Module-1

CONCEPTS OF PPC

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1. **Manufacturing systems- components and types,**
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3. **Functions of PPC**
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6. **Manufacturing methods-** projects & jobbing products, batch, mass / flow production, continuous / process production.
7. **Organization of PPC-** status of PPC department, internal structure, degree of centralization, PPC as an integrated approach
8. **Prerequisites of PPC** – data pertaining to design, equipment, raw materials, tooling, performance standards, labour and operating systems

Introduction

Production…??

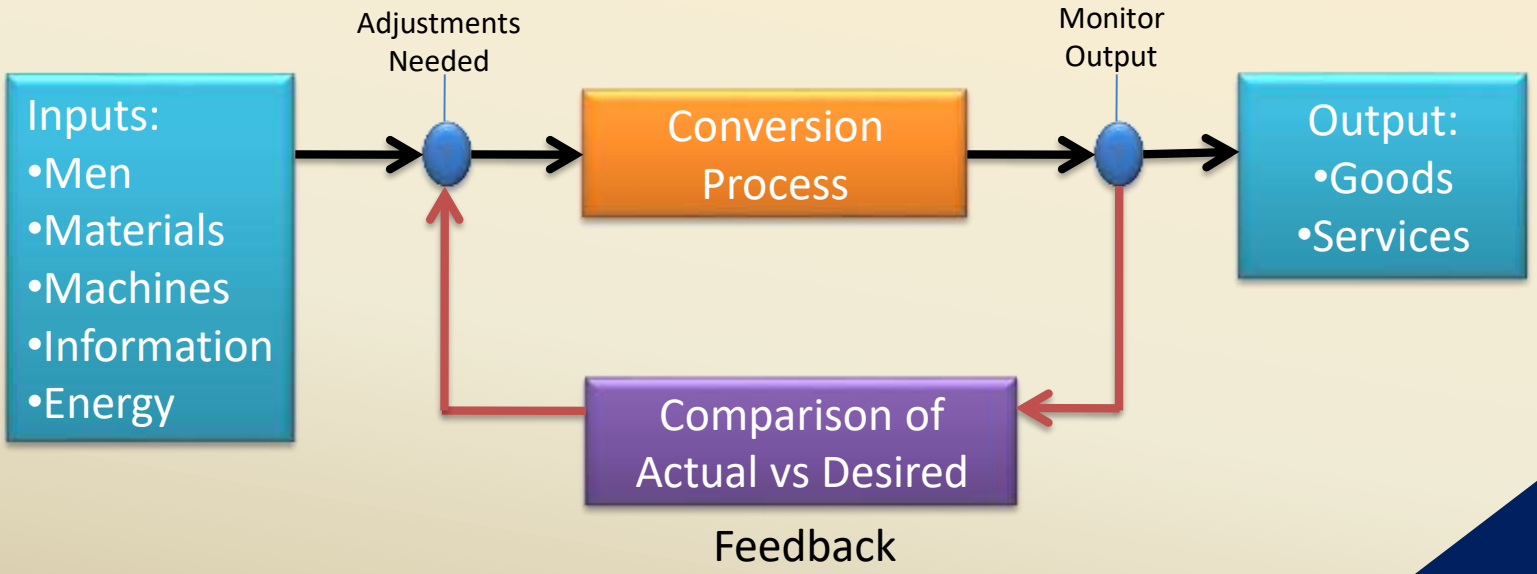
Manufacturing..??

Introduction

- **Production** converts inputs or intermediates to a final output or services, which may or may not use machinery.
- **Manufacturing** is the process of transforming raw materials into finished goods, by deploying various sequential processes, labour, and machinery. It requires physical facilities and produce tangible products

1. Manufacturing systems

- Manufacturing - is the application of tools and processes for the transformation of raw materials into finished products.



1. Manufacturing systems- Components

Production Machines

- In all manufacturing systems, most of the actual assembly work is accomplished by machines or with aid of tools
- Classification of manufacturing systems:

  1. **Manually operated** machines which are controlled or supervised by a human worker.
  2. **Semi-automated** machines perform a portion of work cycle under some form of program control, and worker tends the machine the rest.
  3. **Fully automated** machines.

Material Handling Systems

- The material handling functions in most manufacturing systems:
  1. Loading work units at each station
  2. Positioning work units at each station
  3. Unloading work units at each station
  4. Transporting work units at each station in multi-station systems
  5. Temporary storage of work units Work transport between stations:
     - Fixed Routing
     - Variable Routing

Computer Control Systems

Typical computer functions in manufacturing systems:

- Communicate instruction to workers(receive processing or assembly instructions for specific work unit)
- Download part programs
- Control material handling system
- Schedule production
- Failure diagnosis
- Safety monitoring
- Quality control
- Operations management

Human Resources

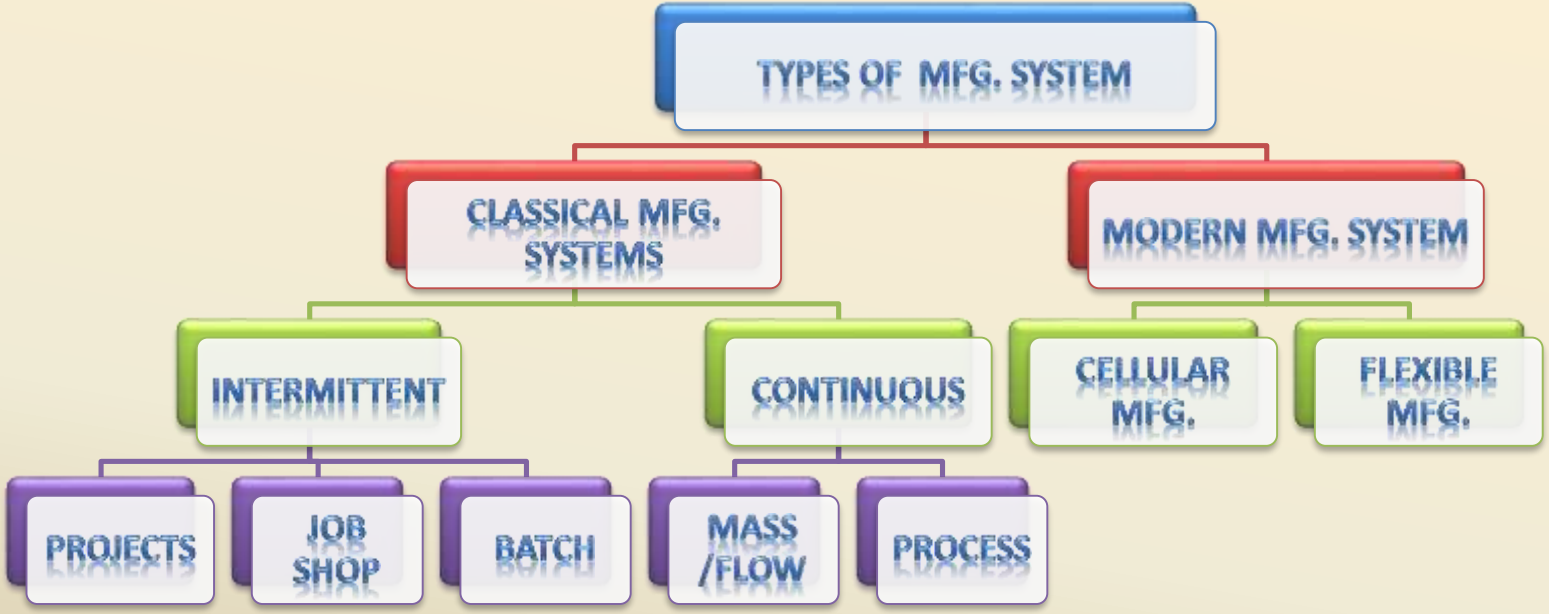
- To operate and manage the system/process
- Required either fulltime or periodically to keep the system running
- Humans refers to all personnel , operators, vendors
- In context of manufacturing system , human perform some or all of the value added work that is accomplished on the parts/products
- Performing either manual (direct)work on it or by controlling the machines
- In fully automated machine, direct labor is still needed
- For example : loading or unloading parts, changing tools, rehappening tools etc.

Manufacturing strategy

- There are different ways of offering a product or service from a company.
- **Make to Order**
- **Make to Stock**
- **Assemble to Order Items**

- Activity - Decide which category the following items fit into
- 1. A Burger in a fast food restaurant
- 2. A specially iced birthday cake from a baker
- 3. A made-to-measure suit of clothes
- 4. An off-the-hook jacket from a department store
- 5. A garden table set sold by a hardware shop

Manufacturing systems - Types



Projects-

- Long time to complete
- Involves a large investment of resources
- Produces one item at a time to a customer order.
- ➢ Characterized by complex sets of activities that must be performed in a particular order within the given period and within the estimated expenditure.
- ➢ Output of a project is a product
- ➢ Operations of such products are carried out in “fixed position assembly type of layout”
- ➢ Examples- production of ships, locomotive and aircraft, construction of roads, buildings, etc.

Projects-

Advantages –

- Handled by a single team
- More efficiency
- Efficient utilization of resources
- More control over budgets
- Timely completion
- Modification is easy

Disadvantages –

- Overlapping of authority and responsibility
- Incompetent staff
- Material movement is too much at location
- Product is too large to move
- Area requirement is high

Job Shop-

Characteristics-

- High variety of products and low volume
- Frequently changing set-ups
- Material movement is long and interrupted
- Imbalanced work load
- Use of general purpose machines and facilities
- Highly skilled operators who can take up each job as a challenge because of uniqueness
- Large inventory of materials, tools, parts
- Detailed planning is essential for sequencing the requirements of each product, capacities for each work centre and order priorities.
- Example of Job production- Designing and implementing an advertising campaign, Auditing the accounts of a large public limited company, a factory machining center, paint shops, a French restaurant, a commercial printing shop, project black book printing..

Job Shop-

Advantages –

- Because of general purpose machines and facilities variety of products can be produced
- Operators will become more skilled and competent, as each job gives them learning opportunities
- Full potential of operators can be utilized
- Opportunity exists for Creative methods and innovative ideas.

Disadvantages-

- Higher cost due to frequent set up changes
- Higher level of inventory at all levels and hence higher inventory cost
- Production planning is complicated
- Larger space requirements
- High skilled labor
- Product cost is very high

Batch production-

Characteristics-

- Volume is relatively low and demand for the items can fluctuate
- The job pass through the functional departments in lots or batches and each lot may have a different routing
- Limited number of products produced at regular intervals and stocked awaiting sales
- Shorter production runs
- Plant and machinery are flexible
- Plant and machinery set up is used for the production of item in a batch and change of set up is required for processing the next batch
- Manufacturing lead-time and cost are lower as compared to job order production
- Examples –Cold drinks, bakeries, furniture making, cheese making etc.

Batch production-

Advantages-

- Better utilization of plant and machinery
- Promotes functional specialization
- Cost per unit is lower as compared to job order production
- Lower investment in plant and machinery
- Flexibility to accommodate and process number of products
- Job satisfaction exists for operators

Disadvantages-

- Material handling is complex because of irregular and longer flows
- Production planning and control is complex
- Work in process inventory is higher compared to continuous production
- Higher set up costs due to frequent changes in set up.

Mass/Flow production-

Characteristics-

- Large volumes of a standard product for a mass market
- Demand for the product is stable and the demand is high
- Most consumer goods are produced using this method
- High degree of automation involved.
- Manufacture of discrete parts or assemblies
- The machines are arranged in a line or product layout
- Standardization of product and process sequence
- Dedicated special purpose machines having higher production capacities and output rates
- Shorter cycle time of production
- Lower in process inventory
- Perfectly balanced production lines
- Flow of materials, components and parts is continuous and without any back tracking
- Production planning and control is easy
- Material handling can be completely automatic.

Mass/Flow production-

Advantages –

- Higher rate of production with reduced cycle time
- Higher capacity utilization due to line balancing
- Less skilled operators are required
- Low process inventory
- Manufacturing cost per unit is low

Disadvantages-

- Breakdown of one machine will stop an entire production line
- Line layout needs major change with the changes in the product design
- High investment in production facilities
- The cycle time is determined by the slowest operation

Examples- Car manufacturing, Household appliances, Electronic Industry

Process Production-

Characteristics-

- Production facilities are arranged as per the sequence of production operations from the first operations to the finished product
- The items (Work in Process, WIP) are made to flow through the sequence of operations through material handling devices such as conveyors, transfer devices, etc.
- Dedicated plant and equipment with zero flexibility
- Material handling is fully automated
- Process follows a predetermined sequence of operations
- Component materials cannot be readily identified with final product
- Planning and scheduling is a routine action.

Examples- Oil refinery, chemical industries, cement manufacturing, etc.

Process Production-

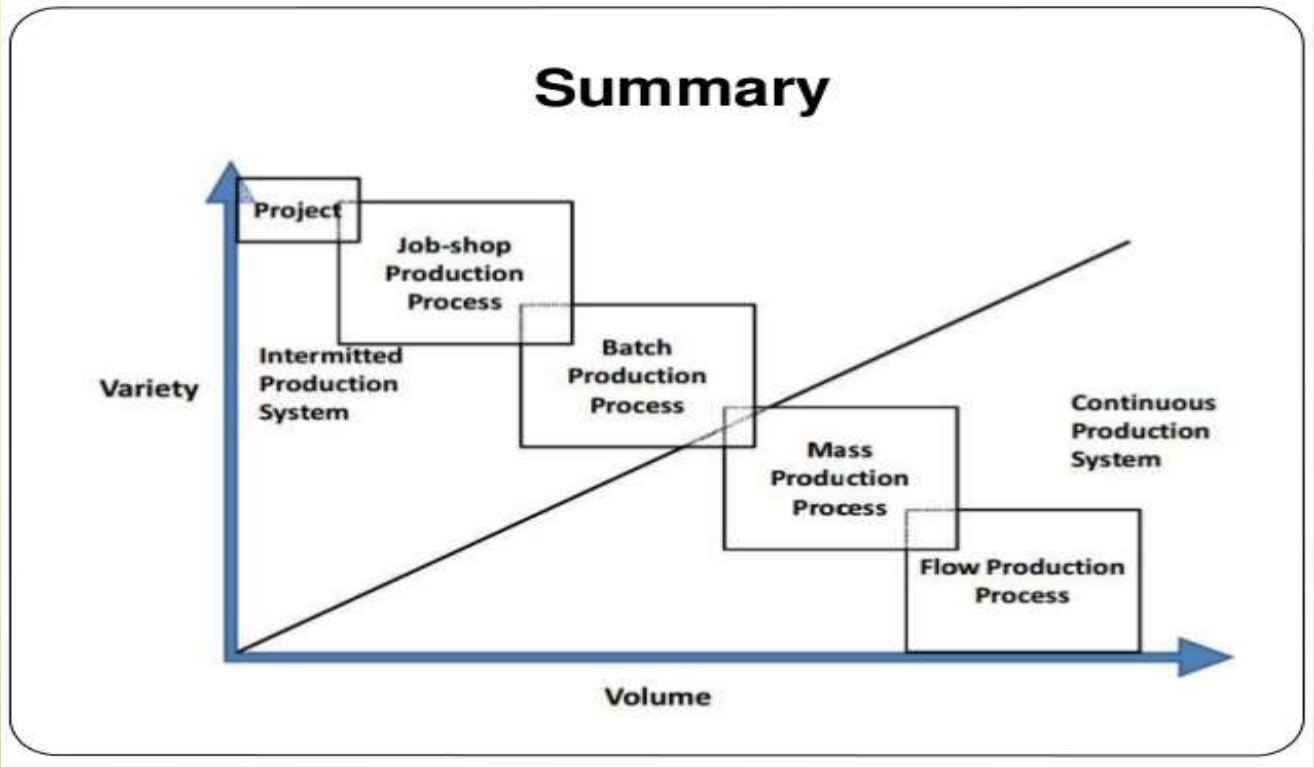
Advantages –

- Standardization of product and process sequence
- Higher rate of production with reduced cycle time
- Higher capacity utilization due to line balancing
- Manpower is not required for material handling as it is completely automatic
- Person with limited skills can be used on the production line
- Unit cost is lower due to high volume of production

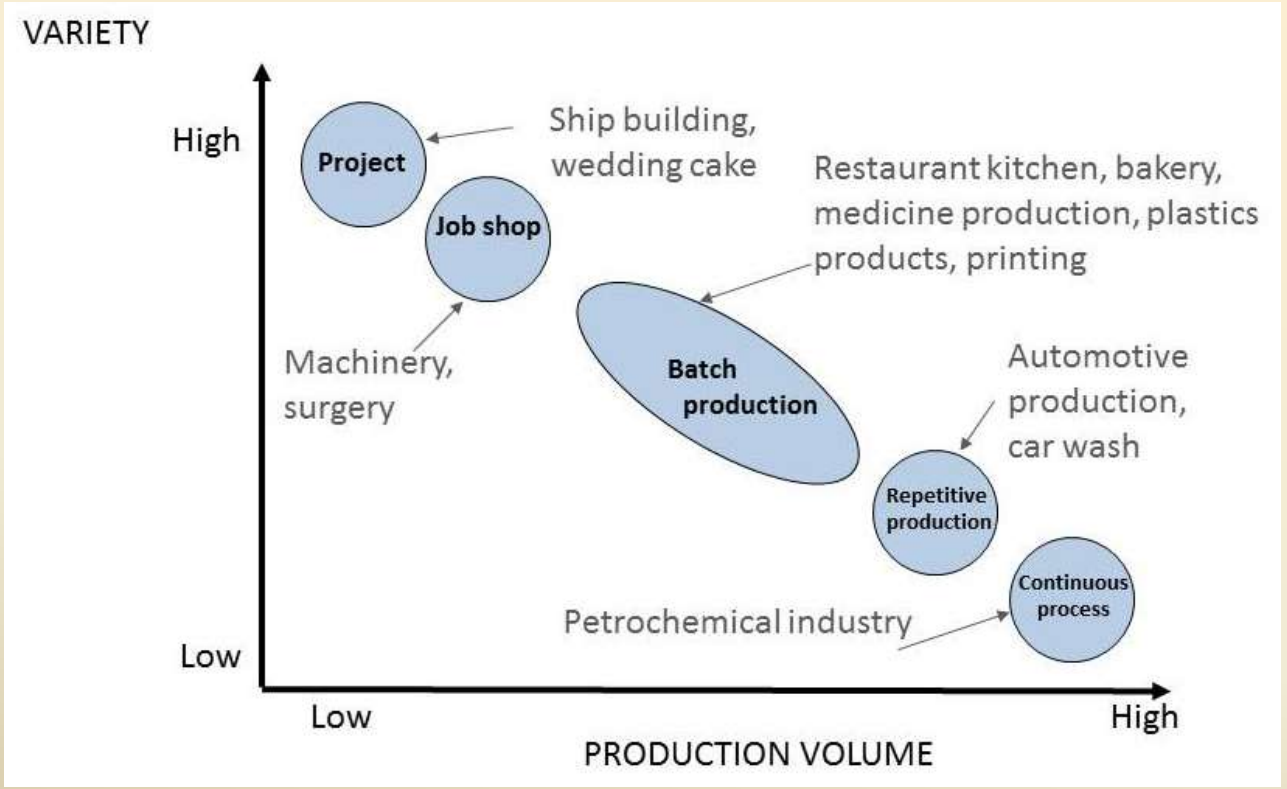
Disadvantages-

- Flexibility to accommodate and process number of products does not exist
- Very high investment for setting flow lines
- Product differentiation is limited.

Comparison of Basic Mfg. Types



Comparison of Basic Mfg. Types



Cellular manufacturing system-

- Hybrid system for linking the advantages of both job shops (flexibility in producing a wide variety of products) and flow lines (efficient flow and high production rate).
- The workstations are arranged like a flow shop
- The machines can be modified, retooled and regrouped for different product lines within the same “family” of parts
- Some degree of automatic control for loading and unloading of raw materials and work pieces, changing of tools, transferring of work pieces and tools between workstations
- Cells are classified as manned and unmanned cells
- Manned cells- multifunctional operators can move from machine to machine and the materials can be moved by the operator
- Unmanned cells, an industrial robot is located centrally in the cell for material handling. Automated inspection and testing equipment can also be a part of this cell.

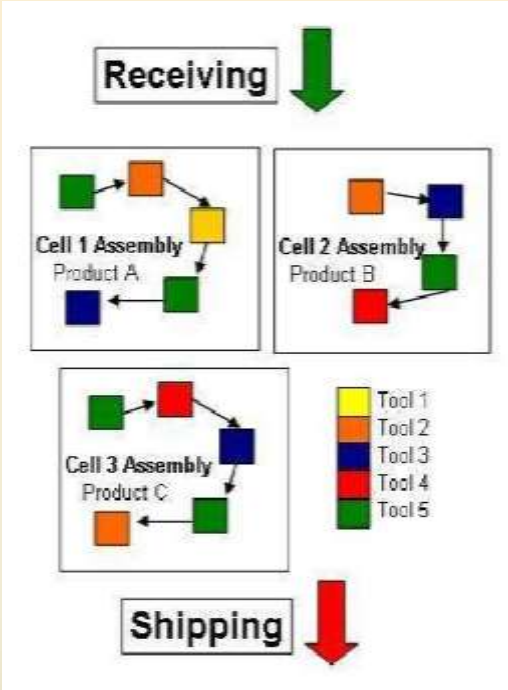
Cellular manufacturing system-

Advantages

- Setup time is reduced
- Lot sizes are reduced Work-in-process (WIP) and finished goods inventories are reduced
- Material handling costs and time are reduced
- A reduction in flow time is obtained
- Tool requirements are reduced
- A reduction in space required
- Throughput times are reduced
- Product quality is improved
- Better overall control of operations

Disadvantages

- High capital investment
- Skilled labor
- Lower machine utilization
- Balancing work across cell



Flexible Manufacturing System-

- Integrates all major elements of manufacturing into a highly automated system
- Higher flexibility -it can handle a variety of part configurations and produce them in any order
- The basic elements - a) works station b) automated material handling and automated storage and retrieval systems c) control systems.
- Major capital investment in efficient machine - utilization is essential - Proper scheduling and process planning are crucial that are complex in nature.
- No setup time is wasted in switching between manufacturing operations
- The system is capable of different operations in different orders and on different machines.

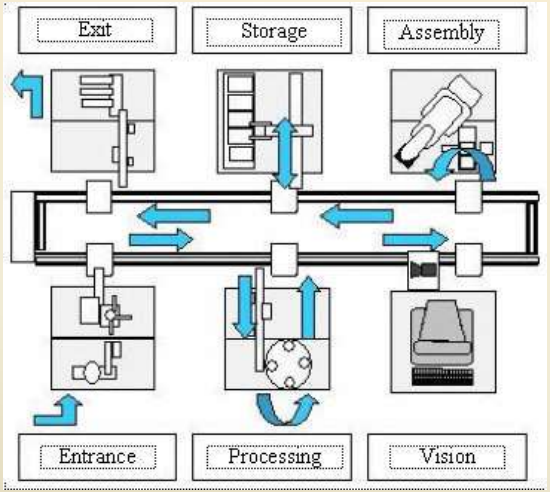
Flexible Manufacturing System-

Advantages

- Parts can be produced randomly in batch sizes, as small as one, and at lower cost.
- The lead times required for product changes are shorter
- Reduced WIP Labor and inventories
- Production is more reliable, because self correcting system and so product quality is uniform
- Increased machine utilization
- Fewer machines required
- Reduced factory floor space
- Greater responsiveness to change

Disadvantages

- FMS is a complex system.
- Requires highly skilled technicians.
- Needs high level of planning.
- Demands high initial investment



Comparison of Basic Mfg. Types

Basis of Comparison	Mass Production	Job Production	Batch Production
Meaning	Mass production means production of one or two standard products on a large scale.	Job production means manufacture of products as per specifications given by the customer. It is a special order production.	Batch production means production of a number of identical items to meet a specific order or to satisfy continuous market demand.
Method of Production	Here, the flow of materials is in a straight line. All facilities are arranged as per the sequence of operations. Standardization is the keynote of mass production method.	Job production is the manufacture of a single complete unit by an operator or a group of operatives. It is providing goods or services according to the needs of the customers.	In batch production, the work content of each unit is broken into a number of operations and operations are divided into groups for the completion of work group – wise.
Flexibility	Mass production method is highly inflexible.	The job production method using general purpose machines is more flexible.	Batch production is more flexible than Mass production method but is less flexible than Job production method.

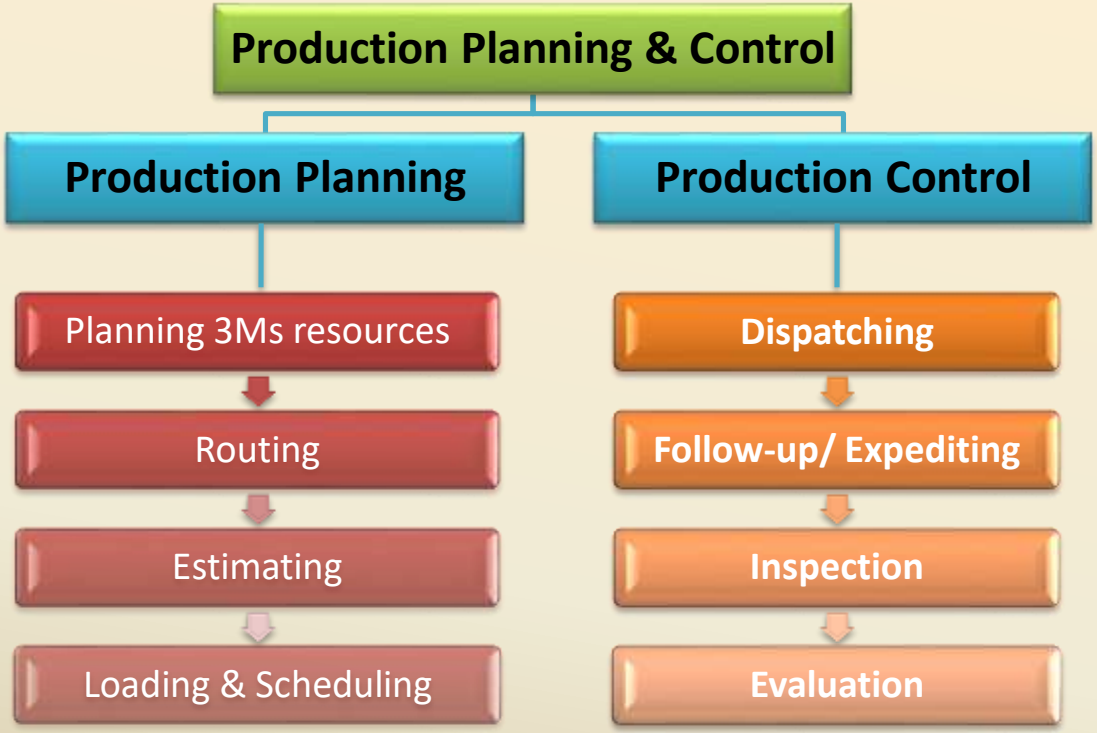
Comparison of Basic Mfg. Types

Basis of Comparison	Mass Production	Job Production	Batch Production
Capital Investment	Huge capital investment is required due to the duplication of machineries.	The capital investment required differs from type of job undertaken. For e.g. a tailor undertaking stitching job requires low investment whereas a road or dam constructing company requires huge capital investment.	Low capital investment is required as compared to Mass production and Job production.
Work in Process Inventories	Work in Process Inventories is small as output of one process becomes input of the next process.	Raw materials and work in process inventories are high due to the uneven and irregular flow of work.	Work in Process Inventory is high and large space is required due to production of more variety of products.
Skilled/ Unskilled Workers	Unskilled or semi-skilled workers are used as most of the work is machine based.	Highly skilled workers are required in a large quantity as production is highly specialized.	Semi- skilled and Skilled workers are required according to the type of production undertaken.
Examples	Products of mass consumption such as Colgate toothpaste, Lux soaps, etc.	Smalls jobs such as Tailoring or hairdresser and Big jobs such as construction of a house, dam or bridge building, etc.	Clothing, bakery and electrical goods.

2. Needs of PPC

1. Utilizes resources effectively.
2. Makes flow of production steady..
3. Estimates production resources.
4. Maintains necessary stock levels.
5. Coordinates departmental activities.
6. Minimizes wastage of resources.
7. Improves labor efficiency.
8. Helps to face competition.
9. Provides better work environment.
10. Facilitates quality improvement.
11. Customer satisfaction.
12. Reduces production costs.

3. Functions of PPC



Functions of PPC

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 (standardization) 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.

Functions of PPC

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. **Process Planning (Routing):**It is concerned with selection of path or route which the raw should follow to get transformed in to finished product.

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.

Functions of PPC

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.

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.

Functions of PPC

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 authorizes 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 centers 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 authorize timely start of operations.
- (e) To record start and finish time of each job on each machine or by each man.

Functions of PPC

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.

The duties include:

- 1. Identification of bottlenecks and delays and interruptions because of which the production schedule may be disrupted.
- 2. To devise action plans (remedies) for correct the errors.
- 3 To see that production rate is in line with schedule.

Functions of PPC

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 analysis.

4. Relationship of PPC with other functions

5. Factors influencing PPC in the organization

- Following are the factors affecting production planning and control:
- Type of product - Complexity of the products - market being served. E.g. Production control procedures are much more complex and involve many more records in the manufacture of large steam turbine generator sets or locomotives to customer orders than in the production of large quantities of a standard product involving only a few component parts, such as electric blankets, steam irons or similar small appliance.
- Type of manufacturing - The most influential factor in the control situation. A large, manufacturing plant producing a standard product is included in planning of the plant layout design.

6.Manufacturing Methods

1. Projects & jobbing products
2. Batch production
3. Mass / flow production
4. Continuous / process production

7. Organization of PPC

1. Status of PPC department
2. Internal structure
3. Degree of centralization
4. PPC as an integrated approach

7.1 Status of PPC Department

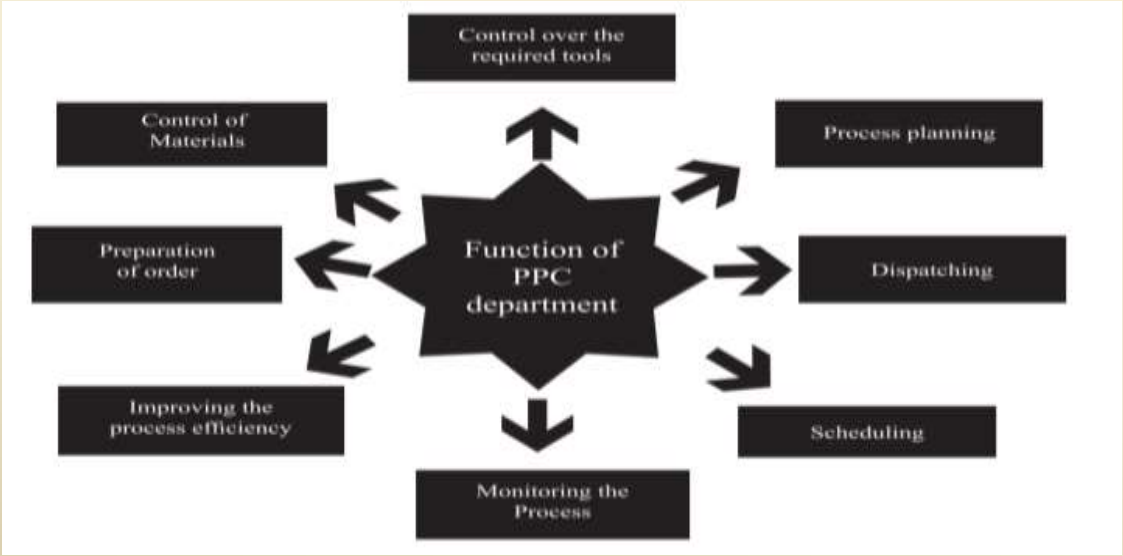
- Dependent on the manufacturing processes that the company intends to perform
- When repetitive work is involved and the number of workers is limited, planning is done directly by the line staff
- In manufacturing units where plant and machinery are laid out as per sequence of operations, the PPC acts as a part of the manufacturing department
- The PPC is set-up as a separate department in firms where a variety of products are produced or where machine capacities vary for different products

7.2 Internal Structure of PPC

The functions given to the PPC department are related to:

- The nature of industry • size of the company • management policies of the company

Following are the common functions related to the PPC department:



Internal Structure of PPC

ORGANISATION CHART FOR P.P.C. DEPARTMENT

P.P.C.

Production Planning	Production Control	Inventory Control
• Order Booking	• Despatching	• Stores management
• Production budget		
• Material Records	• Expediting	• Quality Control
• Methods		
• Machines		• Handling
		• Receiving
• Tools and Jigs		
• Operation Layout		• Simplification
• Time estimating		• Standardisation
• Scheduling		

Internal Structure of PPC

Some of the additional possible functions of PPC department are:

- Estimation of costs
- Measurement of work
- Demand forecasting
- Sub-contracting
- Capacity planning
- Materials control
- Tools control

Each of the unit is staffed by a senior engineer and has additional staff members for planning.

7.3 Degree of Centralization

The extent of centralization means the degree of control between the top management and the autonomy provided.

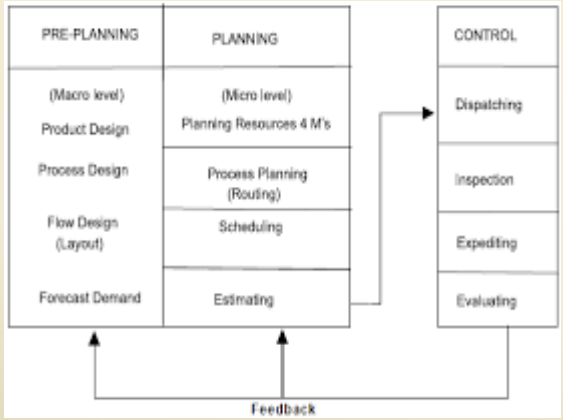
- These can be of two types.

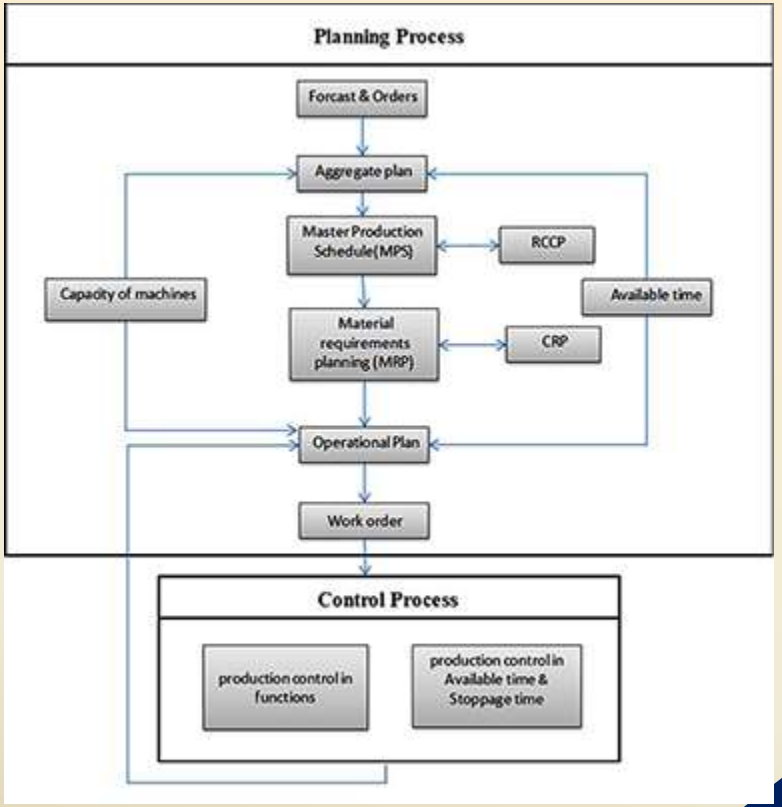
    1. Centralized planning- it is done by specialists
    2. Decentralized planning- the line staff plans the work to be carried out in their own department

Merits and Demerits:

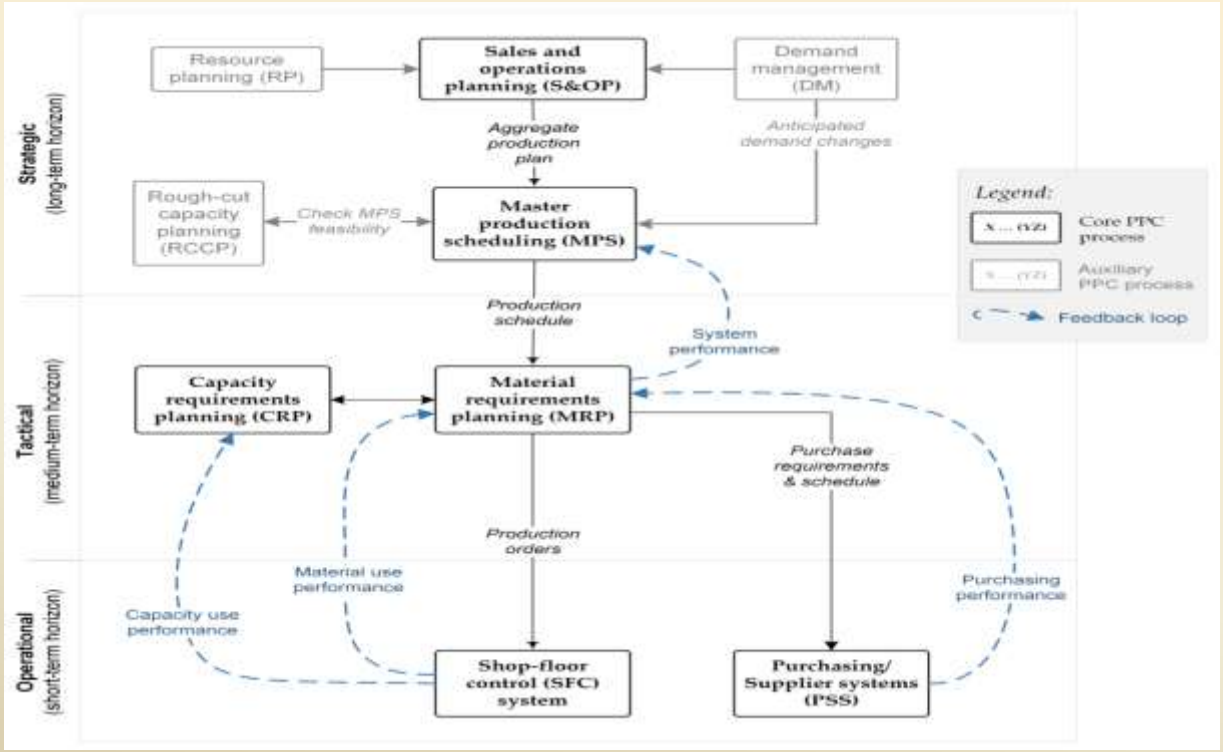
- Centralized planning- the line staffs are relieved from the load of planning thus allowing them freedom to effectively handle both men and machines.
- Decentralized planning allows the line staff to participate and use their experience in performing the tasks. But, it also consumes their time in planning the functions.
- The degree of centralization needed is greater if the number of products manufactured is very large. Centralization is necessary where large number of workmen and machines with different capacities are involved.
- In contrast, a de-centralized planning is desirable where less number of operators are involved and the end product can be produced with less complex operations. In de-centralized planning, interaction and cooperation between various dept. is possible.

7.4 PPC as an Integrated Approach





7.4 PPC as an Integrated Approach



8. Prerequisites of PPC

1. Data pertaining to Design
2. Data pertaining to Equipment
3. Data pertaining to Raw materials
4. Data pertaining to Tooling
5. Data pertaining to Performance standards
6. Data pertaining to Labour
7. Data pertaining to Operating systems

8.1 Data pertaining to Design

- The design of the product is most important which is supplied by the customer.
- Based on the design provided, the entire shop floor plan is decided.
- It gives the core idea of extracting the type of materials required, machine utilization, numbers of workers required etc.
- Approved design of the products
- Drawing of all parts
- Sub-assemblies manufactured and purchased with bill of materials.

8.2 Data pertaining to Equipment

- The equipment's required for manufacturing the products mainly follow a sequence of operations to be performed on the same
- The sequence of operations is mainly decided from the design given by the customers
- These also include the tooling and accessories necessary for holding the job in the machine
- The feed of tool and depth of cut
- The size of machine depends upon dimension of workpiece to be machined.
- Each type of machine
- Task which can be performed
- Different speed and feeds
- Limitations in terms of configuration engg: maximum tool travel, maximum depth of cut etc.

8.3 Data pertaining to Raw Materials

- The raw material requirements for products depends mainly upon the
- Customer requirements and demand
- The type of material to be used
- Specifications like composition chemical involvement
- Type of process etc.
- Information
- List of jobs
- Consideration of machining allowances

8.4 Data pertaining to Tooling

- Type of tooling depends upon composition of workpieces
- It also incorporates the method of machining to be carried out that will give standardized sizes of tools and cutting accessories required for production.
- Standard cutting tools (drills, reamers, milling cutters, gear hobs)
- Standard machine aids (collets, work arbors, tool arbors)
- Special cutting tools (form tools, special hobs, gear shaping cutters)
- Measuring instruments and gauges (Vernier's, bore dial plug gauges, snap gauges a) Life span b) Cost

8.5 Data pertaining to Performance Standard

- Some standard methods or procedures to be followed while planning a process in industries
- The production planning techniques are mainly based on the type of end or final products to be made
- This is decided by the type of drawing or part diagrams sent by the customers.
- Machine set-ups (called set-up time)
- Regular production (called processing time)
- Process planner (optimum manufacturing process)
- Scheduler to determine individual machine capacity
- Industrial engineering department.

8.6 Data pertaining to Labour

- Management of labor on shop floor along with the assignment of Jobs and productivity output
- Labor required in Industrial engineering is mainly categorized into
  - Labor at management level
  - Labor at staff level
  - Labor at shop floor level
- Information (skills, payment rates, qualification ,work experience)

8.7 Data pertaining to Operating System

- The operating systems considered in an industry mainly and wholly depend upon type of products to be manufactured
- The final end products decide the type of operating system applicable
- It is usually called as the plant layout planning
- The layout of the plant forms a major part of operating system.
- Order preparation
- Material control
- Process planning
- Preparation of tool card
- Scheduling
- Dispatching
- Controlling production