

II Semester TECHNOLOGY AND OPERATIONAL STRATEGY

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TECHNOLOGY AND OPERATIONAL STRATEGY

Module 1

Introduction to Production and Operation Management
Meaning, Definition, Scope and Functions. Trends in
operation management

Industry 4.0 and Operations

Management in Indian Context.

Facility Location and various factors, Facility Layout and
its types, Plant Utilities.



Production Management

Production management is the process of controlling a company's operations to provide the services and products it wants to produce.

Production management is the process that oversees turning production inputs, such as raw materials, resources and costs, into production outputs, which are whatever products or goods a company produces. It involves phases that include planning, scheduling, control and maintenance in service of producing quality and quantity on time and within the budget.

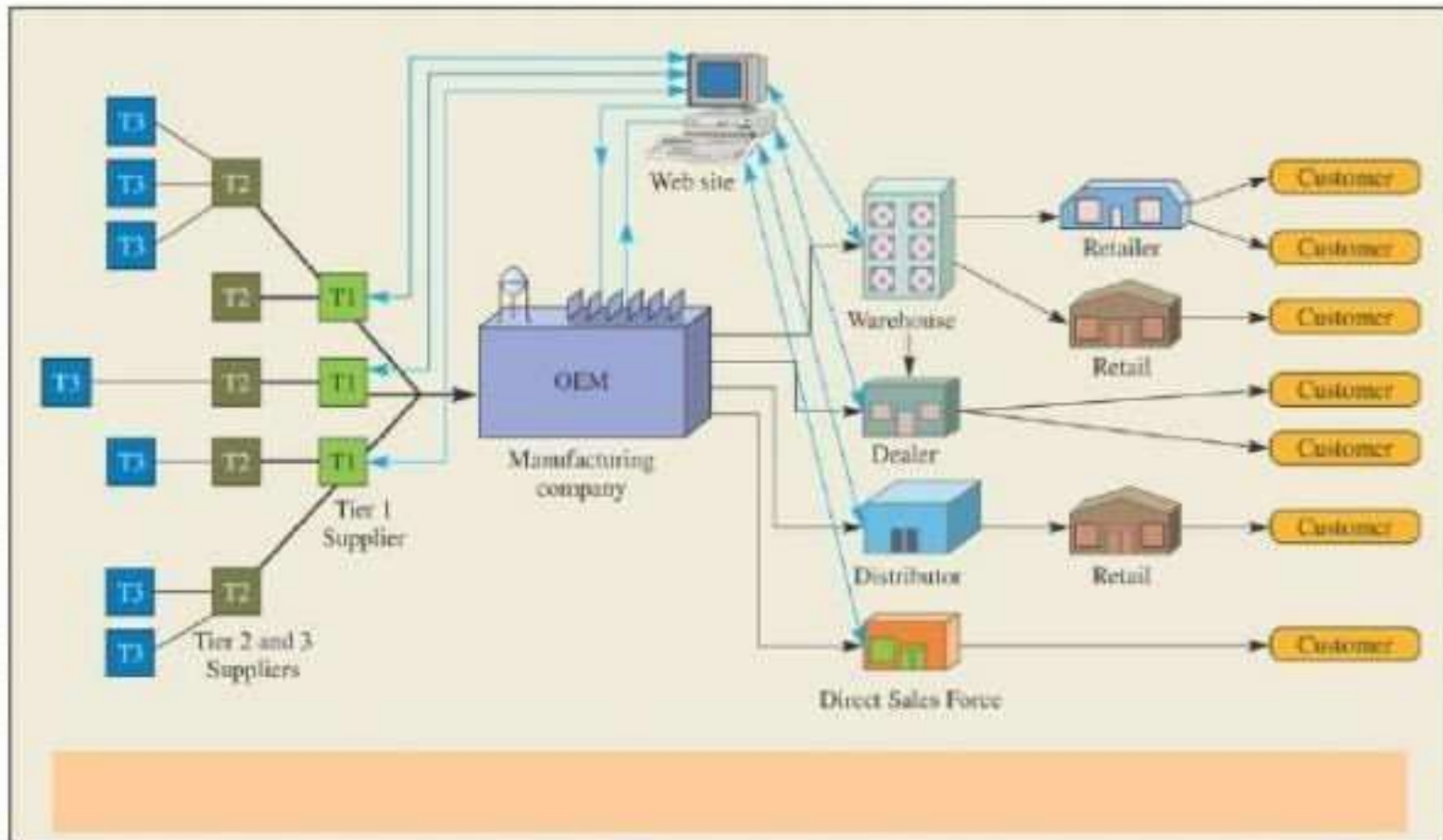


□ **Author's Definition on Production Management**

Mr. E.L. Brech (Edward Francis Leopold Brech) a **british management Consultant and author of management theory and practice books** defines the production management as “It is the process of effective planning and regulating the operations of that section of an enterprise which is responsible for the actual transformation of materials into finished goods.” This definition emphasizes on transformation process of inputs into outputs. It is not considering human factor involved.



TYPICAL MANUFACTURING ORGANIZATION





Tier 1 – The factory that assembles that company's cotton t-shirts. Partners that you directly conduct business with, including contracted manufacturing facilities or production partners

Tier 2 – Where your Tier 1 suppliers get their materials. Mill is a Tier 2 supplier to the apparel company. That is t-shirt factory receives its materials from a fabric mill.

Tier 3 – Supplier here is the farm that sells cotton to the fabric mill.

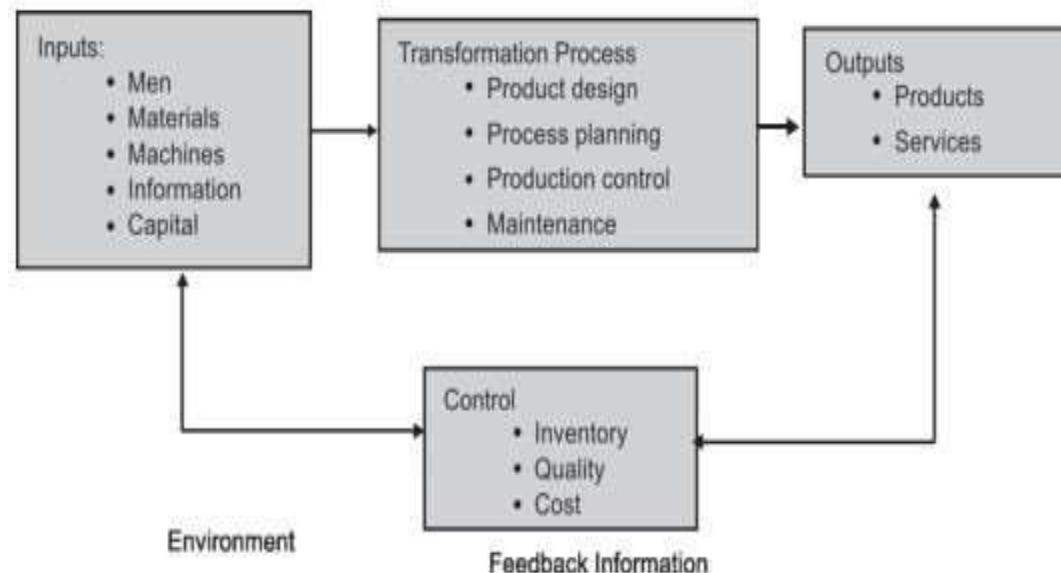


- Production management and operations management are used interchangeably.
- The term '**production management**' is more frequently used for a system where tangible goods are produced, whereas **operations management** is used for various inputs are transformed into intangible services.

Operations management (OM) is the administration of business practises within an organisation to achieve the highest level of efficiency possible. It is concerned with converting materials and labour as efficiently as possible into goods and services in order to maximise an organization's profit.

PRODUCTION SYSTEM OR TRANSFORMATION ROLE OF OPERATIONS MANAGEMENT

- The production system is ‘that part of an organisation, which produces products of an organisation. It is that activity whereby resources, flowing within a defined system, are combined and transformed in a controlled manner to add value in accordance with the policies communicated by management’.



OBJECTIVES OF PRODUCTION AND OPERATION

MANAGEMENT

- ❑ Maximum customer satisfaction through quality, reliability cost and delivery time
- ❑ Minimum scrap/ rework resulting in better product quality
- ❑ Minimum possible inventory levels (optimum inventory levels)
- ❑ Maximum utilization of all kinds of resources needed
- ❑ Minimum cash outflow
- ❑ Maximum employee satisfaction
- ❑ Maximum Possible production (outputs)
- ❑ Higher operating efficiency
- ❑ Minimum production cycle time
- ❑ Maximum possible profit or return on investment
- ❑ Concern for protection for environment
- ❑ Maximum possible productivity

DIFFERENCE BETWEEN PRODUCTION AND OPERATION MANAGEMENT

Basis For Comparison	Production Management	Operations Management
Meaning	Production Management Connotes the administration of the range of activities belonging to the creation of Products	Operations Management refers to the part of Management concerned with the production and delivery of goods and services.
Decision Making	Related to the aspects of production.	Related to the regular business activities
Found in	Enterprises where production is undertaken	Banks, Hospitals, Companies including production companies, Agencies etc.
Objectives	To Produce right quality goods in right quantity at right time and at least cost.	To utilize resources, to the extent possible so as to satisfy customer wants.

THE SCOPE AND FUNCTIONS OF PRODUCTION AND OPERATIONS MANAGEMENT



SCOPE AND FUNCTIONS PRODUCTION AND OPERATIONS MANAGEMENT

1. Location of facilities.
2. Plant layouts and material handling.
3. Product design.
4. Process design.
5. Production and planning control.
6. Quality control.
7. Materials management.
8. Maintenance management.

- **Location of facilities** for operations is a long-term capacity decision which involves a long term commitment about the geographically static factors that affect a business organization. It is an important strategic level decision-making for an organization. It deals with the questions such as “where our main operations should be based?”
- **Example:** NOIDA (New Okhla Industrial Development Authority, Northern East of Uttar Pradesh)
- **Bangalore:** Jiggani, Bidadi, Electronic City, Peenya Industrial Area, Harohalli Industrial Area.

□ **Plant Layout And Material Handling**

Plant layout refers to the physical arrangement of facilities. It is the configuration of departments, work centres and equipment in the conversion process. The overall objective of the plant layout is to design a physical arrangement that meets the required output quality and quantity most economically.

According to **James Moore**, “Plant layout is a plan of an optimum arrangement of facilities including personnel, operating equipment, storage space, material handling equipments and all other supporting services along with the design of best structure to contain all these facilities”.

“**Material Handling**” refers to the „moving of materials from the storeroom to the machine and from one machine to the next during the process of manufacture“. It is also defined as the „art and science of moving, packing and storing of products in any form“. It is a specialized activity for a modern manufacturing concern, with 50 to 75% of the cost of production.

- **Product Design:** Product design deals with conversion of ideas into reality. Every business organization have to design, develop and introduce new products as a survival and growth strategy. Developing the new products and launching them in the market is the biggest challenge faced by the organizations.

- **Process Design :** Process design is a macroscopic decision-making of an overall process route for converting the raw material into finished goods. These decisions encompass the selection of a process, choice of technology, process flow analysis and layout of the facilities.

- **Production Planning And Control** is a predetermined process that plans, manages and controls the allocation of human resource, raw material, and machinery to achieve maximum efficiency.
- Production planning is one part of production planning and control dealing with basic concepts of what to produce, when to produce, how much to produce, etc. It involves taking a long-term view at overall production planning.
- **Therefore, objectives of production planning are as follows:**
 - To ensure right quantity and quality of raw material, equipment, etc. are available during times of production.
 - To ensure capacity utilization is in tune with forecast

demand at all the time.

- The main **objectives** of quality control in production are:
- To improve the companies income by making the production more acceptable to the customers i.e., by providing long life, greater usefulness, maintainability etc.
- To reduce companies cost through reduction of losses due to defects.
- To produce optimal quality at reduced price.
- To ensure satisfaction of customers with productions or services or high quality level, to build customer goodwill, confidence and reputation of manufacturer.
- To Make inspection prompt to ensure quality control.
- To check the variation during manufacturing.



□ **Production Control**

- Production control looks to utilize different type of control techniques to achieve optimum performance out of the production system as to achieve overall production planning targets.

Therefore, objectives of production control are as follows:

- Regulate inventory management
- Organize the production schedules
- Optimum utilization of resources and production process

Advantages

- Ensure a smooth flow of all production processes
- Ensure production cost savings thereby improving the bottom line
- Control wastage of resources
- It maintains standard of quality through the production life cycle.

Production control cannot be same across all the organization. Production control is dependent upon the following factors:

- Nature of production(job oriented, service oriented, etc.)
- Nature of operation and Size of operation

MATERIAL MANAGEMENT

Materials Management is that aspect of management function which is primarily concerned with the acquisition, control and use of materials needed and flow of goods and services connected with the production process having some predetermined objectives. Materials Management is managing purchasing inventory control functions, shipping and receiving, and also planning and administering department budgets.

FIFO (first in, first out) inventory management seeks to sell older products first so that the business is less likely to lose money when the products expire or become obsolete. LIFO (last in, first out) inventory management applies to nonperishable goods and uses current prices to calculate the cost of goods sold.

Materials management is a core supply chain function and includes supply chain planning and supply chain execution capabilities. Specifically, materials management is the capability firms use to plan total material requirements.



The Main Objectives of Materials Management are

- To minimize material cost
- To purchase, receive, transport and store materials efficiently and to reduce the related cost.
- To trace new sources of supply and to develop cordial relations with them in order to ensure continuous supply at reasonable rates
- To reduce investment tied in the inventories for use in other productive purposes and to develop high inventory turnover ratios

Maintenance Management

- **Maintenance management** is defined as the process of maintaining a company's assets and resources while controlling time and costs, ensuring maximum efficiency of the manufacturing process.
- **Maintenance management** is an important component of a well- functioning production. It helps companies maintain their resources while controlling time and costs to ensure maximum efficiency of the manufacturing process, the utilities and related facilities.

Types of maintenance:

- **Corrective and Reactive Maintenance,**
- **Preventive Maintenance,**
- **Predictive Maintenance,**
- **Prescriptive Maintenance,**
- **Reliability - Centered maintenance**



CORRECTIVE/REACTIVE MAINTENANCE

- A **corrective maintenance** strategy, also known as a **reactive** or '**run to failure**' strategy, works on the premise that an item is allowed to fail and is only then repaired or replaced. In order for this to work, the consequence of failure needs to be acceptable and have no significant impact on the environment or safety.
- Reactive maintenance involves rectifying a fault that has caused a failure of the equipment, e.g. a stopped production line. In other words, a failure has occurred and its purpose is to restore an asset to a condition in which it can perform its intended function, either by repairing or replacing it.



PREVENTIVE MAINTENANCE

□ Preventive maintenance involves periodic checkups with the intention of preventing failures before they happen. Preventive maintenance can use time intervals, usage intervals, or condition-based through performance and parameter monitoring. It is typically involves planned downtime for servicing or replacing a component.



❑ **PREDICTIVE MAINTENANCE**

❑ A predictive maintenance management plan aims to stop the “over-maintenance” of preventive methods performing maintenance only when it is necessary. This is done by monitoring equipment conditions with techniques such as:

❑ **Vibration analysis:** Vibrations can indicate imminent failure

❑ **Acoustic analysis:** To detect liquid or gas leaks

❑ **Oil analysis:** Oil particle size can determine equipment state

❑ **Infrared Thermography:** To detect unusually
high temperatures

□ **PRESCRIPTIVE MAINTENANCE**

- The latest development in maintenance strategies is only a few years old. Predictive maintenance uses equipment condition to recommend the optimum time for maintenance. Prescriptive maintenance, however, also analyses millions of data points to determine the best course of action. Prescriptive maintenance is still in its initial stages. Nevertheless, improved artificial intelligence and machine learning make it an area of great potential.

□ **RELIABILITY-CENTERED MAINTENANCE**

- Reliability-centered maintenance is a business-wide strategy. It can incorporate all of the types mentioned above. It aims to optimize maintenance strategy – all pieces of equipment should safely fulfill their function in the most cost-effective way. Effectively, reliability-centered maintenance involves the constant

improvement of a business's overall maintenance management strategy.

SCOPE OF OPERATIONS

MANAGEMENT

- The scope of operations management is very vast, commencing with the selection of location, operations management covers such activities as:

Forecasting

Capacity planning

Scheduling

Managing inventories

Assuring quality

Motivating employees

Deciding where to locate facilities

Design of work system

Operations planning and control

Resource requirement planning

Capacity requirement planning

Project management

Quality management

Maintenance

management

Just-In-Time system

Supply chain

management

Operations function

includes all activities

directly related to

producing goods or

providing services

Trends in Operation Management



Operations management has been gaining increased recognition in recent years because of the following reasons

- The application of operations management concepts in service operations
- The growing importance of quality
- The introduction of Operation management concepts to other areas such as marketing and human resources
- The realization that the operations management function can add value to the end product.



Total Quality Management (TQM)- Total quality management is the ongoing process of detecting and reducing or eliminating manufacturing errors, streamlining supply chain management, improving the customer experience, and ensuring that employees are properly trained. Total quality management seeks to hold all parties involved in the manufacturing process responsible for the overall quality of the final product or service. It is used to improve customer service, streamline supply chain management, and ensure employee training. The goal is to continuously improve internal practises in order to improve the quality of an organization's outputs, including goods and services.



Cycle Time Reduction- Cycle time is reduced by decreasing time spent on non-value added activities and simplifying and streamlining the process, lowering the cost of operations. Benefits of reducing cycle time include faster time-to-market and, if other cost factors are kept in check, the possibility of higher profitability. Reduced cycle time also allows a company to be more competitive with other businesses that offer similar products to the same customer base.



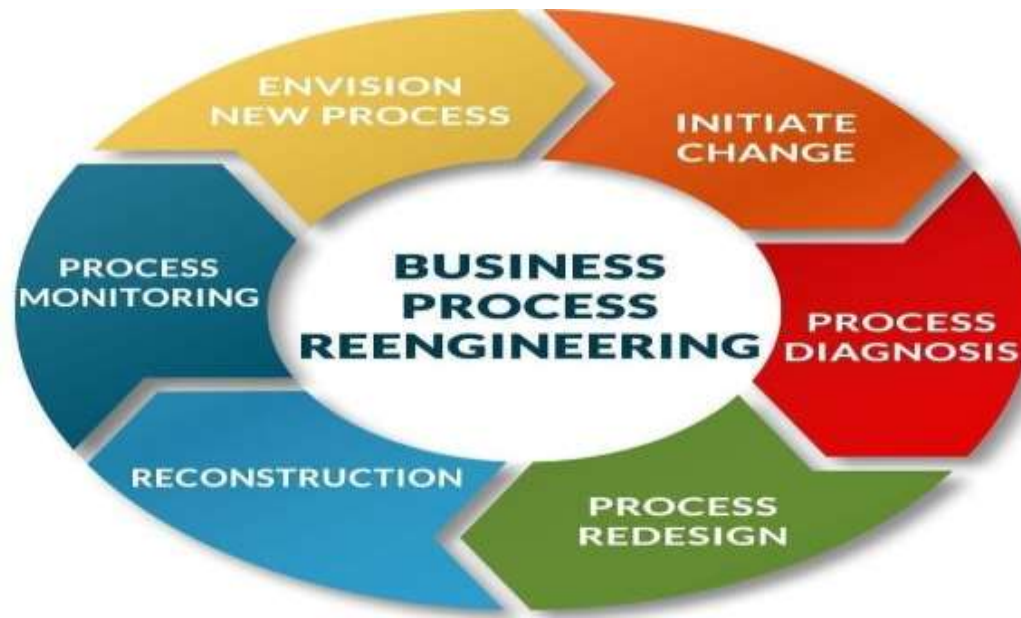
Employee engagement is a vital notion in the endeavour to comprehend and explain the nature of an organization's connection with its employees, both qualitatively and quantitatively. The direct participation of employees in assisting an organisation in fulfilling its mission and meeting its objectives by applying their own ideas, knowledge, and efforts to problem solving and decision making.

Recent tendencies have been to delegate decision-making and problem-solving responsibilities to lower levels of the organisation. Employee involvement and empowerment are terms used to describe this. Quality circles, for example, and the usage of work teams or quality improvement teams.



Business process re-engineering (BPR)- The radical redesign of business processes to achieve dramatic improvements in critical aspects such as quality, output, cost, service, and speed is known as business process re-engineering. Business process reengineering (BPR) aims to drastically reduce enterprise costs and process redundancies.

It entails a start-from-scratch approach to redesigning business processes. During the 1990s, many companies, including Ford Motors, GTE, and Bell Atlantic, experimented with BPR to restructure their operations. The reengineering process they used made a significant difference for them, dramatically lowering their costs and increasing their effectiveness in the face of increasing competition.

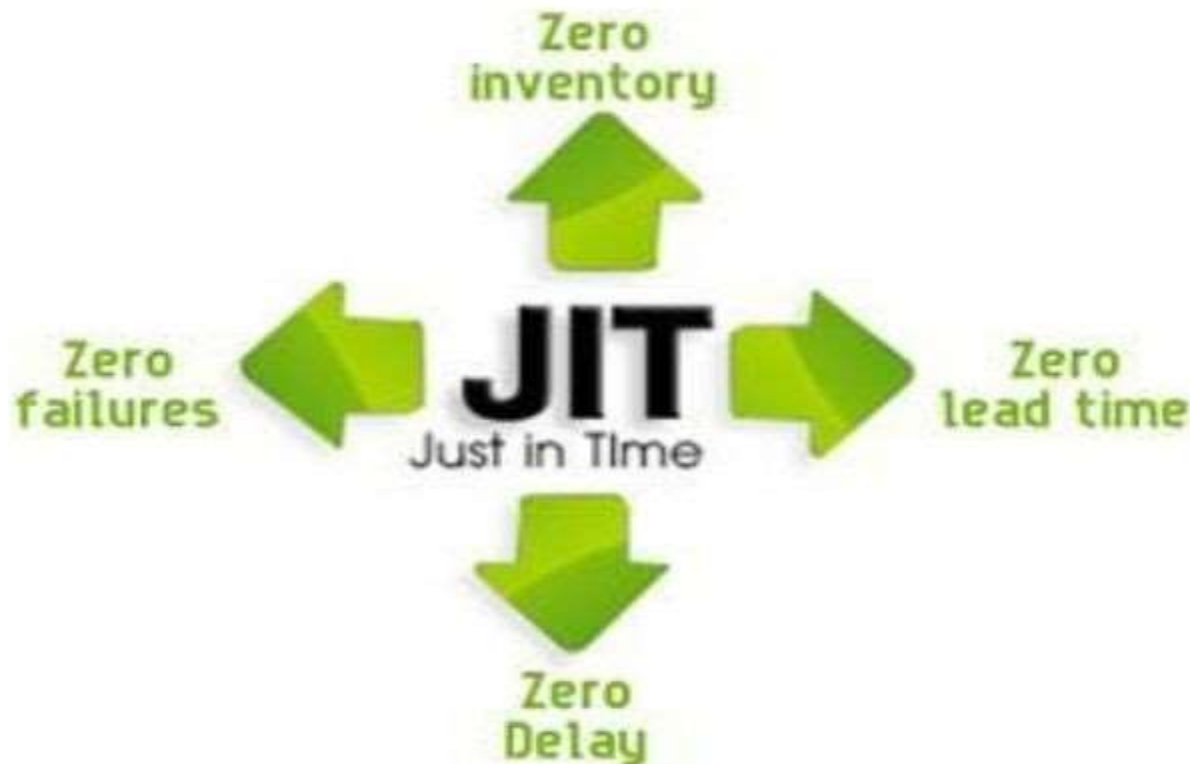


Lean Production is a manufacturing methodology that focuses on reducing waste, with waste defined as anything that does not add value to the customer. Although Lean has its roots in manufacturing, it is applicable to all types of organisations and all of their processes.



It is based on Toyota's operating model "The Toyota Way" from 1930. Toyota has played an important role in the development and application of Lean, and many tools are derived from the Toyota Production System (TPS), which is focused on improving the flow or smoothness of production by eliminating unevenness in the manufacturing process.

Just In Time - JIT inventory is a management strategy that directly aligns raw-material orders from suppliers with production schedules. Companies use this inventory strategy to increase efficiency and reduce waste by receiving goods only as needed for the manufacturing process, which lowers inventory costs. This method necessitates that producers accurately forecast demand. Kanban is a scheduling system that is frequently used in conjunction with JIT to avoid work-in-process overcapacity.



Computer-Aided Manufacturing- The use of software and computer-controlled machinery to automate a manufacturing process is known as computer-aided manufacturing (CAM). By generating toolpaths, software tells a machine how to make a product. Machinery capable of converting raw materials into finished goods.

The following are some examples of computer-aided manufacturing machines: **CNC Routers:** CNC machines use high-speed oscillating components to cut parts and carve out different shapes. **Electrical Discharge Machines (EDM):** EDMs are machines that use electric discharge to cut out desired shapes from raw materials.



Computer-Aided Design- The use of computers to aid in the creation, modification, analysis, or optimization of a design is known as computer-aided design. This software is used to increase the designer's efficiency, improve design quality, improve communication through documentation, and develop a database for manufacturing.

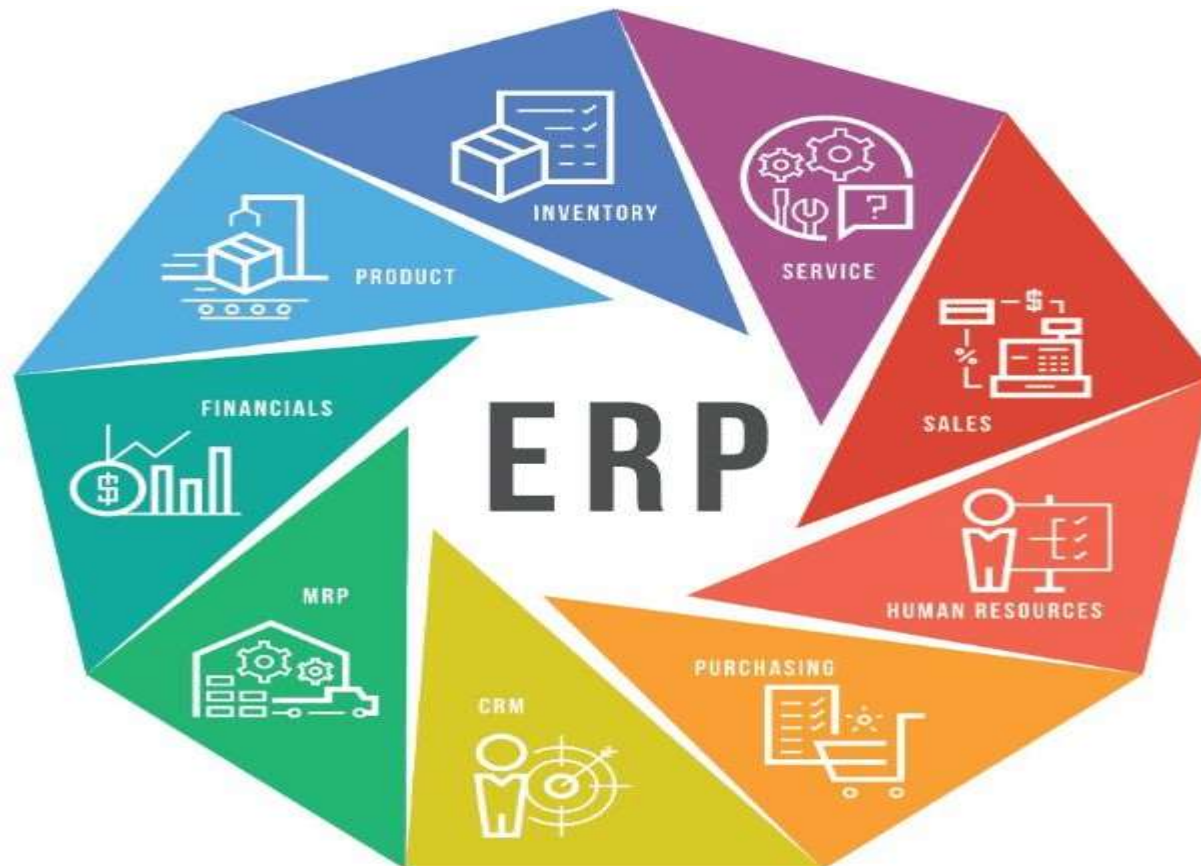
Two-dimensional (2-D) drawings and three-dimensional (3-D) models can be created using CAD software.

In-depth discussion of the advantages of CAD.

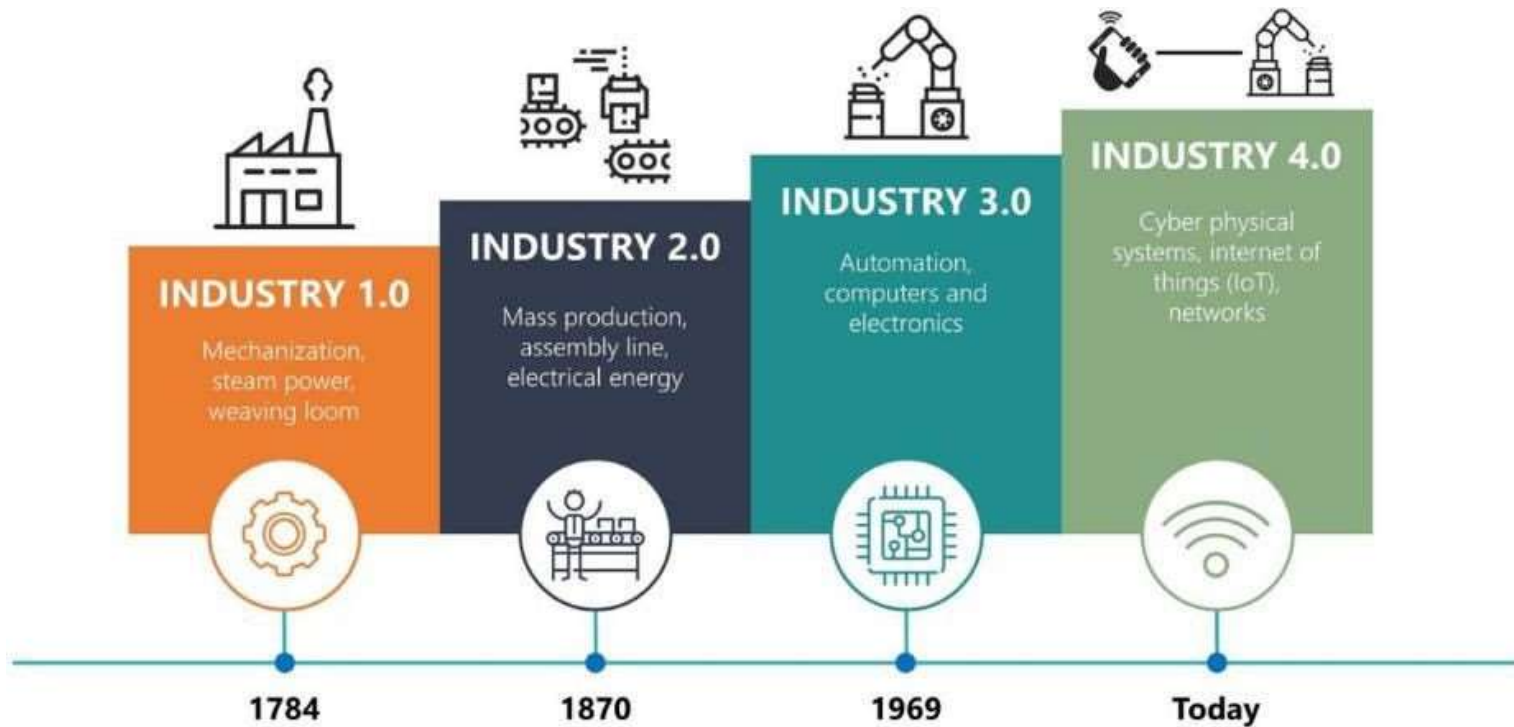
- *Improves Productivity*
- *Designs of Higher Quality*
- *Designs can be reused and easily changed.*
- *Sharing Has Been Made Easier to Read*
- *Design Documentation*



ERP is a software application that automates corporate activities and gives insights and internal controls by utilising a central database that collects data from departments such as accounting, production, supply chain, sales, marketing, and human resources (HR). It is an enterprise-wide information system that is designed to coordinate all of the resources, information, and activities required to execute business operations such as order fulfilment or billing.



INDUSTRIAL REVOLUTION



INDUSTRY 1.0 TO 4.0

- The 1st industrial revolution is dated 1784 when steam-powered factories started replacing the manual-, water- and horse-powered manufactures. A man stopped being an engine for machines.
- The 2nd industrial revolution took place around 1870 when the invention of reliable electric engines allowed building more compact and cost-effective equipment. A man stopped being a workforce for machines. 1 man per 1 unit of equipment.
- The 3rd industrial revolution happened in the 1970-es with the introduction of programmable equipment like CNC machines and first industrial robots. A man stopped working the machines manually.
- The 4th industrial revolution is happening now, powered by interconnectivity, automation, Machine Learning, IoT and real-time Big Data analytics used to minimize the effort needed to produce the goods. A man stops working the machines at all.

- **Industry 4.0 model** was first devised by the German government and represents the implementation of Artificial Intelligence, Industrial Internet of Things, and Big Data analytics in the factories.
- **Industry 4.0** is a new era where manufacturers use **Big Data, the IoT and interconnected computers** to automate processes while minimizing the need for human operators. The Fourth Industrial Revolution (generally referred to as Industry 4.0) is happening everywhere around us. The Industry 4.0 market was estimated to be valued **USD 71.7 billion in 2019 and was expected to reach USD 156.6 billion by 2024, at a CAGR of 16.9% from 2019 to 2024.**
- Industry 4.0 provides the means for significant improvements in all aspects of manufacturing processes - from **material acquisition, usage and supply chain management to product design, engineering and delivery, predictive maintenance of equipment and other assets, and real-time monitoring of all systems.**



The Nine Pillars of Industry 4.0



<https://youtu.be/bNfZWqDLW0Q>

Prepare yourself on Industry 4.0 by referring to the above link



A number of technologies are used to make smart manufacturing a reality, including the following:

- The (IoT)

- Advanced robotics and automation
- Machine learning (artificial intelligence)
- Smart and real-time data sensors
- Cloud computing
- 3D printing for digital fabricators
- Software analytics and data capture
- Mobile device technologies and platforms
- Smart vehicle and transportation
- Real-time data processing and communications

BENEFITS OF USING INDUSTRY

4.0 TECHNOLOGY

Long-term cost-effectiveness: Even though initial infrastructure costs can be high. However, the ROI can be substantial after amortize the cost over time, reduce the cost of human labour, waste and fines for compliance failures, realize a massive increase in productivity, purchase the right manufacturing automation systems, it can pay for itself quickly.

Exceptional customer responsiveness

Companies using Industry 4.0 technology can improve customer satisfaction by producing goods more rapidly. Many customers need to refine their specifications over time. Manufacturers have difficult meeting their evolving expectations with older technology. Fortunately, smart data and automated manufacturing technology improve responsiveness. Manufacturers can alter the software they use to oversee production. A few slight modifications can have a profound impact on their manufacturing, which makes it much easier for them to respond to new customer requests.



Faster production time tables and better scalability

- Industry 4.0 technology also significantly improves the agility of manufacturing processes. Organizations can reduce the time it takes to deliver products by:
 - - Keeping production running 24 hours a day, seven days a week
 - - Not needing to slow production to compensate for employee sickness
 - - Using technology that does not slow due to human fatigue
- Industry 4.0 is already proving to be much more efficient. This will lead to faster product deliveries and better customer satisfaction in industries with high wait times.

- ❑ **Minimizing the risk of human injury and the cost of liability claims**
- ❑ Employee injuries in the manufacturing industry are noticeably higher than most other sectors. The cost of injuries can be substantial because they consist of:
 - ❑ - The risk of employee lawsuits
 - ❑ - Having to pay higher Unemployment Insurance (UI) premiums due to past accidents
 - ❑ - Paying steep fines for regulatory violations after an accident triggers a compliance audit
 - ❑ - Facing the costs of disruptions in production due to reduced manpower after one or more employees are injured
 - ❑ - Experiencing lower employee morale if employees are concerned about being injured along with their colleagues
 - ❑ - Needing to pay to replace or repair damaged equipment caused by human error
- ❑ Automated manufacturing equipment enables companies to depend on smart technology to handle more dangerous tasks. This drastically

reduces the risk of human injuries, which can have crippling costs on their bottom line.

❑ **Better innovation**

- ❑ Most Industry 4.0 advocates emphasize the scalability side of the equation. However, the technology can be equally beneficial when it comes to improving the quality of production.
- ❑ Manufacturers that use smart technology depend on deep learning. Over time, this technology develops a better understanding of the products it develops. Users can test the material specifications and technological properties of goods. Smart manufacturing technology uses this information to improve the production process to create higher quality products.

❑ **Supporting manufacturing**

- ❑ Manufacturing companies are more dependent on smart technology than ever before. They need to depend on companies that produce high-quality sensors, deep learning algorithms and IoT devices to help them meet their expectations.



CONS OR DISADVANTAGES OF THE 4TH

INDUSTRIAL REVOLUTION

- **1. Inequality:** It is all about who gets the benefits of these technologies and of the results they help produce. The reality is that the largest beneficiaries tend to be the providers of intellectual and physical capital (shareholders, investors, and innovators). Technology is one of the main reasons why incomes have stagnated, or even decreased, for a majority of the population in high-income countries.
- The demand for highly skilled workers has increased while the demand for workers with less education and lower skills has decreased and the part in between them will start to wear thin. So this could also lead to potential job losses. Not to even mention that for developing countries there are technological and infrastructure challenges and skill challenges that are not easy to overcome.

□ 2. Cyber security risk

□ When everything is connected, the risk of hacking data and tampering with it or using it for malicious intent is now more prevalent. It is not as contained as before. It's more and more frequent hear of the dreaded news of a new data security breach. Not to mention that it challenges the very nature of identity and privacy, especially with the increased use of data analytics and machine learning.

□ **3. Core industries disruption**

□ We see this already. Taxis are competing against Uber and Lyft, Traditional television and cinema compete with Netflix and YouTube, the hotel industry with AirBnB and any store is competing against Amazon. This has ramifications in the type of services being offered and the model through which they are offered as well as the jobs associated with them.

□ 4. Ethical issues

- With improved AI, genetic engineering, and increased automation, there are new ethical concerns and questions of morality that already differ greatly from individual to individual. With access to more data about an individual and a group of individuals, the risk of using it for personal gain and manipulation is even greater.

□ Example: The **Facebook–Cambridge**
A scandal concerned the
obtaining of personal data of millions

OPERATION MANAGEMENT IN INDIAN CONTEXT

- In the Indian market, the economic growth of the nation, globalization, rising competition and the 'Make In India' initiative have led to an increased demand for operations management for better productivity and success. Whether in the private sector or government services, operations management is a key component for the growth of any company.
- Among the various roles, process managers typically have a higher salary **Top recruiters include Tech Mahindra, Maruti Suzuki, Amazon.in, Wipro, TATA so on.** There is an immense demand for operations management professionals, across multiple industries and at various seniority levels. Considering that nearly every company requires an operations

management team, there are opportunities galore.

CONTINUED....

- **Operations management is vital to nearly all industries, including banking systems, hospitals, suppliers, e-commerce, technology companies and more.** Based on the industry, the role would involve managing the production of manufactured goods or services.
- **For example,** operations management in **pharmaceuticals** would involve overseeing the production of raw materials into drugs ready to be shipped to hospitals or retailers. Operations managers overseeing the manufacture of products are also known as production managers. An **airline** would require operation managers to oversee the transportation of passengers.
- **Operations managers handle strategic issues regarding the size of manufacturing plants, inventory levels, raw materials acquisition, materials handling, quality control, customer demands and cost-effective methods of delivering customer expectations.**



FACILITY LOCATION OR PLANT LOCATION

- Facility location is the process of identifying the best geographic location for a service or production facility
- Selecting suitable location for economic and effective operations.

FACILITY LOCATION OR PLANT

LOCATION

Facility location may be defined as a place where the facility will be set up for producing goods or services.

- The **need for location selection** may arise under any of the following conditions:
 - a. When a business is newly started. Or While starting a new factory.
 - b. When the existing business unit has outgrown its original facilities and expansion is not possible; hence a new location has to be found.
 - c. When the volume of business or the extent of market necessitates the establishment of branches.
 - d. When the lease expires and the landlord does not renew the lease.
 - e. When the existing plant is to be re-located at some other

place, to remove the drawbacks of the present location or to gain the benefits of a still better location

NEED FOR LOCATION

DECISIONS

- ❑ Marketing Strategy
- ❑ Cost of Doing Business
- ❑ Growth
- ❑ Depletion of Resources



Types of Facilities

- ❑ Heavy Industry Facilities: Large, require space, expensive
- ❑ Light Industry Facilities : Smaller , cleaner plants , less costly
- ❑ Retail And service facilities: Smallest and least costly

OBJECTIVES IN LOCATION DECISION

- ❑ Reduce operating cost and capital investment
- ❑ Effective plant layout
- ❑ Coordinating with government policies
- ❑ Employee Security, welfare and public needs
- ❑ **Making Location Decisions**
 - ❑ Decide on the criteria
 - ❑ Identify the important factors
 - ❑ Develop location alternatives
 - ❑ Evaluate the alternatives
 - ❑ Make selection

STEPS IN LOCATION SELECTION

- With in the country or outside
- Selection of the region
- Selection of locality or community
- Selection of the exact site

a. With in the country or Outside

- Domestic OR International
- Which country?
- And the decision is taken on the basis of Political/legal concerns.
- Export or import quotas
- Currency exchange rate
- Cultural issues

b. Selection of the region

- Availability of resources(raw materials ,HR) and customers
- Market facilities

- ❑ Transportation and climate
- ❑ Government incentives
- ❑ Economic and environmental conditions

c. Selection of locality or community

- ❑ Availability of work force
- ❑ Complementary business in the area
- ❑ Availability of safety needs and basic needs of employees
- ❑ Tax in the area
- ❑ Effectiveness in the initial stages

d. Selection of the exact site

Waste disposal

Soil and topology (The surface of a material such as **soil**, as characterized by its **topology** and roughness, typically has a profound effect on its functional behavior.)

Location Decision Factors

Regional Factors



Community Considerations



Multiple Plant Strategies



Site-related Factors



Regional Factors

- Attractiveness of region(culture, taxes, climate)
- Labour availability
- Location of raw materials
- Location of markets
- Availability of utilities
- Govt. Incentives and policies
- Climate and taxes



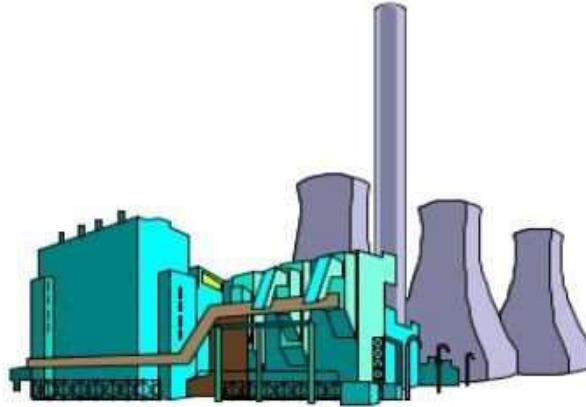
Community Considerations

- Quality of life
- Services
- Attitudes
- Taxes
- Environmental regulations
- Utilities
- Developer support



Site Related Factors

- Land
- Transportation
- Environmental
- Legal



Multiple Plant Strategies

- Product plant strategy
- Market area plant strategy
- Process plant strategy



FACTORS AFFECTING FACILITY LOCATION DECISIONS

- While selecting a facility location, an organisation should consider various factors that may have significant impact on its performance.

These **factors** are explained below:

- Availability of power
- Transportation
- Suitability of climate
- Government policy
- Competition between states
- Availability of labour
- Civic amenities for workers
- Existence of complementary and competing industries
- Finance and research amenities
- Availability of water and fire-fighting facilities

PROCEDURES AND TECHNIQUES FOR SELECTING

FACILITY LOCATION

An organisation follows certain steps to make a correct location choice. These steps are:

- Decide on the criteria for evaluating location alternatives
- Identify important factors
- Develop location alternatives
- Evaluate the alternatives
- Make a decision and select the location

• Following are some main techniques used in making location decisions:

□ **Location rating factor technique:** In this technique, first of all an organisation needs to identify the factors that influence its location decision. Next, each factor is provided a weight between '0' to '1' according to the level of importance, where '0' denotes least important and '1' denotes most important.

- **Centre-of-gravity technique:** This technique emphasizes on transportation cost in the determination of facility location. Transportation cost mainly depends on distance, weight of merchandise and the time required for transportation. Centre-of-gravity maps various supplier locations on a Cartesian plane and suggests a central facility location with respect to the locations of suppliers.
- **Transportation technique:** In simple words, the transportation technique evaluates multiple transportation routes of shipping goods from multiple origins to multiple destinations and finds or develops the least cost route. The technique is often used in determining facility locations for evaluating transportation costs of routes by selecting different facility locations. In the transportation technique, multiple facility location fits are identified and their relative transportation costs are calculated. Finally, the location that is related to the lowest cost routes is selected.

FACILITY LAYOUT

- Facility layout may be defined as the arrangement of machinery, equipment, and other amenities in a facility, which should ensure a smooth movement of materials.
- According to **Moore**, facility layout is the plan of or the act of planning an optimum arrangement of facilities, including personnel, operating equipment, storage space, material handling equipment, and all other supporting services along with the design of the best structure to contain these facilities.

<https://study.com/academy/lesson/process-product-fixed-position-layouts.html>

- Facility layout can be defined as the process by which the placement of departments, workgroups within departments, workstations, machines, and stock- holding points within a facility are determined

This process requires the following inputs:

- Specification of objectives of the system in terms of output and flexibility
- Estimation of product or service demand on the system
- Processing requirements in terms of number of operations and amount of flow between departments and work centers
- Space requirements for the elements in the layout
- Space availability within the facility itself

NEED OF LAYOUT DECISION AND REDESIGN

• Need for layout decisions :

- It helps to determine long term efficiency
- It establishes company's competitive priorities in regard to capacity, processes flexibility.
- It helps the organization to achieve strategic advantage that supports differentiation, low cost, fast response

Need for Redesign:

- in-efficient operation
- Accidents, health_hazards and low safety.
- changes in product design/service design
- Introduction to new products/services.
- Changes in volume of output or product mix changes
- Changes in method, processes or equipment
- Low employee morale.

❑ **Objective Of layout:**

- ❑ Higher space utilization Improved flow of material,
- ❑ information and people
- ❑ Improved employee morale and working conditions
- ❑ Improved production capacity.
- ❑ Reduce material handling cost.
- ❑ Reduce health hazards
- ❑ To allow ease of maintenance
- ❑ Improve productivity
- ❑ Higher flexibility

Factors influencing layout

Material , Worker

- ❑ Machinery, Product
- ❑ Types of industry
- ❑ Location
- ❑ Managerial Policies

OBJECTIVES OF AN EFFECTIVE FACILITY LAYOUT

Minimum Material Handling

Elimination of Bottlenecks Shorter

Production Cycles

Reduction in Production Delays

Improved Quality Control

Efficient Utilization of Labour

Improved Employee Morale



TYPES OF LAYOUT



Types of Layout

TYPES OF FACILITY LAYOUT

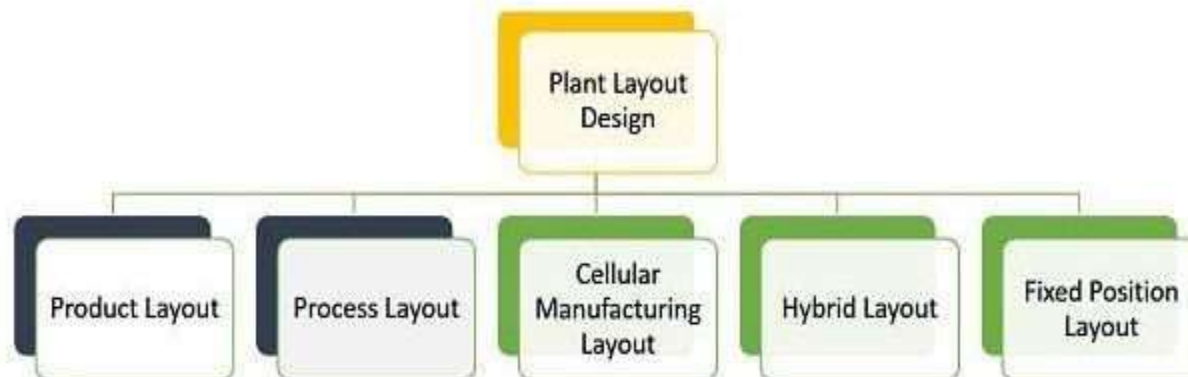
Process Layout

Product Layout

Fixed Position Layout

Cellular Manufacturing Layout

Combination or Hybrid Layout or Mixed Layout



Types of Facility Layouts

- **Process layout or Functional**
functional layout or batch production

Layout: Process layout, also called layout, is characterized by the grouping

together of similar machines, based upon their operational characteristics.

Product layout or Straight Line Method : In product layout, also called straight line layout,
□ machinery is arranged in one line as per the sequence of production operations. Materials are fed into the first machine and finished products come out of the last machine. E.g., Automobile assembly

- Loan application processing • Self-service cafeteria

Fixed position layout or Static Layout: This type of facility layout is used to assemble
□ products that are too large, heavy or fragile to move to a location for completion. In the fixed position layout, machinery, men, as well as other pieces of material, are brought to the location where the product is to be assembled.

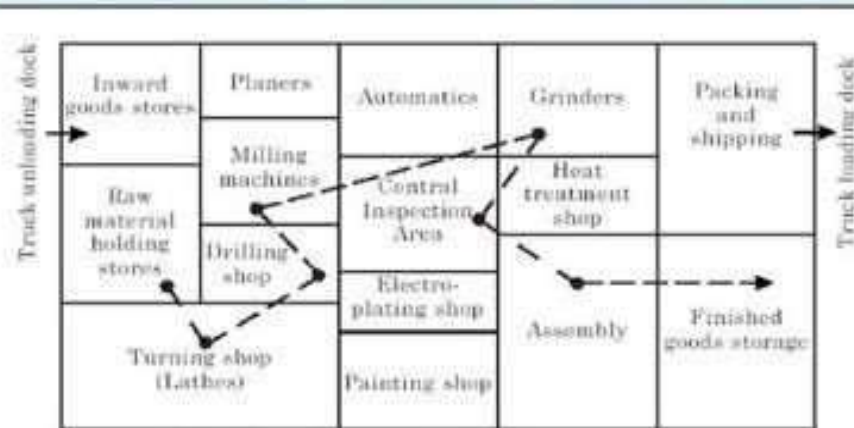
Types of Facility Layouts (Continued.....)

□ **Cellular manufacturing layout:** In Cellular Manufacturing (CM) layout, machines are grouped into cells, which function somewhat like a product layout in a larger shop or a process layout. Each cell in the CM layout is formed to produce a single part family, that is, a few parts with common characteristics.

□ **Combination or hybrid layout or Mixed Layout:** It is difficult to use the principles of product layout, process layout, or fixed location layout in facilities that involve fabrication of parts and assembly. Fabrication tends to employ the process layout, while assembly areas often employ the product layout.

PROCESS LAYOUT

- i. Process layout or functional layout or job shop layout-Machines grouped by process they perform. These machines include lathe, drilling, milling etc.
 - i. Eg: Maruti Service Station.
 - ii. Process layout is commonly found in service set ups like bank, hospitals, post



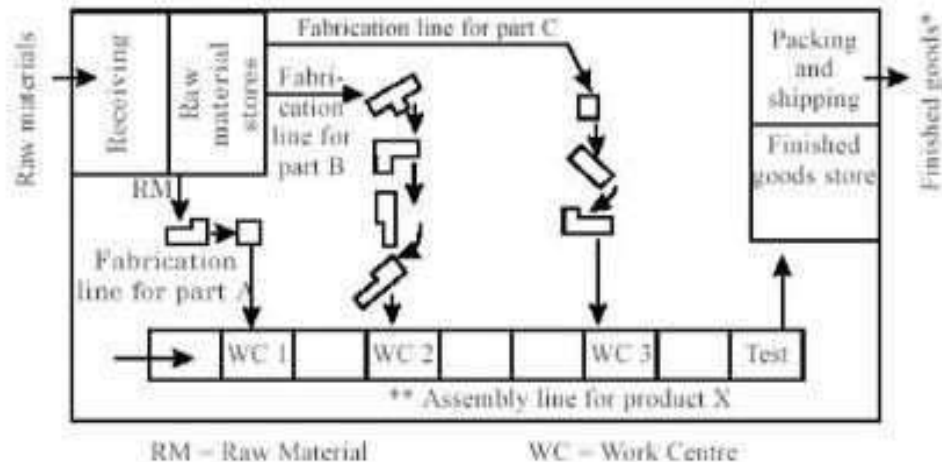
----- Path of flow of materials for part A

ADVANTAGES AND DISADVANTAGES OF PROCESS LAYOUT

Sl. No	Advantages	Disadvantages
1.	Maintenance cost is low because of low cost general purpose machines	Material handling is time consuming as there is no fixed route
2.	This system is more flexible to design changes in products or processes compared to product layout	WIP is high in batch processing
3.	Breakdown in a machine do not lead to halt in production as substitute machines are there	Low output rate , thus high cost per unit.
4.	The system promotes creativity of workers due to variety of tasks performed by them.	Routing and scheduling is tedious and time consuming for different products.
5.	-	High cost of supervision because of special treatment to every products being processed.

PRODUCT LAYOUT

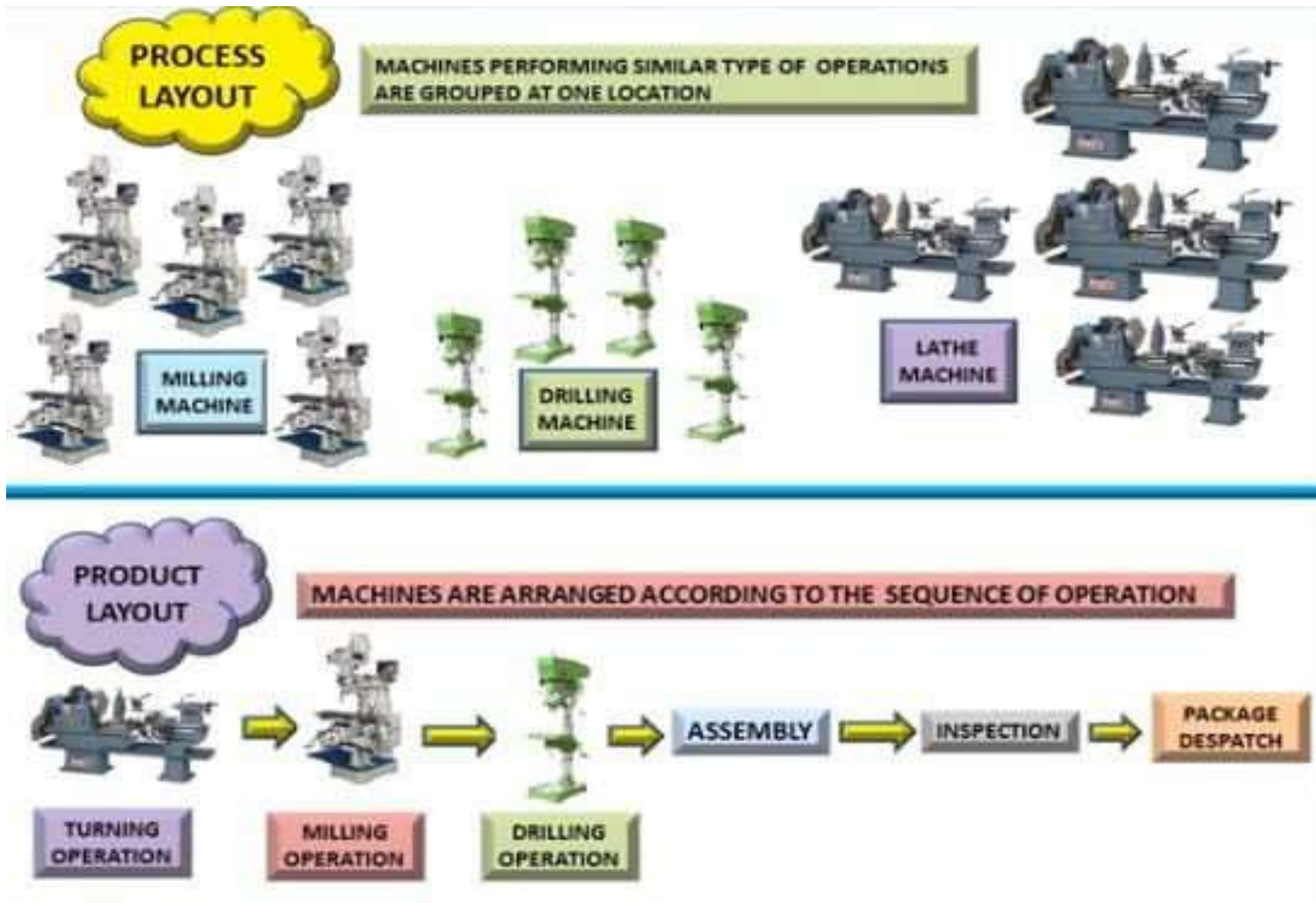
- Product layout or line processing layout or flow-line layout-
Linear arrangement of workstations to produce a specific product
 - The production line is often called the assembly line. The assembly line has a mechanized moving platform which moves at regular intervals.



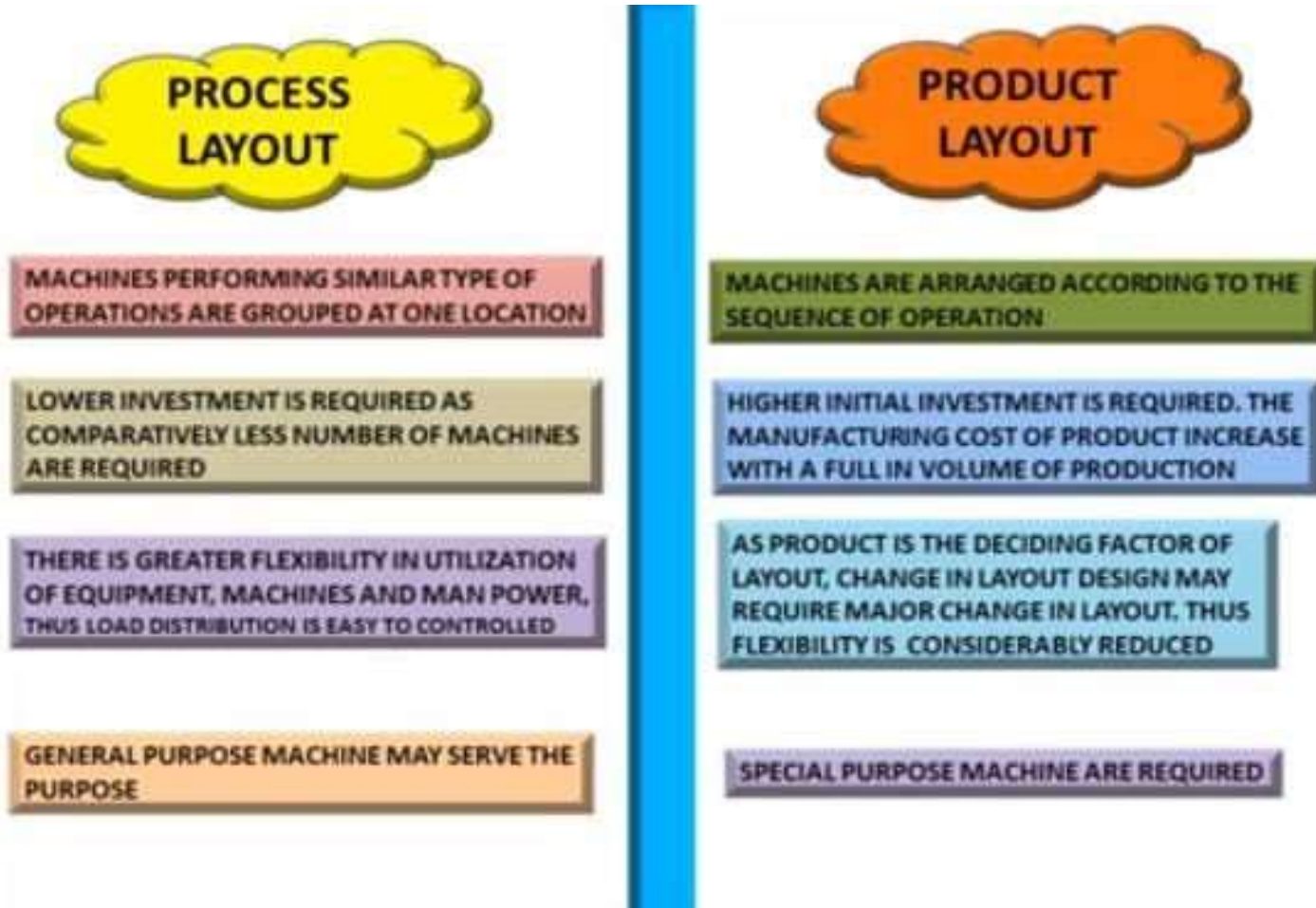
ADVANTAGES AND DISADVANTAGES OF PRODUCT LAYOUT

Sl.N o.	Advantages	Disadvantages
1.	Easier material handling and less inventory cost	Maintenance cost is slightly high to ensure smooth running of line
2.	Less supervision and labor training costs	Inflexible to design changes in products or processes
3.	A high output rate thus low cost of item per unit	Breakdown in machines or absenteeism of workers leads to halt in production
4.	High efficiency of labor and equipment	Monotonous and repetitive works lead to frustration of workers
5.	No need of routing and scheduling once the line is already done	-

PROCESS AND PRODUCT LAYOUT



DIFFERENTIATION BETWEEN PROCESS AND PRODUCT LAYOUT



PROCESS LAYOUT

BREAK DOWN OF MACHINES CAN BE EASILY HANDLED BY TRANSFERRING THE WORK ON OTHER MACHINES

FOR SAME VOLUME OF PRODUCTION MORE FLOOR SPACE IS REQUIRED

COMPLETION OF PRODUCT TAKES MORE TIME

MORE WORK IN PROCESS REMAINS IN QUEUE FOR FURTHER OPERATIONS

EXPENSIVE MATERIAL HANDLING EQUIPMENTS ARE REQUIRED

SKILLED WORKERS ARE REQUIRED

PROCESS LAYOUT IS PREFERRED FOR BATCH PRODUCTION

PRODUCT LAYOUT

IN A SINGLE MACHINE BREAKS DOWN IT MAY SHUT THE WHOLE PRODUCTION LINE

LESS FLOOR AREA IS REQUIRED FOR SAME VOLUME OF PRODUCTION

PRODUCT COMPLETES IN LESSER TIME

LESS AMOUNT OF WORK IN PROGRESS

REDUCED MATERIAL HANDLING DUE TO STRAIGHT FLOW OF MATERIAL

LESS SKILLED WORKERS MAY SERVE THE PURPOSE

PRODUCT LAYOUT IS PREFERRED FOR MASS PRODUCTION

FIXED POSITION LAYOUT

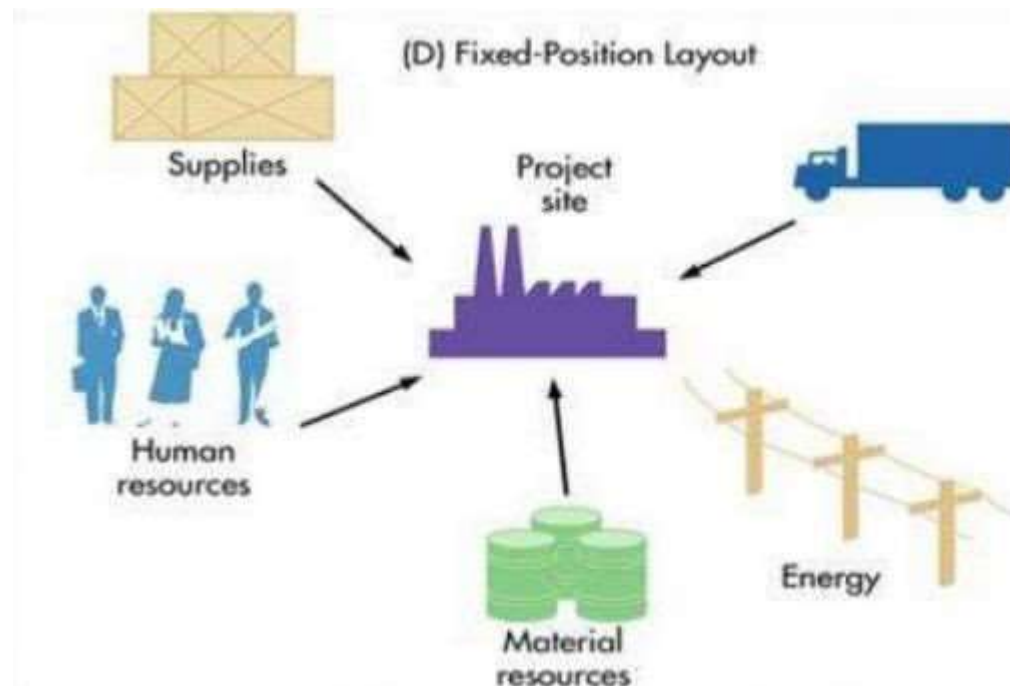
- This is also called the project type of layout.
- In this type of layout, the material, or major components remain in a fixed location and tools, machinery, men and other materials are brought to this location.

This type of layout is suitable when one or a few pieces of identical heavy products are to be manufactured and when the assembly consists of large number of heavy parts, the cost of transportation of these parts is very high.

Examples: Bridge construction, High-class service restaurant, Shipbuilding, Mainframe computer maintenance, ManDams

This type of layout is the least important for today's manufacturing industries. In this type of layout the major component remain in a fixed location, other materials, parts, tools, machinery, man power and other supporting equipment's are brought to this location.

The major component or body of the product remain in a fixed position because it is too heavy or too big and as such it is economical and convenient to bring the necessary tools and equipment's to work place along with the man power. **This type of layout is used in the manufacture of boilers, hydraulic and steam turbines and ships etc.**



ADVANTAGES OFFERED BY FIXED POSITION LAYOUT

- (i) Material movement is reduced
- (ii) Capital investment is minimized.
- (iii) The task is usually done by gang of operators, hence continuity of operations is ensured
- (iv) Production centers are independent of each other. Hence, effective planning and loading can be made. Thus total production cost will be reduced.
- (v) It offers greater flexibility and allows change in product design, product mix and production volume.

LIMITATIONS OF FIXED POSITION LAYOUT

- (i) Highly skilled man power is required.
- (ii) Movement of machines equipment's to production centre may be time consuming.
- (iii) Complicated fixtures may be required for positioning of jobs and tools. This may increase the cost of production.

CELLULAR MANUFACTURING



CELLULAR MANUFACTURING LAYOUT:

- **Cellular Manufacturing** is a lean manufacturing approach that helps companies build a variety of products for their customers with as little waste as possible. In cellular manufacturing, equipment and workstations are arranged in a sequence that supports a smooth flow of materials and components through the process, with minimal transport or delay.
- **One piece flow** is a condition that exists when products move through a manufacturing process one unit at a time, at a rate determined by the needs of the customer. The opposite of one piece flow is mass production with batches and queues. One piece flow focuses on flow efficiency rather than on resource efficiency.

Applying one piece flow allows to:

- Minimize stocks and thereby reduce transport and inventory wastes
- Deliver quicker
- Minimize damage, deterioration and obsolescence.



□ **U-shaped Cell operation**

□ Reduce travel distance by arranging equipment and workstations closer together. The beginning of the process must be close to the end of the process. The goal is to minimize the travel distance between each steps and cycles.

□ **Implementation of Cellular Manufacturing**

□ Organize the operations and equipment in a logic and validated U-Shaped Cell

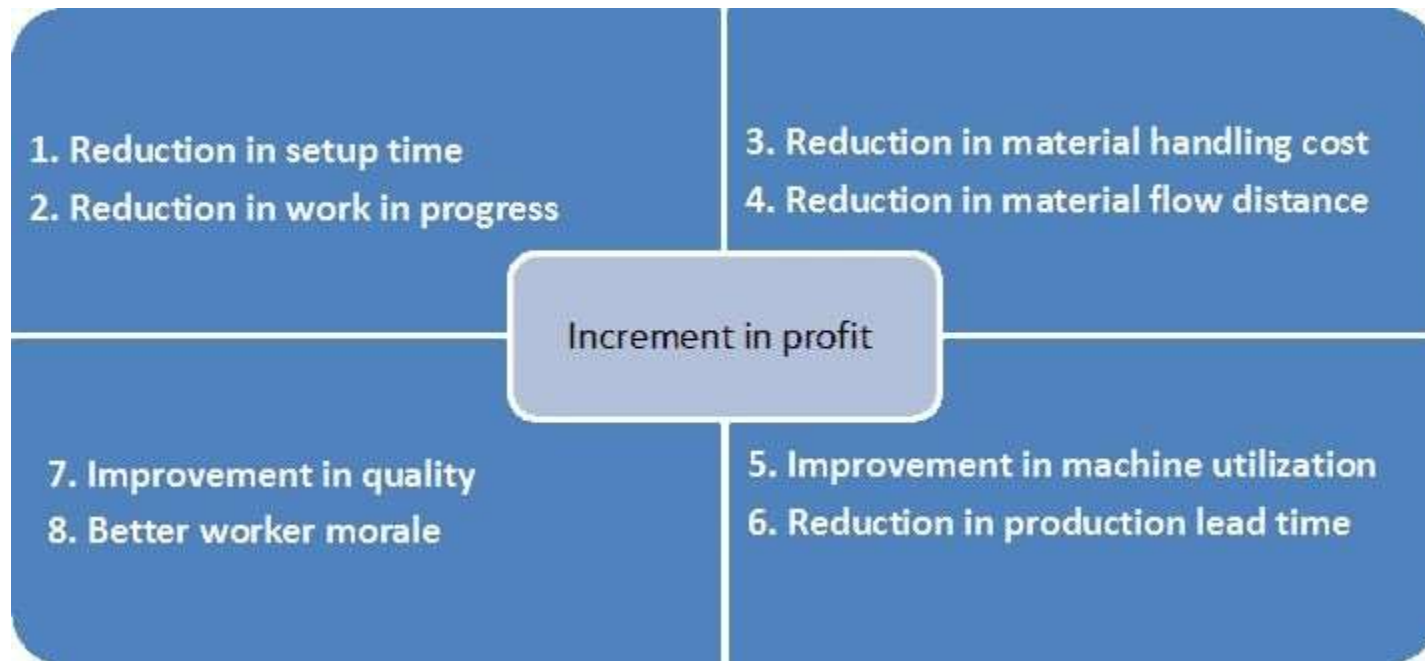
□ Empower the operators and set multimachine and multiskilled operators as a standard

□ Favor small, flexible machines

□ Using automation (*Jidoka*) to eliminate machine watching (automation meaning human automation (*Jidoka*) intelligence/human touch) defines

Discover an abnormality, Stop the process, Fix the immediate problem, Investigate and solve the root cause.)

- Implementing cellular manufacturing begins by splitting the production process down into sensible steps.
- **Advantages of cellular manufacturing** compared to traditional manufacturing by efficient layout design



- **1. Reduction in setup time:** Setup time is defined as period required preparing a device, machine, process or system to be ready to function or accept a job. Manufacturing cells are designed to process parts having similar shapes and relatively similar sizes. So it is not required to change or adjust machines and tools within cells to process similar parts.
- **2. Reduction in work in progress:** Work in progress refers to all materials and partly finished products that are at various stages of the production process. Work in progress excludes inventory of raw materials at the start of the production cycle and inventory of finished products at the end of the production cycle. With reduced setup times, the amount of work in progress can be reduced. Work in progress can be

reduced by 50% when the setup time is cut in half.

□ **3. Reduction in material handling cost and time**

- Material handling is the art and science of moving, storing, protecting and controlling material at the lowest possible cost through the use of proper method and equipment. Hundreds and thousands tons of materials are handled daily requiring the use of large amount of manpower, while the movement of materials takes place from one processing area to another or from one department to another department of the plant.

□ **4. Reduction in material flow distance**

- Material flow distance is defined as total distance travelled by all parts/materials to manufacture a single product or a variety of different products. By reducing it we can significantly reduce total manufacturing cost & time. Material flow distance is low in cellular manufacturing because every parts travel only in a small area (cell). In each cell, machines are close together. By efficient layout design of machines in each cell, 30 to 70% reduction in material flow distance can be achieved.



❑ **5. Improvement in machine utilization**

❑ In cellular manufacturing, single machine can be used to manufacture one or more products in each cell. Unnecessary machines are identified and removed from the manufacturing process. Reduction in setup time also reduces idle time for machines thus machine utilization is improved in cellular manufacturing.

❑ **6. Reduction in production lead time**

❑ Production lead time is defined as period between receipt of an order and until when it is available for packing or shipment. Production lead time is reduced in cellular manufacturing because of reduction in setup time, reduction in work in progress, reduction in material handling time, reduction in material flow distance and improvement in machine utilization.

□ **7. Improvement in quality**

□ In cellular manufacturing, most or all operations occur in one area and among a small team. This focuses responsibility and motivates the team to avoid similar defects in the future. Feedback on quality problems is faster and surer thus quality is improved in cellular manufacturing.

□ **8. Better worker morale**

□ By achieving all above listed advantages of cellular manufacturing, manufacturing industry profit increases more and more day by day and because of increment in profit, worker will get high incentive (bonus) apart from salary. Manufacturing processes become simple in cellular manufacturing. High incentive and simplified

manufacturing processes boost worker morale.

DISADVANTAGES

- Sometimes cells may not be formed because of inadequate part families
- Some cells may have A high volume of production and others very low. This results in poorly balanced cells
- When volume of production changes, number of workers are adjusted and workers are reassigned to various cells. To cope with this type of reassignments, workers must be multi-skilled and cross-trained
- Sometimes, machines are duplicated in different cells. This increases capital investment

COMBINATION OR HYBRID LAYOUT OR MIXED

LAYOUT

- It is difficult to find process or pure layout in practice. They are both mutually exclusive. A good compromise from which it is possible to benefit from both the layout is possible to some extent.
- So efforts must be made to have the combined layout which including advantages of the process and product layout
- A combined layout is developed to expand the production with a vision to tap the idle capacity of the product layout
- Generally combined layout developed where,
 - Product layout is used for main product
 - Process layout used for by products or joint products
- E.g Soap manufacturing unit manufacturing soap is arranged on line layout whereas manufacturing glycerine is on functional layout



Advantages

- Optimum utilization of resources can be done in this layout

Disadvantages

- Combined layout is time consuming
- More investment is needed in this layout
- More space is utilized in it

<https://study.com/academy/lesson/hybrid-layouts-cellular-flexible-manufacturing-mixed-model-assembly.html>

HYBRID LAYOUT



DIFFERENTIATION BETWEEN TYPES OF FACILITY LAYOUTS

Advantages and disadvantages

	Fixed position layout	Process layout	Cell layout	Product layout
Advantages	Very high product and mix flexibility. Product/customer not moved. High variety of tasks for staff.	High product and mix flexibility. Relatively robust in the case of disruptions. Easy to supervise.	Can give good compromise. Fast throughput. Group work can result in good motivation.	Low unit costs for high volume. Opportunities for specialization of equipment.
Disadvantages	Very high unit costs. Scheduling space and activities can be difficult.	Low utilization. Can have very high WIP. Complex flow.	Can be costly to rearrange existing layout. Can need more plant.	Can have low mix flexibility. Not very robust to disruption. Work can be very repetitive.

PLANT UTILITIES

- Plant utilities refer to such services as lighting, ventilation, air-conditioning etc. All these deserve due consideration from operations management as they contribute to increased efficiency and greater output.

The types of plant facilities and services are as follow:

- A. Plant Lighting
- B. Ventilation
- C. Air-conditioning
- D. Industrial Sanitation
- E. Noise control
- F. Industrial safety

A. PLANT LIGHTING: Adequate lighting is necessary for a worker to perform his job with ease and accuracy. According to all India General Standards a minimum of 14 to 18 lumens of illuminations is considered adequate.

Importance of Good illumination: Ease of

- ☐ seeing./reduced eye strain, Improved quality of work.
- ☐ Better utilization of floor space. Good housekeeping.
- ☐ Fewer accidents.
- ☐ Improved employee morale/ better supervision.
- ☐ Flexible layout.
- ☐

- There are two major source of lighting
- 1. Day light
- 2. Artificial light
- a. Day light - It is natural lighting which is received from the sun.
- b. Artificial light – It refers to illumination through artificial means as bulbs and tubes.

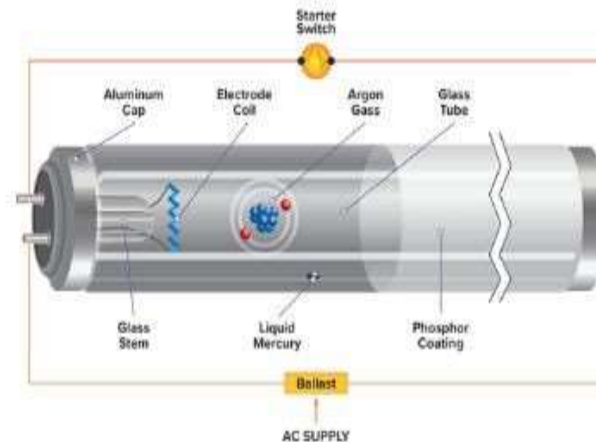
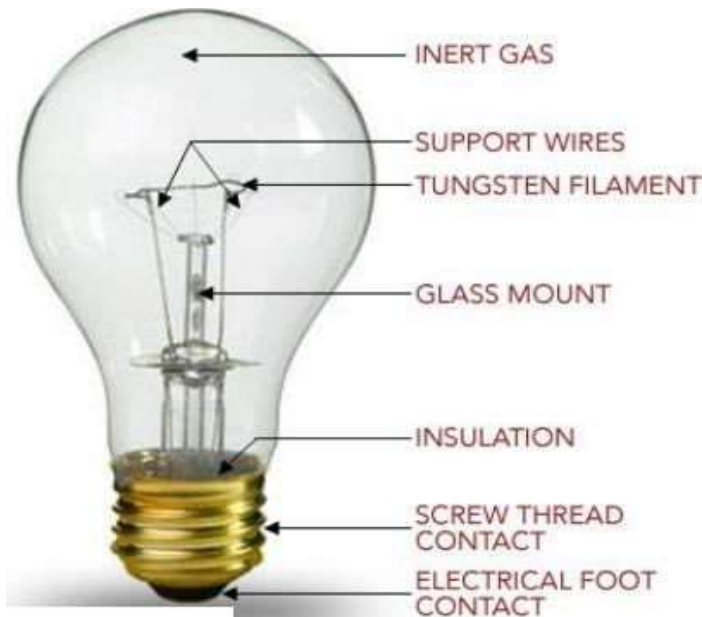
Types of artificial lights are

- a. General lighting - General lighting is provided by fixtures, luminaries or grid system placed 10 ft above the work area. The light is provided uniformly over the whole department in a sufficient intensity to satisfy the requirement of the general manufacturing conditions.

- b. Supplementary lighting – It involves the provision of intense light at the point of work or in adjacent areas to suit the worker particular requirement.

TYPES OF LIGHT SOURCES

- 1. Filament or incandescent lamps.
- 2. Discharge lamps or fluorescent lamps.
- 3. Electro-luminescent lamps, mercury vapor lamps.



B. VENTILATION

□ Ventilation is concerned largely with engineering techniques for controlling air currents within the plant and for introducing outdoor air in a pattern and on a scale that is just adequate to maintain satisfactory air purity.

Importance of ventilation are –

- Protection of the health of workers.
- Preservation of quality of the product
- Meets legal requirement.

TYPES OF VENTILATION

1. General ventilation –

- □ To keep the working conditions at acceptable comforts level.
- □ To keep contaminants in the air within safe limits.

2. General exhaust ventilation

- It is a system for preventing the contamination of factory air by withdrawing the contaminant at its source into a duct system for discharge to the building exterior.

C. AIR CONDITIONING

- Industrial air-conditioning requires control over temperatures, humidity, dust, purity and odors.

Objectives of air-conditioning

To protect worker's health.

To improve workers comfort level.

To secure specified temperature conditions. To improve the quality of products.

Product preservations.

To reduce maintenance charges.

To improve employer-employee relations.

D. INDUSTRIAL SANITATION

- Sanitation refers to control of the spread of infection and other insults to the health of the employees. Occupational disease caused by the industrial process leads to employee's dissatisfaction and turnover.

□ OBJECTIVES

- Supply of portable water.
- Disposal of waste and effluents.
- Provision of food which is free from contamination.
- Elimination of insects and rodents.
- Provision of personal services.
- Good housekeeping.

E. NOISE CONTROL - Noise is unwanted and unpleasant sound.

□ Elements –

- Impairs the hearing of employees.
- Results in fatigue and nervousness.
- Vibration causes damage to machinery and equipments.
- Bad working environment

Noise control methods –

- Control by absorption
- Control at source
- Control by ear protection

EXAMPLE



Name: Exxon Mobile Corporation
(Exxon Mobile F&L)

Industry: oil and gas

Headquarters: Irving, Texas , United States

Area served: worldwide

Products: fuel , lubricant, petrochemicals

Example of the products

- Exxon Mobil white oil and wax
- Exxon Mobil aviation lubricant
- Mobil industrial lubricant
- Exxon Mobil Marine lubricants
- Exxon Mobil asphalt (bitumen)
- Passenger Vehicle lubricant



ExxonMobil
Aviation



ExxonMobil
Chemical



*Thank
You*

COMPLETES MODULE 1