

Industrial Automation

Syllabus Module 2

- **Mechanization and Automation:** Mechanization and automation, product cycle, hard Vs flexible automation, Capital- intensive Vs low cost automation
- Types of systems-mechanical, electrical, hydraulic, pneumatic and hybrid systems
- Automation using CAMS, Geneva mechanisms, gears etc.
- Assembly line Automation: automated assembly systems, transfer systems, vibratory bowl feeders, non-vibratory feeders, part orienting, feed track, part placing & part escapement systems
- Introduction to Material storage/ handling and transport systems, and its automation using AS/RS, AGVS and conveyors etc.

Assembly line Automation

- Assembly involves the joining together of two or more separate parts to form new entity which may be assembly or subassembly.
- Automated assembly refers to the use of mechanized and automated devices to perform the various functions in an assembly line or cell
- Automated assembly system performs a sequence of automated operations to combine multiple components in to a single entity which can be a final product or sub assembly

Need for an automated assembly system

- High product demand.
- Stable product design.
- The assembly consists of not more than a limited number of components.
- The product is designed for automated assembly.

Automated assembly v/s Transfer lines

- Work part produced are smaller in size compared to transfer lines.
- Assembly operations do not have the large mechanical forces and power requirement.
- Size is very less compared to transfer lines.

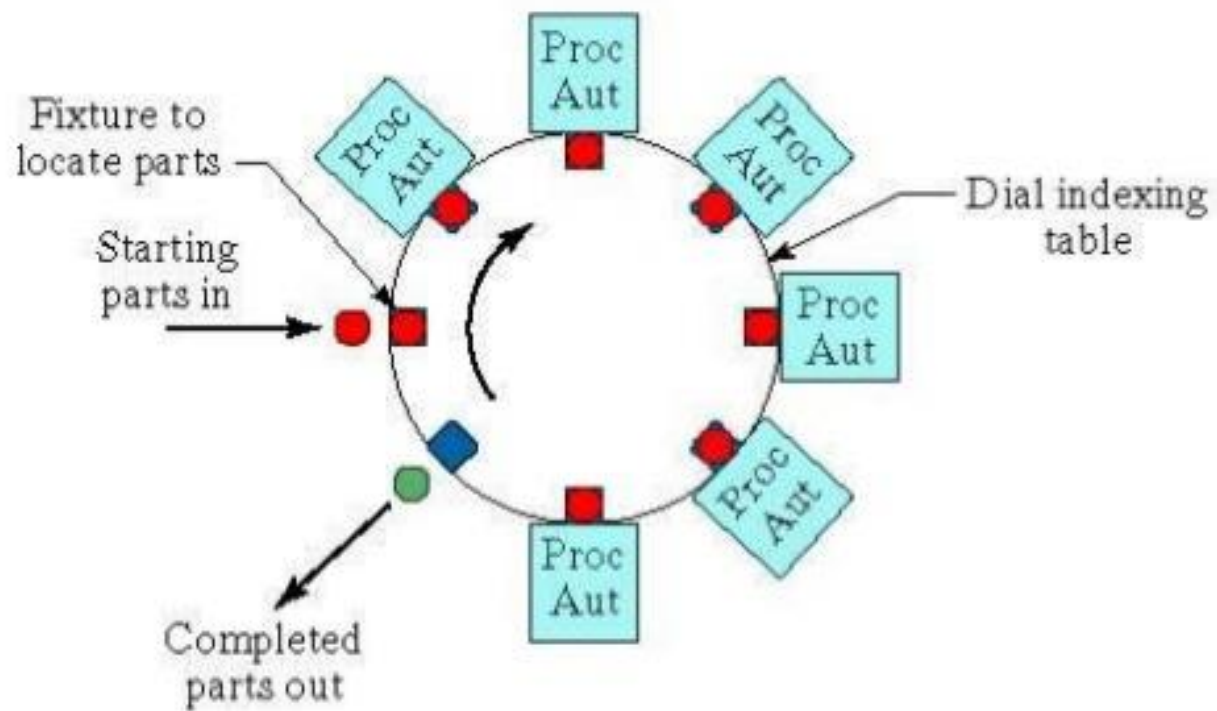
Design for Automated assembly

- Some principles that can be applied in product design to facilitate automated assembly are
 - Reduce the amount of assembly required.
 - Use modular design
 - Reduce the number of fasteners required.
 - Reduce the need for multiple components to be handled at once.
 - Limit the required directions of access.
 - Require high quality in components.

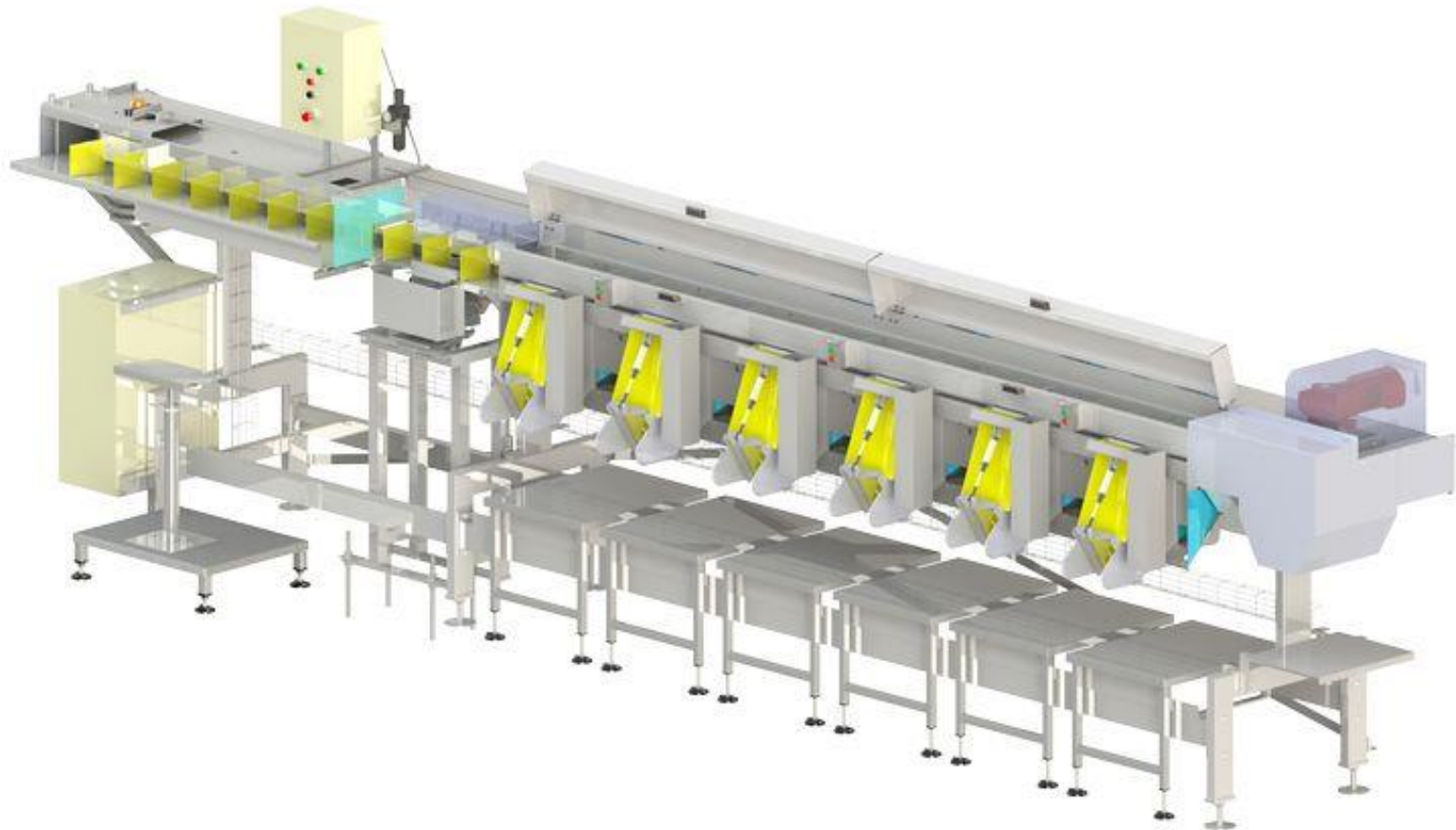
Types of automated assembly systems

- Dial-type assembly machine
- In-line assembly machine
- Carousel assembly system
- Single-station assembly machine

Dial type



In-line assembly machine



Carousel assembly system

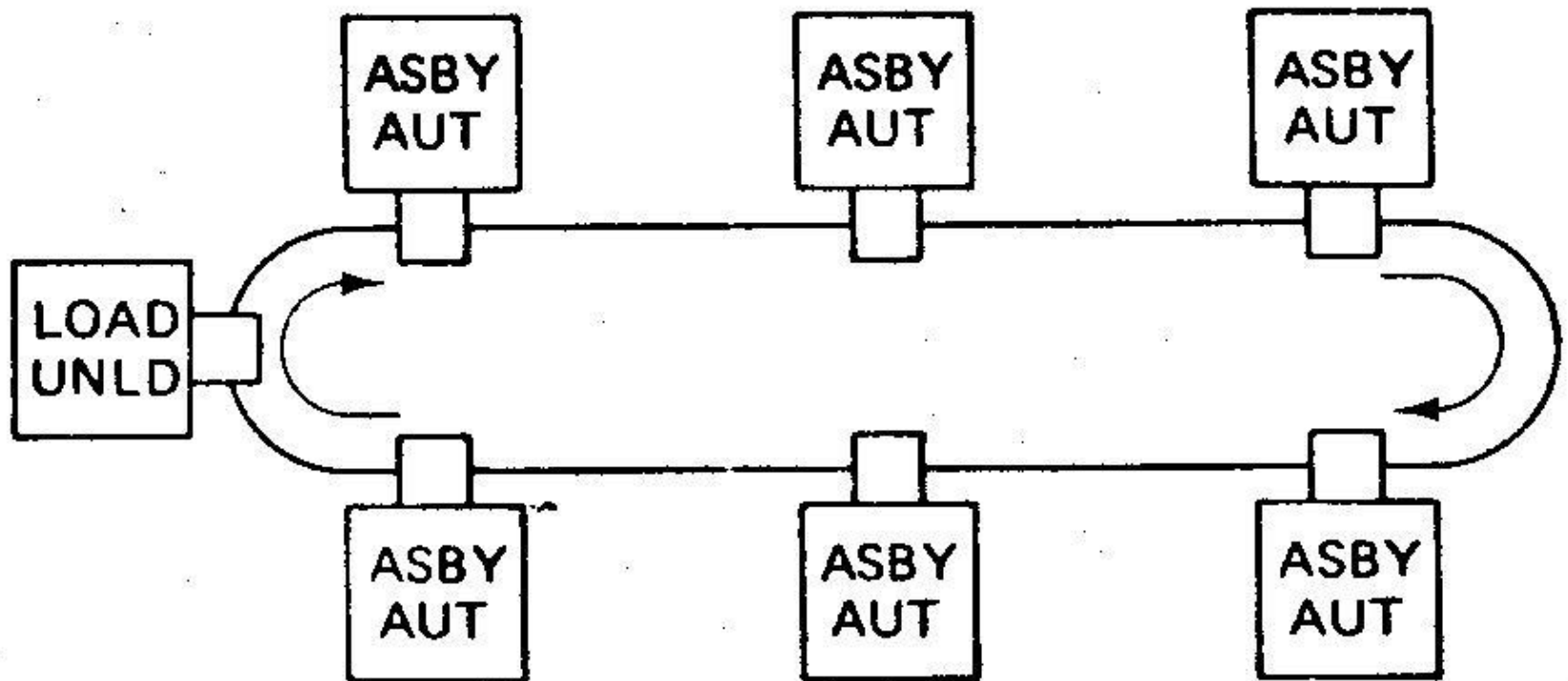


FIGURE 7.2 Configuration of a carousel assembly system.

Single-station assembly machine

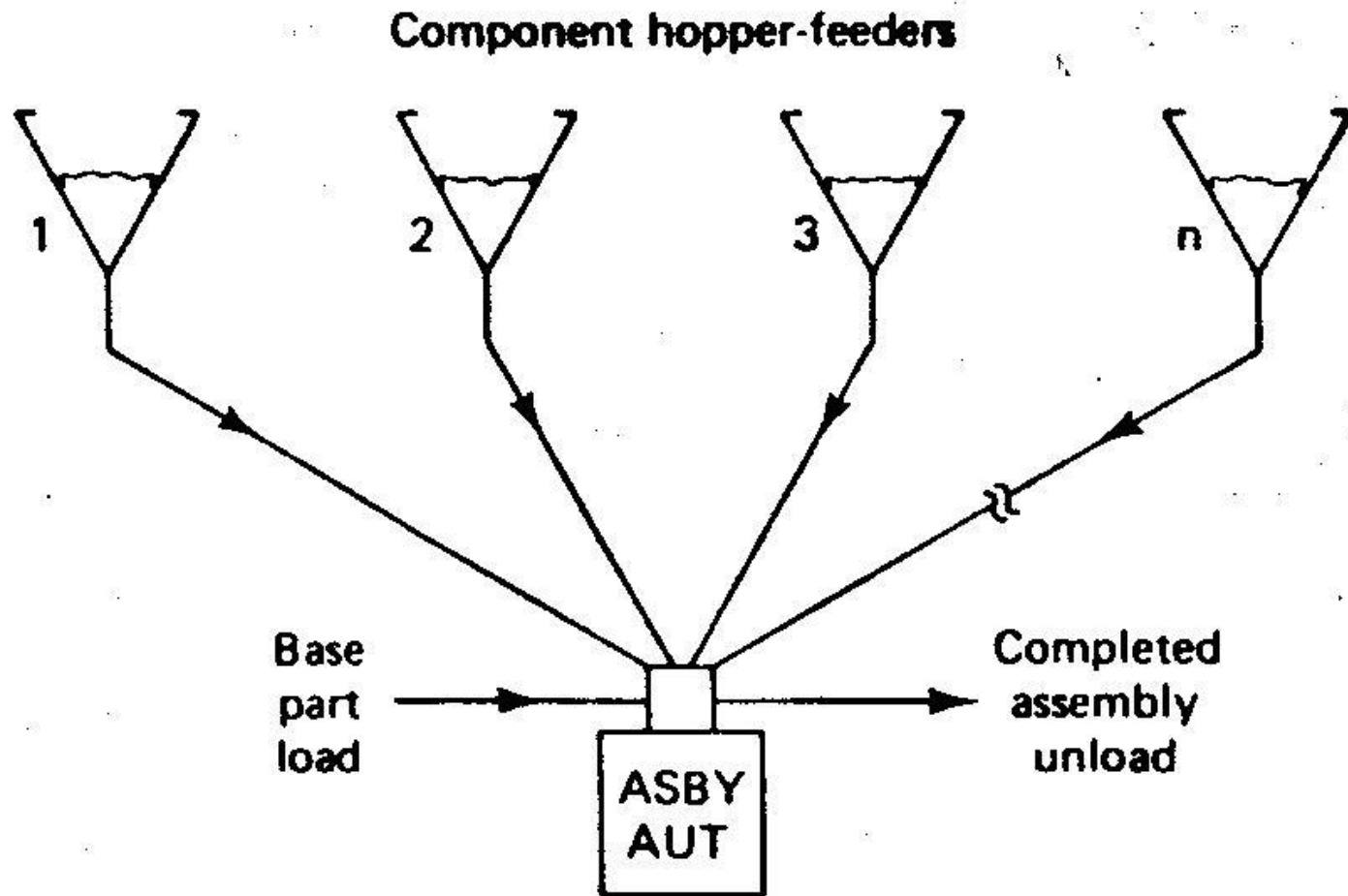
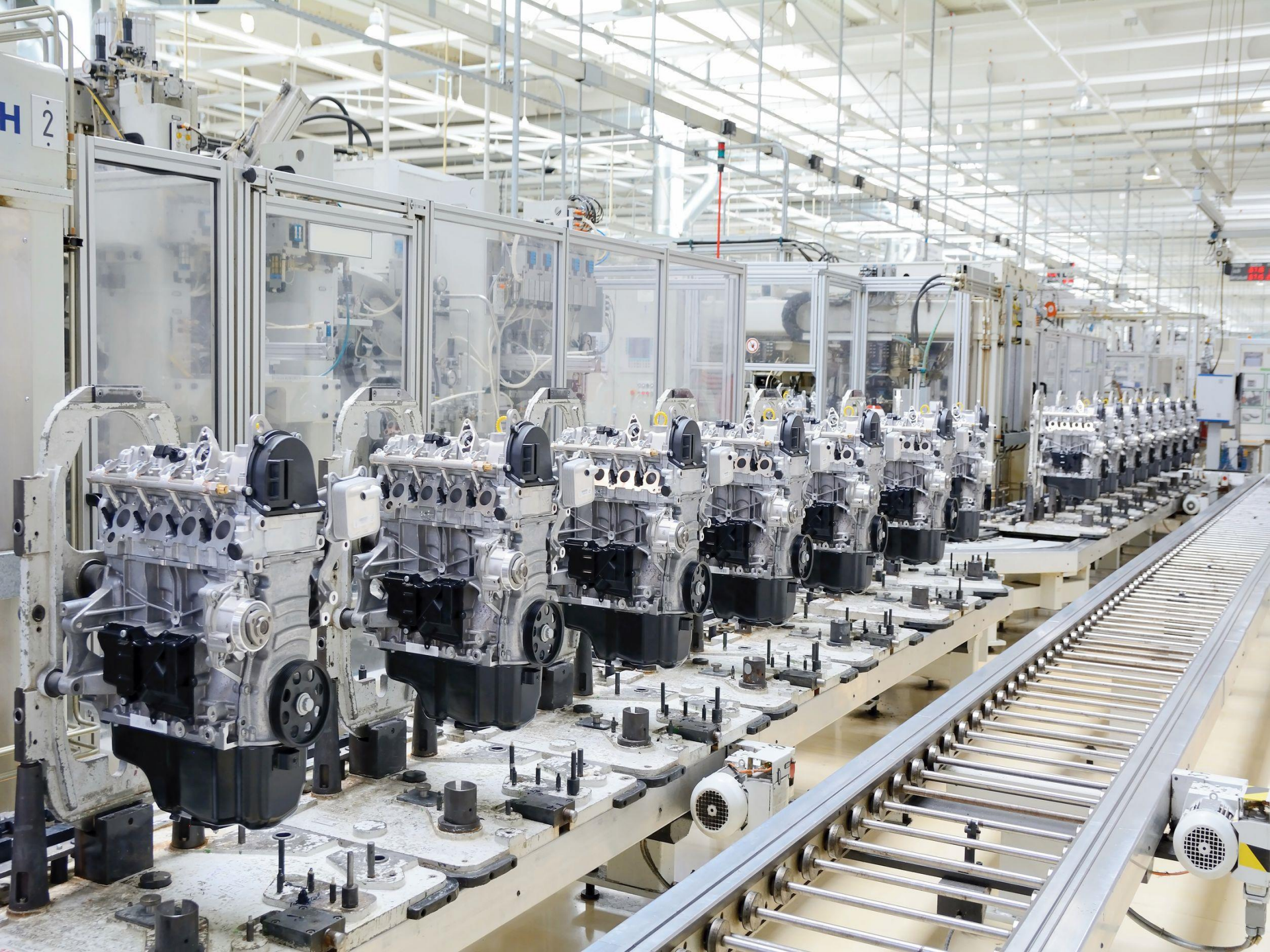


FIGURE 7.8 Single-station assembly machine.

Assembly line Automation

- In the process of finding solutions for the assembly process the main assembly parameters considered
 - Effect on cycle time
 - Investment cost.
- Parameter to consider
 - Levels of automation
 - Possible improvements
 - Comparison between fully automated case and Minimal investment case
 - Equipment
 - The industrial robots
 - The feeder systems
 - Tools
 - Validity and reliability



INDUSTRIAL ROBOT

- An industrial robot is a robot system used for manufacturing
- Industrial robots are automated, programmable and capable of movement on three or more axis.
- Typical applications of robots
 - Welding
 - Painting
 - Assembly
 - Pick and place
 - Packaging and labelling
 - Palletizing
 - Product inspection
 - Product testing;

Feeder Systems

- Vibratory bowl feeders
 - These common devices used to feed individual component parts for assembly on industrial production lines.
 - They are used when a randomly sorted bulk package of small components must be fed into another machine one-by-one, oriented in a particular direction



Feeder Systems

- Parameter
 - Mechanical behaviour of a part
 - Shaking speed
 - Shape of component
 - position of its **centre of mass** in relation to its centre of volume
- Application
 - Pharmaceutical
 - Automotive
 - Electronic
 - Cosmetic
 - Food
 - Fast Moving Consumable Goods (FMCG)
 - Packaging and metalworking industries
 - Glass Industry
 - Foundry Industry
 - Steel Industry
 - Construction Industry
 - Recycling Industry
 - Pulp and paper Industry
 - Plastics Industry

Types of feeding systems

- Bowl feeders
 - Consists of a bowl top with a spiral track inside the bowl.
- Centrifugal feeders
 - Referred as 'rotary feeders'
 - Conical central driven rotor surrounded by a circular bowl wall.
 - The feeder separate component parts utilizing rotary force and the parts revolve with high speed and are pulled to the outside of the bowl
- Step feeders (Video)
 - The component parts are collected from the hopper by elevating plates, pre-sorted and fed until they reach the desired transfer height.
 - Operates quietly and without vibration.

Types of feeding systems

- Linear feeders (Video)
 - Horizontal conveying of components.
 - Used to handle irregular supplies of parts from upstream equipment, creating a buffer store and smooth flow for further processes.
- Carpet feeders (Video 2)
 - Enable gentle handling of orientated components from bulk to escapement devices creating product accumulation prior to a machine or handling unit
- 3-Axis Vibration feeders (Video)
 - Robotic parts feeders using a vibratory plate to distribute parts evenly on a level surface for pickup by an industrial robot.
 - very high performance flexible part feeding, part pre-orientation and optimal surface distribution of bulk parts and components