AutomationThe word ‘Automation’ is derived from greek words “Auto”(self) and “Matos” (moving). Automation therefore is the mechanism for systems that “move by itself”. However, apart from this original sense of the word, automated systems also achieve significantly superior performance than what is possible with manual systems, in terms of power, precision and speed of operation.

***“Automation is a set of technologies that results in operation of machines and systems without significant human intervention and achieves performance superior to manual operation”***

**Types of Automation System**

Automated manufacturing systems can be classified into three basic types:

1. Fixed Automation.
2. Programmable Automation
3. Flexible Automation.
4. **Fixed Automation**

*Fixed automation* is a system in which the sequence of processing (or assembly) operations is fixed by the equipment configuration. Each of the operations is the sequence is usually simple, involving perhaps a plain linear or rotational motion or an uncomplicated combination of the two; for example, the feeding of a rotating spindle. It is the integration and coordination of many such operations into one piece of equipment that makes the system complex. Typical features of fixed automation are:

* high initial investment for custom-engineered equipment
* high production rates
* relatively inflexible in accommodating product variety
1. **Programmable Automation,**

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

* 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
1. **Flexible automation**

*Flexible automation* is an extension of programmable automation. A flexible automated system is capable of producing a variety of parts (or products) with virtually no time lost for changeovers from one part style to the next. There is no lost production time while reprogramming the system and altering the physical setup (tooling, fixtures, machine settings). Consequently, the system can produce various combinations and schedules of parts or products instead of requiring that they be made in batches. What makes flexible automation possible is that the differences between parts processed by the system are not significant. It is a case of soft variety.so that the amount of changeover required between styles is minimal.
The features of flexible automation can be summarized as follows:

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

**Advantages of Automation.**

Companies undertake projects in manufacturing automation and computer integrated manufacturing for a variety of good reasons. Some of the reasons used to justify automated are the following:

**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 tabor 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. Machines are increasingly being substituted for human lahar to reduce unit product cost.

**3. *To migrate the effects of labor shortages.***There is a general shortage of labor in many advanced nations and this has stimulated the development of automated operations as a substitute tor 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

***6. To improve product quality.***Automation not only results in higher production rates than manual operations; it also performs the manufacturing process with greater uniform and conformity to quality specifications. Reduction attraction defect rate is one of the chief benefits of automation.

***7. To reduce manufacturing lead lime.***Automation helps to reduce the elapsed time between customer order and product delivery, providing a competitive advantage 10 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. The benefits of automation often show up in unexpected and intangible ways, such as in improved quality, higher sales, better labor relations, and better company image.

**Disadvantages of Automation**

Aside from these advantages, it is also important for us to discuss about the disadvantages of using and implementing automation in the industrial.

***1. Higher Start-up cost and the cost of operation.***Automated equipment includes the high capital expenditure required to invest in automation. An automated system can cost millions of dollars to design, fabricate, and install.

**2. *Higher Cost of Maintenance*.** A higher level of maintenance needed than with a manually operated machine. These include buying electromechanical devices such as electromechanically valve, sensory devices, and smart devices. Cost of spare parts for automation system may consider higher compare to the manual operate.

**3. *Obsolescence/Depreciation Cost.***Obsolescence and depreciation is a gradual reduction in the value of physical assets. This phenomenon is characteristic of all physical assets in the form of equipment and machinery. It was something that was inevitable due to technology

**4. *Unemployment****.* A disadvantage often associated with automation, is worker displacement. Due to the fact that manual laborers are being replaced by robots or other automated machineries, this results to mass lay-off. A lot of people are losing their jobs especially those who work in the manufacturing industry such as a car factory.

**5. Not economically justifiable for small scale production.**

**Economics of Automation**

Within manufacturing industries, automation has led to increased [labour productivity](https://www.economicshelp.org/blog/5887/economics/uk-labour-productivity/) as fewer workers are needed to produce the same number of manufactured goods. However, there are still concerns about the social and economic impact of the rapid job displacement associated with automation and globalization.

**Benefits of automation for the economy**

* In addition to the benefits accruing to firms, automation can have various benefits for wider society. Consumers have gained the convenience of greater choice of goods and services. For example, ATM cash machines are a very simple example of automation which enables people to get cash when banks are closed.
* Lower costs of production enable lower prices, leading to more disposable income to be spent on a wider range of services.
* Leads to the creation of new kinds of jobs, which are more creative, less repetitive and enable more flexible labour markets. For example, rather than do repetitive jobs in a factory, young workers can become software engineers to develop the ideas, design and methods that the robots will then make.
* More profitable firms should, in theory, enable governments to receive more tax revenue to spend on public goods.
* Automation is essential to remain internationally competitive. If one country doesn’t automate, production will shift to those countries who do, and then gain comparative advantage.

**Problems of automation for the economy**

* It can create winners and losers. Some will benefit significantly from automation – owners of more profitable factories, and software developers. However, those who lose jobs from the process of automation
* In recent years, there has been a rise in male unemployment and automation has been suggested as one reason for these higher structural rates of unemployment –.
* Impact on equality. The process of automation has co-incided with a rise in levels of inequality.
* Automation may increase corporate profit, but not necessarily median wages.
* Automation can increase monopoly power of the most successful technology firms, e.g. Apple, Amazon have all benefitted from automation to gain higher market share.
* Loss of human element. We are moving to a society where we have less personal contact – self-service till, automated announcements and buying online.

**Flow line Manufacturing**

Flow line manufacturing is used to manufacture high volumes of products with high production rates and low costs. Separate dedicated flow line is created for each product. Dedicated machines are used to manufacture the products at high production rates. These machines are generally expensive. A large volume of the products must be produced in order to justify the cost of such expensive machines. Flow line manufacturing is most suitable to manufacture high volumes of products continuously. Flow line manufacturing is used in such industries where raw materials are fed at one end and finished products are produced continuously at the other end. Thus flow line manufacturing is utilized in mass production industries. Flow line manufacturing is shown in figure 1. Flow line layout is also called a product layout.



**Advantages of flow line manufacturing are as per the following**

***1. Smooth and logical flow of materials***

Smooth and logical flow of materials are achieved in flow line manufacturing because dedicated machines are used to manufacture the products at high production rates and separate dedicated flow line is created to manufacture each product.

***2. Simplified production planning and control***

Manufacturing operations are simple in flow line manufacturing which simplify production planning and control. Scheduling jobs, controlling materials and performing machines operations become very simple in flow line manufacturing.

***3. Reduced material handling cost***

Material/parts are moved within small areas during manufacturing process. Machines are ready to accept a job during various stages of manufacturing, almost no need to store and protect materials between two machines. Status & location of materials are easy to track and control. Thus cost of moving, storing, protecting and controlling materials becomes low in flow line manufacturing which ultimately reduces material handling cost.

***4. Shorter production lead time***

Waiting time is minimal for each part during manufacturing process in flow lines and flow of materials is uninterrupted. This causes shorter production lead time and high production rates in flow line manufacturing.

***5. Small amount of work in progress inventory***

Amount of work in progress inventory is small in flow line manufacturing because of shorter production lead time.

**Disadvantages of flow line manufacturing**

***1. Lack of flexibility***

Major drawback of flow line manufacturing is lack of flexibility to manufacture products for which they are not designed. This drawback is inherently present in flow line manufacturing because dedicated machines are setup to execute limited operations and they are not allowed to be reconfigured. Flow line manufacturing is not suitable in such cases where variety of products to be manufactured changes frequently.

***2. High investment in machines and equipments***

Similar machines are not grouped together in flow line manufacturing. High investment in machines and equipments is required and capacity of machines is not fully utilized because of duplication of machinery inherently present in flow line manufacturing.

***3. Lack of specialization in supervision***

Manufacturing processes are executed in one line and different types of machine are installed in one line. In job shop manufacturing, a supervisor is supposed to have the specialized knowledge about his/her departmental activities, machines and processes. But in flow line manufacturing, a supervisor is supposed to have detailed knowledge of all the machines, processes and activities causing lack of specialization in supervision.

***4. Work stoppage because of breakdown***

If one machine in the flow line fails then other machines in that flow line stops functioning and thus manufacturing process will be stopped.

 **Buffer Storage**

 Automated flow lines are often equipped with additional features beyond the basic transfer mechanisms and workstations. For example, the idea of using a buffer storage capacity between stations was introduced in Section 4.1. It is not uncommon for production flow lines to include storage zones for collecting banks of work parts along the line. One example of the use of storage zones would be two intermittent transfer systems, each without any storage capacity, linked together with a work part inventory area. It is possible to connect three, four, or even more lines in this manner. Another example of work part storage on flow lines is the asynchronous transfer line. With this system, it is possible to provide a bank of work parts for every station on the line.
There are two principal reasons for the use of buffer storage zones. The first is to reduce the effect of individual station breakdowns on the line operation. The continuous or intermittent transfer system acts    as a single integrated machine. When breakdowns occur at the individual stations or when preventive maintenance is applied to the machine, production must be halted. In many cases, the proportion of time the line spends out of operation can be significant, perhaps reaching 50% or more. Some of the common reasons for line stoppages are :

* Tool failures or tool adjustments at individual processing stations
* Scheduled tool changes
* Defective work parts or components at assembly stations, which require that the feed mechanism be cleared
* Feed hopper needs to be replenished at an assembly station
* Limit switch or other electrical malfunction
* Mechanical failure of transfer system or workstation

When a breakdown occurs on an automated flow line, the purpose of the buffer storage zone is to allow a portion of the line to continue operating while the remaining portion is stopped and under repair. For example, assume that a 20-station line is divided into two sections and connected by a parts storage zone which automatically collects parts from the first section and feeds them to the second section. If a station jam were to cause the first section of the line to stop, the second section could continue to operate as long as the supply of parts in the buffer zone lasts. Similarly, if the second section were to shut down, the first section could continue to operate as long as there is   room in the buffer zone to store parts. Hopefully, the average production rate on the first section would be about equal to that of the second section. By dividing the line and using the storage area, the average production rate would be improved over the original 20-station flow line.



The second reason for using storage on How lines is to smooth out the effects of variations in cycle times. These variations occur cither between stations or, in the case of flow lines with one or more manual stations, they can occur from cycle to cycle at the same station. To illustrate the second case, suppose that we are considering an assembly line on which all the stations are mechanized except one. The manual station requires the operator to perform an alignment of two components and the time required tends to vary from cycle to cycle. For the transfer system in this line, we must choose between a synchronous system with no parts storage capacity and an asynchronous system which allows a “float” of parts ahead of each station.