# Session 1. Planning, Execution, and Control Overview.

Objectives :

- Explain how to schedule production and process manufacturing plans relative to authorizing, releasing, prioritizing, and sequencing work in the manufacturing process.
- Identify the interface and data exchanges required to execute a plan.
- Demonstrate how various facility layouts influence scheduling and workflow.

## 1. The Manufacturing Planning and Control System

### ▪ The Manufacturing Planning and Control System.

- Roles of MPC.
  - To manage the flow of materials efficiently.
  - To utilize people and equipment effectively.
  - To coordinate internal activities with suppliers.
  - To communicate with customers about market requirements.

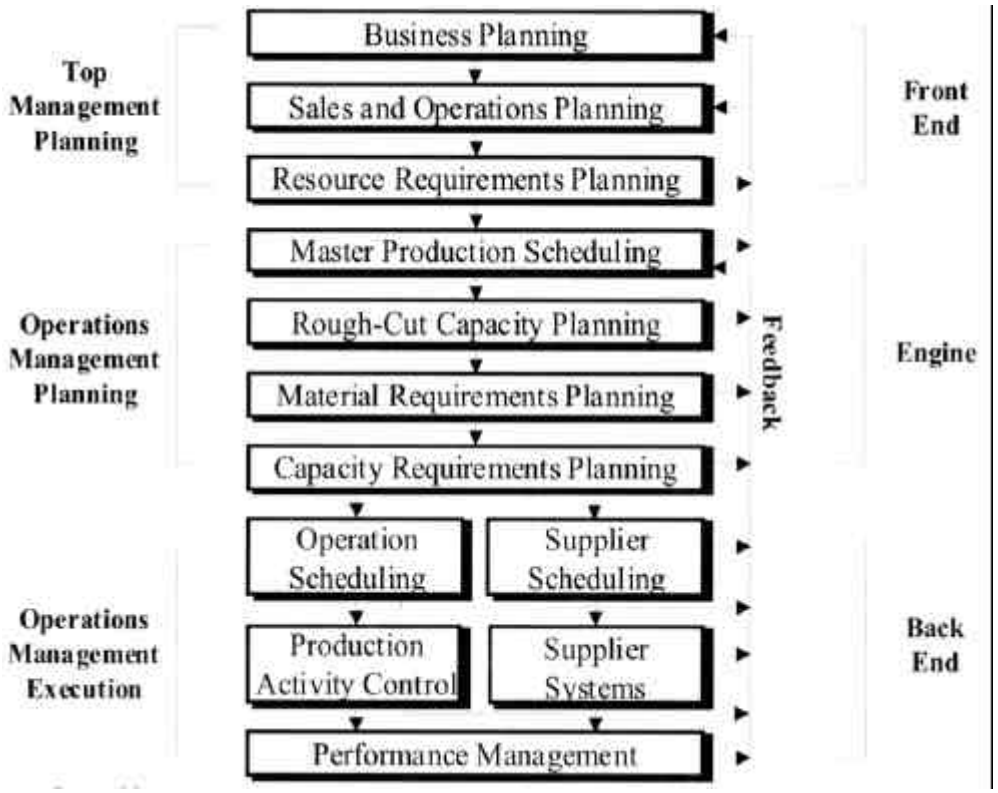



Figure 1. MPC System.

- Three distinct phases of MPC.
  - Front End.
    : The activities in this phase result in an overall end-item production plan.
  - Engine.
    : The activities in this phase convert the end-item production plan into a detailed material and capacity plan.
    : Closed loop system.
  - Back End.
    : This phase deals with the interface of the detailed material requirements and capacity plans with the internal execution and control systems and with external suppliers system.

▪ Closed Loop System.

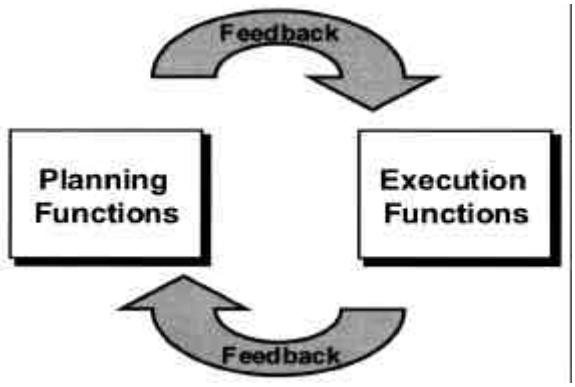



Figure 2. Closed Loop System

- The MPC system is a closed-loop system. A closed-loop system is a system that monitors accomplishment against the plan.
- Contents of closed-loop system in MPC.
  - Sales and operations planning.
  - Master production scheduling.
  - Material requirements planning.
  - Capacity requirement planning.
- The execution functions.
  - Input-output capacity.
  - Detailed scheduling.
  - Dispatching.
  - Anticipated delay reports from both the plant and suppliers.
  - Supplier scheduling.

▪ Planning and Control Process.

- Plan : Key points.
  - Set the manufacturing direction.
  - Establish goals.
  - Considers capabilities and capacities necessary for plan achievement.
- Execute.
  - Execute the plan by performing the planned/scheduled activities.
- Measure.
  - Measure performance against the plan to identify significant deviations.
- Correct.
  - Eliminate the cause of any problems by identifying and implementing alternative solutions.

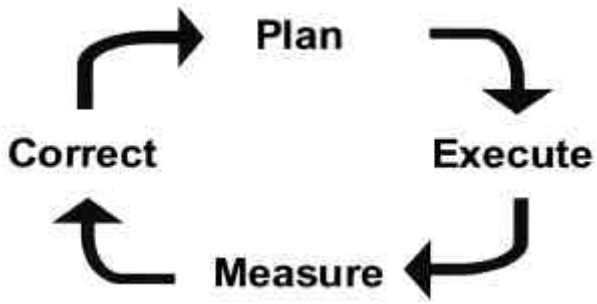



Figure 3. Planning and Control Process.

▪ Primary Objectives of Planning and Control Process.

- Maximizing Customer Service.
  - The goal of achieving a high level of customer satisfaction focuses on quality, product availability, and cost.
  - Performance measures for customer service.
    : Fill rate for stock finished goods.
    : On-time delivery for make-to-order products.
    : Value of goods returned for quality or warranty compared to value of goods shipped.
    : Service calls.
    : Customer complaints.
- Limiting Inventory Investment.
  - Effective control of lead time and priorities will help to achieve smooth production flow with minimal work-in-process inventory.
  - The impacts of ineffective control.
    - Material Shortage.
    - Missed schedule due dates.
    - Higher operating costs, such as overtime, premium freight, and expediting.
    - Inefficient use of resources.

- Maintaining High Operating Efficiencies.
  - Overall operating efficiencies, which are much broader, include managing all the costs involved in manufacturing process.
  - Related costs.
    : Direct labor.
    : Factory supervision and indirect labor.
    : Staff support.
    : Equipment.
    : Facilities.


Figure 4. Planning and Control Objectives.

## 2. Manufacturing Planning and Control Activities.

- **What Are Interfaces ?**
  - An interface is a point of interaction between two systems or work group.
  - There are two types of interface in MPC : Planning and Execution.
    - Planning.
      : Planning interface are the interactions that must occur to develop and maintain a valid plan for production activity.
      : Schedules are the most common form of communication for this type of interface.
    - Execution.
      : Execution interfaces establish communication channels that provide for information exchange with the production facility.
      : It can include to monitor the progress, update priorities, and provide feedback when exception conditions occur.

- **Planning Interface.**
  - Business Planning.
    - A business plan is a statement of long-range
      : Strategy.
      : Revenue.
      : Cost.
      : Profit.
    - The business plan is typically prepared annually and updated on a quarterly basis.
    - The business plan is usually accomplished by supporting financial statements.
    - Considerations for a business plan.
      : Projected markets and sales volumes.
      : Availability of critical raw materials.
      : Facilities and equipment.
      : Labor skills.
      : Technology.
      : Financing.
    - A business plan is usually stated in terms of dollars and grouped by product family.
  - Sales and Operation Planning.
    - Three basic activities of S&OP.
      : Meeting business goals and objectives.
      : Establishing production quantities by product family.
      : Confirming resource availability.
    - Resource requirements planning is used to confirm that critical resources with long lead times can be available.
      : Facility.
      : Long-lead-time equipment.
      : Critical materials.
      : Technology.
      : Labor skills.
    - S&OP provides a direct and consistent dialogue between manufacturing and top management, as well as between manufacturing an other functions.
  - Master Production Scheduling.
    - The MPS is the planned build schedule for manufactured end products or product options. It interfaces with rough-cut capacity planning.
    - The most basic decisions at an operational level.
      : Processing MPS transactions.
      : Maintaining MPS records and reports.
      : Performing a periodic review and update cycle.
      : Processing and responding to exceptions and conditions.
      : Measuring effectiveness on an routines basis.

- Material Requirement Planning.
  - The MRP explodes the MPS into a detailed, time-phased set of component and raw material requirements.
  - Determination of MRP.
    : The quantity of all component and materials.
    : Bill of material level required to fabricate those items.
    : The date that the components and material are required.
  - Time-phased MRP is accomplished by
    : Exploding the bill of material.
    : Adjusting or netting for inventory quantities on hand or on order.
    : Offsetting the net requirements by appropriate component or raw material lead times.
  - Interface with between MRP and JIT.
    : JIT is not a planning tool, but philosophy for execution.
    : Many JIT-based companies have implemented MRP, not necessarily for production scheduling but for planning production over large periods of time.
  - Three characteristics of the two concepts.
    : Informational vs. Physical.
    : Planning vs. Execution.
    : Bills of material.- Flattening and no need for planning and tracking.
- Capacity Requirement Planning.
  - The process of determining in detail the amount of labor and machine resources required to accomplish the tasks of production.
  - The scope of capacity planning.
    : Overall plan of resources.
    : Rough-cut evaluation of a particular schedule's capacity implications.
    : Detailed evaluation of capacity requirements based on material requirement plan.
    : Finite capacity loading parameters.

▪ **Execution Interfaces.**
- Execution interfaces facilitates the production activity and control of manufacturing operations.
- They provide the system, plans, and methods of communicating and executing activities on the shop floor.
- They offer feedback and facilitate production activity flow.
- Production Activity Control (PAC).
  - PAC is composed of shop scheduling and control, typically referred to as shop floor control (SFC), and supplier management systems.
  - The objectives.
    : Communicate detailed shop floor schedules to manufacturing and suppliers.
    : Identify bottleneck resources.
    : Highlight behind-schedule situations.
    : Provide feedback to the front-end systems.

- Manufacturing performance in PAC.
  - : Identify and resolve problems and delays.
  - : Provide status information.
  - : Track costs.
  - : Update inventory balances.
  - : Measure workload.
  - : Adjust work-center priorities.

- Production Activity Control (PAC) and MPC.
  - The connections between PAC and the rest of MPC system are the material and capacity plan.
  - The capacity requirement plan.
    - : Determine the amount of capacity required to execute the MRP.
    - : Allows for achievable shop floor schedules to be established.
    - : Reflects current and future resource availability.
  - The material requirement plan.
    - : Provide detailed, time-phased material requirements information to the SFC and supplier scheduling systems.
    - : Establishes manufacturing schedule performance objectives.

- Production Activity Control (PAC) and MRP.
  - In a push system, shop floor scheduling activities begin when a manufacturing order is released.
  - The links between PAC, CRP and MRP are bi-directional.
  - Feedback is of two types.
    - : Status information.
      Inventory in process, notification of operational completion, count verifications, scrap, order closeout, material and labor accounting data.
    - : Warning signal.
      Flags projected material shortages and projected shortfalls in available capacity.

- Production Activity Control (PAC) and JIT.
  - JIT manufacturing takes place in facilities where
    - : Job progress can often be kept track of visibility.
    - : Lot sizes match actual customer requirements.
    - : Material is moved based on consumption.
    - : Work is complete quickly.
    - : WIP levels are controlled.
    - : Work center have surge capacity or are level loaded.
    - : Capacity utilization is not a key issue.
  - Formal shop floor control systems are unnecessary under JIT. Order release is still part of PAC, but typical shop orders are not used.

- Some typical simplifications of PAC in JIT.
  : Detailed scheduling becomes unnecessary because WIP is pulled through the manufacturing cells.
  : Work is completed fast enough to eliminate the need for detailed operations scheduling.
  : Detailed scheduling of workers and equipment is not an issue because the JIT system design determines schedules.
  : Data collection, monitoring, and order status are not needed since work in process inventory is not tracked.
  : Receipts of finished goods are used to backflush raw materials, components, and labor.
  : Use of kanbans eliminates the need for shop orders.

## ▪ PAC Concepts and Techniques.

- PAC Concepts.
  - Priorities, loading of a particular job onto a machine center.
  - For it, PAC must consider elements of lead time and data inputs.
- A product structure for end item Q.

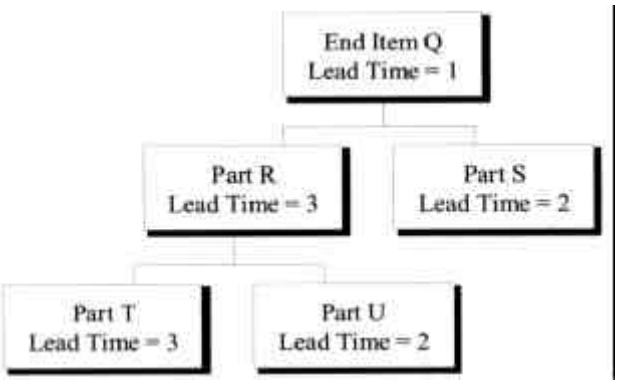



Figure 5. A product structure for end item Q

- Routing Data.

| Part T Routing | | | | | | | |
|---|---|---|---|---|---|---|---|
| Operation | Work Center | Run Time | Setup Time | Move Time | Queue Time | Total Time | Rounded Time |
| 1 | 100 | 2.4 | .4 | .4 | 2.6 | 5.8 | 6.0 |
| 2 | 101 | 2.1 | .8 | .4 | 4.0 | 7.3 | 7.0 |
| 3 | 102 | .5 | .2 | .3 | .7 | 1.7 | 2.0 |
| Total lead time (days) = 15.0 | | | | | | | |
| **Part U Routing** | | | | | | | |
| Operation | Work Center | Run Time | Setup Time | Move Time | Queue Time | Total Time | Rounded Time |
| 1 | 100 | 1.3 | .5 | .3 | 1 | 3.2 | 3.0 |
| 2 | 105 | .2 | .1 | .3 | .5 | 1.1 | 1.0 |
| 3 | 106 | .3 | .2 | .1 | 1.5 | 2.1 | 2.0 |
| 4 | 107 | 1.0 | .6 | .8 | 1.5 | 3.9 | 4.0 |
| Total lead time (days) = 10.0 | | | | | | | |

Figure 6. Routing Data.

- Operation Setback Chart.

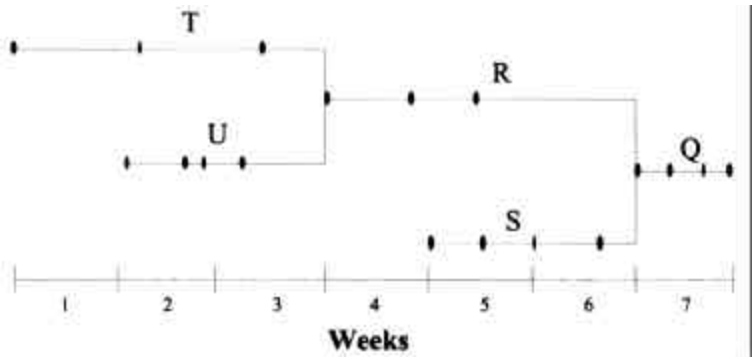



Figure 7. Operation Setback Chart.

- Work Center Schedule.

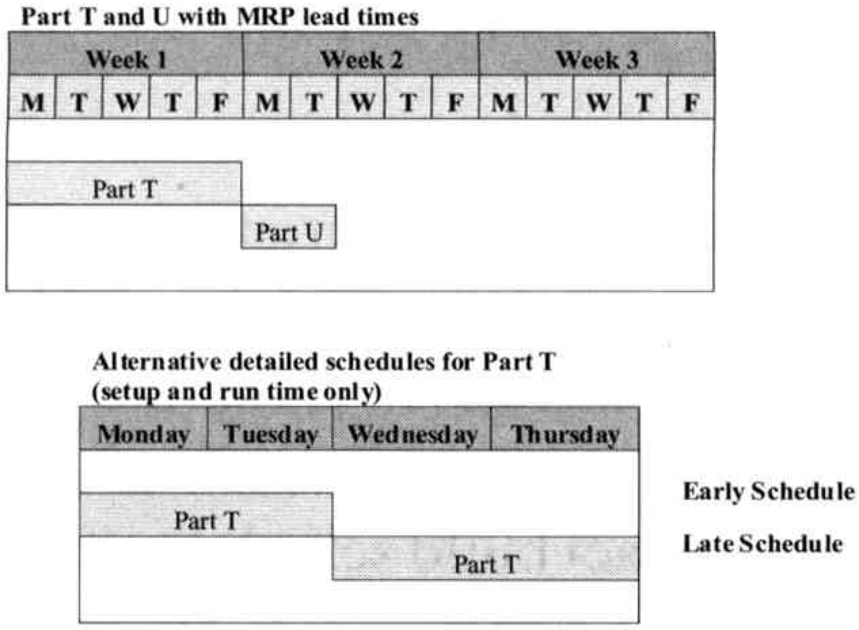



Figure 8. Work Center 100 Schedule.

## 3. Facility Layout.

- **Layout.**
  - The layout of the shop floor is the physical arrangement of resource or centers of economic activity within a facility.
  - Connected flow vs. Disconnected flow.
    - Connected flow is used to describe the assembly line.
    - Disconnected flow refers to a setup composed of individual workbenches or machines - the job shop.
  - Production Layout Characteristics.

| Characteristics | Connected (Assembly line) | Disconnected (Job Shop) |
|---|---|---|
| Line Balance | Equal Times | Different Time |
| Routings | Fixed | Variable |
| Work Stations | Dedicated | Generic |
| Operations | Linked | Decoupled |
| Process | Product dependent | Product independent |
| Expansion | Replicate | Add Workstation |
| Flow | Simple, Rapid | Complex, Unclear |
| Transfer Lot | Container (One) | Batch (One) |
| Throughput Time | Shorter | Longer |
| Training | Operation | Area |
| Setup | Few | More |
| Material Storage | At Position | Off Position |
| Scheduling | Rate Based | Lot Based |
| Distance | Short | Long |
| Flexibility | Less | More |

- Basic information about the processes.
  - Setup times per job.
  - Run times per piece.
  - Aging characteristics, such as cure, stress, and dry bake.
  - Batch size requirements, if any.
  - Number of shifts that each operation is available.
  - External process in flow.
  - Capacity of bottleneck and near-bottleneck areas.
  - Units in process and complete.
  - Units in rework.
  - Units in stock.
  - Time in queue from completion of one operation to start of next.
  - Other unique characteristics.

▪ Functional Layout.

- A functional layout is a shop floor configuration characterized by locating machine tools that perform a similar function in the same area or department.
- The term clustered is used to emphasize the visual appearance of this type of layout.

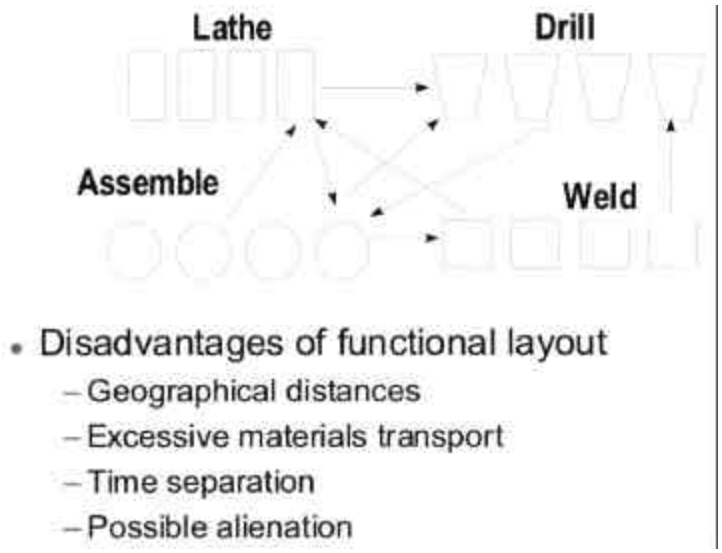
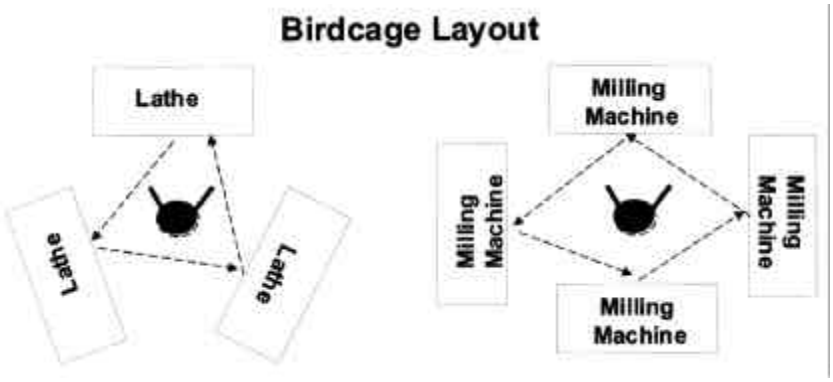


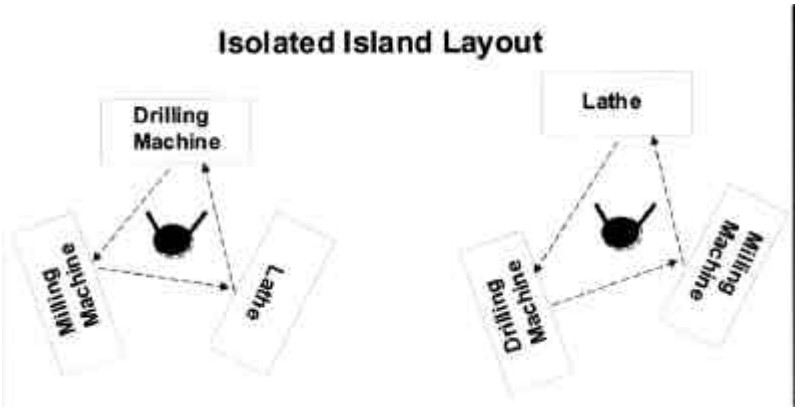

Figure 9. Functional Layout.

▪ Improper Layout in a JIT environment.

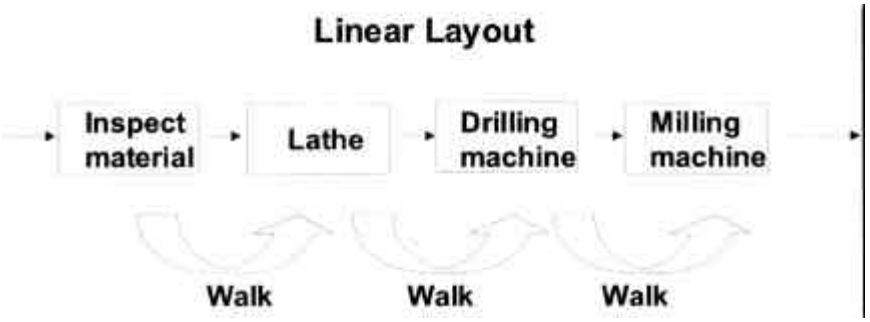
- The birdcage layout.
  - This simple machine layout calls for one worker to be assigned to one type of machine.
  - A major disadvantage of this layout is that there is waiting time after a workcenter has loaded the work piece into the machine and the part is in process.



- Isolated island layout.
  - This layout conforms to the sequential order of processing a part.
  - It assumes the existence of a multifunction worker and enables a continuous, smooth flow of products among different types of machines.
  - Workers are separated from one another and may find it difficult to assist each other.




- A linear Layout
  - A linear layout can overcome some of the problem of an isolated island layout because workers can easily walk to a downstream operation that is on their side of the line.
  - This line is difficult to balance operation.
  - Each line will be independent of other lines, which can cause communication problems.



- **Job Shop.**
  - A job shop process is characterized by the organization of similar equipment by function, such as milling, drilling, turning, forging, and assembly.
  - The large and small batch sizes of similar products are processed concurrently by the job shop.
  - Purpose of Job shop.
    - Providing flexibility of the customer.
    - Making small batches for test marketing or early in the production of a product.
    - Ensuring quantity whenever highly skilled labor is required to meet specifications.
    - Making unique or low-volume products, such as machines, tools, and fixtures used to produce other products.
    - Making prototype of new products.

- **Flow.**
  - There are types of flow designs :
    - Continuous flow - Fluids, wastes, powders, basic metals, and other bulk items.
    - Dedicated repetitive flow - Production of only on product such as shafts, and connecting rods.
    - Batch flow - Two or more product are manufactured in the same facility.
  - The objectives of a flow design :
    - One-piece flow.
    - Lower inventory.
    - Minimized space requirements.
    - Attained of operational requirements.
    - Flexibility to meet changes in output rates.

- **Cellular.**
  - The purpose of cellular manufacturing is to streamline production.
    - Functional clusters are broken up into cells, enabling improved material flow, visibility, and continuous manufacturing.
    - Families of parts are produced within a line or group of cells.
    - Families of parts are produced within a line or group of cells.
    - Floor space is minimized.
    - Direct handoff of part is emphasized.

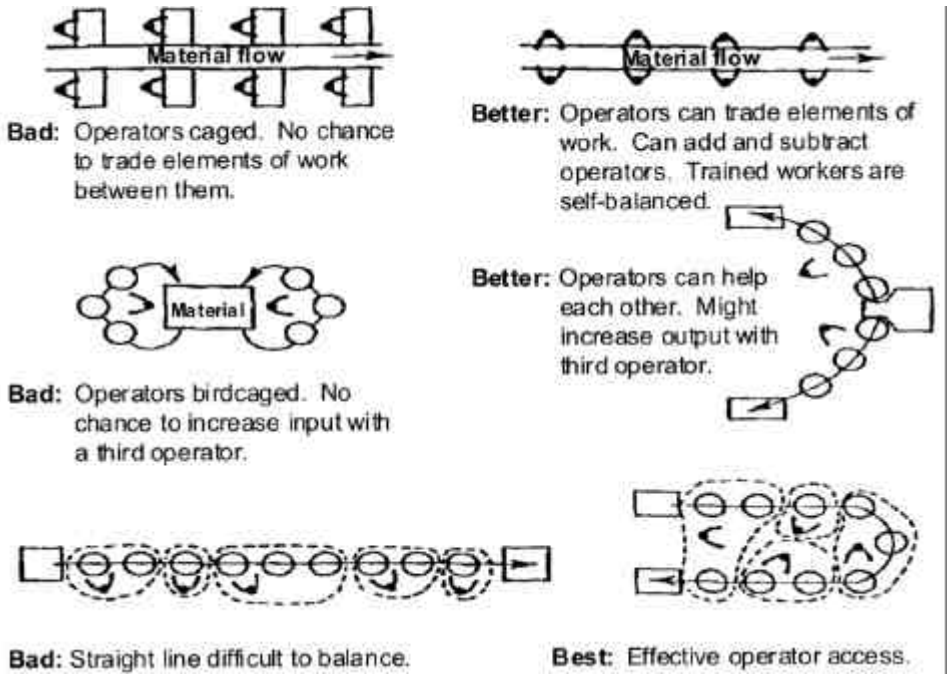



Figure 13. Flexible Layouts for Variable Work.

## ■ Performance Check.

1. Business planning is
   A. Tactical. B. Short range. C. Detailed. D. completed by to top management

2. Closed-loop means
   A. Never changing
   B. Master scheduling is independent of other activities
   C. Activities are best confined to a smaller inner circle
   D. Activities are integrated

3. Which of the following represents the four-step process for planning and control?
   A. Measure, plan, correct, execute
   B. Execute, measure, correct, plan
   C. Plan, execute, measure, correct
   D. plan, execute, correct, measure

4. The objectives of the MPC system are maximizing customer service, limiting inventory investment, and which of the following?
   A. Authorizing work to be released
   B. maintaining high operating efficiencies
   C. Developing human resources
   D. Providing detailed material plans

5. Planning interfaces are
   A. Interactions that facilitate the planning and control of production activity
   B. The systems, plans, and methods of communicating and executing activities on the shop floor
   C. Variations in schedules
   D. status reports

6. Which of the following best defines the process of master scheduling?
   A. Determining in detail the amount of labor and machine resources required to accomplish the tasks of production
   B. Creating, reviewing, and approving the master production schedule
   C. Setting the overall level of manufacturing output
   D. Establishing the overall oobjectives and goals of the MPC system

7. The primary connection between production activity control and the rest of the MPC system is which of the following?
   A. Capacity plan and business plan
   B. Material plan(MRP)
   C. Capacity plan
   D. Capacity and material plans

8. Cellular manufacturing can also be described as
   A. Group technology
   B. Clustered flow
   C. Functional organization
   D. Pull system

9. Which of the following is a type of flow manufacturing?
   A. Dedicated repetitive
   B. Continuous
   C. Batch
   D. All of the above

10. Which of the following best defines the process of capacity requirements planning?
   A. Determining in detail the amount of labor and machine resources required to accomplish the requirements schedule
   B. Establishing the overall objectives and goals of the MPC system
   C. Determining the date that the components and materials are required
   D. Determining the quantity of all components and materials