DEFINITION

A FLEXIBLE MANUFACTURING SYSTEM (**FMS**) IS A SET OF ***NUMERICALLY CONTROLLED MACHINE TOOLS*** AND ***SUPPORTING WORKSTATIONS*** CONNECTED BY AN ***AUTOMATED MATERIAL HANDLING SYSTEM*** AND CONTROLLED BY A ***CENTRAL COMPUTER***

Need to Use FMS

- To reduce set up and queue times
- Improve efficiency
- Reduce time for product completion
- Utilize human workers better
- Improve product routing
- Produce a variety of Items under one roof
- Improve product quality
- Serve a variety of vendors simultaneously
- Produce more product more quickly

FMS FEATURES

- MANY PART TYPES CAN BE LOADED
- PARTS CAN ARRIVE AT MACHINES IN ANY SEQUENCE
- PARTS IDENTIFIED BY CODES
- MANY MACHINES CAN BE INCLUDED
- SMALL FMS LEAD TO FLEXIBLE CELLS

FMS FEATURES

- EXPENSIVE TO IMPLEMENT BUT SAVINGS CAN BE SIGNIFICANT
- FLOOR SPACE REDUCIBLE BY 1/3
- EQUIPMENT UTILIZATION UP TO 85% OR MORE
- DETAILED PRODUCTION SEQUENCE NOT NEEDED WELL IN ADVANCE

FMS FEATURES

- REDUCED VARIABLE COSTS AND THROUGHPUT TIME LEAD TO ENHANCED MANUFACTURING COMPETITIVENESS
- ELIMINATION OF STARTUP CYCLES LEAD TO STANDARIZED PERFORMANCE
- MODULAR DESIGN

FMS FEATURES

- REDUCED DIRECT LABOR COSTS
- THREE SHIFTS READILY FEASIBLE
- IDEAL FOR JIT
- CAN EASILY BE TURNED OVER TO NEW SET OF PRODUCTS IF THE NEED ARISES

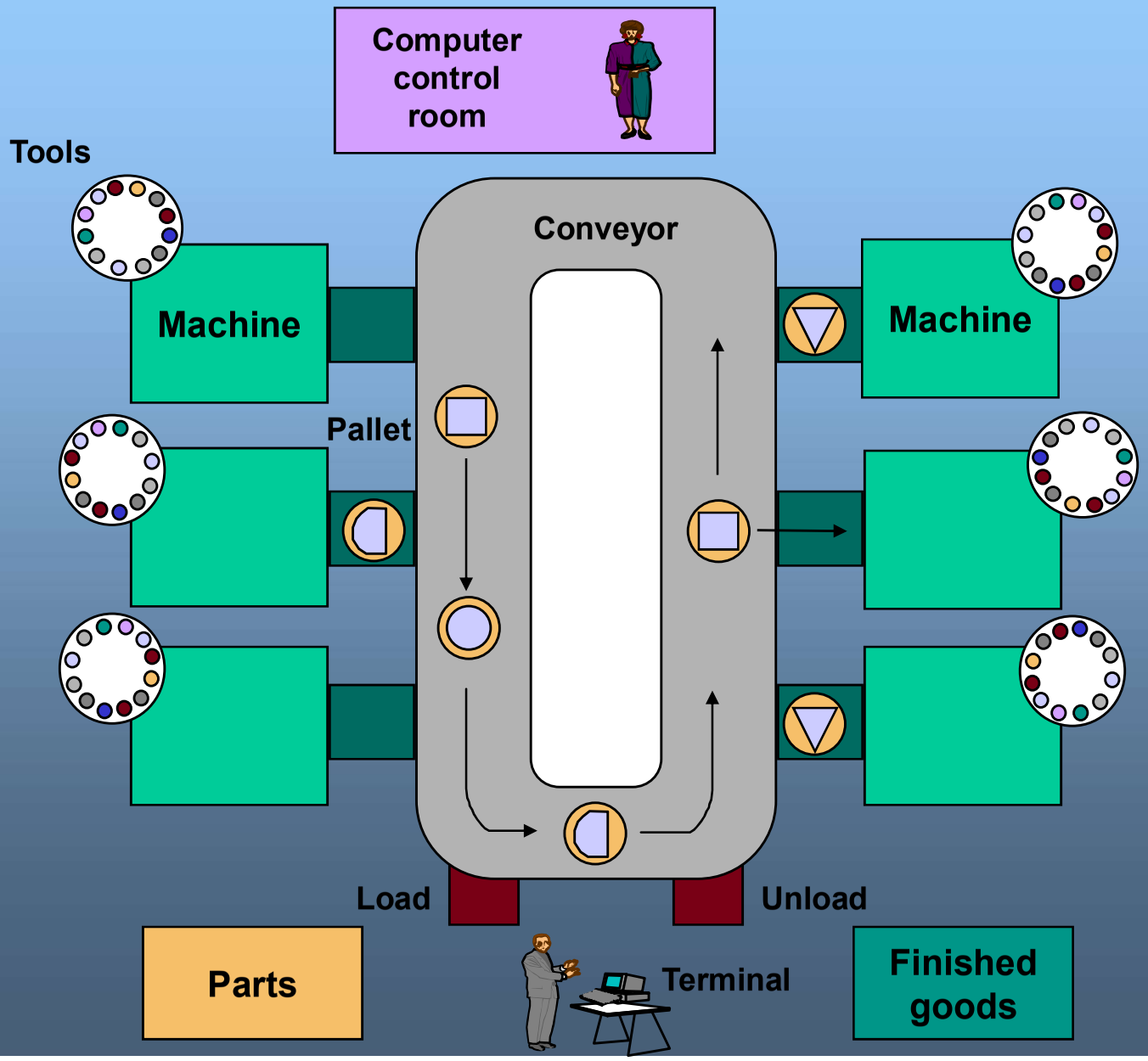
FMS Components

- Processing stations- Machines, assembly, measuring, washing/ deburring etc..
- Automated material handling system (AMHS)
  - Automated guided vehicles (AGV)
  - Conveyors, Industrial Robots
  - Automated storage and retrieval systems (AS/RS)
- Computer control system – software's,

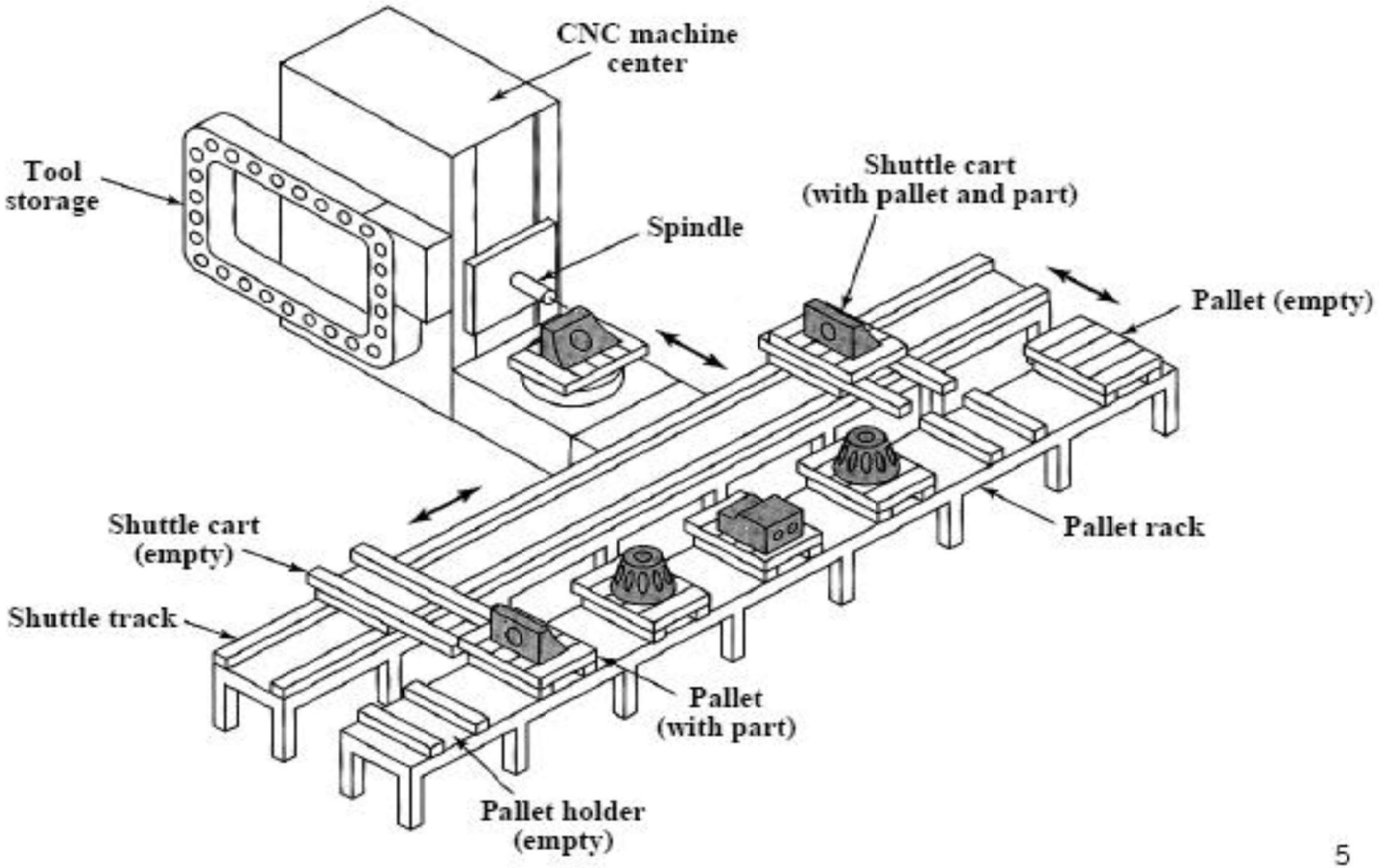
  Monitoring the equipments,

  Communication networks

Flexible Manufacturing System



Single Machine Cell



Single machine cell consisting if one CNC machining center and parts storage unit.

Advantages

- Reduced plant size
- Increased M/c utilization
- Reduced WIP inventory
- Reduced setting up time
- Quicker model change
- Quicker response to market change
- Shorter delivery times
- Consistent accuracy
- Standardization of technology
- Unmanned factory - III rd shift
- Road map to CIM

Disadvantages

- More expensive
- Substantial pre planning activities
- Sophisticated mfg system
- Technological problems- may require a long debugging process.
- Maintenances is complex
- Mid volume and mid product system (optional)

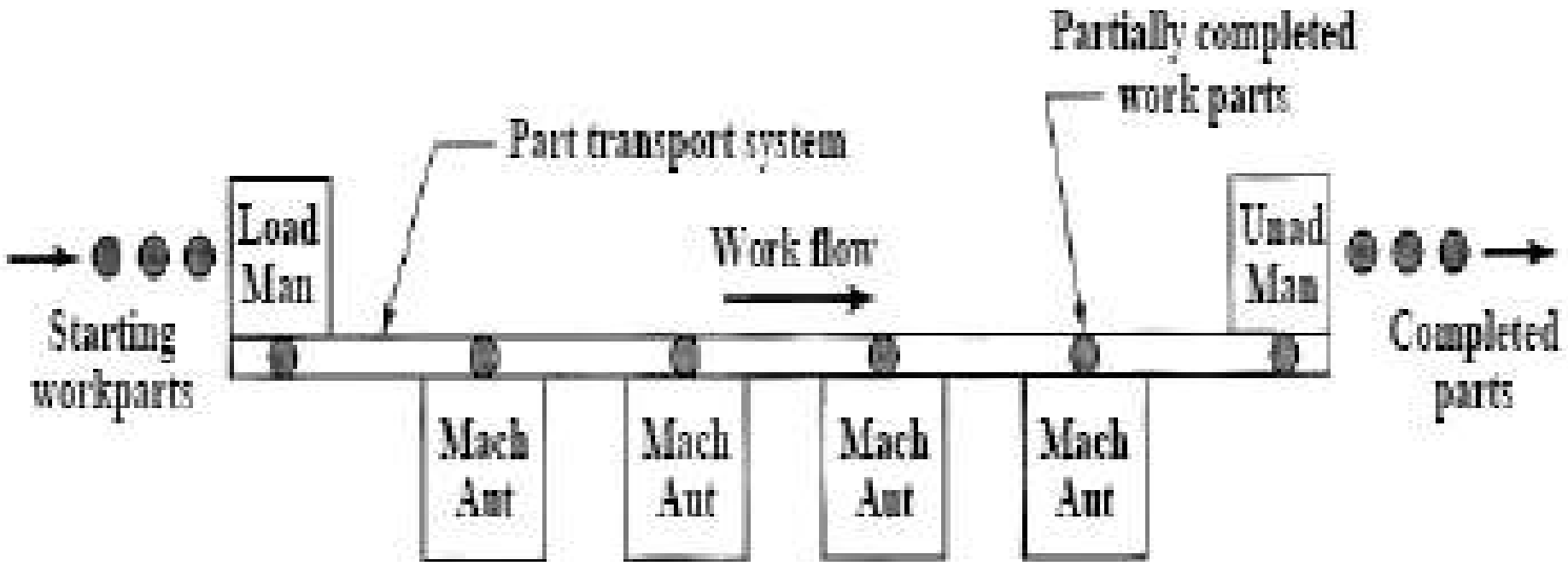
Application of FMS

- Metal-cutting machining
- Metal forming -forging, plastic injection molding
- Assembly of parts and/or equipments (Auto)
- Joining-welding (arc , spot)
- Sheet metal – press working
- Surface treatment
- Inspection
- Testing

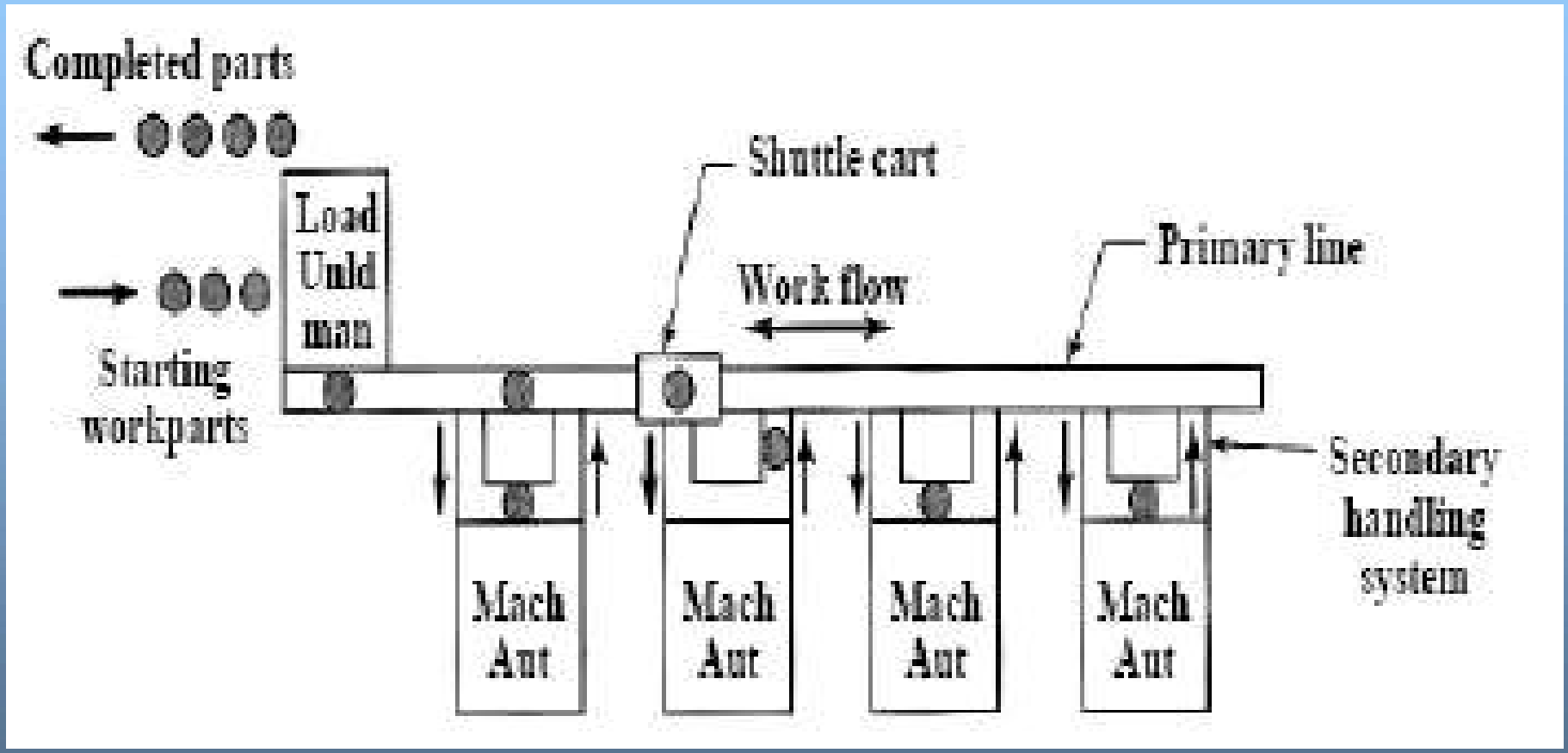
FMS LAYOUT

- In-Line FMS Layout
- FMS Loop Layout
- FMS Ladder Layout
- Open Field FMS Layout

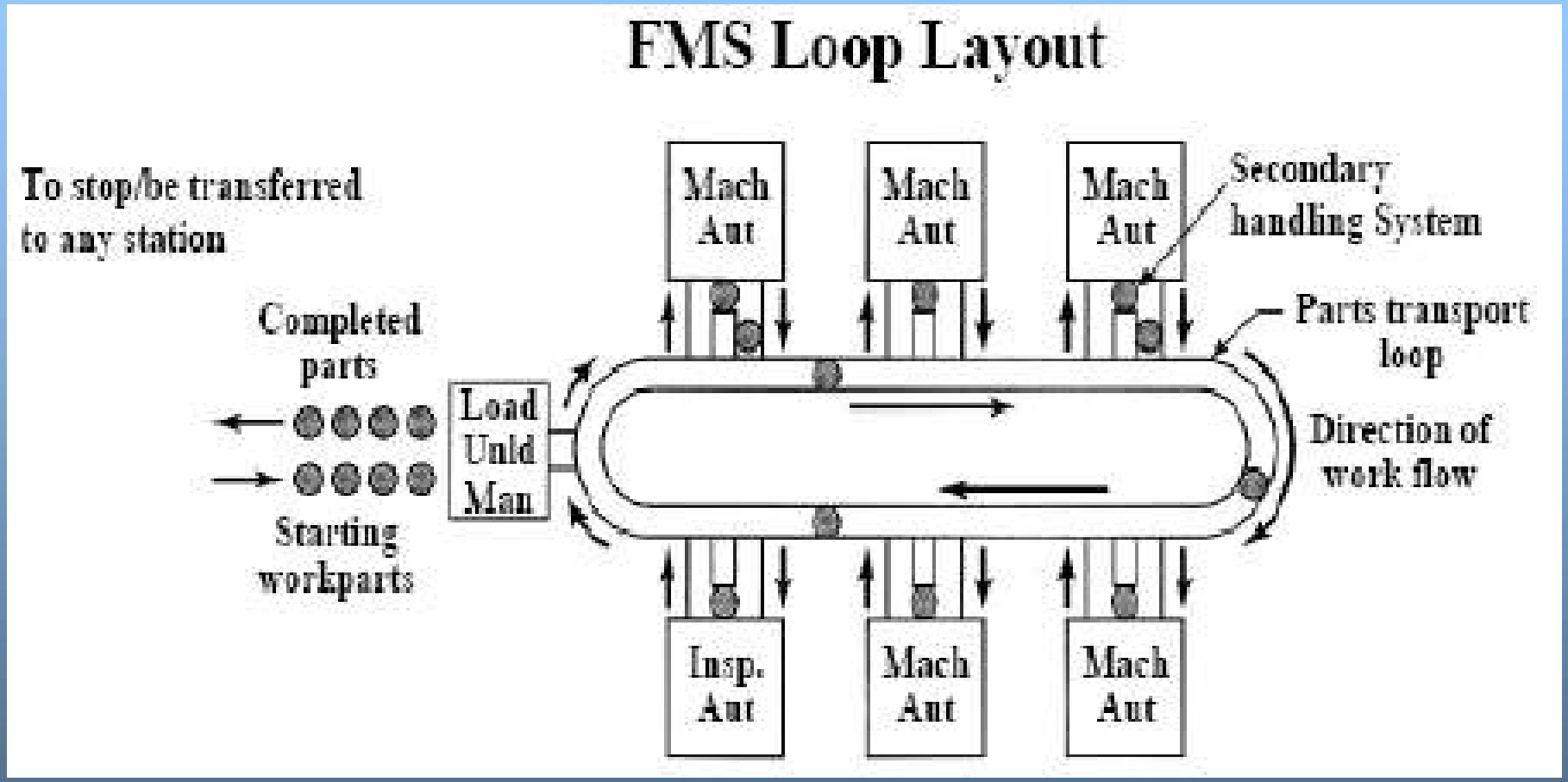
In-Line FMS Layout



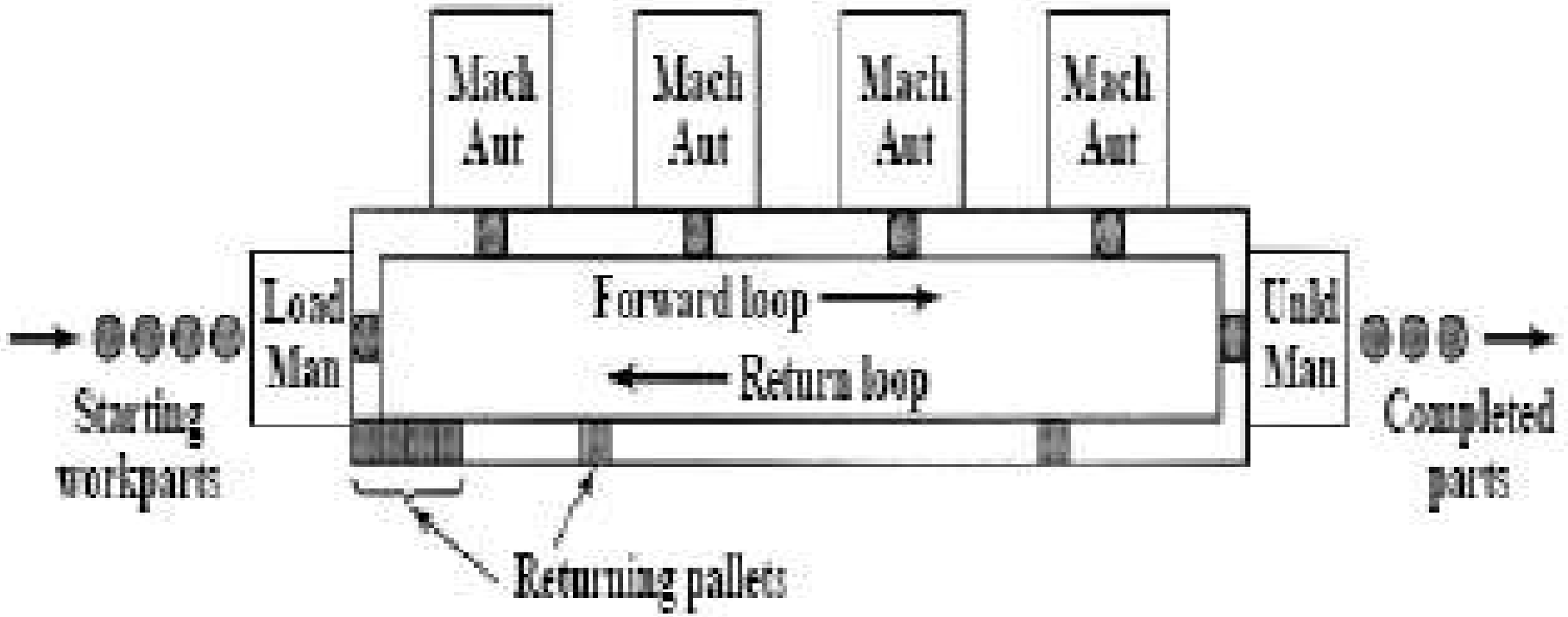
one direction flow similar to a transfer line



Linear transfer system with secondary part handling system at each station to facilitate Flow in two directions

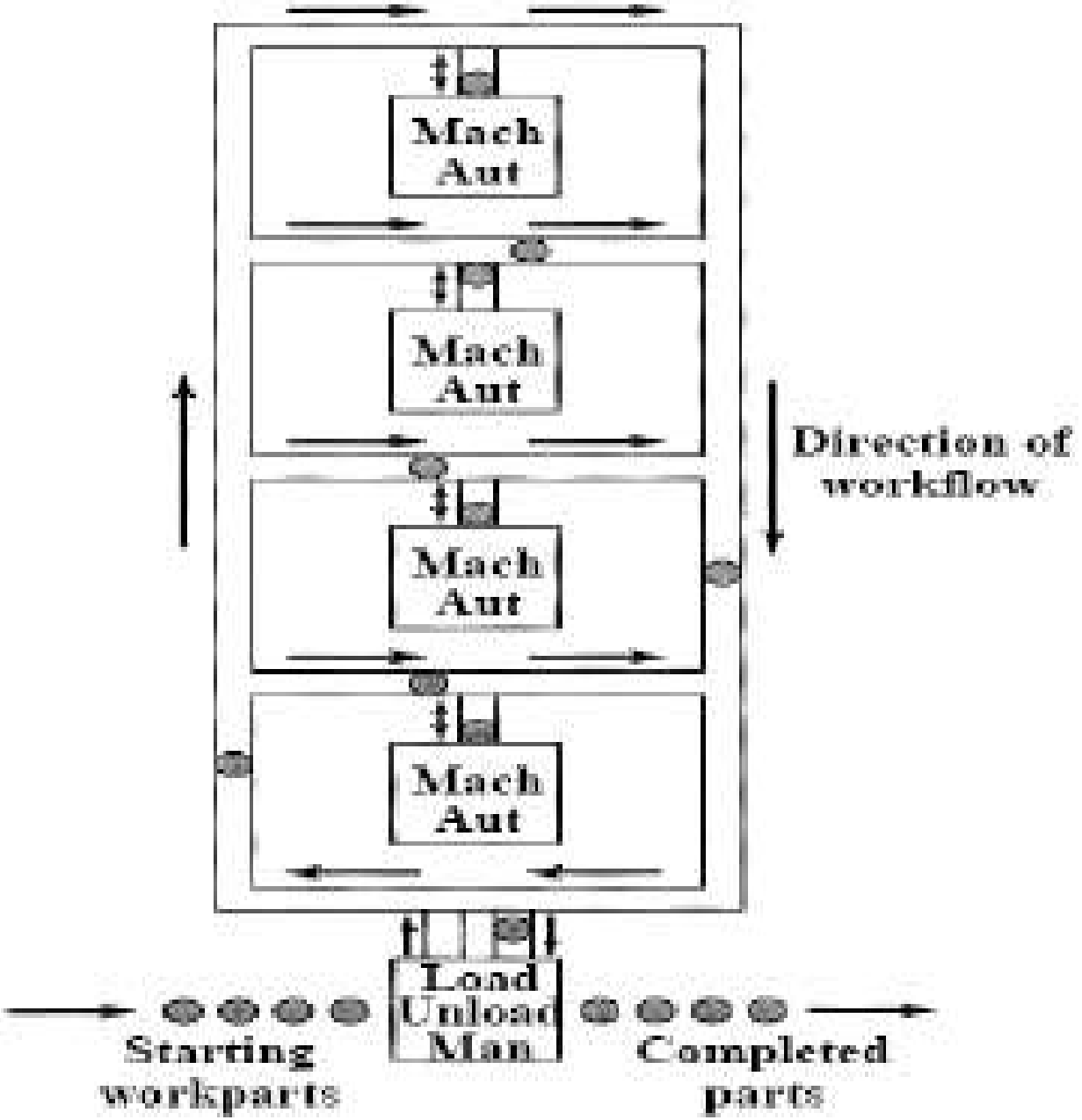


FMS loop layout with secondary part handling system at each station to allow unobstructed flow on loop

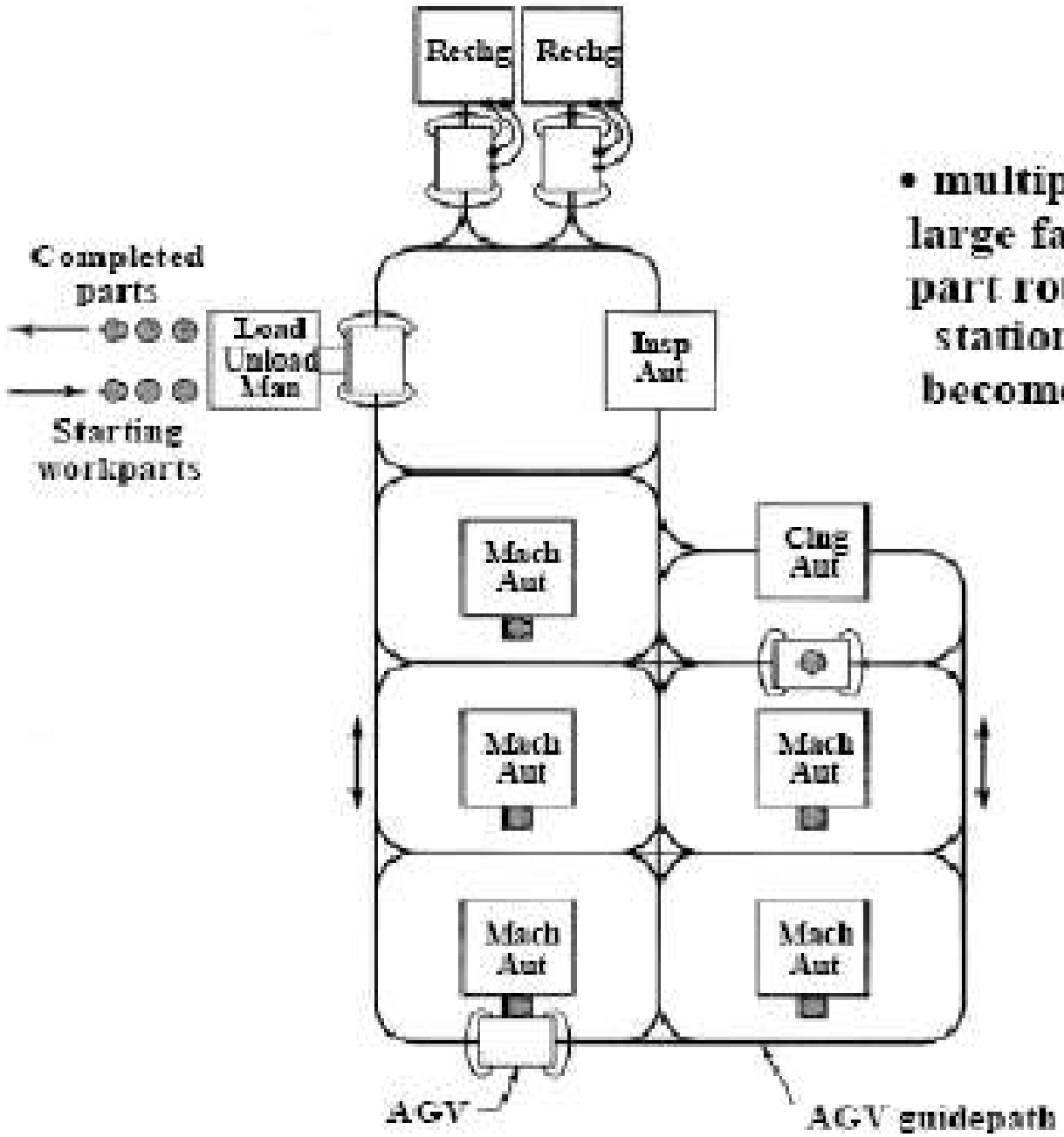


Rectangular layout for recirculation of pallets to the first workstation in the sequence

FMS Ladder Layout



Open Field FMS Layout

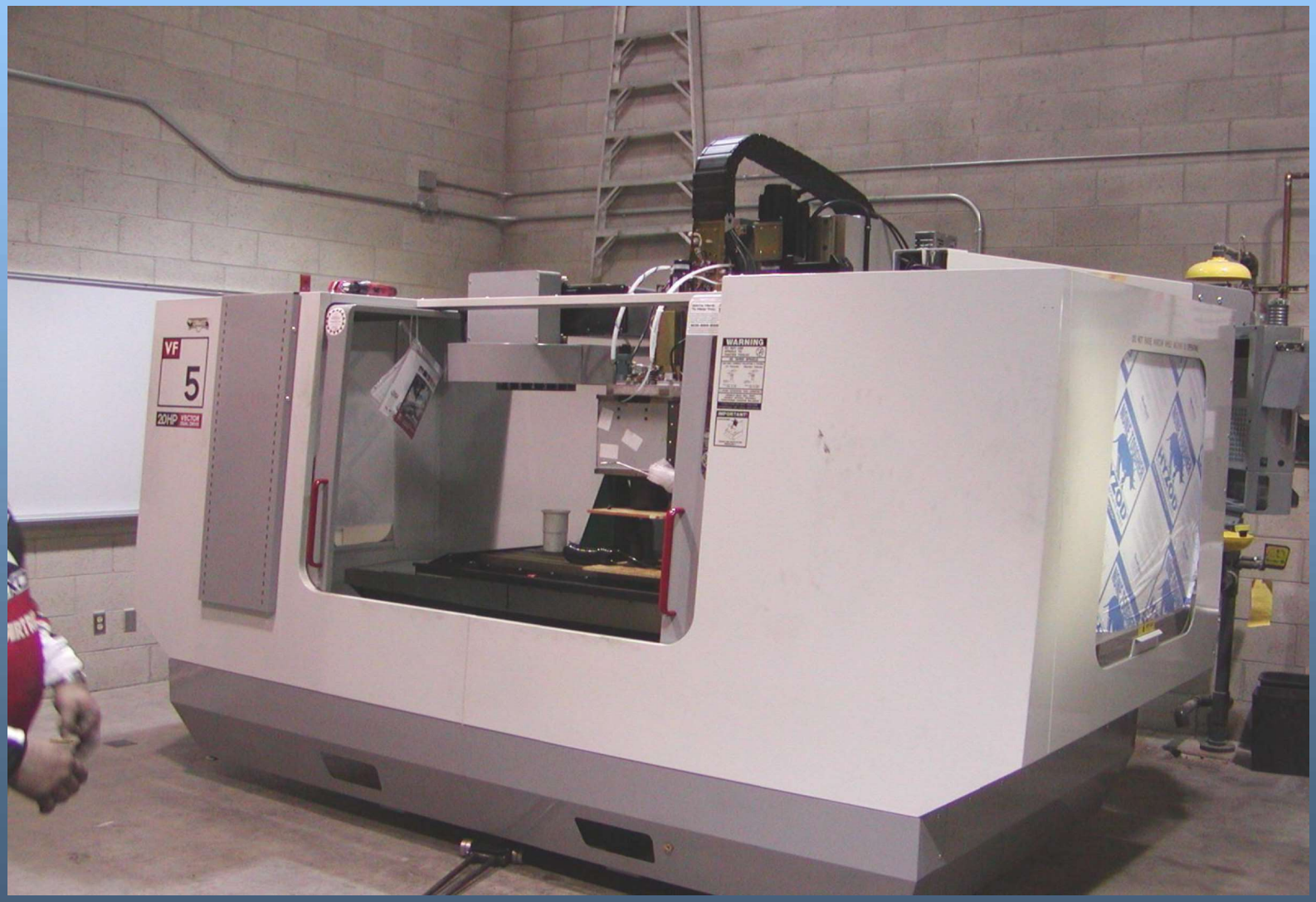


- multiple loops and ladders
large family of parts
part routing to different work stations depending on which one becomes available first.

PROCESSING STATIONS

- CNC Machine Tools
- Machining Center
- Turning Center
- Coordinate measuring machine(CMM)
- De-burring station/Washing station

CNC Machine Tools




CNC
Miyano

MATERIAL HANDLING SYSTEMS(MHS)

- AUTOMATED GUIDED VEHICLE(AGV)
- AUTOMATED STORAGE AND RETRIVEAL SYSTEM(ASRS)
- ROBOTS
- CONVEYOR

Automated Guided Vehicle

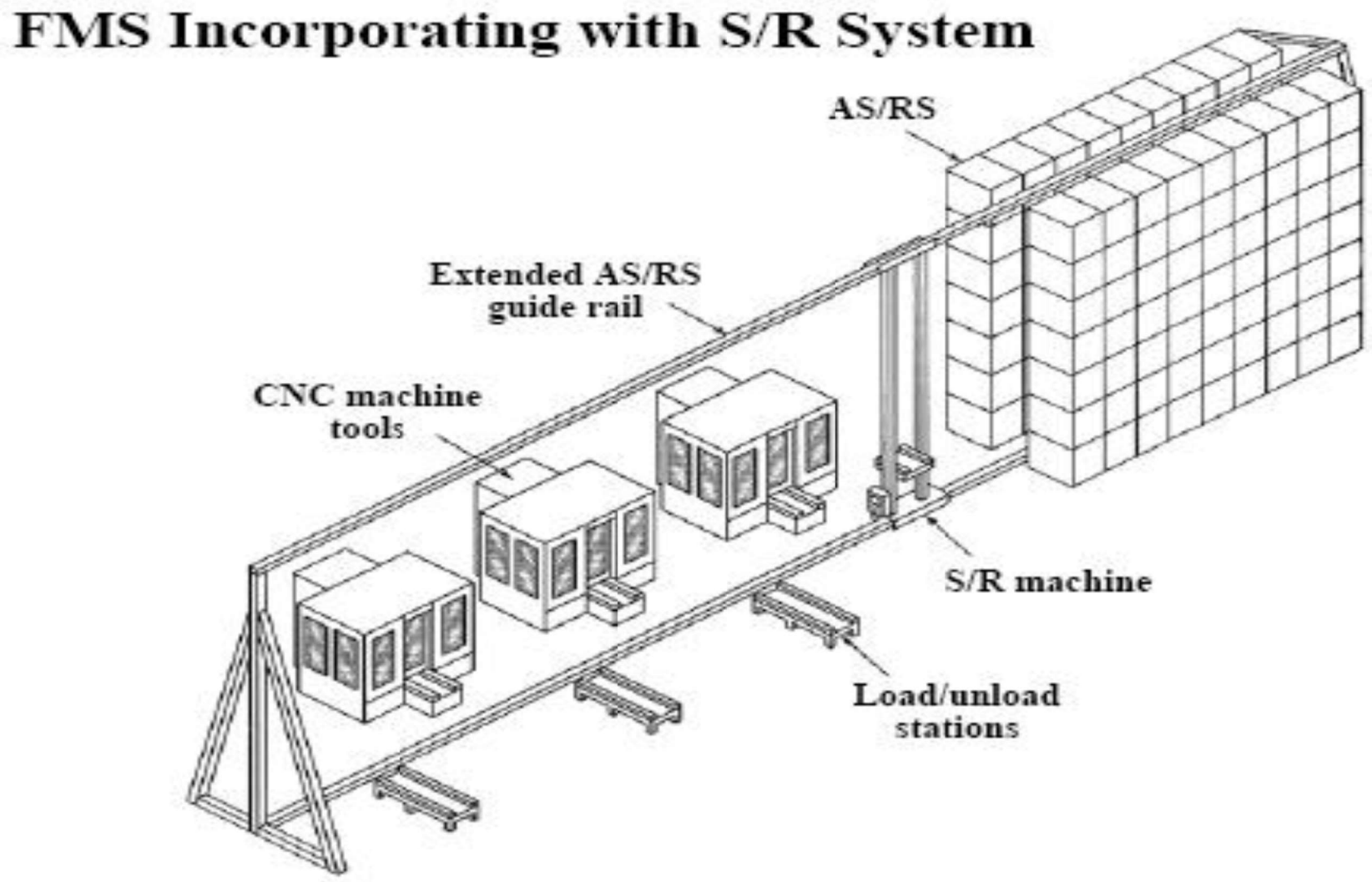
The **Automated Guided Vehicle** or **Automatic Guided Vehicle**(AGV) is a mobile robot used in industrial applications to move materials around a manufacturing facility or a warehouse.

←Heavy-duty AGV

Light-duty assembly AGV →

Laser Guided Forklift AGV

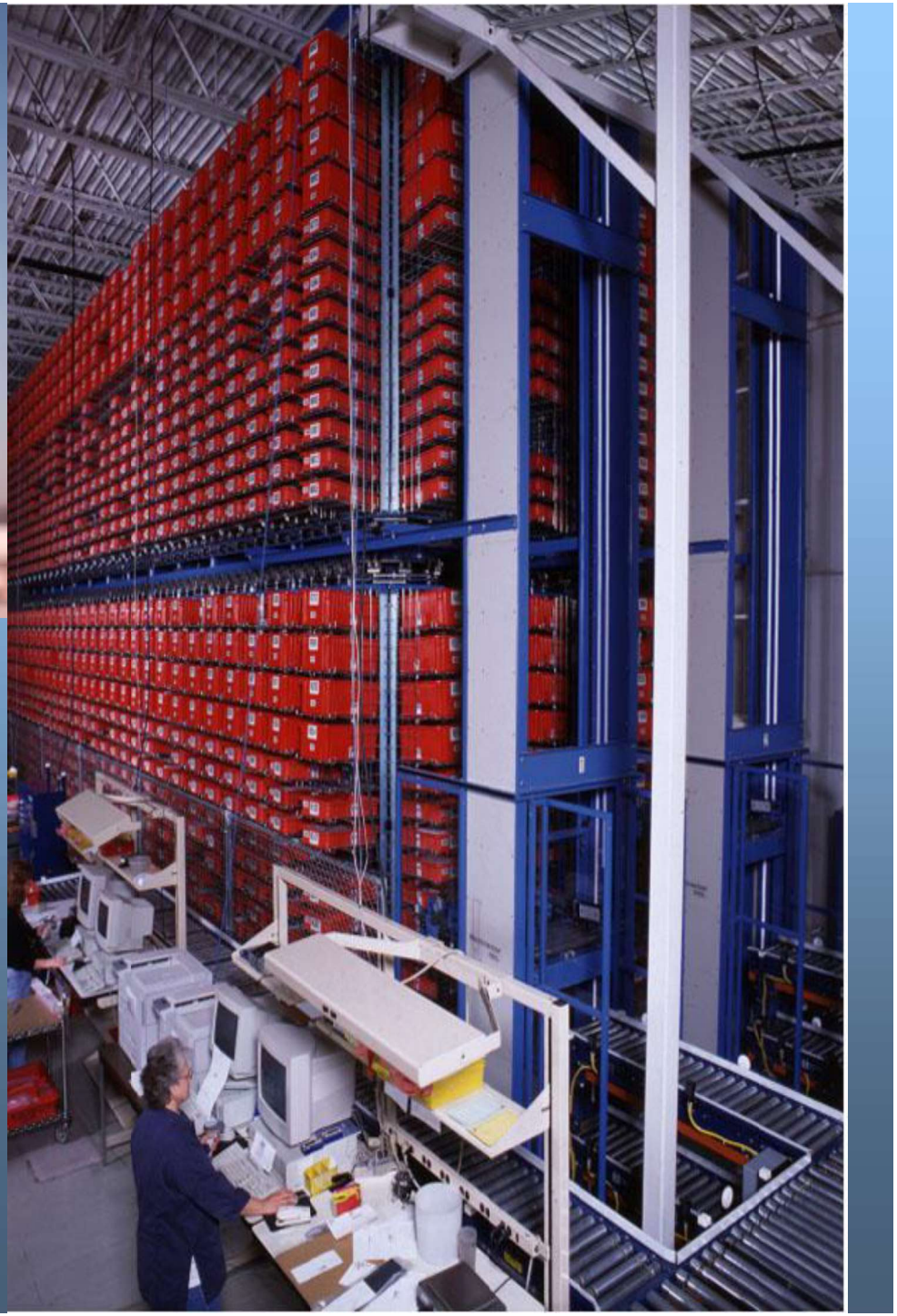
AUTOMATED STORAGE AND RETRIVEAL SYSTEM

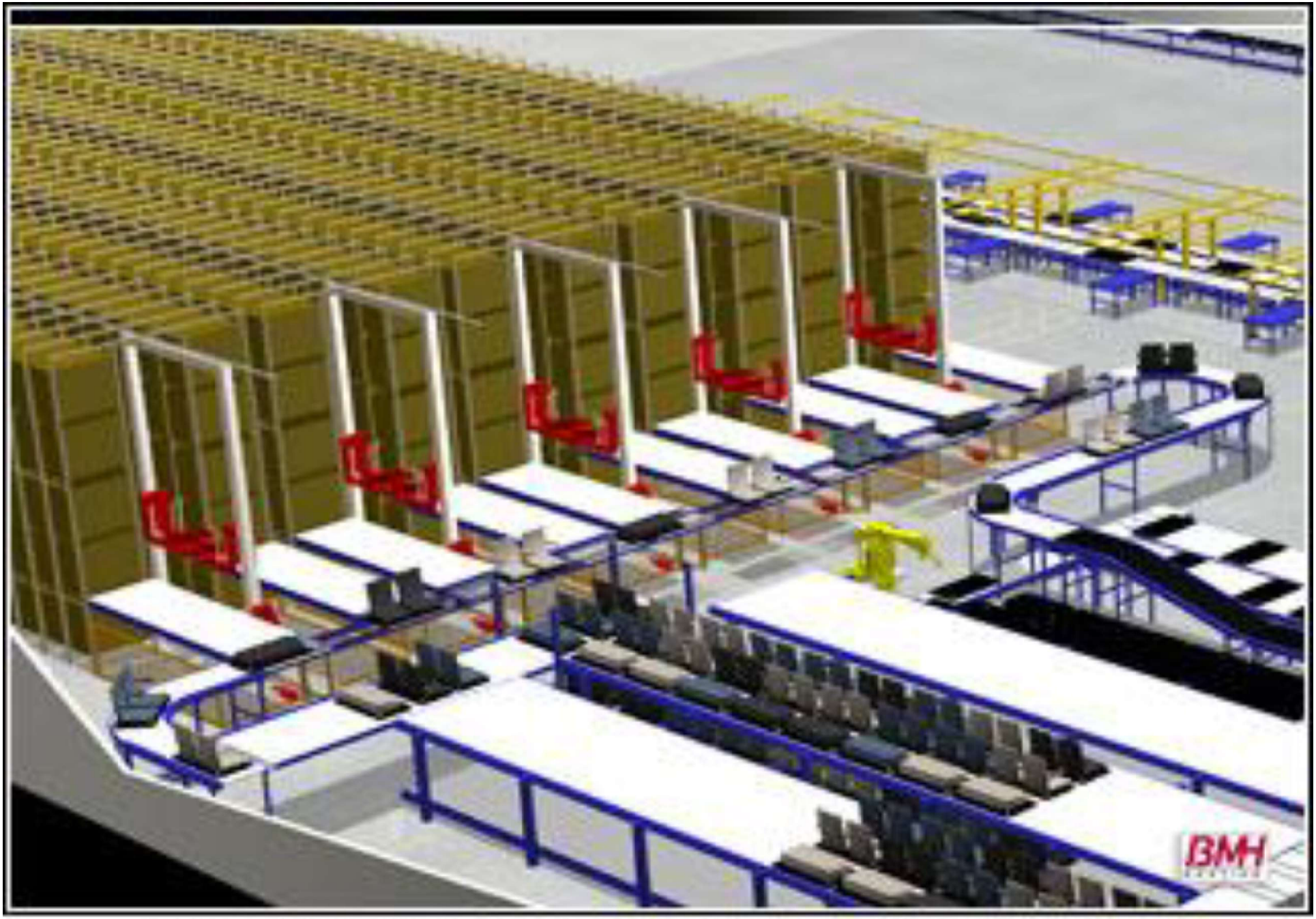


Why ASRS?

- Space is one of the most valuable commodities in modern industries.
- Most industries use off-site storage for less used materials - labor intensive manual storage and retrieval.
- Some industries use compact shelving.

AS/RS





AS/RS Unit Load storage buffer for supply chain delivery

Robot

- Programmable manipulators
- Follow specified path
- Better than humans with respect to
  - –hostile environments
  - –long hours
  - –consistency

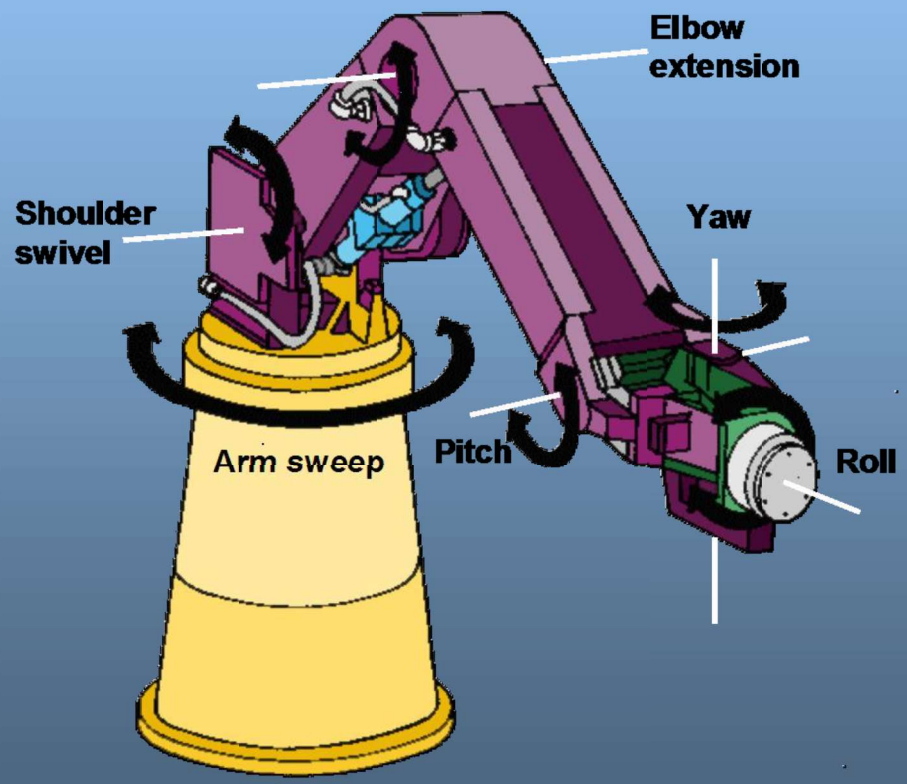
Robot Parts

- Controller
  - –hardware, software, power source
- Manipulator
  - –robot arm
- End-effector
  - –“hand”

Common Uses of Robots

- **Loading and unloading**
- **Spray painting**
- **Welding**
- **Material handling**
- **Inspection**
- **Machine Assembly**

Robot

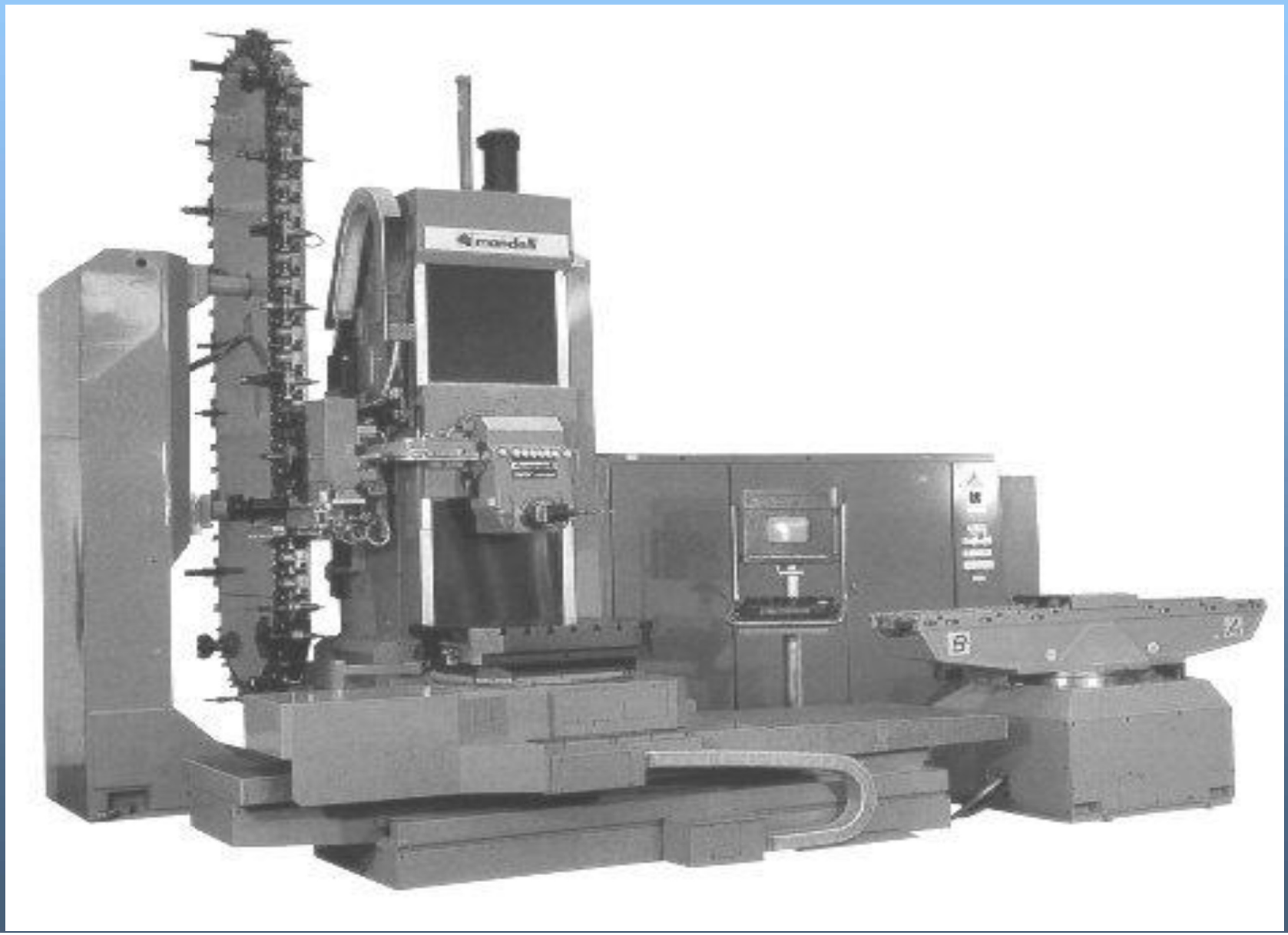


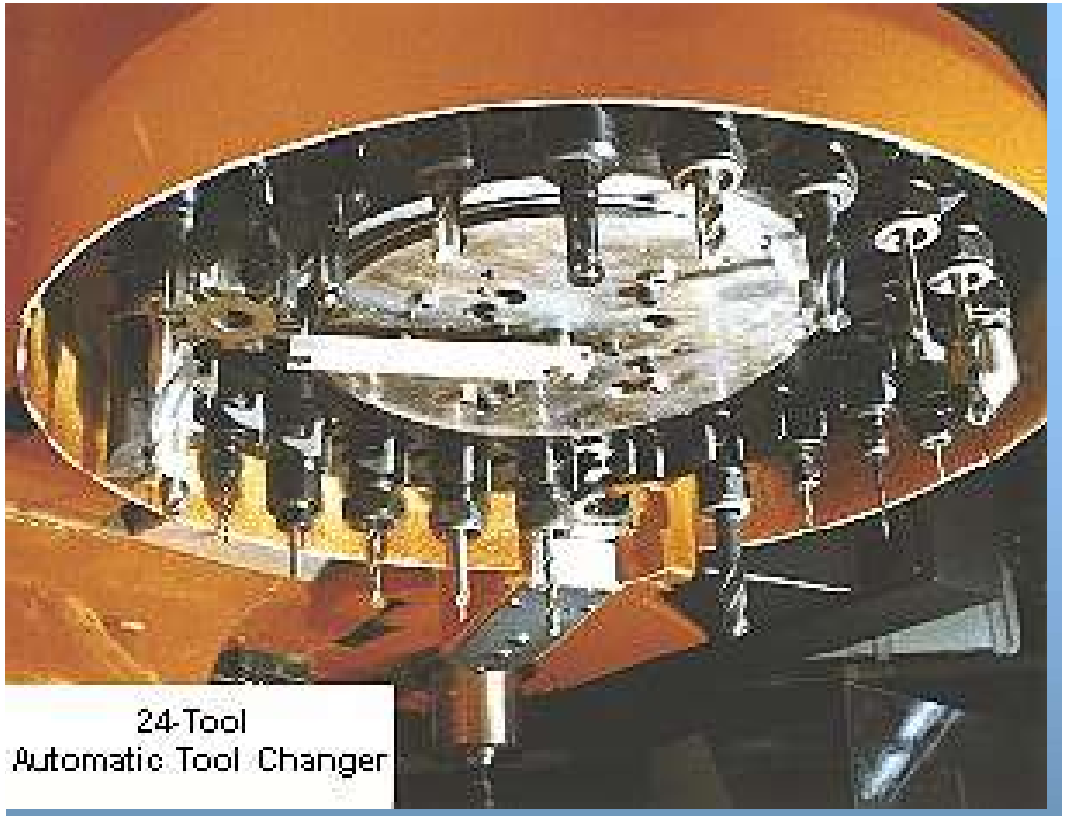

COMAU

Tool Management

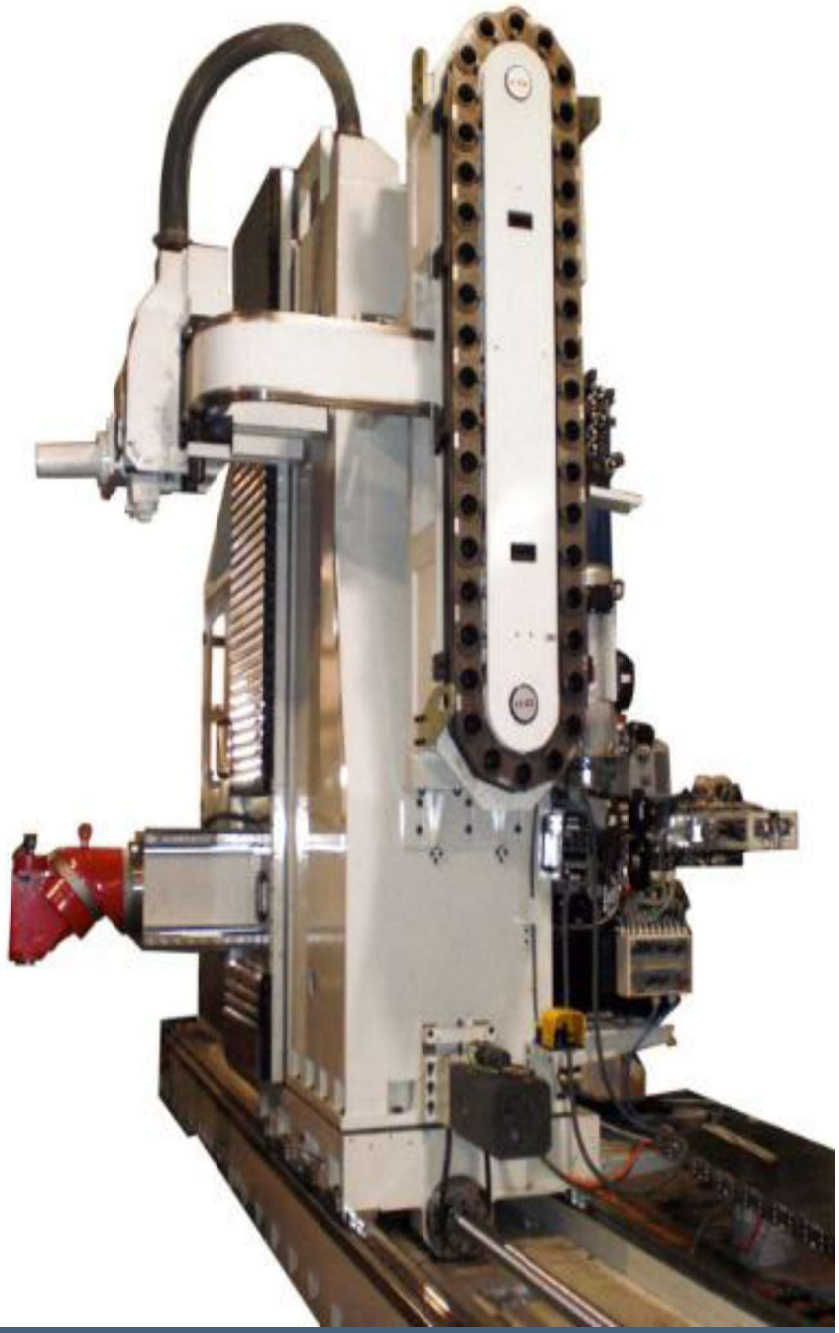
- ✓ Tool magazine
- ✓ Tool Library
- ✓ Automatic Tool Changer(ATC)

Tool magazine

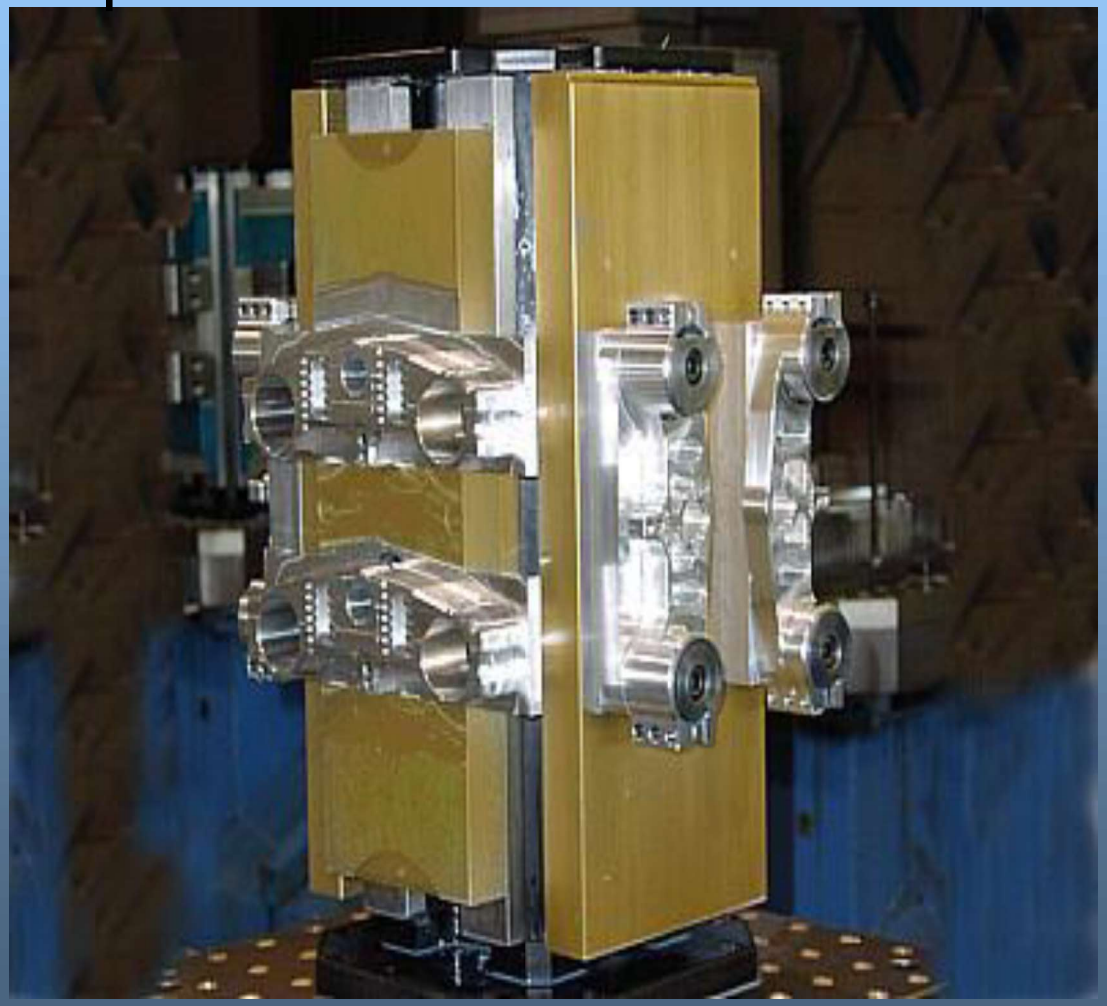


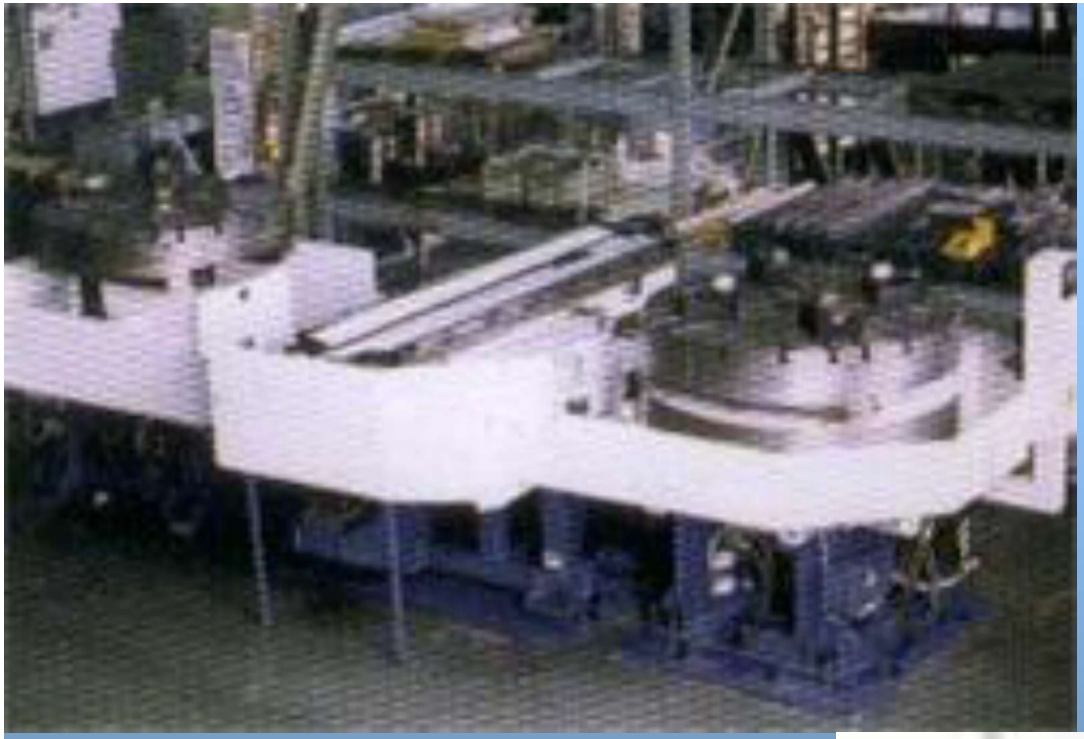


24-Tool
Automatic Tool Changer



Use of fixture plate (right side) and machined soft jaws (left side) to machine different sides of a complex part





APC