multiple-source policy
- Indirect managerial control considerations
- Procurement and inventory considerations
- Brand preference
- Item not essential to the firm's strategy

The two most important factors to consider in a make-or-buy decision are cost and the availability of production capacity. Burt, Dobler, and Starling warn that "no other factor is subject to more varied interpretation and to greater misunderstanding" Cost considerations should include all relevant costs and be long-term in nature. Obviously, the buying firm will compare production and purchase costs. Burt, Dobler, and Starling provide the major elements included in this comparison. Elements of the "make" analysis include:

- Incremental inventory-carrying costs
- Direct labor costs
- Incremental factory overhead costs
- Delivered purchased material costs
- Incremental managerial costs
- Any follow-on costs stemming from quality and related problems
- Incremental purchasing costs
- Incremental capital costs

Cost considerations for the "buy" analysis include:

- Purchase price of the part
- Transportation costs
- Receiving and inspection costs
- Incremental purchasing costs
- Any follow-on costs related to quality or service

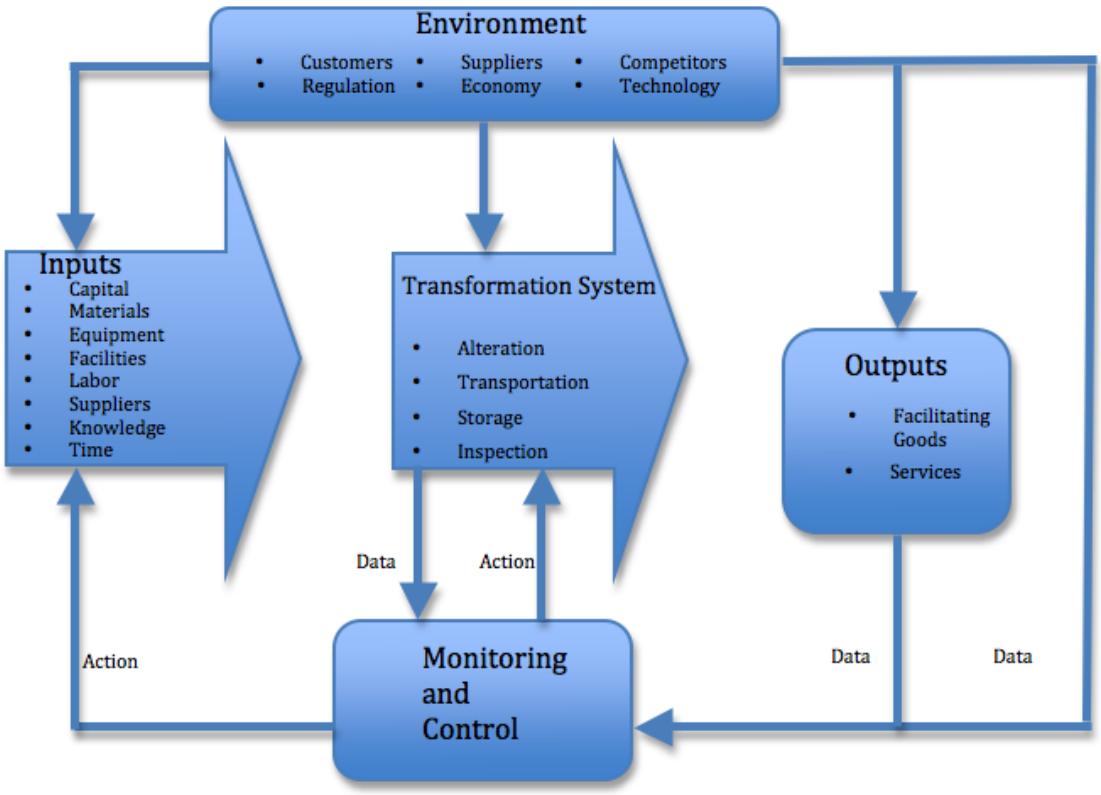
2.3 What is capital equipment?

Capital equipment refers to long-lasting goods a firm acquires and owns that are not consumed in the normal course of business. These may include assets such as machines, trucks, large computers, and office furniture.

Owners expect capital equipment to produce operating benefits over a long period of time, usually several years or more. Accountants normally classify these items as capital assets. And, they track asset earning performance year-to-year with financial metrics such as return on total assets (ROA) and Total Asset Turnover.

Most firms establish criteria for deciding which items they acquire are capital items, and which are not. These criteria result partly from local tax laws, but they also reflect accounting policy choices by the firm's managers. Such criteria typically specify that an item qualifies as a capital item if it meets at least 3 conditions: The item must:

- Have a minimum useful service life or economic life
- Have an acquisition cost above a certain threshold
- Contribute value to the firm's business.



DIFFERENCES IN THE PROCUREMENT OF CAPITAL EQUIPMENT

1. **Non-recurring procurement**

Capital equipment procurements do not occur with regular frequency. A production machine, for example, may remain in use for 10 to 15 years. Even furniture may last over 5 years.

Another unique feature of most capital equipment procurements is the lead-time requirement. While some types of capital equipment are standard, off-the-shelf products, many are not. Much production machinery and even some tools are built to operate under specific conditions peculiar to each buyer's operation.

2. **Nature and size of expenditure**

An expenditure of company funds for capital equipment is an investment. If procured wisely and operated efficiently, capital equipment generates profit for its owner. Because it exerts a direct influence on the costs of production, the selection of major capital equipment is a matter of significant concern to top management.

Although capital equipment prices cover a wide range, the procurement of most major equipment involves the expenditure of a substantial sum of money. However, the procurement price for a piece of equipment is frequently overshadowed in importance by other elements of cost. Since a machine is often used for ten years or more, total costs of operation and maintenance during its lifetime may far exceed its initial cost. Hence, the total life cost of a machine, relative to its productivity, is the cost factor of primary importance. Estimating operating and maintenance costs, which will be incurred in future years, is not easy. Frequently, these costs vary from year to year. Consequently, discussions involving the choice between several alternative machines often centre on the probable accuracy of specific cost estimates. We shall explore this in more detail later.

The timing of many capital equipment procurements often presents a paradoxical situation. Typically, the general supply capabilities of capital equipment producers do not adjust quickly to changes in levels of demand. Thus, because capital equipment procurements are made infrequently and can often be postponed, producers of capital equipment frequently find themselves in a 'feast or famine' type of business. For instance, when a buyer's business is good, it needs additional equipment to satisfy customers' burgeoning demands. However, other buyers

could also be in the same situation when the market is up. The buyer will find capital equipment prices rising in a market of short supply.

3. **Consideration in source selection**

When procuring capital equipment, selection of a supplier is governed largely by four general considerations:

a. **Operating characteristics**: This is by far the most influential factor in selecting the supplier for particular capital equipment. Once the user and engineering personnel have clearly established the function the equipment is to perform, design and operating capability are crucial in selecting the specific equipment to be procured.

The challenge is that design and operating features for a given type of equipment can differ significantly among the equipment available from different suppliers. For this reason, the number of suppliers capable of meeting every aspect of a buyer's operating requirements, no more no less, is frequently limited. This is one reason why Procurement usually finds its freedom of sourcing and selecting capital equipment limited as compared with buying production materials and supplies.

b. **Engineering features**: Closely related to the equipment's operating characteristics are its engineering features. These features must be compatible with the buyer's existing equipment, process, plant-layout, established standards if applicable, e.g., physical size and mounting dimensions, flexibility, power requirements, maintenance, safety features, pollution characteristics, etc. The general questions to be answered are: How does this piece of equipment fit in with the existing operation? Will many costly modifications be involved in adapting the equipment to the existing system?

c. **Economic analysis**: After acceptable equipments have been identified, a thorough evaluation of their relative merits is undertaken. The task is a complicated one. An analysis of the major operating alternatives includes a comparative economic analysis of the potential new equipment, and a comparison of each with the alternative of using the existing equipment now in operation. In all cases, the analysis of equipment must relate its total expected life cost to its total expected productivity. A payback analysis is then often used to determine the number of year's equipment requires to pay for itself from additional earnings generated by its increased level of operation efficiency, which is a useful measure for evaluating a potential procurement in light of the buying firm's liquidity position.

The economic analysis is a critical portion of the formal proposal justifying the need for additional equipment to be prepared for top management. Although the proposal must consist of more than the economic analysis, a complete quantitative analysis showing the potential profitability of the various alternatives should constitute a major section of such a proposal.

d. **Qualitative considerations**: Certain qualitative factors concerning potential suppliers are important in making any procurement. However, not all the factors important in selecting sources for production materials weigh as heavily in selecting sources for capital equipment. Capital equipment procurements require a different type of cooperative relationship between the buyer and the seller. It is important, initially, that a supplier be willing to work with the buyer's technical personnel to ensure a good fit of equipment to operating needs. After the procurement, the buyer may need help with installation, start-up, adjustments and so on. In fact, adjustment or calibration may be a continuing need, depending on the type of equipment and the buyer's in-house capability.

At some future date, the buyer may also require a warranty adjustment. Especially important is an assessment of the supplier's policy and cooperativeness with respect to the supply of replacement parts and service for the equipment, particularly later when the equipment is superseded by a new model. These types of factors represent one group of qualitative considerations that a buyer considers in making a capital equipment procurement decision, with each individual case posing its own unique requirements.

Another group of qualitative considerations are those indicating a supplier's ability to produce reliable equipment that performs in accordance with specifications. This implies the definite need for an assessment of the supplier's technical and production capabilities. As the situation demands, a good buyer uses various approaches and personnel in making such an assessment, including plant visits and technical discussions with the supplier's personnel. However, buyers should not overlook the simple technique of investigating a supplier's reputation among present customers. This is an invaluable source of information that is easy to tap.

Generally speaking, qualitative considerations do not play a primary role in the selection of a supplier for capital equipment. They are usually considered in the final analysis, after the major factors have been weighed. The qualitative factors are the straws that tip the balance one way or the other for the several potential suppliers who rank high on combined technical and economic considerations.

1. India's Foreign Trade Policy also known as Export Import Policy (EXIM) in general, aims at developing export potential, improving export performance, encouraging foreign trade and creating favorable balance of payments position. Foreign Trade Policy is prepared and announced by the Central Government (Ministry of Commerce). Foreign Trade Policy or EXIM Policy is a set of guidelines and instructions established by the DGFT (Directorate General of Foreign Trade) in matters related to the import and export of goods in India.

   The foreign trade policy, has offered more incentives to exporters to help them tide over the effects of a likely demand slump in their major markets such as the US and Europe.

   Foreign trade is exchange of capital, goods, and services across international borders or territories. In most countries, it represents a significant share of gross domestic product (GDP). While international trade has been present throughout much of history, its economic, social, and political importance has been on the rise in recent centuries.

   The Foreign Trade Policy of India is guided by the Export Import in known as in short EXIM Policy of the Indian Government and is regulated by the Foreign Trade Development and Regulation Act, 1992.

   DGFT (Directorate General of Foreign Trade) is the main governing body in matters related to EXIM Policy. The main objective of the Foreign Trade (Development and Regulation) Act is to provide the development and regulation of foreign trade by facilitating imports into, and augmenting exports from India. Foreign Trade Act has replaced the earlier law known as the imports and Exports (Control) Act 1947.

   Indian EXIM Policy contains various policy related decisions taken by the government in the sphere of Foreign Trade, i.e., with respect to imports and exports from the

country and more especially export promotion measures, policies and procedures related thereto.

Objectives Of The FTP (EXIM) Policy: -

The main objectives are:

1. To accelerate the economy from low level of economic activities to high level of economic activities by making it a globally oriented vibrant economy and to derive maximum benefits from expanding global market opportunities.

2. To stimulate sustained economic growth by providing access to essential raw materials, intermediates, components,' consumables and capital goods required for augmenting production.

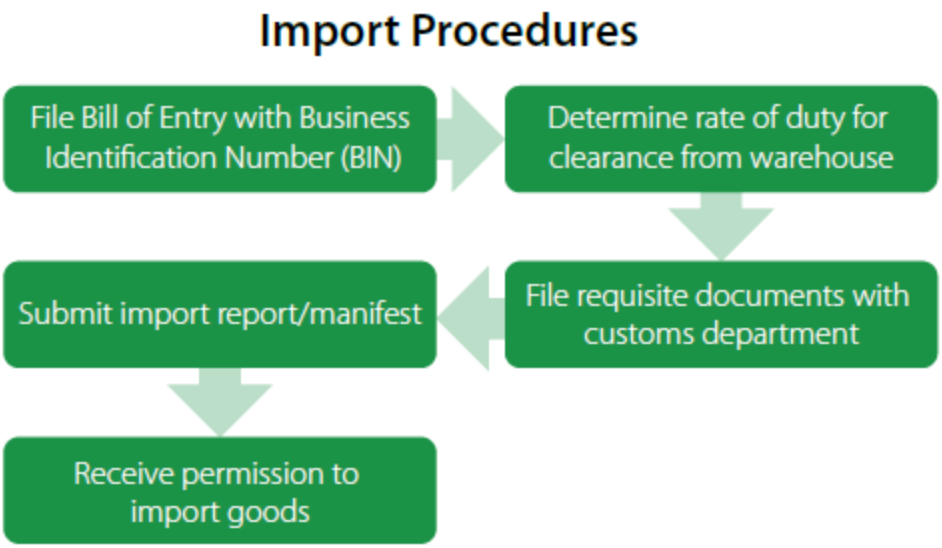
3. To enhance the techno local strength and efficiency of Indian agriculture, industry and services, thereby, improving their competitiveness.

4. To generate employment. Opportunities and encourage the attainment of internationally accepted standards of quality.

5. To provide quality consumer products at reasonable prices.

2.4 INTRNATIONAL BUYING AND IMPORT PROCEDURES

1. **Import procedure** and documentation. 2. **Import** trade refers to the purchase of goods from the foreign country. The **procedure** for **import** trade differs from country to country, depending upon the **import** policy, the statutory requirements and customs of different countries.



Let us discuss some of the common documents required for import customs clearance procedures and formalities in some of the importing countries.

- Bill of Entry:
- Commercial Invoice.
- Bill of Lading / Airway bill :
- Import License.
- Insurance certificate.
- Purchase order/Letter of Credit.
- Technical write up, literature etc.

Bill of Entry:

Bill of entry is one of the major import document for import customs clearance. As explained previously, Bill of Entry is the legal document to be filed by CHA or Importer duly signed. Bill of Entry is one of the indicators of 'total outward remittance of country' regulated by

Reserve Bank and Customs department. Bill of entry must be filed within thirty days of arrival of goods at a customs location.

Once after filing bill of entry along with necessary import customs clearance documents, assessment and examination of goods are carried out by concerned customs official. After completion of import customs formalities, a 'pass out order' is issued under such bill of entry. Once an importer or his authorized customs house agent obtains 'pass out order' from concerned customs official, the imported goods can be moved out of customs. After paying necessary import charges if any to carrier of goods and custodian of cargo, the goods can be taken out of customs area to importer's place.

Commercial Invoice.

Invoice is the prime document in any business transactions. Invoice is one of the documents required for import customs clearance for value appraisal by concerned customs official. Assessable value is calculated on the basis of terms of delivery of goods mentioned in commercial invoice produced by importer at customs location. I have explained about the method of calculation of assessable value in another article in same web blog. The concerned appraising officer verifies the value mentioned in commercial invoice matches with the actual market value of same goods. This method of inspection by appraising officer of customs prevents fraudulent activities of importer or exporter by over invoicing or under invoicing. So Invoice plays a pivotal role in value assessment in import customs clearance procedures.

Bill of Lading / Airway bill :

BL/AWB is one of the documents required for import customs clearance.

Bill of lading under sea shipment or Airway bill under air shipment is carrier's document required to be submitted with customs for import customs clearance purpose. Bill of lading or Airway bill issued by carrier provides the details of cargo with terms of delivery. I have discussed in detail about Bill of Lading and Airway bill separately in this website. You can go through those articles to have a deep knowledge about documents required for import customs clearance.

Import License

As I have mentioned above, import license may be required as one of the documents for import customs clearance procedures and formalities under specific products. This license may be mandatory for importing specific goods as per guide lines provided by government. Import of such specific products may have been being regulated by government time to time. So government insist an import license as one of the documents required for import customs clearance to bring those materials from foreign countries.

Insurance certificate

Insurance certificate is one of the documents required for import customs clearance procedures. Insurance certificate is a supporting document against importer's declaration on terms of delivery. Insurance certificate under import shipment helps customs authorities to verify, whether selling price includes insurance or not. This is required to find assessable value which determines import duty amount.

2.5 DGS&D RATE CONTRACT (Director of General Supply and Disposal)

DGS & D is a Central Purchasing & Quality Assurance Organisation of Govt. of India, Department of Supply, Ministry of Commerce.

In the year 1860, the British Govt. evolved a concept of Central buying & set up India Stores Department in London for meeting procurement needs of Govt. of India. Established in 1951 in its present form for rendering procurement services to Central & State Govt. by placing Rate Contracts for common user items & contracts against their ad-hoc demands.

Adhoc procurement decentralized in December, 1991. Main function now is to conclude RATE CONTRACTS.

- Quality assurance functions continue to remain centralized as before

- Continues to be the NODAL Agency of Govt. of India for purchase policy & procedure.

- Govt. Departments/Organisations, who have not built-up their own infrastructure for purchase, can raise their demands on DGS&D for ad-hoc procurement.

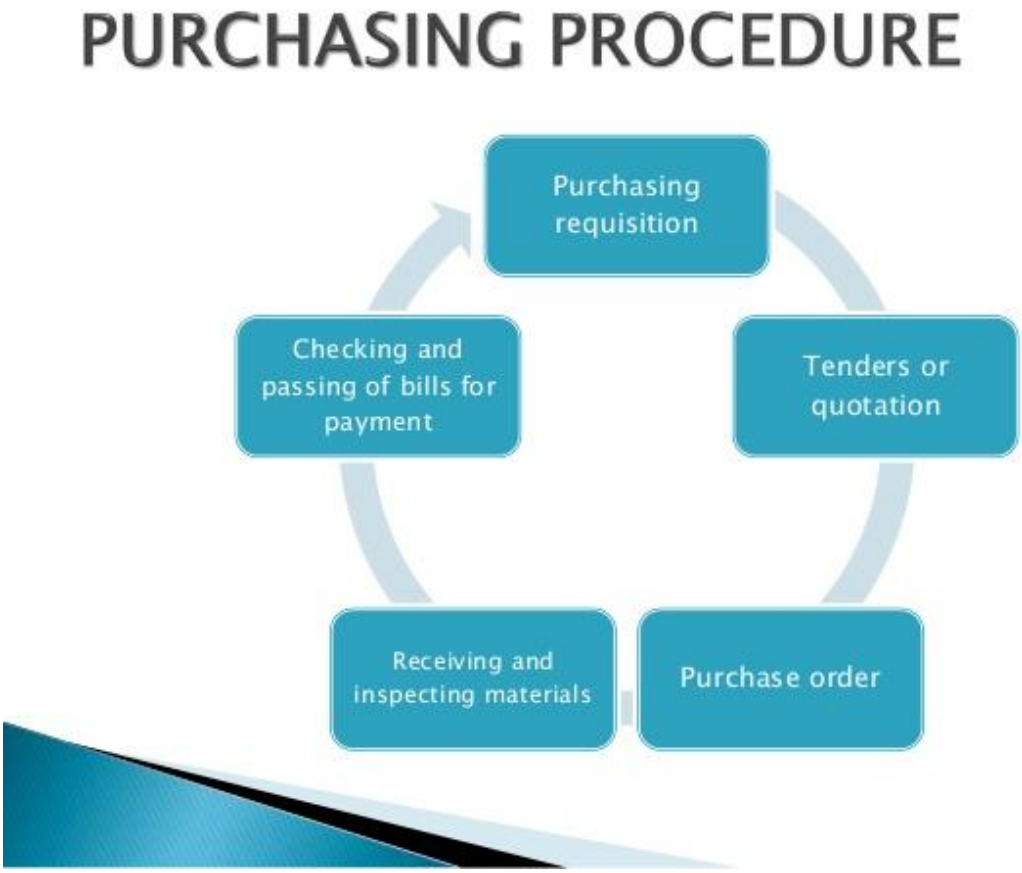
DGS&D is the central purchase organization of the Indian government, functioning under the Ministry of Commerce & Industry. Its role is to finalize the rate contracts to be used by Government departments to procure items of general use.

DGS&D contract rates allow the state, central and government-owned entities to buy required goods at the DGS&D specified prices. The contract rates for such purchases by government departments and public sector undertakings (PSUs) are fixed once every year.

The DGS&D's Rate Contracts provide government buyers with bulk rate pricing, saving them the hassle of frequent re-tendering and allowing them to buy at the same rate throughout the year. This, in turn, allows government agencies to manage their budgets and inventory more efficiently. For suppliers, rate contracts provide access to an assured customer and large volume of purchases for a specific time period without having to respond to tenders frequently.

A **Purchase** Order is a contract between the University and a vendor. It is the standard document used to procure goods and services. ... Employees involved with the **purchasing** process are responsible for understanding the University's **policies and**

procedures regarding **purchasing** and vendor relations.



The function of the **Purchasing** Department is the organization and administration of centralized **purchasing** services to ensure that the user departments' needs are accommodated with quality goods and services in a prompt, cost-efficient manner within the guidelines of the **policy**.

Principles underlying the purchasing policy

Our purchasing policy is based on the following principles:

- an objective selection and award procedure;
- compliance with Belgian and European legislation;
- the constant search for new partners and innovative solutions;
- suppliers who share our goal of operating, maintaining and developing a safe, reliable and high-quality power grid;
- a preference for suppliers who use their knowledge and experience to reduce our costs while minimising the total cost of ownership (i.e. the cumulative cost of a product throughout its life cycle);

- a preference for contracting work and framework agreements, under which the purchasing of goods is linked to delivery of the corresponding services, and for ongoing supplier qualification procedures;
- a preference for performance guarantees (or service level agreements) vis-à-vis resource guarantees;
- ongoing quality assessment and enhancement;
- priority given to safety and the environment (see below).

Elia has drawn up strict **purchasing** rules to safeguard confidentiality, promote transparency and prevent discrimination or conflicts of interest. Everybody involved in the **purchasing** process must abide by Elia's code of **ethics** governing this activity and all the associated regulations.

Our code of ethics for purchasing is based on a number of principles:

- confidentiality;
- non-discrimination against suppliers;
- transparency;
- prevention of conflicts of interest.

Confidentiality

Our employees treat confidential information about the Elia Group, its customers and suppliers with the appropriate care.

One of Elia's priorities is to maintain the confidentiality of the information available to it in its role of grid operator. Furthermore, the relevant legislation requires transmission system operators to sign an enhanced confidentiality undertaking. Therefore, suppliers with access to data relating to Elia customers must sign a **confidentiality undertaking**.

Non-discrimination against suppliers

The following principles apply:

- **application and tender analysis** based on technical and commercial criteria that are objectively established in advance;
- **compliance with legislation**, in particular regarding competition in relation to public works, supplies and services contracts for companies in the energy sector;
- awarding of the contract to the supplier who best meets the **established criteria**.

Transparency

As well as respecting the principle of confidentiality, the Purchasing Department operates in complete transparency vis-à-vis its internal customers and Elia line management.

It also applies an **open and transparent information policy** to all suppliers.

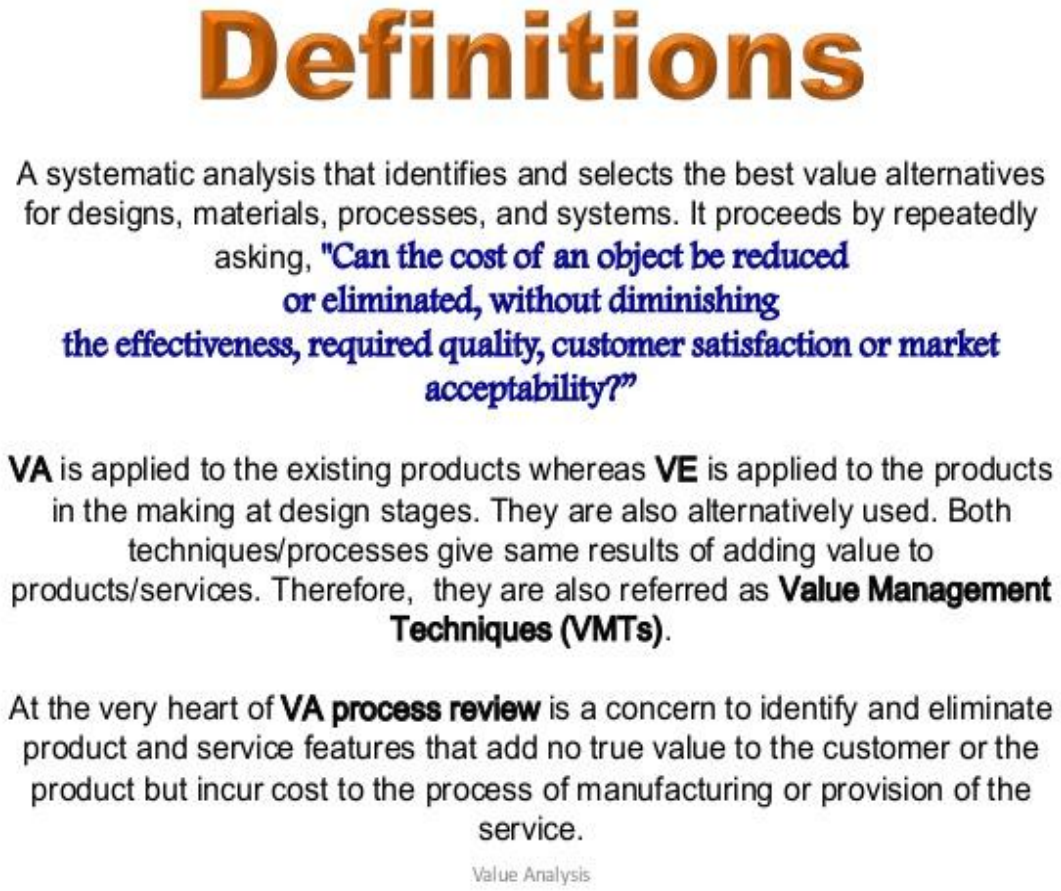
Prevention of conflicts of interest

To avoid any risk of influencing the procedure or discriminating against suppliers, all parties involved in the procurement procedure rule out any unethical or compromising behaviour or activity vis-à-vis suppliers or any actions that may suggest it.

2.6 Value analysis

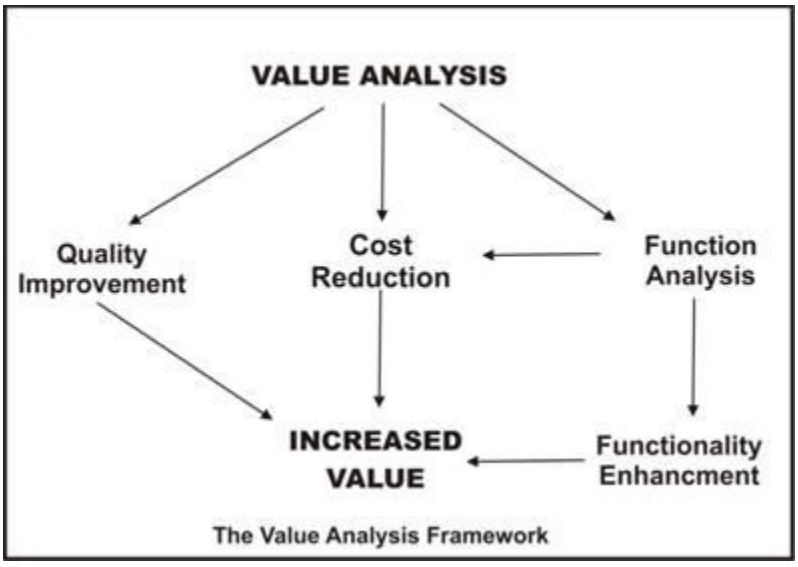
It can also be defined as a systematic analysis and evaluation of techniques and functions in the various areas of a concern with a view to exploring channels of performance improvement so that the value attached to a particular product or service may be improved.

It endeavors to achieve the maximum possible value for a given cost by a continuous process of planned action and aims at cost reduction from the point of view of value.



Although initially the group of techniques, aimed at the systematic identification of unnecessary costs and exploring channels of performance improvement, was used mostly in the engineering field which gave it the name of value engineering, it is now used in the various areas of a concern such as marketing, purchasing, financing etc.

Keeping in view the wide applicability of this technique, value analysis is now used instead of value engineering.



Value analysis involves a creative approach for finding out unnecessary costs. Such costs are those costs which though incurred on a product or service, are unnecessary and do not improve its quality or efficiency, give it a better appearance, prolong its life, nor provide any additional satisfaction to the customer.

By eliminating these costs; the cost of the product or service can be reduced, and the sales and the resulting profit proportionately increased.

Value analysis

Definition of Value Analysis

Value Analysis can be defined as a process of systematic review that is applied to existing product designs in order to compare the function of the product required by a customer to meet their requirements at the lowest cost consistent with the specified performance and reliability needed. This is a rather complicated definition and it is worth reducing the definition to key points and elements:

1. systematic, formal and organized process of analysis and evaluation.
2. 2 function of a product
3. 3. use of a product
4. formal management process must meet these functional specification
5. process of design improvements

WHAT IS VALUE ANALYSIS?

Value analysis as a concept is definitely not a new arrival on the business scene. Much of the original work was developed by Lawrence D. Miles and his colleagues at

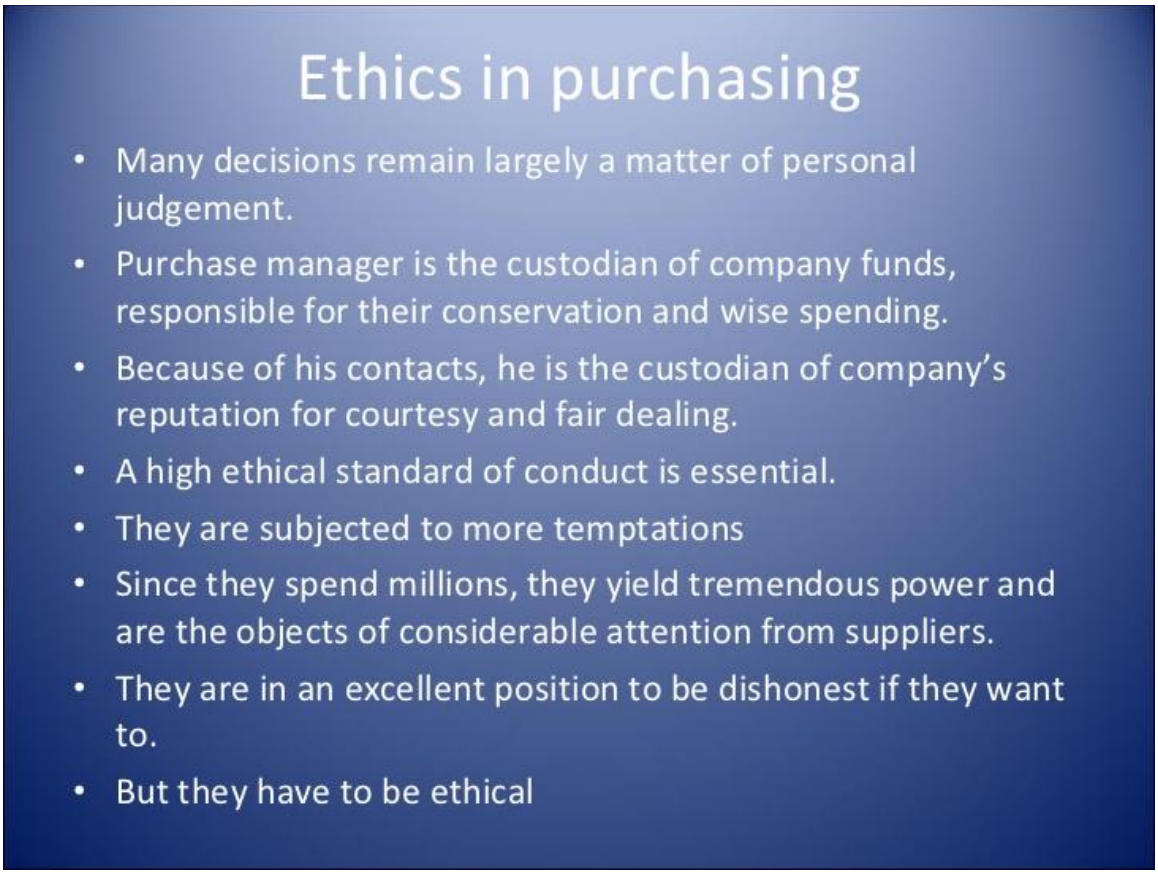
the General Electric Company near the end of World War II. Work continued into the fifties and culminated in the publication of Mile's first book in 1961. Miles described value analysis as follows: Value analysis is a philosophy implemented by the use of a specific set of techniques, a body of knowledge, and a group of learned skills. It is an organized, creative approach which has for its purpose the efficient identification of unnecessary cost, i.e., cost which provides neither quality nor use nor life nor appearance nor customer features. …

2.7 Purchasing Code of Ethics

Purchasing and Materials Managers occupy a special position of trust and responsibility. In order to avoid the potential problems of unethical behavior, strict adherence to a sound Code of Ethics is required and practiced.

The Corporate Purchasing Department subscribes to the following standards:

- Strive to conduct all business with honesty, fairness, integrity and loyalty to the system and our profession.
- Ethical behavior and processes are practiced consistently.
- Conduct ourselves in such a manner as to merit the respect of our employer, co-workers and peers.
- Refuse all gifts or gratuities and do not enter into any transactions resulting in our personal benefit.
- Exercise skill and good judgement to obtain the maximum value for each dollar of expenditure.
- Treat with discretion all information obtained in confidence.
- Strive for standardization to reduce cost and further the development and methods of products that emphasize high quality, safety and effectiveness of patient care.



2.8 CODIFICATION AND STANDARDISATION:

Simplification, Standardization and Specialization

The concepts of simplification, standardization and specialization (known as three S's) are closely interrelated and lead to interchange ability. These concepts can be effectively used in industry to minimize unnecessary activity, reduce inventory costs, simplify controls and improve product quality. All these factors lead to higher efficiency in production. Simplification - Simplification is a process of product analysis through which unnecessary varieties and designs are eliminated. Only a limited number of grades, types and sizes of the product are retained. Standardization - Standardization is the second step after simplification towards interchangeable manufacturing. Having selected the varieties and grades of the products to be retained as much of its manufacturing details are standardized as possible. Since manufacturing involves a large number of decisions from selection of raw material to the process used for

finishing, standardization of some of these items reduces unnecessary repetition of work. Use of standard components reduces inventory costs, ensures interchange ability and makes future maintenance easier. It also reduces component cost since standard components are manufactures by mass production methods and are cheaper. Selection of standard materials ensures physical performance and guarantees failure-free operation. Use of standard methods of production enables comparisons to be made of the standard and actual manufacturing time. The purpose of standardization is, therefore, on one hand, efficiency and economy in the use of human effort and on the other economy of material varieties and stock quantities and therefore reduction in cost and increase in turnover. What is the difference between product simplification specialization and standardization? Answered by The Community Standardization is a technique in which company establishes a standard such as product dimensions, size, quality and then company produces product on the basis of that standard. For example a manufacturing company produces shaft of standard shape and size. Simplification is the technique of reducing the diversity among the products. It is the process of minimizing product items to restrict production of useless products. Note: Simplification and standardization are closely related to each other. To get full benefit of standardization there is always a need of implementing simplification.

Advantages of standardization

Manufactures:

1. Rationalize different varieties of products.
2. Decrease the volume of products in the store and also the manufacturer cost.
3. Improve the management and design.
4. Speed up the management of orders.
5. Facilitate the exportation and marketing of products.
6. Simplify purchasing management

Consumer:

1. Establish quality and safety level to the service and products.
2. Inform to the characteristic of the products.
3. Make easier the comparison between the different offers

Public service:

1. Simplify the production of legal text.

2. Establish quality, environmental and safety policies.

3. Help to the economical development.

4. Facilitate the business.

In conclusion, rules affect in the evolution of the countries making easier the development of the economy in the industrial sector and in the service sector, with the contribution to the improve of the education and the social welfare and the environmental protection.

Classification and coding:

Classification and codification of materials are steps in maintaining stores in a systematic way. Materials are classified in such way that storing, issuing and identifying of materials become easy. Generally, materials are classified on the basis of their nature. Materials can also be classified on the basis of quality and utility. For example, materials may be classified as raw materials, consumable stores, components, spares and tools. Thus classifying materials on different bases such as nature, quality and utility is called classification of materials. For the purpose of identification and convenience in storage and issue of materials, each item of material is given a distinct name. Such a process of giving distinct names and symbols to different items of materials is called codification of materials. Good store-keeping requires proper classification and codification of various items of stores on stock. Stores are generally classified either by their nature or by their usage. The former method of classification or classification by the nature of materials is most commonly used. Under this method of classification, the various items of stores are divided into specific groups like construction materials, belting materials, consumable stores, and spare parts and so on. All the items are grouped, so that each item of stores will be conveniently codified on alphabetical, numerical or alpha-numerical basis and given a distinctive store code number. Following are the advantages of classification and codification of materials

*Quick and easy identification of materials.

* Helps ensure a proper material control.

* Secrecy of materials.

* Saving of time in material handling.

* Eliminating the chances of wrong issue

Codification of materials can also be termed as the identification of materials. This deals with uniquely identifying each item in the inventory. It is useful in requisitioning items or the

operational departments, in placing of orders by the purchase department, in receiving and expediting the items on receipt from the supplier, in having a unique record of each of the items in stores and in work-in-process or in warehouse so as to facilitate the control over the inventory levels, and also in having a good control over the loss, deterioration, obsolescence, non-movement, or pilferage of the items in the inventory. Unique identification of the materials – whether they are raw materials, work-in-process or finished goods – is the first step towards a good materials management system. Without it, the control over inventory by rigorous exercises such as inventory techniques is not very effective. Without it, confusion might prevail in the operational departments. Moreover for a good quality control system a unique identification is a pre-requisite. There are many other advantages such as variety reduction and standardization etc.

It is amazing to find that in many of our large public and private sector corporations, a considerable amount of inventory lies in the stores or elsewhere because of a confused nomenclature and a lack of proper identification system. Many items in inventory such as pipes, rods, angles, electrical switches, cables, valves, similar equipments, spare parts and even nuts, bolts and such items in inventory are available under different names and codes thereby reducing the actual availability of the item for operational needs. An item may be called a 'nut and bolt' by one section of the organization, whereas another may call it a 'fastener' and because of this there are two separate requisitions made, two separate purchase orders sent out, and two separate inventory levels of the items built into the system. One section might call an item a 'pipe' whereas another might call it a 'conduct' in fact both sections using the same item. This increases the inventory level unnecessarily Prevention of duplication is one of the important benefits of a good materials coding system.

Needless to say, for proper stock taking a good identification is of immense help. Many cases have been observed in large corporations where the concerned people do not even know what materials have been lying in the inventory for a large duration of time. These materials could easily be eliminated from the list, salvage value recovered and the storage space freed. It is also not uncommon to observe that although a material is available with the stores in reality due to duplication of the identity it is often quoted as 'not available' and thus, many production programs suffer with consequent loss to the organization as a whole Proper identification of inventory items helps in simplification of all the processes such as storing, receiving, procuring,

manufacturing, warehousing and this results in a multiplicity of benefits to the company. It is a simple concept. If followed it might produce results of proportions equivalent to that of a rigorous application of the inventory control principles with, perhaps much less effort.

Standardisation

Standardisation is the process of implementing and developing technical **standards** based on the consensus of different parties that include firms, users, interest groups, **standards** organizations and governments **Standardization** can help to maximize compatibility, interoperability, safety, repeatability ...

Standardization is the process by which a **company** makes it methods, especially its production processes, uniform throughout its organization. **Standardization** helps cut costs by eliminating duplicated effort and allows a **company** to take advantage of economies of scale when purchasing supplies.

The process of setting generally uniform characteristics for a particular good or service. **Product standardization** among the goods provided by different businesses operating in technology-based industries can be useful for consumers since it permits competition among the various suppliers.

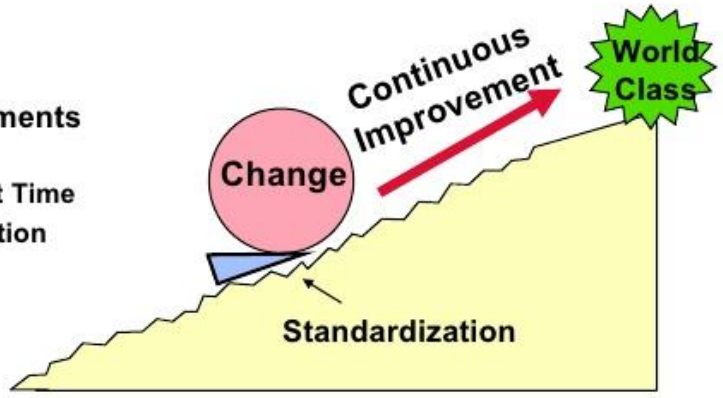
Product Developments Techniques

- Standardization
- Simplification
- Specialization
- Diversification

Standardization

- **Definition:** Standardization is a dynamic process by which we set standards of terminology, principles, methods, and processes within our organization.
- **Purpose:** The purpose of standardization is to stabilize, so as to achieve a base from which to grow and improve.

- **Standardization Elements**
  - Management by Takt Time
  - Workplace Organization
  - Standardized Work
  - Visual Management



3.1 INVENTORY CONTROL

Inventory is an idle stock of physical goods that contain economic value, and are held in various forms by an organization in its custody awaiting packing, processing, transformation, use or sale in a future point of time. Any organization which is into production, trading, sale and service of a product will necessarily hold stock of various physical resources to aid in future consumption and sale. While inventory is a necessary evil of any such business, it may be noted that the organizations hold inventories for various reasons, which include speculative purposes, functional purposes, physical necessities etc. From the above definition the following points stand out with reference to inventory:

1. All organizations engaged in production or sale of products hold inventory in one form or other.

2. Inventory can be in complete state or incomplete state.

3. Inventory is held to facilitate future consumption, sale or further processing/value addition.

4. All inventoried resources have economic value and can be considered as assets of the organization.

Inventory management is the practice overseeing and controlling of the ordering, storage and use of components that a company **uses** in the production of the items it sells. Inventory management is also the practice of overseeing and controlling of quantities of finished products for sale.

Raw materials inventory is the total cost of all component parts currently in stock that have not yet been used in work-in-process or finished goods production.

There are two subcategories of raw materials, which are:

- *Direct materials*. These are materials incorporated into the final product. For example, this is the wood used to manufacture a cabinet.
- *Indirect materials*. These are materials not incorporated into the final product, but which are consumed during the production process. For example, this is the lubricant, oils, rags, light bulbs, and so forth consumed in a typical manufacturing facility.

The cost of raw materials on hand as of the balance sheet date appears in the balance sheet as a current asset. Raw materials may be aggregated into a single inventory line item in the balance sheet that also includes the cost of work-in-process and finished goods inventory.

According to the Merriam-Webster dictionary, **inventory control** can be defined as the "coordination and supervision of the supply, storage, distribution, and recording of materials to maintain quantities adequate for current customer needs without excessive supply or loss."

When it comes to wholesalers and distributors of durable goods, inventory control can be further defined as the process employed to maximize a company's use of inventory. The goal of inventory control is to generate the maximum profit from the least amount of inventory investment without hindering customer satisfaction levels or order fill rates.

Techniques of Inventory Control

There are a number of different techniques employed by wholesale distributors to ensure their inventory control is maximizing efficiency and profitability. Below are six key techniques of inventory control for wholesalers and distributors of durable goods:

1) Establishing Annual Stocking Policies

Management must decide the maximum and minimum level of stocks and supplies that need to be kept in the warehouse or across the network of warehouse locations. Management must also set optimized re-order levels, safety stock levels (below which supply must not be allowed to fall) and an average inventory level to ensure costs are contained.

2) Preparation of Inventory Budgets

Many organizations have an annual inventory budget and they are usually prepared well in advance before inventory is procured. Budgets should include the total cost of ownership to keep inventory on hand during that year's account period. This includes materials cost, fixed operational costs, carrying costs, logistics costs, redistributioncosts and additional miscellaneous costs that contribute to the total costs of ownership.

3) Maintaining A Perpetual Inventory System

Also known as "the automatic inventory system", this method is designed to keep a constant track of the quantity and value of each stocked item. Many wholesale distributors leverage a combination of an Enterprise Resource Planning (ERP) or Warehouse Management System (WMS) in conjunction with an Inventory Optimization solution, such as EazyStock, to optimize inventory balances. Most ERP and WMS technologies struggle to keep costs low and service rates high, which is why optimization software can be so valuable to operations processes.

4) Inventory Turnover Ratio

This is a calculation used to determine how quickly inventory is used up or "turned over" in a given time period. The higher the ratio the shorter the shelf life of the inventory and typically leads to higher sales volume and profitability for companies with lower profit margins. Inventory

turnover should be closely watched for every item in the warehouse. Over the course of the product's life cycle, demand will fluctuate and cause variability in the supply chain. Tracking demand patterns are one way to ensure product replenishment calculations are accurate and optimized.

5) Establishment of Optimized Purchasing Procedures

In order to ensure that inventory is under adequate control, management must adopt purchasing procedures that align with actual sales history and demand pattern data. All inventory items that have not had an inventory turnover or have not been sold within an accounting period, typically 12 months, should be classified as obsolete stock and should be liquidated from inventory to eliminate unnecessary carrying costs. Any item with a declining customer demand should be flagged in the system and its safety stock level thresholds and re-order point counts should be downwardly adjusted to mitigate risk of obsolescence and cost.

3.2 INVENTORY COST

Inventory procurement, storage and management is associated with huge costs associated with each these functions.

Inventory costs are basically categorized into three headings:

1. Ordering Cost
2. Carrying Cost
3. Shortage or stock out Cost & Cost of Replenishment

1. Ordering Cost

Cost of procurement and inbound logistics costs form a part of Ordering Cost. Ordering Cost is dependant and varies based on two factors - The cost of ordering excess and the Cost of ordering too less.

Both these factors move in opposite directions to each other. Ordering excess quantity will result in carrying cost of inventory. Where as ordering less will result in increase of replenishment cost and ordering costs.

These two above costs together are called Total Stocking Cost. If you plot the order quantity vs the TSC, you will see the graph declining gradually until a certain point after which with every increase in quantity the TSC will proportionately show an increase.

This functional analysis and cost implications form the basis of determining the Inventory Procurement decision by answering the two basic fundamental questions - How Much to Order and When to Order.

2. Carrying Cost

Inventory storage and maintenance involves various types of costs namely:

- Inventory Storage Cost
- Cost of Capital

Inventory carrying involves Inventory storage and management either using in house facilities or external warehouses owned and managed by third party vendors. In both cases, inventory management and process involves extensive use of Building, Material Handling Equipments, IT Software applications and Hardware Equipments coupled managed by Operations and Management Staff resources.

c. Inventory Storage Cost

Inventory storage costs typically include Cost of Building Rental and facility maintenance and related costs. Cost of Material Handling Equipments, IT Hardware and applications, including cost of purchase, depreciation or rental or lease as the case may be. Further costs include operational costs, consumables, communication costs and utilities, besides the cost of human resources employed in operations as well as management.

d. Cost of Capital

Includes the costs of investments, interest on working capital, taxes on inventory paid, insurance costs and other costs associate with legal liabilities.

The inventory storage costs as well as cost of capital isdependant upon and varies with the decision of the management to manage inventory in house or through outsourced vendors and third party service providers.

Shortage cost

Inventory is the stock of materials or finished goods a manufacturer or seller keeps to cater to fluctuations in unanticipated demand from the consumer end. Just as carrying excess **inventory** results in high **cost** incurred by the seller, the flipside is the**inventory shortage cost**.

Ordering costs are the expenses incurred to create and process an order to a supplier. These costs are included in the determination of the economic order quantity for an inventory item. Examples of ordering costs are:

- Cost to prepare a purchase requisition
- Cost to prepare a purchase order
- Cost of the labor required to inspect goods when they are received
- Cost to putaway goods once they have been received
- Cost to process the supplier invoice related to an order
- Cost to prepare and issue a payment to the supplier

There will be an ordering cost of some size, no matter how small an order may be. The total amount of ordering costs that a business incurs will increase with the number of orders placed. This aggregate order cost can be mitigated by placing large blanket orders that cover long periods of time, and then issuing order releases against the blanket orders.

An entity may be willing to tolerate a high aggregate ordering cost if the result is a reduction in its total inventory carrying cost. This relationship occurs when a business orders raw materials and merchandise only as needed, so that more orders are placed but there is little inventory kept on hand. A firm must monitor its ordering costs and inventory carrying costs in order to properly balance order sizes and thereby minimize overall costs

The cost of holding goods(Carrying cost) in stock. Expressed usually as a percentage of the inventory value and includes cost of capital, warehousing, depreciation, insurance, taxation, obsolescence, and shrinkage. Also called inventory cost.

The cost consist of four different factors:

1. The expenses of putting the inventory in storage
2. Salary and wages of workers
3. Maintenance in the long term
4. All utilities used in caring the storage

Moreover, the carrying cost will mostly appear as a **percentage** number. It provides an idea of how long the inventory could be held before the company makes a loss, this also tells the manager how much to order.

3.3 Five Techniques of Inventory Control

Inventory Control

Some of the major techniques of inventory control are as follows:

1. Economic Order Quantity
2. Inventory Models
3. ABC Analysis
4. Material Requirements Planning
5. VED Analysis.

1. Economic Order Quantity:

A problem which always remains in that how much material may be ordered at a time. An industry making bolts will definitely would like to know the length of steel bars to be purchased at any one time.

This length is called "economic order quantity" and an economic order quantity is one which permits lowest cost per unit and is most advantages.

2. Inventory Models:

Concept:

Inventory models determine when and how inventory to carry.

i. Inventory models handle chiefly two decisions:

(a) How much to order at one time.

(b) When to order this quantity to minimize total costs.

ii. Lowest-cost decision rules for inventory management pertain to either buying products from outside or producing then within the company.

iii. Single inventory models assume no delivery delay and that demand is known.

iv. Probabilistic models handle situations of risks and uncertainty.

SELECTIVE INVENTORY CONTROL

Selective control means variation in control of items on selective basis .The criterion used for the purpose may be :

1. Usage Value
2. Unit Price
3. Criticality of item
4. Procurement difficulties

5. Seasonality

6. Issues form Stores

7. Inventory investment

• To identify items, which bring significant benefit by proper management from among hundreds and thousands of items managed by an organization

• Determine the importance of items and thus allows different levels of control based on the relative importance of items Stock-Keeping Unit (SKU)

• Management decisions regarding inventories must ultimately be made at the level of an individual item or product

• The specific unit to be controlled will be called a stock-keeping unit

• A SKU will be defined as an item of stock that is completely specified as to functions, style, size, colour, and usually location

Examples:

• The same style shoes in two different sizes would constitute two different SKUs

• Each combination of size and grade of steel rod in raw stock constitutes a separate SKU

• An oil company must regard each segregation of crude as a separate SKU

• A tire manufacturer would normally treat the exactly same tire at two geographically remote locations as two distinct SKUs

XYZ Analysis

• Based on the value of inventory undertaken during the closing of annual accounts X – High value; Y – Medium value; Z – Low value

HML Analysis • Items are classified according to the unit value as high, medium, and low. It is used to control the purchase value of items.

Movement Analysis (FSN Analysis)

• Check stock rotations and identifies the obsolescence of items. This is particularly useful for spare parts Fast-, Slow- and Non-moving Analysis

Criticality criteria (VED Analysis) Vital, Essential and Desirable

• This is in the point view of operation particularly useful for spare parts control

• A vital equipment is one, which feeds a battery of equipments downstream

GOLF – Government-controlled, Ordinarily available in the open market, Locally available and Foreign imported purchase

SDE – Scarce item or single source item, Difficult to obtain or Easy to obtain as it is an offthe-shelf item. SOS – seasonal and Off-seasonal

MUSIC – 3D (Multi-Unit Selective Inventory Control – Three Dimensional) Three dimensions are finance, operations and lead-time of materials

ABC Analysis:

ABC Analysis

• Classifies items based on the annual usage value (AUV)

• Identify a small percentage of items which account for most of the total inventory value

Basic Principle

20/80 - Rule Pareto's Law – Vilfredo Pareto – Italian Economist "Few are vital' and 'many are trivial' AUV = Annual demand xPrice

Pareto's law applied to inventories

• The relationship between the percentage of items and the percentage of AUV follows a pattern

A – about 20 % of items account for about 80 % of the AUV

B - about 30 % of items account for about 15 % of the AUV

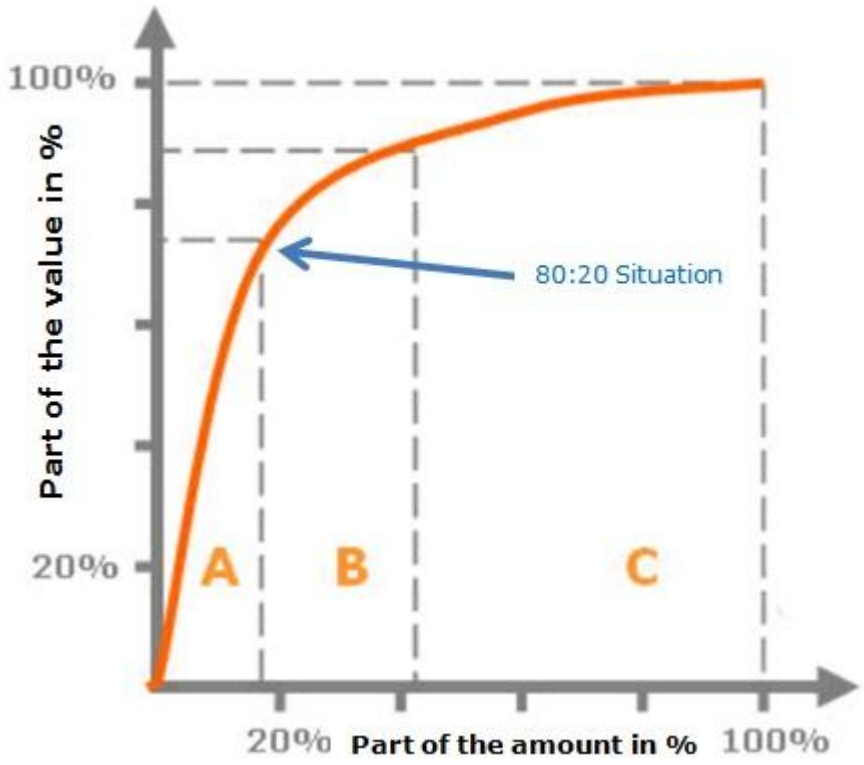
C - about 50 % of items account for about 5 % of the AUV

Steps in Making an ABC Analysis

1. Determine the annual usage for each item
2. Calculate the AUV of each item
3. List the items according to their AUV (descending order)
4. Calculate the cumulative AUV and the cumulative percentage of items
5. Examine the annual usage distribution and group the items into A, B, C based on percentage of AUV Using ABC approach, there are two general rules to follow:

• Have plenty of low-value items

• Use the money and control effort to reduce the inventory of high-value items



Different Controls used with different classes

• A Items: High priority – Tight control including complete accurate records, regular and frequent review by management, frequent review of demand forecast and close follow-up and expediting to reduce lead time

• B Items: Medium priority – Normal Control

• C Items: Lowest priority – Simplest possible control. Perhaps use a two-bin system or periodic review system. Order larger quantities and carry sufficient safety stock

A items: These are 5-10 % of the items which amounts for 70-75% of total money spent on materials . These items need to be stocked in smaller quantities and should be procured frequently , the quantity per occasion being small .

B Items : These are 10-15 % of the items which amounts for 10-15% of total money spent on materials .

C Items :These are 70-80 % of the items which amounts for 5-10 % of total money spent on materials .

Conducting ABC Analysis :

1. Prepare a list of items and estimate their annual consumption (units).

2. Determine unit price of each item .

3. Multiply annual consumption with unit price to get the annual consumption in rupees .

4. Arrange the items in descending order of their annual usage starting with the highest and ending with the lowest .

5. Calculate cumulative usages and express the same as cumulative usage percentage .Also express the no of items into cumulative item percentage .

6. Plot a graph of cumulative usage percentage v/s cumulative item percentage and segregate into three categories as A, B and C items.

7. Decide the policies for control of these three categories .

VED Analysis:

Vital essential and desirable analysis is used primarily for the control of spare parts. The spare parts can be divided into three categories:

(i) Vital

(ii) Essential

(iii) Desirable

(i) Vital:

The spares the stock out of which even for a short time will stop production for quite some time and future the cost of stock out is very high are known as vital spares.

(ii) Essential:

The spare stock out of which even for a few hours of days and cost of lost production is high is called essential.

(iii) Desirable:

Spares are those which are needed but their absence for even a week or so will not lead to stoppage of production.

TITLE	BASIS	MAIN USES
ABC Analysis	Usage value	To control on the Significant few & the Insignificant many
FSN Analysis	Consumption pattern of the Component	To control Obsolescence
VED Analysis	Criticality of the Component	To determine the Stocking Levels of Spare parts
HML Analysis	Unit Price of the Material	To control purchases
SDE Analysis	Problems faced in Procurement	Lead-time analysis and Purchasing Strategies

Material Requirements Planning:

MRP is a computational technique that converts the master schedule for end products into a detailed schedule for raw material and components used in the end products. The detailed schedule indentifies the quantities of each raw material and component items. It also tells when each item must be ordered and delivered so as to meet the master schedule for the final products.

3.3 Inventory models

Mathematical equation or formula that helps a firm in determining the economic order quantity, and the frequency of ordering, to keep goods or services flowing to the customer without interruption or delay

The Economic Order Quantity (EOQ) is the number of units that a company should add to inventory with each order to minimize the total costs of inventory—such as holding costs, order costs, and shortage costs. The EOQ is used as part of a continuous review inventory system in which the level of inventory is monitored at all times and a fixed quantity is ordered each time the inventory level reaches a specific reorder point. The EOQ provides a model for calculating

the appropriate reorder point and the optimal reorder quantity to ensure the instantaneous replenishment of inventory with no shortages. It can be a valuable tool for small business owners who need to make decisions about how much inventory to keep on hand, how many items to order each time, and how often to reorder to incur the lowest possible costs.

Fig. 26.1 EOQ MOdel

EOQ Model Equations

$$\text{Optimal Order Quantity} = Q^* = \sqrt{\frac{2 \cdot D \cdot S}{H}}$$

$$\text{Expected Number Orders} = N = \frac{D}{Q^*}$$

$$\text{Expected Time Between Orders} = T = \frac{\text{Working Days / Year}}{N}$$

$$d = \frac{D}{\text{Working Days / Year}}$$

$$ROP = d \cdot L$$

D = Demand per year
S = Setup (order) cost per order
H = Holding (carrying) cost
d = Demand per day
L = Lead time in days

The EOQ model assumes that demand is constant, and that inventory is depleted at a fixed rate until it reaches zero. At that point, a specific number of items arrive to return the inventory to its beginning level. Since the model assumes instantaneous replenishment, there are no inventory shortages or associated costs. Therefore, the cost of inventory under the EOQ model involves a tradeoff between inventory holding costs (the cost of storage, as well as the cost of tying up capital in inventory rather than investing it or using it for other purposes) and order costs (any fees associated with placing orders, such as delivery charges). Ordering a large amount at one time will increase a small business's holding costs, while making more frequent orders of fewer items will reduce holding costs but increase order costs. The EOQ model finds the quantity that minimizes the sum of these costs.

Economic order quantity (EOQ) is an equation for inventory that determines the ideal order quantity a company should purchase for its inventory given a set cost of production, demand rate and other variables. This is done to minimize variable inventory costs, and the formula takes into account storage, or holding, costs, ordering costs and shortage costs. The full equation is as follows:

$$EOQ = \sqrt{\frac{2SD}{PI}}$$

where :

S = Setup costs

D = Demand rate

P = Production cost

I = Interest rate (considered an opportunity cost, so the risk-free rate can be used)

BREAKING DOWN 'Economic Order Quantity - EOQ'

The EOQ formula can be modified to determine different production levels or order interval lengths, and corporations with large supply chains and high variable costs use an algorithm in computer software to determine EOQ.

How Inventory Impacts Cash-Flow Planning

EOQ is an important tool for management to minimize the cost of inventory and the amount of cash tied up in the inventory balance. For many companies, inventory is the largest asset balance owned by the company, and these businesses must carry sufficient inventory to meet the needs of customers. If EOQ can help minimize the level of inventory, the cash savings can be used for some other business purpose.

Factoring in a Reorder Point

One component of the EOQ formula calculates a reorder point, which is a level of inventory that triggers the need to place an order for more inventory. By determining a reorder point, the business avoids running out of inventory and is able to fill all customer orders. If the company runs out of inventory, there is a shortage cost, which is the revenue lost because the company does not fill an order. Having an inventory shortage may also mean the company loses the customer or the client orders less in the future.

Example of Using EOQ

EOQ takes into account the timing of reordering, the cost incurred to place an order and costs to store merchandise. If the company is constantly placing small orders to maintain a specific inventory level, the ordering costs are higher, along with the need for additional storage space

3.5 ECONOMIC ORDER QUANTITY (EOQ) MODEL

Several models have been developed for the purpose of inventory planning and control. The basic purpose behind such modelling is to arrive at the level of optimum investment in inventories. As will be evident from the discussion that follows, these models allow one to figure out the optimum lot size, i.e. the number of units that should be ordered each time.

There exist basically two kinds of models: deterministic and stochastic or probabilistic. The deterministic models are built on the premise that there is no uncertainty associated with the demand and replenishment or lead times.

The probabilistic model take cognizance of the fact that there is always some uncertainty associated with the demand pattern and lead times.

For the purpose of exposition, we shall now proceed to develop a deterministic model for arriving at the Re-order Quantity or the Economic Order Quantity (EOQ). This is an important concept in the purchase of raw material and in the storage of finished goods and in-transit inventories. We shall determine optimal order quantity for a particular item of inventory. In this exercise, we are going to arrive at the optimal order quantity of an item of inventory, given its forecast usage, the ordering cost and the carrying cost. Ordering cost can mean purchase or production.

Let us assume that the usage of this particular item is known with certainty and that the usage is stationary or steady throughout the period of time being analyzed. In essence, what we are assuming is that if the usage is 5200 units a year, the usage every week is 100 units. Goods are used evenly throughout the year. It is noteworthy that the EOQ model can be modified to take account of increasing or decreasing use over time. For the purpose of this exercise, such modifications are not being considered. We are assuming that the cost per order or the ordering cost, k, is constant regardless of the size of the order. As discussed earlier, k, represent the clerical and administrative and other costs involved in placing an order for the purchase of raw materials. For finished goods inventories, the cost of ordering involves scheduling a production

run and for in-transit inventories it involves basically record keeping. Obviously, the total ordering cost is the cost per order times the number of orders placed.

The average holding cost or carrying cost per unit represent the cost of inventory storage, handling, insurance, etc, and the required rate of return on the investment in inventories. We are assuming that these costs are constant per unit of inventory per unit of time. Therefore, the total carrying cost for a period is the average number of units of inventory for the period times the carrying cost per unit.

We are also assuming that inventory orders are filled without delay, since out-of-stock items can be filled without delay, there is no need to maintain a safety stock or buffer stock.

Since the usage has been assumed to be steady and there is no buffer stock, the average inventory can be expressed as Q/2, where Q = quantity per order and this quantity ordered is assumed to be constant over the period. Let us also assume that the particular item in question is purchased, the total cost involved on this count is the cost per unit times the number of units purchased.

Let average holding cost per unit = C

Total demand per week = D

Quantity per order = Q

The number of orders placed = D/Q

Cost per unit of the item purchased = P

Average inventory carried = Q/2

Cost per order = k

Then, total cost (TC) per week = k D/Q + PD + C Q/2

Where KD/Q represents ordering cost PD represents cost of purchase of the item in question, and C Q/2 represents the holding cost or the carrying cost.

For an optimal solution, we need to minimize the total associated cost. We would therefore set the first derivative = O and find out whether the second derivative is positive.

The EOQ-Model of inventory problem can determine ordering cycle and quantity. When the purchase unit price is constant, ordering cycle and ordering quantity, which minimize the one day's average inventory cost, is not dependent on the purchase price. But if purchase price may

change, the EOQ-Model must be modified. The purchase unit price is discounted as the ordering becomes larger. The discount of purchase price is described with a decreasing function of ordering quantity. This function is not always continuous with respect to the ordering quantity. Under this condition one day's average profit can be defined. And we can determine ordering cycle and ordering quantity, which maximize one day's average profit. Moreover, we consider the situations under which the setup cost depends on the ordering quantity. In this case the setup can be described with the increasing function of ordering quantity. We show that the EOQ-Model can be applied if it is modified by introducing the continuous setup cost function. This function is not differentiable at some levels of ordering quantity.

The most important useful of this study is "How can this concept be applied to spare parts inventory management?", and this concept can be used for reducing the complicated thinking about previous studies. Therefore, the contributions to knowledge of this study are: 1. The Re-Order Point and Purchasing Quantity 2. The Safety Stock concept.
There are two cases for considerations. The first case is inventory management for critical part and the second is inventory management for non-critical part.

Illustration : 1
A factory uses annually 24,000 units of a rawmaterial which costs Rs.1.25 per unit. Placing each order costs of Rs.25. and carrying cost is 6% per year of the average inventory.

a. Find the EOQ and the total inventory cost including the cost of material.
b. The factory works for 320 days a year. If the procurement time is 10 days and safety stock is 450 units, find the re order point the minimum and average inventory.

Solution:
Annual demand (D) = 24,000 units
Unit price P = Rs 1.25
Ordering cost(o) = Rs 25 per order
Carrying cost (c)= 6%

(a) EOQ =

$$\frac{2DO}{PC}$$

$\sqrt{2 \times 24{,}000 \times 25}$

1.25 x 0.06 = 4000

EOQ = 4000 units

Total cost = cost of materials per year + ordering cost per year + inventory cost per year

= 24,000 x 1.25 + 24000/4000 x 25

= +4000/2 x 1.25 x 0.06

= 30000+ 150 + 150

Total cost = Rs 30,300

b) if the factory workers for 320 days a year

consumption rate per day = Annual demand / No of working days per year

= 24000/320 = 75 units.

Safety stock = 450 units

Minimum inventory = safety stock = 450

Maximum inventory = EOQ + Safety stock

= 4000 + 450 = 4450

Average inventory = $\frac{\text{Minimum inventory + Maximum inventory}}{2}$

= 450 + 4450 = 4900/2

= 2450 units

Average inventory = 2450 units

Illustration 2:

Calculate the maximum level, manimum level and reordering level from the following data:

Re ordering quantity 1500 units

Re order period 4 to 6 weeks

Maximum consumption 400 units per week

Normal consumption 300 units per week

Minimum consumption 250 units per week

Solution:

(i) Reorder level = maximum consumption x maximum reorder period

= 400 x 6 = 2,400 units.

(ii) Maximum level= reorder level + reorder quantity – (minimum consumption x maximum reorder period)

= 2400 + 1500 – (250 x 4) = 2900 units

(iii) Minimum level = Re order level –(Normal consumption x Normal reorder period)

= 2400 – (300x5) = 900 units

Normal reorder period = $\frac{\text{Maximum period + Minimum period}}{2}$

= 6 + 4 /2 =10/2

= 5 weeks.

Illustration 3:

The annual demand for an item is 6400 units. The unit cost is Rs 12 and inventory carrying charges 25% p.a. if the cost of the one procurement is Rs 150. Determine:

6. EOQ 2. Number of order per year 3. Time between two consective orders.

Solution:

(1) EOQ = $\sqrt{\frac{2DO}{PC}}$

= $\sqrt{\frac{2 \times 6400 \times 150}{12 \times 25\%}}$

EOQ = 800 units

7. Number of orders = 6400/800 = 8 orders in a year.
8. Time between two consecutive orders = 12 /8 = 1.5 months

UNIT 4

Inventory models

An inventory system can be modelled quantitatively based on demand patterns.

They are

• Deterministic inventory models in which demand rate of an item is assumed to be constant.

• Probabilistic inventory models where the demand for an item fluctuates and is specified in probabilistic terms.

Based on the frequency at which orders are placed for procuring inventory, there are two models. They are single period and multi-period inventory systems. There are few sub-categories in multi-period review models. Each of them is briefly discussed below.

• Single Period models: Typically orders are made only once. They are also known as the Dollar Limit System and are used for one time ordering for seasonal products or spare parts purchases.

• Multi Period models: Orders are placed multiple times over the entire production cycle. Based on the pattern of reviewing current inventory, they are further classified. Continuous Review (also called Fixed Quantity or Q system): Inventory is reviewed continuously and when inventory drops to a certain (prefixed) reorder level, a fixed quantity is ordered. This model is generally used for high volume, valuable, or important items. Periodic Review (also called as P system): Inventory is reviewed at (prefixed) periodic intervals irrespective of the levels to which inventory drops; an order is placed to bring up the inventory to the maximum level. This is used for moderate volume items.

• Other inventory systems: Several other systems use a combination of traditional approaches.

Optional replenishment system: Inventory is reviewed on a fixed frequency and a specific quantity is ordered, if inventory is below a certain level. This is a mix of the P and Q systems.

Two-bin system: An invenory amount equal to R is kept in reserve in a second bin. When the first bin is emptied, the second bin is emptied into the first and an order of size Q is placed.

One-bin system: This is the P-system where one bin is reviewed at a fixed interval and inventory is brought up to a certain level.

4.1 Dynamic inventory models

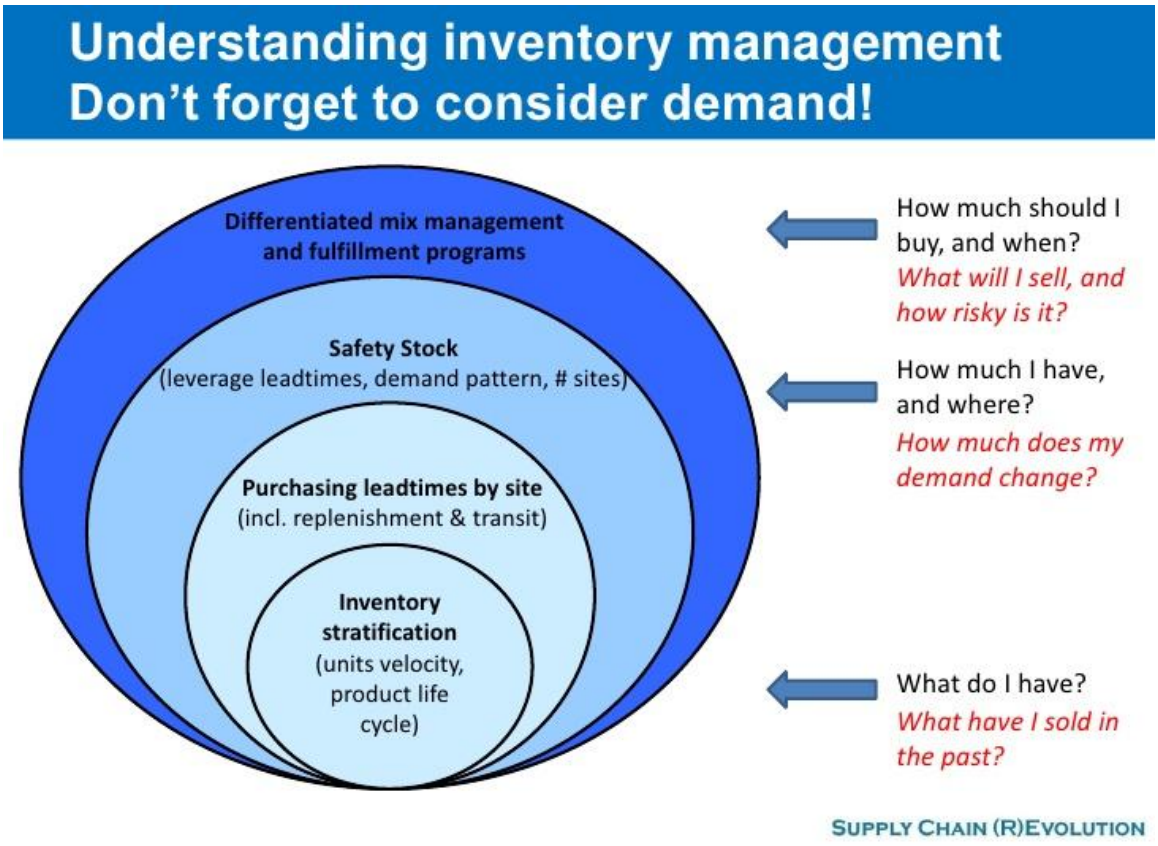
A study is made of a dynamic inventory model with stochastic lead times. A probability model is developed for the arrival of outstanding orders in which it is assumed that orders do not cross in

time and that the arrival probabilities are independent of the number and size of outstanding orders. With these assumptions, it is shown that the sequential multidimensional minimization problem normally associated with the random lead time model can be reduced to a sequence of one-dimensional minimizations. The minimizations are a function of a variable representing the sum of stock on hand plus all outstanding orders. Optimal ordering policies are characterized under the assumptions of convex expected holding and shortage costs, a linear ordering cost and a fixed setup cost (greater than or equal to zero) paid when the order is placed. These policies are shown to be quite similar to those obtained with deterministic lead times but some differences in the behavior of the single-period critical numbers (when the setup cost is zero) are noted.

Deterministic Models:

The order quantity (how much) and reorder point (when) are determined deterministically by minimising the total inventory cost that can be expressed as a function of these two variables. The total inventory cost (T C) is generally composed of the following components:

T C = Tc + To + Ts + D * C, (6) where D is the demand, specified as the number of total units needed for the entire planning period. The purchasing cost (D * C) becomes large, when the order size is large. The ordering cost represents the fixed charge incurred when an order is placed. Thus, frequent smaller orders will result in a higher ordering cost than less frequent larger orders. The holding cost, which represents the costs of carrying inventory in stock (eg., interest on invested capital, storage, handling, depreciation, and maintenance), normally increases with the level of inventory. Shortage of an item leads to two situations; either it shall be a lost business or a back order, when the order is accepted with a promise to deliver at the next time period. Both incur a penalty, the major component being the loss of customer's goodwill. It is very difficult in any business setup to deduce the monetary equivalent of loss of customer goodwill. What can be approximately quantified is shortage cost



Continuous review system (Q system)

In this system a fixed quantity of material or item is ordered every time whenever the inventory on hand reaches and creates the level refered to as re order level (ROL) or order point. The advantages of this system are

Control is provided by continuous monitoring of inventory withdrawls and inventory levels

Since the order quantity is fixed the economic order quantity (EOQ) is justified.

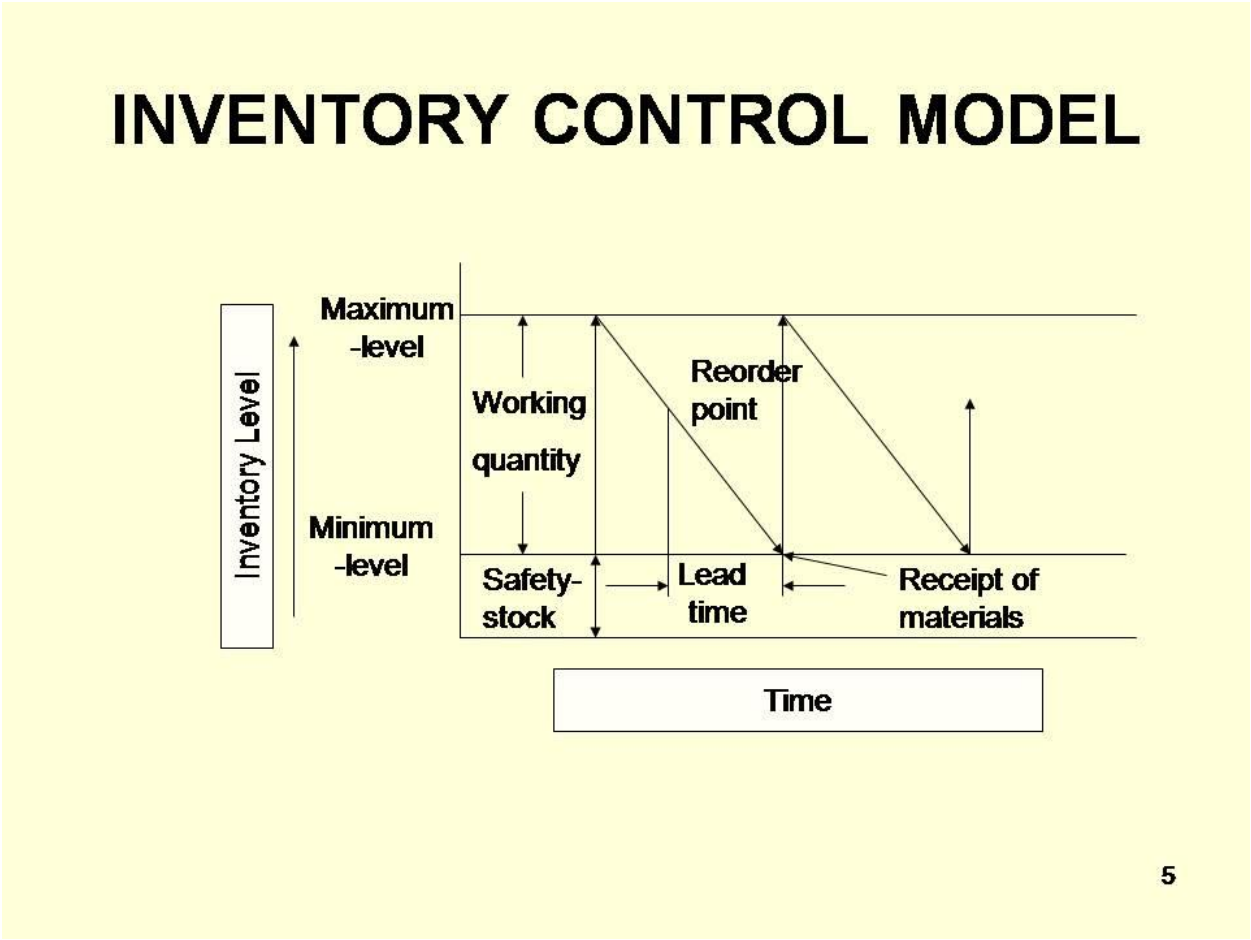
However the disadvantages of the added cost of 1.Record keeping 2. Physical count of inventory must be performed periodically to verify of records because of errors, pilferage, spoilage etc., orders are raised at irregular intervals which may not be convenient to the suppliers. The inventory control decision are how much to order (EOQ) and when to order (when the inventory level falls to re ordered levels)

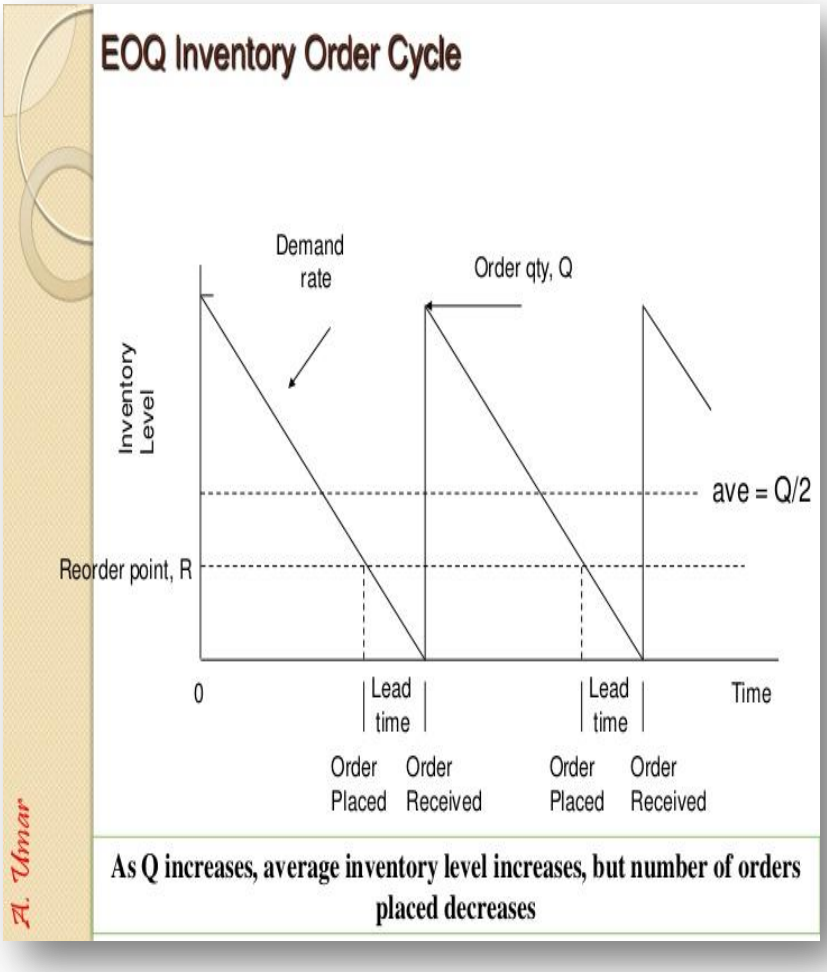
The order quantity is EOQ which is calculated is Q = 2

Where D is the annual demand in units Co is ordering cost per order p= unit price and Ci = inventory carrying changes as a percentage of the value average inventory.

The other decision is regarding the reorder level when the demand rate and lead time are known for certain, the re order level is calculated as the inventory which meets the demand during lead time also refer as buffer stock.

Re – order level = normal or average demand rate x normal or average lead time





	ADVANTAGES of Periodic Review Control System:		DISADVANTAGES of Periodic Review Control System:

1	All stock items are reviewed periodically so that there is likely to be less obsolete stocks	1	In general larger stocks are required, as re-order quantities must take account of the period between reviews as well as lead times
2	Economies in placing orders may be gained by spreading the purchased office load more evenly	2	Re-order quantities are not at optimum level of a correctly calculated EOQ
3	Larger quantity discounts may be obtained when a range of stock items are ordered at the same time from a supplier	3	Less responsive to changes in consumption. If the rate of usage change shortly after a review, a stock-out may well occur before the next review
4	Because orders will always be in the same sequence, there may be production economies due to more efficient production planning being possible and lower set up costs.	4	Unless demands are reasonably consistent, it is difficult to set appropriate periods for review.

Periodic inventory review involves counting and documenting inventory at specified times. For example, a retail store operating under a periodic review policy might count inventory at the end of each month. Continuous inventory review, also known as perpetual review, involves a system that tracks each item and updates inventory counts each time an item is removed from inventory. For example, a retailer may use bar code scanners to record customer purchases and update inventory counts every time a cashier scans a product code.

Advantages and Disadvantages of Perpetual Inventory Review

Perpetual inventory review permits real-time updates of inventory counts, which can make it easier to know when to reorder items to replenish inventory. This method of inventory review also facilitates accurate accounting, since the inventory system can generate real-time costs of goods sold. The main disadvantage of this type of inventory review is the cost of implementation -- bar code scanners, inventory software and computer systems are all necessary to maintain perpetual inventory review.

Considerations

The type of inventory review policy appropriate for a business depends on several factors, including the sales volume of the business and the number of employees handling inventory. A sole proprietorship with limited sales may not need to adopt a continuous review policy to maintain a level of accuracy necessary to continue business operations. Conversely, a large retailer with numerous employees handling merchandise may have difficulty maintaining accurate inventory counts under a periodic inventory review policy.

4.2 What is a 'Two-Bin Inventory Control'

A Two-bin inventory control is an inventory control system used to monitor the quantity of an item left behind. The two-bin inventory control method is mainly used for small or low value items. For example, when items in the first bin have finished, an order is placed to refill or replace these items. The second bin is supposed to have enough items to last until the placed order arrives. The first bin has a minimum of stock and the second bin keeps reserve stock or remaining material. Bin cards and store ledger cards are used to record the inventory.

BREAKING DOWN 'Two-Bin Inventory Control'

This system is used for material control, which is basically the control of materials. This is a cost effective method where the goal is to save money and use it to order more materials. It is used to control overstocking and under-stocking issues and keep track of miss-management of material.

This method is also referred to as kanban, in the United States.

A specific type of inventory control system. The kanban system is based upon a series of colored cards. These cards denote such factors as quantity, the type of part and the manufacturer. A card is placed in the bin or other container with each group of manufactured items as an identifier for those involved with the next phase of production or distribution.

BREAKING DOWN 'Kanban '

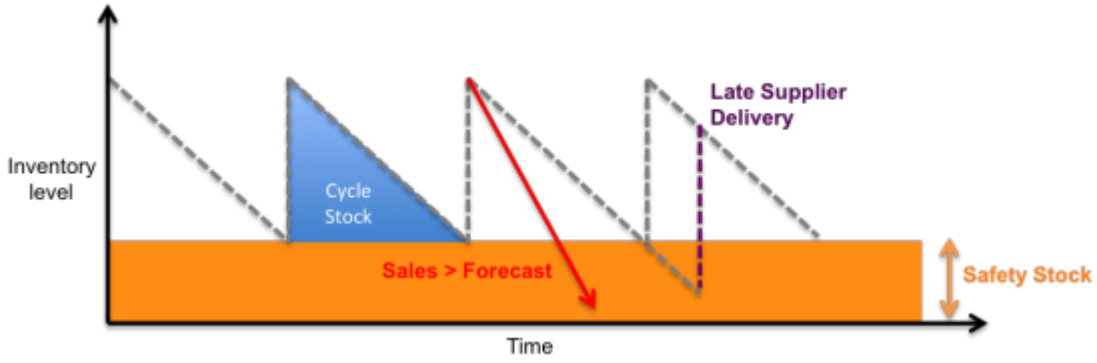
Kanban is a Japanese term meaning signboard or graphic. Cards appear as the container of goods or materials is emptied, allowing the production and delivery of more before a hold-up or shortage develops. These cards may have several colors that are ordered according to priority. Frequently a two-card system is employed where "move" cards are employed to move goods from one area of production to another, while "production" cards that replace materials after they are sold or used.

4.3 SAFETY STOCK

Safety stock is the stock held by a company in excess of its requirement for the lead time. Companies hold safety stock to guard against stock-out.

Safety stock, or buffer stock, is a term that is used to describe the amount of inventory or stock beyond pending orders or average demand that should be kept on hand to reduce the chance of a temporary shortfall of materials, or stockout. Stockout can lead to lost sales and lost customers. Safety stock is helpful in dealing with sudden upswings in demand or for making sure there are enough raw materials and supplies on hand to keep production going while waiting for the next scheduled delivery of materials from a supplier. It is important to calculate it accurately, because while too little stock results in shortages, too much will inflate inventory costs. How much safety stock you carry will depend on your service targets (i.e. how frequently you can accept stockouts), the variability of demand, and the variability of lead time.

Safety stock inventory, sometimes called **buffer stock**, is a term used by **inventory managers** to describe a level of extra **stock** that is maintained to mitigate risk of stockouts or (shortfall in raw **material** or finished goods) due to uncertainties in supply and demand.



Cycle stock is the average amount of inventory a business needs to meet customer demand between the times it orders more inventory from suppliers. A company goes through its cycle stock inventory as it sells products and restocks inventory.

- Cycle stock is the inventory that you plan to sell based on demand forecasts,whilesafety stock provides an additional buffer for excess demand or delayed shipments from your suppliers.

Four Primary Reasons for Carrying Safety Stock

As a result, managers get inventory imbalances that result in excessive inventory costs, impeded cash flow and poor and/or inconsistent service levels all at the same time. In addition, rules-based approaches are only sensitive to changes in demand.

What's the problem, you might ask? Well, this means the safety stock inventory determinations are relatively static and not linked to other important factors, such as service level, forecast accuracy and lead time variability.

Rule-based approaches are proven to be less than effective in determining optimal inventory levels for many operations. A sound, mathematical approach to safety stock calculations will not only justify the required inventory levels to business leaders, but also balance the conflicting goals of maximizing customer service and minimizing inventory cost.

1. Safety stock protects against unforeseen variation in supply and/or demand
2. To compensate forecast inaccuracies (only in case demand is bigger than the forecast)
3. Its purpose is to prevent disruptions in manufacturing or deliveries
4. Avoid stock outs to keep customer service and satisfaction levels high

Safety stock is calculated using the following formula:

formula:

Safety Stock = (Maximum Daily Usage − Average Daily Usage) × Lead Time

Lead time is the time which supplier takes in ordering the items

Example

ABC Ltd. is engaged in production of tires. It purchases rims from DEL Ltd. an external supplier. DEL Ltd. takes 10 days in manufacturing and delivering an order. ABC's requires 10,000 units of rims. Its ordering cost is $1,000 per order and its carrying costs are $3 per unit per year. The maximum usage per day could be 50 per day. Calculate economic order quantity, reorder level and safety stock.

Solution

EOQ = SQRT (2 × Annual Demand × Ordering Cost Per Unit / Carrying Cost Per Unit)

Maximum daily usage is 50 units and average daily usage is 27.4 (10,000 annual demand ÷ 365 days).

Safety Stock = (50-27.4) × 10 = 226 units.

Reorder Level = Safety Stock + Average Daily Usage × Lead Time

Reorder Level = 226 units + 27.4 units × 10 = 500 units.

Purpose of safety stock

Safety stock (also called buffer **stock**) is a term used by logisticians to describe a level of extra **stock** that is maintained to mitigate risk of stockouts (shortfall in raw material or packaging) due to uncertainties in supply and demand.

Minimum stock level

This number is 0 only if backorders are not permitted. It is determined by calculating the estimated amount of time from the beginning of production, through the time of transit, to the point at which the product is either "on the shelf" or in the hands of the customer who ordered it. Also called **minimum stock level**.

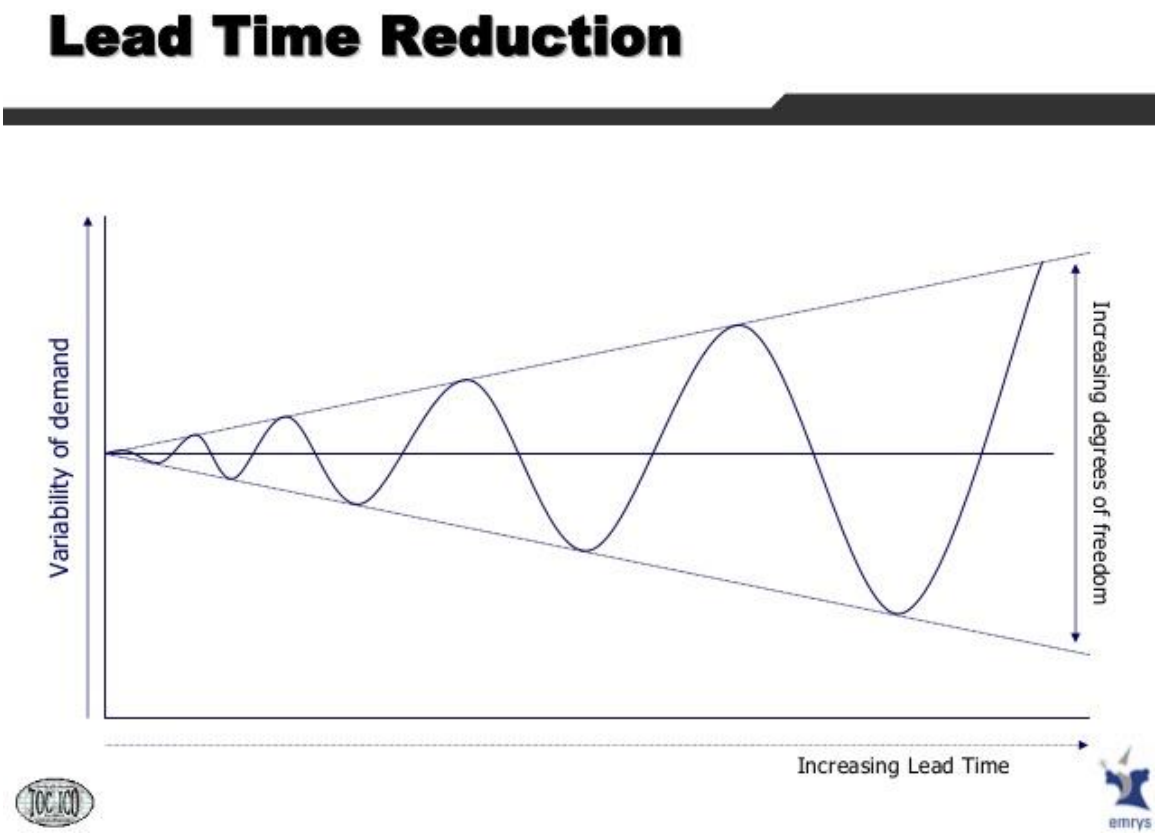
Maximum stock level

The **maximum stock** limit is upper **level** of the inventory and the quantity that must not be exceeded without specific authority from management. In other words, the **maximum stock**

level is that quantity of material above which the **stock** of any item should not normally be allowed to go.

4.4 Lead time

The **lead time** is the delay applicable for **inventory control** purposes. This delay is typically the sum of the supply delay, that is, the **time** it takes a supplier to deliver the goods once an order is placed, and the reordering delay, which is the **time** until an ordering opportunity arises again.



The satisfaction of the client is the most valuable assets of an enterprise can record. The measurement of the service level is important due to its connection to the management of stocks because it can affect the relationship with its customers and depending on the nature of the business, it can determine an important impact on profitability. Even though many companies regard to stocks as being an element of cost, there are companies which regard them as active components that contribute to the leading of a specific market share through a high level of

service, offering an availability of products in the quantities that are needed when a request is made from clients. The most important objectives in improving the management of stocks are:

- Reduce inventory carrying costs and other related;
- Customer retention issue need to improve service level;
- Support growth in new channel;
- Gain market share through superior service and product availability

The *lead time* is the delay applicable for inventory control purposes. This delay is typically the sum of the supply delay, that is, the time it takes a supplier to deliver the goods once an order is placed, and the reordering delay, which is the time until an ordering opportunity arises again. This lead time is usually computed in days.

Lead time has very distinct meanings depending on the industry being considered. In this page, we are looking at the lead time from the inventory control angle, i.e. as one of the key factors that needs to be taken into account for inventory optimization. This angle is typically most useful for retailers and wholesalers.

Supply delay

In most businesses, inventory cannot be *instantly* replenished by a supplier. Hence, in order to guarantee that the frequency of stock-outs remains sufficiently low, the demand planner needs to anticipate how much inventory will be consumed between now and the next replenishment, assuming that an order is made right away. Indeed, while goods are in transit, inventory will gradually get depleted.

Let's review a few examples that are typical in supply chain management:

- 1 day of supply delay for next day delivery for stores replenished by a regional warehouse.
- 1 week of supply delay for a wholesaler ordering from a local producer.
- 3 months of supply delay for a manufacturer producing in Asia and having a warehouse in Europe or North America.

Reordering delay

A common mistake found in lead time calculation is to omit the *reorder delay*. Indeed, if a shipment takes 3 days to be delivered from a supplier, but reordering from the same supplier is only carried out once a week, the inventory ordered on Monday 1st of any month is not just supposed to last until Thursday 4th (3 days ahead), but until Thursday 11th (10 days later - 7 days of reordering delay + 3 days of supply delay), since no additional reorder will be made between Tuesday 2nd and Sunday 7th.

In food retail, it is frequently observed that some suppliers only accept orders certain days of the week. In such situations, it must be noted that the reorder delay will vary depending on the day when the reorder is made. For example, if a supplier accepts reorders only on Mondays and Wednesdays, the reorder delay on Monday is 2 days, while the reorder delay on Wednesday is 5 days.

Sum of supply delay plus reorder delay

The lead time is the sum of the supply delay and the reordering delay. The lead time is the applicable duration to calculate the lead demand, the safety stock or the reorder point through a direct quantile forecast.

The longer the lead time, the higher the total inventory level. Indeed, total inventory includes both stock *on hand* but also stock *on order*. Longer lead time also increases the dependence of any company making an order on forecasting accuracy. Indeed, when next day delivery is available, an erroneous order (too large or too small) can be fixed with 2 or 3 days by applying corrective measures. In case of overseas shipments, incorrect orders can penalize the company for 6 months or more.

Varying lead time

The classic safety stock model assumes that lead time is a constant that gets factored into the calculation of the optimal reorder point. In practice though, lead times, when measured, are typically varying.

However, there is a frequent misconception about the impact of the variations in lead time on, say, safety stock calculation. The only variations that matter are the *unexpected* variations. If the lead time is varying in a perfectly predicable manner - for example, the supplier delivers in two *business days* instead of two *calendar days* - then this variation in itself has no impact on any inventory control calculations. All calculations of lead demand, safety stock and reorder points, should just leverage the correct lead times which change over time.

The only lead time variations that need to be accounted for, as far as inventory control is concerned, are the *unexpected* variations, typically caused by an increase in the supply delay due to a stock-out experienced by the supplier itself.

Measuring the supply delay

Since the reordering delay is usually driven by the reordering company itself, there is little or no uncertainty on this value. However, expected variations are anticipated to happen for the supply delay. Thus, it is usually important to keep track of the supply delay for each order and delivery. First, it allows to keep an eye on supplier performance; second, it allows to fine-tune inventory levels.

SERVICE LEVEL AND SAFETY STOCK In inventory management, service level is the expected probability of not hitting a stock-out during the next replenishment cycle or the probability of not losing sales. The service level is determined in a company by the level of stocks. Therefore, the safety stock level must be high enough to cover vendor's delivery times, sufficient enough to cover customers' demand, but not so high that your company loses money because of high carrying costs. The main reason is because demand fluctuations and is not enough consistency to predict future variability

Cost optimization is a business-focused, continuous discipline to drive spending and cost reduction, while maximizing business value. It includes:

- Obtaining the best pricing and terms for all business purchases
- Standardizing, simplifying and rationalizing platforms, applications, processes and services

Optimizing MRO Inventory

To achieve key business benefits, companies need an approach that supports the unique management requirements of MRO inventory, including:

- High criticality
- Long lead time
- High price
- Generally infrequent and highly variable usage
- Low data quality

Optimized inventory requires frequently obtained data points and evolution of the inventory in question based on those measurements in real time. A decision support system that incorporates best practice methodologies gives inventory managers a powerful tool to manage their business objectives and make their teams significantly more effective.

By leveraging technology tools, automated processes and inventory management best practices to optimize MRO spares and consumables, asset-intensive organizations can consistently produce results like these:

- **15-25 percent** reduction in funds invested in safety stock
- **5-20 percent** decrease in write-offs of surplus and obsolete stock
- **10-25 percent** fewer stock-outs, for improved availability and productivity
- **10-25 percent** drop in administrative costs for replenishing inventory
- **33-66 percent** less resource time spent managing inventory.

The 12 best practices of inventory optimization

These best practices — the new business requirements for MRO inventory optimization — are based on specialist inventory analysis and optimization methodologies developed by Oniqua — and supported by Oniqua Analytics Solution (OAS). These proven best practices are fundamental to achieving the significant inventory reductions and substantial bottom-line savings that are the hallmarks of inventory optimization.

1. **Criticality Analysis**

Generate a recommended criticality (business impact code) for each stock item by analyzing:

- Application (where used and fitted.
- Commodity classifications
- Practical “real-world” considerations or “workarounds”

- Supplier or OEM
- Price

2. **Demand Forecasting**

Commissioning of additional equipment may be expected to increase demand for certain inventory items. Demand forecasting capabilities should include:

- Selection of appropriate forecasting algorithms
- Automatic selection of algorithms for each stock item
- Use of forecasting and statistical distributions that are appropriate for a wide range of spares items including slow moving and lumpy demand
- Clipping and filtering techniques to manage abnormal data
- The ability to isolate planned maintenance and project demand from unplanned demand
- Capabilities to use knowledge of expected future events or trends to apply demand profiles to future forecasts

3. **Lead Time Forecasting**

Forecast lead time is a key factor in determining optimal safety stocks — aspire to achieve these capabilities:

- Forecast average lead time using purchase order and receipts history
- Filtering and clipping techniques to eliminate abnormal data
- Override lead times as required, and calculate lead time variance to assess expected service level

4. **Issue Size Forecasting**

The number of units typically required for an application (the issue size) is also a key factor in determining stock levels — a good inventory optimization solution will provide:

- The ability to forecast average issue size using issues history
- Appropriate filtering and clipping techniques to eliminate abnormal data
- Capabilities to override forecast issue size as required
- Calculation of issue size variance and use of this variable in calculating expected service level

5. **Economic Modeling**

Economic modeling capabilities should allow for "what-if" modeling of inventory trade-off decisions:

- Inventory holding costs for different types of items
- Total replenishment costs for different purchasing methods
- Expediting or emergency freight costs
- Stock-out costs, based on criticality and duration of stock-out
- Comparing existing and optimized results for metrics such as inventory value, service level and more

6. **Optimization of Reordering Parameters**

The reordering parameters — minimum and maximum levels (MIN/MAX) — used by the ERP materials management system to generate replenishment orders are the main determinants of inventory outcomes. Reordering parameters should be optimized periodically to reflect changes. The optimization process addresses:

- Selection of appropriate algorithms to optimize minimum and maximum stocking levels
- Use of an economic cost model that considers costs of holding inventory, replenishment, expediting and stock-outs as a preferred alternative to a fixed service level approach
- Analysis of groups of items rather than one-by-one, one at a time
- The ability to perform "what-if" modelling and compare optimized results against current inventory performance
- Consideration of "real-world" constraints including maximum bin capacity, storage capacity and more

7. **Exception Management**

For large, complex MRO inventories, a "management by exception" approach ensures that inventory review time is focused on high value or problem items. Exception management capabilities include:

- Tools for users to define any number of exception conditions with related alert thresholds
- The ability to search, sort and filter by exceptions
- Mechanisms to exclude changes to reordering parameters for items with exception conditions

8. **Inventory Segmentation**

Inventory segmentation provides a management framework for inventory that recognizes that a number of different management techniques are required for various item profiles:

- Segment the inventory based on characteristics such as usage or holding value, movement frequency and more
- Apply structured policies or business rules to the management of each inventory segment, such as manual control of special items or review or potentially obsolete items

9. **Spares Risk Assessment**

Some MRO inventories will include a high proportion of spares that are high cost, critical, have little or no expected usage and require long lead times to receive. Managing these items requires specific techniques:

- Risk modelling of the effect of holding zero, one or two sets
- The ability to perform sensitivity analysis around expected mean-time-between-demand and stock-out cost
- The ability to model or override all inputs to the stocking decision

10. **Spares Pooling**

Significant reductions in overall safety stock investment are possible through the pooling or sharing of high value, infrequent items (insurance spares) across multiple sites. To facilitate such arrangements, companies should:

- Identify common spares that are suitable for sharing
- Establish the optimal number of pooled spares to be held
- Determine the optimal location for holding the spares

11. **Knowledge Capture**

Capturing organizational knowledge relating to inventory items is an important business process in preventing mistakes and re-investigation; the inventory optimization solution should:

- Capture notes and commentary about inventory items
- Provide an audit trail for decisions
- Ensure high data quality for input parameters and classification codes
- Provide reminders when reviews are due

12. **Reporting Inventory KPIs**

Inventory KPI reporting is important to allow progress in improving inventory to be tracked. KPI reporting should include:

- A selection of pre-defined inventory management reports
- The ability to automatically capture a large selection of pre-defined inventory KPIs
- The ability for users to customize reports and statistics

Conclusion

For today's asset-intensive companies, competitive advantage requires a positive mindset towards innovation and technology. Without technology solutions and best practices, companies are left to struggle with manual processes, standard ERP system functionality, and ad hoc databases or spreadsheets. These manually intensive approaches are prone to error and impossible to sustain on a repetitive basis.

Inventory optimization is just good business. Achieving and maintaining inventory optimization is possible and profitable, with the right tools and the right type of help.

4.5 SIMULATION ININVENTORY CONTROL

Simulation is the process of imitating a real phenomenon with a set of mathematical formulas. Advanced computer programs can simulate weather conditions,chemicalreactions,atomic reactions and even biological processes.In theory any phenomenon that can be reduced to mathematical data and equations can be simulated on a computer.One of the tricks to developing useful simulations ,is to determine which are the most important factors .In addition to imitating processes to see how they behave under different conditions,simulators are also used to test new theories .After creating a theory of causal relationships, the theorist can codify the relationship in the form of a computer program. If the program the behaves in the same way as the real process,there is a good chance that proposed relationships are correct. An inventory control system should take into account key factors such as demand fluctuation based on market trends, spoilage in unstable goods such as food or chemicals, shrinkage due to spills, product damaged in shipping, and shrinkage caused by staff. Demand fluctuation based on market trends can only be predicted in a general sense by analyzing past precedences with similar products and how they relate to new items.

SIMULATION IN INVENTORY MANAGEMENT Choosing an inventory control strategy for the simulation experiment requires an intimate knowledge of the specific nature of the business being analyzed. A small-scale greengrocer, for example, should focus their inventory control strategy on anticipating consumer demand and minimizing loss due to spoilage, whereas a large stable goods retailer such as Wal-Mart, Kmart or Target can afford to make large purchase orders of items, store them in a warehouse and distribute them internally while receiving volume purchasing discounts. To provide efficient service to customers,it is necessary to choose reorder point with proper consideration of demand during lead time.If the lead time and demand of inventory per unit time both are random variables,then the simulation techniques can be applied to determine the effect of alternate inventory policies on a stochastic inventory system i.e. different combinations of order quantity and reorder point.Thus we run the inventory system artificially by generating the future observations on the assumptions of the same distributions. In inventory control, the problem of determining the replenishment policy due to uncertain demand and lead time can be solved by simulation.Instead of trying manually the three replenishment alternatives for each level of demand and lead time for a period of one year and then selecting the best one,we process on the computer and obtain the results in a very short time at a small cost. Uncertainty and variation in construction process has an important influence on project performance. The common practice to deal with variation is the holding of inventory. A suitable inventory improves the performance of project.

However, excessive inventory induces no-added value. Simulation experiments show that application of DES(discrete event simulation) and CONWIP(constant work-in-progress) provides an effective way of inventory control, simultaneously, maintain throughout the cycle time . Using advanced computer simulation models is an economical way to help in decision-making which allows the user to visualize the effects of changes to existing systems and what the costs will be prior to implementation. Just -in-Time(JIT), Total Quality Management (TQM) ,decision support systems for continuous improvement, graphical display of physical elements, simulating dynamic changes of the system, communication tool, problem understanding tool, AS-IS vs. TO-BE models, random behaviour of system elements captured in models, manufacturing oriented models, models usually represent the flow of physical object, is used in Inventory control management.

A simulation model of a production system could be used for investigating operating strategies that would reduce the size of inventory, machine cycle times, assess various scheduling rules, or reduce the level of faults. By doing this, any changes to be done to the real system could be tested on the model to avoid risks of inadequate decisions, and business activities could then be better understood. When changes tested on the model are implemented in the real system, effectiveness of the system should be improved as well as the competitiveness of an organisation. Simulation can be performed for existing or proposed systems to help cost-justification of decisions for improving the productivity of a system(Simulation). It analyzes the trade-offs between demand forecasts, material availability, lead times, and resource capacity to reduce product time in the supplychain and meet inventory and safety stock targets. Models were developed to include all the planning, production, and distribution functions in the current business process. It helps planners to meet forecasted and unexpected demand for produced goods. A supply chain process is made up of the flow of materials, information, and services and the monitoring and control of this flow, which includes raw materials, procurement, production, inventory management, order processing, warehousing, transportation, and distribution The development of functions to support these operations is known as supply chain management (SCM). Simulations can help with justifying capital equipment expenditures, flexible automation changes, the effects of downtime and setup time of the new system, and material handling selections.

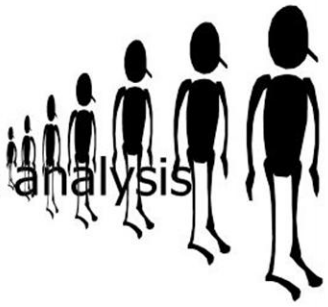
Simulation Model

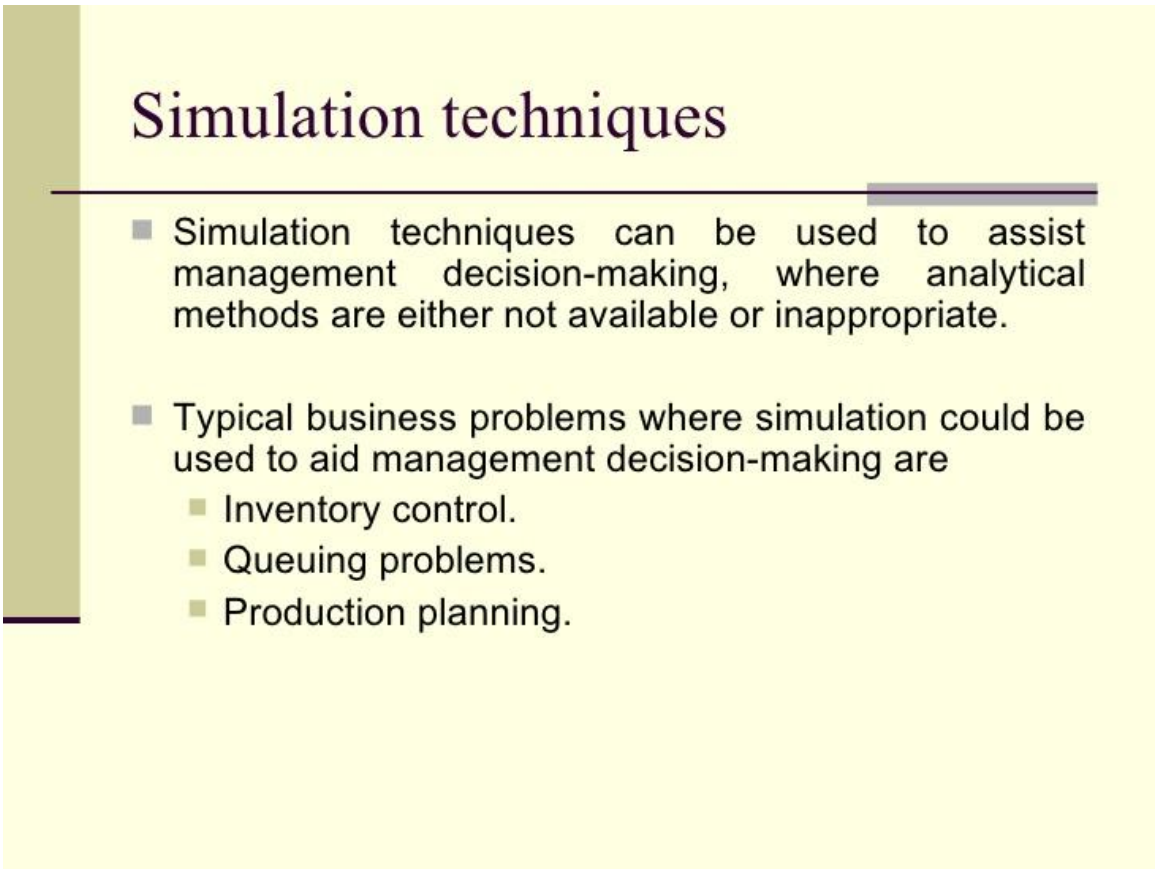
- A **simulation model** is a mathematical model that calculates the impact of **uncertain** inputs and decisions we make on outcomes that we care about, such as profit and loss, investment returns, etc.

- A simulation model will include:
  - **Model *inputs*** that are uncertain numbers/ uncertain variables
  - Intermediate calculations as required
  - **Model *outputs*** that depend on the inputs -- These are uncertain functions

Areas Of Simulation Application

- Waiting lines/service
- Inventory management
- Production & manufacturing systems
- Supply chain systems
- Service operations
- Environmental & resource analysis





4.6 Maintenance operations

Different from regular production operations, maintenance operations are not instigated by demand from an outside customer, but by the need for maintenance of equipment. To perform maintenance, typically several resources are needed, the most important of which are:

- a specialist, mechanic, engineer or other trained professional
- tools and equipment
- spare parts.

Preventive maintenance strategies can be further divided into usage and condition based maintenance. Under usage based maintenance, the total usage of a part is measured and maintenance is conducted when a certain threshold level has been reached. The usage of parts can be measured in many ways depending on the nature of the equipment. Time in the field is perhaps the most common mean to measure usage. For vehicles (e.g., rolling stock), mileage is a common measure of usage. The number of on-off cycles is a measure of usage for equipment that is mainly loaded at the end or beginning of on-off cycles. For example, the number of

landings is a measure of usage for the landing gear of an aircraft. Since the usage of equipment is usually scheduled, the moment that maintenance is performed can also be scheduled. If there is a large set-up cost associated with maintenance, it can be beneficial to interchange several parts simultaneously (Block replacement and/or overhaul). Otherwise, maintenance can be performed on a single component (Component replacement and/or overhaul).

4.7 Spare parts in maintenance operations

In this thesis, we distinguish three different types of maintenance spare parts:

•Rotables - These are items that constitute a sufficiently large subsystem of theoriginal equipment to warrant a separate usage based maintenance strategy.Rotables are individually tracked and traced so that the correct usage can beascribed to each rotable individually. Usually, there are dedicated resources forthe maintenance and overhaul of rotables. Examples include aircraft engines,rolling stock bogies (see Figure1.2a), and elaborate weapon or radar systemson frigates.

•Repairables - These are items that are repaired after replacement after whichthey are ready-for-use (RFU) again. Contrary to rotables, repairables donot have their own usage based maintenance strategy, and are not usuallyindividually tracked and traced. A repair shop handles the repair of manydifferent types of repairables. Examples of repairables include compressors and pumps.

•Consumables - These are items that are discarded after replacement and boughtnew from a supplier.

- The major problem in the supply of spare parts, is planning, executing, the required spares planning. Spare parts requirement requires articulate planning procedural lead time, and the correct required spares. Drawing/specification should be confirm to standards. The Purchase order should given correct description, code no: drawings and amendments if any in due course.
- The other problem in spares part management is identification and procurement of exact match. Normally in India, the technicians on the road are not aware of exact specifications and try to fit the materials available with them to make quick money.

Standard workshops are the best solution. They procure and manage spares parts from genuine source and exact match.

Identification of spare parts is not a problem, but keeping inventory of the spares is the biggest problem. How do you identify the correct spares, and do allow to keep excess inventory. A good planning for spares, with proper drawing/identification/requirement of spares is required. Forecast the required quantity and keep minimum stock.

Unit 5

5. Store keeping

It is primarily service function in which the store keeper acts as a custodian of all items carried in the stores. Store management should aim provide the service as a efficient as a possible with minimum possible cost. Store keeping may be defined as a function receving storing, and issuing of rawmaterials, bought out, spareparts, components, tools , consumables, supplies and stationery items etc., to the user department which have identified for the same. It is aspect of material control concerned with the physical storage of materials and goods.

After the completion of purchase procedure, the next important aspect Of materials management is storekeeping.

A storehouse is a building provided for preserving materials, stores and finished goods. The in-charge of store is called storekeeper or stores manager. The organisation of the stores department depends upon the size and layout of the factory, nature of the materials stored and frequency of purchases and issue of materials.

Stores may be centralised or decentralised. Centralised storage means a single store for the whole organisation, whereas decentralised storage means independent small stores attached to various departments. Centralised storekeeping ensures better layout and control of stores, economical use of storage space, lesser staff, saving in storage costs and appointment of experts for handling storage problems. It further ensures continuous stock checking.

It suffers from certain drawbacks also. It leads to higher cost of materials handling, delay in issue of materials to respective departments, exposure of materials to risks of fire and accident losses are practical difficulties in managing big stores.

On the other hand, decentralised stores involve lesser costs and time in moving bulky materials to distant departments and are helpful in avoiding overcrowding in central store. However, it too suffers from certain drawbacks viz., uniformity in storage policy of goods cannot be achieved under decentralised storekeeping, more staff is needed and experts may not be appointed.

Objectives of storekeeping:

Following are the main objectives of an efficient system of storekeeping:

1. To ensure uninterrupted supply of materials and stores without delay to various production and service departments of the organisation.

2. To prevent overstocking and understocking of materials,

3. To protect materials from pilferage, theft fire and other risks.

Functions:

1. Issuing purchase requisitions to Purchase Department as and when necessity for materials in stores arises.

2. Receiving purchased materials from the purchase department and to confirm their quality and quantity with the purchase order.

3. Storing and preserving materials at proper and convenient places so that items could be easily located.

4. Storing the materials in such a manner so as to minimise the occurrence of risks and to prevent losses due to defective storage handling.

5. Issuing materials to various departments against material requisition slips duly authorized by the respective departmental heads.

6. Undertaking a proper system of inventory control, taking up physical inventory of all stores at periodical intervals and also to maintain proper records of inventory.

7. Providing full information about the availability of materials and goods etc., whenever so necessary by maintaining proper stores records with the help of bin cards and stores ledger etc.

Working of the stores:

There are four sections in the process of storekeeping viz.

(a) Receiving section,

(b) Storage section,

(c) Accounting section, and

(d) Issue section.

Types of materials stored:

Store is a building where materials are kept preserve and saved. The word stores refers to the all kinds of materials and goods and held in stock and storage or storekeeping is defined as the act of storing the goods. The word stores is sometimes used to refer to anything in store. Stores are classified as

1. Rawmaterials stores
2. Components stores
3. Semi finished goods stores
4. Consumable material stores
5. Finished goods stores
6. Inwards goods stores or transit stores
7. Holding stores
8. Spare parts stores
9. Inflammable material stores
10. Scrap or disposal stores

Objectives

- To facilitate a balanced and smooth flow of rawmaterials, components, tools and anyother items necessary to meet production requirements
- To maintain optimum stock of materials to compensate for irregular supply by suppliers
- To achieve efficient use of store place
- To reduce usage of materials handling equipments
- To provide codification of storage items for easy recognition.
- To enable flexibility in production schedules
- To facilitate the quantity purchases at discount prices.

Stock verification

No matter how diligently a storekeeper performs the custodial job or how carefully a ledger clerk a maintain records (compuertised or manual) some discrepancy between the actual the book balances of inventory is bound to occur. The system is operated by people, and people to commit to mistakes. For this reason, every inventory item should be physically counted and checked against its book balance at least once in a year. The books are subsequently adjusted to match the actual count. Most companies create an inventory discrepancy or inventory short or over account to absorb such discrepancies. This account is eventually closed by transferring the balance to manufacturing the overhead account.

Stock verification can be conducted in one of the three ways:

1. Periodic inventory or fixed annual inventory

2. Perpectual or continuous inventory
3. Low point inventory

Under the low point inventory method companies take physical inventory when the stock is lowest, irrespective of the period. Stock taking is naturally irregular. The low point approach is minimises the time required for actual inventory work because of the small quantities of materials involved. However, it has the disadvantage of producing an irregular inventory schedule which leads to peak the work load for stores personnel.

In the continuous inventory approach, at the beginning of the each year, some firms divide the inventory in to 52 equal groups and assign one of them to be physically counted each week. Thus the physical inventory operation goes on without interrupting production operation or upsetting store room activities. This approach has three advantages. It can be planned and worked into scheduled activities without a shutdown. It canbe conducted in an orderly and relaxed manner; these conditions are also conductive to accurate work. Secondly there is a possibility of detecting and eliminating causes for discrepancies without allowing them to continue to throughout the year. Finally this approach facilities efficient utilization of stores personnel. In many storerooms, withdrawls are heavy early in the day and are much lighter later on. Thus, when the issue clerk's busy work slacks off, he will have blacklog of inventory work to do.

In some companies separate staff are appointed for the purpose of continuous stock taking. This approach involves extra cost and only very large companies can afford it.

In the fixed or periodic inventory, inventory is taken once a year, generally coinciding with the financial year. This necessitate shutting down the production operation and organizing a special crew for the inventory job. This approach is ideal for seasonal business. It is troublesome because it is a major task which task which must be accomplished in a short time, interrupting production operation.

Stock valuation:

Valuation of materials stocked in stores as inventory and of materials issued for production is necessary because of two reasons they are:

Inventory valuation of converting physical quantities of materials into monetary value is necessary to judge the performance of materials management function in terms of inventory turnover ratio and to control inventory to satisfy the norms set for inventory by top management.

Material costing in terms of the valuation of the cost of materials consumed by the user departments in order to estimate the cost of the products produced which forms the basis for pricing decisions.

Costing the receipt of materials:

The factors to be considered in the cost of the materials received and calculating materials price, freight charges, insurance, taxes, customs duty, packing charges, discounts availed if any, duty draw backs against export orders etc.,

Valuation of stocks has to be on occasions:

While issuing the materials to the consuming departments to enable the costing of production and

When preparing periodic performance statements in terms of value of inventory on hand from time to time.

Stores accounting:

A Stores is a virtual money that can be encashed. However, this money needs to be properly counted or accounted for. Stock accounting is thus a systematic way of assessing the money value of the items lying in stores as also the items under transaction through stores.

Transactions, in terms of receipts and issues are a regular feature in any stores and therefore Stock accounting process , in most of the cases, concentrates only on the stock in hand, lying in Stores.

The most popular methods of accounting are, FIFO i.e First In First Out and LIFO, Last In First Out.

FIFO and LIFO Methods as accounting techniques are used in managing inventory (Stock lying in Stores for future use) and financial matters involving the amount of money a company has tied up within inventory of produced goods, raw materials, parts, components, or feed stocks. These methods are used to manage assumptions of cost flows related to inventory, stock repurchases (if purchased at different prices), and various other accounting purposes.

FIFO standing for first-in, first-out, implies that the oldest inventory items are recorded as sold first but do not necessarily mean that the exact oldest physical object has been tracked and sold.

LIFO stands for last-in, first-out, meaning that the most recently produced items are recorded as sold first. Since the 1970s, some U.S. companies shifted towards the use of LIFO, which reduces their income taxes in times of inflation, but with International Financial Reporting Standards banning the use of LIFO, more companies have gone back to FIFO. LIFO is only used in Japan and the U.S.

Methods of valuation:

The process of valuation of the material in the industry varies from conservative practice of considering the market price or cost of procurement whichever is less, on hand to modern method such as replacement cost or current value method.

The choice of a method should be based in the nature of the material and the type of business.

Some of the methods of pricing of materials issued are below:

1. FIFO (First in First out method)
2. LIFO (Last in First out method)
3. Average price method & weightage average method
4. Actual price method
5. Inflated price method
6. Replacement price or current value method or market value method

For the income tax purpose only one of the following methods, ie., FIFO or standard price or actual price or market value, which ever is lower is accepted. However for internal control purposes the organization can choose .any of the above method

5.5 **DISPOSAL OF SURPLUS AND SCRAP MATERIAL:**

Before going into the details of waste management, some of the important terms, i.e. surplus, obsolete and scrap etc. need to be defined. The corporate have

aims to achieve advantageous disposal outcomes by:

a) enhancing value for money by encouraging competition in disposal practices and using competitive disposal processes;

b) promoting the use of resources in an efficient, effective and ethical manner;

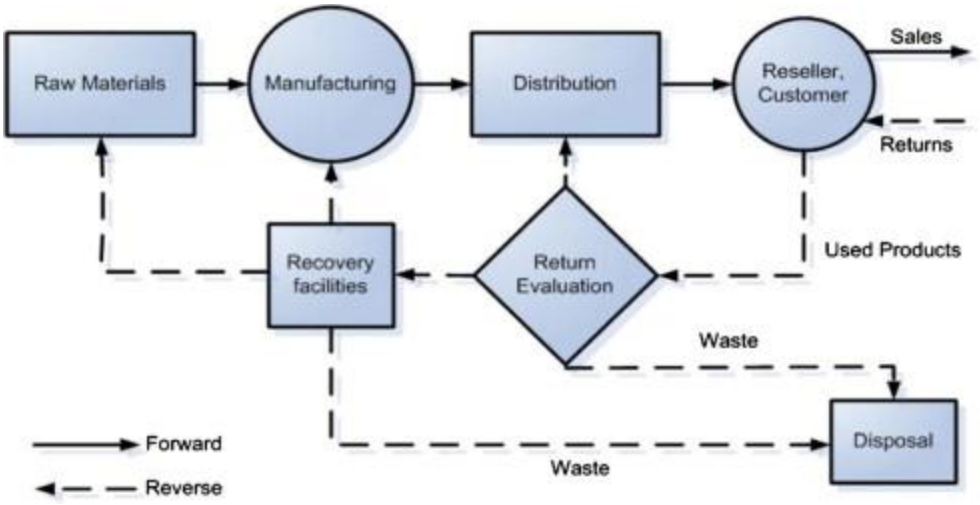
c) ensuring fair and equitable process and decisions;

d) making decisions with probity, accountability and transparency;

e) advancing and/or working within Council's economic, social and environmental policies;

f) appropriately managing risk; and

g) promoting compliance with all relevant legislation.



- **Surplus Stocks :** These are materials which have no immediate use or at least in the foreseeable future. They have accumulated due to faulty planning, forecasting and purchasing. Sometimes, they may have accumulated since they are standard bought in quantities only and not in loose form where they would be more expensive. In short, surplus stocks are the items which are in excess of their requirement.
- **Obsolete Stocks :** They are those items which are not damaged and have economic worth but are not suitable for the company's specific operations. For example, the spare parts of machines that have been phased out. Changes in product design, technological advancements, rationalistic, food and drugs whose effectiveness has lapsed over time, wrong codification etc. are some of the reasons why obsolescence occurs. As the name implies, they are non-moving items of the inventory.
- **Salvageable Items :** These are items which cannot be used for the original purpose but out of which certain parts may be removed and used either with or without rework. For example, the motor of a spoil air-conditioner may be used for other air-conditioners.

While removing, theses motors should again be regularized as spares for inventory purpose.

- **Reclaimable Items :** These are items which have worn out by use but their life can be extended by some specialized processes. An example is worn out treys which can be retreaded. Before reclaiming items, their extended life should be properly determined as sometimes~reclaiming is expensive and the extended life is not commensurate to the cost incurred.
- **Scrap :** This is another term which is used to describe material not useful to the organisation (sometimes, used also for obsolete and surplus items when these are not useful to the organisation). Scrap can be defined as the residue from a construction or manufacturing process which cannot be used economically within the organisation. Typical scrap material in the construction industry are empty tins, drums, and packing material etc.

The obsolete, surplus & scrap items can be put under the following categories.

1. Obsolete materials &equipments
2. Unserviceable equipment & machines
3. Deteriorate stock
4. Surplus stock
5. Scrap material

1. Obsolete Materials &Equipments:

Obsolete should be defined as materials, equipments or parts which are no longer usable in the service for which they are purchased and which cannot be utilised safely or economically for any other purpose. Broadly, it can be said that spares for plants sold become obsolescent when the machines they are carried for go out of production or are no longer available. Ordinarily, obsolescence arises on account of the following reasons:

(a) Adoption of standardisation or elimination of non-standard varieties.

(b) Faulty planning leads to over stocking of inventory.

(c) Non-implementation of project/job.

(d) Changes in demand due to change in fashions and supply conditions and change in business policy.

(e) Purchasing wrong items results in non-utilisation of stores.

(f) Bad communication within the organisation as well as with suppliers.

(g) The sudden emergence of new technology or a design change.

(h) Excess purchasing, whether due to wrong forecast of requirement or to take advantage of quantity discount.

2. Unserviceable Equipments& Machines:

The unserviceable equipments and machines are those inventories which outlived their life. No amount of repairs, renewals or replacements can bring them back to their usable life. Such equipments become irreparable and thus fit only for disposal as scrap. Examples are crankshaft, connecting rods, bearing etc. of an engine. Replacement is taken from stores on requisition and old ones are thrown into the scrap dump and sold by weight.

3. Deteriorate Stock:

Deterioration because of evaporation, spoilage, damage, moisture, rust or any other reason causing reduction in the value of stock is known as deteriorated stock. It is a state or condition when with the lapse of time the usable value of stores falls. For example, rust to iron, moisture to cotton over a period of time will reduce the economic value of stocks.

4. Surplus Stock:

Surplus means such items which are more than the required quantity and cannot be consumed during a specific time for certain reasons. These are the materials which can be consumed at some future time or that which is no longer required for the job, for which it was purchased. Surplus materials arise from many reasons:

(i) When manufacturing operations are suddenly curtailed on account of design improvement etc.

(ii) When the project has been completed.

(iii) These stores may be in excess of the normal manufacturing and repairing requirements to the job concerned.

(iv) Excess purchase of stores due to wrong judgement at the procurement stage.

(v) When there is a change in the specification of size.

5. Scrap Material:

Scrap has been defined as the incidental residue from certain type of manufacturing operations, such as turnings, boring, spurs, flashes etc. According to ICMA (London), “It is a discarded material having some value which is usually either disposed off without further treatment i.e.,

other than the reclamation and handling or is introduced into the production processes in place of raw materials

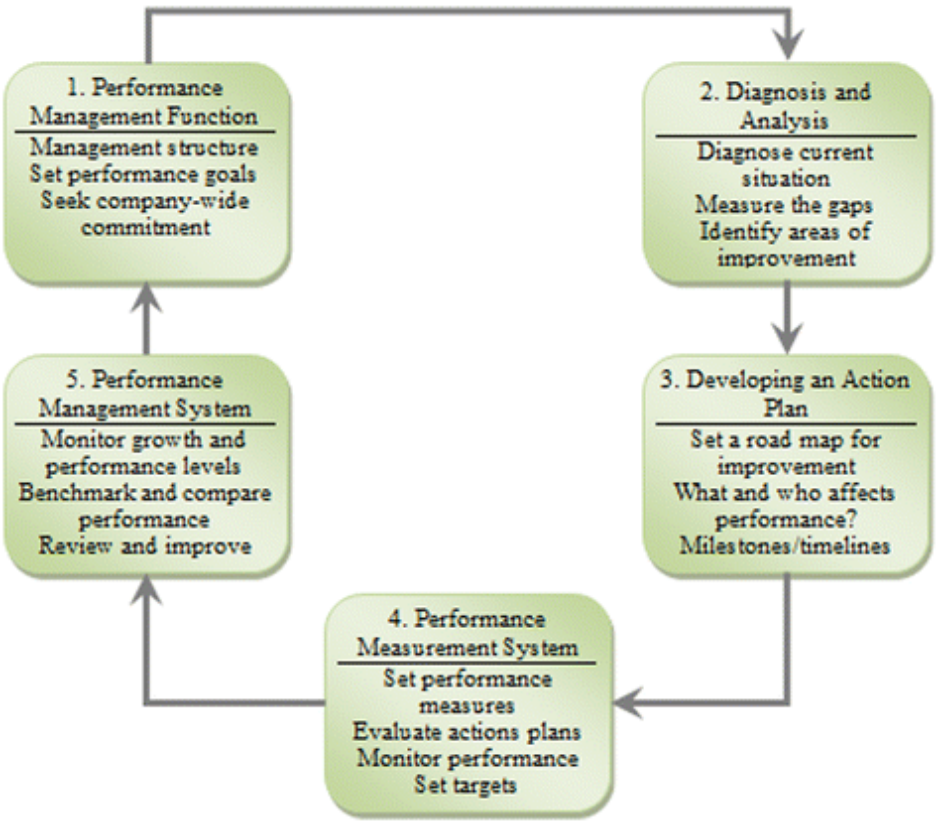
5.6 Performance and evaluation of material Management:

A need exists within the industrial construction industry to measure the effectiveness of the materials management process to provide a basis for analyzing the impact of process changes on process performance. Process changes, like the implementation of data-management technologies and reengineering, often take place concurrently with other changes. A concurrent situation complicates the task of identifying the actual impact on overall process performance. Although the initial costs are often available, the benefits are not readily determined in a manner that directly relates investment decisions and process changes to increased performance and profit margins. A classification scheme, consisting of six effectiveness categories (accuracy, quality, quantity, cost, timeliness, and availability) was applied to categorize the measures. To facilitate the implementation of the effectiveness measures, an industry-wide benchmarking mechanism is proposed.

Manufacturing Execution Systems & Manufacturing Operations Management

Manufacturing Execution Systems (MES) is based on providing our clients with the right information at the right time and showing the manufacturing decision maker ***"how the current conditions on the plant floor can be optimized to improve production output***."

Materials Management is a tool to optimize performance in meeting customer service requirements at the same time adding to profitability by minimizing costs and making the best use of available resources. The basic objective of Materials Management is to ensure that the right item is bought and made available to the manufacturing operations at the right time, at the right place and at the lowest possible cost. According to wild (1995), materials management is a concept which brings together the responsibility for determining the manufacturing requirement that is scheduling the manufacturing processes and procuring, storing and dispensing materials. An integrated approach to material management defines it as the function responsible for the coordination of planning, sourcing, purchasing, moving, storing and controlling materials in an optimum manner so as to provide a predetermined service to the customer at a minimum cost These definitions provide the scope of materials management which includes materials requirements planning (MRP), decision on purchasing, procurement of materials, inventory management, staffing, stores and warehouse management, production and distribution of finished goods at minimum cost at due time



✓ Effects of Lead Time on Organizational Performance Lead time is an important activity in effective materials management aimed at obtaining timely provision of materials, components and work-in progress. The main purpose of lead time is to actually enable the organization to acquire competitive advantages while delivering the right product at the correct place and at the right time hence satisfying the ultimate customer

✓ It is a positive and significant relationship between inventory control system and lead time on organizational performance. This implies that through inventory control systems and lead time in materials management, an organization can achieve the benefits of effective use of labour, providing system flexibility, increasing productivity, decreasing lead times, reduction in wastes, reduction in production costs, increased product quality are achieved. The ratings showed that inventory control systems played a vital role in organizational performance, and as such, organizations must ensure that inventory control system be highly involved in material management activities hence achieving higher organizational performance.

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