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Flexible Manufacturing System A Modern Approach To Manufacturing Technology

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Abstract:- Flexibility in manufacturing system is one of the most important issues of present scenario, to fulfill the desired customer's requirement & getting low cost and high quality of product that enforced to adopting the flexible manufacturing system for various modern manufacturing enterprises. The basic of FMS is to convert & increases positivity throughout the manufacturing process for achieving higher productivity and best quality of product. Flexible manufacturing system consist of an integrated system of computerized numerically controlled (CNC) machine tool , automated material handling system operating under the controlled computer , workstation, storage etc. This paper highlights the merits, demerits, application of FMS and also overviewed of other aspect of FMS.

Keyword:- Computer Numerical Control, FMS Layout, Flexibility, Flexible Manufacturing System

I. INTRODUCTION

The global competition has been increasing and enforced to various manufacturing enterprises to adopt flexible manufacturing system (FMS) to get improved productivity and quality of the product. flexible manufacturing system involve following items**,** an integrated system of Computerized Numerically Controlled (CNC) machine tools and automated Material Handling System (MHS), operating under the control of computer(s). Many supporting workstations such as load/unload stations, washing stations, storage, de-burring stations, tools and fixtures setting stations can be added to FMS (Aly and Subramaniam, 1993; Bayazit, 2005). The fundamental building block of an FMS is data communication because flexibility is mainly imparted by integrating the functions of various elements such as machining cells, robots, AGVs using computers (Venkatesh and Ilyas, 1993; Ficko et al, 2010). Hence FMS is very complex and expensive in nature and requirement large amount of planning and investment thus The flexible manufacturing system may be defined as it is a highly automated group technology machine cell consisting of a group of processing work stations interconnected by an automated material handling and storage system and controlled by a distributed computer system. The Flexible manufacturing systems (FMS) is made up of hardware and software elements. Hardware elements are visible and tangible such as CNC machines tools. Software elements are invisible and intangible such as NC programs. Flexible manufacturing is a concept that allows manufacturing systems to be built under high customized production requirements. The issues such as reduction of inventories and market-response time to meet customer demands, flexibility to adapt to changes in the market, reducing the cost of products and services to grab more market shares, etc have made it almost obligatory to many firms to switch over to flexible manufacturing systems (FMSs) as a viable means to accomplish the above requirements while producing consistently good quality and cost effective products. FMS is actually an automated set of numerically controlled machine tools and material handling systems, capable of performing a wide range manufacturing operations with quick tooling and instruction changeovers. In studying FMS, we need to keep in mind what Peter Drucker said: "We must become managers of technology not merely users of technology". Since FMS is a technology, well adjusted to the environmental needs, we have to manage it successfully.

II. FLEXIBLE MANUFACTURING AND FLEXIBILITY

Flexibility is an attribute that allows a mixed mode manufacturing system to cope up with a certain level of variation in part or product cycle , without any interruption in production due to change over's between model and hence 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. The different type of flexibility that's exhibited by manufacturing system are given below

2.1 Machine Flexibility

It is the capability to adapt a given machine in the system to a wide range of production operations and part styles. The greater the range of operations and part styles the greater will be the machine flexibility. The various factors on which machine flexibility depends are:

- Setup or changeover time
- Ease with which part-programs can be downloaded to machines
- Tool storage capacity of machines
- Skill and versatility of workers in the systems

2.2 Production Flexibility.

It is the range of part styles that can be produced on the systems. The range of part styles that can be produced by a manufacturing system at moderate cost and time is determined by the process envelope. It depends on following factors:

- Machine flexibility of individual stations
- Range of machine flexibilities of all stations in the system

2.3 Mix Flexibility.

It is defined as the ability to change the product mix while maintaining the same total production quantity that is, producing the same parts only in different proportions. It is also known as process flexibility. Mix flexibility provides protection against market variability by accommodating changes in product mix due to the use of shared resources. However, high mix variations may result in requirements for a greater number of tools, fixtures, and other resources. Mixed flexibility depends on factors such as:

- Similarity of parts in the mix
- Machine flexibility
- Relative work content times of parts produced

2.4 Product Flexibility

It refers to ability to change over to a new set of products economically and quickly in response to the changing market requirements. The change over time includes the time for designing, planning, tooling, and fixturing of new products introduced in the manufacturing line-up. It depends upon following factors:

- Relatedness of new part design with the existing part family
- Off-line part program preparation
- Machine flexibility

2.5 Routing Flexibility.

It can define as capacity to produce parts on alternative workstation in case of equipment breakdowns, tool failure, and other interruptions at any particular station. It helps in increasing throughput, in the presence of external changes such as product mix, engineering changes, or New product introductions. Following are the factors which decide routing flexibility:

- Similarity of parts in the mix
- Similarity of workstations
- Common tooling

2.6 Volume Flexibility.

It is the ability of the system to vary the production volumes of different products to accommodate changes in demand while remaining profitable. It can also be termed as capacity flexibility. Factors affecting the volume flexibility are:

- Level of manual labor performing production
- Amount invested in capital equipment
-

2.7. Expansion Flexibility.

It is defined as the ease with which the system can be expanded to foster total production volume. Expansion flexibility depends on following factors:

- Cost incurred in adding new workstations and trained workers
- Easiness in expansion of layout
- Type of part handling system used

III. BASIC COMPONENT OF FMS

The basic components of FMS are:
3.1 Workstations
3.2 Automated Material Handling and Storage System
3.3 Computer Control System
3.4 .Inspection Equipments
3.5 Other Component

3.1 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.

3.2 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 with computer control

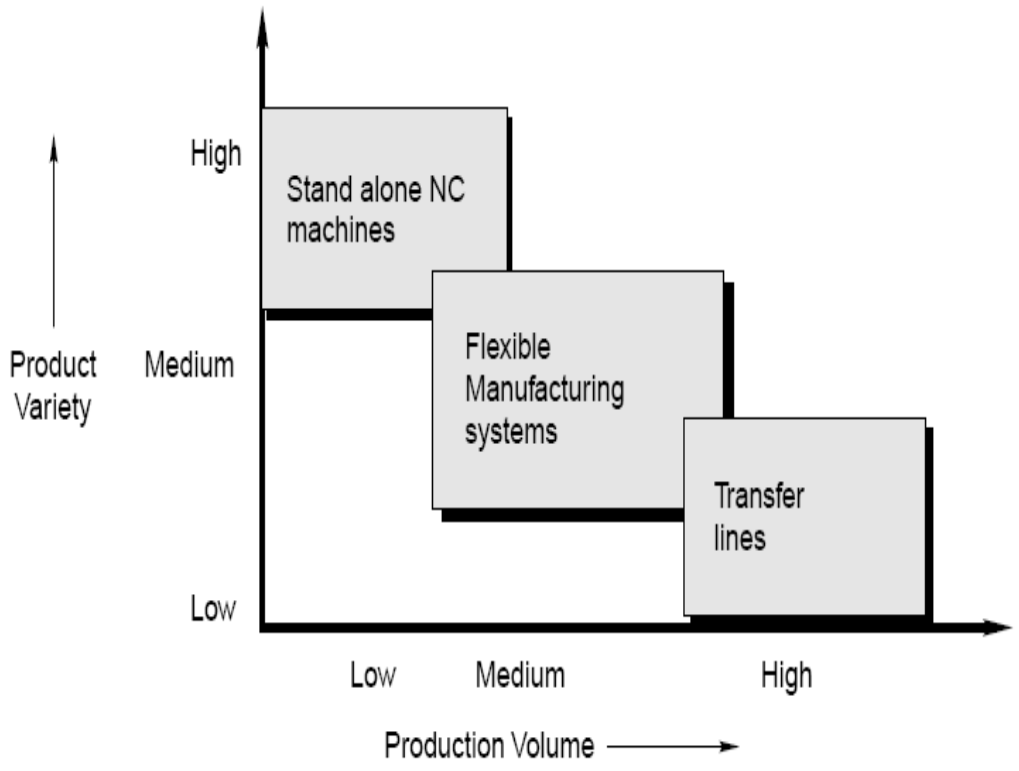


Fig. 2.1 Application characteristics of FMS

3.3 Inspection equipments

It includes coordinate measuring machines (CMMs) used for offline inspection and programmed to measure dimensions, concentricity, perpendicularity, and flatness of surfaces. The distinguishing feature of this equipment is that it is well integrated with the machining centers.

3.4 Other components

It includes a central coolant and efficient chip separation system. Their features are:

- . The system must be capable of recovering the coolant.
- The combination of parts, fixtures, and pallets must be cleaned properly to remove dirt and chips before operation and inspection.

3.5. 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.

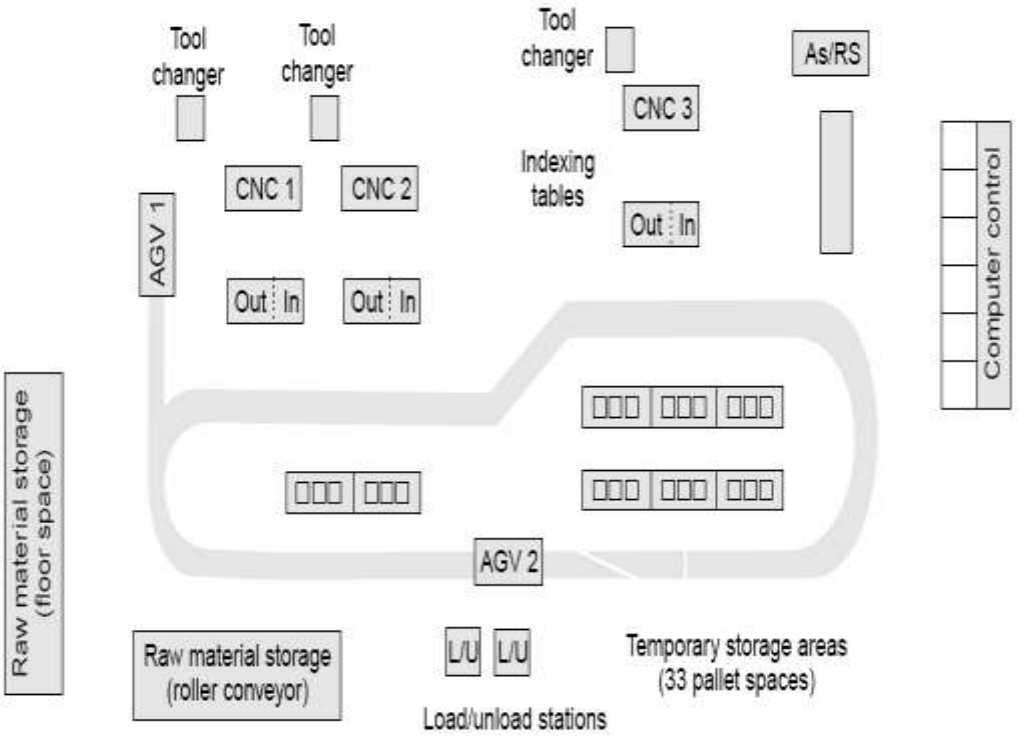


Fig. 2.2 Flexible Manufacturing System

IV. TYPES OF FMS LAYOUT

The different type of layout is:

- Progressive layout
- Loop type
- Ladder type
- Open field type
- Robot centered type

4.1 Progressive type or line type

The machine and handling system are arranged in a line as shown in fig.3.1 (a) . it is most appropriate for a system in which the part progress from one work station 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.

4.2 Loop type

The basic loop configuration is as shown in Fig. 3The part usually moves in one directional around the loop, with the capability to stop and be transferred to any station. The loading and unloading station is typically located at one end of the loop.

4.3 Ladder type

The configuration is as shown in Figure 3.1. The loading and un loading station is typically located at the same end. The sequence to the operation and transfer of part from one machine tool to another is in the form of ladder

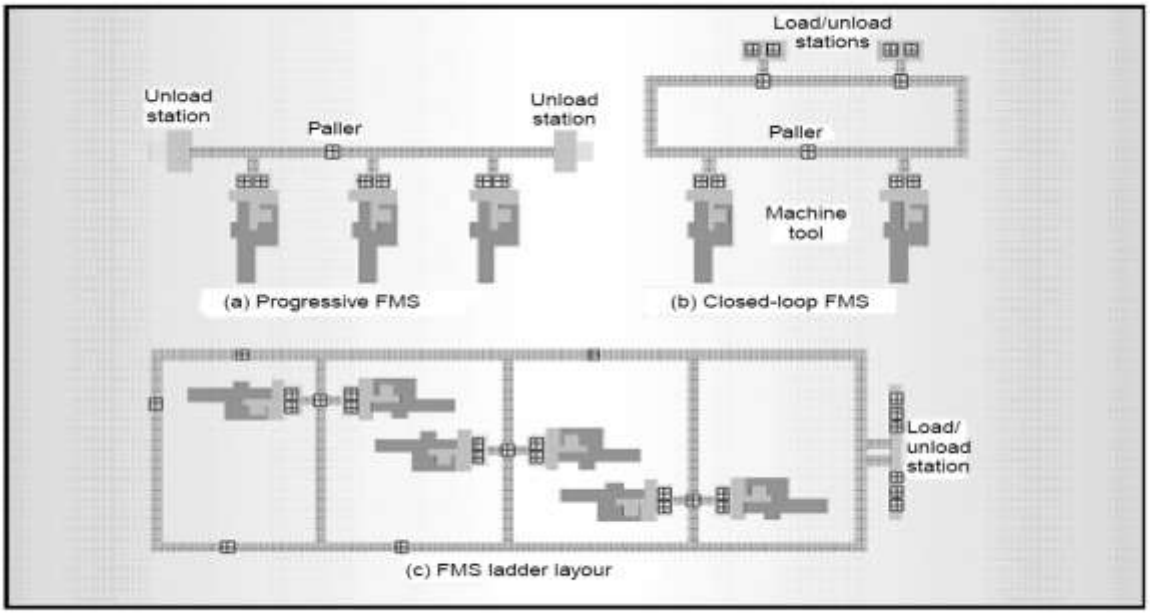
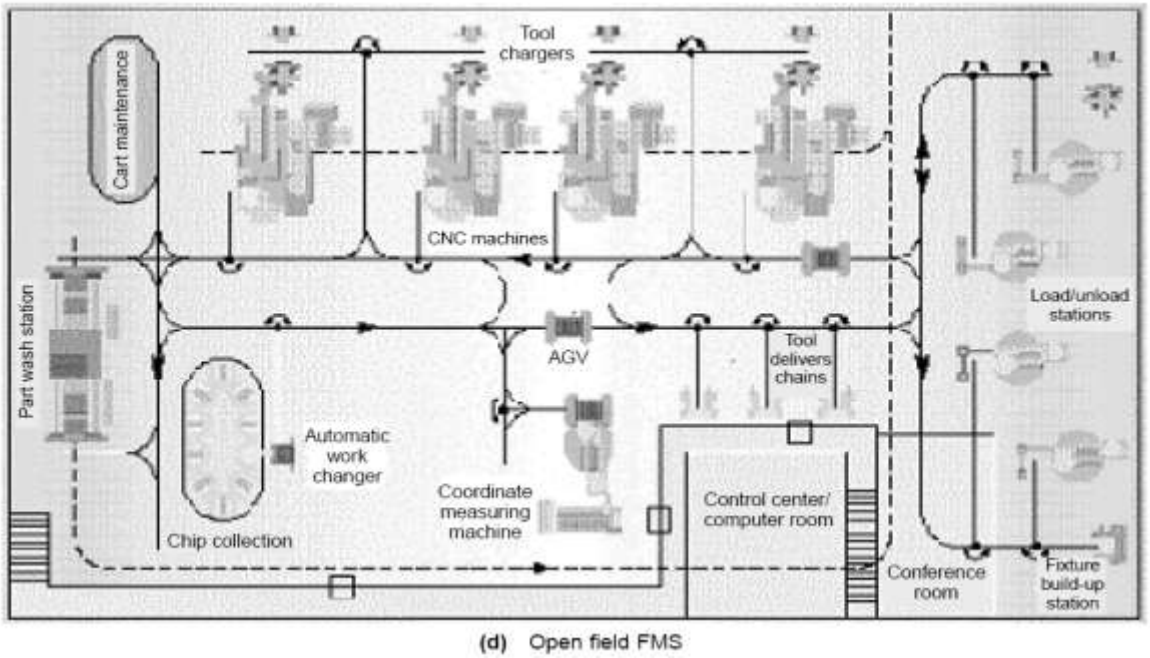
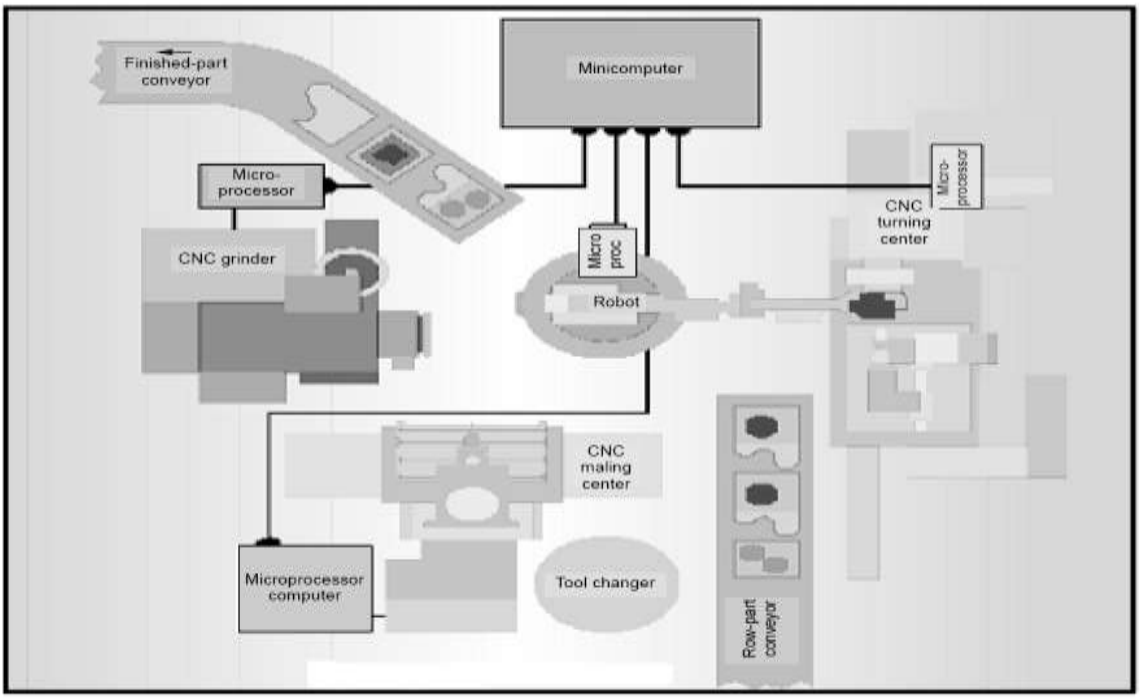


Fig. 3 layout



(d) Open field FMS



(e) Robot centered FMS

Fig. 3.1 layout

4.4. Open field type

The configuration of the open field is shown in fig. 3.1(d). The loading and unloading station is typically located at the same end. The part will go through all the substations, such as CNC machines , coordinate measuring and wash station by the help of AGV"S from one substation to another.

4.5 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 system as shown in fig. 3.1(e) .Industrial robots can be equipped with grippers that make them well suited for handling of rotational par

V. OBJECTIVE OF FMS

A study is carried out with West Germany manufacturing has shown the major aims of installing an FMS to be:

- Decreased lead time
- Increase throughput
- Increased machine utilization
- Improved due date reliability
- Decreased store inventors level
- Decreased work in progress
- Increased quality

VI. Aims OF FMS

- To reduce cost
- To reduce stocks
- Reduction of piece part unit cost
- To increase technical performance
- Increased production level
- Smaller batch size
- Shorter or zero change over or reset times
- To improve order development
- Shorter lead time or delivery time
- Increase competitiveness
- Increased quality
- Improve company reputation

VII. Merits OF FMS

Following are the derived benefits of FMS

- Reduction of inventories
- Reduction of lead times
- Improved machine utilization
- Reduction of labor times
- Quick and uncompleted reaction to engineering and design changes
- Increased management control over the entire manufacturing process.
- Reduced equipment cost
- Reduced floor space
- High product quality
- Financial benefits

VIII. DEMERITS OF FMS

Following are the derived benefits of FMS

- FMS systems are quite expensive.
- It is complex than transfer lines. As every system is different and tailored made, its commissioning And developing takes times
- Highly knowledgeable persons are required.

IX. AREA OF APPLICATION OF FMS

The following charts in the Fig. 3.2 shows the various applications in an industry

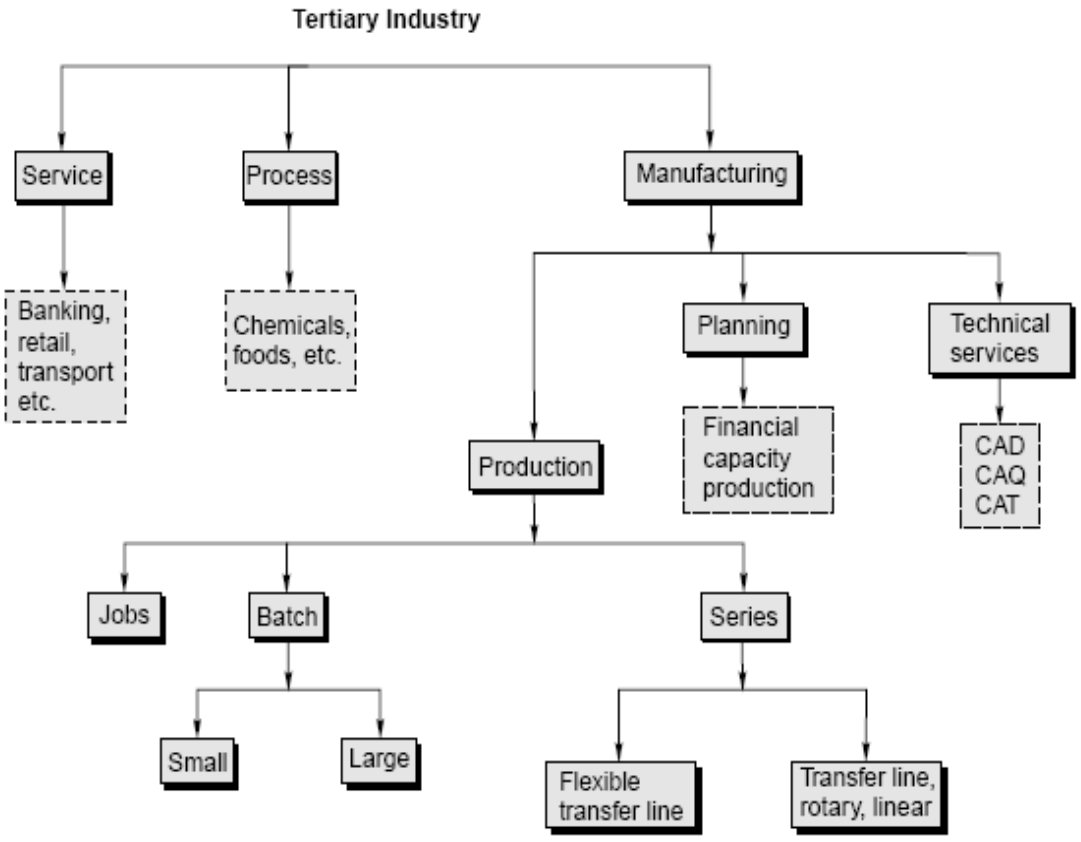


Fig. 3.2 Area of application

X. CONCLUSION

In the current business scenario and competitive environment among various manufacturing enterprises in order to achieve higher productivity & high quality product at low cost as per market demand, the FMS is efficient and effective tool in respect of their merits and applications. The FMS further create challenge to futuristic view of innovation for newer manufacturing technology.

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