

# What is Flexible Manufacturing System?

- A flexible manufacturing system (FMS) is a form of flexible automation in which several machine tools are linked together by a material-handling system, and all aspects of the system are controlled by a central computer.

What does flexible mean?

1. Can identify and operate on different part/product styles
2. Quick changeover of process/operating instructions
3. Quick changeover of physical setup

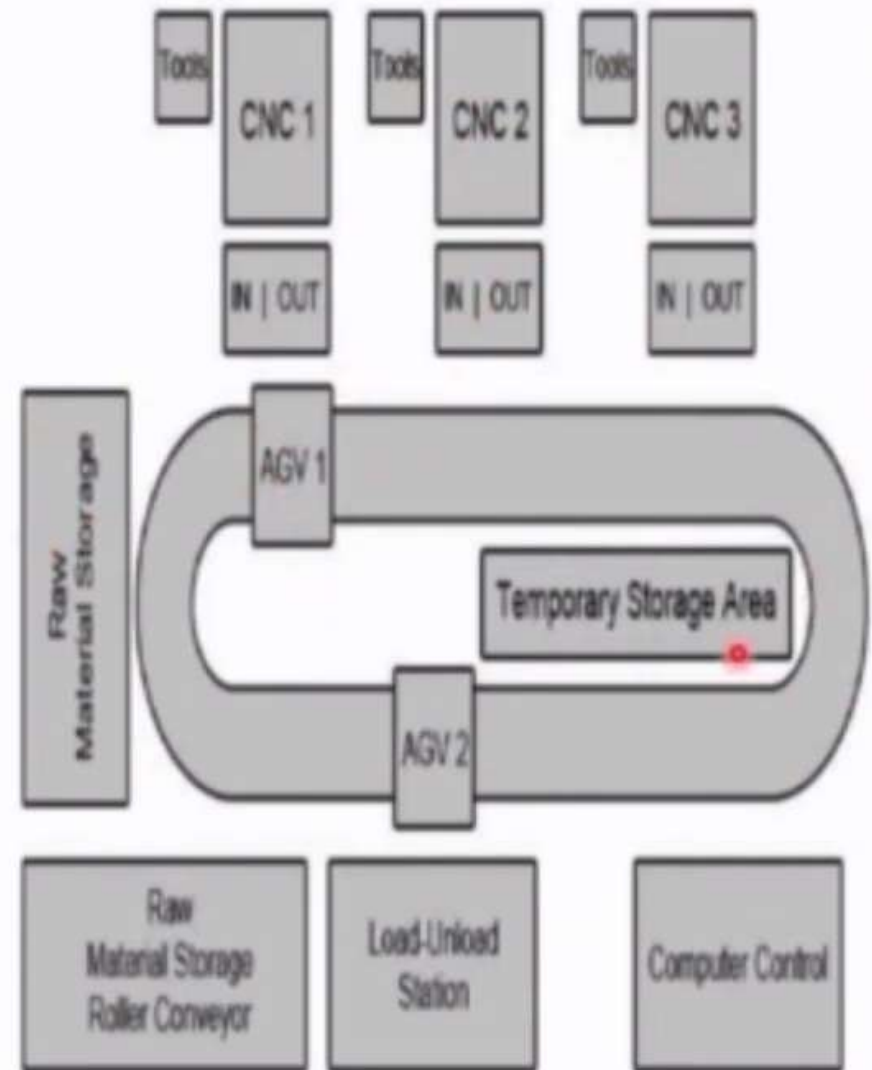
FMS operations:

1. Processing operations, or
2. Assembly operations



# What is Flexible Manufacturing System?

A flexible manufacturing system is an automated Machine cell, consisting of a group of processing work stations, interconnected with automated material handling and storage system.



## What are the Features of FMS?

- An FMS is distinguished from an automated production line by its ability to process more than one product style simultaneously.
- At any moment, each machine in the system may be processing a different part type.
- FMS can let us make changes in production schedule in order to meet the demands on different products.
- New product styles can be introduced into production with an FMS, so long as they are to be used on the products that the system can process.
- This kind of system is, therefore, ideal when there are likely to be changes in demands.

# FMS characteristics

- A manufacturing cell used to implement group technology (GT)
- Independent machines performing multiple operations and having automated tool interchange capabilities
- Automated material-handling between stations (move parts between machines and fixturing stations)
- Hierarchical computer control architectures
- Often include CMM, inspection and part washing devices

# Components of an FMS?

1. Robotics
2. Numerical control machine tools.
3. Work holding and tooling considerations.
4. Material-Handling Equipment/ Transport
5. Manual or Automated assembly cells.
6. Inspection equipment.
7. Computers



# Types of FMS

## 1. Depending Upon Kinds Of Operation

I. **Processing operation.** Such operation transforms a work material from one state to another moving towards the final desired part or product. It adds value by changing the geometry, properties or appearance of the starting materials.

II. **Assembly operation.** It involves joining of two or more component to create a new entity which is called an assembly/subassembly

# Types of FMS

## 2. Depending Upon Level Of Flexibility

- I. **Dedicated FMS.** It is designed to produce a particular variety of part styles. The product design is considered fixed. So, the system can be designed with a certain amount of process specialization to make the operation more efficient.
- II. **Random order FMS.** It is able to handle the substantial variations in part configurations. To accommodate these variations, a random order FMS must be more flexible than the dedicated FMS. A random order FMS is capable of processing parts that have a higher degree of complexity. Thus, to deal with these kinds of complexity, sophisticated computer control system is used for this FMS type.

# Types of FMS

## 3. Depending Upon Number Of Machines

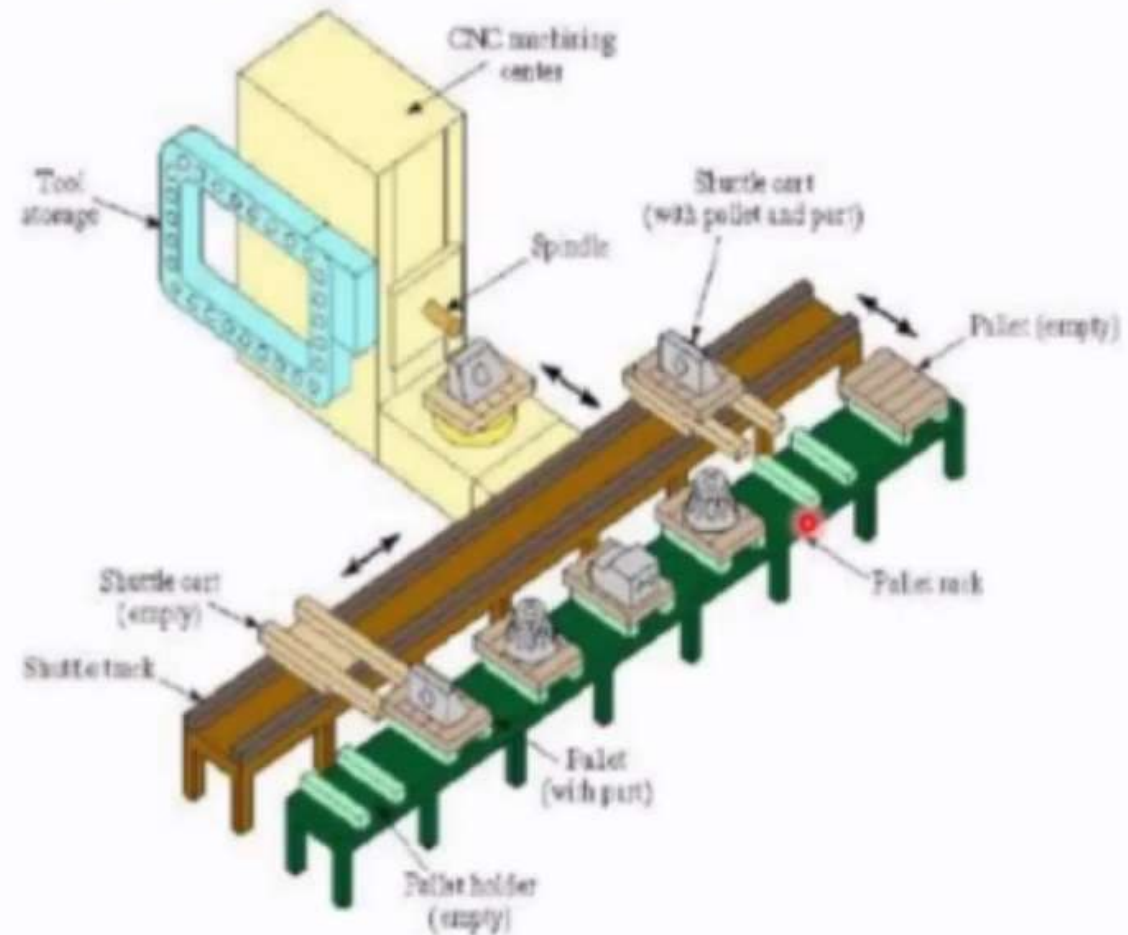
- I. Single machine cell (SMC).
- II. Flexible manufacturing cell (FMC).
- III. A Flexible Manufacturing System (FMS).



# Types of FMS

## 1. Single machine cell—

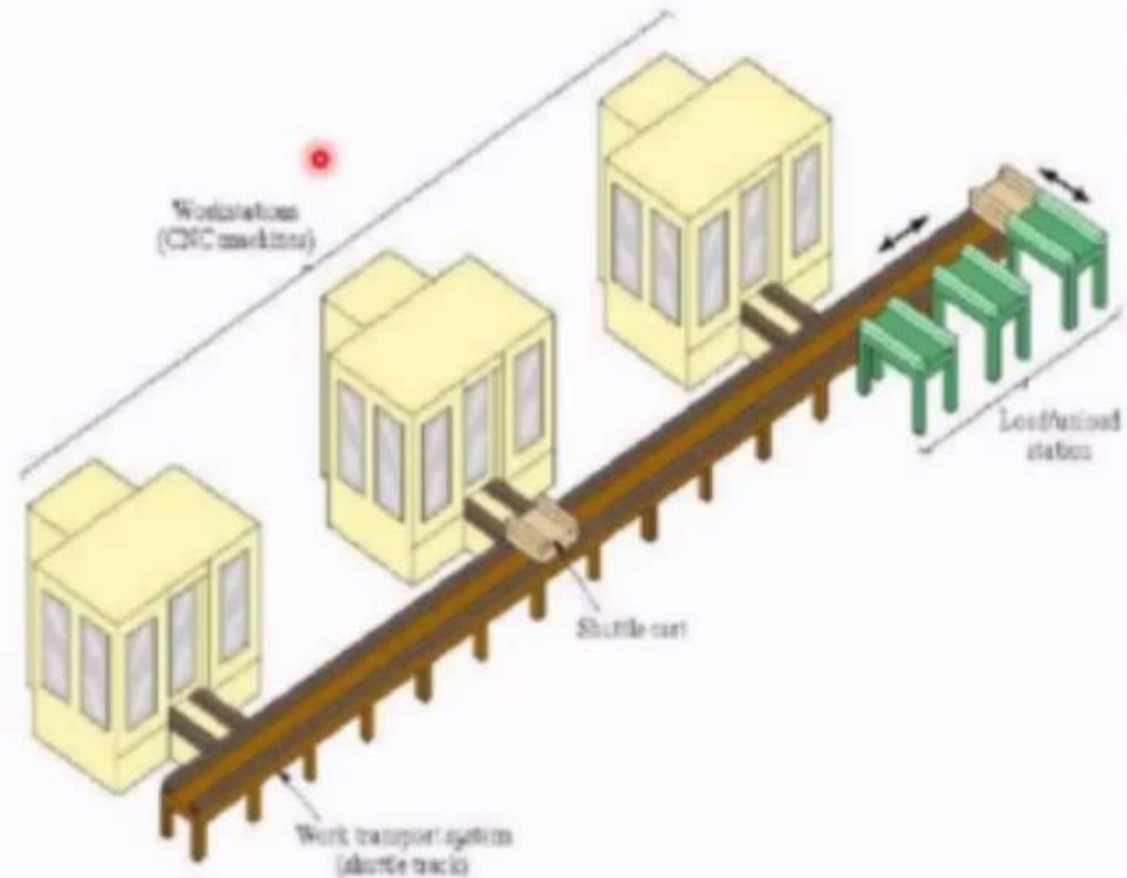
- It contains one machine (often a CNC machining centre) connected to a parts storage system, which can load and unload parts to and from the storage system.
- It is designed to operate in batch mode, flexible mode, or a combination of the two.



# Types of FMS

## 2. Flexible manufacturing cell

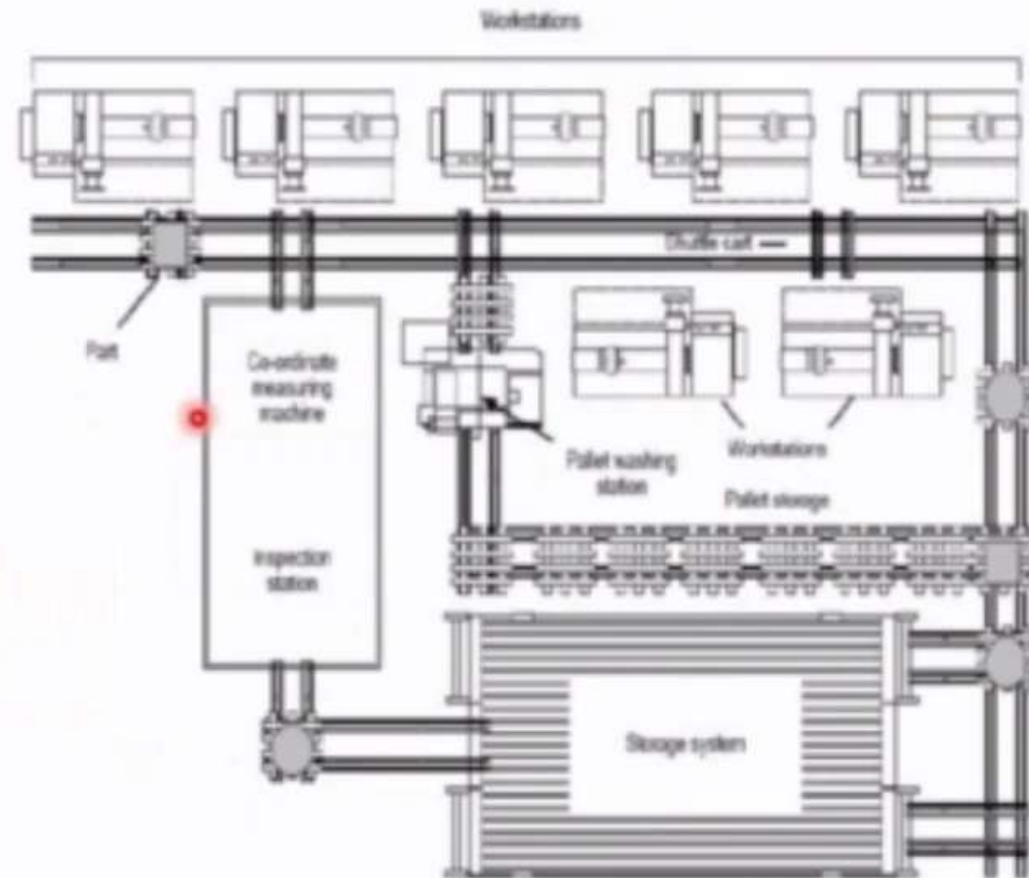
- It contains two or three processing workstations (often CNC machining or turning centers), plus a parts handling system.
- This set-up can operate in flexible mode and batch mode, as necessary, and can readily adapt to evolving production schedule and increased production volumes.



# Types of FMS

## 2. Flexible Manufacturing System (FMS)

- It consists of four or more processing stations connected mechanically by a common parts handling system and electronically by a distributed computer system.
- FMS is larger than the flexible manufacturing cell, not only in the number of workstations it may contain, but also in the number of supporting stations in the system, such as part/pallet washing stations, coordinate measuring machines, storage stations and so on.

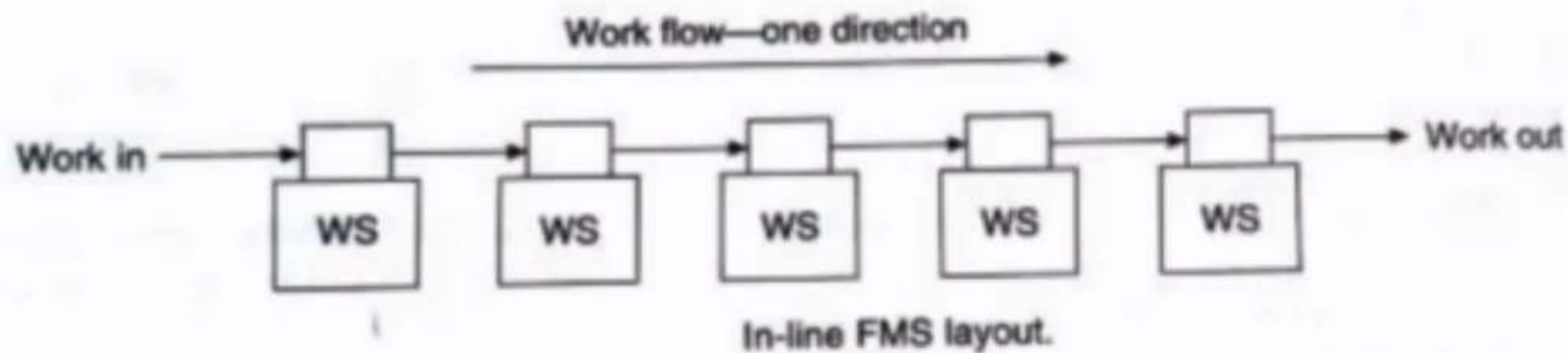
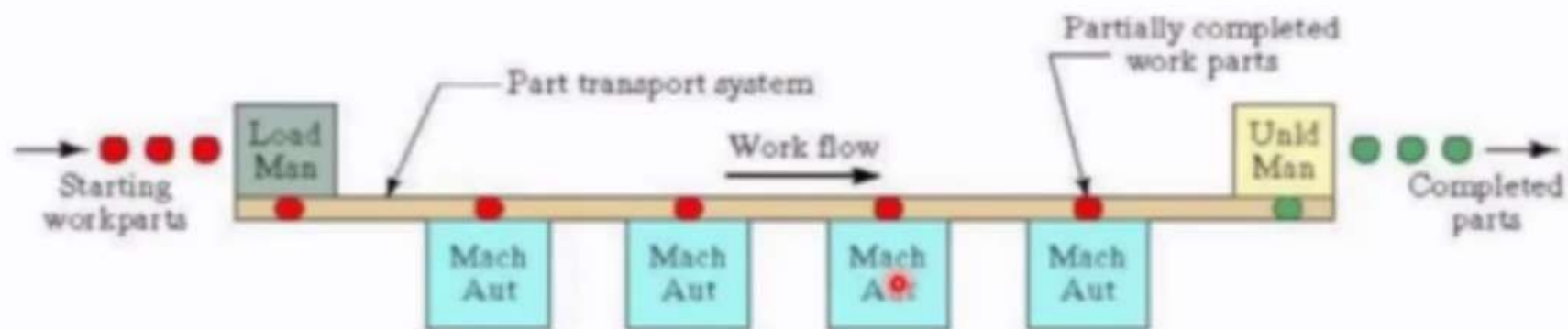


# FMS Layout

- The FMS layouts are Broadly Classified into the Following categories:
  1. FMS line layout
  2. FMS loop layout
  3. FMS Rectangular layout
  4. FMS ladder layout
  5. Open field layout
  6. Robot – centred cell.

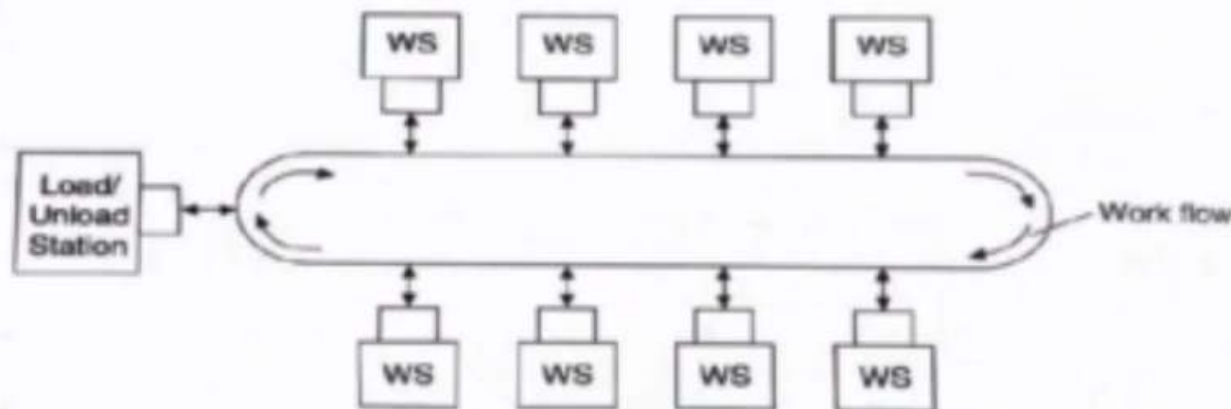
# 1. In-line or progressive FMS layout

- It is most appropriate for systems in which the work parts progress from one workstation (WS) to the next in a well – defined sequence with no back flow.

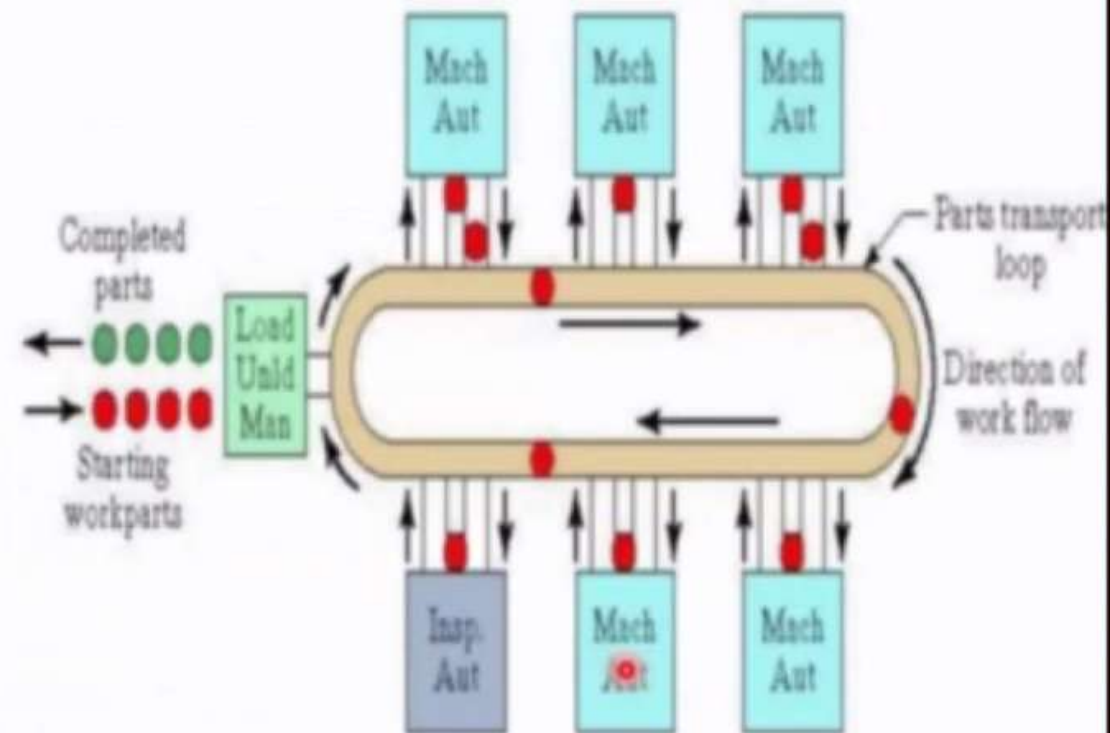


## 2. LOOP FMS Layout:

- In this layout work part usually flow in one direction along the loop with the capability at any workstation
- The load/unload stations are located at one end of the loop.

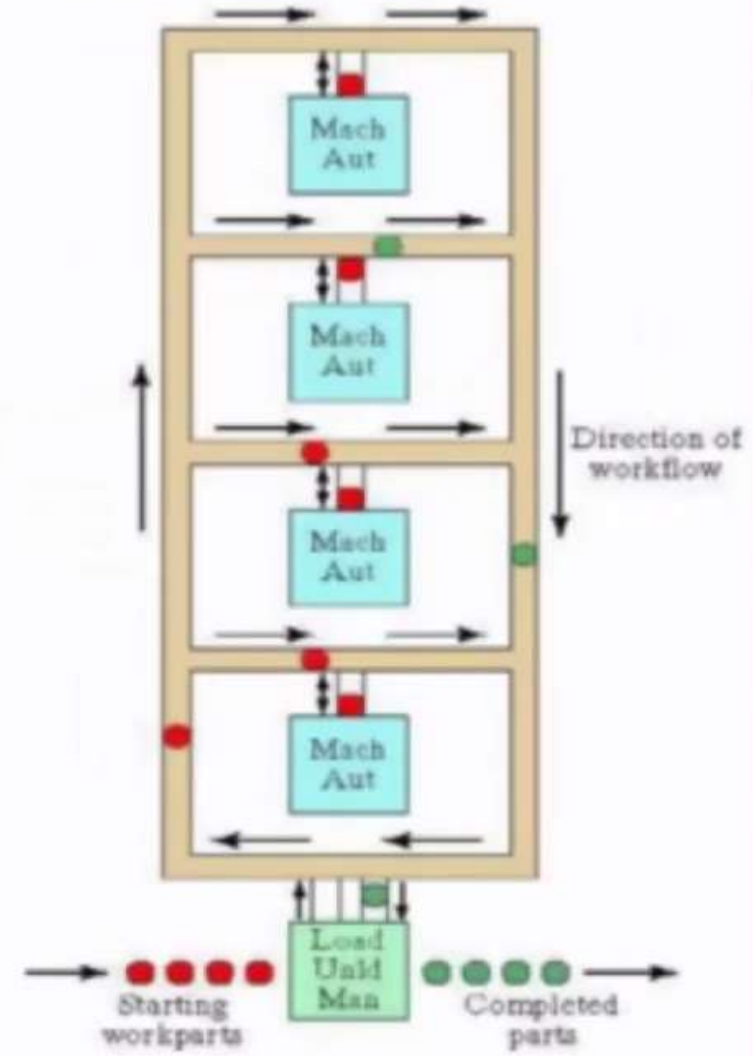
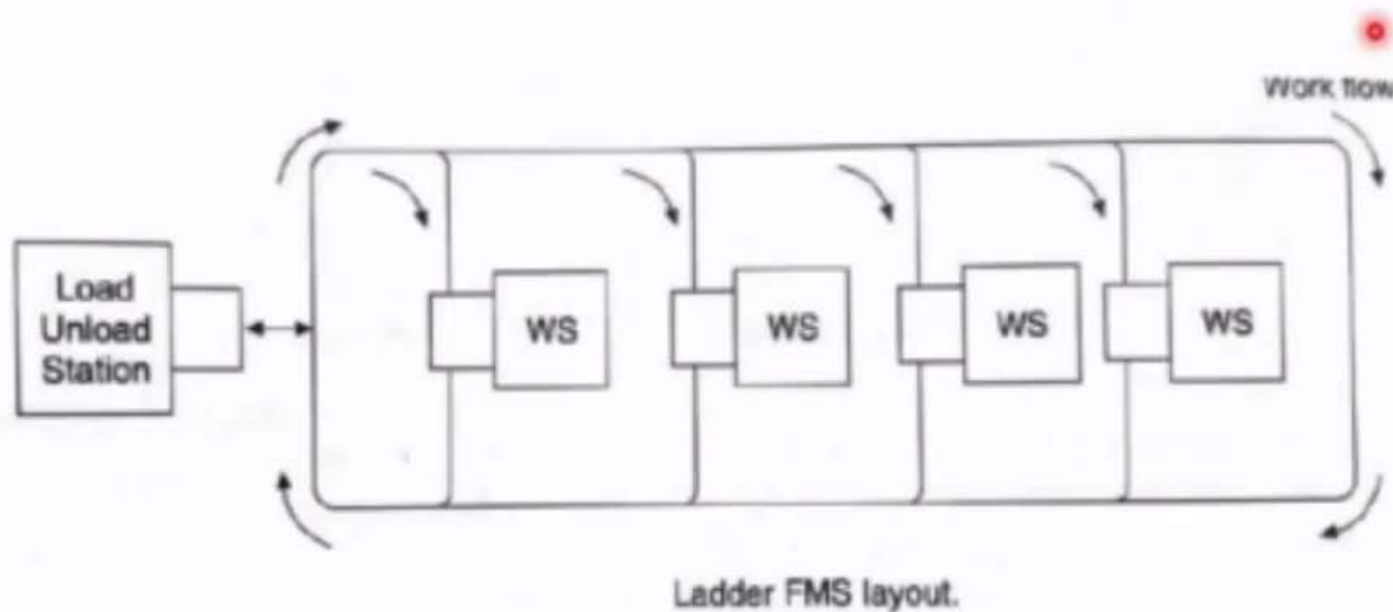


Loop FMS layout.



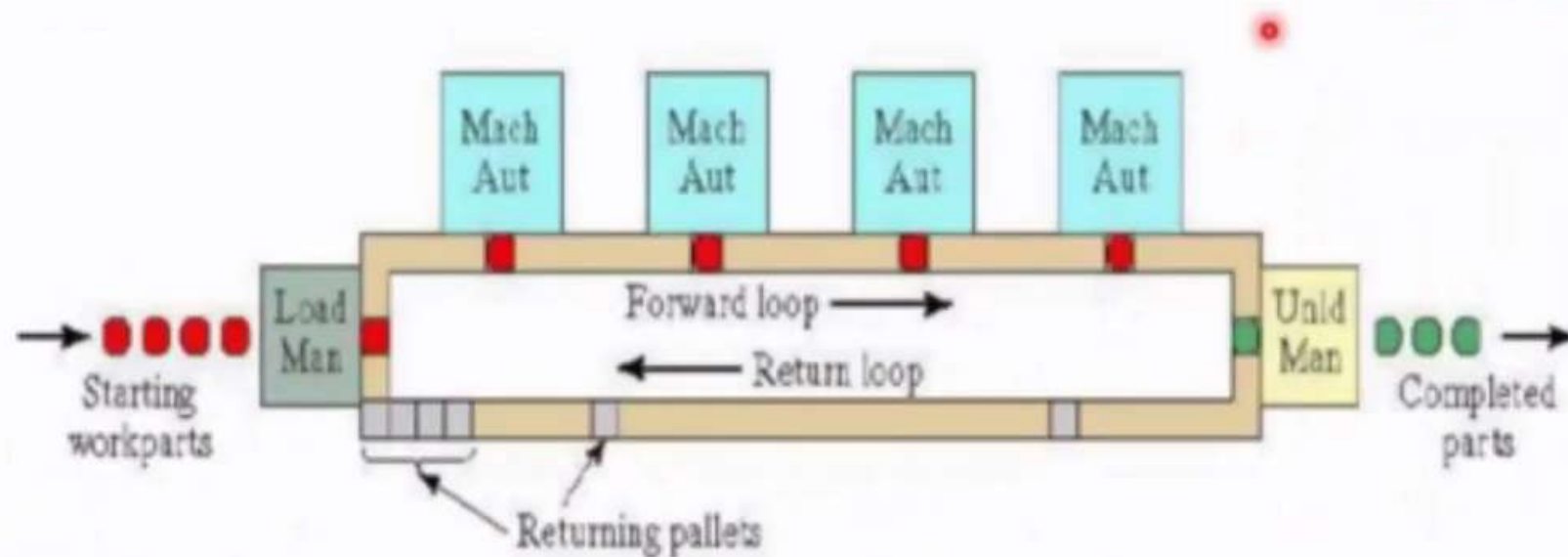
### 3. Ladder FMS Layout

- This type of layout contains rungs on which workstations are located.
- This layout reduces the average distance travelled to transfer work parts between stations.



## 4. Rectangular FMS layout:-

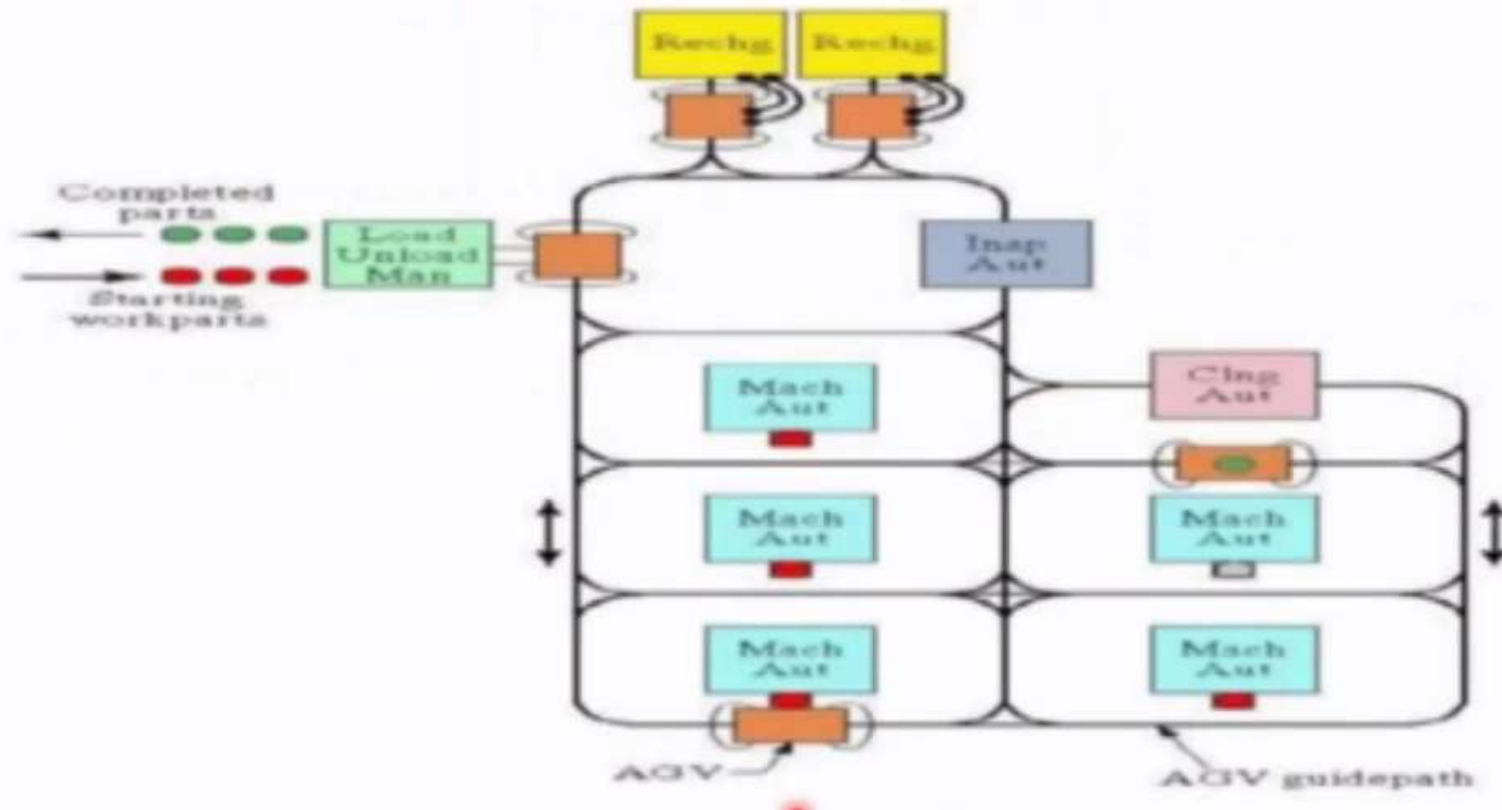
- Rectangular layout allows recirculation of pallets back to the first station in the sequence after unloading at the final station..





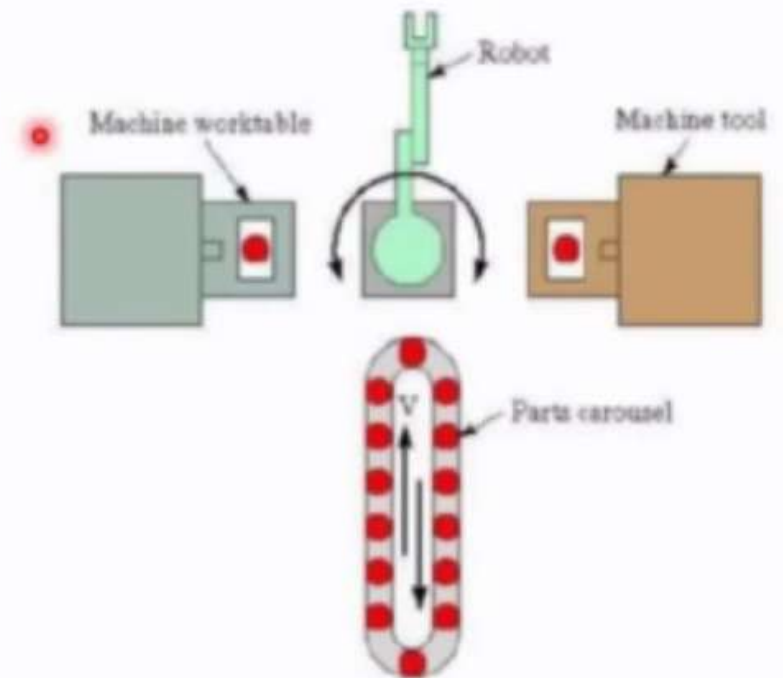
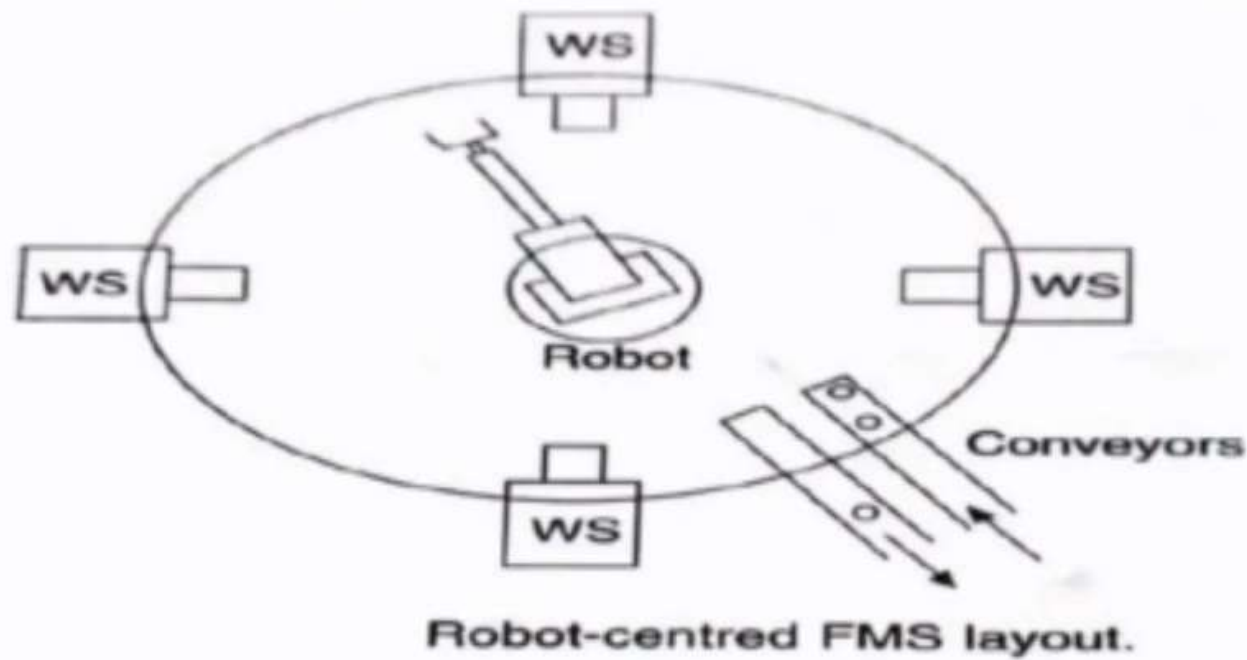
## 5. Open – field FMS layout

- The open field layout configuration consists of Loops, ladders, and sliding organised to achieve the desired processing requirements
- This is appropriate for a large family of parts.



## 6. Robot – Centred FMS layout

- In this the robot is located at the approximate centre of the layout and the other workstations are arranged around it.
- Industrial robot equipped with grippers may be used for the handling of rotational parts.
- The type of layout is well – suited for handling of cylindrical or disk shaped parts.



## Benefits of FMS

1. Greater flexibility
2. Higher machine utilisation
3. Reduced work-in- progress
4. Lower manufacturing lead times
5. Higher labour productivity (Reduced direct and indirect labour)
6. Better management control
7. Consistent and better quality
8. Reduced inventory

# Applications of FMS

- Metal-cutting machining
- Metal forming
- Assembly
- Joining-welding (arc , spot), gluing
- Surface treatment
- Inspection
- Testing