CAM

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COMPUTER AIDED MANUFACTURING

Types of automation

- Fixed automation
- Programmable automation
- Flexible automation

FIXED AUTOMATION

It is a system in which the sequence of processing (or assembly) operations is fixed by the equipment configuration.

- The operations in the sequence are usually simple.
- It is the integration and coordination of many such operations into one piece of equipment that makes the system complex.

The typical features of fixed automation are:

- High initial investment for custom engineered equipment.
- High production rates.
- Relatively inflexible in accommodating product changes.

Programmable Automation

In programmable automation, the production equipment is designed with the capability to change the sequence of operations.

- The operation is controlled by a program.
- New programs can be prepared and entered into the equipment.

The features that characterize programmable automation include:

- High investments in general purpose equipment.
- Low production rates relative to fixed automation.
- Flexibility to deal with changes in production configuration.
- More suitable for batch production.

FLEXIBLE AUTOMATION

Flexible automation is an extension of programmable automation.

Capable of producing a variety of products with virtually no time lost for chan geovers from one product to the next.

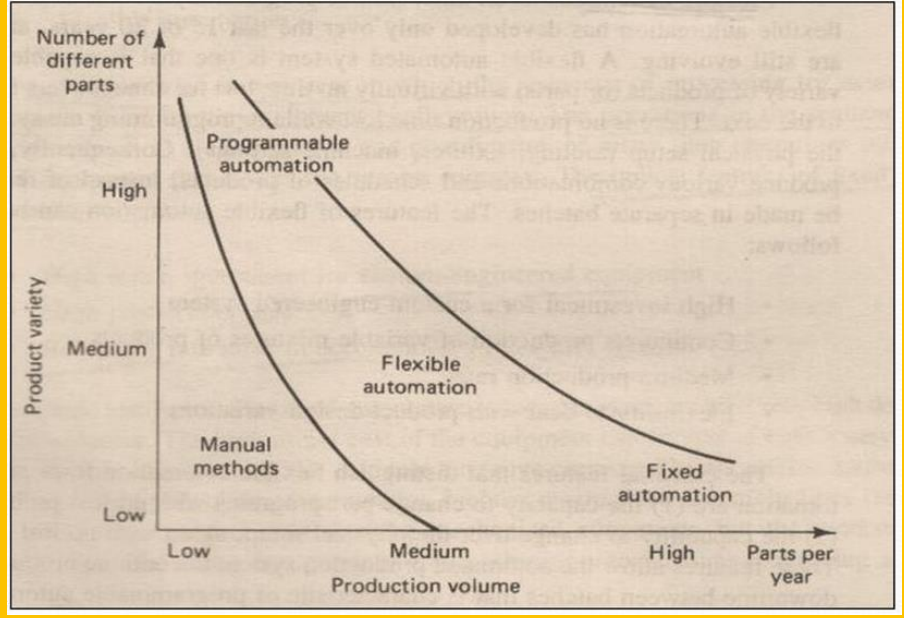
- There is no production time lost while reprogramming the system altering the physical setup (tooling, fixtures, machine settings).
- Consequently the system can produce various combinations and schedules of products, instead of requiring that they be made in separate batches.

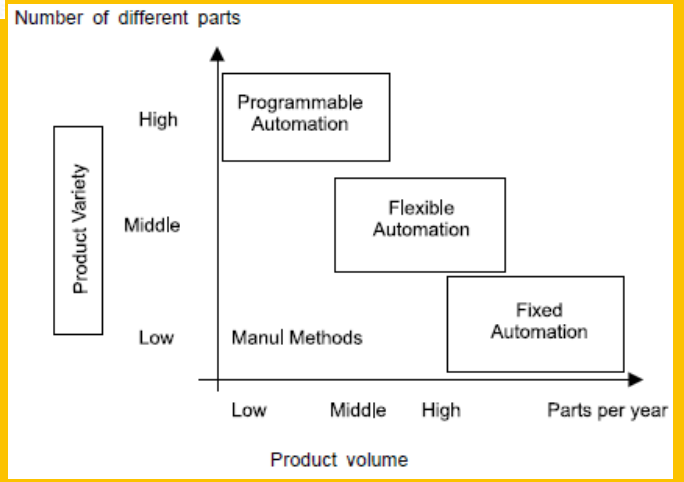
The features of flexible automation can be summarized as follows:

- High investment for custom engineered system.
- Continuous production of variable mixtures of products.
- Medium production rates.
- Flexibility to deal with product design variations.

The essential features that distinguish flexible automation from programmable automation are:

- The capacity to change part program with no lost production time and
- The capability to change over the physical setup, again with no lost produc tion time.


Number of different parts
Programmable automation
High
Product variety
Medium
Flexible automation
Manual methods
Fixed automation
Low
Low
Medium
High
Parts per year
Production volume


Number of different parts
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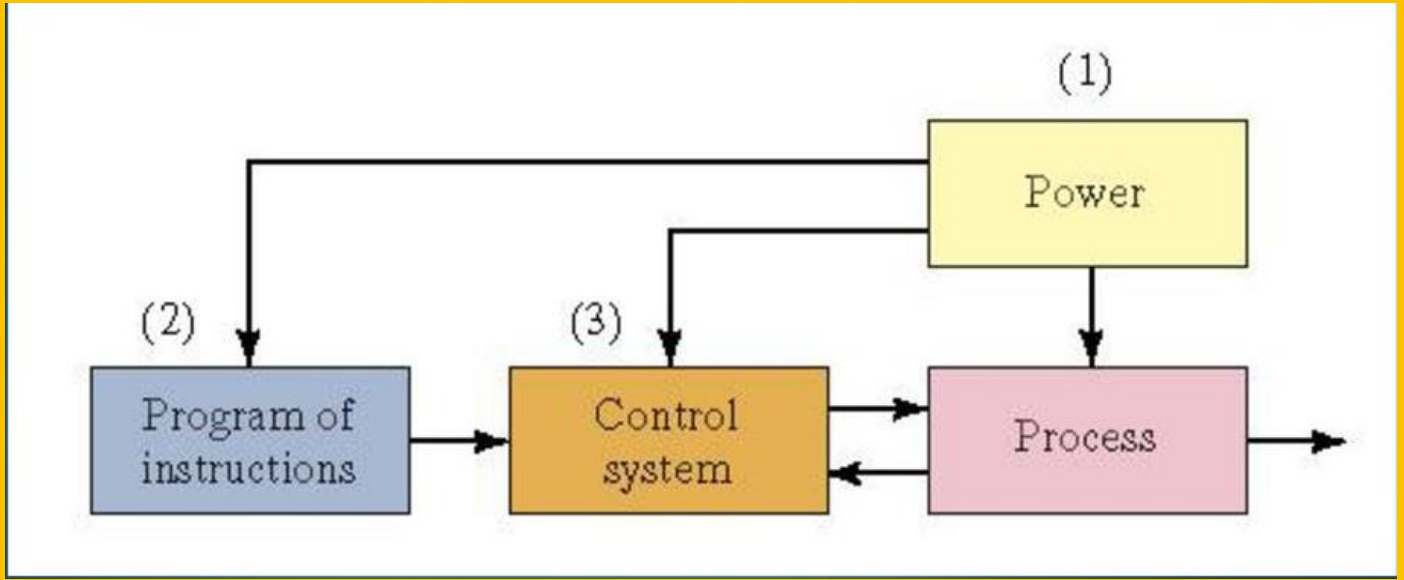
Basic elements of automation



Power to Accomplish the Automated Process

An automated system is used to operate some process, and power is required to drive t he process as well as the controls.

The principal source of power in automated systems is ***electricity.*** Alternative power sources include fossil fuels, solar energy, water, and wind. However, their exclusive use is rare in automated systems.

Power is required for

- Process: In context of production the process is referred to the manufacturing opera tion that is performed on the work unit. Few example are as follows

Process	*Power Form*	*Action Accomplished*
Casting	Thermal	Melting the metal before pouring into a mold cavity where solidification occurs.
Electric discharge machining (EDM)	Electrical	Metal removal is accomplished by a series of discrete electrical discharges between electrode (tool) and workpiece. The electric discharges cause very high localized temperatures that melt the metal.
Forging	Mechanical	Metal workpart is deformed by opposing dies. Workparts are often heated in advance of deformation, thus thermal power is also required.

Other material handling operation:

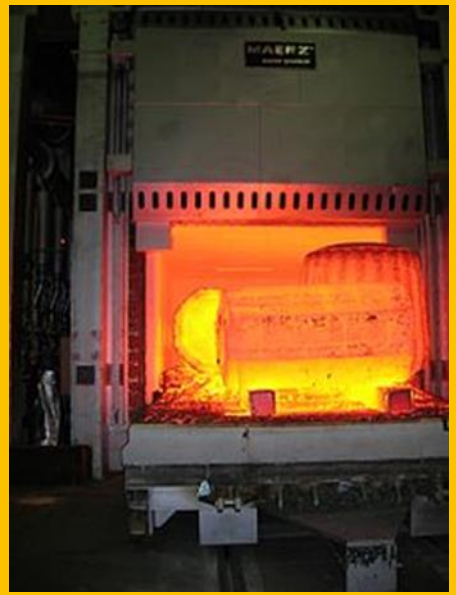
- Loading and unloading the work unit.
- Material transport between operations.

Power for automation:

- Controller unit
- Power to actuate the control signal
- Data acquisition and information processing.

Program of Instructions

Also known as *work cycle program.* It is basically *set of instruction* need to be performed.



Control System

Control system executes the program of instruction.

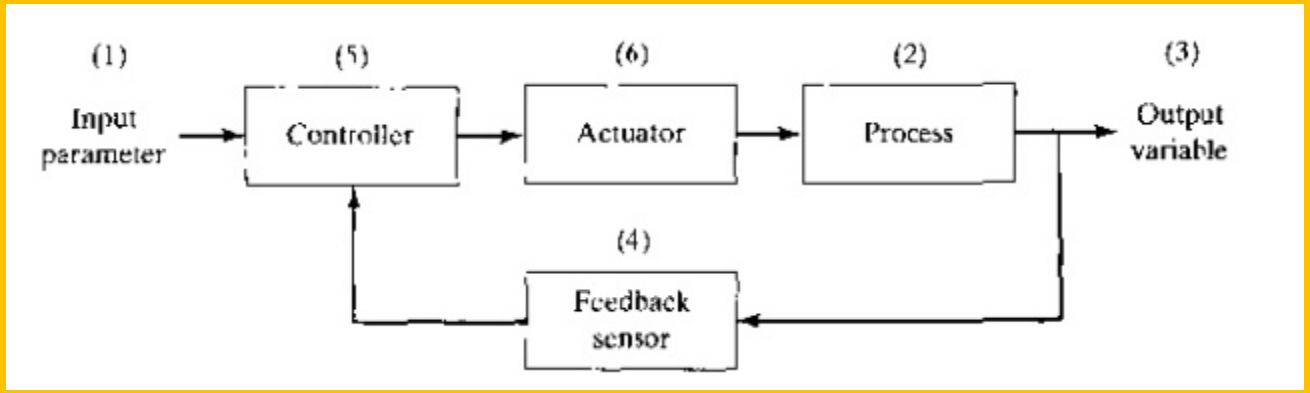
The control system in an automated system can be:

- Open loop
- Closed loop (also known as feedback control system)

Closed loop control system

A closed loop control system consists of six basic elements:

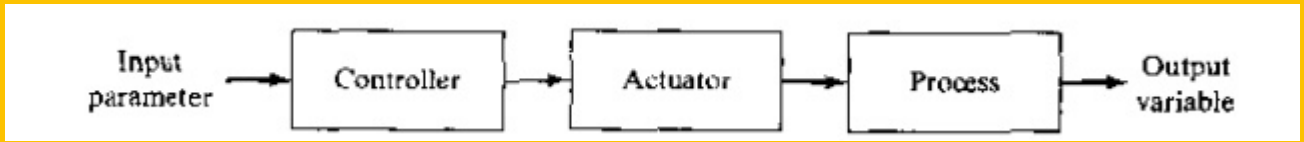
(I) input parameter,
(II) process,
(III) Output variable
(IV) feedback sensor.
(V) controller. and
(VI) actuator.



Open loop control system

An open loop control system operates without the feedback loop

- No comparison is made between the actual value of the output and the desi red input parameter, The controller relies on an accurate model of the effect of its actuator



With an open loop system, there is always the risk that the actuator will not have the intended effect on the process, a nd that is the disadvantage of an open loop system

advantage is that it is generally simpler a nd less expensive than a closed loop syst em.

Open loop systems are usually appropriate when the following conditions appl y:

(1) The actions performed by the control system are simple,

(2) the actuating function is very reliable, and

(3) any reaction forces opposing the actuation are small enough to have no ef fect on the actuation.

If these characteristics are not applicable, then a closed loop control system m ay be more appropriate.

Advance automation functions

Safety monitoring
Maintenance and repair diagnosis
Error detection and recovery

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Thank You