# DIGITAL NOTES

## PRODUCTION AND OPERATIONS MANAGEMENT

**R15A0328**

## B.Tech –IIIYear – IISemester

## DEPARTMENT OF MECHANICAL ENGINEERING


# MALLA REDDY COLLEGE OF ENGINEERING & TECHNOLOGY

**(An Autonomous Institution – UGC, Govt.of India)**

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# MALLA REDDY COLLEGE OF ENGINEERING & TECHNOLOGY

**COURSE OBJECTIVES:**

- To provide a comprehensive exposure to Production Planning & Control (PPC) and its significance in Industries.
- To acquaint students with various activities of PPC and to give insight into the ongoing & futuristic trends in the control of inventory.

To appraise about need and benefits of planning functions related to products and processes

**UNIT – I**

**Introduction to Operations Management:** Introduction to Operations Management - Role of Operations Management in total management System- Interface between the operation systems and systems of other functional areas, Process planning and process design, Production Planning and Control: Basic functions of Production Planning and Control, Production Cycle - characteristics of process technologies. Project, Job Shop, Assembly, batch and Continuous - Inter Relationship between product life cycle and process life cycle.

**UNIT – II**

**Scheduling and control of production operations:** Aggregate planning, MPS, Operations scheduling, Product sequencing: Sequencing of products in multi- product multi-stage situations - Plant Capacity and Line Balancing. Plant layout -different types of layouts. Location and the factors influencing location. Maintenance Management: Objectives – Failure Concept, Reliability, Preventive and Breakdown maintenance, Replacement policies

**UNIT – III**

**Quality control:** Standards and specifications, Quality Assurance and Quality Circles – Statistical Quality Control – Control Charts for Variables- Average, Range and S.D., Control charts for Attributes-fraction defective and number of defects, Acceptance Sampling Plans, OC Curve Work Study, various techniques in the Methods Study for identifying the most appropriate method. Work measurement - its uses and different methods, computation of allowance and allowed time.

**UNIT-IV**

**Materials Management:** Need and importance of Materials management-Materials Requirement Planning-Materials Budgeting- Techniques for prioritization of materials-Sources of Supply of Materials -selection, evaluation and Performance of suppliers-make or buy decisions and its implications under various circumstances Vendor rating - determinants of vendor rating, concept of waste management

**UNIT – V:**

**Stores Management:** Objectives of Stores Management – Requirements for efficient. Management of Stores - safety stock Inventory Control - Different Systems of Inventory Control, Types of Inventory. Costs - Systems of inventory control – ABC, VED and FNSD analyses. Value Analysis – Importance in cost reduction – concepts and procedures.

**COURSE OUTCOMES:**

- The student will be able to Illustrate production planning functions and manage manufacturing functions in a better way.
- Develop competency in scheduling and sequencing in manufacturing operations and effect affordable manufacturing lead time.

Manage and control inventory with cost effectiveness. Get conversant with various documents procedural aspects and preparation of orders for various manufacturing methods

**TEXT BOOKS:**

1. Aswathappa K. and Sridhara Bhat, "Production and Operations Management", 2010, HPH. Mahadevan. B, "Operations Management", 2010, Pearson Education.
2. Production and Operations Management by Paneer Selvam.
3. Production and Operations Management by P Rama Murthy.

**REFERENCES:**

1. Kanishka Bedi, "Production and Operations Management", 2007, 2nd Ed. Oxford University Press.
2. Production and Operations Management by S.N.Murthy.
3. Upendra Kachru, "Production and Operations Management", 2010, Excel Books.

# CONTENTS

UNIT-I

# INTRODUCTION TO OPERATIONS MANAGEMENT

## OPERATIONS MANAGEMENT:

Operation Management is a way or means through which the listed objectives of an operating system is achieved. There is always a confusion between the word OM & PM (Production Management). It is accepted norm that OM includes techniques which are enabling the achievement of operational objectives in an operation system.

The operation system includes both manufacturing sector as well as service sector, but when you use the word PM, you should be careful to note that it refers to the manufacturing sector but not the service sector. Suppose, you are designing a layout for the hospital you should say that you are applying Operations Management Technique not the Production Management Technique.

When you design a layout for a manufacturing sector you can say that you are applying Production Technique or Operation Technique or vice versa. From, the above discussion we can come to a conclusion that production management is a subset of Operations Management.


Operation managers are concerned with planning, organizing, and controlling the activities which affect human behavior through models.

### Planning

Activities that establishes a course of action and guide future decision-making is planning.
The operations manager defines the objectives for the operations subsystem of the organization, And the policies, and procedures for achieving the objectives. This stage includes clarifying the Role and focus of operations in the organization's overall strategy. It also involves product Planning, facility designing and using the conversion process.

### Organizing

Activities that establishes a structure of tasks and authority. Operation managers establish a Structure of roles and the flow of information within the operations subsystem. They determine The activities required to achieve the goals and assign authority and responsibility for carrying

Them out.

Controlling
Activities that assure the actual performance in accordance with planned performance. To Ensure that the plans for the operations subsystems are accomplished, the operations manager Must exercise control by measuring actual outputs and comparing them to planned operations Management. Controlling costs, quality, and schedules are the important functions here.

Behavior
Operation managers are concerned with how their efforts to plan, organize, and control affect Human behavior. They also want to know how the behavior of subordinates can affect Management's planning, organizing, and controlling actions. Their interest lies in decision-making behavior.

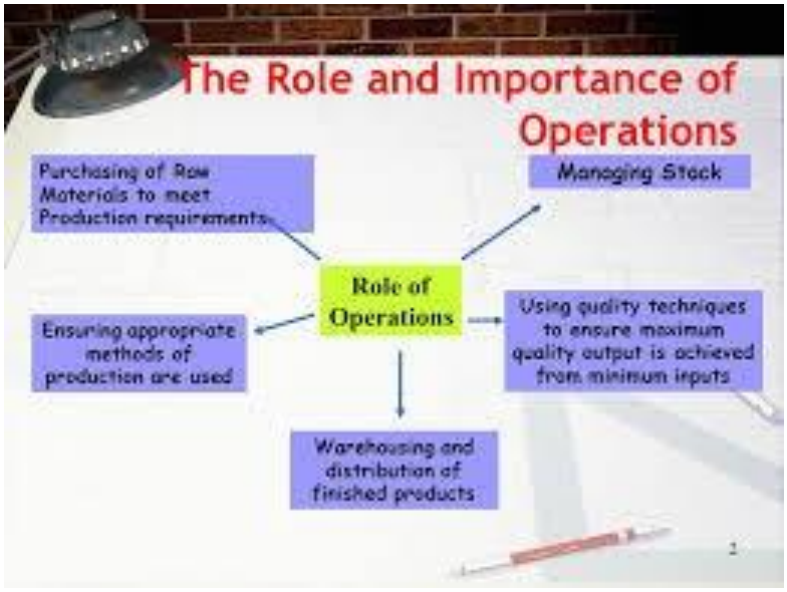
OBJECTIVES OF OPERATIONS MANAGEMENT
Objectives of operations management can be categorized into customer service and resource Utilization.

Customer service
The first objective of operating systems is the customer service to the satisfaction of customer Wants. Therefore, customer service is a key objective of operations management. The operating System must provide something to a specification which can satisfy the customer in terms of cost And timing. Thus, primary objective can be satisfied by providing the 'right thing at a right price At the right time'.

Resource utilization
Another major objective of operating systems is to utilize resources for the satisfaction of Customer wants effectively, i.e., customer service must be provided with the achievement of Effective operations through efficient use of resources. Inefficient use of resources or inadequate Customer service leads to commercial failure of an operating system.
Operations management is concerned essentially with the utilization of resources, i.e., obtaining Maximum effect from resources or minimizing their loss, underutilization or waste. The extent Of the utilization of the resources' potential might be expressed in terms of the proportion of Available time used or occupied, space utilization, levels of activity, etc. Each measure indicates The extent to which the potential or capacity of such resources is utilized. This is referred as the Objective of resource utilization.

- ROLE OF OPERATION MANAGEMENT

Operations Management concern with the conversion of inputs into outputs, using physical resources, so as to provide the desired utilities to the customer while meeting the other organizational objectives of effectiveness, efficiency and adoptability. It distinguishes itself from other functions such as personnel, marketing, finance, etc. by its primary concern for 'conversion by using physical resources'.




Operations management functions:

1. Location of facilities
2. Plant layouts and material handling
3. Product design
4. Process design
5. Production and planning control
6. Quality control
7. Materials management
8. Maintenance management.

1. Location of facilities

Location of facilities for operations is a long-term capacity decision which involves a long term Commitment about the geographically static factors that affect a business organization. It is an Important strategic level decision-making for an organization. It deals with the questions such as 'Where our main operations should be based?'

The selection of location is a key-decision as large investment is made in building plant and Machinery. An improper location of plant may lead to waste of all the investments made in plant And machinery equipment's. Hence, location of plant should be based on the company's expansion.

2. Plant layout and material handling

Plant layout refers to the physical arrangement of facilities. It is the configuration of departments, Work centers and equipment in the conversion process. The overall objective of the plant layout Is to design a physical arrangement that meets the required output quality and quantity most Economically.

3. Product design

Product design deals with conversion of ideas into reality. Every business organization have to Design, develop and introduce new products as a survival and growth strategy. Developing the

New products and launching them in the market is the biggest challenge faced by the organizations.

The entire process of need identification to physical manufactures of product involves three Functions: marketing, product development, manufacturing. Product development translates the Needs of customers given by marketing into technical specifications and designing the various Features into the product to these specifications. Manufacturing has the responsibility of selecting the processes by which the product can be manufactured. Product design and development provides link between marketing, customer needs and expectations and the activities required to manufacture the product.

4. Process design

Process design is a macroscopic decision-making of an overall process route for converting the Raw material into finished goods. These decisions encompass the selection of a process, choice Of technology, process flow analysis and layout of the facilities. Hence, the important decisions In process design are to analyze the workflow for converting raw material into finished product And to select the workstation for each included in the workflow.

5. PRODUCTION PLANNING AND CONTROL

Production planning and control can be defined as the process of planning the production in advance, setting the exact route of each item, fixing the starting and finishing dates for each item, to give production orders to shops and to follow up the progress of products according to orders. The principle of production planning and control lies in the statement 'First Plan Your Work And then Work on Your Plan'. Main functions of production planning and control includes Planning, routing, scheduling, dispatching and follow-up.

Planning is deciding in advance what to do, how to do it, when to do it and who is to do It. Planning bridges the gap from where we are, to where we want to go. It makes it possible For things to occur which would not otherwise happen.

Routing may be defined as the selection of path which each part of the product will follow, Which being transformed from raw material to finished products. Routing determines the most Advantageous path to be followed from department to department and machine to machine till Raw material gets its final shape. Scheduling determines the programmed for the operations. Scheduling may be defined as 'the fixation of time and date for each operation' as well as it determines the sequence of operations to be followed.

Dispatching is concerned with the starting the processes. It gives necessary authority so As to start a particular work, which has already been planned under 'Routing' and 'Scheduling'. Therefore, dispatching is 'release of orders and instruction for the starting of production for any Item in acceptance with the route sheet and schedule charts'.

The function of follow-up is to report daily the progress of work in each shop in a prescribed Preform and to investigate the causes of deviations from the planned performance.

6. QUALITY CONTROL

Quality Control (QC) may be defined as 'a system that is used to maintain a desired level of Quality in a product or service'. It is a systematic control of various factors that affect the quality Of the product. Quality control aims at prevention of defects at the source, relies on effective Feedback system and corrective action procedure.

Quality control can also be defined as 'that industrial management technique by means of which Product of uniform acceptable quality is manufactured'. It is the entire collection of activities which ensures that the operation will produce the optimum quality products at minimum cost.

The main objectives of quality control are:

- To improve the companies income by making the production more acceptable to the
- Customers i.e., by providing long life, greater usefulness, maintainability, etc.
- To reduce companies cost through reduction of losses due to defects.
- To achieve interchangeability of manufacture in large scale production.
- To produce optimal quality at reduced price.
- To ensure satisfaction of customers with productions or services or high quality level, to
- Build customer goodwill, confidence and reputation of manufacturer.
- To make inspection prompt to ensure quality control.
- To check the variation during manufacturing.

7. MATERIALS MANAGEMENT

Materials management is that aspect of management function which is primarily concerned with The acquisition, control and use of materials needed and flow of goods and services connected With the production process having some predetermined objectives in view.

The main objectives of materials management are:

- To minimize material cost.
- To purchase, receive, transport and store materials efficiently and to reduce the related cost.
- To cut down costs through simplification, standardization, value analysis, import substitution, etc.
- To trace new sources of supply and to develop cordial relations with them in order to
- Ensure continuous supply at reasonable rates.
- To reduce investment tied in the inventories for use in other productive purposes and to
- Develop high inventory turnover ratios.

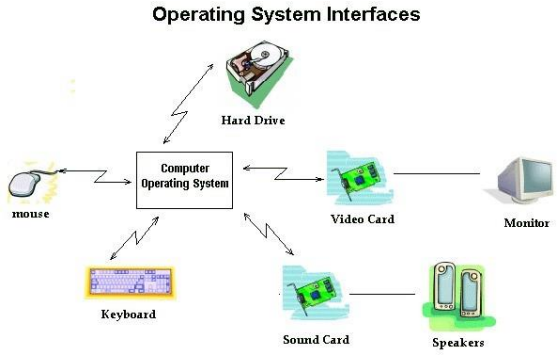
8. MAINTENANCE MANAGEMENT

In modern industry, equipment and machinery are a very important part of the total productive Effort. Therefore, their idleness or downtime becomes are very expensive. Hence, it is very Important that the plant machinery should be properly maintained.

The main objectives of maintenance management are:

1. To achieve minimum breakdown and to keep the plant in good working condition at the Lowest possible cost.
2. To keep the machines and other facilities in such a condition that permits them to be used At their optimal capacity without interruption.
3. To ensure the availability of the machines, buildings and services required by other sections Of the factory for the performance of their functions at optimal return on investment.

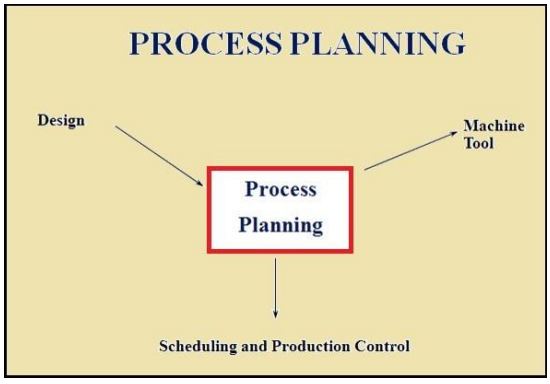
- INTERFACE BETWEEN THE OPERATION SYSTEMS AND SYSTEMS OF OTHER FUNCTIONAL AREAS




- PROCESS PLANNING

A process is described as a set of steps that result in a specific outcome. It converts input into output. Process planning is also called manufacturing planning, material processing, process engineering, and machine routing.

Process planning determines how the product will be produced or service will be provided. Process planning converts design information into the process steps and instructions to powerfully and effectively manufacture products.




Principles of Process Planning

General principles for evaluating or enhancing processes are as follows:

1. First define the outputs, and then look toward the inputs needed to achieve those outputs.
2. Describe the goals of the process, and assess them frequently to make sure they are still appropriate. This would include specific measures like quality scores and turnaround times.

3. When mapped, the process should appear as a logical flow, without loops back to earlier steps or departments.
4. Any step executed needs to be included in the documentation. If not, it should be eliminated or documented, depending on whether or not it's necessary to the process.
5. People involved in the process should be consulted, as they often have the most current information.

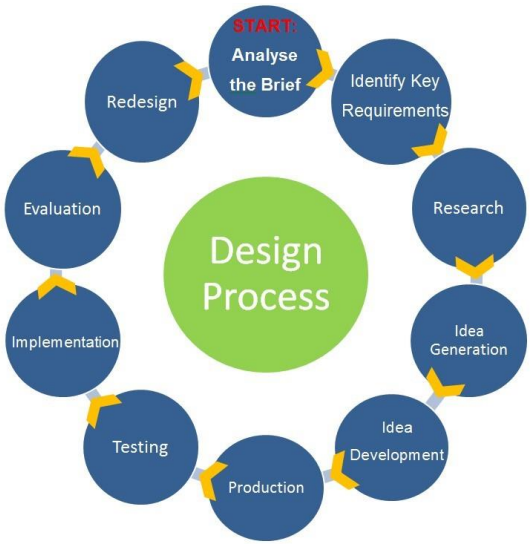
Major steps in process planning: Process planning has numerous steps to complete the project that include the definition, documentation, review and improvement of steps in business processes used in a company.

- PROCESS DESIGN

Process design is concerned with the overall sequence of operations required to achieve the product specifications. It specifies the type of work stations that are to be used, the machines and equipment necessary and the quantities in which each are required.

The sequence of operations in the manufacturing process is determined by

1. The nature of the product
2. The materials used
3. The quantities being produced
4. The existing physical layout of the plant.

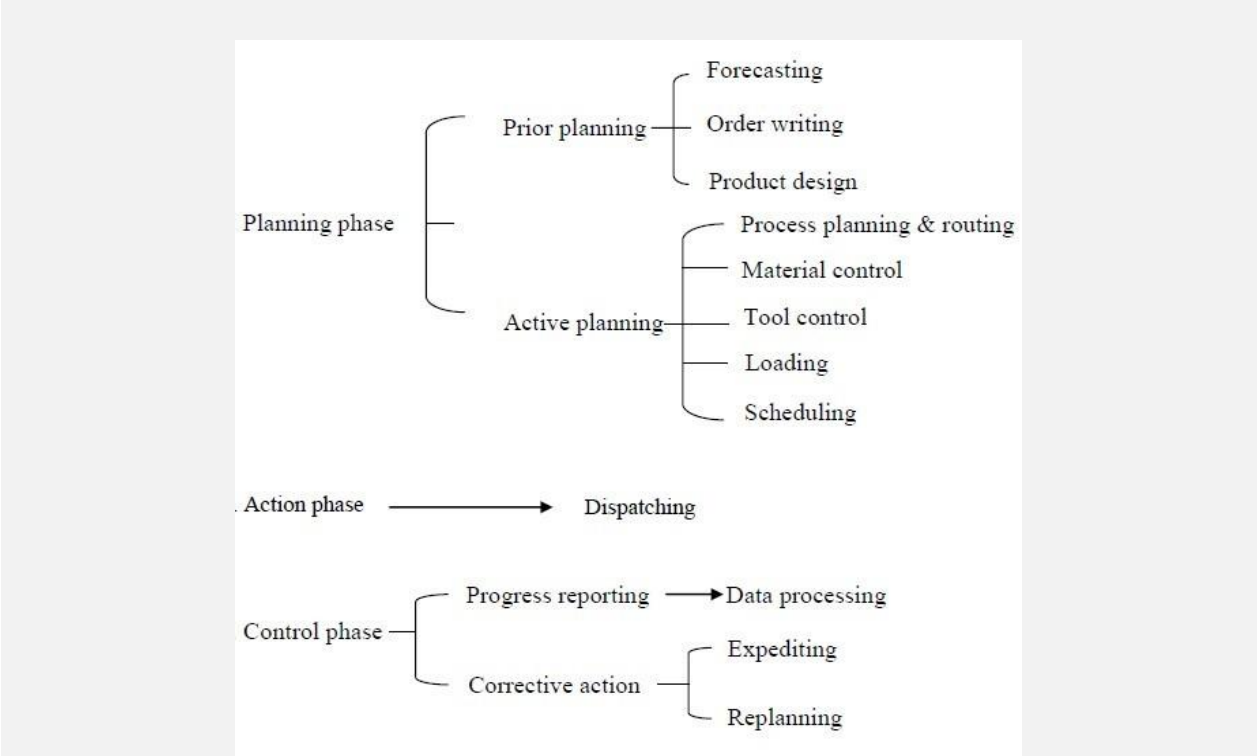



- PRODUCTION PLANNING AND CONTROL

Production planning and control the process of planning the production in advance. Setting the exact route of each item and fixing the starting and finishing date for each

item is the key operation. Giving the production orders to different shops and observing the progress of products according to order.

- THE VARIOUS FUNCTIONS OF PPC :




- PRODUCTION CYCLE

The production cycle is a recurring set of business activities and related data processing operations associated with the manufacturing of products.  The first function of the AIS is tosupport the effective performance of the organization's business activities.

Production Cycle Activities

1. Product design
2. Planning and scheduling
3. Production operations
4. Cost accounting

1. Product design: The objective of this activity is to design a product that meets customer requirements for quality, durability, and functionality while simultaneously minimizing production costs.

2. Planning and scheduling: a production plan efficient enough to meet existing orders and anticipate short-term demand without creating excess finished goods inventories.

3. Production operations: Every firm needs to collect data about the following four facets of its production operations: 1. Raw materials used 2. Labor-hours expended 3. Machine operations performsed 4. Other manufacturing overhead costs incurred

4. Cost accounting: three principal objectives of the cost accounting system? 1. To provide information for planning, controlling, and evaluating the performance of production operations 2. To provide accurate cost data about products for use in pricing and product mix decisions 3. To collect and process the information used to calculate the inventory and cost of goods sold values

## CHARACTERISTICS OF PROCESS TECHNOLOGIES

Every process inside a client's plant is unique and has special characteristics. Process technology services are divided into process technologies and process engineering. The characteristics are;

1. The degree of automation of the technology: the ratio of technology to human effort it employs is sometimes called capital intensity of the process technology.
2. The scale or scalability of the technology: the ability to shift to a different level of useful capacity quickly and cost effectively.
3. The degree of coupling or connectivity of the technology: linking together of separate activities within a single piece of process technology to form an interconnected processing system.

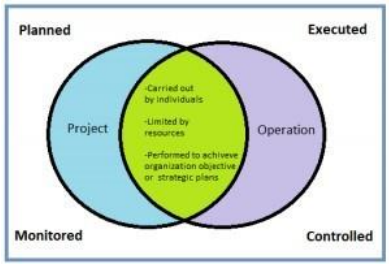
## PROJECT

A Project is a temporary endeavor (attempt with lot of effort) undertaken to create a unique product, service or result.

Temporary means having a definite beginning and end. The end is reached when the project's objectives have been achieved, or if the project is terminated for any reason.

Temporary does not mean short in nature, and it could well be a mammoth project – like a 10 year project – for example, sending a man to moon, sending Curiosity to Mars, Building the Taj Mahal or the Pyramids (I visited the amazing Pyramids today, as I am in Cairo this week to conduct a series of corporate training in Egypt, and it was absolutely fantastic…)

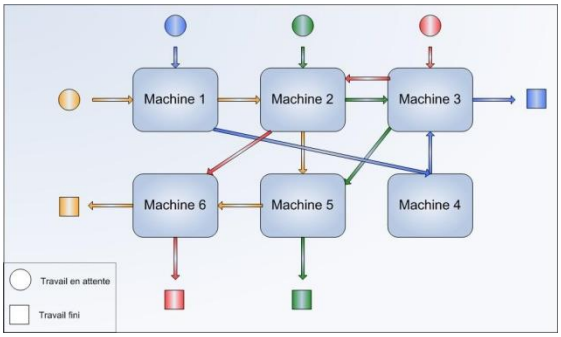
Secondly, each project creates a unique product, service or result. Sure, there may be some repetitive elements present in each project, but the output must be unique – like similar housing projects in the same area with the same design may be similar, but each will have unique challenges, different contractors, issues, etc. that will make them each unique.




JOB SHOP

A job shop is a type of manufacturing process in which small batches of a variety of custom products are made. In the job shop process flow, most of the products produced require a unique set-up and sequencing of process steps.

Examples of job shops include a wide range of businesses—a machine tool shop, a machining center, a paint shop, a commercial printing shop, and other manufacturers that make custom products in small lot sizes.




CHARACTERISTICS OF A JOB SHOP: Layout, Routing, Employees, Information, Scheduling.

Layout

In the job shop, similar equipment or functions are grouped together, such as all drill presses in one area and grinding machines in another in a process layout. The layout is designed to minimize material handling, cost, and work in process inventories. Job shops use general purpose equipment rather than specialty, dedicated product-specific equipment.

Routing

When an order arrives in the job shop, the part being worked on travels throughout the various areas according to a sequence of operations. Not all jobs will use every machine in the plant. Jobs often travel in a jumbled routing and may return to the same machine for processing several times.

Employees

Employees in a job shop are typically highly skilled craft employees who can operate several different classes of machinery. These workers are paid higher wages for their skill levels. Due to their high skill level, job shop employees need less supervision.

Information

Information is the most critical aspect of a job shop. Information is needed to quote a price, bid on a job, route an order through the shop, and specify the exact work to be done. Information begins with quoting, then a job sheet and blueprint are prepared before the job is released to the floor.

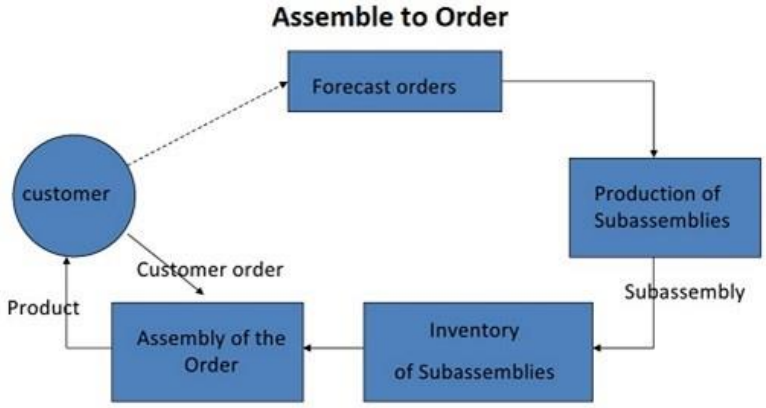
Scheduling

A job is characterized by its route, its processing requirements, and its priority. In a job shop the mix of products is a key issue in deciding how and when to schedule jobs.

- ASSEMBLY

An assembly line is a manufacturing process in which interchangeable parts are added to a product in a sequential manner to create an end product.....Thanks to the assembly line, production periods shortened, equipment costs accelerated, and labor and management alike endeavored to keep up with the changes.

1. An arrangement of workers, machines, and equipment in which the product being assembled p asses consecutivelyfrom operation to operation until completed. Also called production line.
2. A process in which finished products are turned out in a mechanically efficient, though impers onal, manner: auniversity that functions as a sports assembly line.




- BATCH AND CONTINUOUS PROCESS OPERATIONS

Continuous production is a flow production method used to manufacture, produce, or process materials without interruption.....Continuous processing is contrasted with batch production.

Batch processing

This involves the processing of bulk material in batches through each step of the desired process. Processing of subsequent batches must wait until the current batch is finished. This method seems effective at first glance, but in most cases falls short of continuous flow.

Continuous flow

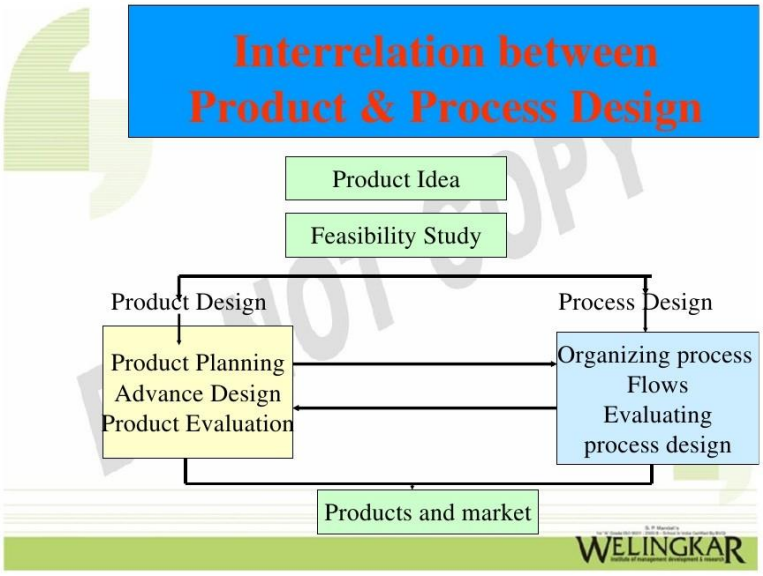
This processing involves moving one work unit at a time between each step of the process with no breaks in time, sequence, substance or extent.

For most applications, continuous flow saves time, energy and costs. When implemented correctly, continuous flow processing:

- Reduces waste.
- Saves money by reducing inventory and transportation costs.
- Increases productivity – more units completed in less time.
- Improves quality by making it easier to spot and correct errors.
- Cuts down on overhead via increased stability and reduced lead times.
- Adapts to customer needs more effectively than batch processing.

- RELATIONSHIP BETWEEN PRODUCT LIFE CYCLE AND PROCESS LIFE CYCLE
- A process life cycle normally refers only to the development process for developing and testing a product up to the point that the product is released to the market.

- A product life cycle is much broader and covers the entire life of the product and all it's revisions and enhancements until the product is ultimately retired.



The Product-Process Matrix. The process life cycle has been attracting increasing attention from business managers and researchers over the past several years. Just as a product and market pass through a series of major stages, so does the production process used in the manufacture of that product.

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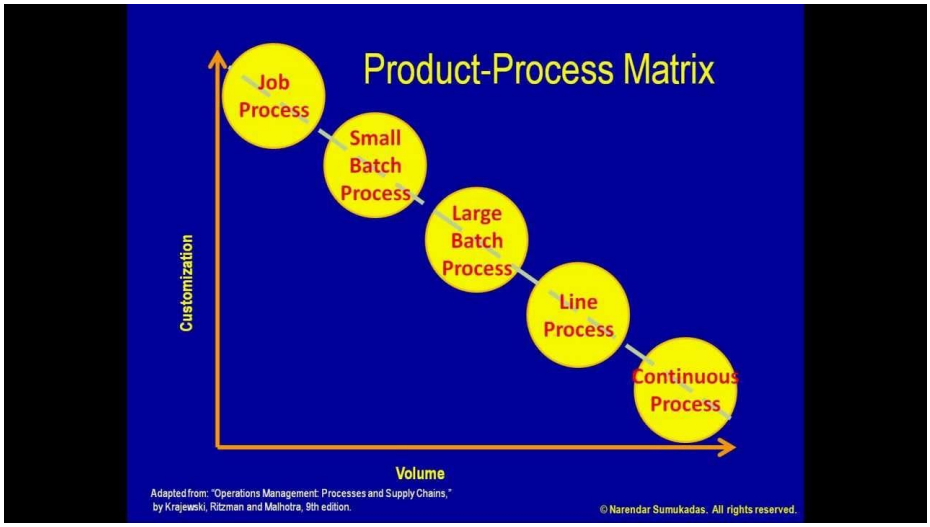


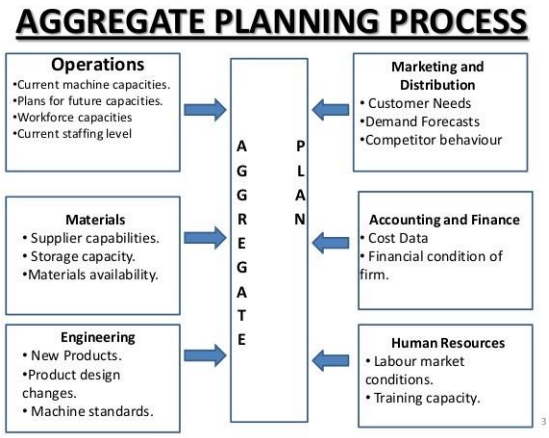
UNIT – II

SCHEDULING AND CONTROL OF PRODUCTION OPERATIONS

- AGGREGATE PLANNING:

Aggregate planning' is a marketing activity that does an aggregate plan for the production process, in advance of 6 to 18 months, to give an idea to management as to what quantity of materials and other resources are to be procured and when, so that the total cost of operations of the organization is kept to the minimum over that period.

The quantity of outsourcing, subcontracting of items, overtime of labour, numbers to be hired and fired in each period and the amount of inventory to be held in stock and to be backlogged for each period are decided. All of these activities are done within the framework of the company ethics, policies, and long term commitment to the society, community and the country of operation.




Aggregate Plan Strategies Level plans

- Use a constant workforce & produce similar quantities each time period
- Use inventories and back-orders to absorb demand peaks & valleys
- Use inventories in better way to absorb the peak of demand and valleys

Aggregate Plan Strategies Chase plans

- Minimize finished goods inventories by trying to keep pace with demand fluctuations
- Matches demand varying either work force level or output rate.

Advantages of Aggregate Planning

1. Aggregate planning is a forecasting technique that businesses use in an attempt to predict the supply and demand of their products and services
2. Mainly, this is done in an effort to save money, streamline operations and increase productivity.

3. To accomplish this, businesses use an aggregate planning model to develop a game plan that will assist them with determining their staffing requirements, materials needed, estimated timelines and budget costs so they can better plan ahead.

Disadvantages of Aggregate Planning

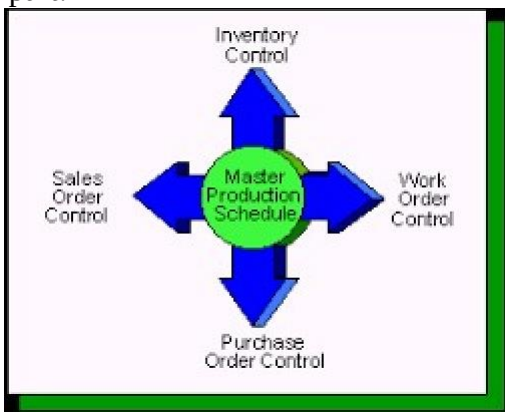
1. Planning for changes in demand months in advance ensures that the change of production schedules can occur with little effort.
2. Aggregate production planning is a general approach to altering a company's production schedule to respond to forecasted changes in demand.

- MASTER PRODUCTION SCHEDULE (MPS)

A master production schedule (MPS) is a plan for individual commodities to be produced in each time period such as production, staffing, inventory, etc. It is usually linked to manufacturing where the plan indicates when and how much of each product will be demanded.

This plan quantifies significant processes, parts, and other resources in order to optimize production, to identify bottlenecks, and to anticipate needs and completed goods. Since an MPS drives much factory activity, its accuracy and viability dramatically affect profitability. Typical MPSs are created by software with user tweaking.

The MPS translates the customer demand (sales orders, PIR's), into a build plan using planned orders in a true component scheduling environment. Using MPS helps avoid shortages, costly expediting, last minute scheduling, and inefficient allocation of resources. Working with MPS allows businesses to consolidate planned parts, produce master schedules and forecasts for any level of the Bill of Material (BOM) for any type of part.




Advantages of Master production schedule

- Give production, planning, purchasing, and management the information to plan and control manufacturing
- The overall business planning and forecasting to detail operations
- Enable marketing to make legitimate delivery commitments to warehouses and customers
- Increase the efficiency and accuracy of a company's manufacturing

- Rough cut capacity planning
- OPERATIONS SCHEDULING

Operations scheduling helps in the confirmation or the revision of the tentative delivery date that has been promised in the original quotation. Sometimes during the operations scheduling of the work order, it may be discovered that the delivery date originally and tentatively promised cannot be met.

All this may be due to the several problems like the materials that are required may not be available at that particular time or may not be available immediately. This problem can also occur due to the increased plant loading while the customer is deciding whether or not to award the quoted job to this company.

Objectives of the Operations Scheduling –

1. Making efficient use of the labor.
2. Making best possible use of the equipment's that are available for the use.
3. Increasing the profit.
4. Increasing the output.
5. Improving the service level.
6. Maximizing the delivery performance i.e. meeting the delivery dates.
7. Minimizing the inventory.
8. Reducing the manufacturing time.
9. Minimizing the production costs.
10. Minimizing the worker costs.

Functions of the operations scheduling –

1. Allocation of the resources.
2. Shop floor control.
3. Making maximum use of the plant at minimum possible cost.
4. Ensure that the needs of the manpower are optimum.
5. Determination of the sequence of the jobs.
6. Specifying the start and the end time for each job (actively scheduled).
7. Getting quick feedback from the shops regarding the delays and the various interruptions.
8. Possess up – to – date information for the availability of the materials, expected delivery dates etc.
9. Possess up – to – date data on the machine regarding its breakdown, servicing etc.
10. Keep itself abreast of the hiring, dismissals, holidays etc. of the work force.

Inputs of the Operations Scheduling

1. Performance standards
2. Unit of the measurement
3. Unit of the loading and the scheduling
4. Effective capacity per work centre
5. Extent of the rush orders

6. Overlapping of the operations
7. Loading charts

- PRODUCT SEQUENCING

The product sequencing model is the evolution of knowledge to new product introductions over time in technology intensive or operationally complex organizations.
Product sequencing is one way to reduce cost and improve product quality for multistage manufacturing systems (MMS). However, systematically evaluating the influence of product sequence on quality performance for MMS is still a challenge.
By considering the rate of incoming conforming product, manufacturing system quality transition between batch to batch, and quality propagation along stages, this paper investigates the appropriate batch policies and product sequencing for MMS so that satisfied quality performance can be achieved.

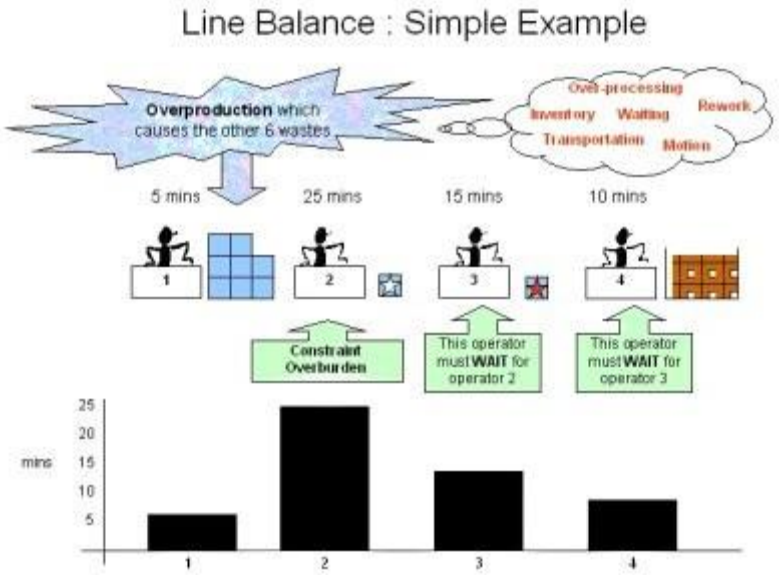
- PLANT CAPACITY Plant capacity is the maximum amount of production for a specific production facility.

- Factors affecting determination of Plant Capacity

(a) Market demand for a product/service.
(b) The amount of capital that can be invested.
(c) Degree of automation desired.
(d) Level of integration (i.e. vertical integration).
(e) Type of technology selected.
(f) Dynamic nature of all factors affecting determination of plant capacity, viz., changes in the product design, process technology, market conditions and product life cycle, etc.
(g) Difficulty in forecasting future demand and future technology.
(h) Obsolescence of product and technology over a period of time.
(i) Present demand and future demand both over short-range, intermediate-range and long-range time horizons.
(j) Flexibility for capacity additions.

- LINE BALANCING

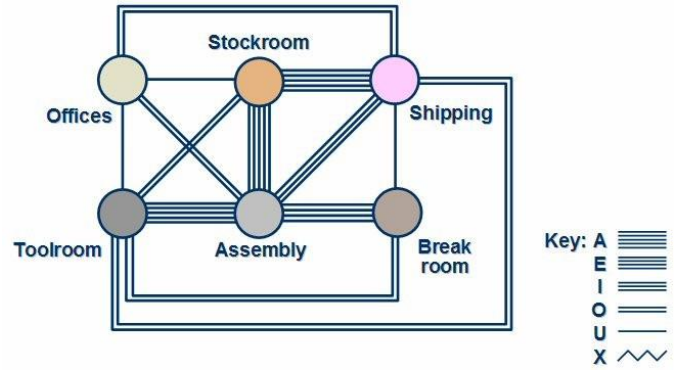
Everyone is doing the same amount of work doing the same amount of work to customer requirement. i.e Variation is ‘smoothed’, No one overburdened, No one waiting, Everyone working together in a BALANCED fashion.




- PLANT LAYOUT

Plant layout design has become a fundamental basis of today's industrial plantswhich can influence parts of work efficiency. It is needed to appropriately plan and position employees, materials, machines, equipment, and other manufacturing supports and facilities to create the most effective plant layout.

Plant layout is the most effective physical arrangement, either existing or in plans of industrial facilities i.e arrangement of machines, processing equipment and service departments to achieve greatest co-ordination and efficiency of 4M’s (Men, Materials, Machines and Methods) in a plant.




Facility Layout Planning

- IMPORTANCE OF PLANT LAYOUT:
- The layout of a plant is quite important in view of the above definition but the importance of a layout may greatly vary from industry to industry.

- The Weight, Volume or Mobility of the Product
- Complexity of the Final Product
- The Length of the Process in relation to Handling Time
- The Extent to which the Process Tends towards Mass Production

- TYPES OF PLANT LAYOUT

1. Product or Line Layout.
2. Process or Functional Layout.
3. Fixed Position Layout.
4. Combination type of Layout.

## 1. PRODUCT OR LINE LAYOUT:

If all the processing equipment and machines are arranged according to the sequence of operations of a product, the layout is called product type of layout. In this type of layout, only one product or one type of products is produced in an operating area. This product must be standardized and produced in large quantities in order to justify the product layout.

The raw material is supplied at one end of the line and goes from one operation to the next quite rapidly with a minimum work in process, storage and material handling. Fig. 3.3 shows product layout for two types of products A and B.

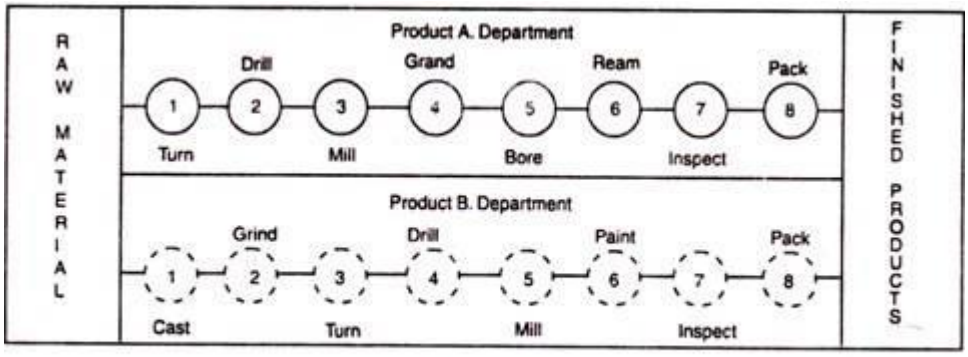



Fig. 8.3.

Advantages offered by Product Layout:

(i) Lowers total material handling cost.
(ii) There is less work in processes.
(iii) Better utilization of men and machines,
(iv) Less floor area is occupied by material in transit and for temporary storages.
(v) Greater simplicity of production control.
(vi) Total production time is also minimized.

- Limitations of Product Layout:

(i) No flexibility which is generally required is obtained in this layout.
(ii) The manufacturing cost increases with a fall in volume of production.
(iii) If one or two lines are running light, there is a considerable machine idleness.
(iv) A single machine break down may shut down the whole production line.
(v) Specialized and strict supervision is essential.

- 2. PROCESS OR FUNCTIONAL LAYOUT:

The process layout is particularly useful where low volume of production is needed. If the products are not standardized, the process layout is more low desirable, because it has creator process flexibility than other. In this type of layout, the machines and not arranged according to the sequence of operations but are arranged according to the nature or type of the operations.
This layout is commonly suitable for non repetitive jobs.
Same type of operation facilities are grouped together such as lathes will be placed at one place, all the drill machines are at another place and so on. See Fig. 8.4 for process layout. Therefore, the process carried out in that area is according to the machine available in that area.

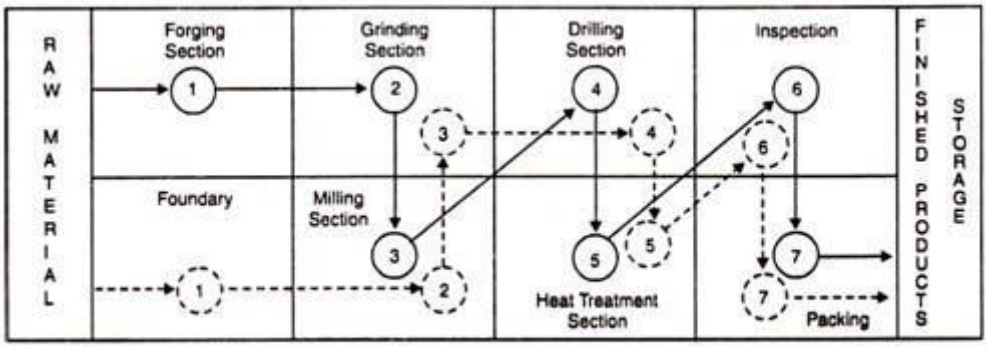



Fig. 8.4.

- Advantages of Process Layout:

(i) There will be less duplication of machines. Thus, total investment in equipment purchase will be reduced.
(ii) It offers better and more efficient supervision through specialization at various levels.
(iii) There is a greater flexibility in equipment and man power thus load distribution is easily controlled.
(iv) Better utilization of equipment available is possible.
(v) Break down of equipment can be easily handled by transferring work to another machine/work station.
(vi) There will be better control of complicated or precision processes, especially where much inspection is required.

- Limitations of Process Layout:

(i) There are long material flow lines and hence the expensive handling is required.
(ii) Total production cycle time is more owing to long distances and waiting at various points.
(iii) Since more work is in queue and waiting for further operation hence bottle necks occur.
(iv) Generally, more floor area is required.
(v) Since work does not flow through definite lines, counting and scheduling is more tedious.
(vi) Specialization creates monotony and there will be difficult for the laid workers to find job in other industries.

- 3. FIXED POSITION LAYOUT:

This type of layout is the least important for today's manufacturing industries. In this type of layout the major component remain in a fixed location, other materials, parts, tools, machinery, man power and other supporting equipment's are brought to this location.
The major component or body of the product remain in a fixed position because it is too heavy or too big and as such it is economical and convenient to bring the necessary tools and equipment's

to work place along with the man power. This type of layout is used in the manufacture of boilers, hydraulic and steam turbines and ships etc.

- Advantages Offered by Fixed Position Layout:

(i) Material movement is reduced
(ii) Capital investment is minimized.
(iii) The task is usually done by gang of operators, hence continuity of operations is ensured
(iv) Production centers are independent of each other. Hence, effective planning and loading can be made. Thus total production cost will be reduced.
(v) It offers greater flexibility and allows change in product design, product mix and production volume.

- Limitations of Fixed Position Layout:

(i) Highly skilled man power is required.
(ii) Movement of machines equipment's to production centre may be time consuming.
(iii) Complicated fixtures may be required for positioning of jobs and tools. This may increase the cost of production.

- 4. COMBINATION TYPE OF LAYOUT:

Now a days in pure state any one form of layouts discussed above is rarely found. Therefore, generally the layouts used in industries are the compromise of the above mentioned layouts. Every layout has got certain advantages and limitations. Therefore, industries would to like use any type of layout as such.

- LOCATION FOR PRODUCTION

location for production will include some or all of the following ingredients:

1. Closeness to point of sale. The higher the sales revenue - the higher the productivity will be.
2. Closeness to raw materials.
3. Away from centers of population - for noisy, environmentally unfriendly plant.
4. Near to skilled labour source.
5. Have room for expansion.
6. Have good communication links.

- FACTORS INFLUENCING INDUSTRIAL LOCATION

Generally, location of industries is influenced by economic considerations though certain non-economic considerations also might influence the location of some industries. Maximisation of profit which also implies cost minimization is the most important goal in their choice of particular places for the location of industries. There are several factors which pull the industry to a particular place. Some of the major factors influencing location are discussed below:

1. Availability of raw materials: In determining the location of an industry, nearness to sources of raw material is of vital importance. Nearness to the sources of raw materials would reduce the cost of production of the industry. For most of the major industries, the cost of raw materials form the bulk of the total cost. Therefore, most of the agro-based and forest-based industries are located in the vicinity of the sources of raw material supply.

2. Availability of Labour: Adequate supply of cheap and skilled labour is necessary for and industry. The attraction of an industry towards labour centres depends on the ratio of labour cost to the total cost of production which Weber calls 'Labour cost of Index'. The availability of skilled workers in the interior parts of Bombay region was one of the factors responsible for the initial concentration of cotton textile industry in the region.

3. Proximity to Markets: Access to markets is an important factor which the entrepreneur must take into consideration. Industries producing perishable or bulky commodities which cannot be transported over long distance are generally located in close proximity to markets. Industries located near the markets could be able to reduce the costs of transport in distributing the finished product as in the case of bread and bakery, ice, tins, cans manufacturing, etc. Accessibility of markets is more important in the case of industries manufacturing consumer goods rather than producer goods.

4. Transport Facilities: Transport facilities, generally, influence the location of industry. The transportation with its three modes, i.e., water, road, and rail collectively plays an important role. So the junction points of water-ways, roadways and railways become humming centres of industrial activity. Further, the modes and rates of transport and transport policy of Government considerably affect the location of industrial units. The heavy concentration of cotton textile industry in Bombay has been due to the cheap and excellent transportation network both in regard to raw materials and markets.

5. Power: Another factor influencing the location of an industry is the availability of cheap power. Water, wind, coal, gas, oil and electricity are the chief sources of power. Both water and wind power were widely sought at sources of power supply before the invention of steam engine. During the nineteenth century, nearness to coal-fields became the principal locating influence on the setting up of new industries, particularly, for heavy industries. With the introduction of other sources of power like electricity, gas, oil, etc. the power factor became more flexible leading to dispersal and decentralization of industries.

6. Site and Services: Existence of public utility services, cheapness of the value of the site, amenities attached to a particular site like level of ground, the nature of vegetation and location of allied activities influence the location of an industry to a certain extent. The government has classified some areas as backward areas where the entrepreneurs would be granted various incentives like subsidies, or provision of finance at concessional rate, or supply of power a cheaper rates and provision of education and training facilities. Some entrepreneurs induced by such incentives may come forward to locate their units in such areas.

7. Finance: Finance is required for the setting up of an industry, for its running, and also at the time of its expansion. The availability of capital at cheap rates of interests and in adequate amount is a dominating factor influencing industrial location. For instance, a review of locational history of Indian cotton textile industry indicates that concentration of the industry in and around Bombay in the early days was mainly due to the presence of rich and enterprising Parsi and Bhatia merchants, who supplied vast financial resources.

8. Natural and Climatic Considerations: Natural and climatic considerations include the level of ground, topography of a region, water facilities, drainage facilities, disposal of waste products, etc. These factors sometimes influence the location of industries. For instance, in the case of cotton textile industry, humid climate provides an added advantage since the frequency of yarn breakage is low. The humid climate of Bombay in India and Manchester in Britain offered great scope for the development of cotton textile industry in those centres.

9. Personal Factors: In deciding location of industrial units, sometimes an entrepreneur may have personal preferences and prejudices against certain localities. For instance, Mr. Ford started to manufacture motor cars in Detroit simply because it was his home-town. In such cases, personal factor dominates other considerations. However, this kind of domination is rare.

10. Strategic Considerations: In modern times, strategic considerations are playing a vital role in determining industrial location. During war-time a safe location is assuming special significance. This is because in times of war the main targets of air attacks would be armament and ammunition factories and industries supplying other commodities which are required for war. The Russian experience during the Second World War provides and interesting example.

11. External Economies: External economies also exert considerable influence on the location of industries. External economies arise due to the growth of specialized subsidiary activities when a particular industry is mainly localized at a particular centre with port and shipping facilities. External economies could also be enjoyed when a large number of industrial units in the same industry were located in close proximity to one another.

## MAINTENANCE MANAGEMENT

The maintenance s managments knoledge and experinces if there is then will be the maintainance s materials needed if itis ok then the badest manpower if they are active then experince managments availability of maintainance materials then active manpower there will be no any maintenance objectives what do you need more to run the maintenance department.

### OBJECTIVES OF MAINTENANCE MANAGEMENT:

1. Minimizing the loss of productive time because of equipment failure (i.e. minimizing idle time of equipment due to break down)
2. Minimizing the repair time and repair cost.
3. Minimizing the loss due to production stoppages.
4. Efficient use of maintenance personnel and equipments.
5. Prolonging the life of capital assets by minimizing the rate of wear and tear.
6. To keep all productive assets in good working conditions.
7. To maximize efficiency and economy in production through optimum use of facilities.
8. To minimize accidents through regular inspection and repair of safety devices.
9. To minimize the total maintenance cost which includes the cost of repair, cost of preventive maintenance and inventory carrying costs, due to spare parts inventory.
10. To improve the quality of products and to improve productivity.

## FAILURE CONCEPT

Event in which any part of an equipment or machine does not perform according to its operational specifications. Failures are classified into several categories: dependent failure, non- critical failure, random failure, etc.

## RELIABILITY

The ability of an apparatus, machine, or system to consistently perform its intended or required function or mission, on demand and without degradation or failure.

## TYPES OF MAINTENANCE

### 1. Breakdown maintenance

It means that people waits until equipment fails and repair it. Such a thing could be used when the equipment failure does not significantly affect the operation or production or generate any significant loss other than repair cost.

### 2. Preventive maintenance ( 1951 )

It is a daily maintenance ( cleaning, inspection, oiling and re-tightening ), design to retain the healthy condition of equipment and prevent failure through the prevention of deterioration, periodic inspection or equipment condition diagnosis, to measure deterioration. It is further divided into periodic maintenance and predictive maintenance. Just like human life is extended by preventive medicine, the equipment service life can be prolonged by doing preventive maintenance.

### 2a. Periodic maintenance ( Time based maintenance - TBM)

Time based maintenance consists of periodically inspecting, servicing and cleaning equipment and replacing parts to prevent sudden failure and process problems.

### 2b. Predictive maintenance

This is a method in which the service life of important part is predicted based on inspection or diagnosis, in order to use the parts to the limit of their service life. Compared to periodic maintenance, predictive maintenance is condition based maintenance. It manages trend values, by measuring and analyzing data about deterioration and employs a surveillance system, designed to monitor conditions through an on-line system.

### 3. Corrective maintenance ( 1957 )

It improves equipment and its components so that preventive maintenance can be carried out reliably. Equipment with design weakness must be redesigned to improve reliability or improving maintainability

### 4. Maintenance prevention ( 1960 )

It indicates the design of a new equipment. Weakness of current machines are sufficiently studied ( on site information leading to failure prevention, easier maintenance and prevents of defects, safety and ease of manufacturing ) and are incorporated before commissioning a new equipment.

- Preventive maintenance

A preventive maintenance program looks for triggers that identify when a problem is likely to occur. It relies on testing, both online and offline, of any equipment that falls under the program. Preventive maintenance discovers any issues before a catastrophic failure. Preventive maintenance involves routine equipment testing and maintenance when identifying a problem.
Applying an effective preventative maintenance program saves money by replacing or rebuilding a failing part.

- Breakdown maintenance

Breakdown maintenance is perhaps the least desirable of the three different types of maintenance programs. This type of maintenance involves repairing or rebuilding the equipment, just as the other maintenance programs. The trigger event, though, is the actual breakdown of the equipment. Breakdown maintenance can be beneficial if it's used with preventive and predictive maintenance. It may still be necessary, at times, to use breakdown maintenance as a program when unexpected events take place. If it is the only type of maintenance in place, yet, it tends to be the most costly option.

- Replacement Policies

Basic to the implementation of virtual memory is the concept of demand paging. This means that the operating system, and not the programmer, controls the swapping of pages in and out of main memory as they are required by the active processes. When a non-resident page is needed by a process, the operating system must decide which resident page is to be replaced by the requested page. The part of the virtual memory which makes this decision is called
the replacement policy.

- Classification/Types of Policies (Timing)

All replacement policies can be considered to fall into two broad categories in regards to the timing of the replacement, as follows:

- Preventive Replacement Policy
- Failure Replacement Policy

Listed below are some of the primary replacement strategies that can be applied to different types of assets.

Group 1: Preventive Replacement

- Constant-Interval Replacement Policy (CIRP)
- Age-Based Replacement Policy (ABP)
- Time-Based Replacement Policy
- Inspection Replacement Policy (IRP)
- Just-in-Time Replacement Policy (JITP)
- Modified-Age Replacement Policy (MARP)
- Block Replacement Policy (BRP)

- Order/Rank-Based Replacement Policy (ORP)

Group 2: Failure Replacement:

- Run to Failure (RTF)
- Unintended Failure Replacement (UFR)

There are many approaches to the problem of deciding which page to replace but the object is the same for all--the policy which selects the page that will not be referenced again for the longest time. Examples:

First In First Out (FIFO):
The page to be replaced is the "oldest" page in the memory, the one which was loaded before all the others

Least Recently Used (LRU):
The page to be replaced is the one which has not been referenced since all the others have been referenced

Last In First Out (LIFO):
The page to be replaced is the one most recently loaded into the memory

Least Frequently Used (LFU):
The page to be replaced is the one used least often of the pages currently in the memory

Optimal (OPT or MIN):
The page to be replaced is the one that will not be used for the longest period of time. This algorithm requires future knowledge of the reference string which is not usually available. Thus, this policy is used for comparison studies

# UNIT –III
# QUALITY CONTROL

Quality control (QC) is a procedure or set of procedures intended to ensure that a manufactured product or performed service adheres to a defined set of quality criteria or meets the requirements of the client or customer.

QC is similar to, but not identical with, quality assurance (QA). QA is defined as a procedure or set of procedures intended to ensure that a product or service under development (before work is complete, as opposed to afterwards) meets specified requirements. QA is sometimes expressed together with QC as a single expression, quality assurance and control (QA/QC).

In order to implement an effective QC program, an enterprise must first decide which specific standards the product or service must meet. Then the extent of QC actions must be determined (for example, the percentage of units to be tested from each lot). Next, real-world data must be collected (for example, the percentage of units that fail) and the results reported to management personnel. After this, corrective action must be decided upon and taken (for example, defective units must be repaired or rejected and poor service repeated at no charge until the customer is satisfied). If too many unit failures or instances of poor service occur, a plan must be devised to improve the production or service process and then that plan must be put into action. Finally, the QC process must be ongoing to ensure that remedial efforts, if required, have produced satisfactory results and to immediately detect recurrences or new instances of trouble.

## Quality Control Standards

ASTM's quality control standards provide the mathematical and statistical procedures instrumental in the evaluation of experiments and test methods. These procedures encompass the information-gathering stage of an experiment where variation is present, and includes the probability sampling process, the determination of the precision and bias of an experiment, and the measurement of the reliability and degree of uncertainty of test results and data. These quality control standards help guide laboratories and their respective scientists and engineers in the careful planning and design of experiments and test procedures.

## ISO 9000 - Qualitymanagement

The ISO 9000 family addresses various aspects of quality management and contains some of ISO’s best known standards. The standards provide guidance and tools for companies and organizations who want to ensure that their products and services consistently meet customer’s requirements, and that quality is consistently improved.

## ISO 9001:2015

ISO 9001:2015 sets out the criteria for a quality management system and is the only standard in the family that can be certified to (although this is not a requirement). It can be used by any organization, large or small, regardless of its field of activity. In fact, there are over one million companies and organizations in over 170 countries certified to ISO 9001.

This standard is based on a number of quality management principles including a strong customer focus, the motivation and implication of top management, the process approach and continual improvement. These principles are explained in more detail in the pdf Quality Management Principles. Using ISO 9001:2015 helps ensure that customers get consistent, good quality products and services, which in turn brings many business benefits.

## Quality Control Specifications

1. Policy Statement

Scholars Portal is committed to ensuring that the integrity of digital objects within the repository is maintained.

Quality Control Standards

Upon ingest, SP requires that publishers provide their content in PDF format and in XML or SGML (in a format agreed upon between SP and the publisher) containing descriptive metadata, and full-text content is strongly encouraged.

Every time the digital object is moved during the ingest process, a fixity check is performed. This ensures that the file has been transferred correctly, and not become corrupted in the process. Any errors are recorded automatically in an error log, as well as in the publisher problem directory. A notification of error is emailed immediately to the metadata librarian. The errors are troubleshot and corrected as soon as possible.

Descriptive metadata is normalized to a SP-specific profile of the NIH Journal Archive & Interchange Tag set. Transformed metadata is validated against a DTD to ensure its compliance.

Organizational Responsibility

Please refer to the Scholars Portal Roles and Responsibilities document for delineation of responsibilities by staff member.

Please refer to the Scholars Portal Organizational Chart for the structure of the organization.

2. Implementation Examples

Procedures for data integrity testing:

Test during pull script (see Pull Script Detail):

After a new dataset is saved into the Journals FTP in Pillar, it is retrieved and the file size is compared to that of the original copy held in the publisher FTP server.

If the file size matches, the script makes a record of the FTPed files with the file name, size, and current date and adds the file name to the FTP downloaded log file.

If the file size does not match, the script sets the error flag and increments the try count. Once the try count hits three and there is still an error flag, the file is deemed corrupt and an email is sent to loaders@scholarsportal.info.

Test during the preparation of datasets (see Prepare Datasets Detail):

New datasets are retrieved from the Journals FTP in Pillar and decompressed.

If decompression is successful, the script checks for the file name in the publisher error log and removes the file name from the publisher problem directory if it exists.

If there is an error during decompression, the script writes the file name to the publisher error log and moves the error file to publisher problem directory. The zip file information is then emailed to JIRA.

Test during journals loader (see Manual Log File Check):

New datasets are converted from the publisher XML/SGML into NLM XML, given a URI, and inserted into the journals database. Any errors are recorded in a log file.

Either the SP programmer or metadata librarian manually checks the log file for errors during the conversion and insertion into the journals database of each dataset.

If the conversion or the insertion failed, the SP programmer or metadata librarian investigate the error log file to find out where the error occurred.

If the error is due to a publisher problem, the publisher reloads the SIPs.

If the error is due to a loader problem, a reworking of the loader script is necessary.

Control of incoming data (see Pull Script Detail):

Depending on the publisher, incoming data is either pulled or pushed from the publisher FTP into SPs journals FTP in Pillar.
If it is pushed in by the publisher, they send new content to the location that SP gives them and notifies the SP programmers or metadata librarian.
If it is pulled in by SP's pull script, the process is activated daily at 11am.
The pull script loads configuration properties of the publisher and connects to the publisher FTP server using the FTP username and password.
The script retrieves the file names from the publisher FTP server and compares them to names in the FTP downloaded log file to look for new file names.
If a new file name is found in the publisher FTP server, the script creates a new dataset and saves it in the journals FTP in Pillar.
SP ingests new files at a controlled rate.

Explanation of repository workflow (see Workflow Charts)

Metadata fields with quality control information (see Data Dictionary):

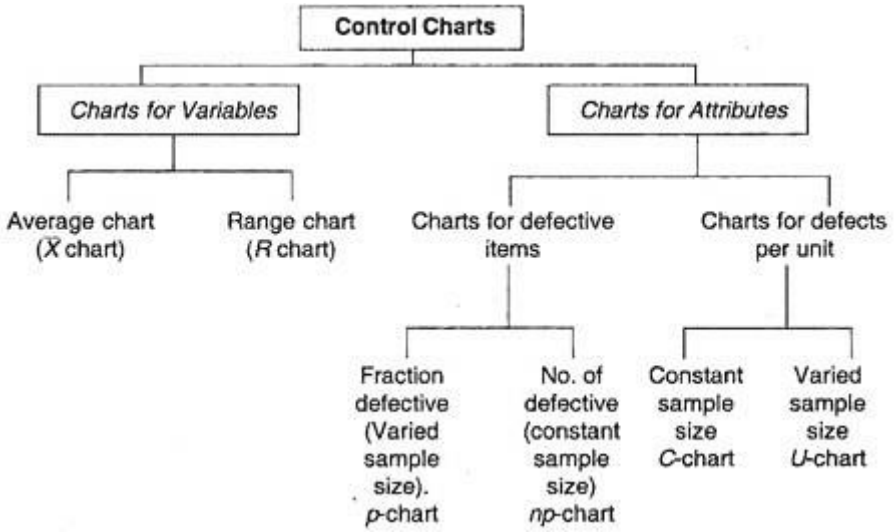
Object Characteristics – contains technical properties of a file or bit stream that are applicable to all or most formats. It includes the following:
Fixity – information used to verify whether an object has been altered in an undocumented or unauthorized way
Size – size in bytes of the file or bit stream stored in the repository
Format – identification of the format of a file or bit stream where format is the organization of digital information according to preset specifications
Storage – information about how and where a file is stored in the storage system
Quality assurance (QA) is a way of preventing mistakes or defects in manufactured products and avoiding problems when delivering solutions or services to customers; which ISO 9000 defines as "part of quality management focused on providing confidence that quality requirements will be fulfilled".[1] This defect prevention in quality assurance differs subtly from defect detection and rejection in quality control, and has been referred to as a shift left as it focuses on quality earlier in the process.[2]
The terms "quality assurance" and "quality control" are often used interchangeably to refer to ways of ensuring the quality of a service or product.[3] For instance, the term "assurance" is often used as follows: Implementation of inspection and structured testing as a measure of quality assurance in a television set software project at Philips Semiconductors is described.[4] The term "control", however, is used to describe the fifth phase of the DMAIC model. DMAIC is a data- driven quality strategy used to improve processes.[5]
Quality assurance comprises administrative and procedural activities implemented in a quality system so that requirements and goals for a product, service or activity will be fulfilled.[3] It is the systematic measurement, comparison with a standard, monitoring of processes and an associated feedback loop that confers error prevention.[6] This can be contrasted with quality control, which is focused on process output.
Quality assurance includes two principles: "Fit for purpose" (the product should be suitable for the intended purpose); and "right first time" (mistakes should be eliminated). QA includes management of the quality of raw materials, assemblies, products and components, services related to production, and management, production and inspection processes.[7] The two principles

Also manifest before the background of developing (engineering) a novel technical product: The task of engineering is to make it work once, while the task of quality assurance is to make it work all the time.[8]
Historically, defining what suitable product or service quality means has been a more difficult process, determined in many ways, from the subjective user-based approach that contains "the different weights that individuals normally attach to quality characteristics," to the value-based approach which finds consumers linking quality to price and making overall conclusions of quality based on such a relationship.[9]

A quality circle or quality control circle is a group of workers who do the same or similar work, who meet regularly to identify, analyze and solve work-related problems.[1] Normally small in size, the group is usually led by a supervisor or manager and presents its solutions to management; where possible, workers implement the solutions themselves in order to improve the performance of the organization and motivate employees. Quality circles were at their most popular during the 1980s, but continue to exist in the form of Kaizen groups and similar worker participation schemes.[2]
Typical topics for the attention of quality circles are improving occupational safety and health, improving product design, and improvement in the workplace and manufacturing processes. The term quality circles was most accessibly defined by Professor Kaoru Ishikawa in his 1988 handbook, "What is Total Quality Control? The Japanese Way"[3] and circulated throughout Japanese industry by the Japanese Union of Scientists and Engineers in 1960. The first company in Japan to introduce Quality Circles was the Nippon Wireless and Telegraph Company in 1962. By the end of that year there were 36 companies registered with JUSE by 1978 the movement had grown to an estimated 1 million Circles involving some 10 million Japanese workers.
Contrary to some people's opinion this movement had nothing whatever to do with Dr. W. Edwards Deming or indeed Dr Juran and both were skeptical as to whether it could be made to work in the USA or the West generally.
Quality circles are typically more formal groups. They meet regularly on company time and are trained by competent persons (usually designated as facilitators) who may be personnel and industrial relations specialists trained in human factors and the basic skills of problem identification, information gathering and analysis, basic statistics, and solution generation.[4] Quality circles are generally free to select any topic they wish (other than those related to salary and terms and conditions of work, as there are other channels through which these issues are usually considered).[5][6]
Quality circles have the advantage of continuity; the circle remains intact from project to project. (For a comparison to Quality Improvement Teams, see Juran's Quality by Design.

Statistical quality control refers to the use of statistical methods in the monitoring and maintaining of the quality of products and services. One method, referred to as acceptance sampling, can be used when a decision must be made to accept or reject a group of parts or items based on the quality found in a sample
In Chapter 5 we learned that total quality management (TQM) addresses organizational quality from managerial and philosophical viewpoints. TQM focuses on customer-driven quality standards, managerial leadership, continuous improvement, quality built into product and process design, quality identified problems at the source, and quality made everyone’s responsibility.
However, talking about solving quality problems is not enough. We need specific tools that can

help us make the right quality decisions. These tools come from the area of statistics and are used to help identify quality problems in the production process as well as in the product itself.
Statistical quality control is the subject of this chapter. Statistica1 quality control (SQC) is the term used to describe the set of statistical tools used by quality professionals. Statistical quality control can be divided into three broad categories: 1. Descriptive statistics are used to describe quality characteristics and relationships. Included are statistics such as the mean, standard deviation, the range, and a measure of the distribution of data.
Control Charts for Variables:
A number of samples of component coming out of the process are taken over a period of time. Each sample must be taken at random and the size of sample is generally kept as 5 but 10 to 15 units can be taken for sensitive control charts.
For each sample, the average value $\bar{X}$ of all the measurements and the range R are calculated. The grand average $\bar{\bar{X}}$ (equal to the average value of all the sample average, $\bar{X}$) and R ($\bar{R}$ is equal to the average of all the sample ranges R) are found and from these we can calculate the control limits for the $\bar{X}$ and R charts.




The proportion or fraction nonconforming (defective) in a population is defined as the ratio of the number of nonconforming items in the population to the total number of items in that population. The item under consideration may have one or more quality characteristics that are inspected simultaneously.
The 3 Types of Quality Defects
Defects are classified into three main categories – minor, major and critical. Based on the level applied, there will be an allowable number of defects for each category, within a given sample size.
Minor defects are small, typically insignificant issues that do not affect function or form of the item. If evident, it likely would not cause the customer to return the item to the store. Your order can fail inspection, however, if the number of minor defects found exceeds the limit set by the acceptable quality level.
Major defects are considered those which could adversely affect performance of the product. Such a defect would likely cause a customer to return the product.

Critical defects are those which would render the item unusable, or could cause harm to the user or someone in the vicinity of the product. An item will often fail product inspection if a single critical defect is found within the order. According to estimates from the U.S. Consumer Product Safety Commission (CPSC), there were about 256,700 toy-related injuries treated by emergency personnel in 2013, many resulting in product recalls.

What is Acceptance Sampling?

| | |
|---|---|
| Contributions of Dodge and Rooming to acceptance sampling | Acceptance sampling is an important field of statistical quality control that was popularized by Dodge and Rooming and originally applied by the U.S. military to the testing of bullets during World War II. If every bullet was tested in advance, no bullets would be left to ship. If, on the other hand, none were tested, malfunctions might occur in the field of battle, with potentially disastrous results. |
| Definition of Lot Acceptance Sampling | Dodge reasoned that a sample should be picked at random from the lot, and on the basis of information that was yielded by the sample, a decision should be made regarding the disposition of the lot. In general, the decision is either to accept or reject the lot. This process is called Lot Acceptance Sampling or just Acceptance Sampling. |
| "Attributes" (i.e., defect counting) will be assumed | Acceptance sampling is "the middle of the road" approach between no inspection and 100% inspection. There are two major classifications of acceptance plans: by attributes ("go, no-go") and by variables. The attribute case is the most common for acceptance sampling, and will be assumed for the rest of this section. |
| Important point | A point to remember is that the main purpose of acceptance sampling is to decide whether or not the lot is likely to be acceptable, not to estimate the quality of the lot. |
| Scenarios leading to acceptance sampling | Acceptance sampling is employed when one or several of the following hold:<br>Testing is destructive<br>The cost of 100% inspection is very high 100% inspection takes too long |
| Acceptance Quality Control and | It was pointed out by Harold Dodge in 1969 that Acceptance Quality Control is not the same as Acceptance Sampling. The latter depends on specific sampling plans, which when |

Acceptance Sampling

implemented indicate the conditions for acceptance or rejection of the immediate lot that is being inspected. The former may be implemented in the form of an Acceptance Control Chart. The control limits for the Acceptance Control Chart are computed using the specification limits and the standard deviation of what is being monitored (see Ryan, 2000 for details).

An observation by Harold Dodge

In 1942, Dodge stated:

"basically the "acceptance quality control" system that was developed encompasses the concept of protecting the consumer from getting unacceptable defective product, and encouraging the producer in the use of process quality control by: varying the quantity and severity of acceptance inspections in direct relation to the importance of the characteristics inspected, and in the inverse relation to the goodness of the quality level as indication by those inspections."

To reiterate the difference in these two approaches: acceptance sampling plans are one-shot deals, which essentially test short-run effects. Quality control is of the long-run variety, and is part of a well-designed system for lot acceptance.

An observation by Ed Schilling

Schilling (1989) said:

"An individual sampling plan has much the effect of a lone sniper, while the sampling plan scheme can provide a fusillade in the battle for quality improvement."

Control of product quality using acceptance control charts

According to the ISO standard on acceptance control charts (ISO 7966, 1993), an acceptance control chart combines consideration of control implications with elements of acceptance sampling. It is an appropriate tool for helping to make decisions with respect to process acceptance. The difference between acceptance sampling approaches and acceptance control charts is the emphasis on process acceptability rather than on product disposition decisions.

The operating characteristic (OC) curve depicts the discriminatory power of an acceptance sampling plan. The OC curve plots the probabilities of accepting a lot versus the fraction defective. When the OC curve is plotted, the sampling risks are obvious.

What is an operating characteristic (OC) curve?

The operating characteristic (OC) curve depicts the discriminatory power of an acceptance sampling plan. The

OC curve plots the probabilities of accepting a lot versus the fraction defective.
When the OC curve is plotted, the sampling risks are obvious. You should always examine the OC curve before using a sampling plan.
For example, you sample 52 pens from a shipment of 5000. If the actual % defective is 1.5%, you have a 0.957 probability of accepting this lot based on the sample and a 0.043 probability of rejecting it. If the actual % defective is 10%, you have a 0.097 probability of accepting this lot and a 0.903 probability of rejecting it.
WORK STUDY
"Work study is a generic term for those techniques, method study and work measurement which are used in the examination of human work in all its contexts. And which lead systematically to the investigation of all the factors which affect the efficiency and economy of the situation being reviewed, in order to effect improvement." Work study is a means of enhancing the production efficiency (productivity) of the firm by elimination of waste and unnecessary operations. It is a technique to identify non-value adding operations by investigation of all the factors affecting the job. It is the only accurate and systematic procedure oriented technique to establish time standards. It is going to contribute to the profit as the savings will start immediately and continue throughout the life of the product. Method study and work measurement is part of work study. Part of method study is motion study, work measurement is also called by the name 'Time study'.

Advantages of Work Study Following are the advantages of work study:
It helps to achieve the smooth production flow with minimum interruptions. It helps to reduce the cost of the product by eliminating waste and unnecessary operations. Better worker-management relations. Meets the delivery commitment. Reduction in rejections and scrap and higher utilization of resources of the organization. Helps to achieve better working conditions. Better workplace layout. Improves upon the existing process or methods and helps in standardization and simplification. Helps to establish the standard time for an operation or job which has got application in manpower planning, production planning. 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 duration of time it takes to complete a work task assigned to a specific job.

Usage

Work measurement helps to uncover non-standardization that exist in the workplace and non-value adding activities and waste. A work has to be measured for the following reasons:

To discover and eliminate lost or ineffective time.
To establish standard times for performance measurement.
To measure performance against realistic expectations.
To set operating goals and objectives.

Techniques

Time study Predetermined motion time systems
Synthesis from elemental data Work sampling
The allowance was exactly what we had hoped for as this made our budget work and go according to plan

The amount of this allowance can be determined by making all-day time study or work sampling. Mostly, a 5 % allowance for personal time (nearly 24 minutes in 8 hours) is considered appropriate.

Allowed time is granted more frequently to salaried employees than to wage earners, Allowed time is usually finite; after its expiration, the employee often must begin to forgo payment. Examples of allowed time include sick time or grieving time. It is also called waiting time.

UNIT-4
MATERIALS MANAGEMENT

- INTRODUCTION TO MANAGEMENT

Management is defined as the creation and maintenance of an internal environment in an enterprise where individuals working together in groups, can perform efficiently and effectively towards the attainment of group goals.

- 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:
- Minimization of materials costs
- To reduce inventory for use in production process and to develop high inventory turnover ratios.
- To procure materials of desired quality when required, at lowest possible overall cost of the country.
- To reduce paper work procedure in order to minimize delays in procuring materials.
- To note changes in market conditions and other factors
- Affecting the concern.
- The purchase, receive, transport, store materials efficiently
- To reduce cost, through simplification, standardization, value analysis etc.
- 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:

- Materials planning and programming
- Purchasing materials inspection of materials
- Inspection of Materials
- Classification, codification and standardization in stores
- Storage of materials
- Issuing of materials

- Maintence of proper inventory records
- Materials receiving

- Characteristics of Management:

- Setting goals for organizations: Goals differ from organization to organization in business, the basic economic goal is to earn maximum profit, while in service organization like hospital and educational institution for the basic goal is to provide better service and better education.

- Awareness of opportunities and resources: Management have awareness of opportunities and resources like men, materials, money which assembles and integrates by management.

Management is transformation process: Management is a transformation process consisting of planning, organizing, staffing, directing and controlling.

Management is universal: The principles and techniques of management are universally applicable to all group activities performed at any level of organization.

System of authority: System of authority means a hierarchy of command and control. Managers at different levels possess varying degrees of authority.

Co – Ordination: Various human beings organized in formal groups are endeavoring to achieve the common organizational objectives, so various departments in the organization must work in harmony with one another.

Management is Dynamic: The ever changing social environment directly and indirectly effect the group activity thus changing environments provide a challenge to management. Efficient management cannot remain static it must adopt itself to changing conditions.

Management is decision making: The managers are decision makers he marketing managers decides about how to market, when to market, where to market how to collect funds for organization.

Management is a profession: Management is not only a science but also an art. Art means managers has to handle the person and things tactfully. Science means achieving objectives through procedures.

 Importance of Management: No ideology, no ism, or political theory can win greater output with less efforts from a given complex of human and materials resource only sound management And it is on such greater output that a higher standard of life, more leisure, more amenities for all must necessarily be found.

Effective utilization of resources: Management tries to make effective utilization of various resources. The resources are scarce in nature and to meet the demand of the society, their contribution should be maximum for the general interests of the society. Management not only decides in which particular alternative a particular resource be used but also takes actions to utilize it in that particular alternative in the best way.

Development of resources: Management develops various resources. This is true with human as well as non-human factors. Most of the researches for resource development are carried on in an organization way and management is involved in those activities.

To incorporate innovations: Today changes are occurring at a very fast rate in both technology and social process and structure these changes need to be incorporated to keep the organizations alive and efficient.

Therefore, they require high degree of specialization, high level of competence, and complex technology. All these require efficient management so that organizations work in the most efficient way.

Integrating various interest groups: In the organized efforts, there are various interest groups and they put pressure over other groups for maximum share in the combined output. For example, in the case of business organization, there are various pressure groups such as shareholders, employees, government etc. These interest groups have pressure on an organization.

Stability in the society: Management provides stability in the society by changing and modifying the resources in accordance with the changing environment of the society. In the modern age, more emphasis is on new inventions for the betterment of human beings. These inventions make old systems and factors mostly obsolete and inefficient. Management provides Integrated between traditions and new inventions and safeguards, society from the unfavorable impact of these inventions so that continuity in social process is maintained.

 Levels of Management:

1. Top Management
2. Upper Middle management
3. Middle Management
4. Lower Management
5. Operating Force or Rank and file workmen Top Management includes:

a) Board of directors b) Managing directors c) Chief executives d)General Manager e) Owners

 Functions:

Setting basic goals and objectives  Expanding or contracting activities Establishing policies  Monitoring performance  Designing/Redesigning organization system Shouldering financial responsibilities etc.

Upper Middle Management includes: 
Sales executives
Production executives
Finance executives

 Accounts executives Functions:

a) establishment of the organization
b) Selection of staff for lower levels of management
c) Installing different departments
d) Designing operating policies and routines
e) Assigning duties to their subordinates Middle Management includes Superintendent
Branch Managers General forcemeat etc.

 Functions:

- To cooperate to run organization smoothly 
- To understand inter locking of department in major policies 
- To achieve coordination between different parts of the organization 
- To conduct training for employee development 
- To build an efficient company team spirit 

 Lower Management includes:

Foremen
Supervisors or charge-hands
Office Superintendent Inspectors etc.

- Functions:

1. Direct supervision of workers and their work
2. Developing and improving work methods operations
3. Inspection function
4. Imparting instruction to workers
5. To give finishing touch to the plans and policies of top management
6. To act as link between top management and operating force
7. To communicate the feelings of workers to the top management.

- Operating force includes:
  - Workers
  - Rank and file workman
  - Skilled and Semi-skilled workers
  - Unskilled workers
- Function:
  - To do work on machines or manually, using tools etc.
  - To work independently (in case of skilled workers) or under the guidance of supervisor.

UNIT-5
STORES MANAGEMENT

- Stores Management: It deals with planning, coordination and control of various activities pertaining or effective efficient and economic storage and store keeping.

Store: Generally, un worked material is known as store Storage: The store room is the place where stores are housed

Storage: Storage is meant holding in custody all kinds of stores and materials semi-processed and fully processed products.

Store Keeping: It may be defined as that aspect of materials control concerned with physical storage of goods.

- Functions of stores:
- To receive raw materials, semi-finished or purchased items from vendors and to check them for identification.
- To receive parts and components which has been processed in the factory
- To make a record of material receipt and current status of material in the store
- To maintain positioning of materials in the store.
- To maintain stock safety and in good condition to ensure that they do not suffer from damage
- Issuing the items/materials to operational personnel
- Making a record of receipt and issue slips
- To avoid illegal attics in store areas.
- To plan for optimum utilization of space.
- Cooperating to full extent which purchasing, manufacturing and production planning and control departments.
- Stores Records:
- Material requisition note: Whenever the materials are required by a department/section, this form has to be filled in. This note provides information about the job number, description of the items required in terms of number. The head of the department/section should authorize it. Whenever the materials are issued, the receiving person should sign the note.
- This is to be entered in the materials issued record, which is to be signed by the storekeeper.
- Purchase order: The purchasing officer will release the purchase order.

The following is the format of a purchase order. Here, we find Vivek

enterprises placing a purchase order on Business Solutions Ltd., for the following materials. The terms and conditions of the purchase order such as delivery, payment, and other have to be mentioned clearly.

- Invoice: Invoice is a statement sent by the seller to the buyer mentioning the particulars of the goods supplied, net amount payable for the goods, and the terms and conditions governing the sale. It is very important document because it shows the net amount payable by the buyer after all the discounts and the taxes, if any.
- Goods received note: The goods received note furnishes the particulars of the suppliers, purchase order number, purchase requisition number, and the job for which the goods are received. These details are to be certified by a competent authority. On this basis, the accounts department initiates the process of payment for the goods received.
- Goods returned note: Sometimes, a part or whole of the goods received may not be of acceptable quality debited by the amount mentioned in this debit note for the goods returned.
- Stores ledger account: This is maintained to provide the details of the quantity, price and amount of the receipts, issues, and balance of stocks on a day-to-day basis. At any given time, the physical quantity of stocks should match with the balance as per the stores ledger account. A separate account is maintained for each type of the material in the stores. It should necessarily mention the method such as FIFO or LIFO, followed to value the issues of stocks. It is a valuable tool for the costing department in exercising stores control.
- Inventory: It defined as a comprehensive list of movable items which are required for manufacturing the products and to maintain the plant facilities in working conditions.
- Inventory Control: The systematic location, storage and recording of goods in such a way the desired degree of service can be made to the operating shops at minimum ultimate cost.
- Objectives of Inventory Control:

1. To support the production departments with materials of the right quality in the right quantity, at the right time and the right price, and from the right supplier
2. To minimize investments in the materials by ensuring economies of storage and ordering costs
3. To avoid accumulation of work in process
4. To ensure economy of costs by processing economic order quantities

5. To maintain adequate inventories at the required sales outlets to meet the market needs promptly, thus avoiding both excessive stocks and shortages at any given time

6. To contribute directly to the overall profitability of the enterprise

- Functions of inventory control:

- To develop policies, plans and standards essential to achieve the objectives
- To build up a logical and workable plan of organization for doing the job satisfactory
- To develop procedure and methods that will produce the desired results economically
- To provide the necessary physical facilities
- To maintain overall control by checking results and taking corrective actions.

- Inventory Management System or Level:

- Which The will objects serve of two inventory minimize control the company is to establish costs and level maximize of inventory its revenue.
- It is determined by five basic variables
- a) Minimum inventory b) Reorder point c) Recorder quantity d) Procurement lead time e) Maximum inventory.
- Minimum inventory: Minimum inventory or buffer stock is needed to take care of any temporary unpredictable increase in the part usage or in the procurement lead time.
- Reorder point: It is sufficiently above the minimum inventory to allow for

- issuing the purchase order and for delivery by a vendor. Reorder point stock level is equal to the minimum stock plus the expected consumption during the procurement lead time.
- Reorder Quantity: This is the fixed quantity of item for which order is placed every time the stock drops to the reorder point. This quantity is fixed either on the basis of experience or calculated.
- Procurement lead time: This comprises the time required for preparing the purchase order, the time gap between placing an order and receiving supplies and time required for inspection etc.
- Maximum inventory: It is approximately the sum of the order quantity and minimum inventory. It will exactly equal the sum of these two quantities if the ordered material is received just when the minimum stock is reached.
- First in First Out (FIFO) : In this system, the materials first received are issued first materials from the second lot are issued only, when first lot is exhausted and so on. The prices of the materials are charged at the cost at which that lot was purchased.
- Last in First out (LIFO): In this system, the materials first received are issued first materials from the second lot are issued only when first lot is exhausted and so on. The prices of the materials are charged at the cost at which that lot was purchased.
- Simple average price method: In this method, the stock are issued at an average price. The average price is determined by dividing the sum of the prices (at which the goods are received) by the number of price available.
- Weighted average price method: This method is an improvement over simple average price. While calculating the average price, the quantities of each of the receipts are considered. The weighted average price is calculated as given below:
- (W1 P1 ) (W2 P2 ) (W3 P3 )

- W1 W2 W3
- Where W1, W2, and W3 refer to the quantities of each of the three receipts and P1, P2, and P3 are the prices of each of the receipts. Under this method, the quantity of each of the receipts is called the weight.
  Hence, the average price so computed is called the weighted average price.
  Weighted average is calculated after each time a purchase is made.
- Purchasing: It deals with investment, overheads dealing with other andalso result in server losses mass production industries that requires large purchasing for a continues flow of materials, demand for an efficient purchase decision. It implies procurement of raw materials machinery, service etc. needed for production and maintenance of the concern.
- It has several benefits in terms of reduced costs, higher inventory turnover, buying the materials at the best prices, turnover, buying the materials at the best prices, continues supplies, reduced lead time and so on.
  - Objectives:
- To procure rightmaterial
- To procure materials in desired quantities
- To procure material of desired quality
- Purchasing from reliablesource
- To pay less for materials purchased
- To receive and deliver materials at right place and time.
  - Purchasing process:
- The following are the logical steps in the purchasing process:
- Requisitioning purchases
- Exploring sources of supply
- Issuing of tenders and obtainingquotations
- Opening of tenders and quotations and preparation of comparative statement
- Negotiating over the purchase price and terms of supply
- Placing purchase order
- Receiving of materials along with the invoice
- Checking inward invoice
- Inspecting and testingmaterials
- Forwarding the materials to stores
- Checking invoice and passing of bills for payments

ABC Analysis:

ABC analysis is a technique of controlling inventories based on their value and quantities. It is more remembered as an analysis for 'Always Better Control' of inventory. Here all items of the inventory are listed in the order of descending values, showing quantity held and their corresponding value.

Then, the inventory is divided into three categories A, B and C based on their respective values.

A – Refers to high value item

B – Refers to medium value item

C – Refers to low value item

A category comprises of inventory, which is very costly and valuable. Normally 70% of the funds are tied up in such costly stocks, which would be around 10% of the total volume of stocks. Because the stocks in this category are very costly, these require strict monitoring on a day-to-day basis.

B category comprises of inventory, which is less costly. Twenty percent of the funds are tied up in such stocks and these accounts for over 20% of the volume of stocks. These items require monitoring on a weekly or fortnightly basis

C category consists of such stocks, which are of least cost. Volume wise, they form 70% of the total stocks but value-wise, they do not cost more than 10% of the investment in the stocks. This category of stocks can be monitored on a monthly or bi-monthly basis.

VED stands for vital, essential and desirable. This analysis relates to the classification of maintenance spare parts and denotes the essentiality of stocking spares.

The spares are split into three categories in order of importance. From the view-points of functional utility, the effects of non-availability at the time of requirement or the operation, process, production, plant or equipment and the urgency of replacement in case of breakdown.

Some spares are so important that their non-availability renders the equipment or a number of equipment in a process line completely inoperative, or even causes extreme damage to plant, equipment or human life.

On the other hand some spares are non-functional, serving relatively unimportant purposes and their replacement can be postponed or alternative methods of repair found. All these factors will have direct effects on the stocks of spares to be maintained.

Therefore, it is necessary to classify the spares in the following categories:

V:Vital items which render the equipment or the whole line operation in a process totally and immediately inoperative or unsafe; and if these items go out of stock or are not readily available, there is loss of production for the whole period.

E:Essential items which reduce the equipment's performance but do not render it inoperative or unsafe; non-availability of these items may result in temporary loss of production or dislocation of production work; replacement can be delayed without affecting the equipment's performance seriously; temporary repairs are sometimes possible.

D:Desirable items which are mostly non-functional and do not affect the performance of the equipment.

FNSD Analysis FNSD analysis divides the items of stores into 4 categories in the descending order of importance of their usage rate. 'F' stands for fast moving items that are consumed in a short span of time. 'N' stands for normal moving items which are exhausted over a period of a year

In FSN analysis, items are classified according to their rate of consumption. The items are classified broadly into three groups: F – means Fast moving, S – means Slow moving, N – means Non-moving. The FSN analysis is conducted generally on the following basis:

- The last date of receipt of the items or the last date of the issue of items, whichever is later, is taken into account.
- The time period is usually calculated in terms of months or number of days and it pertains to the time elapsed seems the last movement was recorded.

FSN analysis helps a company in identification of the following

- The items considered to be "active" may be reviewed regularly on more frequent basis.
- Items whose stocks at hand are higher as compared to their rates of consumption.
- Non-moving items whose consumption is "nil" or almost insignificant.

## VALUE ANALYSIS

Value engineering or value analysis had its birth during the World War II Lawrence D. Miles was responsible for developing the technique and naming it. Value analysis is defined as "an organized creative approach which has its objective, the efficient identification of unnecessary cost-cost which provides neither quality nor use nor life nor appearance nor customer features." Value analysis focuses engineering, manufacturing and purchasing attention to one objective- equivalent performance at a lower cost.

Value Analysis Framework The basic framework for value analysis approach is formed by the following questions, as given by Lawrence D. Miles:

Steps in Value Analysis In order to answer the above questions, three basic steps are necessary:

Identifying the function: Any useful product has some primary function which must be identified a bulb to give light, a refrigerator to preserve food, etc. In addition it may have secondary functions such as withstanding shock, etc. These two must be identified.

Evaluation of the function by comparison: Value being a relative term, the comparison approach must be used to evaluate functions. The basic question is, 'Does the function accomplish reliability at the best cost' and can be answered only comparison.

Cost reduction. Cost reduction is the process used by companies to reduce their costs and increase their profits. Depending on a company's services or product, the strategies can vary. ...
Cost becomes more important when competition increases and price becomes a differentiator in the market.

Importance of Cost Reduction in marketing

The following are the importance of reduction of costs in marketing.

1. Economies of scale:
2. The experience effect
3. Location of production facility