UNIT- II

Plant Location

- Plant location decisions deal with where the plant is to be located.
- Plant location is a strategic decision.
- The plant should be located in such a place where the large-scale economies accrue. Optimum size and optimum location go hand in hand.
- Plant location is more a corporate decision than an engineering one
- However, an entrepreneur has to necessarily understand the different factors that influence the location of a plant and their relative merits and demerits.

Factors Affecting Plant Location

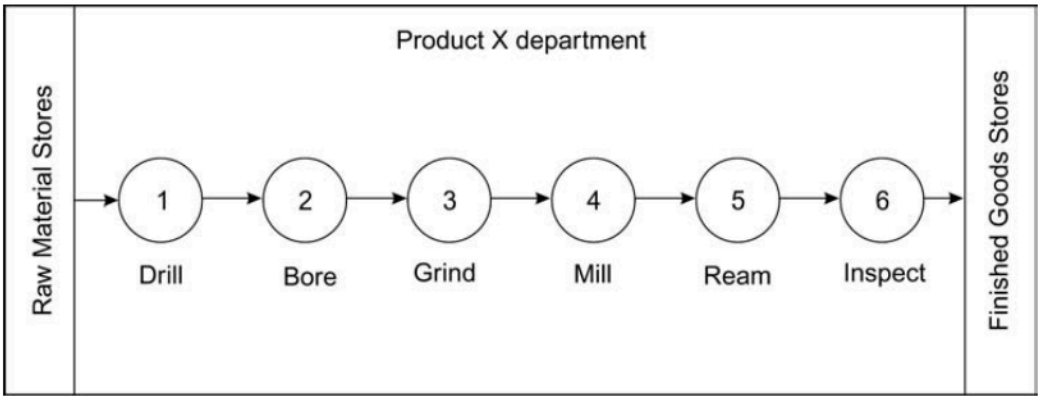
- There are many factors determining plant location. These are:
- Closeness to Raw Materials
- Nearness to the Markets
- Fuel and Power – SEZ, AQUA PARK
- Transport
- Availability of Labour
- Agglomeration Economies
- Natural and Climatic Factors
- Government Influence
- Political Factors and
- Other Considerations.

PLANT LAYOUT

- Plant layout refers to the arrangement of the physical production facilities
- It is concerned with arranging
- The manufacturing and servicing departments in the factory site
- The machinery within these departments
- The layout of individual work places

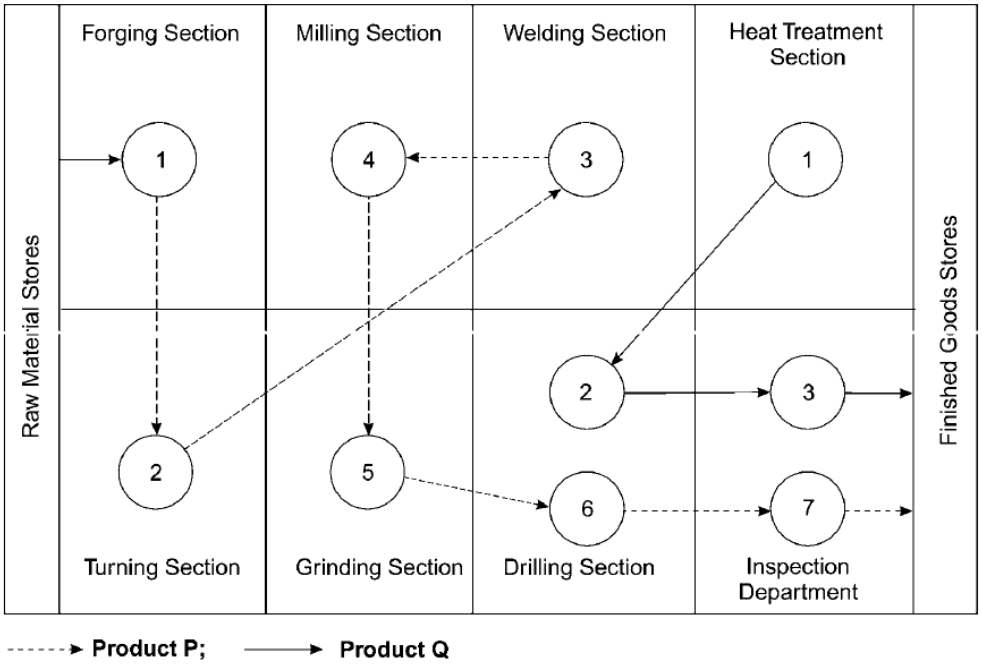
Product layout

Product layout is based on the logical sequence to be followed in the production of a given product or service. It facilitates large-scale production. A change in the logical sequence may necessitate large scale changes in the layout. Material handling costs in this method are lower. Monitoring is made easier. This method of layout promotes a sense of team effort that results in higher productivity.



Process layout

Process layout is based on the nature or types of operations involved in the manufacture of a given product or service. Each operation of process is a section by itself, for instance, drilling section, milling section, and so on.



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Fixed layout

Fixed layout, production facilities are fixed in their position. They cannot be shifted from place to place, for example—ship building, and others. Here, the material handling costs tend to be high because all the resources of production have to be moved to this point of production facilities

Combination layout

Combination layout integrates the advantages of both the product and process layouts.

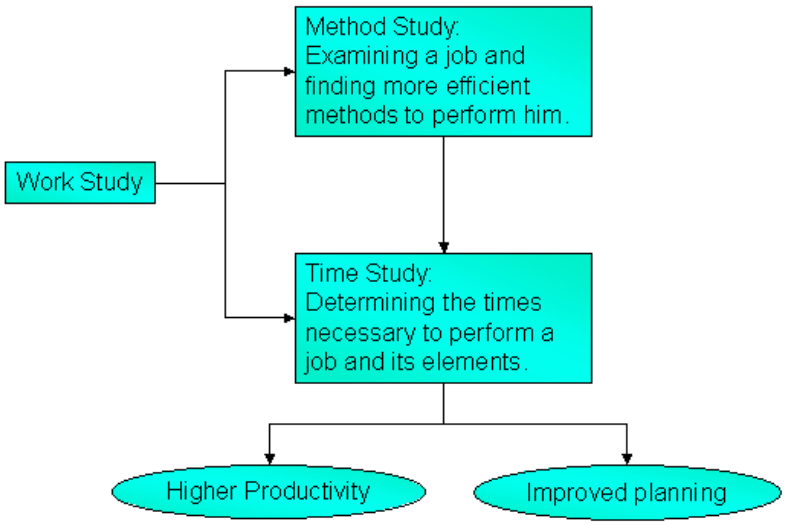
WORK STUDY

Work study investigates the work done in an organization and aims at finding the best and the most efficient way of utilizing the available resources (man, material, money and machinery) to achieve best possible quality work in minimum possible time.

Definition by ILO: Is a generic term for techniques, particularly *method study* and *time study*, which are used for the examination of human work in all its contexts, and which lead systematically to investigation of all the factors which affect the efficiency and economy of the situation being reviewed, in order to seek improvements.

Benefits of Work Study:

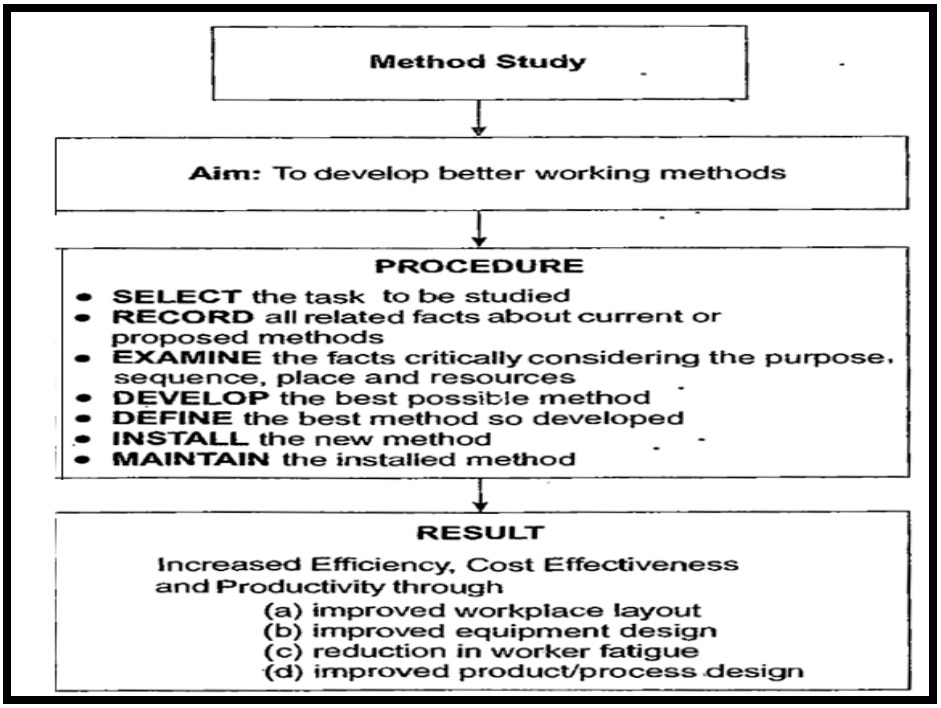
- It directly leads to standardization of the job process
- It determines the cost of the work performed
- It save and minimizes time since the unnecessary movements are eliminated
- It enhances productivity of the workers and machines
- It helps to evaluate the performance of the employee or department as against hard targets
- It enables the workers to earn incentives
- It contributes to cost savings
- It enhances the employee morale



METHOD STUDY

Method Study is the systematic recording and critical examination of existing and proposed ways of doing work, as a means of developing and applying easier and more effective methods and reducing costs.

Method-study concerned with "the way in which work is done (i.e., method)". It is used to simplify the way to accomplish a work and to improve the method of production. Method-study results in a more effective use of material, plant, equipment and manpower



1. Select: select the work to be studied.

• The job should be selected for the method study based upon the followingConsiderations:

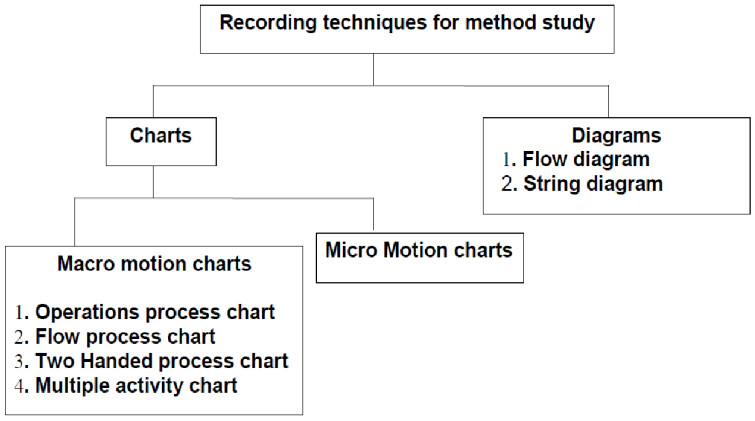
a) Economical aspect

b) Technical aspect

c) Human aspect

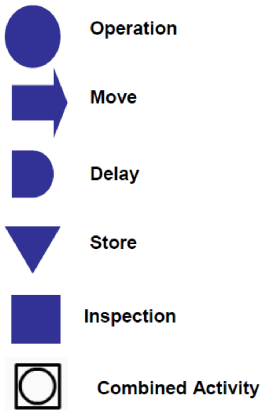
2. Record: record the relevant facts about the job by direct observation

• Recording techniques used for method study are charts and diagrams.



Recording techniques for method study

Production Terminology



3. Examine:

Examine the way the job is being performed and test its purpose, place, sequence and method of performance.

- In this step, the information provided by charts and diagrams is critically examined and screened by asking some searching questions. Like, what is done?, why it is done?, what else might be done? Etc.
- This examination is carried out with a view to eliminate, combine, rearrange and/or simplify the activities.

4. Develop:

Develop the most practical, economical, and effective method. After critical examination of records is complete, it is necessary to transform the learning's into the development of new methods. Some approaches are:

a) Eliminate unnecessary activities.
b) Combine two or more activities. For example, if one uses a combination tool for two operations, say, facing and drilling, the total set-up time will reduce.
c) Re-sequence activities so as to reduce time and effort.
d) Simplify process to reduce number of operations or reduce effort or reduce throughput, etc.
e) Attack on constraints, which are preventing the method to perform better.

5. Evaluate:

Evaluate different alternatives to develop a new improved method comparing the cost-effectiveness of the selected new method with the current method of performance.

6. Define:

Define the new method in a clear manner and present it to those concerned, i.e., management, supervisors and worker.

A report on new improved method should be prepared. It should include:

- Description of the method.
- Cost of installing the new method, including cost of new equipment and of relaying out shops or working areas.
- Diagram of the work place layout.
- Tools and equipment to be used and diagrams of jigs/fixtures etc.
- Executive actions required to implement the new method.

7. Install:

Install the new method as a standard practice and train the persons involved in applying it.

8. Maintain:

Maintain the new method and introduce control procedures to prevent a drifting back to the previous method of work.

WORK MEASUREMENT

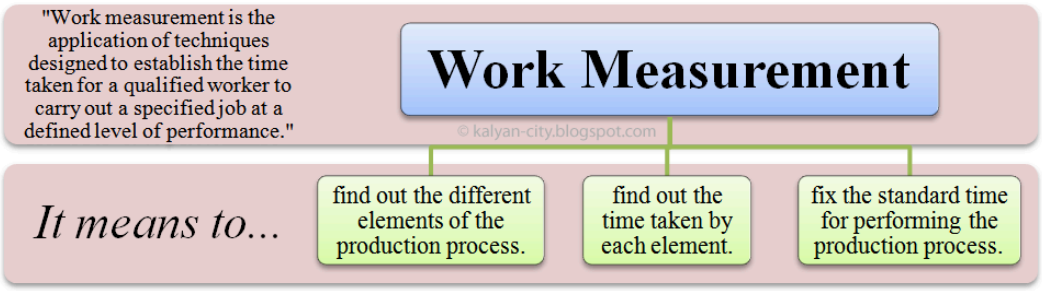
Work measurement is the application of techniques designed to establish the time for a qualified worker to carry out specified jobs at a defined level of performance or at a defined rate of working.

A qualified worker is one who has acquired the skill, knowledge and other attributes to carry out the work in hand to satisfactory standards of quantity, quality and safety. Defined rate of working is the amount of work that can be produced by a qualified worker/employee when working at normal space and effectively utilizing his time and where work is not restricted by process limitation.

Work measurement is the application of techniques designed to establish the time for an average worker to carry out a specified manufacturing task at a defined level of performance. It is concerned with the length of time it takes to complete a work task assigned to a specific job .

Uses of work measurement:

- To compare the efficiency of alternative methods.
- Cost estimation
- Pricing of products and services
- Incentive pay systems
- Capacity planning
- Production scheduling
- To provide information on which estimates for tenders, selling prices and deliverypromises can be based

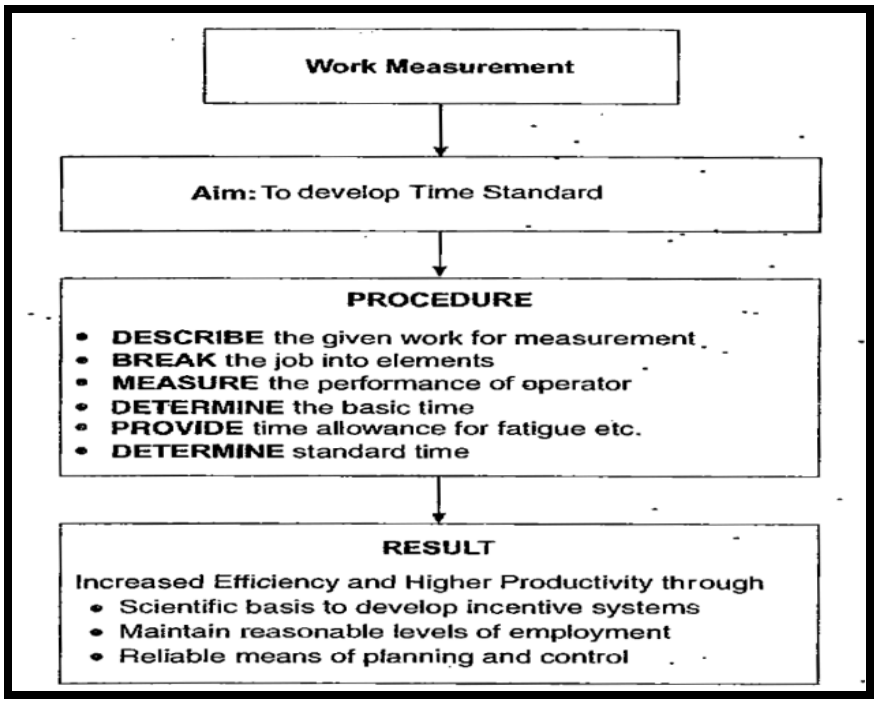


Technique of work measurement:

a) Time study: short cycle repetitive jobs

b) Work sampling: Long cycle jobs

c) Predetermined motion time standards: manual operations confined to one work centre



Statistical Quality Control (SQC)

Statistical Quality Control (SQC) is the term used to describe the set of statistical tools usedby quality professionals. SQC is used to analyze the quality problems and solve them. Statistical quality control refers to the use of statistical methods in the monitoring and maintaining of the quality of products and services. All the tools of SQC are helpful in evaluating the quality of services.

Objective of Statistical Quality Control

Quality Control is very important for a every company. Quality control includes service quality given to customer, company management leadership, commitment of management, continuous improvement, fast response, actions based on facts, employee participation and a quality driven

The main objectives of the quality control module are to control of material reception, internal rejections, clients, claims, providers and evaluations of the same corrective actions are related to their follow-up. These systems and methods guide all quality activities. The development and use of performance indicators is linked, directly or indirectly, to customer requirements and satisfaction, and to management.

Elements of Statistical Quality Control

The techniques under SQC can be divided into two parts: a) Process control and b) Acceptance of Sampling.

a**) Process Control:**

Control charts for Variables (Mean Charts and Range Charts)

Control Charts for Attributes(C charts and P Charts)

b) **Acceptance of Sampling**:

Single Sampling

Doubling Sampling and

Multiple Sampling

ELEMENTS OF STATISTICAL QUALITY CONTROL

The techniques under SQC can be divided into two parts: (a) process control and (b) acceptance sampling. The following table outlines the scope of SQC.

Statistical Quality Control		
Process Control *is carried out through*		***Acceptance Sampling*** *is carried out through*
Control Charts		
For Variables	*For Attributes*	
$\bar{X}$ Charts R Charts σ charts *	**'c' chart** for number of defects per unit **'p' chart** for defectives in a given sample	1. Single sampling plan * 2. Double sampling plan 3. Multiple sampling plan♣ 4. Sequential sampling plan♦

Table of Constant for Mean and Range Charts			
N	**A_2**	**D_3**	**D_4**
2	1.880	0	3.268
3	1.023	0	2.574
4	0.729	0	2.282
5	0.544	0	2.114
6	0.483	0	2.004
7	0.419	0.076	1.924
8	0.373	0.136	1.864

9	0.337	0.184	1.816
10	0.308	0.223	1.777

PROCEDURE FOR $\bar{X}\,\bar{X}$ CHARTS

a. Compute average of Averages of $\bar{X}\,\bar{X}$

b. Calculate average range $\bar{R}\,\bar{R}$

c. Multiply the average range by the conversion factor A_2. This gives $A_2\bar{R}\,\bar{R}$

1) To obtain the upper control limit, apply the following formula

Upper control limit= $\bar{X} + A_2 * \bar{R}\,\bar{X} + A_2 * \bar{R}$

Lower control limit= $\bar{X} - A_2 * \bar{R}\,\bar{X} - A_2 * \bar{R}$

Procedure for constructing R charts

a) Compute average range $\bar{R}\,\bar{R}$

b) Multiply the average range by the conversion factor (D_4or D_3)

1) To obtain the upper control limit, apply the following formula:

Upper Control Limit = D_4*$\bar{R}\,\bar{R}$

2) To obtain the lower control limite, apply the following formula

Lower Control Limit – D_3* $\bar{R}\,\bar{R}$

Example:1 Construct $\bar{X}\,\bar{X}$ and $\bar{R}\,\bar{R}$ charts from the following information and state whether the process is in control. For each of the following $\bar{X}\,\bar{X}$ has been computed from a sample of 5 units drawn at an interval of half an hour from an ongoing manufacturing process.

Sample	1	2	3	4	5	6	7	8	9	10
$\bar{X}$	20	34	45	39	26	29	13	34	37	23
$\bar{R}$	23	39	14	5	20	17	21	11	40	10

Sol:

The mean of the mean calculated as below:

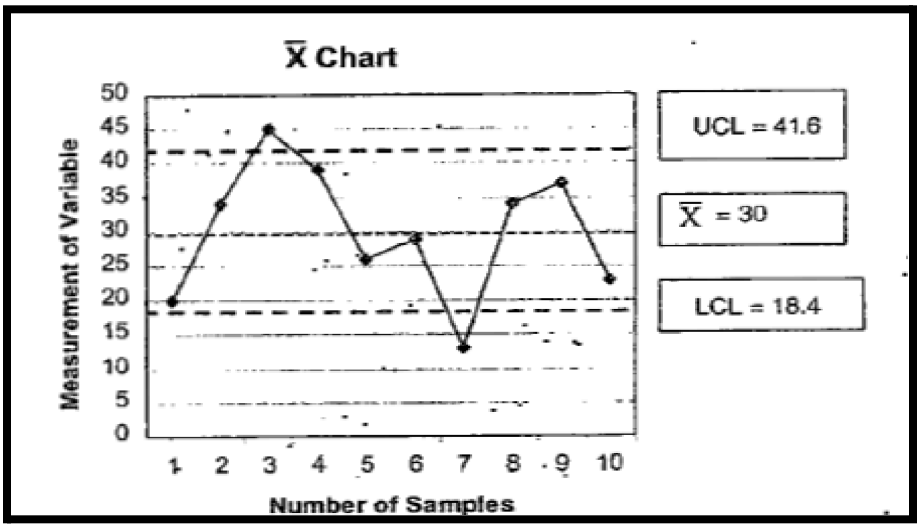
$\bar{X} = \frac{\Sigma X}{n}\,\bar{X} = \frac{\Sigma X}{n}$ $\bar{X} = \frac{300}{10}\,\bar{X} = \frac{300}{10}$

The upper and lower control limits for the $\bar{X}$ chart are computed as below:

Considering the value of $\bar{\bar{X}} = 30$, $\bar{R} = 20$, and $A_2 = 0.58$

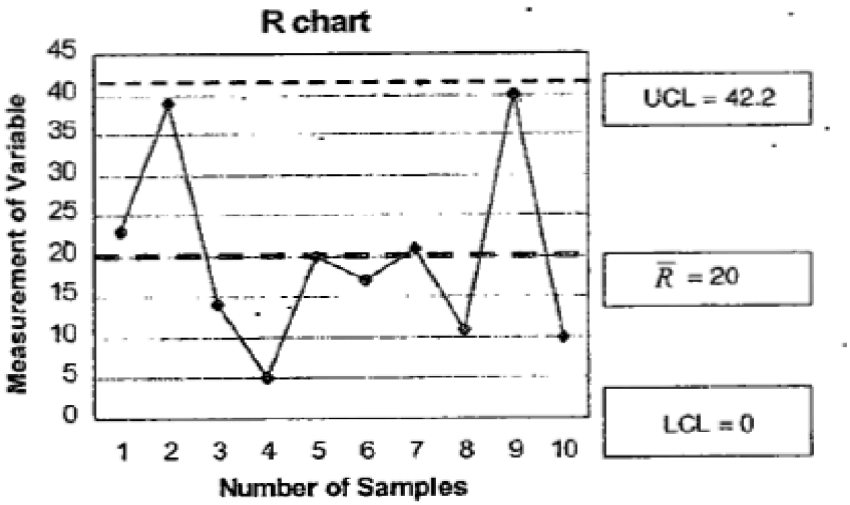
$$\text{Upper control limit} = \bar{\bar{X}} + A_2\bar{R} = 30 + (0.58 \times 20)$$
$$= 30 + 11.6$$
$$= 41.6$$

$$\text{Lower control limit} = \bar{\bar{X}} - A_2\bar{R} = 30 - (0.58 \times 20)$$
$$= 30 - 11.6$$
$$= 18.4$$



$$\text{Upper control limit} = D_4\bar{R} = 2.11(20) = 42.2$$

$$\text{Lower control limit} = D_3\bar{R} = 0(20) = 0$$



INVENTORY MANAGEMENT

It is commonly used to indicate Raw Materials, Work in Process, Finished goods, Spare parts and others which are kept in stores to meet an expected demand or distribution in future.

Types of Inventory:

The inventoryisdivided intotwo categories;vizdirect inventory and indirectinventory

The direct inventory is one that is used for manufacturing the product. Itis furthersub-divided into following groups.

1. Raw material inventories
2. Work-in-process inventories
3. Finished– goods inventory
4. Spare parts inventory

Need for Inventory Control

- Improvement in Customer relationship because of the timely delivery of goods and services.
- Smooth and Uninterrupted Production and hence no Stock out.
- Efficient Utilization of Working Capital.
- Economy in Purchasing.
- Helps in minimizing Loss due to deterioration, and damage.
-

Inventory Control Techniques

- **Economic Order Quantity (EOQ)**
- **ABC Analysis**

ECONOMIC ORDER QUANTITY (EOQ)

EOQ is one of the oldest and most commonly known techniques. This model was first developed by Ford Harris and R.Wilson independently in 1915 the objective is to determine economic order quantity, Q which minimizes the total cost of an inventory system when demand occurs at a constant rate.

In EOQ involves two types of costs those are

- Inventory Ordering Cost - to place order through mobile or mail (Power, telephone bill, Fax and etc.)
- Inventory Carrying Cost (Rent, Insurance, Tax, and etc.)

CALUCULATION OF EOQ: -

Total ordering cost = No of order placed per year x ordering cost per order

$= (A/S) \times B$

Total carrying cost per year = Avg inventory level × carrying cost per year

$= (S/2) \times C$

Economic order quantity is that of order where ordering cost is equal to carrying cost…..

$(A \times B)/S = (S \times C)/2$

$2AB = s^2 \times C$

$S^2 = 2AB/C$

$S = \sqrt{(2AB/C)}$

S = Economic Order Quantity

A = Annual Demand

B = Buying cost (or) Ordering cost

C = Carrying cost

ABC Analysis:-

The inventory of an organization of large no of large items with varying price & usage rate. It is not possible to pay equal attention on all the items. ABC analysis is a selective approach of inventory control. It enables the management where to be paid concentration and its efforts. Usually materials are classified into three categories.

'A' class items: These items consist of hardly 10% of the total items and account for 70% of the total value of inventory.

'B 'class items: These items relatively less important. They may constitute 20% of the total items and the % of the investment in inventory about 20% of the total inventory value.

'C 'class items: These are about 70% in number but it consists of 10% investment in inventory value. (10% of the total expenditure on inventory)

'A 'class items required rigid and strict control and need to be stocked in smaller quantity. An attention should be paid in estimating requirements. Purchasing & storing them. A little attention should be paid on class 'B' items. The control on these items should be intermediate between A & C, 'C' items being less expensive does not required strict control. These are ordered in bulk quantity.

Category	Value (%)	Volume (%)
A	**70**	**10**
B	**20**	**20**
C	**10**	**70**

ABC Analysis (Policy Guidelines)

'A ' class items	**' B ' class items**	**' C ' class items**
□ Tight control on stock level. □ Low safety stock. □ Regular and continuous check on wastage. □ Procure material through multiple source	□ Moderate control. □ Median safety stock □ Quarterly check on wastage □ Two or more reliable sources	□ Lesser control □ Large safety stock □ Annual review on wastage

		Only one or two reliable sources