ENGINEERING PRODUCTION SYSTEMS (FMS)

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DEEMED TO BE UNIVERSITY

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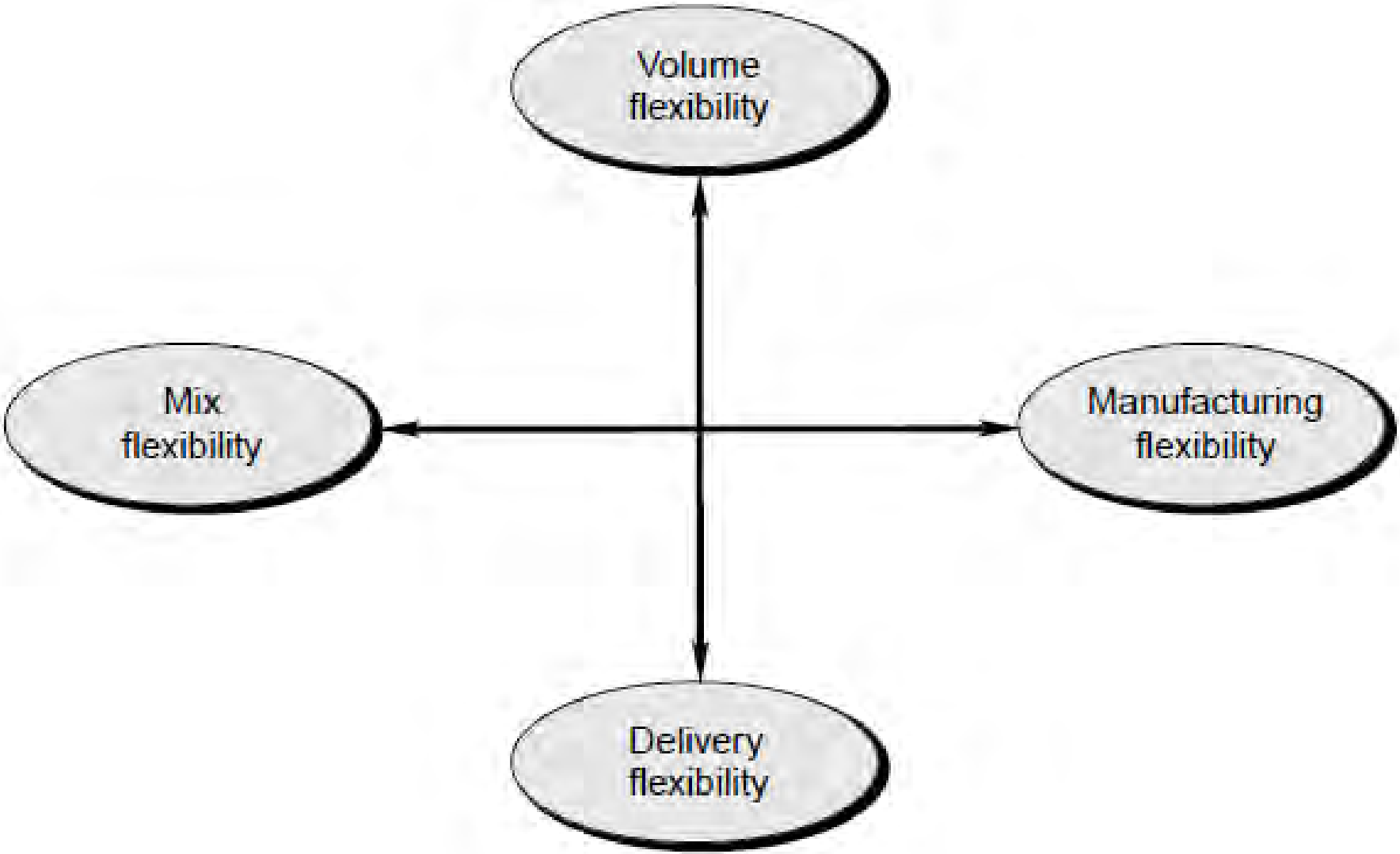
INTRODUCTION

In the middle of 1960s, market competition became more intense. During 1960 to 1970 cost was the primary concern. Later quality became the priority. As the market became more and more complex, speed of delivery became something customer also needed.

A new strategy was formulated (*Customizability). The companies have to adapt to the* environment in which they operate, to be more *flexible in their operations and to satisfy different* market segments. Thus the innovation of FMS became related to the effort of gaining competitive advantage.

First of all, FMS is a manufacturing technology. Secondly, FMS is a philosophy. “System” is the key word. Philosophically, FMS incorporates a system view of manufacturing. The buzzword for today’s manufacturer is “agility”. An agile manufacturer is one who is the fastest to the market, operates with the lowest total cost and has the greatest ability to “delight” its customers. FMS is simply one way that manufacturers are able to achieve this agility.

INTRODUCTION



AIMS OF A FMS

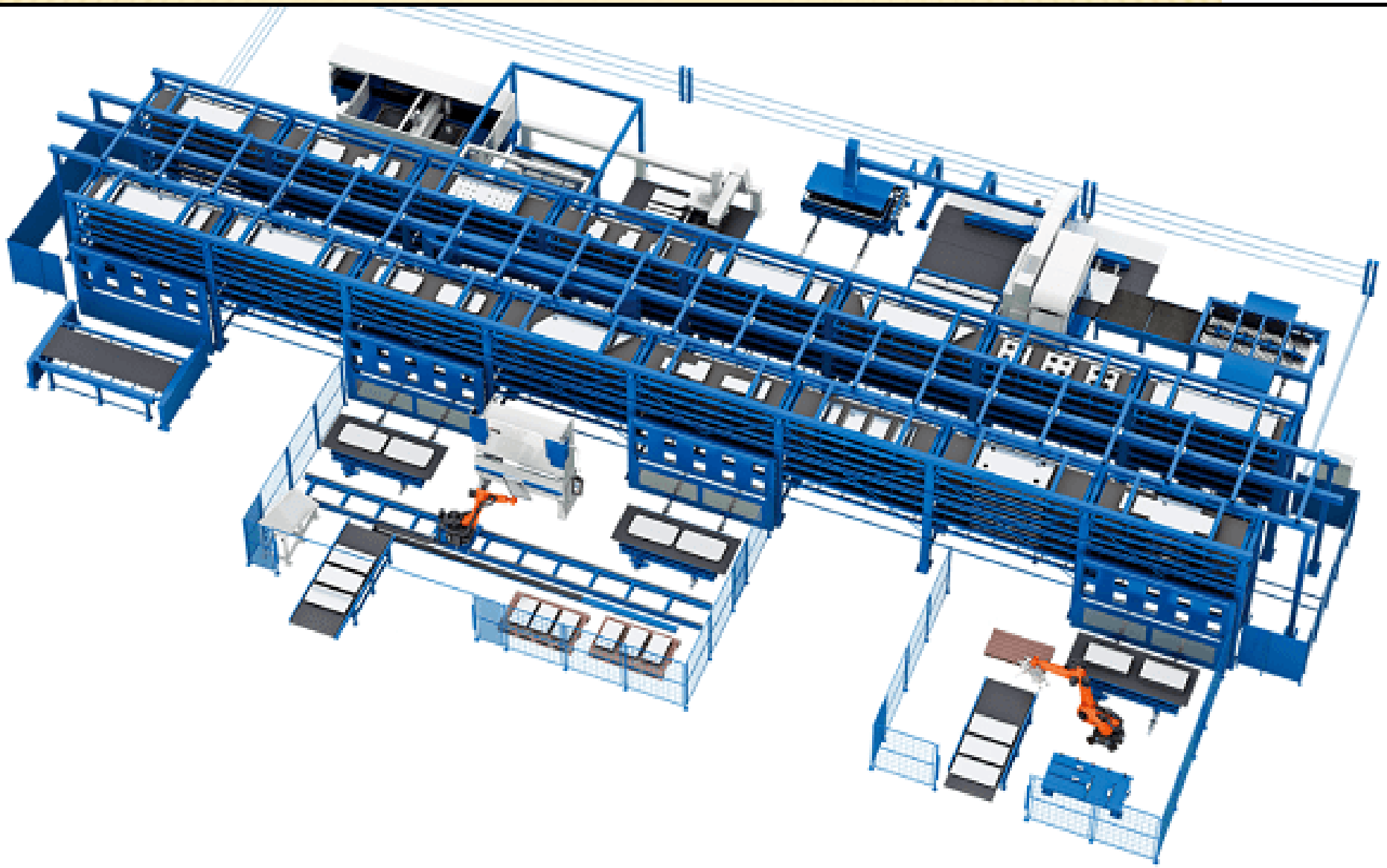
- To reduce costs
- Better utilization of the production equipment reduction of stocks (ex: Work in progress—capital shorter through put times)
- Reduction of piece part unit costs.
- To increase Technical Performance:
  - Increased production levels
  - Greater product mixture
  - Simultaneous product mixture manufacturing
  - Integration of the production system into the factory's logistical system
  - Smaller batch sizes
  - Shorter or zero change over or reset of times
- To improve Order Development:
  - Shorter lead times/delivery times
  - Determination of production capacities
- To assist future Corporate Security:
  - Increased Competitiveness
  - Increased Quality
  - Improved Company Image

OBJECTIVES OF A FMS

The major objectives of installing an FMS for production is:

- Decreased Lead Times
- Increased Through put
- Increased machine utilization
- Improved Due Date Reliability
- Decreased Store Inventors Levels
- Decreased Work in Progress
- Increased Quality

FLEXIBLE MANUFACTURING SYSTEM



HISTORY

- The idea of an FMS was proposed in England (1960s) under the name "System 24", a flexible machining system that could operate without human operators 24 hours a day under computer control. From the beginning the emphasis was on *automation rather than the "reorganization of* workflow"
- The installed worldwide FMS base in 1989 was estimated to be around 500 to 1200 systems, the higher figure arising when a system is defined as having 2 or more CNC machine tools connected by a materials handling system, and controlled by a central computer. Ranta and Tchijov suggest that "the strategic majority of production of the metal-working industries in the industrialized countries will be produced by FMS or similar systems [by the year 2000]."
- There are significant practical reasons for the disparity between the promise of FMS in the 1980s and its narrowness and scarcity of application in the early 1990s.

DEFINITION

- A flexible manufacturing system (FMS) is an arrangement of machines … interconnected by a transport system. The transporter carries work to the machines on pallets or other interface units so that work-machine registration is accurate, rapid and automatic. A central computer controls both machines and transport system.

Or

- "FMS consists of a group of processing work stations interconnected by means of an automated material handling and storage system and controlled by integrated computer control system."
- FMS is called flexible due to the reason that it is capable of processing a variety of different part styles simultaneously at the workstation and quantities of production can be adjusted in response to changing demand patterns.

BASIC COMPONENTS OF FMS

The basic components of FMS are:

- **Workstations:** In present day application these workstations are typically computer numerical control (CNC) machine tools that perform machining operation on families of parts. Flexible manufacturing systems are being designed with other type of processing equipments including inspection stations, assembly works and sheet metal presses. The various workstations are
  - *Machining centers*
  - *Load and unload stations*
  - *Assembly work stations*
  - *Inspection stations*
  - *Forging stations*
  - *Sheet metal processing, etc.*

BASIC COMPONENTS OF FMS

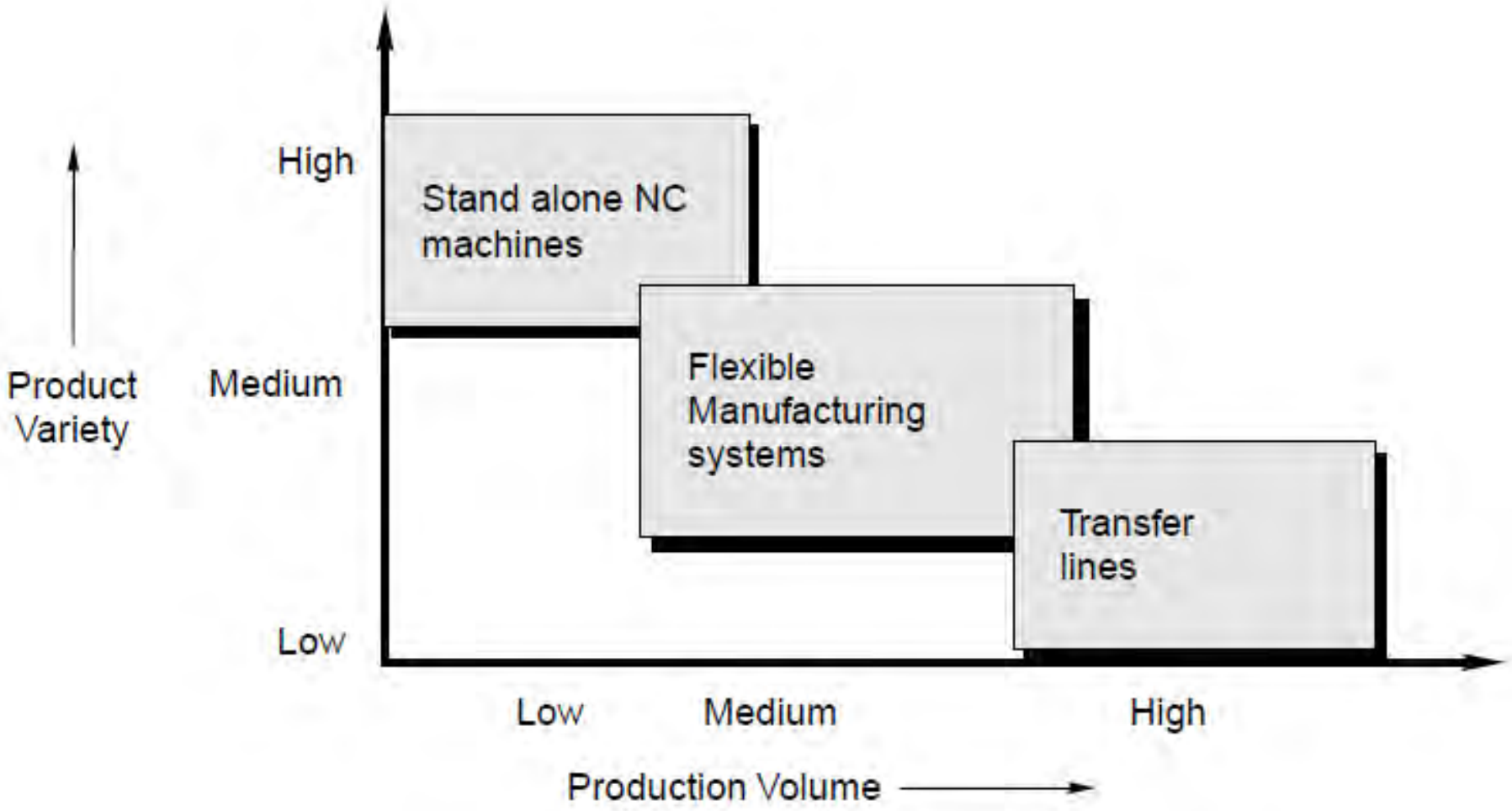
- **Automated Material Handling and Storage system:** The various automated material handling systems are used to transport work parts and subassembly parts between the processing stations, sometimes incorporating storage into function. The various functions of automated material handling and storage system are
  - *Random and independent movement of work parts between workstations*
  - *Handling of a variety of work part configurations*
  - *Temporary storage*
  - *Convenient access for loading and unloading of work parts*
  - *Compatible*

BASIC COMPONENTS OF FMS

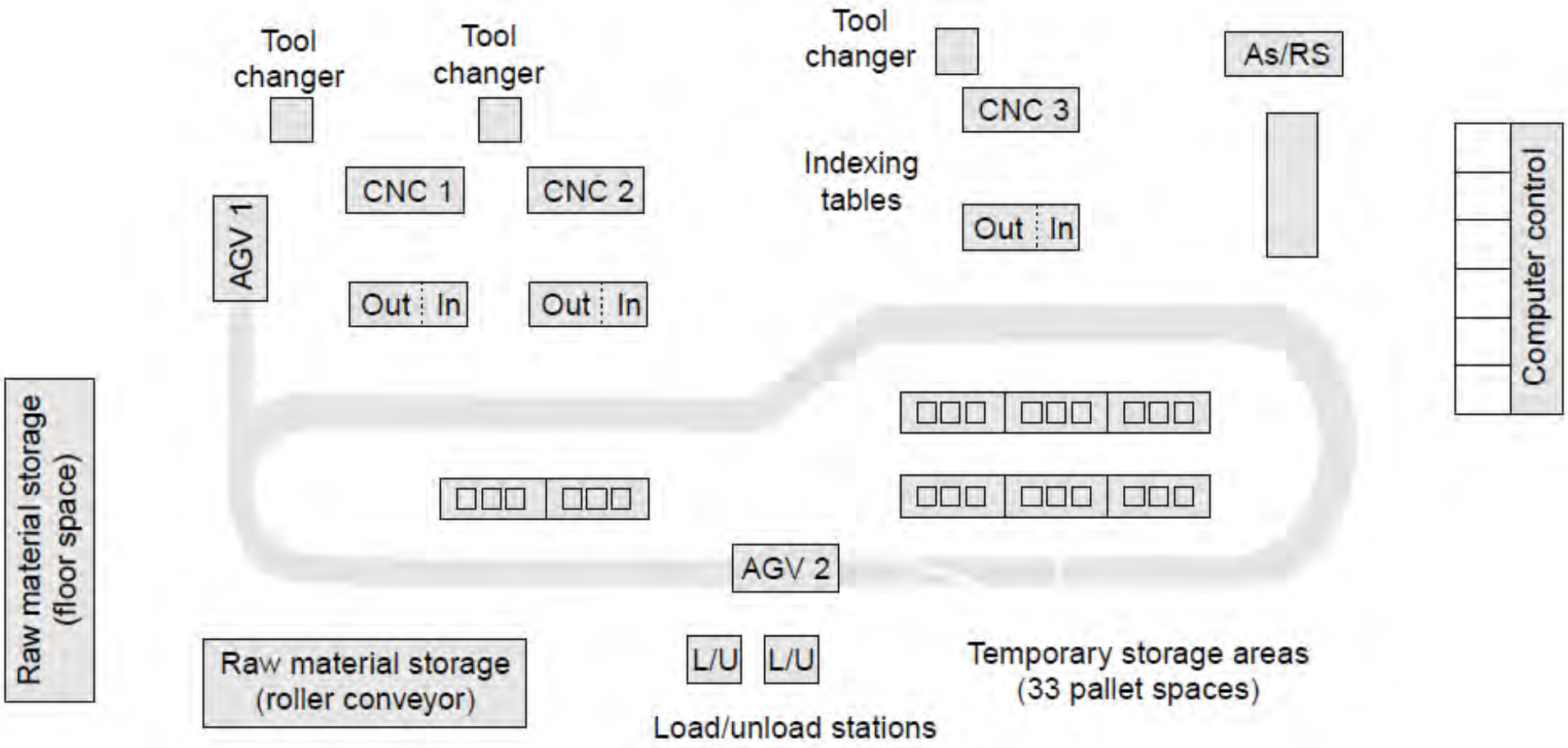
- **Computer Control System:** It is used to coordinate the activities of the processing stations and the material handling system in the FMS. The various functions of computer control system are:
  - *Control of each work station*
  - *Distribution of control instruction to work station*
  - *Production control*
  - *Traffic control*
  - *Shuttle control*
  - *Work handling system and monitoring*
  - *System performance monitoring and reporting*

  The FMS is most suited for the mid variety, mid value production range.

APPLICATION CHARACTERISTICS OF FMS



FLEXIBLE MANUFACTURING SYSTEM LAYOUT



DIFFERENT TYPES OF FMS

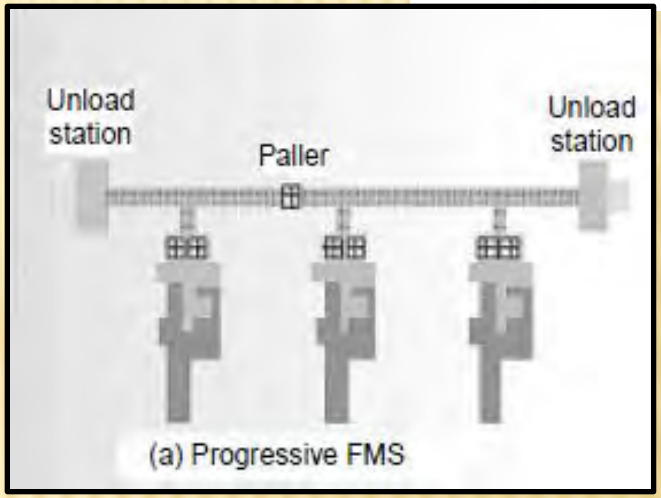
The different types of FMS are:

- **Sequential FMS:** It manufactures one-piece part batch type and then planning and preparation is carried out for the next piece part batch type to be manufactured. It operates like a small batch flexible transfer line.
- **Random FMS:** It manufactures any random mix of piece part types at any one time.
- **Dedicated FMS:** It continually manufactures, for extended periods, the same but limited mix of piece part batch types.
- **Engineered FMS:** It manufactures the same mix of part types throughout its lifetime.
- **Modular FMS:** A modular FMS, with a sophisticated FMS host, enables and FMS user to expand their FMS capabilities in a stepwise fashion into any of the previous four types of FMS.

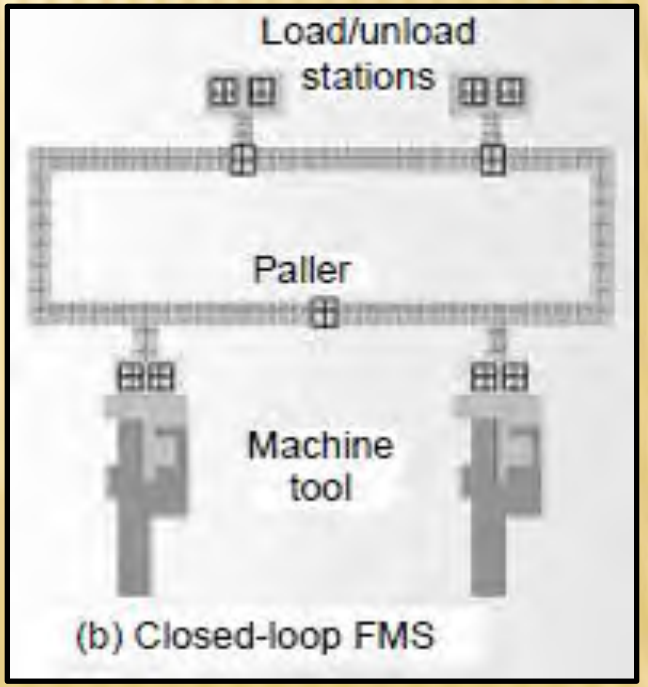
TYPES OF FMS LAYOUTS

The different types of FMS layouts are:

- **Progressive or Line type:** The machines and handling system are arranged in a line as shown in Fig.(a). It is most appropriate for a system in which the part progress from one workstation to the next in a well defined sequence with no back flow. The operation of this type of system is very similar to transfer type. Work always flows in unidirectional path as shown in Fig.(a).
- **Loop Type: The basic loop configuration is as shown in Fig.(b). The parts usually move in** one direction around the loop, with the capability to stop and be transferred to any station. The loading and unloading station are typically located at one end of the loop Fig.(b)



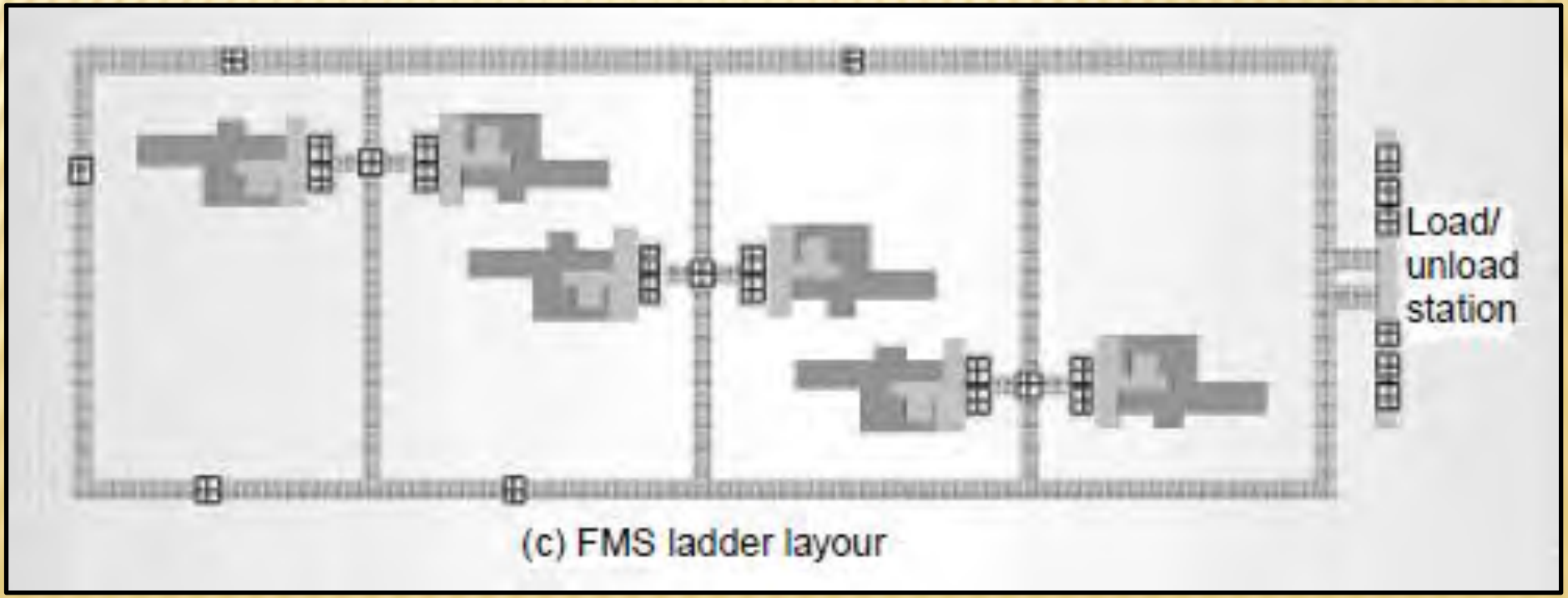
(a) Progressive FMS



(b) Closed-loop FMS

TYPES OF FMS LAYOUTS

- **Ladder Type:** **The configuration is as shown in Fig.(c). The loading and unloading station** is typically located at the same end. The sequence to the operation/transfer of parts from one machine tool to another is in the form of ladder steps as shown in Fig.(c)

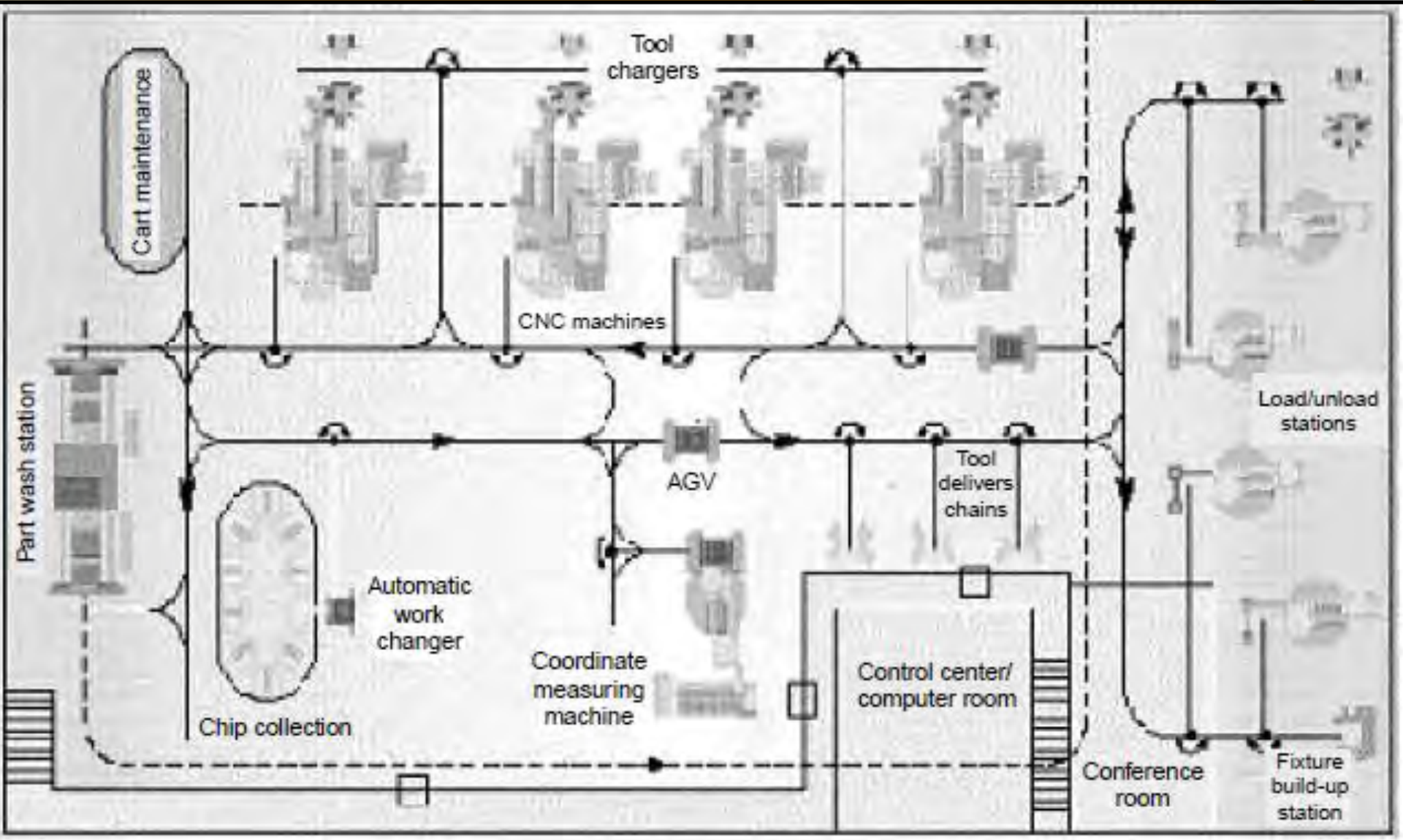


(c) FMS ladder layour

TYPES OF FMS LAYOUTS

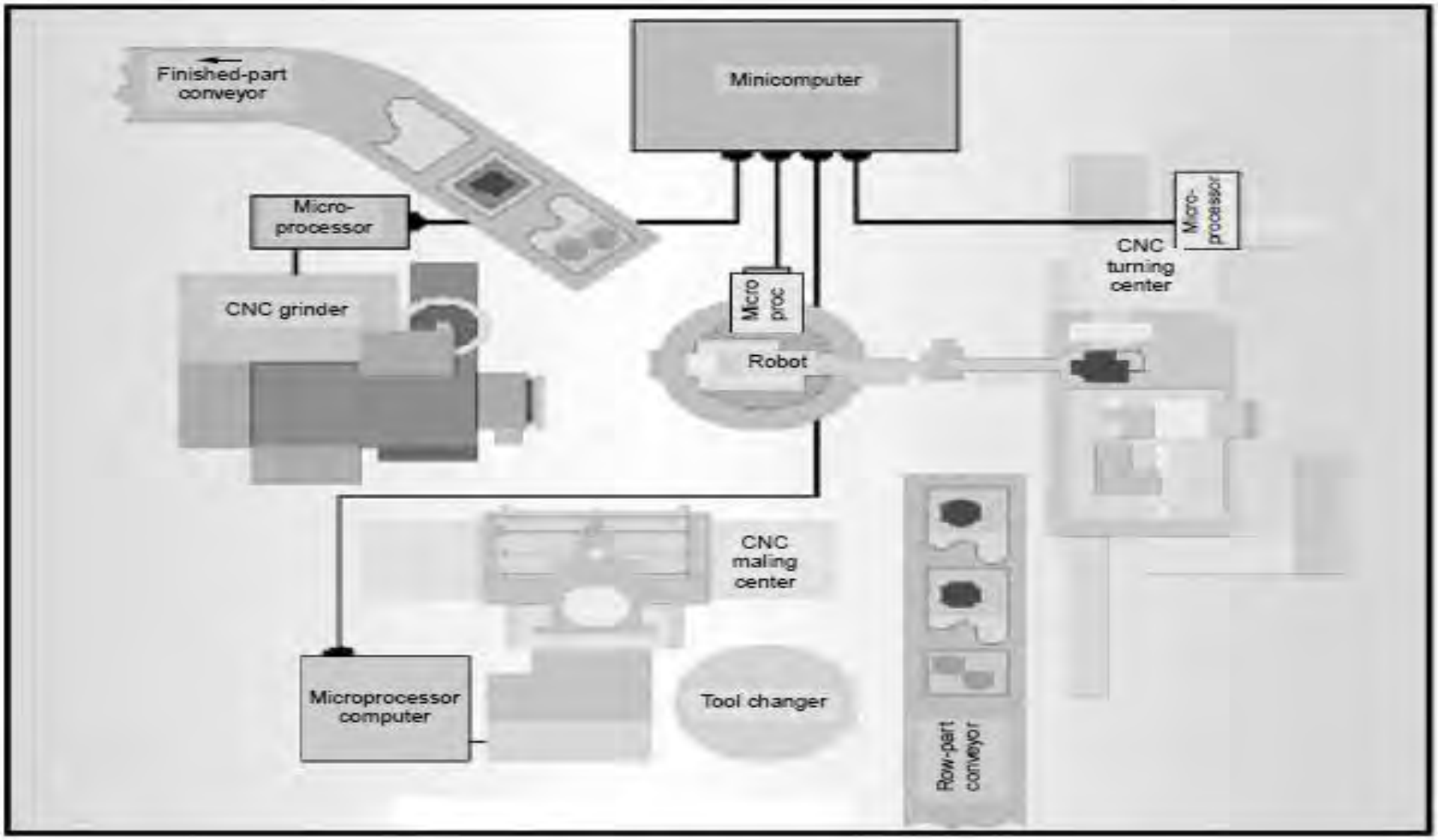
- **Open Field Type:** The configuration of the open field is as shown in Fig.(d). The loading and unloading station is typically located at the same end. The parts will go through all the substations, such as CNC machines, coordinate measuring machines and wash station by the help of AGV's from one substation to another.
- **Robot Centered Type:** Robot centered cell is a relatively new form of flexible system in which one or more robots are used as the material handling systems as shown in Fig.(e). Industrial robots can be equipped with grippers that make them well suited for handling of rotational parts.

TYPES OF FMS LAYOUTS



(d) Open field FMS

TYPES OF FMS LAYOUTS



(e) Robot centered FMS

THE PRINCIPLE OBJECTIVES OF FMS

The principle objectives of FMS are

- **To improve operational control through:**
  - Reduction in the number of uncontrollable variables.
  - Providing tools to recognize and react quickly to deviations in the manufacturing plan
  - Reducing the dependence of human communication.
- **To reduce direct labor:**
  - Removing operators from the machining site (their responsibilities activities can be broadened).
  - Eliminating dependence on highly skilled machines (their manufacturing skills can be better utilized in manufacturing engineering functions).
  - Providing a catalyst to introduce and support unattended or lightly attended machining operation.

THE PRINCIPLE OBJECTIVES OF FMS

- To improve short run responsiveness consisting of:
  - Engineering changes
  - Processing changes
  - Machining downtime or unavailability
  - Cutting tool failure
  - Late material delivery
- To improve long-run accommodations through quicker and easier assimilation of:
  - Changing product volumes
  - New product additions and introductions
  - Differentiation part mixes
    - Increase Machine Utilization by:
    - Eliminating machine setup
    - Utilizing automated features to replace manual intervention
    - Providing quick transfer devices to keep machines in the cutting cycle
  - Reduce inventors by:
    - Reducing lot sizes
    - Improving inventors turn-over
    - Providing the planning tools for JIT manufacturing

REQUIREMENTS OF FMS

The two important equipments requirements of FMS are:

- ***Primary equipment:*** *It adds value to the piece parts being manufactured. It consists of* work centers, which physically machine a piece part, and process centers, which assemble, check or wash, etc. the piece parts.
- ***Secondary equipment:*** *It is used to support the primary equipment in achieving this goal.* It consists of support stations such as pallet/fixture load-unload stations and tool commissioning/setting area, etc. It also consists of support equipments such as robots, pallet/fixture/stillage stores, pallet buffer stations, tool stores, raw material stores, transport system (AGVs, RGVs, robots) for tooling and piece parts, etc.

Advantages and Disadvantages of FMS Implementation

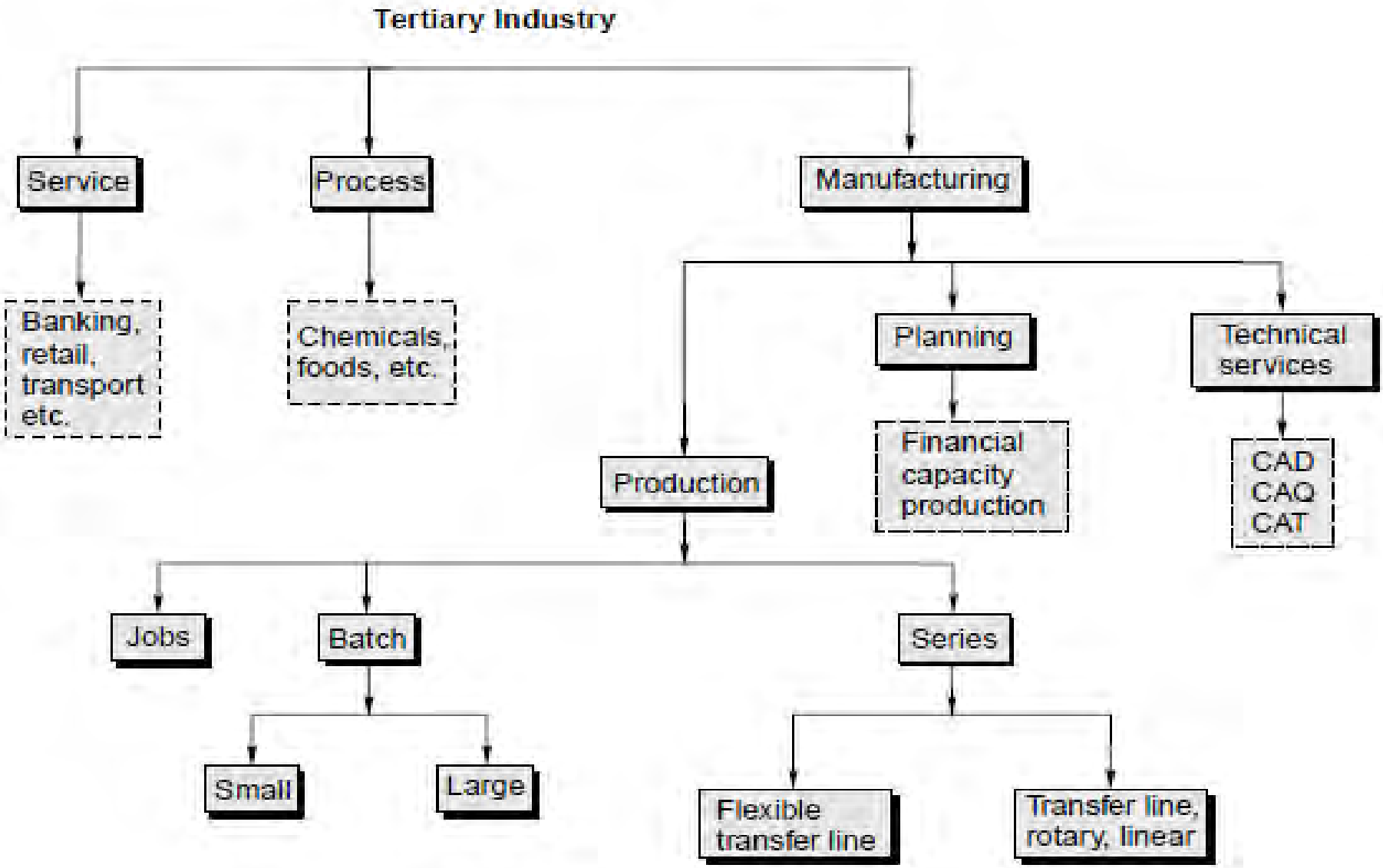
Advantages:

- Faster, lower-cost changes from one part to another which will improve capital utilization
- Lower direct labor
- Reduced inventory, due to the planning and programming precision
- Consistent and better quality, due to the automated control
- Lower cost/unit of output, due to the greater productivity using the same number of workers
- Savings from the indirect labor, from reduced errors, rework, repairs and rejects

Disadvantages:

- Limited ability to adapt to changes in product or product mix (ex. machines are of limited capacity and the tooling necessary for products, even of the same family, is not always feasible in a given FMS)
- Substantial pre-planning activity
- Expensive, costing millions of dollars
- Technological problems of exact component positioning and precise timing necessary to process a component
- Sophisticated manufacturing systems

AREA OF APPLICATION OF FMS



TYPES OF PRODUCTION

- Some of the most important types of production are:

  (i) Job Production

  (ii) Batch production

  (iii) Mass or flow production

  (iv) Continuous production
- A production manager will have to choose most appropriate method for his enterprise.
- The final decision regarding any particular method of production is very much affected by the nature of the products and the quantity to be produced. Production methods may be broadly classified as Job Production, Batch production and Mass or Flow Production.

PIECE OR JOB PRODUCTION

- Under this method peculiar, special or non-standardized products are produced in accordance with the orders received from the customers. As each product is non- standardized varying in size and nature, it requires separate job for production. The machines and equipment's are adjusted in such a manner so as to suit the requirements of a particular job.
- Job production involves intermittent process as the work is carried as and when the order is received. It consists of bringing together of material, parts and components in order to assemble and commission a single piece of equipment or product.
- Ship building, dam construction, bridge building, book printing are some of the examples of job production. Third method of plant layout viz., Stationery Material Layout is suitable for job production.

PIECE OR JOB PRODUCTION

Characteristics:

The job production possesses the following characteristics.

- A large number of general purpose machines are required.
- A large number of workers conversant with different jobs will have to be employed.
- There can be some variations in production.
- Some flexibility in financing is required because of variations in work load.
- A large inventory of materials, parts and tools will be required.
- The machines and equipment setting will have to be adjusted and re-adjusted to the manufacturing requirements.
- The movement of materials through the process is intermittent.

PIECE OR JOB PRODUCTION

Limitations:

Job production has the following limitations:

- The economies of large scale production may not be attained because production is done in short-runs.
- The demand is irregular for some products.
- The use of labour and equipment may be an inefficient.
- The scientific assessment of costs is difficult.

BATCH AND LOT PRODUCTION

- Batch production pertains to repetitive production. It refers to the production of goods, the quantity of which is known in advance. It is that form of production where identical products are produced in batches on the basis of demand of customers' or of expected demand for products.
- This method is generally similar to job production except the quantity of production. Instead of making one single product as in case of job production, a batch or group of products are produced at one time. It should be remembered here that one batch of products may not resemble with the next batch.
- Under batch system of production the work is divided into operations and one operation is done at a time. After completing the work on one operation it is passed on to the second operation and so on till the product is completed. Batch production can be explained with the help of an illustration. An enterprise wants to manufacture 20 electric motors.

BATCH AND LOT PRODUCTION

- The work will be divided into different operations. The first operation on all the motors will be completed in the first batch and then it will pass on to the next operation. The second group of operators will complete the second operation before the next and so on. Under job production the same operators will manufacture full machine and not one operation only.
- Batch production can fetch the benefits of repetitive production to a large extent, if the batch is of a sufficient quantity. Thus batch production may be defined as the manufacture of a product in small or large batches or lots by series of operations, each operation being carried on the whole batch before any subsequent operation is operated. This method is generally adopted in case of biscuit and confectionery and motor manufacturing, medicines, tinned food and hardware's like nuts and bolts etc.
- A **batch** is an homogenous quantity of a material with certain characteristics. A (**production**) **lot** is the quantity produced in one **production** order. The quantity deriving from the same **production lot** can represent a certain **batch** — but this is not necessarily so. Material in **batches** could as well be procured from a vendor.

BATCH AND LOT PRODUCTION

Characteristics

The batch production method possesses the following characteristics:

- The work is of repetitive nature.
- There is a functional layout of various manufacturing processes.
- One operation is carried out on whole batch and then is passed on to the next operation and so on.
- Same type of machines is arranged at one place.
- It is generally chosen where trade is seasonal or there is a need to produce great variety of goods.

MASS PRODUCTION

- This method involves a continuous production of standardized products on a large scale. Under this method, production remains continuous in anticipation of future demand. Standardization is the basis of mass production. Standardized products are produced under this method by using standardized materials and equipment. There is a continuous or uninterrupted flow of production obtained by arranging the machines in a proper sequence of operations. Process layout is best suited method for mass production units.
- Flow production is the manufacture of a product by a series of operations, each article going on to a succeeding operation as soon as possible. The manufacturing process is broken into separate operations.
- The product completed at one operation is automatically passed on to the next till its completion. There is no time gap between the work done at one process and the starting at the next. The flow of production is continuous and progressive.

MASS PRODUCTION

Characteristics:

The mass or flow production possesses the following characteristics.

- The units flow from one operation point to another throughout the whole process.
- There will be one type of machine for each process.
- The products, tools, materials and methods are standardized.
- Production is done in anticipation of demand.
- Production volume is usually high.
- Machine set ups remain unchanged for a considerable long period.
- Any fault in flow of production is immediately corrected otherwise it will stop the whole production process.

MASS PRODUCTION

Suitability of flow/mass production:

- There must be continuity in demand for the product.
- The products, materials and equipments must be standardized because the flow of line is inflexible.
- The operations should be well defined.
- It should be possible to maintain certain quality standards.
- It should be possible to find time taken at each operation so that flow of work is standardized.
- The process of stages of production should be continuous.

MASS PRODUCTION

Advantages of mass production:

A properly planned flow production method, results in the following advantages:

- The product is standardized and any deviation in quality etc. is detected at the spot.
- There will be accuracy in product design and quality.
- It will help in reducing direct labour cost.
- There will be no need of work-in-progress because products will automatically pass on from operation to operation.
- Since flow of work is simplified there will be lesser need for control.
- A weakness in any operation comes to the notice immediately.
- There may not be any need of keeping work-in-progress, hence storage cost is reduced.

CONTINUOUS PRODUCTION

- There is a lot of confusion between mass production and Continuous production. It can be differentiated by a single element. The amount of mechanical work involved. In Mass production, both machines and humans work in tandem. However, in Continuous production, most of the work is done by machines rather than humans. In Continuous production, the production is continuous, 24×7 hours, all days in a year.
- The Plastic industry is known to adopt the Continuous production methodology where production can go continuously for weeks or months depending on the demand. Once the production starts, you only need to feed in the raw material, and the machines turn out the finalized products.

Features of Continuous production

- Majority of the work is done by machines rather than humans.
- Work is continuous in nature. Once production starts, it cannot be stopped otherwise it will cause huge loss.
- A very controlled environment is required for continuous production.

MECHANIZATION AND AUTOMATION

- Mechanization is a process of reducing the human efforts in manufacturing. In modern-day manufacturing, the mechanization is of great importance as it can provide greater production in lowest possible time and at a lower cost. So if some manufacturing process is done by machinery and not by hands then it can be called mechanization. These days all the manufacturing is done to achieve some milestone. So to achieve this milestone at a lower human effort and time some mechanization is necessary. And mechanization will lead to the automation. So to use the machine to its highest capability by adopting mechanical and electrical means or methods will automate the process eventually. Automation and mechanization can be performed in many areas of the manufacturing process.

MECHANIZATION AND AUTOMATION

- The trend of automation can be applied in the material handling or material transporting methods. Loading and unloading is an important and time-consuming process on the production floor. If the process is automated then this will reduce a great deal of hustle. The machining operations done on the materials can be automated.
- Machines when operated it can do the work but no feedback is provided. But an extension of the mechanization is the automation which provides useful feedback by means of sensors. It works in a closed loop in which sensors are active and provides feedback. Through these feedbacks, different machining operations are performed automatically. If all the operations are done through the automated process then the machine is known as a fully automated machine. While if some of the operations are automated and some are manual then the machine is known as the semi-automated machine. The term automation was defined by the Ford Motor Company after the World War II. It was done to perform the automatic handling of the materials. Mainly the word automation was derived from the Greek word 'Automatos'.

'Automatos' means self-acting. So automation is a process of manufacturing in which no or very less human efforts are needed.

WHY AUTOMATION IS SIGNIFICANT IN MANUFACTURING

In the modern era of industrial revolution, automation can have multiple meanings. From a long time, automatic machines are being used in manufacturing processes. Automation does not cover the automatic machines. Automation is a technology in which mechanical, electrical and computer-based systems are incorporated to operate the process and to control the production. Every machine has some kind of automation involved in it. But the degree of automation may vary according to the limitations of the machines as well as the economic considerations. In an automated system, all the processes or a selected number of processes are governed by the self-operated devices which are known as controllers. So the essential elements of the automation are-

- Mechanization
- Sensors
- Feedback system
- Controllers

WHY AUTOMATION IS MUST IN MODERN PRODUCTION FACILITIES?

- Automation improves the rate of productivity to a great level. Only one program is needed to be set and the works will go on without any interruption.
- Less manpower is needed. So the cost of labour is reduced. The production floor will not suffer due to the shortage of manpower.
- The consistency of the production will be great. Automated machines can replicate the same process numerous times. So the production quality is highly improved.
- In the process, inventory is reduced to a great deal.
- Manufacturing time is shortened. This will certainly happen. Automated machines do not need to take rest like humans. The machines can be shut down once in a while due to the maintenance work. But that doesn't affect the production that much.
- Dependence on the skilled operator reduces to a great extent when automation is done. An automated process can be continued with people with very fewer Even people with skills can perform the job after some training.
- Less human efforts required so less involvement of the humans in the automated machining technologies. So the risk of human life to be in danger is reduced greatly.

TYPES OF AUTOMATION

Three broad categories are there for the automation:

- Fixed or Hard Automation
- Programmable automation technology
- Flexible automation or Flexible Manufacturing System (FMS)

FIXED OR HARD AUTOMATION TECHNOLOGY

- Fixed automation, also known as hard automation, is generally used in the production of the standardized products. The standardized products may include gears, nuts, bolts, bearings, standard tubes, washers etc. Fixed or hard automation is used for the products which are needed to be manufactured in a large quantity. But there may be some marginal difference in the design of the components. For this automation technology to be implemented, highly specialized tools, jigs, fixtures and equipment are needed. These are essential for the highest production rate. This decreases the cost to a great extent.

PROGRAMMABLE AUTOMATION

- This technique is very much needed for the manufacturing units producing versatile products. The companies in which frequent design changes are very normal are generally using the programmable automation system. In the programmable automation, the design of the product is changed through the programs. Even if you want to switch the manufacturing of one product to another, that is also possible. Low quantity production unit can use the programmable automation systems. Small batch production can be easily done with programmable automation techniques. Most of the time cell phone manufacturers are using programmable automation.

FLEXIBLE AUTOMATION

- Another type of automation technology is the flexible automation. It lies between the programmable and fixed automation systems. Flexible automation involves the Computer Aided Design (CAD) and Computer Aided Manufacturing (CAM). It is also known as the Flexible Manufacturing System (FMS). So one unit can be used to produce same product or different products. Robots can be a great example of Flexible Automation. Robots are an integral part of FMS. A large number of products can be manufactured with the help of robots and Computer Integrated Manufacturing (CIM) system. It greatly reduces the human labour.

ROLE OF AUTOMATION ON INDUSTRIAL PRODUCTION

Automated production lines

- An automated production line consists of a series of workstations connected by a transfer system to move parts between the stations. This is an example of fixed automation, since these lines are typically set up for long production runs, perhaps making millions of product units and running for several years between changeovers. Each station is designed to perform a specific processing operation, so that the part or product is constructed stepwise as it progresses along the line. A raw work part enters at one end of the line, proceeds through each workstation, and emerges at the other end as a completed product. In the normal operation of the line, there is a work part being processed at each station, so that many parts are being processed simultaneously and a finished part is produced with each cycle of the line. The various operations, part transfers, and other activities taking place on an automated transfer line must all be sequenced and coordinated properly for the line to operate efficiently. Modern automated lines are controlled by programmable logic controllers, which are special computers that facilitate connections with industrial equipment (such as automated production lines) and can perform the kinds of timing and sequencing functions required to operate such equipment.

ROLE OF AUTOMATION ON INDUSTRIAL PRODUCTION

Automated production lines

- Automated production lines are utilized in many industries, most notably automotive, where they are used for processes such as machining and press-working. Machining is a manufacturing process in which metal is removed by a cutting or shaping tool, so that the remaining work part is the desired shape. Machinery and motor components are usually made by this process. In many cases, multiple operations are required to completely shape the part. If the part is mass-produced, an automated transfer line is often the most economical method of production. The many separate operations are divided among the workstations. Transfer lines date back to about 1924.
- Press-working operations involve the cutting and forming of parts from sheet metal. Examples of such parts include automobile body panels, outer shells of major appliances (e.g., laundry machines and ranges), and metal furniture (e.g., desks and file cabinets). More than one processing step is often required to complete a complicated part. Several presses are connected together in sequence by handling mechanisms that transfer the partially completed parts from one press to the next, thus creating an automated press-working line.

ROLE OF AUTOMATION ON INDUSTRIAL PRODUCTION

Numerical Control

- Numerical control is a form of programmable automation in which a machine is controlled by numbers (and other symbols) that have been coded on punched paper tape or an alternative storage medium. The initial application of numerical control was in the machine tool industry, to control the position of a cutting tool relative to the work part being machined. The NC part program represents the set of machining instructions for the particular part. The coded numbers in the program specify *x-y-z* coordinates in a Cartesian axis system, defining the various positions of the cutting tool in relation to the work part. By sequencing these positions in the program, the machine tool is directed to accomplish the machining of the part. A position feedback control system is used in most NC machines to verify that the coded instructions have been correctly performed.

ROLE OF AUTOMATION ON INDUSTRIAL PRODUCTION

Numerical Control

- Today a small computer is used as the controller in an NC machine tool, and the program is actuated from computer memory rather than punched paper tape. However, initial entry of the program into computer memory is often still accomplished using punched tape. Since this form of numerical control is implemented by computer, it is called computer numerical control, or CNC. Another variation in the implementation of numerical control involves sending part programs over telecommunications lines from a central computer to individual machine tools in the factory, thus eliminating the use of the punched tape altogether. This form of numerical control is called direct numerical control, or DNC.
- Many applications of numerical control have been developed since its initial use to control machine tools. Other machines using numerical control include component-insertion machines used in electronics assembly, drafting machines that prepare engineering drawings, coordinate measuring machines that perform accurate inspections of parts, and flame cutting machines and similar devices.

ROLE OF AUTOMATION ON INDUSTRIAL PRODUCTION

Automated Assembly:

- Assembly operations have traditionally been performed manually, either at single assembly workstations or on assembly lines with multiple stations. Owing to the high labour content and high cost of manual labour, greater attention has been given in recent years to the use of automation for assembly work. Assembly operations can be automated using production line principles if the quantities are large, the product is small, and the design is simple (e.g., mechanical pencils, pens, and cigarette lighters). For products that do not satisfy these conditions, manual assembly is generally required.
- Automated assembly machines have been developed that operate in a manner similar to machining transfer lines, with the difference being that assembly operations, instead of machining, are performed at the workstations.

ROLE OF AUTOMATION ON INDUSTRIAL PRODUCTION

Automated Assembly:

- A typical assembly machine consists of several stations, each equipped with a supply of components and a mechanism for delivering the components into position for assembly. A workhead at each station performs the actual attachment of the component. Typical workheads include automatic screwdrivers, staking or riveting machines, welding heads, and other joining devices. A new component is added to the partially completed product at each workstation, thus building up the product gradually as it proceeds through the line. Assembly machines of this type are considered to be examples of fixed automation, because they are generally configured for a particular product made in high volume. Programmable assembly machines are represented by the component-insertion machines employed in the electronics industry, as described above.

FLEXIBLE MANUFACTURING SYSTEM

- A flexible manufacturing system (FMS) is a form of flexible automation in which several machine tools are linked together by a material-handling system, and all aspects of the system are controlled by a central computer. An FMS is distinguished from an automated production line by its ability to process more than one product style simultaneously. At any moment, each machine in the system may be processing a different part type. An FMS can also cope with changes in product mix and production schedule as demand patterns for the different products made on the system change over time. New product styles can be introduced into production with an FMS, so long as they fall within the range of products that the system is designed to process. This kind of system is therefore ideal when demand for the products is low to medium and there are likely to be changes in demand.

FLEXIBLE MANUFACTURING SYSTEM

- The components of an FMS are

  (1) processing machines, which are usually CNC machine tools that perform machining operations, although other types of automated workstations such as inspection stations are also possible,

  (2) a material-handling system, such as a conveyor system, which is capable of delivering work parts to any machine in the FMS, and

  (3) a central computer system that is responsible for communicating NC part programs to each machine and for coordinating the activities of the machines and the material-handling system.
- In addition, a fourth component of an FMS is human labour. Although the flexible manufacturing system represents a high level of production automation, people are still needed to manage the system, load and unload parts, change tools, and maintain and repair the equipment.


So in a modern-day manufacturing scenario is changed and the hardware and software concepts are also changed.
So the use of Mechatronics and Automation in the production floor is the future.

THANK YOU