ADVANCED MANUFACTURING CAD & CAM

CHAPTER 2-AUTOMATION

Automation is the creation of technology and its application in order to control and monitor the production and delivery of various goods and services. It performs tasks that were previously performed by humans. Automation is being used in a number of areas such as manufacturing, transport, utilities, defense, facilities, operations and lately, information technology.

Automation is the technology by which a process or procedure is performed with minimal human assistance. Automation has been achieved by various means including mechanical, hydraulic, pneumatic, electrical, electronic devices and computers, usually in combination.

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

Types of Automation System with Examples

Automated production systems can be classified into three basic types:

1. Fixed automation,
2. Programmable automation, and
3. 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:

a. High initial investment for custom–Engineered equipment;
b. High production rates; and
c. Relatively inflexible in accommodating product changes.

The economic justification for fixed automation is found in products with very high demand rates and volumes. The high initial cost of the equipment can be spread over a very large number of units, thus making the unit cost attractive compared to alternative methods of production. Examples of fixed automation include mechanized assembly and machining transfer lines.

PROGRAMMABLE AUTOMATION

In this the production equipment is designed with the capability to change the sequence of operations to accommodate different product configurations. The operation sequence is controlled by a program, which is a set of instructions coded so that the system can read and interpret them. New programs can be prepared and entered into the equipment to produce new products. Some of the features that characterize programmable automation are:

a. High investment in general-purpose equipment;
b. Low production rates relative to fixed automation;
c. Flexibility to deal with changes in product configuration; and

d. Most suitable for batch production.

Automated production systems that are programmable are used in low and medium volume production. The parts or products are typically made in batches. To produce each new batch of a different product, the system must be reprogrammed with the set of machine instructions that correspond to the new product. The physical setup of the machine must also be changed over: Tools must be loaded; fixtures must be attached to the machine table also be changed machine settings must be entered. This changeover procedure takes time. Consequently, the typical cycle for given product includes a period during which the setup and reprogramming takes place, followed by a period in which the batch is produced. Examples of programmed automation include numerically controlled machine tools and industrial robots.

FLEXIBLE AUTOMATION

It is an extension of programmable automation. A flexible automated system is one that is capable of producing a variety of products (or parts) with virtually no time lost for changeovers from one product to the next. There is no production time lost while reprogramming the system and altering the physical setup (tooling, fixtures, and machine setting). 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:

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

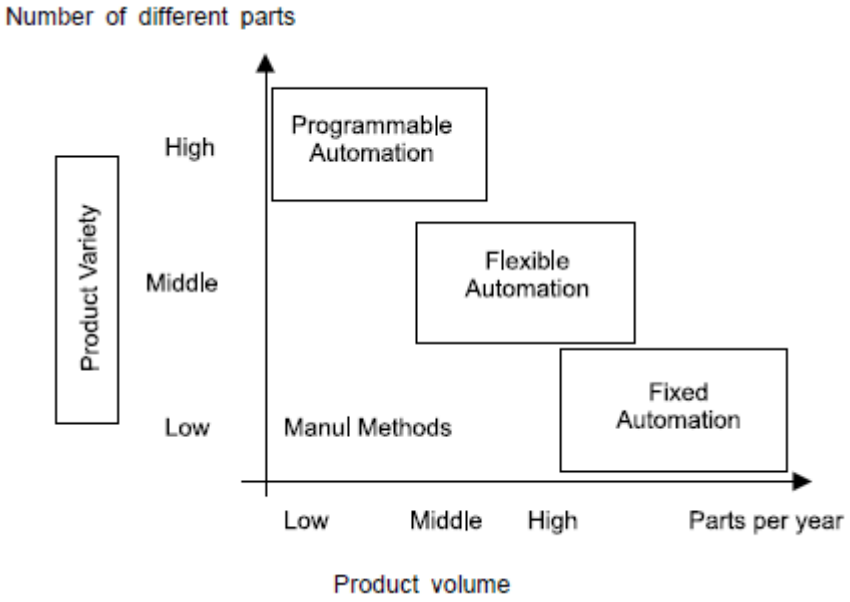
The essential features that distinguish flexible automation from programmable automation are:

1. the capacity to change part programs with no lost production time; and
2. the capability to changeover the physical setup, again with no lost production time.

These features allow the automated production system to continue production without the downtime between batches that is characteristic of programmable automation. Changing the part programs is generally accomplished by preparing the programs off-line on a computer system and electronically transmitting the programs to the automated production system. Therefore, the time required to do the programming for the next job does not interrupt production on the current job. Advances in computer systems technology are largely responsible for this programming capability in flexible automation. Changing the physical setup between parts is accomplished by making the changeover off-line and then moving it into place simultaneously as the next part comes into position for processing. The use of pallet fixtures that hold the parts and transfer into position at the workplace is one way of implementing this approach. For these approaches to be successful; the variety of parts that can be made on a flexible automated production system is usually more limited than a system controlled by programmable automation.

The relative positions of the three types of automation for different production volumes and product varieties are depicted in the following figure.

Automation in Production system



NEED OF AUTOMATION

They are called automated because they perform their operations with a reduced level of human participation compared with the corresponding manual process. In some highly automated systems, there is virtually no human participation.

Companies undertake projects in manufacturing automation and computer-integrated manufacturing for a variety of good reasons. Some of the reasons used to justify automation are listed below.

1. To increase labor productivity

Automating a manufacturing operation usually increases production rate and labor productivity. This means greater output per hour of labor input.

2. To reduce labor cost

Ever-increasing labor cost has been and continues to be the trend in the world's industrialized societies. Consequently, higher investment in automation has become economically justifiable to replace manual operations.

3. To mitigate the effects of labor shortages

There is a general shortage of labor in some countries, and this has stimulated the development of automated operations as a substitute for labor.

4. To reduce or eliminate routine manual and clerical tasks

An argument can be put forth that there is social value in automating operations that are routine, boring, fatiguing, and possibly irksome. Automating such tasks serves a purpose of improving the general level of working conditions.

5. To improve worker safety

By automating a given operation and transferring the worker from active participation in the process to a supervisory role, the work is made safer. The safety and physical well-being of the worker has become a national objective with the enactment of the Occupational Safety and Health Act (OSHA) in 1970. This has provided an impetus for automation.

6. To improve product quality

Automation not only results in higher production rates than manual operations. It also performs the manufacturing process with greater uniformity and conformity to quality specifications . Reduction of fraction defect rate is one of the chief benefits of automation.

7. To reduce manufacturing lead time

Automation helps to reduce the elapsed time between customer order and product delivery, providing a competitive advantage to the manufacturer for future orders. By reducing manufacturing lead time, the manufacturer also reduces work-in-process inventory.

8. To accomplish processes that cannot be done manually

Certain operations cannot be accomplished without the aid of a machine. These processes have requirements for precision, miniaturization, or complexity of geometry, that cannot be achieved manually.

9. To avoid the high cost of not automating

There is a significant competitive advantage gained in automating a manufacturing plant. The advantage cannot easily be demonstrated on a company's project authorization form.