

# Introduction of Industrial Automation

# 1. Introduction

- Automation can be defined as the process of following a predetermined sequence of operations with little or no human labor, using specialized equipment and devices that perform and control manufacturing processes
- **Example : Bottling Plant for beverages**



## 2. Scope of industrial automation

- Explosive growth with nanotechnology and Nano scale assembly system, MEMS and nanotech sensors (tiny, low-power, low-cost sensors)
- Adaptive and multi- processing system interfaced with the real time automatic system
- Remote controlled automation systems - factory will be small, movable, and flexible

# Impacts of Automation

- Social economic impacts of automation
- Automation and society
- Employment
- Automation and the individual

# 3. Advantages and disadvantages of automation

## Advantages:

- Human operator replacement from hard physical or monotonous work
- Use of Robot and other automatic machines in hazardous environments (i.e. fire, space, volcanoes, nuclear facilities, underwater, etc)
- Performing tasks beyond the human capabilities: handling too heavy loads, too large objects, too hot or too cold substances or to make things too fast or too slow

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# 3. Advantages and disadvantages of automation

## Advantages:

- Increased reliability and precision
- Improved worker environment
- High quality, high production rates and ultimately Economic Growth

# 3. Advantages and disadvantages of automation

Disadvantages:

- Security Threats/Vulnerability
- Unpredictable development costs
- High initial cost



# 4. Automation principles and strategies

- Automation Approach
- The Ten Strategies for Automation and Production Systems, and
- An Automation Migration Strategy

# 4. Automation principles and strategies

- 4.1 Automation Approach

- 4.1.1 Understand the existing process

- What are the in-puts?
    - What are the outputs?
    - What exactly happens to the work unit between input and output?
    - What is the function of the process?
    - How does it add value to the product?
    - What are the upstream and downstream operations in the production sequence

# 4.1 Automation Approach

## 4.1.2 Simplify the process

- What is the purpose of a step or a transport?
- Is this step necessary?
- Can this step be eliminated?
- Is the most appropriate technology being used in this step?
- How can this step be simplified?
- Any unnecessary steps in the process that might be eliminated without detracting from function?

# 4.1 Automation Approach

## 4.1.2 Simplify the process (Contd.)

- Can steps be combined?
- Can steps be performed simultaneously?
- Can steps be integrated into a manually operated production line?

## 4.1.3 Automate the process

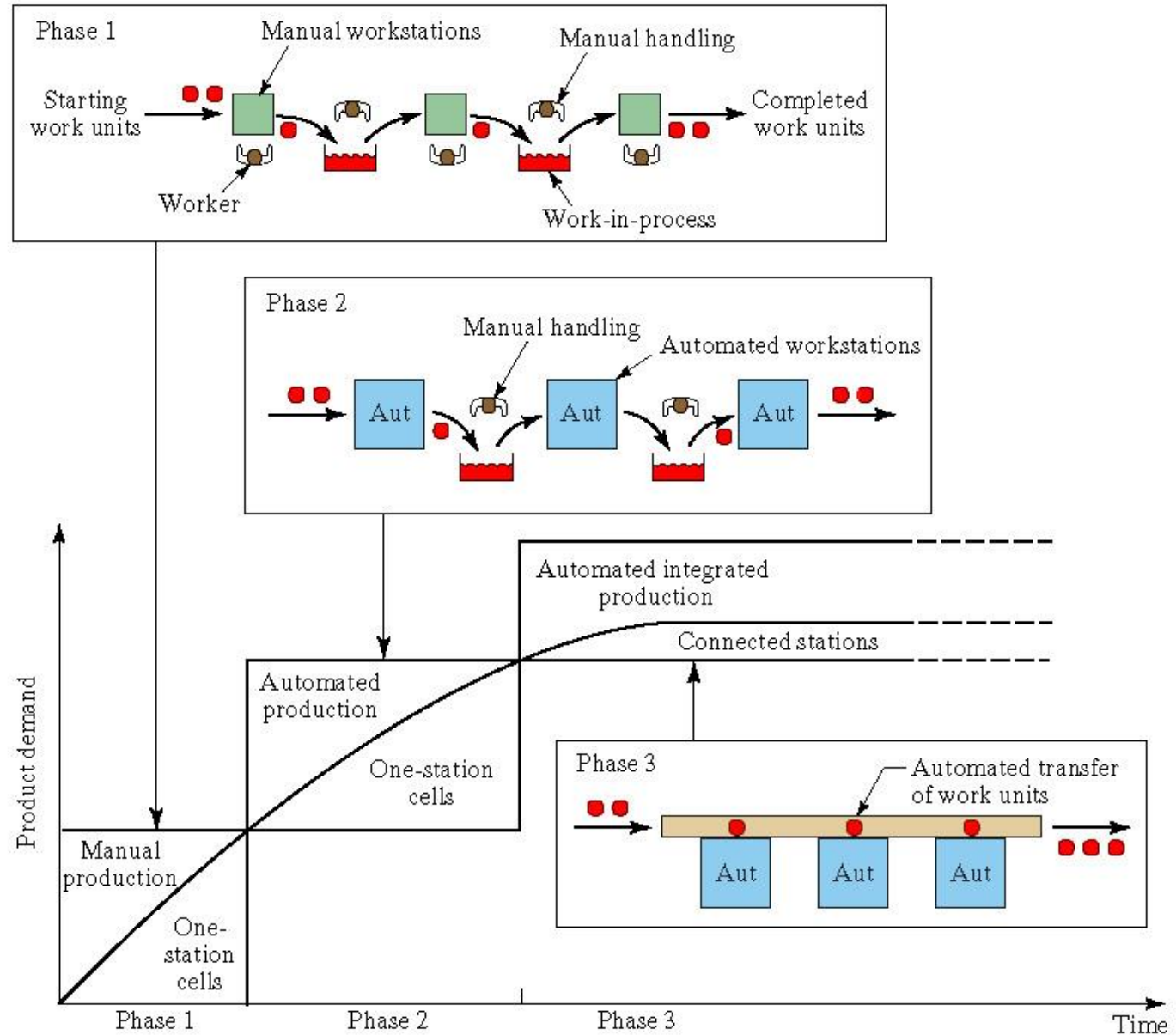
## 4.2 Ten strategies for automation and production systems

1. Specialization of operations
2. Combined operations
3. Simultaneous operations
4. Integration of operations
5. Increased flexibility
6. Improved material handling and storage
7. On-line inspection
8. Process control and optimization
9. Plant operations control
10. Computer-integrated manufacturing (CIM)

# Automation migration strategy

- Phase 1: Manual production with single independent workstations, used for introduction of the new product for quick and low cost tooling to get started
- Phase 2: Single stations automated to reduce labor and increase production rate but Work units still moved between workstations manually
- Phase 3: Automated integrated production with automated handling between stations

# Automation Migration Strategy



# 5. Low cost automation

- Risk associated with heavy automation
  - Heavy initial investment
  - Economic recession
  - Slump in demand
  - Lack of funds with long gestation period
- Low Cost Automation: A technology that creates some degree of automation around the existing equipment, tools, methods and people, using mostly standard components available in the market



# Low cost automation

- Benefits of Low cost automation
  - Low investment required, hence low risk
  - Automation tailored around the existing machines with the people involved; hence the changes are gradual, smooth and very cost effective
  - Technologies used are easy and simple to understand, maintain and upgrade; losses will be minimal in case of breakdowns

# Low cost automation

- Benefits of Low cost automation
  - Hardware components are flexible, reusable and very adaptable to changes in product, market conditions etc.
  - Minimal Labour resistance since fatigue and drudgery of work get eliminated and manpower can be made to feel involved in the developments

# Types of Automation

The automated elements of the production system can be separated into two categories:

- Automation of manufacturing systems in the factory
- Computerization of the manufacturing support systems.

# Automation of Manufacturing System

- Automated manufacturing systems operate in the factory on the physical product.
- They perform operations such as processing, assembly, inspection and material handling, in some cases accomplishing more than one of these operations in the same system.

# Automation of Manufacturing System

Examples of automated manufacturing system includes:

- Automated machine tools that process parts.
- Transfer lines that perform a series of machining operations.
- Automated assembly systems.
- Manufacturing systems that use industrial robots to perform processing or assembly operations.
- Automated material handling and storage systems.
- Automatic inspection systems for quality control.

# Automation of Manufacturing System

- Automated manufacturing systems can be classified into three basic types:
  - Fixed Automation
  - Programmable Automation
  - Flexible Automation

# Fixed Automation

A manufacturing system in which the sequence of processing (or assembly) operations is fixed by the equipment configuration

## Typical features:

- Suited to high production quantities
- High initial investment for custom-engineered equipment
- High production rates
- Relatively inflexible in accommodating product variety

# Fixed Automation

- Fixed automation is suitable for products that are produced in very large quantities and at high production rates.
- Examples of fixed automation include machining transfer lines and automated assembly machines.



# Programmable Automation

A manufacturing system designed with the capability to change the sequence of operations to accommodate different product configurations

Typical features:

- High investment in general purpose equipment
- Lower production rates than fixed automation
- Flexibility to deal with variations and changes in product configuration
- Most suitable for batch production
- Physical setup and part program must be changed between jobs (batches)

# Programmable Automation

- Programmable automated production systems are used in low and medium volume production.
- Examples of programmable automation include numerically controlled (NC) machine tools, industrial robots and programmable logic controllers.

# Flexible Automation

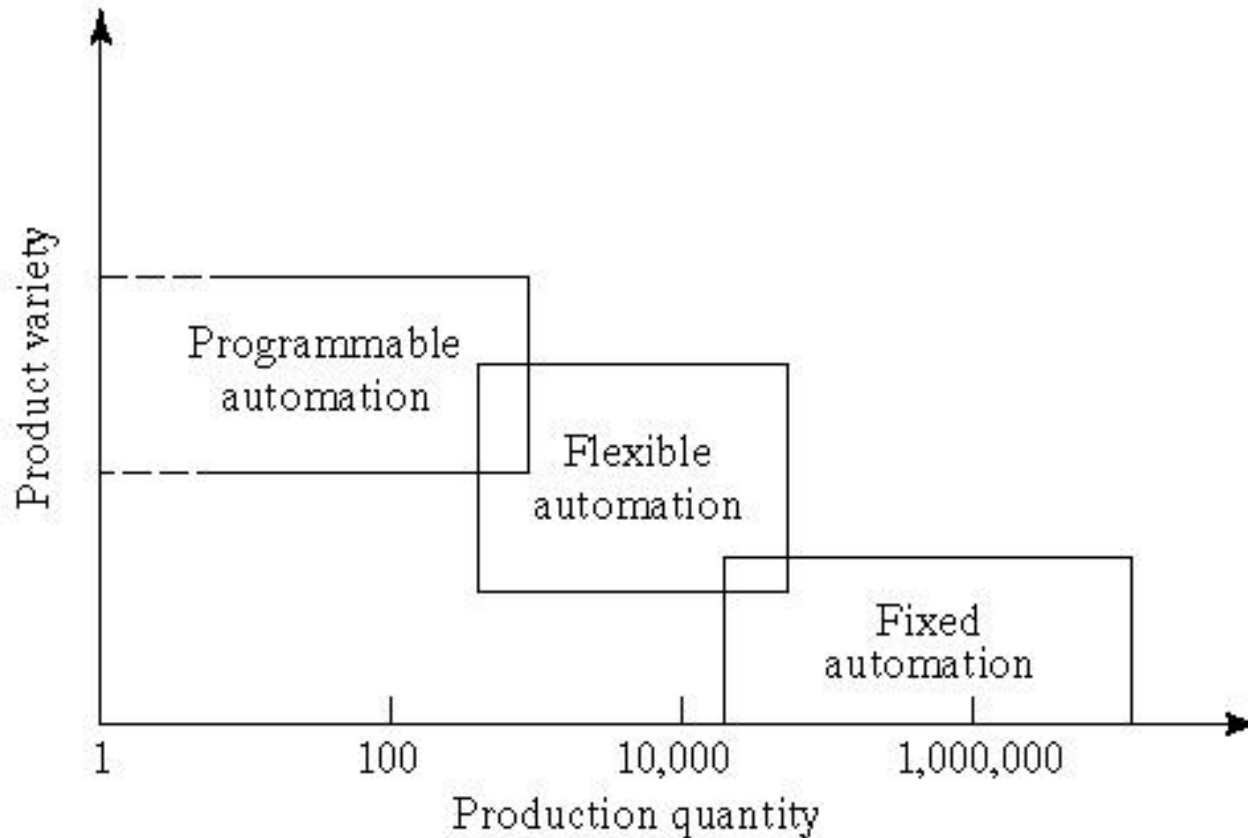
An extension of programmable automation in which the system is capable of changing over from one job to the next with no lost time between jobs.

Example: Flexible Manufacturing Systems (FMS)

Typical features:

- High investment for custom-engineered system
- Continuous production of variable mixes of products
- Medium production rates
- Flexibility to deal with soft product variety

# Product Variety and Production Quantity for Three Automation Types



# Computerized Manufacturing Support Systems

Objectives of automating the manufacturing support systems:

- To reduce the amount of manual and clerical effort in product design, manufacturing planning and control, and the business functions
- Integrates computer-aided design (CAD) and computer-aided manufacturing (CAM) in CAD/CAM
- CIM includes CAD/CAM and the business functions of the firm









