PRODUCTION PLANNING AND PRODUCTION CONTROL

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[1]Production

- It is the foundation on which every organization is built. Production is an intentional act of producing something in an organized manner.
- It is a fabrication of a physical object through the use of man, material and equipment.
- The main objectives of production are:
  1. Optimum use of resources at optimum cost

2. Manufacture of desired quality and quantity of goods and services in the most efficient and economical way

Therefore efficient management of the production function is of utmost importance in order to achieve this objective.

[2]Production management

- It 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 product.
- 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 with minimum cost.
- Form the above definitions it is clear that production planning and its control are the main characteristics of production management.
- Functions of production management:
  1. Design and development of production process
  2. Production planning and control
  3. Implementation of the plan and related activities to produce the desired output
  4. Administration and coordination of the activities of various components and departments responsible for producing the necessary goods and services

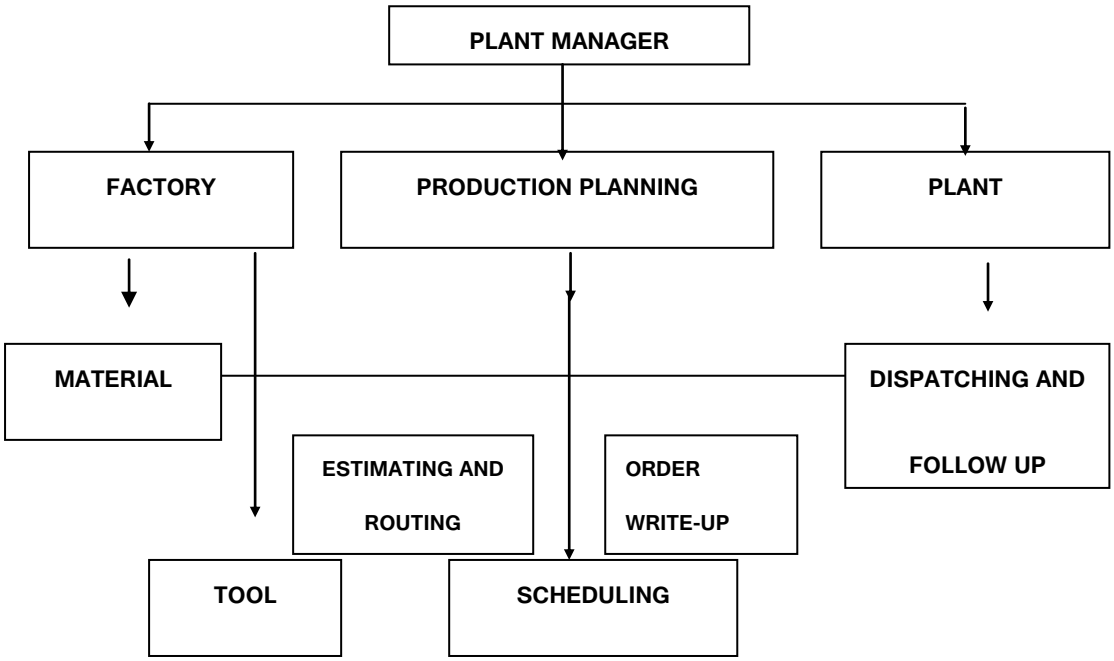
[3]Production planning

It is the function of management which decides about the resources the firm will require for its future manufacturing operations and allocating these resources to produce the desired output in required amount at lowest cost.

PP is necessary for directing and controlling the methods used for production and deals with the setting up of production facilities viz. building, machine, equipment etc. in available space.

It involves the predetermination of manufacturing requirements such as materials, money; order priority, production process etc. for efficient production of desired goods and services.

❖ A representative organization chart of a PPMC Department



❖ Objectives

1. Define production management, production function and its component
2. Explain the design of production system and manufacturing process
3. List out the factors influencing the choice of production process
4. To establish targets and checking these against performance
5. To establish routes and schedules for work that will ensure the optimum utilization of materials, workers, and machines
6. To coordinate labour, machine and equipment in the most effective and economic manner
7. To ensure smooth flow of material by eliminating all types of bottlenecks.
8. To utilize the underemployed resources
9. To provide the means for ensuring the operation of the plant in accordance with these plans

10. To manufacture the desired output of right quality and quantity at right time.

❖ **Importance**

- It reduces the cost of production by minimizing the wastage of material and economic utilization of resources.
- It leads to lower investment by efficient and balanced utilization of sources.
- It promotes employee morale by avoiding all sorts of bottlenecks.
- It enhances customer satisfaction and confidence.

❖ **Scope**

- To liaison with purchase department for efficient and effective procurement of inputs.
- To liaison with marketing dept, to determine the nature and magnitude of output.
- To plan the layout of operations indicating in detail the places/points in the system where various production activities/operations are to be performed.
- Establishment of time schedule for various stages/levels of production by setting up necessary standards.
- To ensure continuous inspection over the quality of goods manufactured.
- Instituting necessary controls to complete the work according to schedule.

❖ **Functions**

- Forecasting to predict customer demand on various products over a given horizon.
- Aggregate Planning to determine overall resource needed.
- Materials Requirement Planning to determine all required components and timing.
- Inventory Management to decide production or purchase quantities and timing.
- Scheduling to determine shop-floor schedule of various components.

❖ **Levels of Production Planning**

It can be done at three levels which are:

1) **FACTORY PLANNING**

Here the sequence of work tasks is planned in terms of building, machines and equipment required for manufacturing the desired good sand services.
The relationship of workplaces in terms of departments is also planned at this stage.
This stage also deals with plant location and layout.

2) **PROCESS PLANNING**

There are many operations involved in factory planning for transforming the inputs into some desired end product.
In process planning, these operations are located and the sequence of these operations in production process is determined.
Plans are also made for the layout of work centers in each process.

3) **OPERATION PLANNING**

It is concerned with planning the details of the methods required to perform each operation viz. selection of work centers, designing of tools required for various operations.
Then the sequences of work elements involved in each operation are planned.
Specification about each transfer, work centers, nature of tools required and time necessary for completion of each operation are prescribed.

❖ Steps of Production Planning

A. Routing

- "Routing means determination of path or route over which each piece is to travel in being transformed from raw material into finished products."-Kimball and Kimball
- Under this, the operations, their path and sequence are established. To perform these operations the proper class of machines and personnel required are also worked out.
- The main aim of routing is to determine the best and cheapest sequence of operations and to ensure that this sequence is strictly followed.
- IT INVOLVES FOLLOWING ACTIVITIES

1) An analysis of the article to determine what to make and what to buy
2) To determine the quality and type of material
3) Determining the manufacturing operations and their sequences
4) A determination of lot sizes
5) Determination of scrap factors
6) An analysis of cost of article
7) Organization of product control forms

B. **Scheduling**

- "The determination of time that is required to perform each operation and also the time required to perform entire series as routed is Scheduling." -Kimball and Kimball.
- It means working out of time that should be required to perform each operation and also the time necessary to perform the entire series as routed, making allowances for all factors concerned.
- It mainly concerns with amount of work to be done and the time when each element of work will start.

♦ **Features of Scheduling**

- Description of When and Where of each operation in a production process is to be executed.
- Establishment of timetable at which to begin and complete each event or operation comprising any procedure.

♦ **Objectives of scheduling**

The main objective of scheduling is to arrange the work of the production in such a way that:

- Items are delivered on due date
- Prevent unbalanced allocation of time among various department
- The production cost is minimum

♦ **Types of scheduling**

❖ **Operation schedule**

- It determines the total time require d to do a piece of work with a given machine or process. It indicates the time required to perform as well as other details of types of materials, machines, labour etc. required for each and every operation.
- It takes into account following factors.
    1) Physical plant facilities of the type required to process the material being scheduled.
    2) Personnel who possess the desired skills and experience to operate the equipment and perform the type of work involved.
    3) Necessary materials and purchased parts.

❖ **Master schedule**

- It is a list showing how many of each item to make in each period of time in future.
- The nature of master schedule depends on whether the manufacture is to order to stock.
- The development of master schedule for manufacture to stock begins with a sales forecast.

❖ **Sequential scheduling**

- It is difficult to define a sequence for multi product plant which passes through a number of departments.
- If sequence is varied in each department the number of sequences increases will increase and there is no known technique to identify the optimum sequence.
- If duration of each operation is known, then optimum sequence can be find by two rules:-
    1. For minimum time lost, each operation should be shorter than any predecessor in a program.
    2. For minimum individual lead time, each operation should be shorter than any predecessor in a programme.

♦ **Tools of scheduling /PP**

1. GANTT CHARTS
2. Network analysis/ technique(CPM & PERT)
3. WORK BREAKDOWN STRUCTURE
4. MOTION STUDY (METHOD STUDY)

5. TIME STUDY (WORK MEASUREMENT)
6. JUST IN TIME (JIT)

1) GANTT CHART

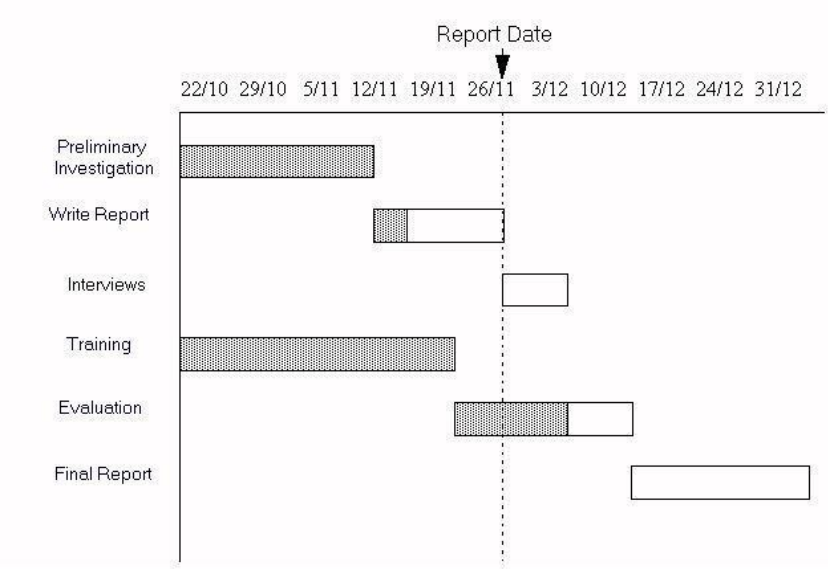


Figure 1: Gantt Chart

- A Gantt chart is a horizontal bar chart developed as a production control tool in 1917 by Henry L. Gantt, an American engineer and social scientist.
- Frequently used in project management, a Gantt chart provides a graphical illustration of a schedule that helps to plan, coordinate, and track specific tasks in a project
- The bar chart is a means of displaying simple activities or events Plotted against time
- A project is broken down into separate tasks. Estimates are made of how much time each requires as well as total time required to complete the entire project.
- A Gantt chart is constructed with a horizontal axis representing the total time span of the project, broken down into increments (for example, days, weeks, or months) and a vertical axis representing the tasks that make up the project

- Horizontal bars of varying lengths represent the sequences, timing, and time span for each task.
- As the project progresses, secondary bars, arrowheads, or darkened bars may be added to indicate completed tasks, or the portions of tasks that have been completed. A vertical line is used to represent the report date.
- Gantt charts may be simple versions created on graph paper or more complex automated versions created using project management applications such as Microsoft Project or Excel

Advantages

1. Simple to understand and easy to change
2. Simplest and least complex means of portraying progress or the lack of it
3. Can easily be expanded to identify specific elements that may be either behind or ahead of schedule
4. Automated Gantt charts store more information about tasks, such as the individuals assigned to specific tasks, and notes about the procedures.

Limitation

1. Bar charts do not show the interdependencies of the activities and hence do not represent a network of the activities. You cannot tell how one task falling behind schedule affects other tasks.
2. The relationship between activities is crucial for controlling program costs. Without this relationship bar charts have little predictive value.
3. Do not clearly indicate DETAILS REGARDING THE PROGRESS of activities.

2) Network analysis/ technique

- Deficiency of GANNT technique can be eliminated to a large extent by showing the interdependence of various activities by means of connecting arrows called network technique
- It is the general name given to certain specific techniques which can be used for the planning, management and control of projects.
- CPM was developed by Du pont and the emphasis was on the trade off between the cost of the project and its overall completion time.

- PERT was developed by the US Navy for the planning and control of the Polaris missile program and the emphasis was on completing the program in the shortest possible times
- In CPM ACTIVITIES are shown as network of precedence relationships using activity- on- node network construction
- It is used for the jobs of repetitive in nature where the activity time estimates can be predicted with considerable certainty due to the existence of past experience.
- In PERT activities are shown as network of precedence of relationships using activity-on- arrow network construction.
- It is used for non repetitive jobs (R&D), where the time and cost estimates tend to be quite uncertain.

Terminology of network analysis

Activity: a time consuming effort that is required to perform a part of the work.

It is bound to two events: Predecessors event and Successors event.

Arrows ⟶

An arrow leads form tail to head directionally indicate activity

Event: a point in the time where one or more activities start and /or finish.

Nodes ● a node is represented by a circle indicate event

Time Estimate (Expected Time): completion time is assumed to be uncertain and unknown therefore project completion time is estimated. Three time estimates are made for each activity-

Optimistic Time (a),

Pessimistic Time (b),

Normal Time or Most Likely Time (m)

Expected Time (Te): $\frac{a + 4m + b}{6}$

Network diagram: It is pictorial presentation of events and Interconnecting activities, which define series or parallel sequence of activities.

Critical Path: It is longest path in a network (it is the sequence of activities that requires the maximum time for completion.)

It is denoted by darker or double lines to distinguish

Earliest Start Time (EST): This is the earliest time when an activity can start up.

Earliest Finish Time (EFT): This is the earliest time when an activity can finish.

EFT = EST + Time taken by the activity.

Latest Start Time (LST): It is the latest time at which an activity should be started if the project is to be completed.

Latest Finish Time (LFT): It is the latest time at which an activity should be completed, if the project is to be completed at a fixed time.

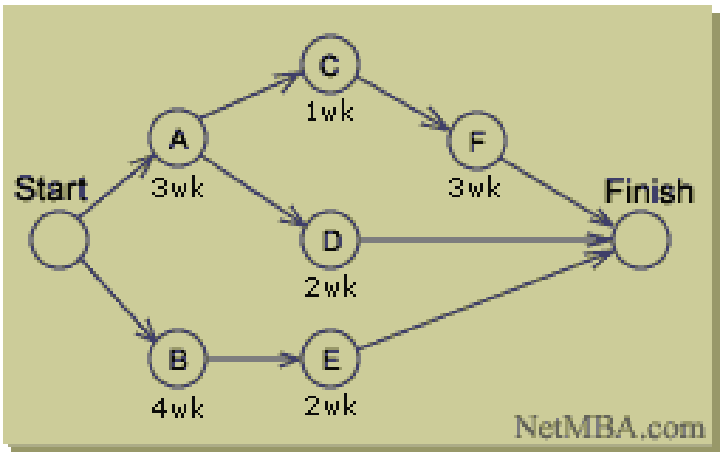
LST = LFT – Te

Slack Time: Slack time can be defined as the amount of time a task can be delayed without causing another task to be delayed or impacting the completion date of your project.

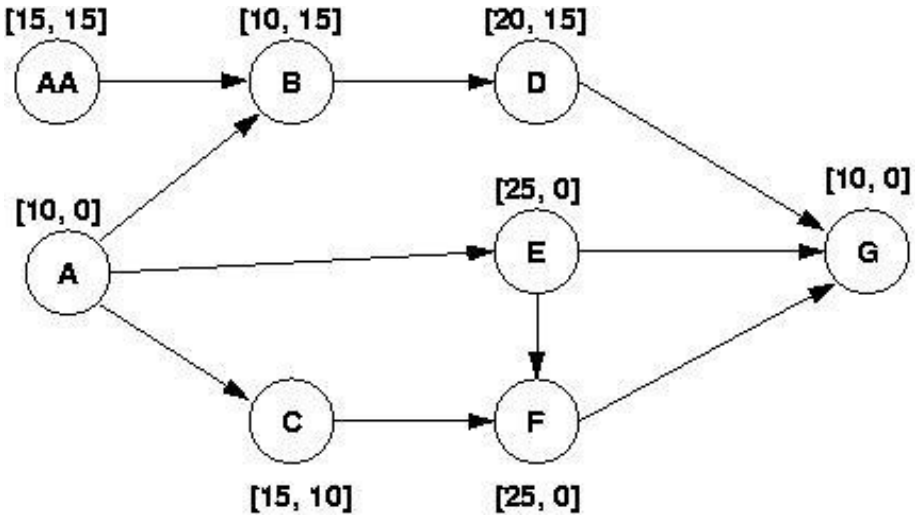
Slack may be positive or negative. Positive slack represents idle time. Negative slack occurs when project requires more resources.

Float: Delay in completion of an event is called float.

The following is an example of CPM network diagram



The following figure shows an example PERT chart:



The first number above each node represents the time to complete that task and the second number represents the slack time for that task. The critical path is A-E-F-G and the minimum completion time is 70 (10 + 25 + 25 + 10).

Steps in the PERT process

1. Identify the specific activities and milestones
2. Determine the proper sequence of the activities
3. Construct a network diagram
4. Estimate the time required for each activity
5. Determine the critical path
6. Update the PERT chart as the project progresses.

Benefits of PERT

- EXPECTED project completion time
- Probability of completion before a specified date
- The critical path activities that directly impact the completion time
- The activities have slack time and that can lend resources to critical path activities
- Activity start and end dates.

Limitations

- The activity time estimates are somewhat subjective and depend on judgment. In cases if the person or group performing the activity estimates the time there may be bias in the estimate.

3) WORK BREAKDOWN STRUCTURE

- A complex project is made manageable first breaking it down into individual components in a hierarchical structure, known as the work breakdown structure, or the WBS.
- Generally, WBS uses a tree diagram/structure diagram to show the resolution of overall requirements into increasing levels of detail.
- WBS allows a team to accomplish its general requirements by partitioning a large task into smaller components and focusing on work that can be more easily accomplished

Importance of WBS

It is the single most important element because it provides a common framework from which:

1. The total program can be described as summation of subdivided elements.
2. Planning can be performed
3. Costs and budgets can be established
4. Time, performance and cost can be tracked
5. Objectives can be linked to company resources in logical manner
6. Schedules and status reporting procedures can be established
7. Network construction and control planning can be initiated
8. The responsibility assignments for each element can be established

When to use it:

- In the quality planning process, WBS begins with a generalized goal and then identifies progressively finer levels of actions needed to accomplish the goal.
- In the quality improvement process, the tool is especially useful for creating an implementation plan to remedy identified process problems.

- For WBS to accurately reflect the project, however, it is essential that the team using it have detailed understanding of the tasks required.

How to use it:-

1. **Identify the primary requirement or objective:-**

- This should be a clear item, based on customer requirements, to which the entire team agrees. Write this requirement at the top of the chart.

2. **Subdivide the requirement statement into major secondary categories:-**

- These branches should represent requirements, products, or activities that directly lead to the primary objective or that are directly required to fulfill the overall requirement.
- The team should continually ask, "What is required to meet this condition?", "What happens next?", and "What needs to be addressed?" Write the secondary categories below the primary requirement statement.

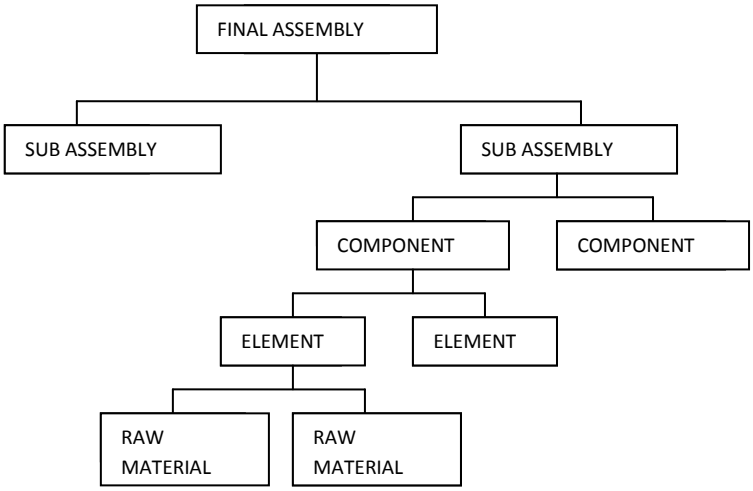
3. **Break each major heading into greater detail:-**

- As you move from top to bottom in the WBS, products and activities should become more and more specific. Stop the breakdown when each task is tiny enough to be easily completed and evaluated for accuracy.

4. **Review the WBS for logic and completeness:-**

- Make sure that each subheading and path has a direct cause-and-effect relationship with the one before. Examine the paths to ensure that no obvious products or actions have been left out.
- Also ensure that the development of listed products or completion of listed actions will indeed lead to the anticipated results.

SCHEMATIC REPRESENTATION



4) MOTION STUDY (METHOD STUDY)

Motion study is a technique, which analyzes each operation, of a given piece of work, very closely in order to eliminate unnecessary operations and to approach the quickest and earliest methods of performing each necessary operation.

PROCEDURE OF MOTION STUDY

Motion Study can be performed in the following steps:

Step 1: Break up the operation and make a detailed list of all steps in the present operation.

Step 2: Question each detail of job:
Purpose?
Place?
Sequence?
Person?
Means?

Step 3: After considering the above questions, a new and better method is developed.

Step 4: Installing the new method.

Step 5: Maintaining new method.

5) TIME STUDY (WORK MEASUREMENT)

Time study is defined as 'the art of observing and recording the time required to do each detailed element of an industrial operation.'

Time study is done on a printed time-study record. After noting all these readings, average time is calculated.

Standard time = Average time $\times$ Rating Factor / other allowances.

Where,

Standard time: It is the time, which is taken by normal worker for a specific task.

Rating Factor: This is expressed as percentage of the efficiency of representative operator (generally taken as 110% - 120%).

Allowances:

Interference allowances: When worker is attending more than one machine.

Process allowances: This is an allowance provided to compensate the enforced idleness during a process. (It includes: no work, power failure, faulty material, faulty tools and equipments).

Contingency allowances: Delays, which cannot be measured correctly.

Special allowances: It includes: start up, cleaning, shut down, change-over time, equipment change, etc.

6) Just-In-Time Concept:

- Just In Time (JIT) is a production and inventory control system in which materials are purchased and units are produced only as needed to meet actual customer demand.
- Its objective is to eliminate product inventories from the supply chain and inventories are reduced to the minimum and in some cases are zero.
- As much a managerial philosophy as an inventory system, JIT encompasses all activities required to make a final product from design engineering onwards to the last manufacturing operation.

- JIT systems are fundamental to time based competition and rely on waste reduction, process simplification, setup time and batch size reduction, parallel (instead of sequential) processing.
- It was developed and perfected by Taiichi Ohno of Toyota Corporation during 1960s and 70s to meet fast changing consumer demands with minimum delays
- It has the most profound effects, however, on the operations of manufacturing companies which maintain three class of inventories-raw material, Work in process, and finished goods. Traditionally, manufacturing companies have maintained large amounts of all three types of inventories to act as buffers so that operations can proceed smoothly even if there are unanticipated disruptions.
- While these inventories provide buffers against unforeseen events, they have a cost.
- In addition to the money tied up in the inventories, presence of inventories encourages inefficient and sloppy work, results in too many defects, and dramatically increase the amount of time required to complete a product.

Advantages of Just in Time Manufacturing System:

1. Funds that were tied up in inventories can be used elsewhere.
2. Areas previously used, to store inventories can be used for other more productive uses.
3. Throughput time is reduced, resulting in greater potential output and quicker response to customers.
4. Defect rates are reduced, resulting in less waste and greater customer satisfaction.
5. The flows of goods from warehouse to shelves are improved.
6. Employees who possess multiple skills are utilized more efficiently.
7. Better consistency of scheduling and consistency of employee work hours.
8. Increased emphasis on supplier relationships.
9. Supplies continue around the clock keeping workers productive and businesses focused on turnover

Disadvantages of Just in Time Manufacturing System:

1. There can arise unexpected delivery hang-ups that cause a loss in sales

C. Loading

- It is the study of the relationship between load and capacity at the places where work is done.
- Loading and scheduling are designed to assist in the efficient and systematic planning of work.
- It provides complete and correct information about the number of machines available and their operating characteristics, such as, speed, capability etc.
- This information can be used to calculate the difference between workload and actual capacity and then to determine whether customers order can be completed on due date or not.

[4]PRODUCTION CONTROL

- It is one of the important functions of the enterprise. It ensures the desired output of specified quantity at the prescribed time in the most economical way to meet an approved sales program.

- Production provides the foundation on which most of the other industrial controls are based.
- **Production control is some scientific procedure to regulate an orderly flow of the material and co ordinate various production operations to accomplish the objective of producing desired item in right quantity of desired quality, at the required time by the best and cheapest method i.e. to attain highest efficiency in production.**

Techniques of production control

1) Programming

- Production programming regulates the supply of the finished product in desired amount at due date in accordance with the production plan.

- In production programming three decisions are taken i.e.
    a) Nature of the product to be manufactured.
    b) The total quantities to be produced
    c) When to produce

- The main objectives of programming are
    a) Reliable delivery to the customers
    b) Even loading of plant
    c) Even loading of labor in total man hours per week
    d) Efficient use of capital

2) <u>Ordering</u>

- It breaks down the requirements for products to be completed at specific times into orders for materials and processed parts and attempts to do so in such a way that they are available when needed.

- The information such as requirement, quantity and order quantity is required for each other.

3) <u>Dispatching</u>

- It is routine of setting production activities in motion through the release of the order and instruction in accordance with the previously planned times and sequences embodied in rote sheets and schedule charts

- The decision of assigning various jobs to different machines is known as dispatching.

- The functions of dispatching are
    a) To check the immediate availability of materials.
    b) To ensure that all production and inspection aids are available for use
    c) To obtain the appropriate drawing specification or material list.

4) <u>Progressing or follow up</u>

- Follow up or expediting is checking production activities systematically so that production may be carried out according to plan.

- It is the measurement of output against plan, analysis of performance for shortfalls and following up the line management to apply corrective action for excessive shortfall.
- Follow up is the most important step of production control.
- It can be done at three stages, for materials, work in progress and stage during assembly and execution.

- Progressing is the function by which one can give an early warning when actual production deviates from planned production and thus makes it possible to take corrective action.

5) Inventory control

- It ensures protection against fluctuations in demand, better use of men, machines and materials and protection against fluctuation in output.
- The main of inventory control is to observe the stock investments and to ensure that it lies within limits which the organization can afford.
- Production control tries to serve the interests of both producer and consumer. Its operation ensures the quality and quantity of the product. Consumer is able to get the desired product
- Similarly production control tries to minimize the chances of the product being rejected by the consumer and avoid or minimize waste and scrap. In this way it saves the producer from losses.

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Questions

1) **Discuss JIT –Just in time for PPMC. (July 05)**
2) **Define PPMC, organization, objective & functioning of it, what is scheduling, tool for it? (July 05, 07&uni 05, 06, 07)**
3) **Relationship between PP & MC. (July 05, 07 uni 05, 07)**
4) **How can you contribute to production planning and material control as a person of Pharmatechnology to run your industry economically viable? (July 04, 08)**
5) **What is inventory control? Discuss the role of PPMC Manager in effective running of Pharma Unit. (uni 04)**