DEPARTMENT OF AUTOMOBILE ENGINEERING

LECTURER NOTE

INDUSTRIAL ENGINEERING AND MANAGEMENT

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BRANCH- AUTOMOBILE ENGINEERING

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PLANT LAYOUT

Plant layout is the overall arrangement of the production process, store-room, stock-room, tool-room, material handling equipment, aisles, racks and sub-stores, employee services and all other accessories required for facilitation of the production in the factory.

It encompasses production and service facilities and provides for the most effective utilization of the men, materials and machine' constituting the process, it is a master blueprint for coordinating all operations performed inside the factory.

Objectives of Plant Layout

1. Minimization of material handling.
2. Elimination of bottlenecks through the balancing of plant capacities.
3. High material turnover through a shorter operating cycle.
4. Effective utilization of installed capacity so that the returns on the investments may be maximized.
5. Effective utilization of cubic space in the factory area.
6. Effective utilization of manpower resources through the elimination of idle time.

7. Elimination, improvement or confinement of objectionable operations e.g., operations with bad odour, vibrating operations etc.

8. Elimination of physical efforts required by operative workers.

9. Avoidance of industrial accidents.

10. Better working conditions for the employees like lighting, ventilation, control of noise and vibrations etc.

11. Decency and orderliness inside the plant area.

12. Better customer services through cheaper and better product supplies according to the delivery promises

Type of Plant Layout

The popular **types of plant layout** are:

1. Process layout
2. Product layout
3. Combined layout
4. Project layout
5. Group Layout

Process Layout

This type of layout is also called functional layout. All machines performing a similar type of operations are grouped at one location in the process layout e.g., all lathes, milling, machines, cutting machines etc. in the engineering shop are clustered in their like groups. Thus all forging will be done in one area and all the lathes will be placed in another area.

In this layout, several products may share a machine to make its full use. The sequential arrangement of the machine group is generally, but not necessarily made on the basis of labor operations

In this type of layout, the process rather than the product has dominating role. The product is given secondary consideration and is moved for the purpose of operations to the process section with like machines stationed at a particular point. This type of layout is more suitable to job order type of production.

The typical arrangement of the machines in the process layout will be as under:

Advantages of Process Layout

- It eliminates the duplication of machines and enables the optimum use of installed capacity.
- It facilitates flexibility in production. It is more flexible than a line layout. Different products can be made without changes in the arrangements of the machine.
- The production capacity is not arranged in rigid sequence and fixed rated capacity with line balancing.
- The break down of one machine does not interrupt the entire production flow.
- Specialization in supervision becomes possible.
- Individual incentive schemes can be developed.

Disadvantages of Process Layout

- Due to a lack of straight-line sequence of production, it is impossible to maintain the line balancing in production. So the problems of bottleneck and waiting and the idle

capacity.

- The cost of material handling increases due to long routing and backtracking between the processes.

- The inspection cost increases. Due to frequent changes in the machine set up, inspection is required at each stage of the process.
- The cost of supervision increases due to specialist supervisors and more number of supervisors are required at each process unit.
- The production planning and control become difficult due to complexities arising in routing, scheduling, dispatching and follow-up.
- It is not possible to implement the group incentive schemes on the basis of the quantity of the products manufacturing.
- More space is required for internal storing, a reservoir of materials and provision for the expansion of the particular process section.

Product layout

In this type of layout, the machines are arranged in the sequence as required by the particular product. All machines as required to balance the particular product line are arranged in a sequential line but not necessarily in the straight line. It is also known as " the product line layout."

In this layout, one product goes through all the machines lined up, in the order required by its manufacture. The best-known example of this type of layout is seen in motor car production. To make this layout successful, the workload on the various machines must be balanced. The process of getting even loading at each stage of production is called **line balancing**

In this type of layout, the product is dominating over the process, in the sense that the product is given the primary

importance and the process machine must remain present at a point where the product needs its services.

Thus, unlike the **process layout**, the process is given secondary importance in relation to the product. **Product layout** is more suitable for continuous flow-production with few items of production. It does not require frequent changes in machine set up.

Advantages of Product layout

- Reduced material handling cost due to straight-line production flow.
- Mechanization of material handling between fixed points.
- Line balancing may eliminate bottlenecks and idle capacity.
- Shorter operating cycle due to shorter and speedy movement of materials.
- Maximum utilization of machine and labour capacity through developing a proper balance between them.
- Effective control over production with reduced supervision by generalists supervisor. By reducing the manufacturing to simple steps we can often use less skilled labour.

- Effective quality control with reduced inspection points. It does not require frequent changes in machine set-up.
- Effective production planning and control. Unlike process layout, the routing, scheduling, dispatching and follow up are relatively easier.
- Maximum use of space due to straight production flow and reduced need of interim storing.
- It facilitates the implementation of group incentive schemes for the workers.
- It is relatively easy to control.

Disadvantages of Product layout

- The duplication of machines and equipment necessitates the increased investments in them sometime resulting in idle capacity.
- The production flow is regulated through the straight line sequence and fixed rated capacity, and thus makes it highly inflexible.
- The breakdown of one single machine in the line interrupts the entire production flow.
- Unlike process layout, the benefits of specialized supervision is not possible.
- As the entire production is the result of the joint efforts of all operations in the line, it is difficult to implement individual incentive schemes.
- They are less flexible than others. Any change in product requires

Combined Layout

Generally pure process or pure product layout is not found in practice. Both process and product layouts are mutually exclusive. Proper compromise reaping the benefits of both the layouts is possible to some extent. So efforts are made to have the combined layout incorporating the benefits of process and product layout.

Combined layout is developed as under:

- Product layout for the main product with a process layout for joint or by-product tapping the idle capacity of product layout along with marginal investments required in process layout.

- To diversify the production with a view to tap the idle capacity of the product layout. Products with a complete negative correlation with the product line can make the maximum use of idle capacity of the product layout.

- In the product layout, some process may be segregated from the product line e.g., objectionable, hazardous, requiring special treatment and repetitive performance etc.

Project Layout

The manufacturing operation require the movements of men, machines and materials. Generally few inputs tend to be static while the others are moving.

In the product layout and process layout generally the machines have fixed installations and the operators are static in terms of their specified work stations.

It is only the materials which move form operation to operation for the purpose of processing. But where the product is large in size and heavy in weight, it tends to be static, e.g., shipbuilding.

In such a production system, the product remains static and the men and machines move performing the operations on the product. The production characteristics are sufficient enough to treat it as a separate type of layout, viz. static product layout.

Group Layout

Here an attempt is made to introduce some of the advantages of a line layout into a situation where pure line layout is not practicable. Here machines are placed in groups.

Each machine group makes maximally of parts which require similar treatment. This layout lies between process layout and line layout. It is easier to control than a strictly process layout and has more flexibility into the manufacturing system as regards the batch size variations and the differing operations

sequence

Techniques to improve layout

The six tools and techniques used for layout planning/plant layout are as follows: 1. Operation process charts 2. Flow process charts 3. Process flow diagram 4. Machine date cards 5. Templates 6. Scale models.

1. Operation Process Chart:

The manufacturing process is divided into separate operations with the help of the operation process chart. It shows the points at which materials are introduced into the process and the sequence of various operations and inspections other than material handling.

The operation process chart is meant for new plant which is to be laid out. This chart represents the basic activities required for producing a product. Since it presents the overall visualization of the process, basis for studying possibilities for the improvement of operations by elimination, combination, rearrangement or simplification is available.

2. Flow Process Chart:

This chart is a graphic representation of all the production activities occurring on the shop floor. It may be considered as an elaboration of the operation process chart which includes transportation, storage and delay. The data required for preparing the flow process chart are collected by tracing the actual flow of work occurring in the distance moved and the time required for the operation.

The flow process chart provides the complete information for the analysis and improvement of the unit/plant operations as a whole. On the basis of this analysis, operations may be combined, rearranged or eliminated.

Work station, storage space and inspection may be reallocated to minimize distances moved and labour time. An improved flow process chart provides a basis for revising an existing plant layout. The charts are also utilized to check and verify the efficiency of a proposed new layout.

3. Process Flow Diagrams:

This diagram is used to supplement the flow process chart. It is the diagram of building plan representing graphically the relative

position of productive machinery storage space, gangways etc. and path followed by men or materials. All routes foll It is possible to trace out the undesirable characteristics of the layout which are responsible for increased transportation and delay by studying the process flow diagrams and flow process chart. It also shows nature of back tracking of present layout which there by helps in improving the layout.

4. Machine Data Cards:

These cards give complete specification of each machine to be installed showing its capacity, space and other requirements, foundations methods of operation, maintenance and handling devices of machines etc.

5. Templates:

After studying the flow process chart, process flow diagram and machine data cards, a floor plan is prepared by fixing the area occupied by each item (machine/equipment, benches, racks, material handling equipment etc.) to be erected in the shops.

Now from the thick sheets of cardboard, plywood or plastic on the same scale pieces of sheet are cut (known as templates) to represent various items which are to be housed in the plants and are placed on the floor plans at suitable locations.

These templates are arranged in such a way so as to provide the best layout. This procedure makes the layout visual before actually drawn and is carefully examined. The changes, if any, are in corporate before making the actual layout drawing.

6. Scale Models:

It is an improvement over the template technique. In this tools, instead of templates, three dimensional scale model is utilized. These models may be of wood plastic or metals. When these are used on a layout, series of additional information about the height and of the projected components of the machines are obtained. This tool is useful for complete layout which initially requires huge investment.

Principles of material handling equipment

Raw materials form a critical part of manufacturing as well as service organization. In any organization, a considerable amount of material handling is done in one form orthe other. This movement is either done manually or through an automated process. Throughout material, handling processes significant safety and health; challenges are presented to workers as well as management.
Therefore, manual material handing is of prime concern for health and safety professional, and they must determine practical ways of reducinghealth risk to the workers.

Material Handling

Manual material handling ranges from movement of raw material, work inprogress, finished goods, rejected, scraps, packing material, etc. These

materials are of different shape and sizes as well as weight. Material handling is a systematic and scientific method of moving, packing and storing of material in appropriate and suitable location. The main objectivesof material handling are as follows:

- It should be able determine appropriate distance to be covered.
- Facilitate the reduction in material damage as to improve quality.
- Reducing overall manufacturing time by designing efficient materialmovement
- Improve material flow control
- Creation and encouragement of safe and hazard-free work condition
- Improve productivity and efficiency
- Better utilization of time and equipment

It is critical for manufacturing organization to identify importance of material handling principle as the critical step in promoting the job improvement process. Manual materialhandling significantly increases health hazard for the workers in from lower back injuries.

In the current competitive and globalized environment, it is important to control cost andreduce time in material handling. An efficient material handling process promotes:

- Design of proper facility layout
- Promotes development of method which improves and simplifies the workprocess
- It improves overall production activity.
- Efficient material handling reduces total cost of production.

Principles of Material Handling

Material handling principles are as follows:

- **Orientation Principle:** It encourages study of all available system relationships before moving towards preliminary planning. The study includes looking at existing methods, problems, etc.
- **Planning Principle:** It establishes a plan which includes basic requirements, desirable alternates and planning for contingency.
- **Systems Principle:** It integrates handling and storage activities, which is cost effective into integrated system design.
- **Unit Load Principle:** Handle product in a unit load as large as possible
- **Space Utilization Principle:** Encourage effective utilization of all the space available
- **Standardization Principle:** It encourages standardization of handling methods and equipment.

- **Ergonomic Principle:** It recognizes human capabilities and limitation by design effective handling equipment.
- **Energy Principle:** It considers consumption of energy during material handling.
- **Ecology Principle:** It encourages minimum impact upon the environment during material handling.
- **Mechanization Principle:** It encourages mechanization of handling process wherever possible as to encourage efficiency.
- **Flexibility Principle:** Encourages of methods and equipment which are possible to utilize in all types of condition.
- **Simplification Principle:** Encourage simplification of methods and process by removing unnecessary movements
- **Gravity Principle:** Encourages usage of gravity principle in movement of goods.
- **Safety Principle:** Encourages provision for safe handling equipment according to safety rules and regulation
- **Computerization Principle:** Encourages of computerization of material handling and storage systems
- **System Flow Principle:** Encourages integration of data flow with physical material flow
- **Layout Principle:** Encourages preparation of operational sequence of all systems available
- **Cost Principle:** Encourages cost benefit analysis of all solutions available
- **Maintenance Principle:** Encourages preparation of plan for preventive maintenance and scheduled repairs
- **Obsolescence Principle:** Encourage preparation of equipment policy as to enjoy appropriate economic advantage

Plant maintenance

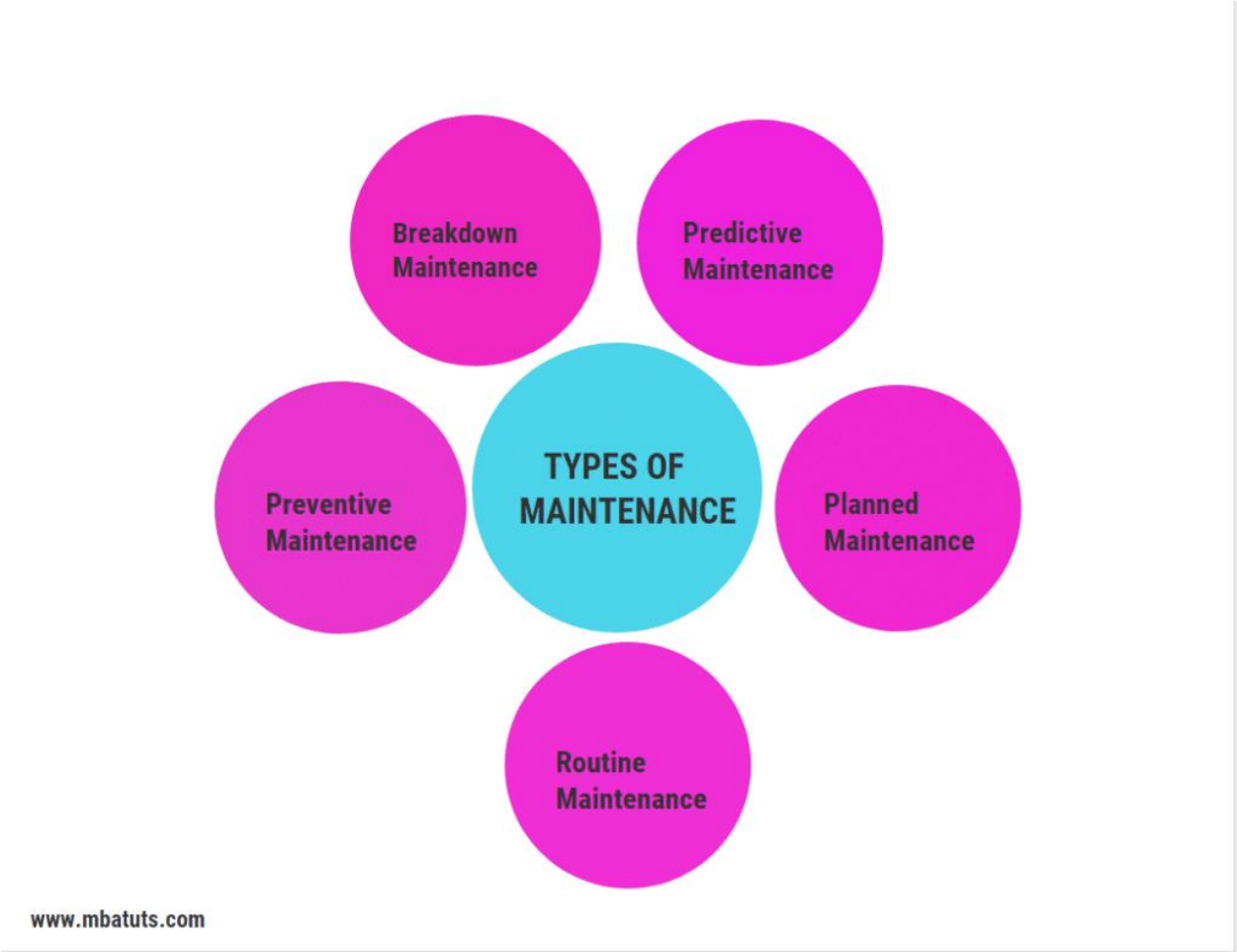
good operating conditions to avoid Plant maintenance is defined as a set of activities that are necessary to keep machinery, parts &

types of equipment in production stoppage and loss.

Objectives of maintenance management.

1. Minimizing the loss of production time due to equipment failure
2. To reduce loss due to the production stoppage.
3. To keep all productive assets in good working conditions
4. Improve the quality of the product and to improve productivity
5. Helps to reduce the total maintenance cost of repair, preventive maintenance &inventory carrying a cost due to a spare part inventory.

The following are different types of maintenance



1. Breakdown Maintenance

This is also called corrective maintenance it occurs when work gets stopped because of a machine breakdown. In this sense, maintenance becomes repair work. Repairs are made after the equipment is out of order

For eg- A electric motor will not start if the conveyor belt is ripped or shaft has broken. In this case, the maintenance department checks into difficulty and makes the necessary repairs

2. Preventive Maintenance

In contrast to corrective maintenance, preventive maintenance is undertaken before the need arises and aims to minimize the possibility of un-anticipated production interruptions or a major breakdown, preventive maintenance consists of,

a) Proper design and installation of equipment.

b) periodic inspection of plant & equipment.

c) Repetitive servicing of types of machinery.

d)Adequate lubrication, cleaning, and painting of the building.

3. Predictive Maintenance

One of the new type of maintenance that may be anticipated to gain increasing attention. In this sensitive instrument are used to predicting trouble conditions can be measured on a continuous basis and this enables the maintenance of people to plan for an overhaul.

4. Routine Maintenance

This includes activities such as periodic inspection cleaning, lubrication& repair of production equipment. This can be classified into two types,

i) Running maintenance

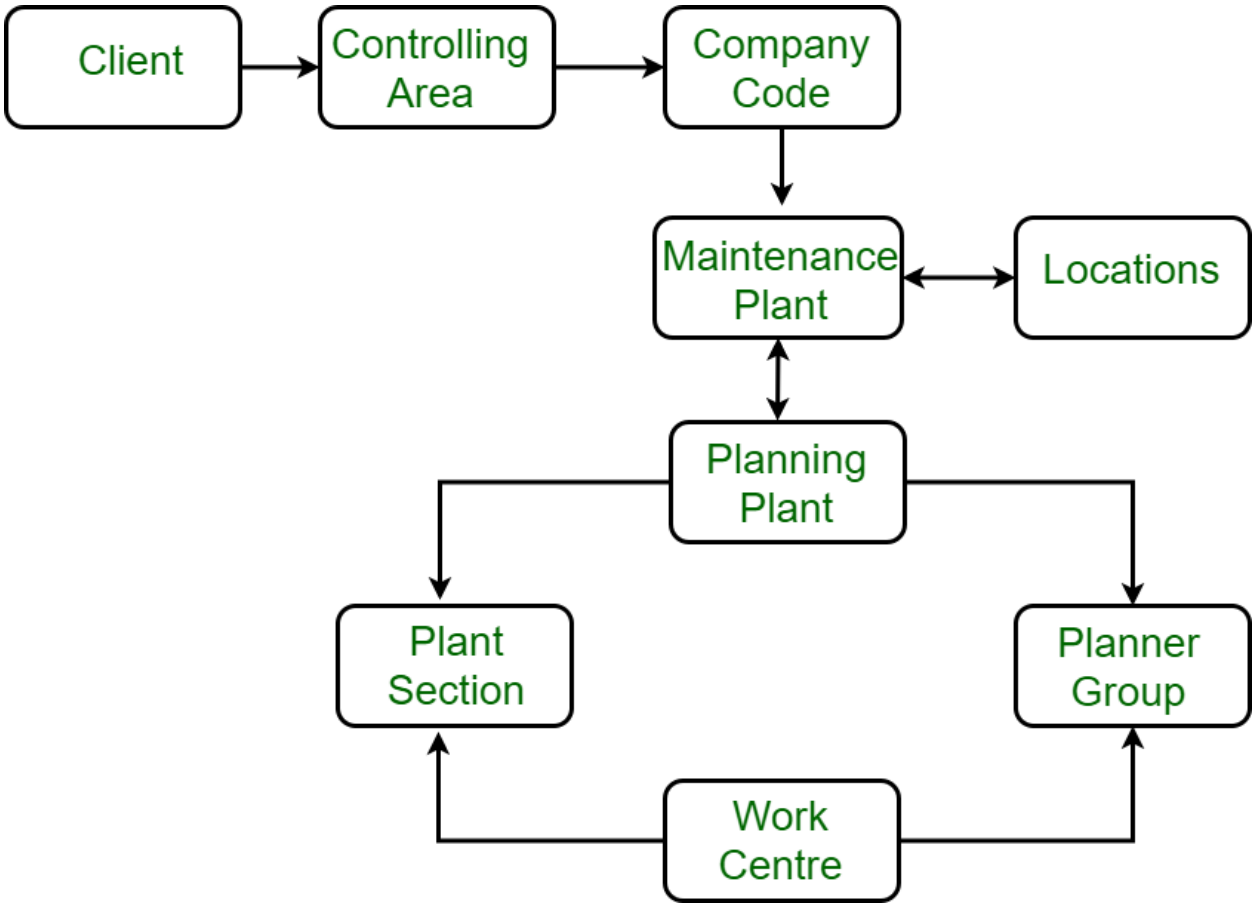
In this, the maintenance work is carried out while the equipment is in the operating conditions.

ii) Shutdown maintenance

Here the maintenance work is carried out when the machine or equipment is out of service.

5.Planned Maintenace

The breakdown of a machine does not occur in a planned manner but maintenance work can be planned well in advance. Planned maintenance is also known as scheduled maintenance it involves inspection of all plants & equipment, machinery, building according to a predetermined schedule.

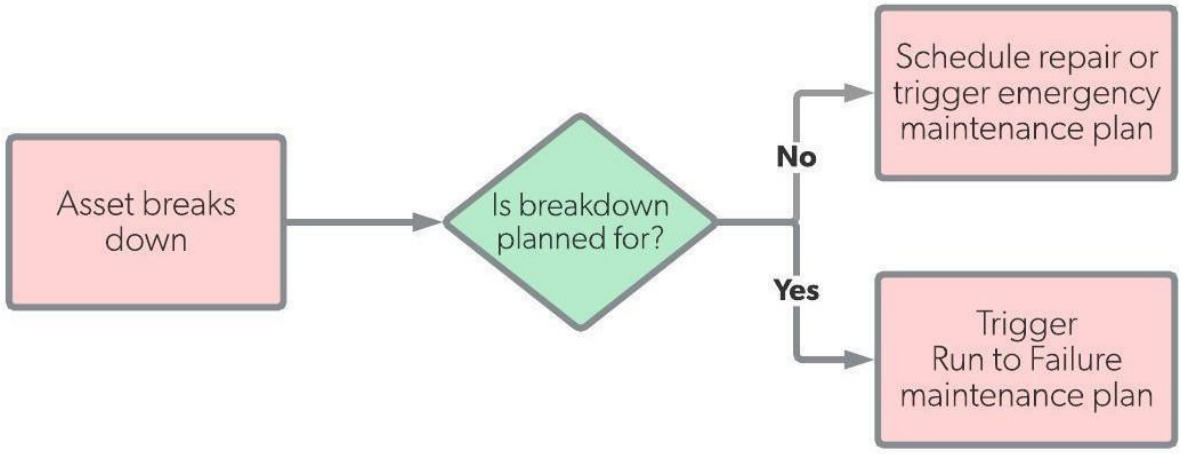


Break down maintenance.

Breakdown maintenance is maintenance performed on a piece of equipment that has broken down, faulted, or otherwise cannot be operated. The goal of breakdown-maintenance is to fix something that has malfunctioned. To the contrary, preventive maintenance is performed in order to keep something running

Sometimes it is performed because of an unplanned event. For example, if a critical piece of machinery breaks, the maintenance is performed because of the imminent need for that machine to operate again. However, breakdown-maintenance can be planned for in advance, which is what we might call “good” breakdown-maintenance.

Breakdown Maintenance Workflow



2 types of breakdown maintenance

There are two types:

Planned maintenance

Planned maintenance means that the organization is prepared for a breakdown and even expects it to happen. The equipment runs until it breaks, which initiates a run to failure (RTF) trigger. While RTF triggers can be unplanned, breakdown-maintenance plans use RTF as a way of lowering the cost of maintenance.
Unplanned breakdown maintenance, on the other hand, occurs when a piece of equipment fails or breaks unexpectedly—also called an unplanned downtime event. While some facilities may not utilize a planned maintenance plan, nearly every facility needs resources in place for unplanned maintenance. After all, every piece of equipment will break or fault at some point in its life.

5 examples of breakdown maintenance

It is unique in its applications because it cannot be used with certain industries or products, especially ones that involve health and safety. This means that it is most frequently used when parts are inexpensive or nonessential.

It is unique in its applications because it cannot be used with certain industries or products, especially ones that involve health and safety. This means that it is most frequently used when parts are inexpensive or nonessential.

Here are some examples in which breakdown maintenance is applicable:

- Equipment can’t be repaired at all (inaccessible, designed to not be repaired)
- Asset consists of inexpensive or easy-to-replace parts
- Non-critical pieces of equipment (like hand tools)
- Objects/equipment that are disposable or meant to be replaced at the end of their lifespan
- Short-life assets (batteries, high flow pump

Preventive maintenance

Preventive maintenance (PM) is a simple and popular maintenance strategy. Preventive maintenance can help extend asset life, increase productivity, and ultimately decrease maintenance spending.

You wouldn’t wait until your car’s engine fails to get the oil changed. So, you already know the value of preventive maintenance. Simply put, maintenance performed on a regular basis to reduce the likelihood of failure is preventive maintenance.

Also called planned or preventative maintenance, PM is conducted throughout an asset’s normal operating conditions. This helps avoid unexpected breakdowns and their pricey consequences, such as unplanned downtime.

Preventive maintenance is not based on a machine’s condition. Instead, it is based on recommendations from the asset manufacturer or on the average life cycle of an asset. Basing maintenance on a calendar means that some maintenance tasks

are done when they aren't strictly needed. It also means that teams can ensure that they have the budget, inventory, and scheduling to perform the tasks.

Types of Preventive Maintenance and Preventive Maintenance Examples

- **Calendar- or Time-based preventive maintenance**

  These types of preventive maintenance are completed at regular or scheduled intervals with help from preventive maintenance software. While all critical equipment should have PM, regularly checking equipment critical to production will help decrease breakdowns.

  A motor-pool may have required fleet maintenance every 4 months. This is a great example of preventive maintenance.

- **Usage-based preventive maintenance**

  Another type of preventive maintenance example is called usage-based, where a machine's statistics are used to determine corrective actions. Usage statistics can include cycle counts, runtime, miles/kilometers traveled, or hours, among others.

For example, one kind of PM could be where an industrial maintenance technician checks machine usage

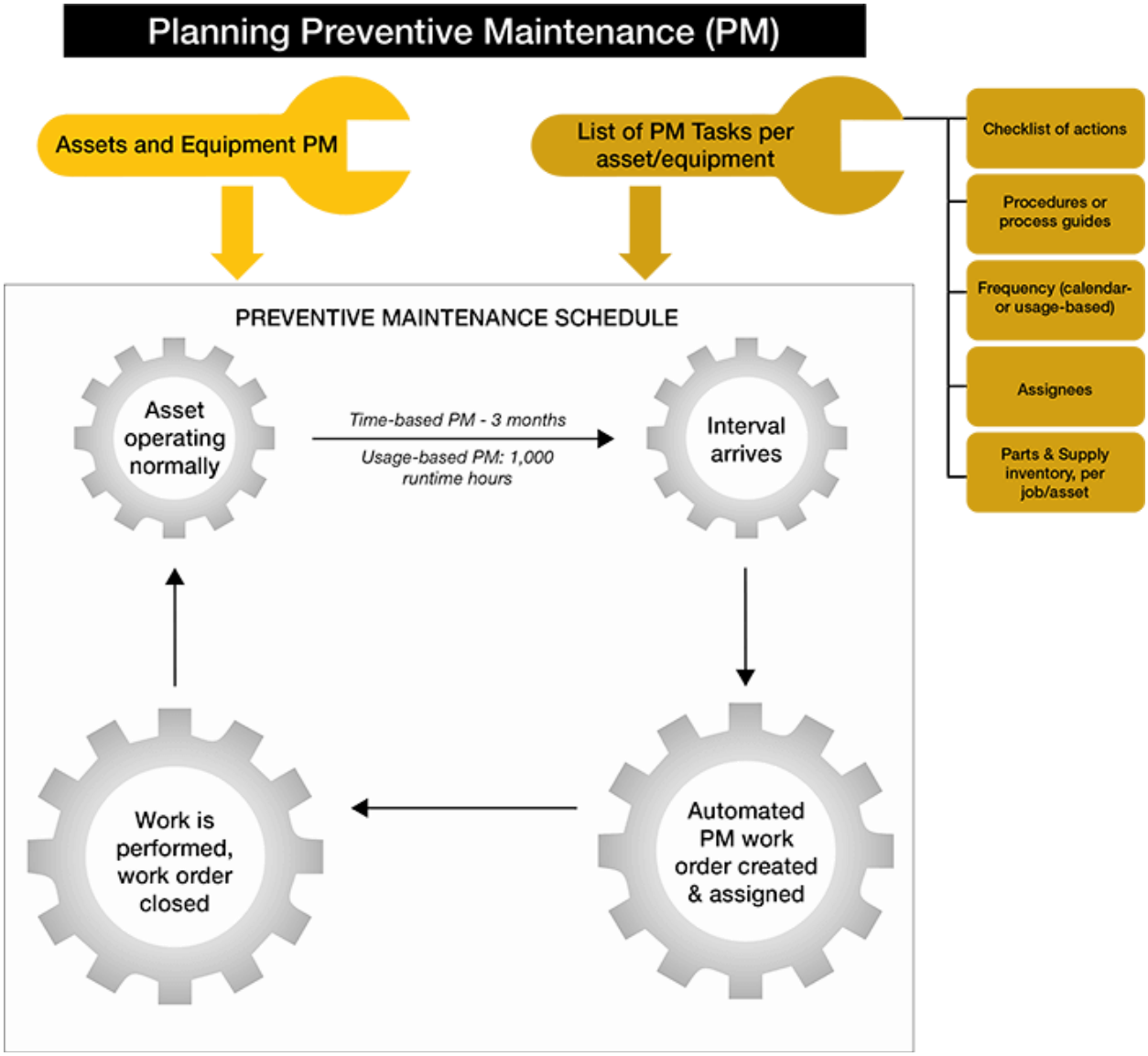
atistics. Then, depending on measurements and usage readings gathered in rounds, maintenance may be

scheduled.

- Preventive maintenance software, such as eMaint's CMMS, is a key tool to moving away from reactive maintenance and daily disruptions. With the right program, maintenance teams can reduce costs and increase uptime. Preventive maintenance software allows maintenance teams to set calendar- and/or meter- based PM tasks for every asset. Within the preventive maintenance task record, users add a detailed description that can include important information like task procedures and guidelines.

- Preventive maintenance software also reduces data entry by eliminating the need to create new tasks for every PM schedule. The preventive maintenance software simply associates a PM task with multiple PM schedules.

- It also lets users maintain consistency in their processes. Preventive maintenance software enables teams to create a sequence of procedures for every preventive maintenance



reventive Maintenance Benefits

The benefits of preventive maintenance programs are numerous.. An effective PM program helps organizations reduce costs while improving their processes and operations. Some of the specific, quantifiable preventive maintenance benefits include:

Pros of preventive maintenance

- Increased safety
- Longer equipment lifecycles
- Decreased unplanned downtime

Cons of preventive maintenance

- Requires time investment for planning
- Frequency of planned maintenance may need fine-tuning
- Learning curve for workflow chan
- Preventive maintenance is the simplest and most straightforward maintenance strategy to implement. It requires following manufacturer recommendations and establishing a standard maintenance schedule for critical assets and equipment. A PM program helps maintenance teams boost their planning and efficiency while reducing unplanned breakdowns and lost production. Switching to preventive maintenance can be done one step at a time, starting with the most critical assets.

Introduction to Operations Research and its applications.

"Operation research is a scientific method of providing executive departments with a quantities basis for decisions regarding the operations under their control".

2. “Operation research is concerned with scientifically deciding how best to design and operate man machine systems usually under conditions requiring the allocation of & care resources”. O.R. Society of America

“Operation research is an aid for the executive in making his decisions by providing him with the needed quantitative information based on the scientific method of analysis”.

6. “O.R in the most general sense can be characterized as the application of scientific methods techniques and tools to problems involving the operations of systems so as provide those in control of the operation with optimum solution to the problems”.

Applications of Operation Research:

O.R. is a problem solving and decision taking technique. It is considered a kit of scientific and programmable rules which provides the management a “quantitative basis” for decisions concerning the operation under its control.

3. “Operation research is a scientific approach to problem solving for executive management”. H.M. Warner

4. “O.R is the application of scientific method by interdisciplinary teams to problems involving the control of organized (men-

machines) systems so as to provide solution which best serve the purpose of the organisation as a whole”

(i) Optimal allocation of resources such as men materials machines, time and money to projects.

(ii) Determination and deployment of proper workforce.

(iii) Project scheduling, monitoring and control.

2. Production and Faciliti

(i) Factory size and location decision.

(ii) Estimation of number of facilities required.

(iii) Preparation of forecasts for the various inventory items and computation of economic order quantities and reorder levels.

(iv) Scheduling and sequencing of production runs by proper allocation of machines.

(v) Transportation loading and unloading,

(vi) Warehouse location decision.

(vii) Maintenance policy decisions.

3. Programmes Decisions:

(i) What, when and how to purchase to minimize procurement cost.

(ii) Bidding and replacement policie

4. Marketing:

) Advertising budget allocation.

(ii) Product introduction timing.

(iii) Selection of advertising media.

(iv) Selection of product mix

5. Organization Behaviour:

(i) Selection of personnel, determination of retirement age and skills.

(ii) Recruitment policies and assignment of jobs.

(iii) Recruitment of employees.

(iv) Scheduling of training programs.

6. Finance:

(i) Capital requirements, cash flow analys

(ii) Credit policies, credit risks etc.

(iii) Investment decision.

(iv) Profit plan for the company.

7. Research and Development:

(i) Product introduction planning.

(ii) Control of R&D projects.

(iii) Determination of areas for research and developme

Some of the commonly used techniques of operation research are as follows:

1. Linear programming.

2. Waiting line theory or queuing theory.

3. Inventory control models.

4. Replacement problems.

5. Network Analysis.

6. Sequencing.

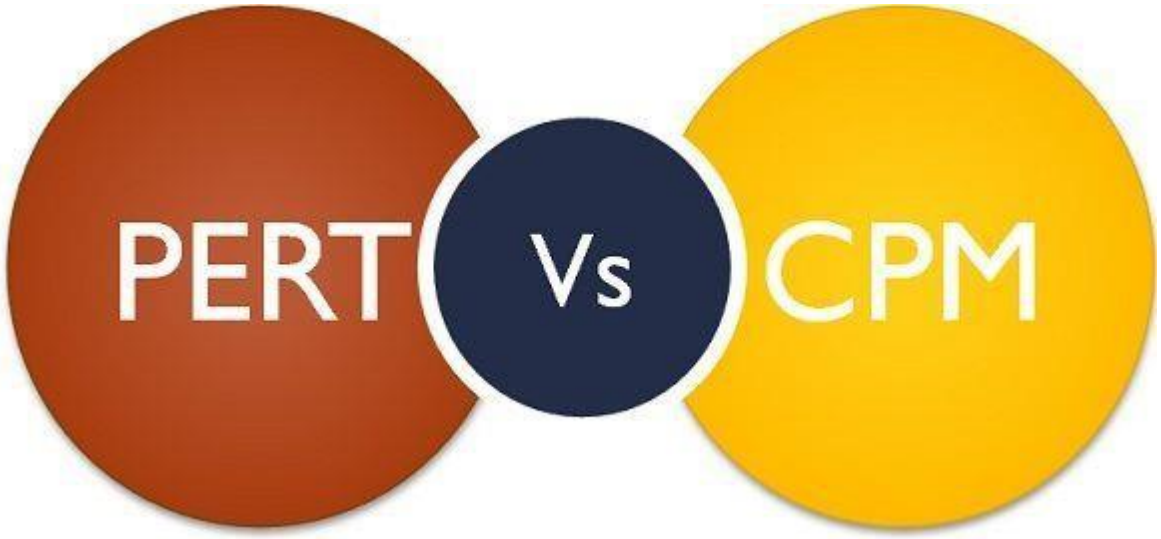
7. Dynamic programming.

8. Assignment problems.

9. Decision theory.

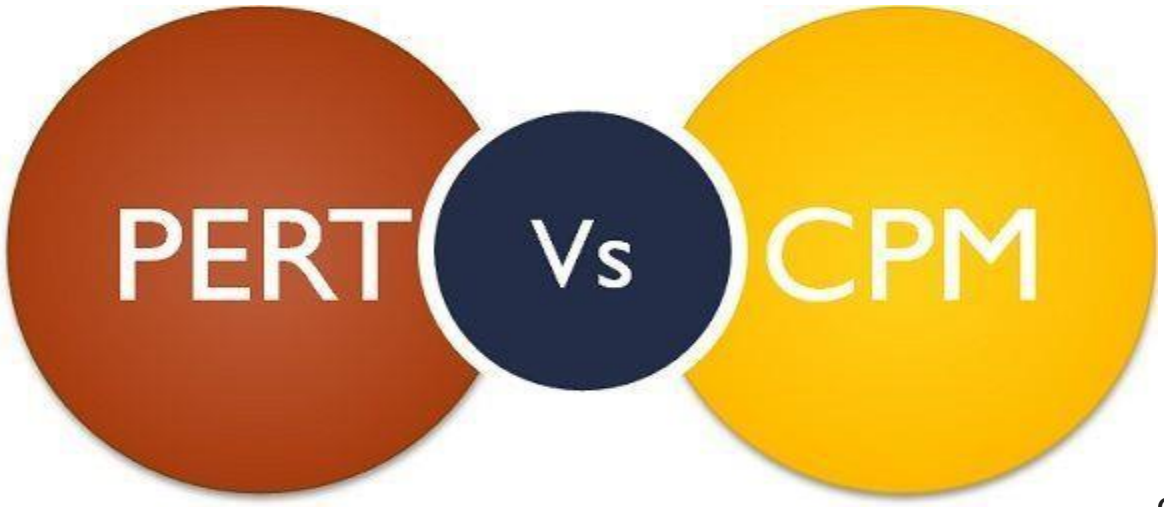
10. Integer Programming.
11. Transportation Problems.
12. Simulation.
13. Goal Programming.
14. Markov Analysis.
15. Game Theory.
16. Heuristic Models.
17. Routing Models.
18. Symbolic logic.

Difference Between PERT and CPM



Difference Between PERT and CPM
Last updated on January 8, 2019 by Surbhi S

Project management can be understood as a systematic way of planning, scheduling, executing, monitoring, controlling the different as



pects

of the project, so as to attain the goal made at the time of project formulation. PERT and CPM are the two network-based project management techniques, which exhibit the flow and sequence of the activities and events. **Program (Project) Management and ReviewTechnique (PERT)** is appropriate for the projects where the time needed to complete different activities are not known.

Definition of PERT

PERT is an acronym for Program (Project) Evaluation and Review Technique, in which planning, scheduling, organizing, coordinating and controlling uncertain activities take place. The technique studies and represents the tasks undertaken to complete a project, to identify the least time for completing a task and the minimum time required to complete the whole project. It was developed in the late 1950s. It is aimed to reduce the time and cost of the project

PERT uses time as a variable which represents the planned resource application along with performance specification. In this technique, first of all, the project is divided into activities and events. After that proper sequence is ascertained, and a network is constructed. After that time needed in each activity is calculated and the critical path (longest path connecting all the events) is determined.

Definition of CPM

Developed in the late 1950s, Critical Path Method or CPM is an algorithm used for planning, scheduling, coordination and control of activities in a project. Here, it is assumed that the activity duration is fixed and certain. CPM is used to compute the earliest and latest possible start time for each activity.

The process differentiates the critical and non-critical activities to reduce the time and avoid the queue generation in the process. The reason for the identification of critical activities is that, if any activity is delayed, it will cause the whole process to suffer. That is why it is named as Critical Path Method

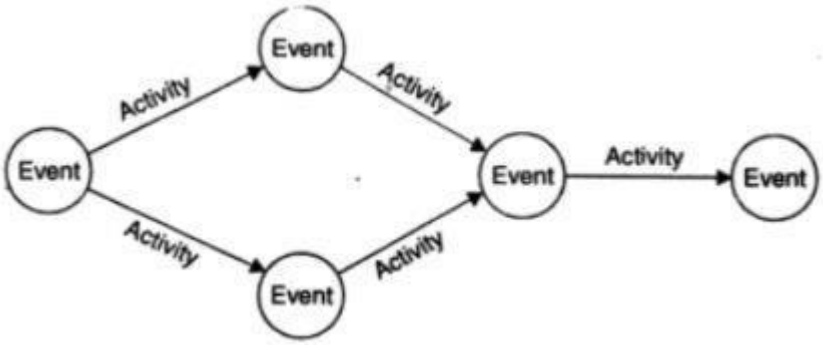
Key Differences Between PERT and CPM

The most important differences between PERT and CPM are provided below:

1. PERT is a project management technique, whereby planning, scheduling, organising, coordinating and controlling uncertain activities are done. CPM is a statistical technique of project management in which planning, scheduling, organising, coordination and control of well-defined activities take place.
2. PERT is a technique of planning and control of time. Unlike CPM, which is a method to control costs and time.
3. While PERT is evolved as a research and development project, CPM evolved as a construction project.
4. PERT is set according to events while CPM is aligned towards activities.
5. A deterministic model is used in CPM. Conversely, PERT uses a probabilistic model.
6. There are three times estimates in PERT, i.e. optimistic time (to), most likely time ™, pessimistic time (tp). On the other

hand, there is only one estimate in CPM.

7. PERT technique is best suited for a high precision time estimate, whereas CPM is appropriate for a reasonable time estimate.
8. PERT deals with unpredictable activities, but CPM deals with predictable activities.
9. PERT is used where the nature of the job is non-repetitive. In contrast to, CPM involves the job of repetitive nature.
10. There is a demarcation between critical and non-critical activities in CPM, which is not in the case of PERT.
11. PERT is best for research and development projects, but CPM is for non-research projects like construction projects.
12. Crashing is a compression technique applied to CPM, to shorten the project duration, along with the least additional cost. The crashing concept is not applicable to PERT.



INVENTORY CONTROL

Inventory is the accounting of items, component parts and raw materials that a company either uses in production or sells. As a business leader, you practice inventory management in order to ensure that you have enough stock on hand and to identify when there's a shortage.

The verb "inventory" refers to the act of counting or listing items. As an accounting term, inventory is a current asset and refers to all stock in the various production stages. By keeping stock, both retailers and manufacturers can continue to sell or build items.

Inventory is a major asset on the balance sheet for most companies, however, too much inventory can become a practical liability.

Key Takeaways

- Inventory, which describes any goods that are ready for purchase, directly affects an organization's financial health and prosperity.
- While there are many types of inventory, the four major ones are raw materials and components, work in progress, finished goods and maintenance, repair and operating supplies.
- While there are many ways to count and value your inventory, the importance lies in accurately tracking, analyzing and managing it. Insights gained from inventory evaluations are necessary for success as they help companies make smarter and more cost-efficient business decisions.

- **Inventory Explained**
- An organization’s inventory, which is often described as the step between manufacturing and order fulfillment, is central to all of its business operations as it often serves as a primary source of revenue generation. Regardless of the fact that inventory can be described and classified in numerous ways, it’s ultimately its management that directly affects an organization’s order fulfillment capabilities.
- For example, in keeping track of raw materials, safety stock, finished goods or even packing materials, businesses are collecting crucial data that influences their future purchasing and fulfillment operations. Understanding purchasing trends and the rates at which items sell determines how often companies need to restock inventory and which items are prioritized for re-purchase. Having this information on hand can improve customer relations, cash flow and profitability while also decreasing the amount of money lost to wasted inventory, stockouts and re-stocking delays.

13 Types of Inventory

1. **Raw Materials:**
   Raw materials are the materials a company uses to create and finish products. When the product is completed, the raw

materials are typically unrecognizable from their original form, such as oil used to create shampoo.

2. **Components:**
   Components are similar to raw materials in that they are the materials a company uses to create and finish products, except that they remain recognizable when the product is completed, such as a screw.

3. **Work In Progress (WIP):**
   WIP inventory refers to items in production and includes raw materials or components, labor, overhead and even packing materials.

4. **Finished Goods:**
   Finished goods are items that are ready to sell.

5. **Maintenance, Repair and Operations (MRO) Goods:**
   MRO is inventory — often in the form of supplies — that supports making a product or the maintenance of a business.

6. **Packing and Packaging Materials:**
   There are three types of packing materials. Primary packing protects the product and makes it usable. Secondary packing is the packaging of the finished good and can include labels or SKU information. Tertiary packing is bulk packaging for transport.

7. **Safety Stock and Anticipation Stock:**
   Safety stock is the extra inventory a company buys and stores to cover unexpected events. Safety stock has carrying costs, but it supports customer satisfaction. Similarly, anticipation stock comprises of raw materials or finished items that a business purchases based on sales and production trends. If a raw material's price is rising or peak sales time is approaching, a business may purchase safety stock.

8. **Decoupling Inventory:**
   Decoupling inventory is the term used for extra items or WIP kept at each production line station to prevent work stoppages. Whereas all companies may have safety stock,

decoupling inventory is useful if parts of the line work at different speeds and only applies to companies that manufacture goods.

9. **Cycle Inventory:**
   Companies order cycle inventory in lots to get the right amount of stock for the lowest storage cost. Learn more about cycle inventory formulas in the "Essential Guide to Inventory Planning."

10. **Service Inventory:**
    Service inventory is a management accounting concept that refers to how much service a business can provide in a given period. A hotel with 10 rooms, for example, has a service inventory of 70 one-night stays in a given week.

11. **Transit Inventory:**
    Also known as pipeline inventory, transit inventory is stock that's moving between the manufacturer, warehouses and distribution centers. Transit inventory may take weeks to move between facilities.

12. **Theoretical Inventory:**
    Also called book inventory, theoretical inventory is the least amount of stock a company needs to complete a process without waiting. Theoretical inventory is used mostly in production and the food industry. It's measured using the actual versus theoretical formula.

13. **Excess Inventory:**
    Also known as obsolete inventory, excess inventory is unsold or unused goods or raw materials that a company doesn't expect to use or sell, but must still pay to store

Real-world examples can make inventory models easier to understand. The following examples demonstrate how the different types of inventory work in retail and manufacturing businesses.

- **Raw Materials/Components:**
  A company that makes T-shirts has components that include fabric, thread, dyes and print designs.

- **Finished Goods:**
  A jewelry manufacturer makes charm necklaces. Staff attaches a necklace to a preprinted card and slips it into cellophane envelopes to create a finished good ready for sale. The cost of goods sold (COGS) of the finished good includes both its packaging and the labor exerted to make the item.

- **Work In Progress:**
  A cell phone consists of a case, a printed circuit board, and components. The process of assembling the pieces at a dedicated workstation is WIP.

- **MRO Goods:**
  Maintenance, repair and operating supplies for a condominium community include copy paper, folders, printer toner, gloves, glass cleaner and brooms for sweeping up the grounds.

- **Packing Materials:**
  At a seed company, the primary packing material is the sealed bag that contains, for example, flax seeds. Placing the flax seed bags into a box for transportation and storage is the secondary packing. Tertiary packing is the shrink wrap required to ship pallets of product cases.

- **Safety Stock:**
  A veterinarian in an isolated community stocks up on disinfectant and dog and cat treats in order to meet customer demand in case the highway floods during spring thaw and delays delivery trucks.

- **Anticipated/Smoothing Inventory:**
  An event planner buys discounted spools of ribbon and floral tablecloths in anticipation of the June wedding season.

- **Decoupled Inventory:**
  In a bakery, the decorators keep a store of sugar roses with which to adorn wedding cakes–so even when the ornament team's supply of frosting mix is late, the decorators can keep working. Because the flowers are part of the cake's design, if the baker ran out of them, they couldn't deliver a finished cake.1

- **Cycle Inventory:**
  As a restaurant uses its last 500 paper napkins, the new refill order arrives. The napkins fit easily in the dedicated storage space.

- **Service Inventory:**
  A café is open for 12 hours per day, with 10 tables at which diners spend an average of one hour eating a meal. Its service inventory, therefore, is 120 meals per day.

- **Theoretical Inventory Cost:**

A restaurant aims to spend 30% of its budget on food but discovers the actual spend is 34%. The “theoretical inventory” is the 4% of food that was lost or wasted.

- **Book Inventory:**
  The theoretical inventory of stock in the inventory record or system, which may differ from the actual inventory when you perform a count.

- **Transit Inventory:**
  An art store orders and pays for 40 tins of a popular pencil set. The tins are en route from the supplier and, therefore, in transit.

- **Excess Inventory:**
  A shampoo company produces 50,000 special shampoo bottles that are branded for the

summer Olympics, but it only sells 45,000 and the Olympics are over — no one wants to buy them, so they're forced to discount or discard them.

Functions or Characteristics of Inventory:

From the definition of inventory, it is clear that it is related to stock of raw materials, semi-finished and finished products/items maintained by the enterprise/business/organization.

The following points will explain the concept and functions of inventory:

(i) Inventories Serve as Cushions:

Against shocks due to demand/supply fluctuations, it separates different manufacturing operations from one another and makes them independent so that each operation can be performed economically.

For example, an organization has to deal with several consumers and vendors and due to their unpredictable behaviour there are always fluctuations in demand or supply of goods which disturbs the schedule of the enterprise.

Inventories absorb these fluctuations and help in maintaining undisturbed production i.e., we decouple the manufacturing activities from the consumer and vendor successfully by cushions of stocks.

Furthermore purchasing/order of raw material can be carried out independently of the finished products distribution and both of these activities can be made low cost operations say by ordering raw material and distributing products in one big lot than in small batches. Thus it leads to better utilization men and machines besides economy.

ii) Inventory, a Necessary Evil for Any Enterprise:

Inventories require valuable space, capital and other overheads for maintaining it. The invested capital remains idle till the stocks are not consumed. On the other hand, smooth working of the organization is not possible without inventory so it is a necessity. Further it has been observed that costs of not having inventory (stock out

conditions) are usually greater than costs of having them. Thus inventory is a necessary evil.

(iii) Inventory Provides Production Economies:
Purchase in desired quantities nullifies the effects of change in prices or supply. Stocks bring economy so purchase of various inputs due to discounts on bulk purchase.

(iv) Maintenance of Smooth and Efficient Production Flow: Maintains smooth and efficient production flow thus keeps a process continually operating.

(v) Creation of Motivational Effect in Decision Making:
Creates motivational effect in decision and policy making e.g. a person may be tempted to purchase more if inventories are displayed in bulk.

Explain and Derive economic order quantity for Basic model. (Solve numerical).

The economic order quantity (EOQ) refers to the ideal order quantity a company should purchase in order to minimize its inventory costs, such as holding costs, shortage costs, and order costs. EOQ is necessarily used in inventory management, which is the oversight of the ordering, storing, and use of a company's inventory. Inventory management is tasked with calculating the number of units a company should add to its inventory with each batch order to reduce the total costs of its inventory The EOQ model seeks to ensure that the right amount of inventory is

ordered per batch so a company does not have to make orders too frequently and there is not an excess of inventory sitting on hand. It assumes that there is a trade-off between inventory holding costs and inventory setup costs, and total inventory costs are minimized when both setup costs and holding costs are minimized

KEY TAKEAWAYS

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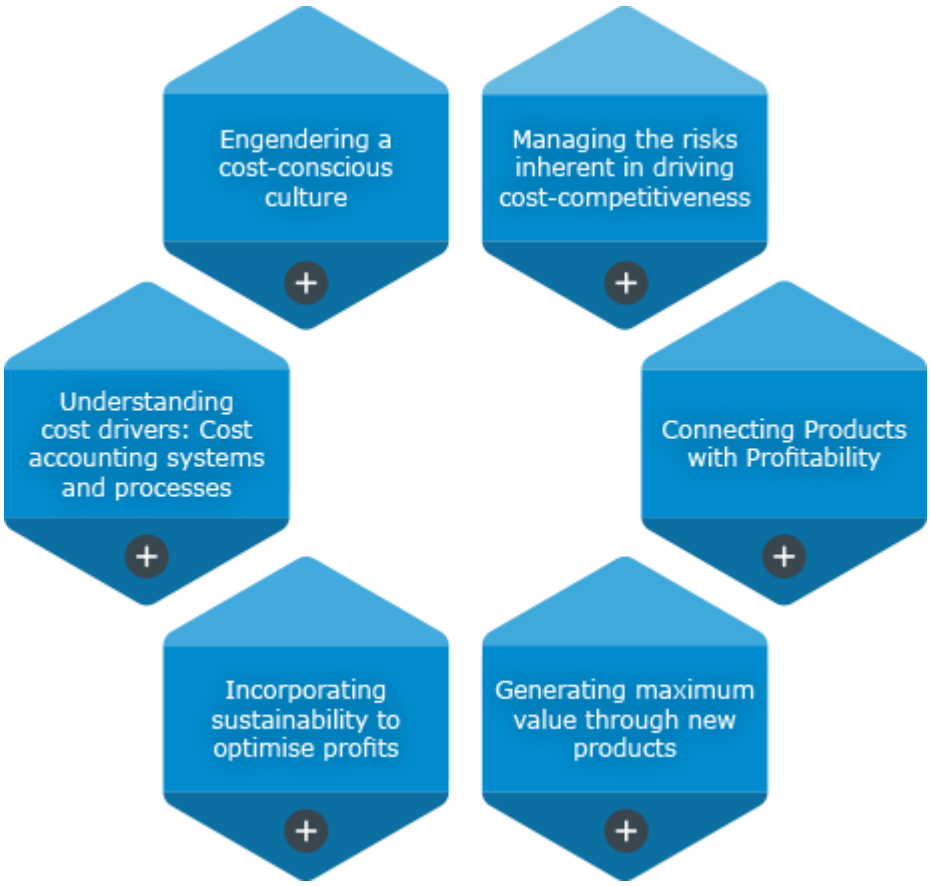
Define and Explain ABC analysis.



- ABC analysis is an inventory management technique that determines the value of inventory items based on their importance to the business. ABC ranks items on demand, cost and risk data, and inventory mangers group items into

classes based on those criteria. This helps business leaders understand which products or services are most critical to the financial success of their organization.

- The most important stock keeping units (SKUs), based on either sales volume or profitability, are “Class A” items, the next-most important are Class B and the least important are Class C. Some companies may choose a classification system that breaks products into more than just those three groups (A-F, for example).

- ABC analysis in cost accounting, or activity-based costing, is loosely related but different from ABC analysis for inventory management. Accountants use activity- based costing in manufacturing to assign indirect or overhead costs like utilities or salaries to products and service

ABC analysis is an approach for classifying inventory items based on the items' consumption values. Consumption value is the total value of an item consumed over a specified time period, for example a year. The approach is based on the Pareto principle to help manage what matters and is applied in this context:

- A items are goods where annual consumption value is the highest. Applying the Pareto principle (also referred to as the 80/20 rule where 80 percent of the output is determined by 20 percent of the input), they comprise a relatively small number of items but have a relatively high consumption value. So it's logical that analysis and control of this class is relatively intense, since there is the greatest potential to reduce costs or losses.
- B items are interclass items. Their consumption values are lower than A items but higher than C items. A key point of having this interclass group is to watch items close to A item and C item classes that would alter their stock management policies if they drift closer to class A or class C. Stock management is itself a cost. So there needs to be a balance between controls to protect the asset class and the value at risk

of loss, or the cost of analysis and the potential value returned by reducing class costs. So, the scope of this class and the inventory management policies are determined by the estimated cost-benefit of class cost reduction, and loss control systems and processes.

- C items have the lowest consumption value. This class has a relatively high proportion of the total number of lines but with relatively low consumption values. Logically, it's not usually cost-effective to deploy tight inventory controls, as the value at risk of significant loss is relatively low and the cost of analysis would typically yield relatively low returns.

Since businesses are not all the same, the thresholds that define the

Quality Control

Quality control (QC) is a process through which a business seeks to ensure that product quality is maintained or improved. Quality control requires the company to create an environment in which both management and employees strive for perfection. This is done by training personnel, creating benchmarks for product quality, and testing products to check for statistically significant variations.

A significant aspect of quality control is the establishment of well-defined controls. These controls help standardize both production and reactions to quality issues. Limiting room for

KEY TAKEAWAYS

- Quality control (QC) is a process through which a business seeks to ensure that product quality is maintained or improved.
- Quality control involves testing units and determining if they are within the specifications for the final product.
- The quality control used in a business is highly dependent on the product or industry, and several techniques exist for measuring quality.
- The food industry uses quality control methods to ensure customers do not get sick from their products.
- Quality control creates safe measures that can be implemented to make sure deficient or damaged products do not end up with customers
- Understanding Quality Control
- Quality control involves testing units and determining if they are within the specifications for the final product. The purpose of the testing is to determine any needs for corrective actions in the manufacturing process. Good quality control helps companies meet consumer demands for better products
- Quality testing involves each step of the manufacturing process. Employees often begin with the testing of raw materials, pull samples from along the manufacturing line, and test the finished product. Testing at the various stages of manufacturing helps identify where a production problem is occurring and the remedial steps it requires to prevent it in the future.
- The quality control used in a business is highly dependent on the product or industry. In food and drug manufacturing, quality control includes ensuring the product does not make a consumer sick, so the company performs chemical and

microbiological testing of samples from the production line. Because the appearance of prepared food affects consumer perception, the manufacturers may prepare the product according to its package directions for visual inspection.

- In automobile manufacturing, quality control focuses on how parts fit together and interact and ensure engines operate smoothly and efficiently. In electronics, testing might involve using meters that measure the flow of electricity.

Quality Control Methods

There are several methods of measuring the performance of quality control. A quality control chart is a graphic that depicts whether sampled products or processes are meeting their intended specifications—and, if not, the degree by which they vary from those specifications. When each chart analyzes a specific attribute of the product, it is called a univariate chart. When a chart measures variances in several product attributes, it is called a multivariate chart.

X-Bar Chart

Randomly selected products are tested for the given attribute or attributes the chart is tracking. A common form of a quality control chart is the X-Bar Chart, where the y-axis on the chart tracks the degree to which the variance of the tested attribute is acceptable. The x-axis tracks the samples tested. Analyzing the pattern of variance depicted by a quality control chart can help determine if defects are occurring randomly or systematically.

Taguchi Method

The Taguchi Method of quality control is another approach that emphasizes the roles of research and development, product design, and product development in reducing the occurrence of defects and failures in products. The Taguchi Method considers design to be more important than the manufacturing process in quality control and tries to eliminate variances in production before they can occur.

100% Inspection Method

This 100% inspection method is a quality control process that involves looking at and assessing all parts of a product. This type of quality control is done to rule out flaws in products. This method is often used to evaluate valuable metals and produce. When conducting the 100% inspection method calls for data about the manufacturing process and software to analyze inventory.

The challenge for using this method is that looking at every single item that makes up a product is expensive, and it could destabilize or render the product unusable. For example, if you use this method to examine organic strawberries, you would risk the delicate berries being bruised or mushed, rendering them unsellable to customers.

The Role of Quality Control Inspectors

Quality control inspectors protect the consumer from defective products and the company from damage to its reputation due to inferior manufacturing processes. If the testing process reveals issues with the product, the inspector can fix the problem himself, return the product for repairs, or tag the product for rejection. When issues arise, the inspector notifies supervisors and works with them to correct the problem.

The Benefits of Quality Control

Implementing quality control procedures ensures you are selling the best products to your customers. In addition, practicing quality control has a positive impact on employee conduct. Quality control can inspire employees to create high-quality goods leading to greater customer satisfaction.

Quality control protocols may help you lower your inspection costs and use your resources in a more cost-effective manner, too.

Example of Quality Control

In 1986, Motorola, Inc. created a quality control methodology called Six Sigma, which uses data-driven review to keep defects to a minimum. The process focused on cycle-time improvement to reduce defects in its manufacturing of products to no more than 3.4 occurrences per million units.[1]

This methodology was created to minimize mistakes while documenting all the manufacturing procedures.

Motorola introduced this method because, at the time, they faced fierce competition from similar companies overseas, primarily the success of the Japanese manufacturing market, and complain

ts by Motorola's customers were high.

After implementing this then-new form of quality control, the company's performance improved dramatically. By the end of the initial five-year period (1986-1991), Motorola had reached its target for improvement in every sector of business.[2]

The continued use of Six Sigma and Lean Six Sigma

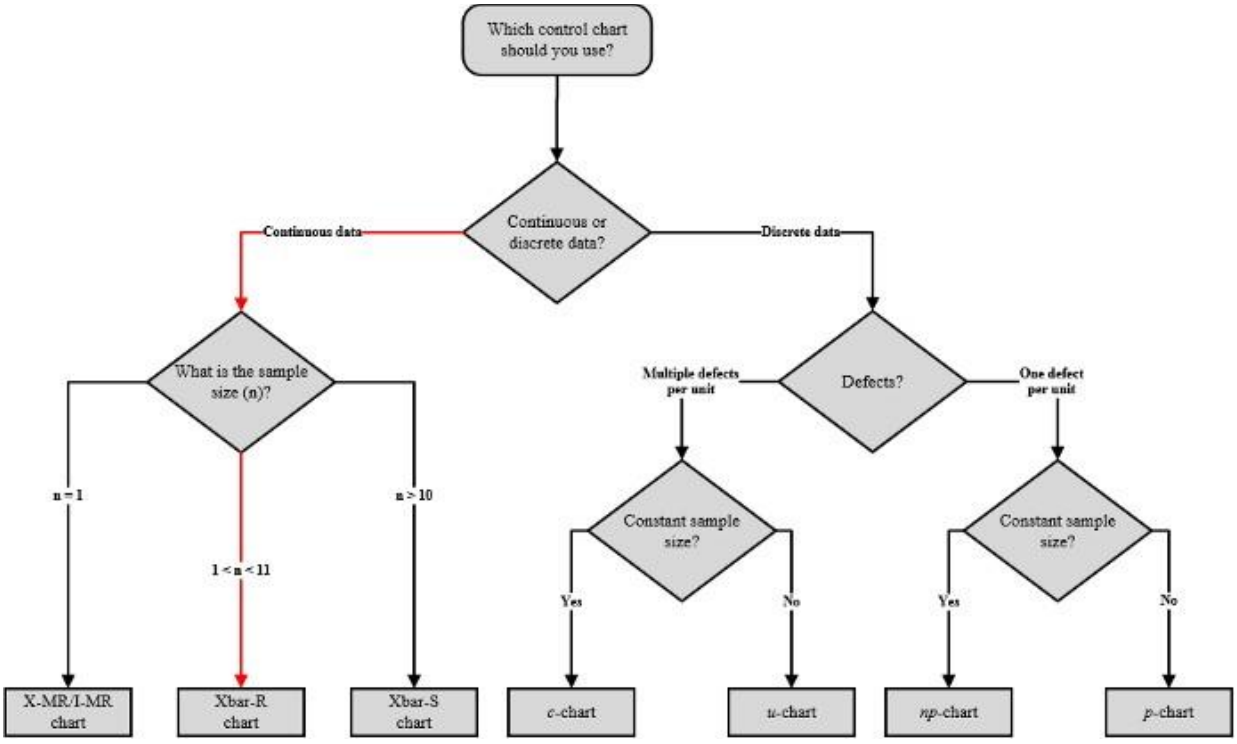
Describe planning of inspection

Quality Control Charts

Quality control charts represent a great tool for engineers to monitor if a process is under **statistical control**. They help visualize variation, find and correct problems when they occur, predict expected ranges of outcomes and analyze patterns of process variation from special or common causes. Quality control

charts are often used in Lean Six Sigma projects and DMAIC projects under the control phase and are considered as one of the seven basic quality tools for process improvement.

However, how can we determine the right quality control chart to use for monitoring a process? The following decision tree can be used to identify which is the correct quality control chart to use based on the given data:



x-bar chart

The x-bar and R-chart are quality control charts used to monitor the **mean and variation** of a process based on samples taken in a given time. The control limits on both chats are

used to monitor the mean and variation of the process going forward. If a point is out of the control limits, it indicates that the mean or variation of the process is out-of- control; assignable causes may be suspected at this point. On the x-bar chart, the y-axis shows the grand mean and the control limits while the x-axis shows the sample group. Let's take a look at the *R* code using the *qcc* package to generate a x-bar chart

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Process Capability Analysis

The process capability is a statistical measure of the inherent process variability of a given characteristic. In other words, the ability of a process to meet the given specifications (e.g. customer requirements, engineering tolerances or other specifications).

Once you have generated the x-bar and R-charts using *R*, you will only have to add the following lines of code specifying the lower control limit, upper control limit and the target. Once you have done so, add the last line of code below to generate the process capability summary chart

R-chart

In order to use the R-chart along with the x-bar chart, the sample size *n* must be greater than 1 and less than 11. For bigger samples, the s-chart must be used instead to monitor the standard

deviation of the sample rather than its range. On the R-chart, the y-axis shows the range grand mean and the control limits, while the x-axis shows the sample group. Once you have created a x-bar chart, you will only need to add the following lines of code to generate the R-chart.

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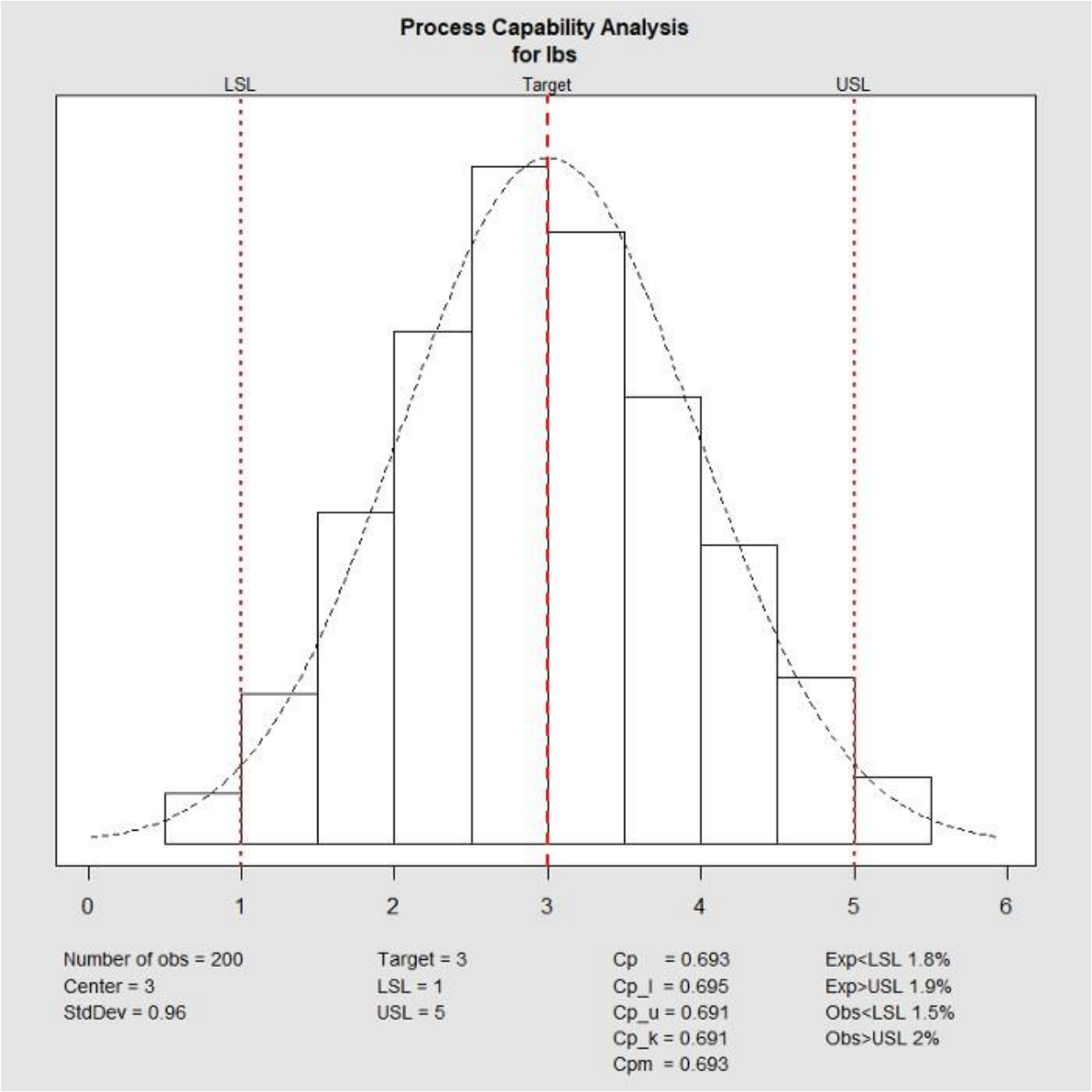
Process Capability Analysis
for lbs
LSL
Target
USL
0
1
2
3
4
5
6
Number of obs = 200
Center = 3
StdDev = 0.96
Target = 3
LSL = 1
USL = 5
Cp = 0.693
Cp_l = 0.695
Cp_u = 0.691
Cp_k = 0.691
Cpm = 0.693
Exp<LSL 1.8%
Exp>USL 1.9%
Obs<LSL 1.5%
Obs>USL 2%

Production Planning and Control

1. Materials Function:

Raw materials, finished parts and bought out components should be made available in required quantities and at required time to ensure the correct start and end for each operation resulting in uninterrupted production. The function includes the specification of materials (quality & quantity) delivery dates, variety reduction (standardisation) procurement and make or buy decisions.

2. Machines and Equipment:

This function is related with the detailed analysis of available production facilities, equipment down time, maintenance policy procedure and schedules. Concerned with economy of jigs and fixtures, equipment availability. Thus the duties include the analysis of facilities and making their availability with minimum down time because of breakdowns.

3. Methods:

This function is concerned with the analysis of alternatives and selection of the best method with due consideration to constraints imposed. Developing specifications for processes is an important aspect of PPC and determination of sequence of Operations.

4. Proces s Planning (Routing):

It is concerned with selection of path or route which the raw should follow to get transformed in to finished product.

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The duties include:

(a) Fixation of path of travel giving due consideration to layout.

(b) Breaking don of operations to define each operation in detail.

(c) Deciding the set up time and process time for each operation.

5. Estimating:

Once the overall method and sequence of operations is fixed and process sheet for each operation is available, then the operations times are estimated. This function is carried out using extensive analysis of operations along with methods and routing and standard times for operation are established using work measurement techniques.

6. Loading and Scheduling:

Scheduling is concerned with preparation of machine loads and fixation of Starting and completion dates for each of the operations. Machines have to be loaded according to their capability of performing the given task and according to their capacity.

Thus, the duties include:

(a) Loading the machines as per their capability and capacity

(b) Determining the start and completion times for each operation.

(c) To Co-ordinate with sales department regarding delivery schedules.

7. Dispatching:

This is the execution phase of planning. It is the process of setting production activities in motion through release of orders and instructions. It authorises the start of Production activities by releasing materials, components, tools, fixtures and instruction sheets to the operator.

The activities involved are

(a) To assign definite work to definite machines, work centres and men.

(b) To issue required materials from stores.

(c) To issue jigs, fixtures and make them available at correct point of use.

(d) Release necessary work orders, time tickets etc. to authorise timely start of operations.

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8. Expediting:

This is the control tool that keeps a close observation on the progress of the work. It is a logical step after dispatching which is called “follow-up” or “Progress”. It co- ordinates extensively to execute the production plan. Progressing function can be divided in to three parts, i.e. follow up of materials, follow up of work in process and follow up of assembly.

2. To devise action plans (remedies) for correct the errors.

3 To see that production rate is in line with schedule.

9. Inspection:

It is a measure control tool. Though the aspects of quality control are the separate function, this is of very much important to PPC both for the execution of the current plans and in scope for future

planning. This forms the basis for knowing the limitations with respects to methods, processes etc. which is very much useful for evaluation phase.

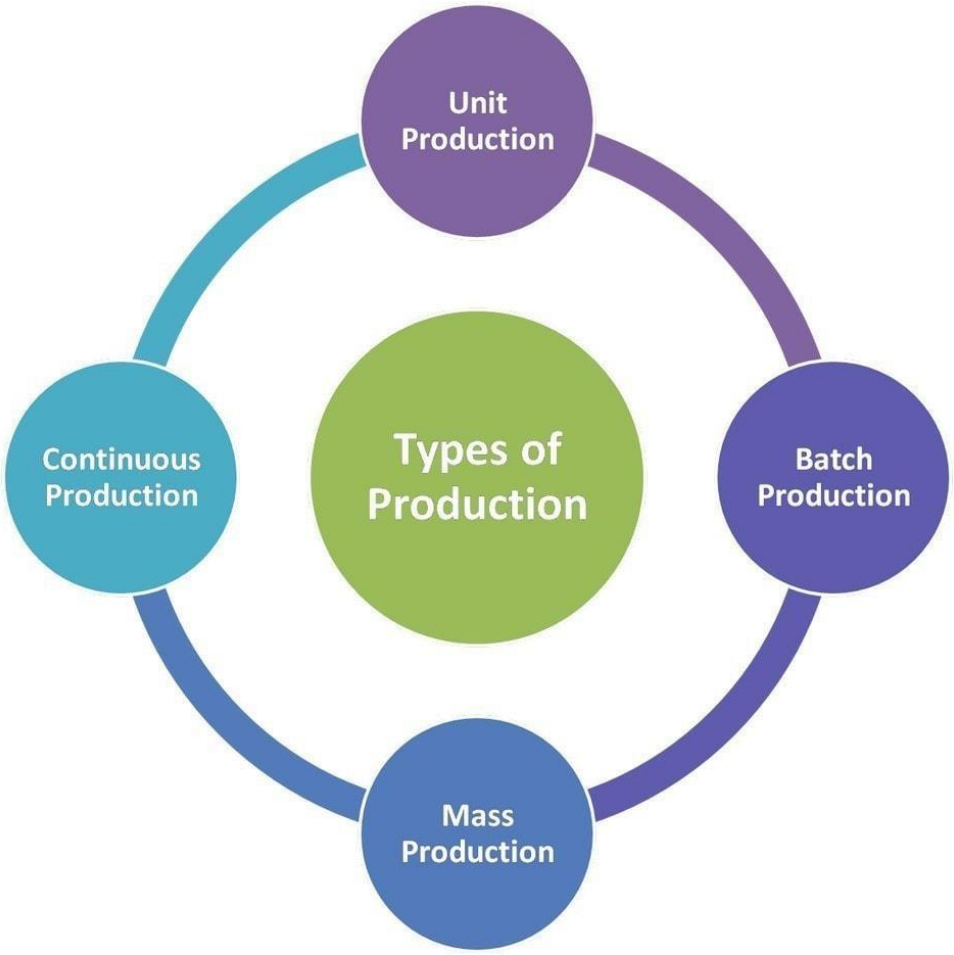
10. *Evaluation:*

This stage though neglected is a crucial to the improvement of productive efficiency. A thorough analysis of all the factors influencing the production planning and control helps to identify the weak spots and the corrective action with respect to preplanning and planning will be effected by a feed back. The success of this step depends on the communication, Data and information gathering and analysi

Production Management and it's Types!

The term 'production' has, however, been substituted with 'operating' at present, with the result that references to operations management rather than production management are appearing with increasing frequency. The words production and operations will be used synonymously.

E.L. Brech, "Production Management is the process of effective planning and regulating the operations of that section of an enterprise which is responsible for the actual transformation of materials into finished products." This definition limits production management into an activity of transforming inputs into outputs. It completely ignores the contribution of human factor in this activity.


Unit Production
Batch Production
Mass Production
Continuous Production
Types of Production

S. Buffa, “Production management deals with decision-making related to production process so that the resulting goods and services are produced in accordance with the quantitative specifications and demand schedule at the minimum cost.” The emphasis in this definition is on proper planning and control of production management. It looks from the above definitions that production planning and control are the main characteristics of production management. The organization will be able to achieve its objectives only if production planning and control are exercised properly.

Production management in short, deals with the following activities:

(i) Deciding and procuring various inputs such as material, labour, land, equipment, capital,

(ii) Determining the production process by designing the product. The inputs are transformed into goods and service

(iii) Supervision and control of transformation process for achieving good results.

Types of Production:

There can be many methods of production. A production manager will have to choose an appropriate method for his unit. The nature of product and the quantity to be produced should be

taken into account while selecting a particular method.

Production methods may be broadly classified as: Job Production, Batch Production and Flow Production

1. Job Production:

Job production involves the procedure of manufacturing a product according to a specific customer order. The products manufactured are generally non-standardized and heterogeneous in nature. It usually refers to

(i) The supply of components to a larger manufacturer;

(ii) The provision of one particular area of production to a large one; or

(iii] Making of special equipment or material.

The manufacture of single product is considered as one operation. It consists of bringing together of materials, parts, and components, in order to assemble and commission a single piece of equipment or product. Ship building, dam construction, bridge building, book printing, are some of the examples of job production

2. *Batch Production:*

Batch production pertains to repetitive production. It refers to the production of goods, the quantity of which is known in advance. Under batch system the work is divided into operations and one operation is done at a time. After completing the work on one operation it is passed on to the next operation and so on till the product is complete. Batch production may be explained with the help of an example. A company wants to manufacture 50 electric motors. The work will be divided into different operations. The first operation on all the motors will be completed in the first batch and then it will pass on to the next operation.

The second group of operators will complete the second operation before passing to the next and so on. Under job production the same operators will manufacture full machine and not one operation only. Batch production can fetch the benefits of repetitive production to a considerable degree, provided the batch

is of a sufficient quantity. Thus batch production may be defined as the manufacture of a product in small or large batches or lots by a series of operations, each operation being carried out on the whole batch before any subsequent operation is operated.

3. Mass or Flow Production:

Flow production, also called on-line mass production and continuous production, refers to the production on a large-scale to provide a continuous supply. Flow production is the manufacture of a product by a series of operations, each article going on to a succeeding operation as soon as possible. The manufacturing process is broken into separate operations. The product completed at one operation is automatically passed on to the next till it is complete. There is no time gap between

the work done at one process and the starting at the next. The flow of production is continuous and progressive.

The planning for any organization forms the backbone of production process. Planning of productions helps organizations to understand the situation at the Gemba better. Effective planning facilitates to book the entire capacity and also assists in committing accurate delivery time frames to the customers.

At its core, production planning represents the beating heart of any manufacturing process. Its purpose is to minimise production time and costs, efficiently organise the use of resources and maximise efficiency in the workplace.

Production planning incorporates a multiplicity of production elements, ranging from the everyday activities of staff to the ability to realise accurate delivery times for the customer. With an effective production planning operation at its nucleus, any form of manufacturing process has the capability to exploit its full potential.

6 Principles of Production Planning:

Customer Demand

Before you can plan to assign resources, you have to know how much to produce. Production planning focuses on the principle of meeting the targeted customer demand rate in the most efficient way possible while keeping open the capability to respond to variations in demand.

Materials

To fulfill your production target, the materials availability needed

to produce should be ensured. The most efficient production planning keeps the minimum materials as standard inventory. Planners should evaluate how much material the company needs, the lead times for orders, the delivery times for suppliers and the reliability of the supply.

Equipments

The production planner takes into account the capabilities of the equipment used to produce the output. Basic stability of equipment comprising of availability (A), performance (P) and quality (Q) parameters can be determined by Overall Equipment Effectiveness (OEE).

Manpower

Manpower planning requires accurately estimating the number of employees required to do the work. The capacity of the workforce has to match the capabilities of the equipment to plan for the highest efficiency.

Processes

Effective production planning makes sure that the processes used for the output continue to operate efficiently and safely. Often the normal operation of a process requires occasional testing and adjustments.

Controls

A final production planning principle puts in place controls that detect problems as soon as they occur. Verification of inventory, use of qualified suppliers and personnel, standardization where possible. When controls are in place, it enables to take possible corrective actions to minimize the effects and return production to the required levels.

After the analysis of each aspect at the client place, the modular kitchen manufacturer, the overall plant capacity was ascertained.

The next step was to assist the client with a proper production plan. The Faber Infinite team worked over best possible alternatives to provide the client with an user friendly, simple yet powerful module which will cater to all the basic requirements and also keeping room for the surprise elements.

The solution module was developed encompassing order receipt process, capacity booking, production to dispatchs and even installations at the client sites. Making it a comprehensive solution. It also consisted of provision to calculate the delivery performance by measuring OnTime InFull ratio (OTIF) and also highlighting the reasons for failure, if any.

The production planning solution was designed to cater all the issues related to production and hiccups in planning process. The overall benefit to the client can be summarized as captured below

. Overall production planning made simpler and easy to manage

2. Proper, logical and achievable delivery date can be promised to customer

3. No back logs in order

4. No delay in delivery leading to customer WOW!