

Flexible Manufacturing System

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Master Eng. in Computer Integrated Manufacture

Chapter 1

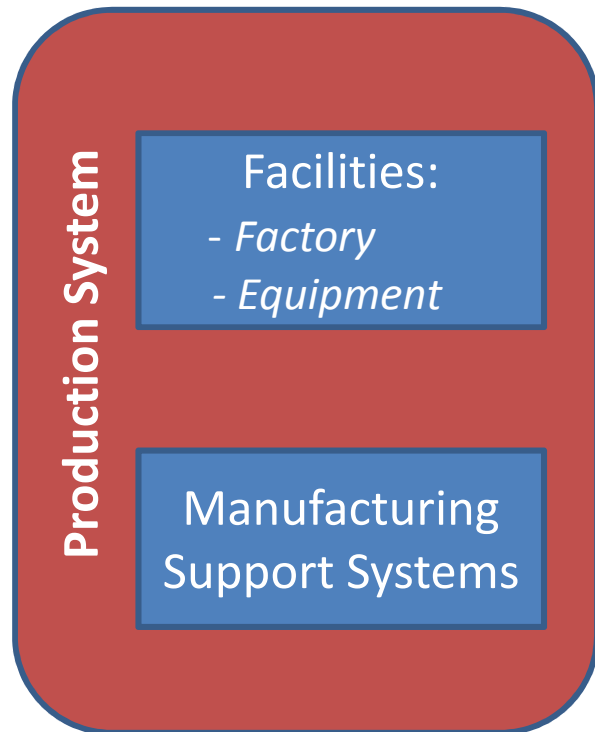
INTRODUCTION



Definition

- *Flexible manufacturing system (FMS)* is a highly automated GT machine cell, consisting of a group or processing workstations (usually CNC machine tools), interconnected by an automated material handling and storage system, and controlled by a distributed computer system.
- A system that consists of numerous programmable machine tools connected by an automated material handling system.

Production System



Facilities

The facilities of the production system consist of the factory, the equipment in the factory, and the way the equipment is organized.

Manufacturing support Systems

This is the set of procedures used by the company to manage production and to solve the technical and logistics problems encountered in ordering materials, moving work through the factory and ensuring that products meet quality standards. Product design and certain business functions are included among the manufacturing support systems.

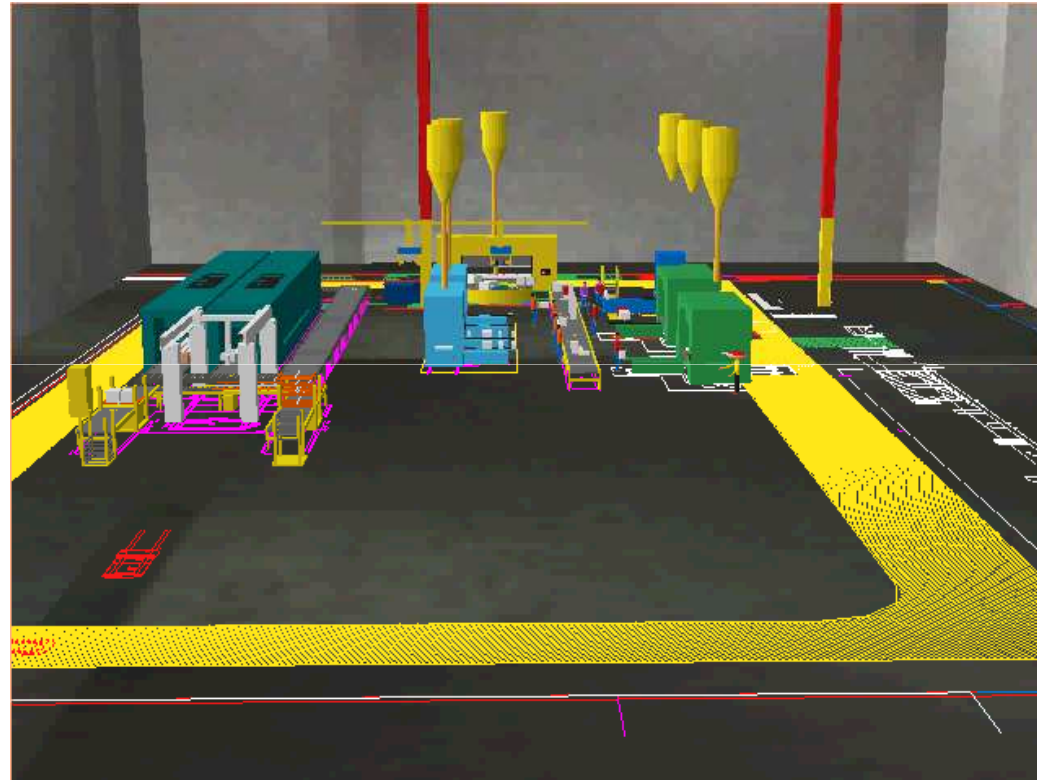
Production System Facilities

- *The facilities* in the production system are the factory, production machines and tooling, material handling equipment, inspection equipment, and the computer systems that control the manufacturing operations.



Production System Facilities

- Facilities also include the *plant layout*, which is the way the equipment is physically arranged in the factory. The equipment is usually organized into logical groupings (*equipment arrangements*) and the workers who operate them as the *manufacturing systems* in the factory.



Manufacturing Systems

- Manufacturing systems can be **individual work cells**, consisting of a single production machine and worker assigned to that machine.
- We more commonly think of manufacturing systems as **groups of machines and workers**, for example, a production line.

The manufacturing systems come in direct physical contact with the parts and/or assemblies being made. They "touch" the product.

Manufacturing Types

One of the most important factors that determine the type of manufacturing is the type of products that are made.

- *Discrete products manufacturing*: including automotive, aircraft, appliances, computers, machinery, etc.
- *Process manufacturing*: products that are in liquid or bulk form, such as chemicals, pharmaceuticals, petroleum, basic metals, food, beverage, electric power generation, etc

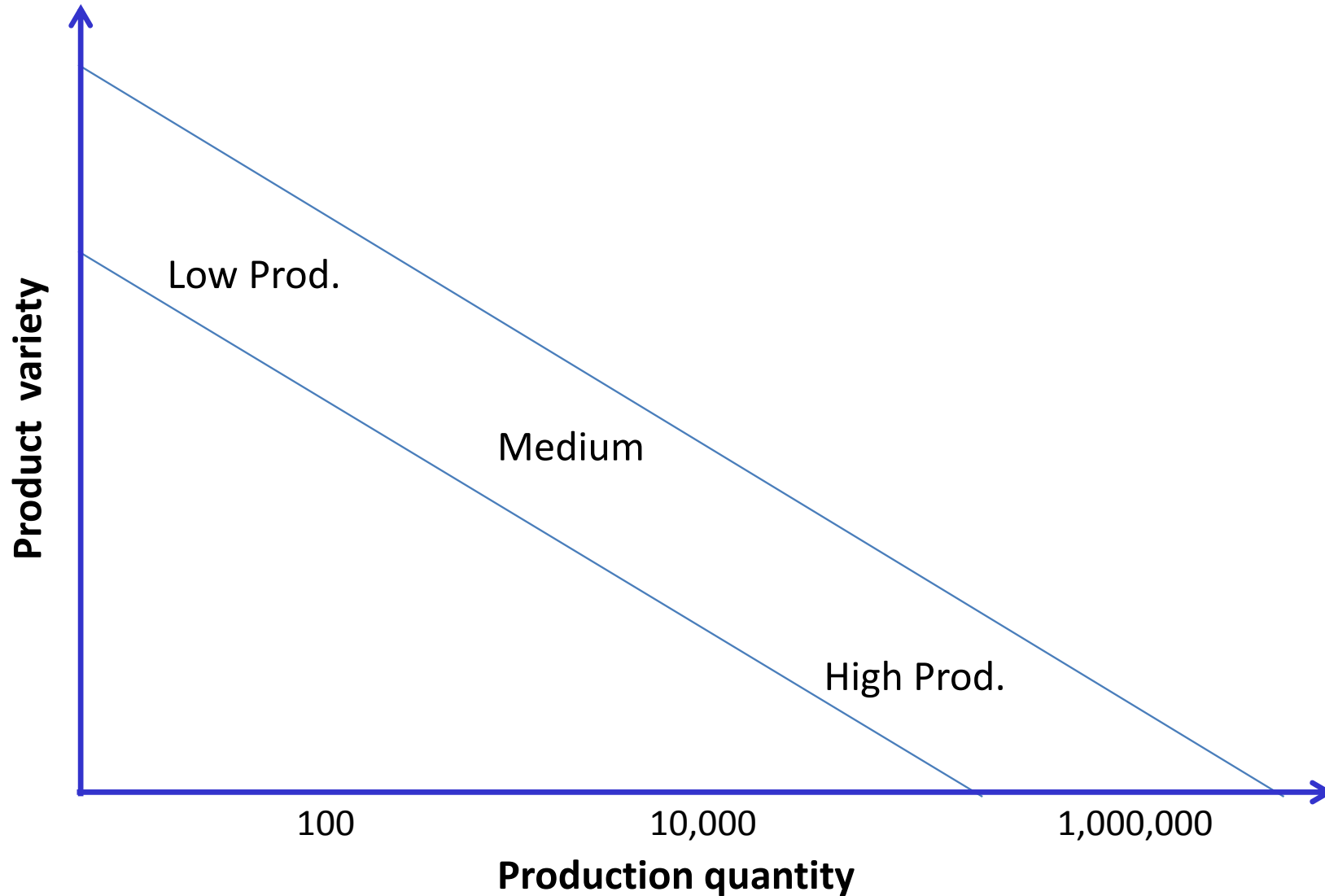
Production Quantity

In discrete products manufacturing, the quantity produced by a factory has a very significant influence on its facilities and the way manufacturing is organized.

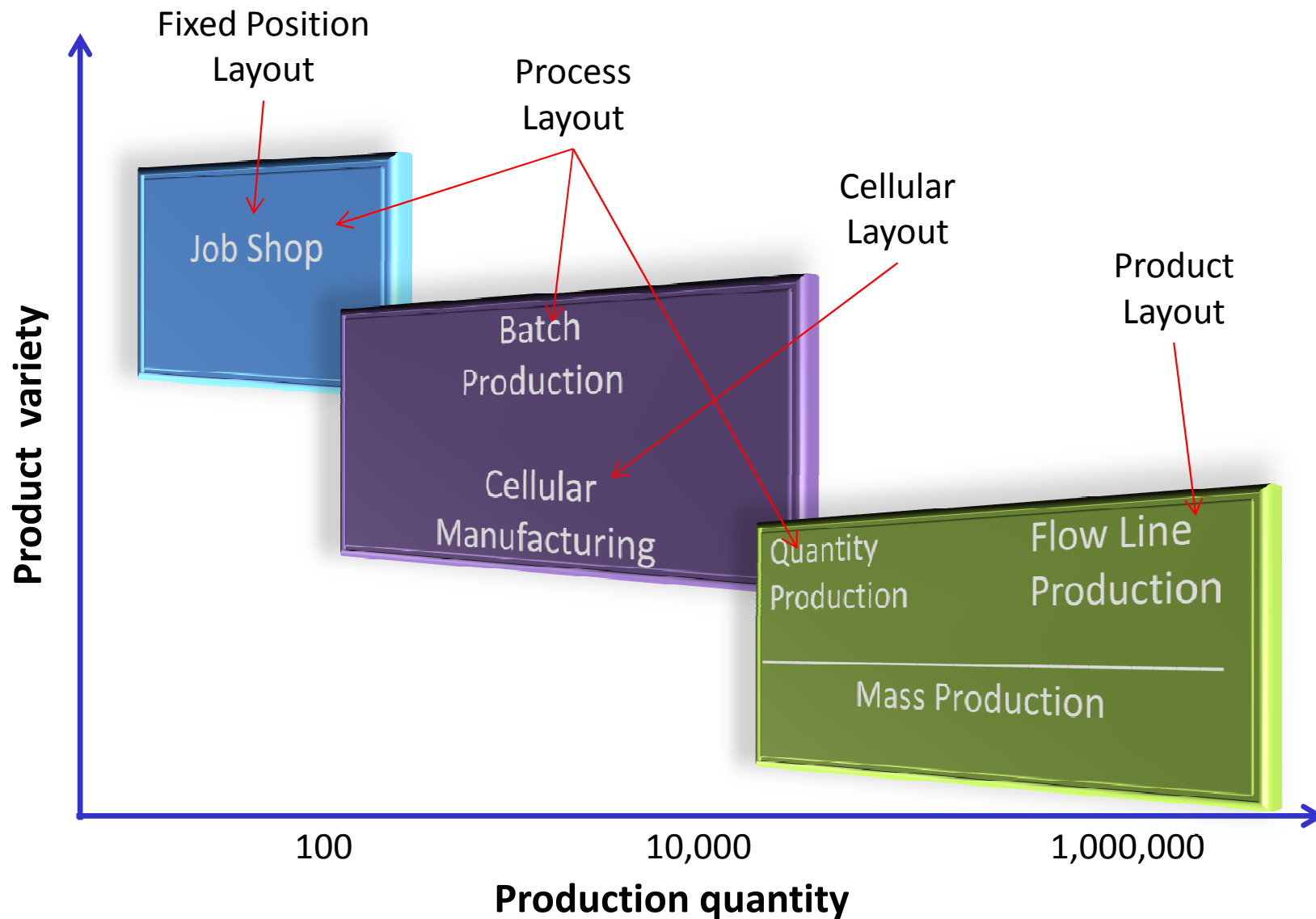
The annual part or product quantities produced in a given factory can be classified into three ranges:

1. *Low production*: Quantities in the range of 1 to 100 units per year
2. *Medium production*: Quantities in the range of 100 to 10,000 units per year
3. *High production*: Production quantities are 10,000 to millions of units per year

Product Variety vs Production Quantity

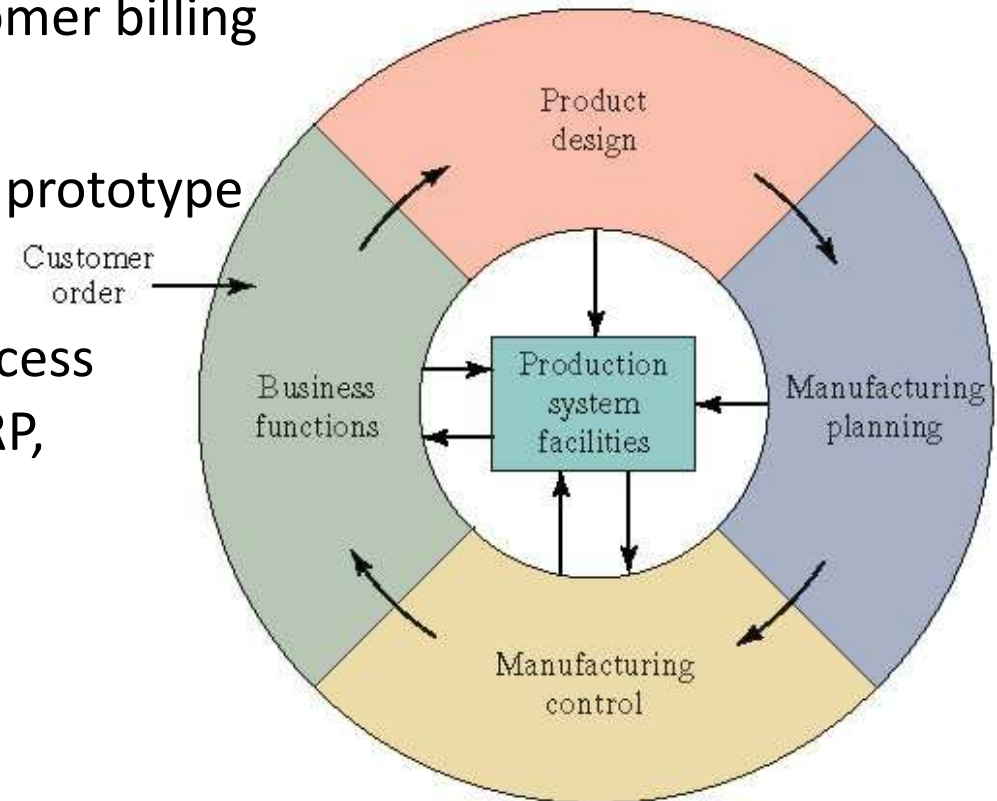


Facility and Layout



Manufacturing Support System

- Business Function - sales and marketing, order entry, cost accounting, customer billing
- Product Design - research and development, design engineering, prototype shop
- Manufacturing Planning - process planning, production planning, MRP, capacity planning
- Manufacturing Control - shop floor control, inventory control, quality control

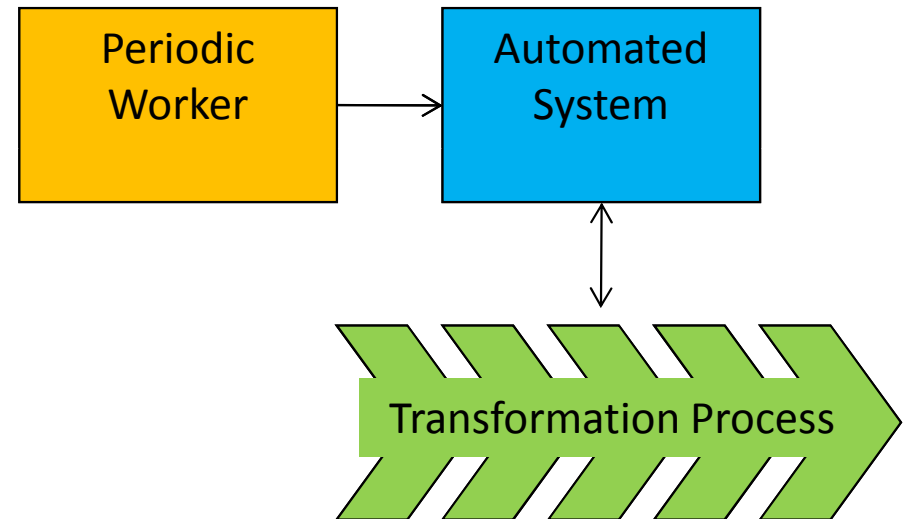


Automation

The automated elements of the production system can be separated into two categories:

- automation of the manufacturing systems in the factory
- computerization of the manufacturing support systems.

Automated Manufacturing Systems



Examples:

- Automated machine tools
- Transfer lines
- Automated assembly systems
- Industrial robots
- Automated material handling and storage systems
- Automatic inspection systems for quality control

Automated Manufacturing Systems Types

- Fixed automation
- Programmable automation
- Flexible Automation

Fixed Automation

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

- Suited to high production quantities
- high initial investment for custom-engineered equipment
- high production rates
- relatively inflexible in accommodating product variety

Programmable Automation

In *programmable automation*, the production equipment is designed with the capability to change the sequence of operations to accommodate different product configuration.

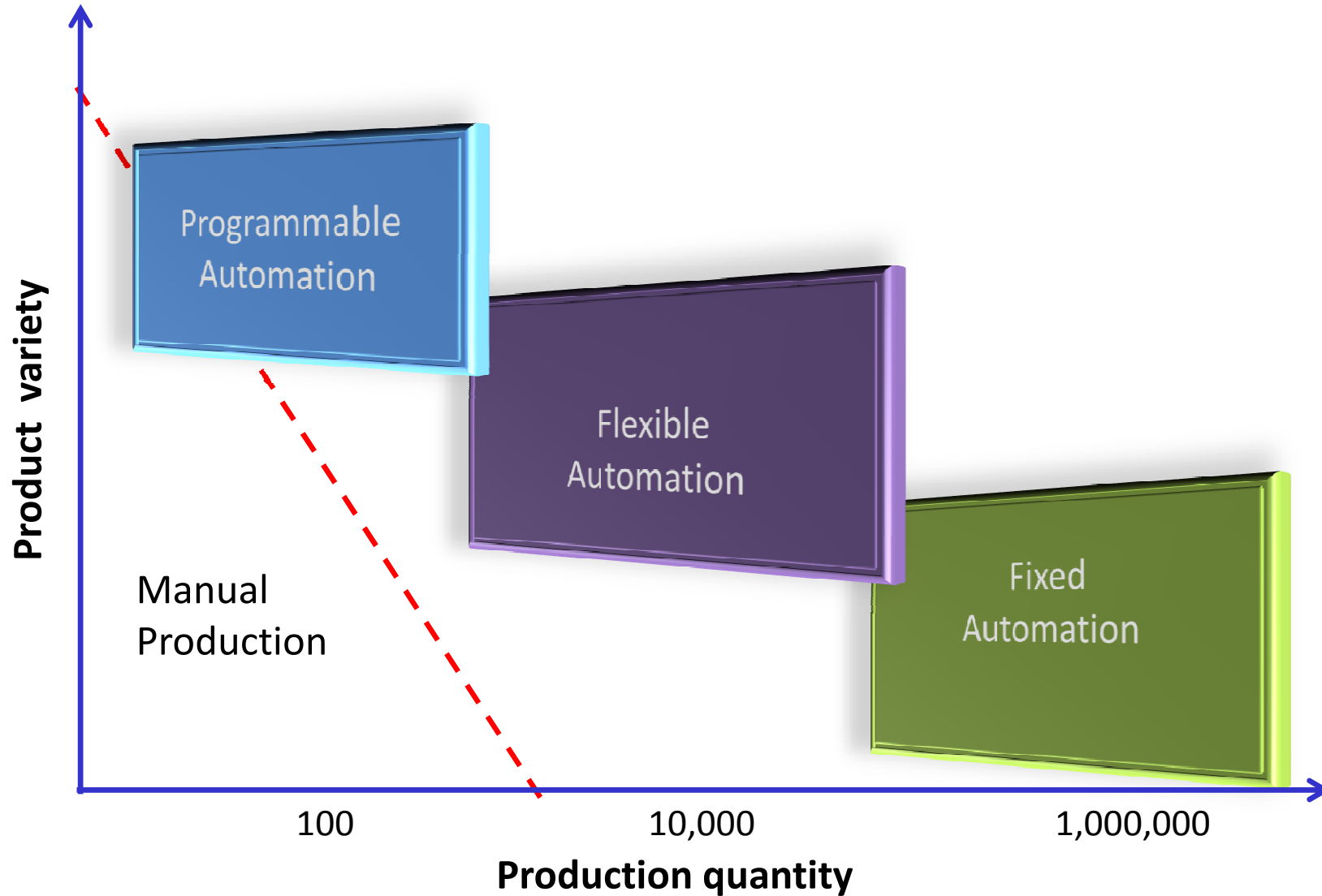
- high investment in general purpose equipment
- lower production rates than fixed automation
- flexibility to deal with variations and changes in product configuration
- most suitable for batch production

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.

- high investment for a custom-engineered system
- continuous production of variable mixtures of products
- medium production rate
- flexibility to deal with product design variations

Automation



Computerized Manufacturing Support Systems

Automation of the manufacturing support systems is aimed at *reducing the amount of manual and clerical effort* in product design, manufacturing planning and control, find the business functions of the firm. Nearly all modern manufacturing support systems are implemented using computer systems.

- Business Function: ERP, CRM, SCM
- Product Design: CAD, CAE
- Manufacturing Planning: CAM, CAPP
- Manufacturing Control: CAIC, CAQC

Reason for Automation

- To increase labor productivity. This means greater output per hour of labor input
- To reduce labor cost.
- To mitigate the effects of labor shortages.
- To reduce or eliminate routine manual and clerical tasks.
- To improve worker safety
- To improve product quality
- To reduce manufacturing lead time. By reducing manufacturing lead time, the manufacturer also reduces work-in-process inventory
- To accomplish processes that can not be done manually.
- To avoid the high cost of not automating.

Situation which human labor is preferred over automation

- Task is too technologically difficult to automate.
- Short product life cycle.
- Customized product.
- To cope with up and down in demand.
- To reduce risk of product failure, especially at the beginning of product's life

Review Question

- What is Production System?

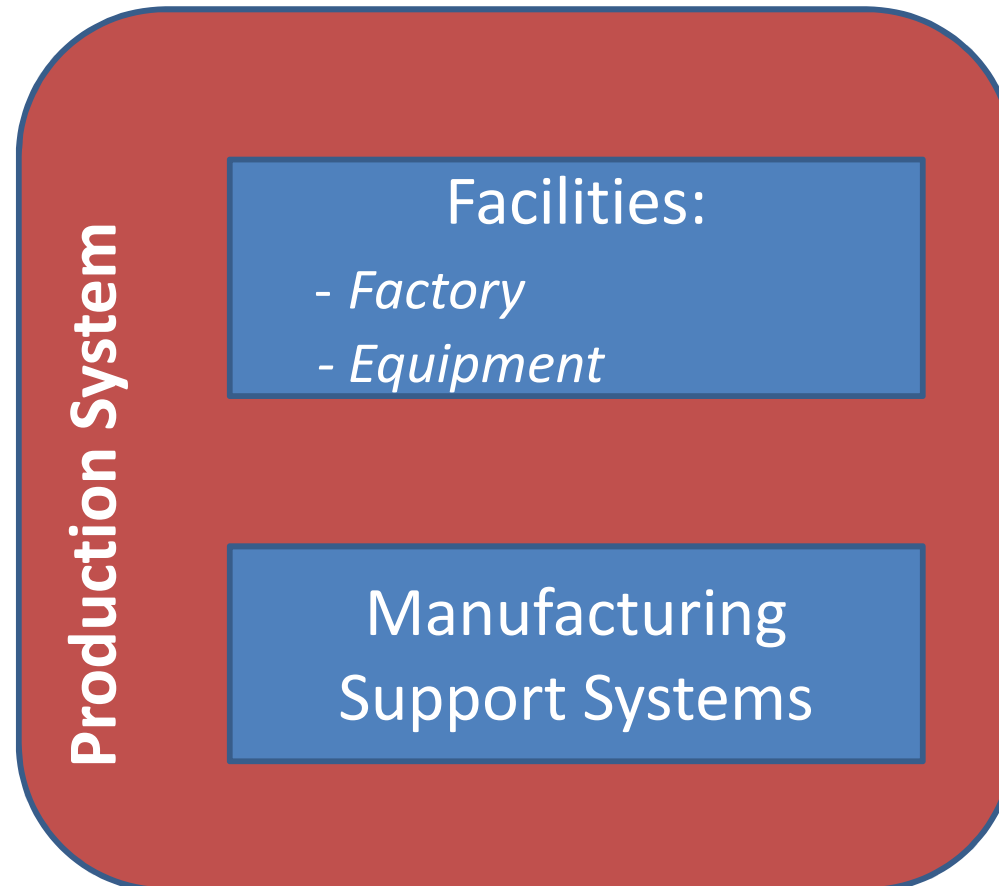
The *production system* is the collection of people, equipment, and procedures organized to accomplish the manufacturing operations of a company (or other organization).

- What is Automation?

Automation is a technology concerned with the application of mechanical, electronic, and computer based system to operate and control production.

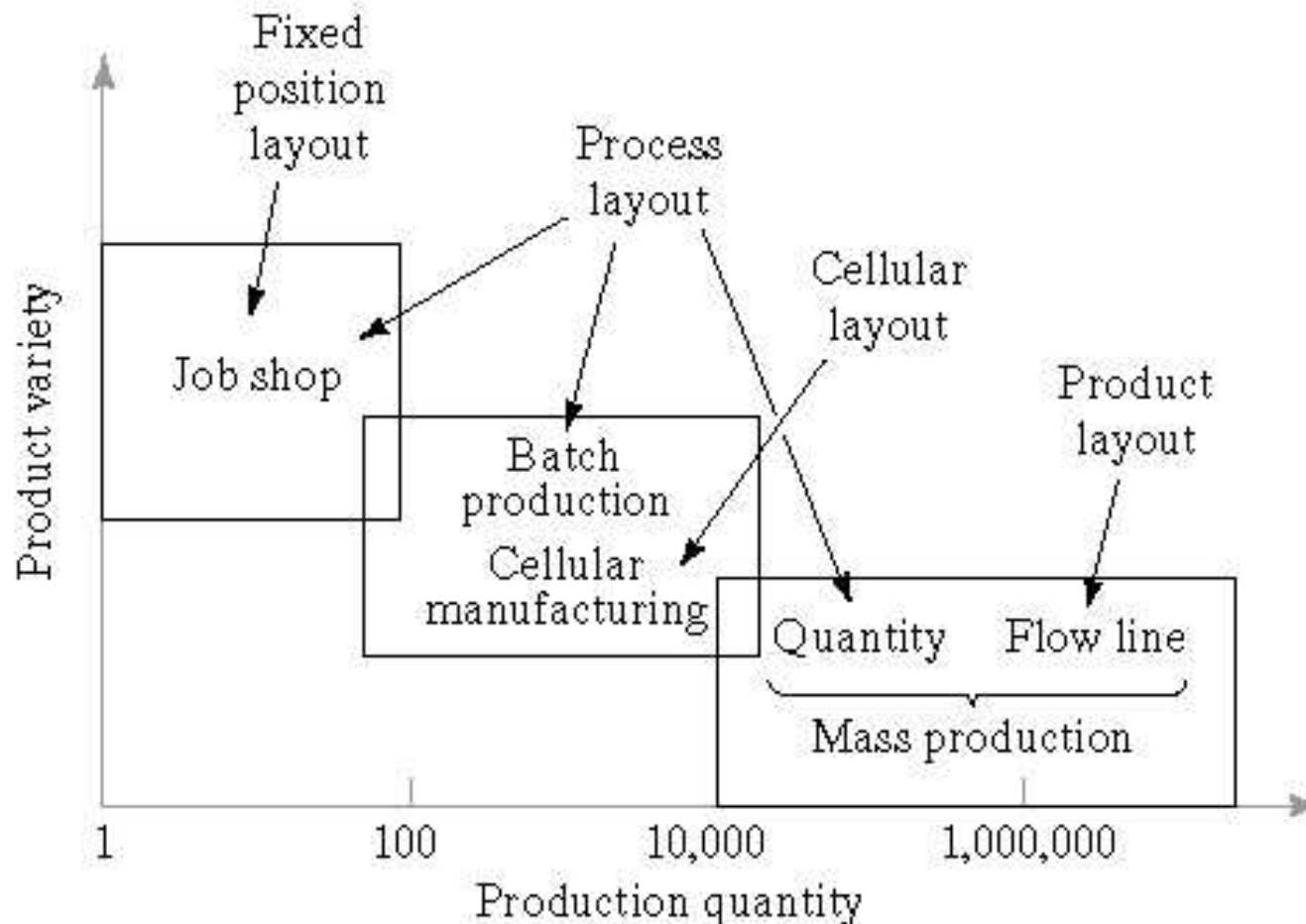
Review Question

- What production system consists of?



Review Question

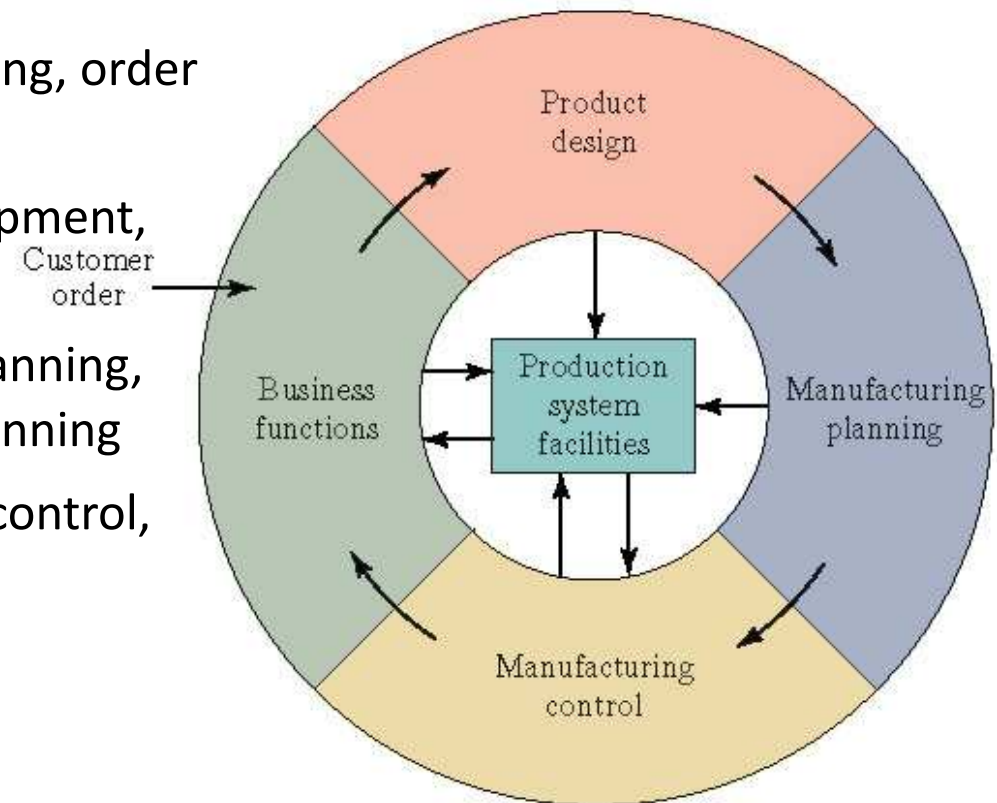
Describe the Relationships between Plant Layout and Type of Production Facility as shown in this figure



Review Question

Describe the elements of Manufacturing Support System

- Business Function - sales and marketing, order entry, cost accounting, customer billing
- Product Design - research and development, design engineering, prototype shop
- Manufacturing Planning - process planning, production planning, MRP, capacity planning
- Manufacturing Control - shop floor control, inventory control, quality control



Review Question

Explain the differences among types of automation, i.e Fixed Automation, Programmable Automation, and Flexible Automation

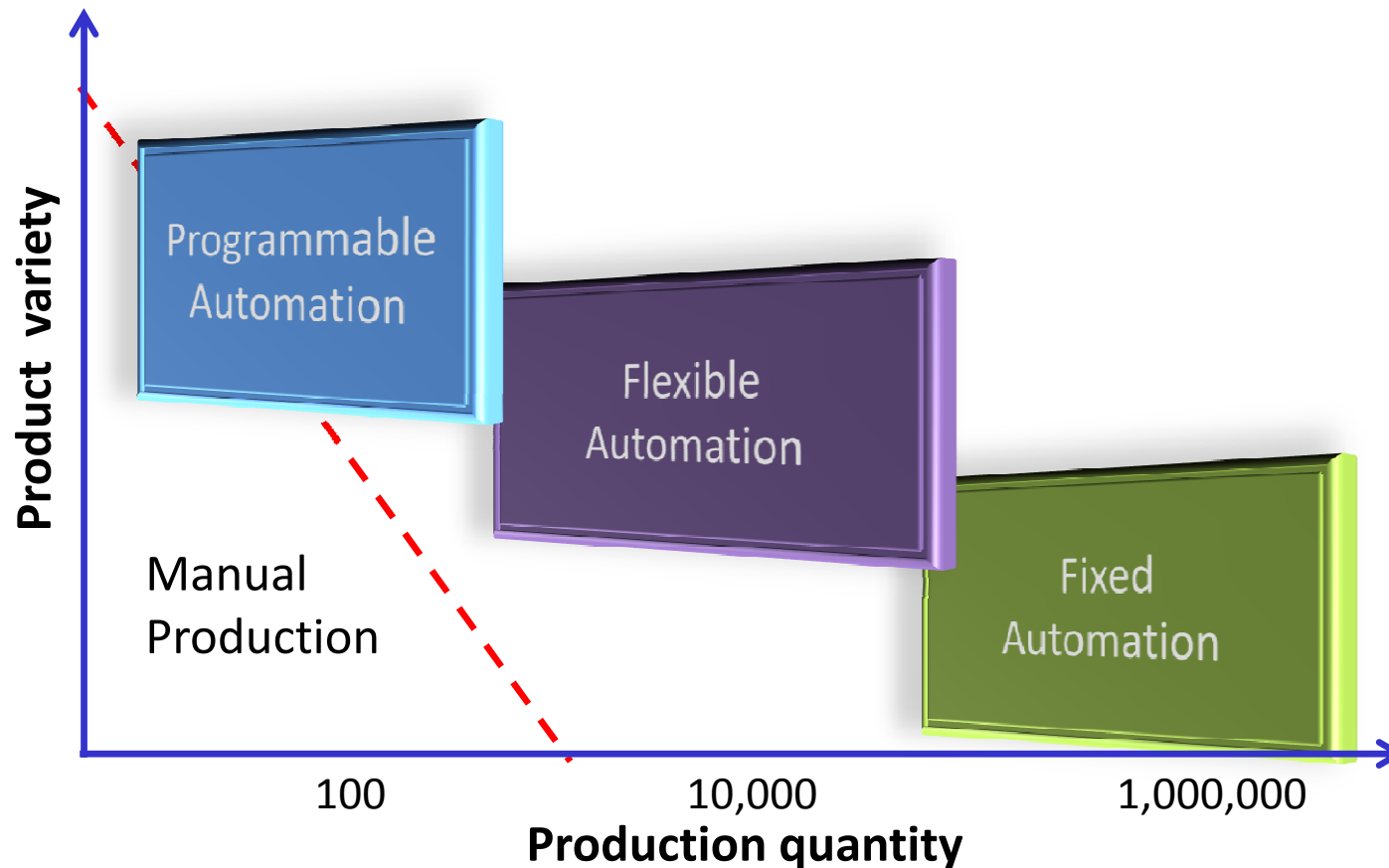
Fixed automation is a system in which the sequence of processing (or assembly) operations is **fixed by the equipment configuration**.

Programmable automation is a system which the production equipment is designed with the **capability to change the sequence** of operations to accommodate different product configuration

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.

Review Question

Describe the features of different types of Automation as shown in the below figure



Review Question

Please name five reasons for automating and for Not automating the production systems

5 Reasons for Automating:

- To increase labor productivity
- To reduce or eliminate routine manual and clerical tasks.
- To improve worker safety
- To improve product quality
- To reduce manufacturing lead time

5 Reasons for NOT Automating:

- Task is too technologically difficult to automate.
- Short product life cycle.
- Customized product.
- To cope with up and down in demand.
- To reduce risk of product failure, especially at the beginning of product's life