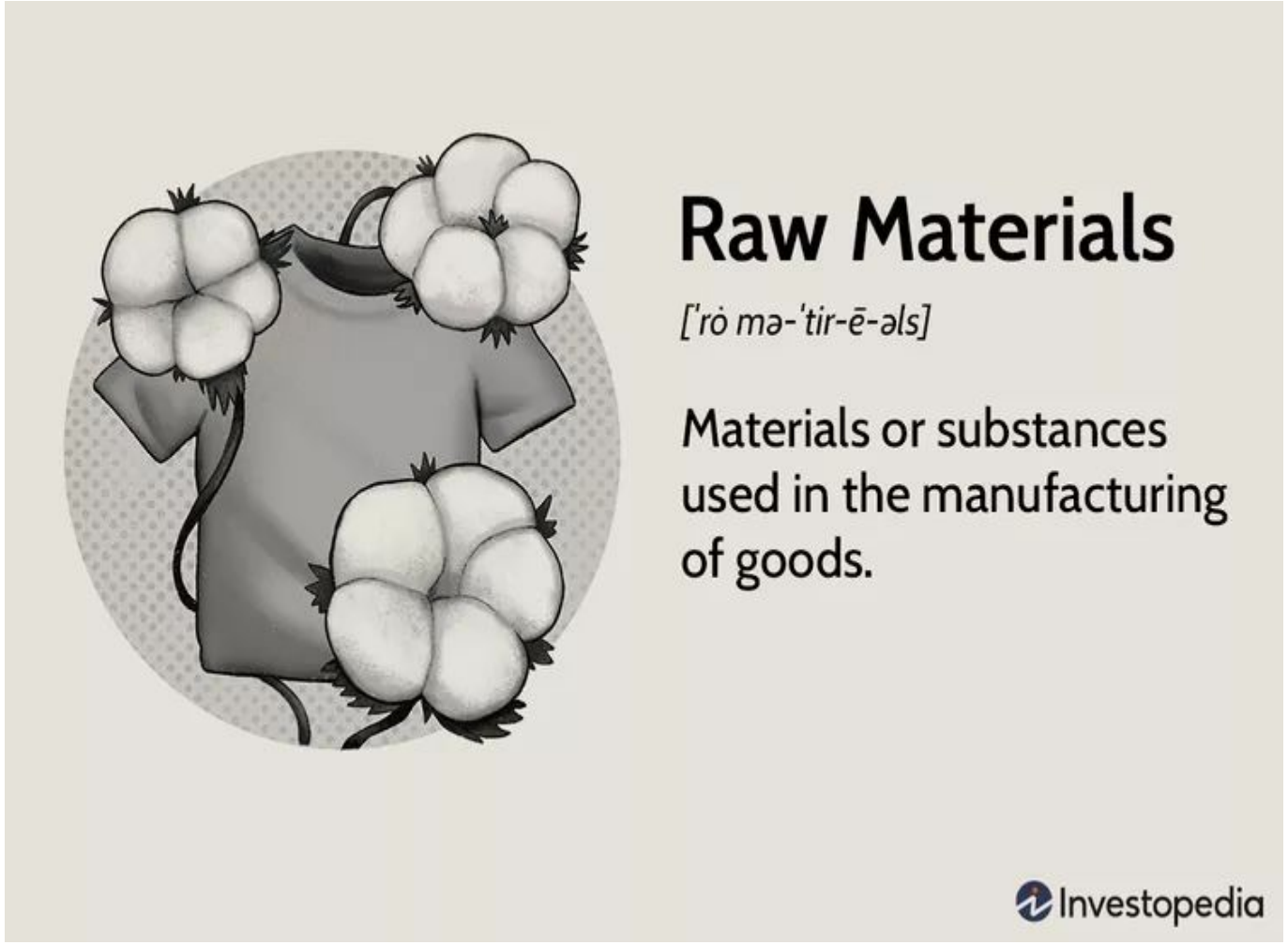
Module 3 Technical Profile

Type of raw material to be used, Demand and supply position of raw material, Availability of substitutes of raw material, Details about production process and production methods, Technical details about production technology and availability of substitutes, Costs involved in operation and maintenance of technology.

What Are Raw Materials?

- Raw materials are materials or substances used in the primary production or manufacturing of goods.
- Raw materials are commodities that are bought and sold on commodities exchanges worldwide.
- Businesses buy and sell raw materials in the factor market because raw materials are factors of production.



- Raw materials are the input goods or inventory that a company needs to manufacture its products.
- Examples of raw materials include steel, oil, corn, grain, gasoline, forest resources, plastic, natural gas, coal, and minerals.
- Raw materials can be direct raw materials, which are directly used in the manufacturing process, such as wood for a chair.
- Indirect raw materials are not part of the final product but are instead used comprehensively in the production process.
- The value of direct raw materials inventory appears as a current asset on the balance sheet.

❑PURCHASE SPECIFICATION

❖ **Definition** :

- Written guidelines that precisely define the operational, physical, and/or chemical characteristics, as well as the quality and quantity of a particular item to be acquired.

rawmaterial.doc

❖ **Mode of purchasing** :

- By inspection
- By sample
- By description of brand
- By grading

❑Steps involved in purchase procedure:

1. Purchase requisition
2. Selection of supplies
3. Inviting Quotation
4. Placing the order
5. Receiving the material
6. Checking of invoice or bill
7. Recording of bills in books
8. Releasing the payment to the supplier

Accounting for Raw Materials

- Manufacturing companies take special steps to account for raw materials inventory.
- This includes three distinct inventory classifications on their balance sheet compared to just one for non-manufacturers.
- The current assets portion of the balance sheet represents the assets that are likely to be used up in less than one year and include:
    - Raw materials inventory
    - Work-in-process
    - Finished goods
- All inventory, including raw materials inventory, should be valued at its comprehensive cost. This means its value includes shipping, storage, and preparation.

Types of Raw Materials

Raw materials can be classified in several ways, but one common classification is the nature of how the good is extracted. These types include:

- **Mined raw materials** extracted from the earth, such as ores, stones, metals, minerals, lime, sand, soil, oil, and coal.
- **Plant-based raw materials** come from trees or plants, including fruits, nuts, flowers, vegetables, resins, wood, cotton, and latex.
- **Animal-based raw materials** are extracted from animals such as milk, meat, furs, leather, and wool.

Example of Raw Materials

Consider a company manufactures tables and chairs. Below are the materials used in production:

- **Direct raw materials:** timber, wood, cushions, padding for the chairs, cloth fabric to cover the chairs
- **Indirect raw materials:** fittings, nails, wood glue, equipment for workers

Since the wood, padding, and fabric can be directly tied to the production of the tables and chairs, they are considered direct raw materials. When calculating the cost on a per-unit basis, the direct raw materials could be traced to each unit.

The glue, nails, and worker equipment would likely be considered indirect materials since the quantities used would not be significant, nor would they be directly tied to each unit produced. These types of costs would likely be allocated to a product via manufacturing overhead.

What Are Raw Materials in Food?

Raw materials in food can be standalone items like meats, milk, fruits, and vegetables. They can also refer to the ingredients that go into a food item or recipe. For instance, milk is a raw material used in the production of cheese and yogurt.

Is Water a Raw Material?

Yes, water can be thought of as a raw material that is used in a wide range of products and production processes, from beverages to agriculture to industrial uses.

What Is the Difference Between Inventory and Raw Materials?

- In many cases, raw materials are a type of inventory.
- It represents goods on a balance sheet that have not yet been converted to work-in-progress or a finished product. Companies often buy, acquire, or extract raw materials for use, then report raw materials as an asset.
- Then, as the company uses raw materials in the production of finished goods, it converts the raw materials into products it can sell to consumers.

Demand and supply position of raw material.

What is Supply Chain Management (SCM)

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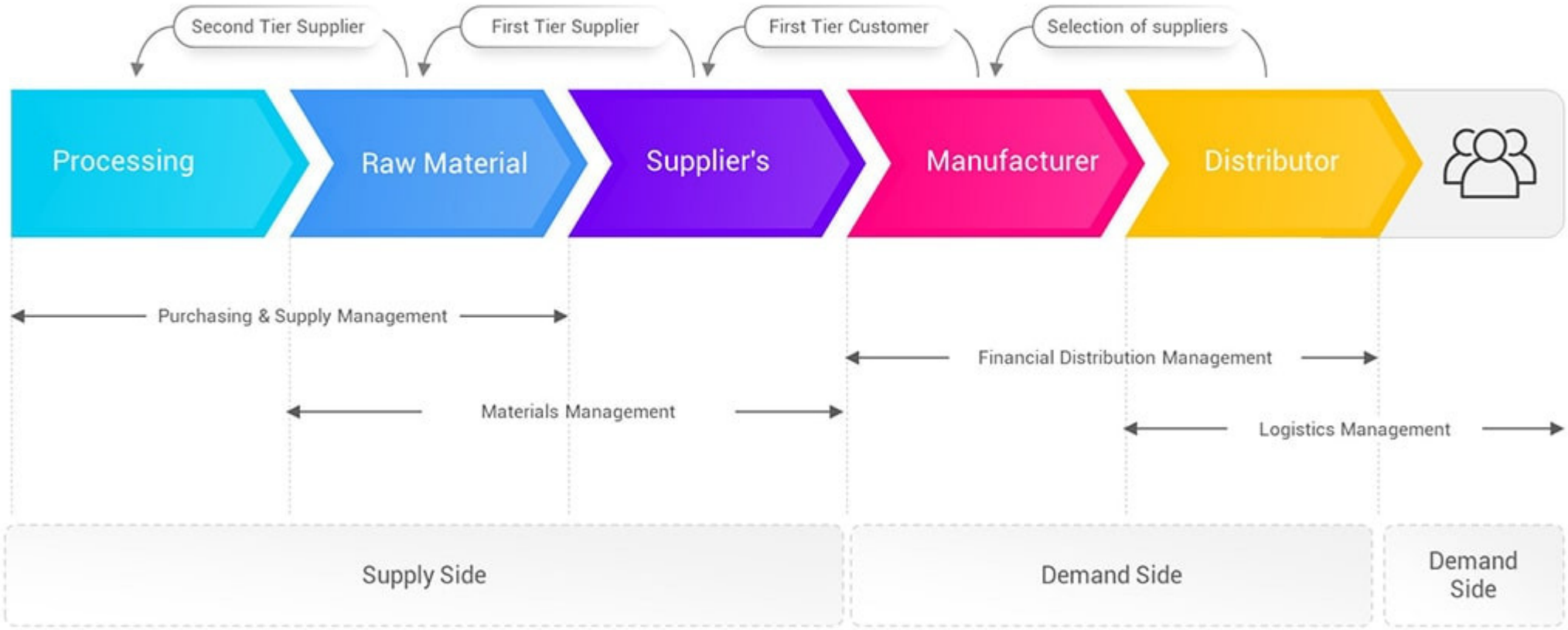
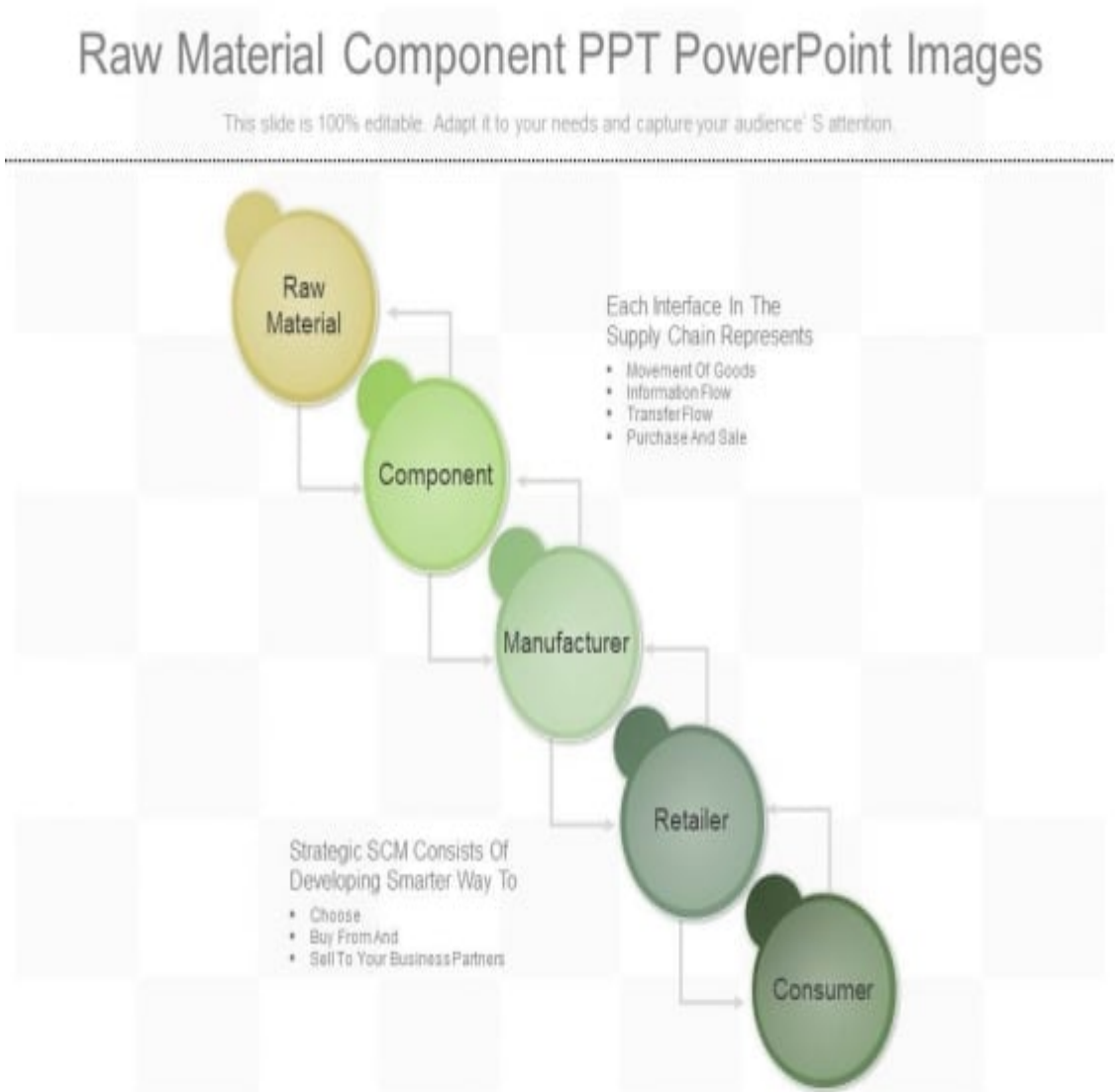


Supply Chain Defining Raw Materials Supplie...



DEFINITION OF SUPPLY CHAIN

- **According to Ganeshan & Harrison.**

"A supply chain is a network of facilities and distribution options that perform the function of procurement of material transformation of these materials into intermediate and finished products, and the distribution of these finished products to customers."

TYPES OF SUPPLY CHAIN.

- Raw supply chain.
- Ripe supply chain.
- Internal supply chain.
- Extended supply chain.
- Self monitored Supply Chain.
- Outsourced supply Chain.

ESSENTIAL FEATURES OF SUPPLY CHAIN MANAGEMENT.

- Integrated behavior- SCM incorporates integrates integration of stakeholders from supplier to customers.
- Mutually sharing information- For effective SCM mutually sharing information among channel members is required, especially for planning and monitoring processes.
- Mutually sharing channel risk and Rewards- Effective SCM also requires mutually sharing channel risks and rewards that yield a competitive advantage. Risk and reward sharing should happen over the long term focus and cooperation among the supply chain members.
- **Co-operation-** Co-operation among channel members is required for effective SCM. Co-operation refers to similar or complimentary co-ordianted activities performed by firm in a business relationship to produce superior mutual outcomes or singular outcomes that are mutually expected over time.

- Focus on serving customers – Supply chain succeeds if all the members of supply chain have the same goal and the same focus serving customers. Establishing the same goal and same focus among Supply chain members is a form of policy integration.
- Integration of Processes – The implementation of SCM needs the integration of processes from sourcing to manufacturing and to distribution across the supply chain. The integration can be accomplished through cross functional terms, in plant supplier personnel and third party service provide.
- Partners to Build and Maintain Long Term Relationship – Successful relationships aim to integrates channel policy to avoid redundancy and overlap while seeking a level of co-operation that allow participants to be more effective at lower cost levels. Policy integration is possible if there are compatible cultures and management techniques among the chain members.

OBJECTIVES OF SUPPLY CHAIN MANAGEMENT

- Service Orientation.
- System Orientation.
- Competitiveness and Efficiency.
- Minimizing the Time.
- Minimizing Work in Progress.
- Improving Pipeline Visibility.
- Improving visibility Demand.
- Improving Quality.
- Reduces Transportation Cost.
- Reduces Warehousing Cost.

- Competitiveness and Efficiency – Supply chain is a business organization. It provides value to the customers while being competitive. Competitiveness is essential for it to healthy sustain itself in order to be able to provide increasing value to its customer. Efficiency is an important element of competitiveness.
- Minimizing the time – efficient supply chain is an organization reduces the time required for converting orders into cash. So there is minimal time lag and increase in productivity of the organization.
- Minimizing Work in Progress- supply chain minimizes total work in process in supply chain.
- Improving Pipeline Visibility – efficient supply chain improve the visibility of each one of the activities of the supply chain by each one of the partner.
- Improving visibility Demand- Efficient supply chain improves visibility of demand by each one of the partners.
- Improving Quality- Efficient supply chain management helps in improving the quality of operation of the organization. TQM has become a major commitment throughout all facet of industry. Overall commitment to TQM is one of the major commitment throughout all facets of industry.

COMPONENTS OF SUPPLY CHAIN MANAGEMENT

- Procurement.
- Processing.
- Distribution.

FACTORS INFLUENCING SUPPLY CHAIN MANAGEMENT

- Consumer Demand.
- Globalization.
- Competition.
- Information and communication.
- Government Regulation.
- Environment.

FUNCTIONS OF SUPPLY CHAIN MANAGEMENT

- Supply chain management is a cross functional approach to manage the movement of raw material into an organization, certain aspects of the internal processing of material into finished goods, and then the movement of finished goods out of the organization towards the end consumers. As organization strive to focus on core competencies and becoming more flexible, they have reduced their ownership of raw material sources and distribution channel.

FUNCTIONS OF SUPPLY CHAIN MANAGEMENT

- **Strategic level**
- Strategic network optimization, including the number, location, and size of warehousing, distribution centers, and facilities.
- Strategic partnerships with suppliers, distributors, and customers, creating communication channels for critical information and operational improvements such as cross docking, direct shipping, and third-party logistics.
- Product life cycle management, so that new and existing products can be optimally integrated into the supply chain and capacity management activities.
- Information technology chain operations.
- Where-to-make and make-buy decisions.
- Aligning overall organizational strategy with supply strategy.
- It is for long term and needs resource commitment.

FUNCTIONS OF SUPPLY CHAIN MANAGEMENT

- **Tactical level**
- Sourcing contracts and other purchasing decisions.
- Production decisions, including contracting, scheduling, and planning process definition.
- Inventory decisions, including quantity, location, and quality of inventory.
- Transportation strategy, including frequency, routes, and contracting.
- Benchmarking of all operations against competitors and implementation of best practices throughout the enterprise.
- Milestone payments.
- Focus on customer demand and Habits.

FUNCTIONS OF SUPPLY CHAIN MANAGEMENT

- **Operational level**
- Daily production and distribution planning, including all nodes in the supply chain.
- Production scheduling for each manufacturing facility in the supply chain (minute by minute).
- Demand planning and forecasting, coordinating the demand forecast of all customers and sharing the forecast with all suppliers.
- Sourcing planning, including current inventory and forecast demand, in collaboration with all suppliers.
- Inbound operations, including transportation from suppliers and receiving inventory.
- Production operations, including the consumption of materials and flow of finished goods.
- Outbound operations, including all fulfillment activities, warehousing and transportation to customers.
- Order promising, accounting for all constraints in the supply chain, including all suppliers, manufacturing facilities, distribution centers, and other customers.
- From production level to supply level accounting all transit damage cases & arrange to settlement at customer level by maintaining company loss through insurance company.

Raw materials-Availability

- Raw materials are **the inputs used in the production process to create finished products that are ready to sell to consumers**. This makes raw materials a vital piece of the global economy and international trade. Having natural resources that can serve as raw materials can boost exports and help a country grow its GDP.

Material substitution is **an evolutionary process**

- Material substitution is **an evolutionary process that requires material research, market knowledge and time**. And as with all types of change processes, you may meet forces that resist change, such as tradition, or people. In other words, your fact-based arguments may not be enough.

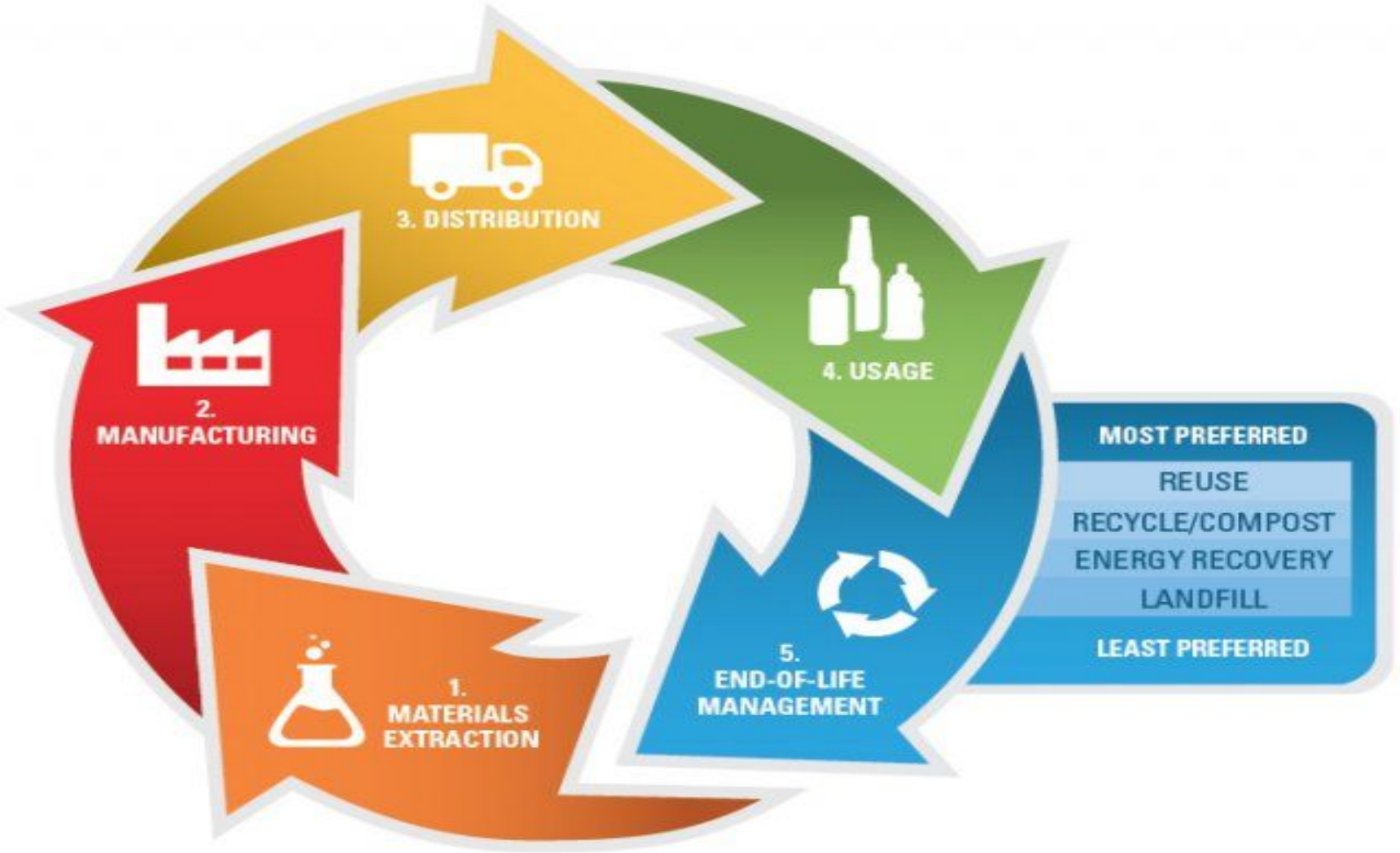
substituting materials-3 Methods

- There are three methods for substituting materials during the production process:
- By date, when one material is substituted for another after a specific date
- During master planning, when a material in a formula is substituted with a different material, because it's out of stock
- During production, when a material is unexpectedly out of stock and is substituted with a different material

aerospace applications-CFRP

- Such as carbon-fibre reinforced polymers (CFRP), combine high specific stiffness with design flexibility and therefore have particularly high weight-reduction potential. In aerospace applications the use of CFRP-materials can result in lifetime ��2-reductions of 14-20%

Sustainable materials management (SMM)



Sustainable materials management (SMM)

- Sustainable materials management (SMM) is a systematic approach to using and reusing materials more productively over their entire life cycles.
- Use materials in the most productive way with an emphasis on using less.
- Reduce toxic chemicals and environmental impacts throughout the material life cycle.
- Assure we have sufficient resources to meet today's needs and those of the future.

Material substitution

- Material substitution is an ongoing process and materials used for a given product should be reviewed regularly through a materials audit process
- In substituting a new material for an established one, the characteristics of the new material should be well understood and that advantages outweigh the drawbacks of adopting it
- Risk, cost of conversion and equipment needed, as well as the environmental impact, need to be carefully evaluated.

Raw materials substitution

- concept of raw materials substitution implies effective and efficient use of raw materials (to minimize losses along the process system) as well as using different raw materials that will not generate waste during processing. This concept also further implies re-using materials or using recycled materials

Substitution Process

- In an NGL (Natural Gas Liquid) process system, this means: (i) changing the source of raw gas feed and substituting the feed with a feed that will produce less waste in the process system; (ii) changing chemicals for other chemical reactions in the process by substituting them with different chemicals that will not generate waste and that are more environmentally friendly and safe to process or use.

Material Substitution in Cement Industry

- 60% of the industry's emissions are 'process emissions' caused by decarbonation of limestone during the production process.
- Limestone needed to make clinker can be partially substituted by a range of alternative calcium containing materials, including waste and industrial by-products, which are already increasingly being used.
- Many of the alternative materials are ashes provided by the combustion of alternative fuels.
- Further research into the use of alternative raw materials and ensuring access to these materials should be supported.

Ecomaterials

- Ecomaterials emerged as a new field in international research on hi-tech new materials in the early 1990s. The development of ecomaterials is of great importance to the reduction, substitution, and recycling of raw materials. Ecomaterials are those materials with good performance or good functions that can be used in harmony with the environment.

Ecomaterials

- They consume fewer resources and less energy, cause less pollution to the ecology and the environment, have a high rate of reproduction, and are in accord with the ecological environment throughout their whole life cycle, from materials manufacture, use, and discarding to recycling.

Production Process

- It is an activity that processes raw materials by combining them into a finished product.
- An example is the **car production process**, where car parts are made separately, starting from the steering wheel, frame, engine, tires, and so on

Objective of Production Process

- Meeting the human needs in achieving prosperity from the availability of goods and services.
- To maintain the survival of a company.
- Provide added value to a product.
- To meet market demand, both from domestic and international markets .
- Gaining profit so that a company achieves the desired level of prosperity.
- Produces export goods to increase the country's foreign exchange sources.
- Stimulates the growth of other production businesses so that they can attack.

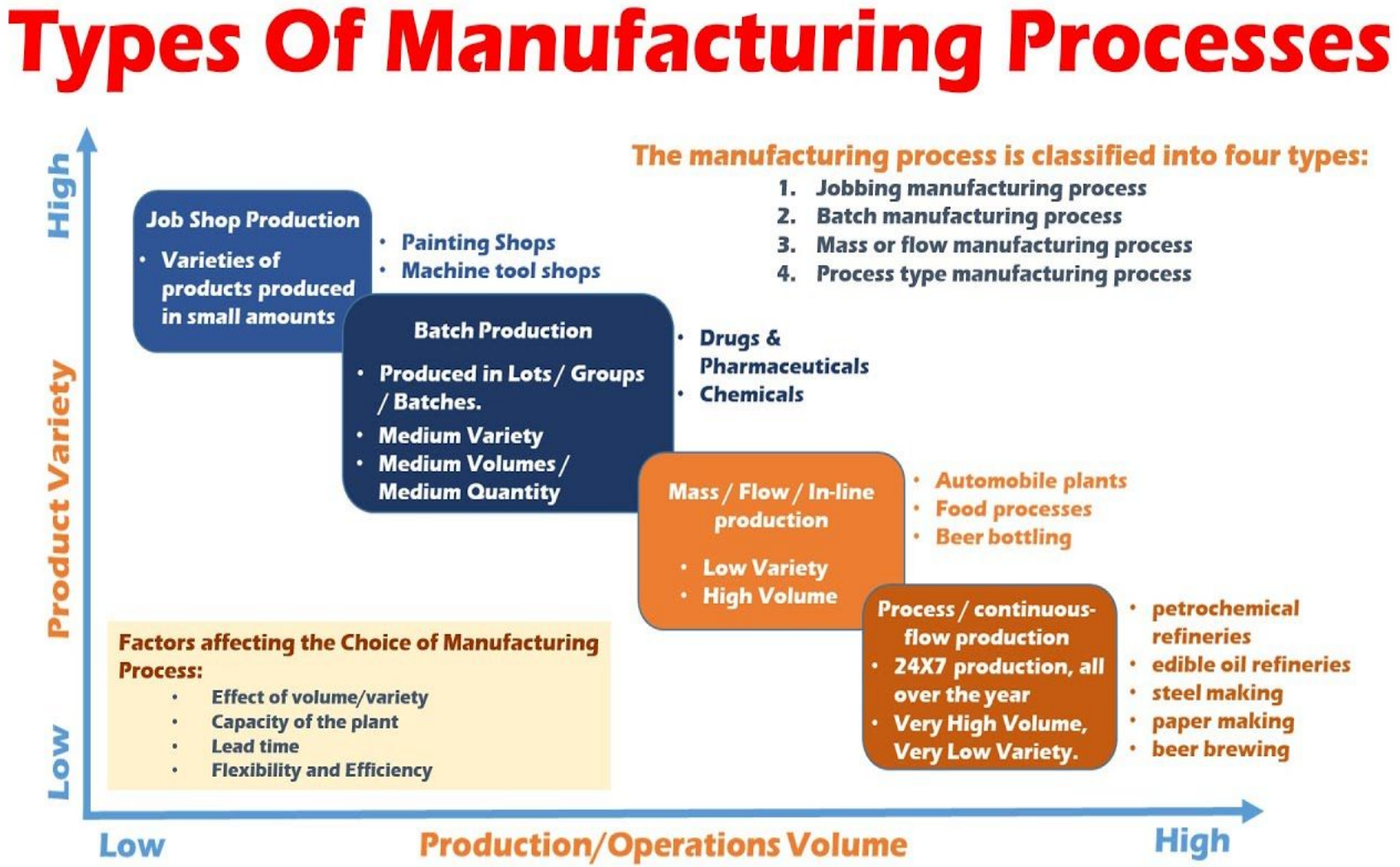
steps in production process

- Initial planning stage. ...
- Product Development Phase. ...
- Prototype production/evaluation. ...
- Commercial prototype production planning. ...
- Commercial Prototype Production/Evaluation. ...
- Commercial Production. ...
- Inspection,Shipment,Delivery.

Types of production processes

- Batch,
- Unit,
- Mass,
- Continuous production.
- Short term
- Long term
- Intermediate

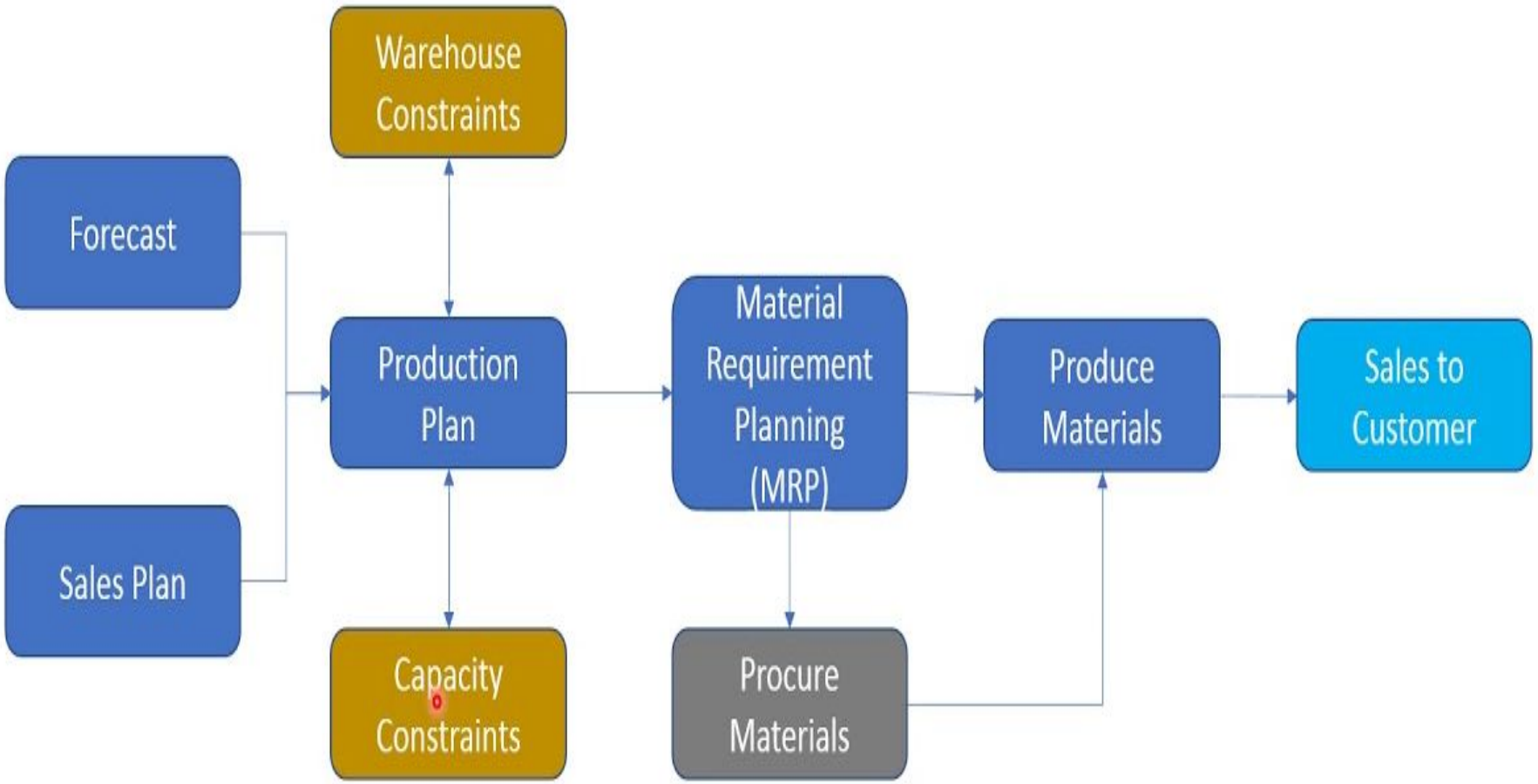
Types of production processes



Characteristics of Business Process

- Extractive process: Production activities by taking products directly from nature.
- Analytical process: Production activities that separate a product into more and more similar forms to the original.
- Fabrication process: The process of converting a material into several new product forms.
- Synthetic process. The process of combining several production materials into a product form.Synthetic procedures are also often referred to as assembly processes

Production Process



Demand forecasting

- **Demand forecasting** is known as the process of making future estimations in relation to customer **demand over a specific period**. Generally, demand forecasting will consider historical data and other analytical information to produce the most accurate predictions. More specifically, the methods of demand forecasting entails using predictive analytics of historical data to understand and predict customer demand

What is in a sales plan?

- What is in a sales plan?
- A sales plan **details the overall sales strategy of a business, including the revenue objectives of the company and how the sales department will meet those goals**. This may also include revenue goals, the target audience and tools the team will use in their day-to-day.

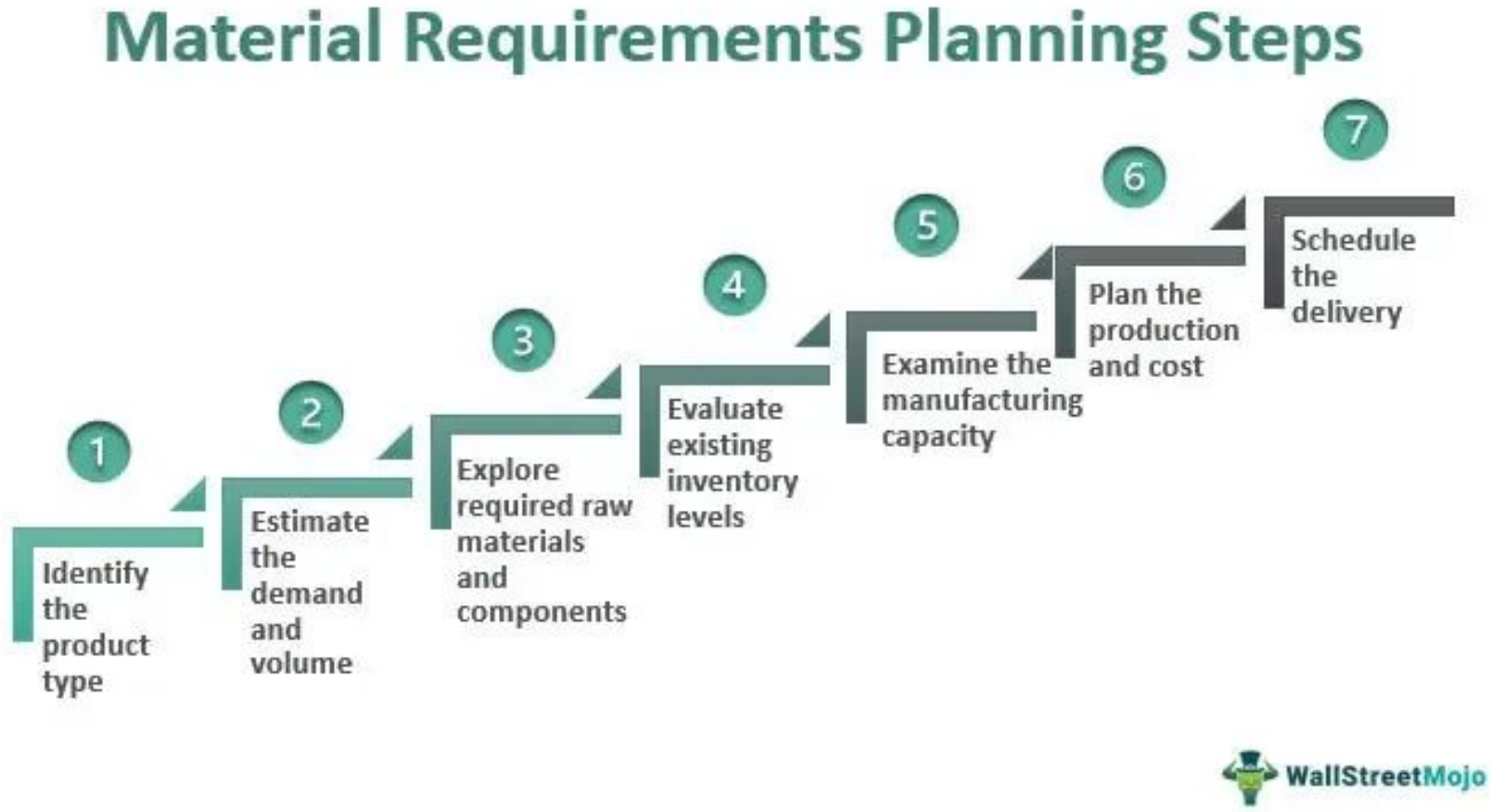
warehouse constraint

- The warehouse constraint is **one of the most challenging problem of the supply chain**. We can optimize the inventory and order quantities with the opportunity cost and production & logistics issues. This is done per product. We can add the warehouse constraint to the model

Production planning

- the planning of production and manufacturing modules in a company or industry. It utilizes the resource allocation of activities of employees, materials and production capacity, in order to serve different customers.

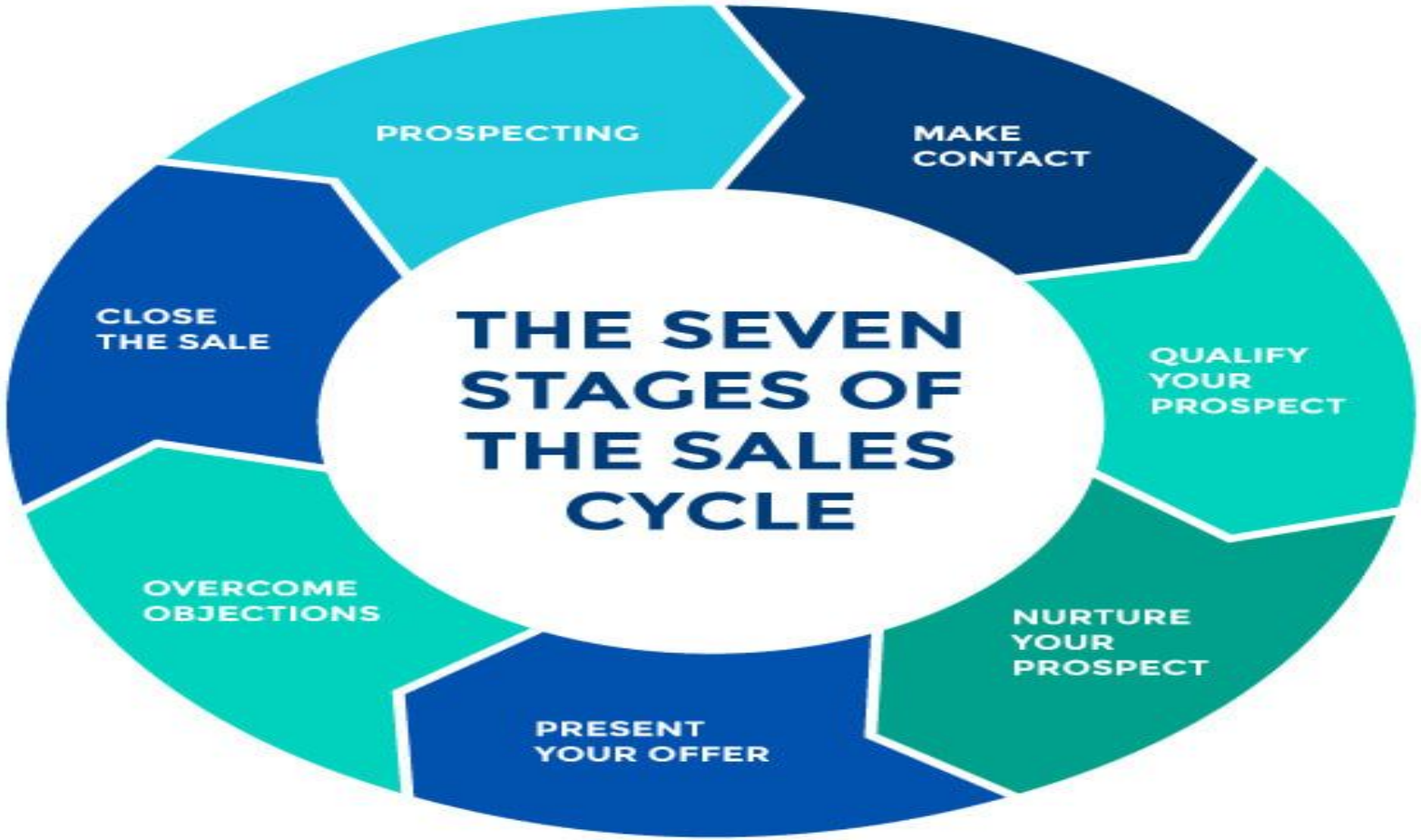
MRP-Material Requirement Planning



Production Process

- **Industrial processes** are procedures involving **chemical, physical, electrical or mec hanical steps** to aid in the manufacturing of an item or items, usually carried out on a very large scale. Industrial processes are the key components of heavy industry.

Sales Process

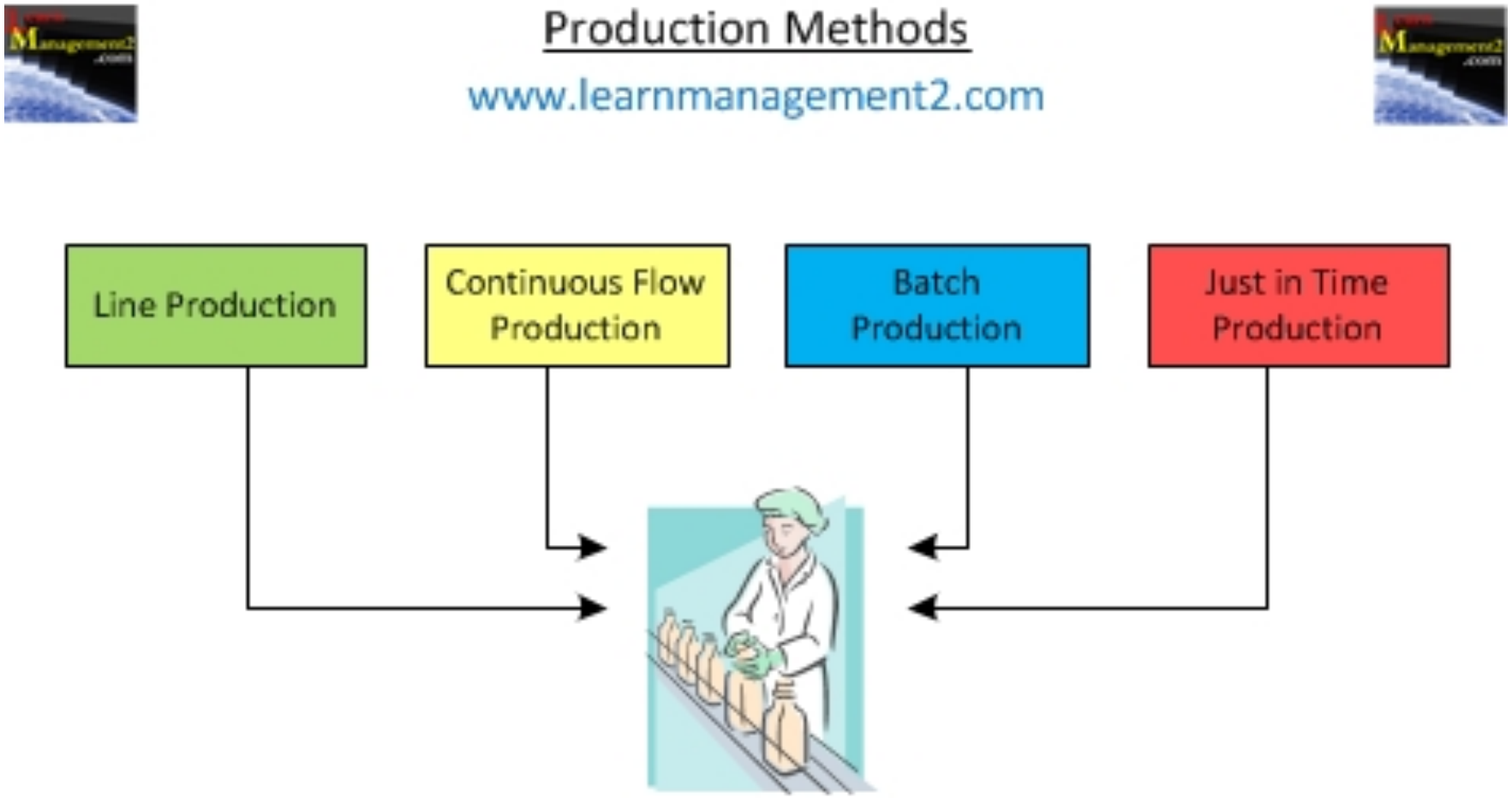


The Seven Stages of the Sales Cycle

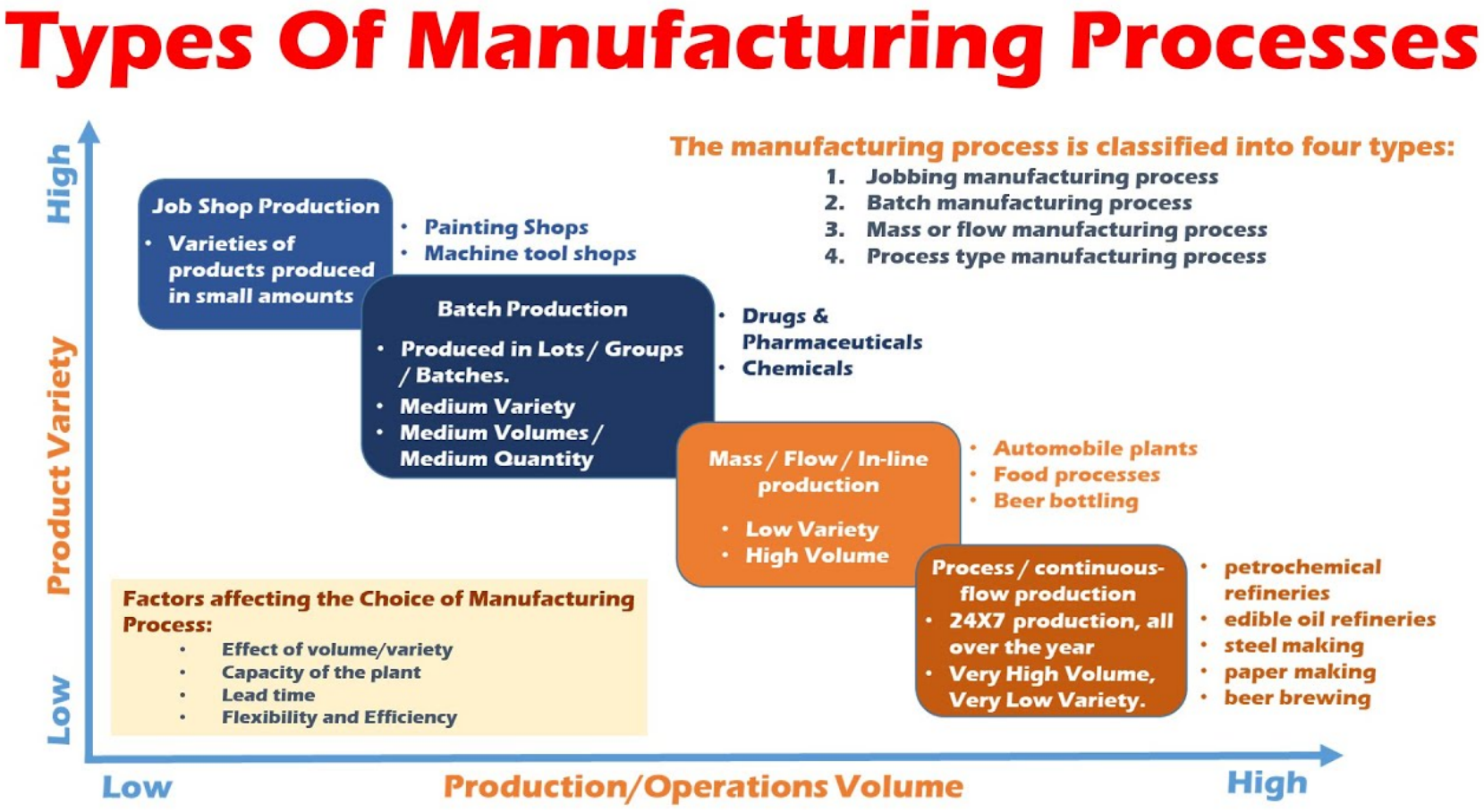
1. Prospecting
2. Make Contact
3. Qualify your prospect
4. Nurture your prospect
5. Present your offer
6. Overcome objections
7. Close the sale

Production Methods & Production planning and scheduling

production methods in business



production methods in business



Method of Production

Type	Description	Example
Job	Production of special **one-off** products made to specific order.	Custom-made cars with individualized accessories.
Batch	Groups of a particular product made to order.	Car models with different features for each model.
Mass Flow Line	Standardized products made in large quantities, usually by assembly lines	Cars that are made to a standard design.
Cell	An adaption of mass production in which the flow is broken up by teams of workers who are responsible for certain parts of the line	Cars that are made to a standard design, but produced by a number of different cells.

Components of Production Methods

- **economic input or resources**
- **labor,**
- **capital equipment or land,**
- **To provide goods and services to consumers**

COMPARISON OF THE THREE PRODUCTION METHODS

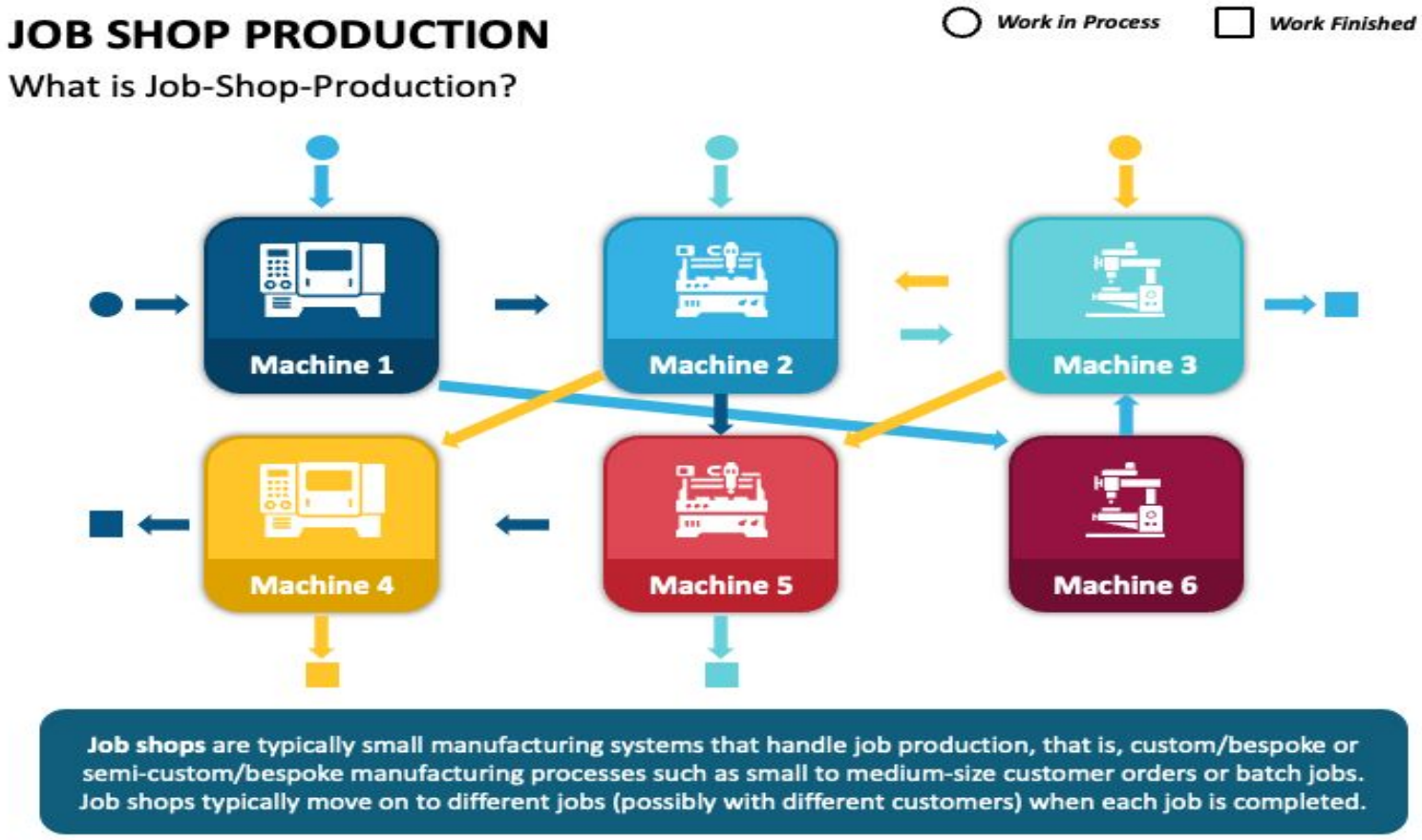
Criteria	Job Production	Batch Production	Mass Production
Set up time	Long set-up time as there is a new set up for every new job.	Can be reasonably fast as set up is usually a modification of an existing process. Otherwise as for mass production.	Very long set up as it takes time to synchronize the whole process.
Cost per unit	High	Medium	Low
Capital (machinery)	Can be flexible as it depends on specific use	A mixture of machines used, but this method is based on general purpose machines	Can involve large numbers of general purpose machines designed for a specific function
Labour	Highly skilled may be craft workers.	Semi-skilled and need to be flexible.	Unskilled & need medium training
Production time	Likely to be long	Once set up, production can be swift	Production is swift.
Stock	Low raw materials and finished stock, but high work in progress.	High raw materials-buffer stocks. Medium work in progress & finished stock	High raw materials & finished stock – low work in progress

Job Shop Production

The Job Shop Defined

- Job Shop
  - **An organization whose layout is process-oriented (vs. product-oriented) and that produces items in batches.**
  - **A functional organization whose departments or work center are organized around particular processes that consist of specific types of equipment and/or operations.**

Job shop Production



Job Production

- Designing and implementing an advertising campaign.
- Auditing the accounts of a large public limited company.
- Building a new factory.
- Installing machinery in a factory.
- Machining a batch of parts per a CAD drawing supplied by a customer.
- Building the Golden Gate bridge.

Job Production

JOB PRODUCTION

ADVANTAGES	DISADVANTAGES
Easy to organise staff	Production costs are likely to be high as there are fewer economies of scale
One-off orders can be easily accommodated	Production time longer as individual needs have to be met
Workers involved in entire production so they can see the end results	Capital investment is higher since specialist machinery may be required

Batch production

- Batch production is **a method of manufacturing where the products are made as specified groups or amounts, within a time frame**. A batch can go through a series of steps in a large manufacturing process to make the final desired product.

Batch Production Examples:

- Baked goods.
- Clothing.
- Computer chips.
- Computer software.
- Die- or mold-making.
- Electrical goods.
- Flat-pack furniture.
- Jet engine production.

Batch production

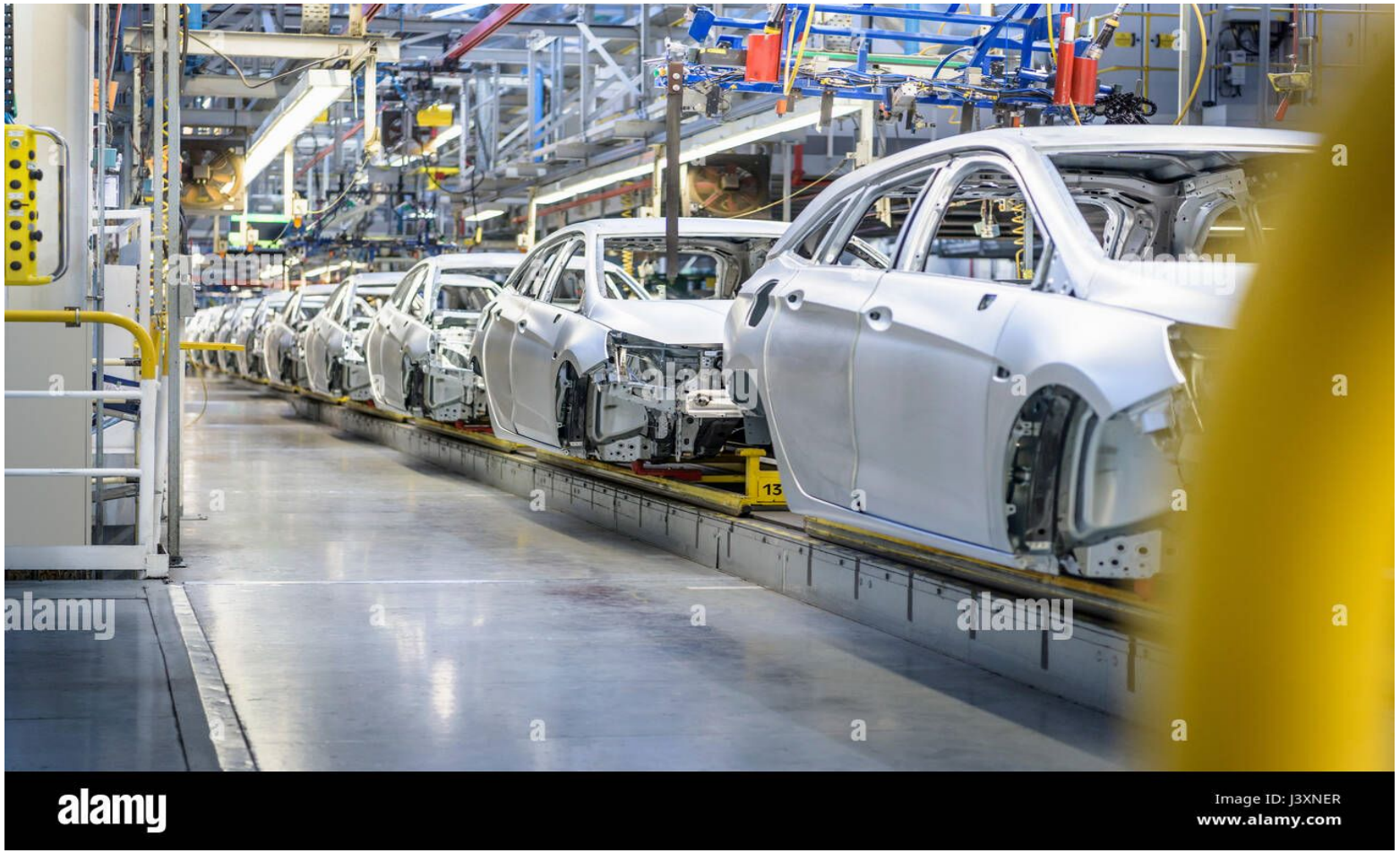
Batch Production

Advantages	Disadvantages
• Workers may specialise to some degree • Labour costs reduced so final price is lower • Machinery may be used • Production is faster • Begins to take advantage of economies of scale	• The work is less interesting and very repetitive • More space is required for working and storage • Larger stocks of raw materials must be kept • Machines have to be re-set between batches, losing time

Mass production

- Mass production, also known as flow production or continuous production, is the production of substantial amounts of standardized products in a constant flow, including and especially on assembly lines. Together with job production and batch production, it is one of the three main production methods

Mass production



Mass Production

Mass Production

- **Disadvantages:**
  - Production halts if there is a problem.
  - Changing the line to making a different product or style can take a long time.

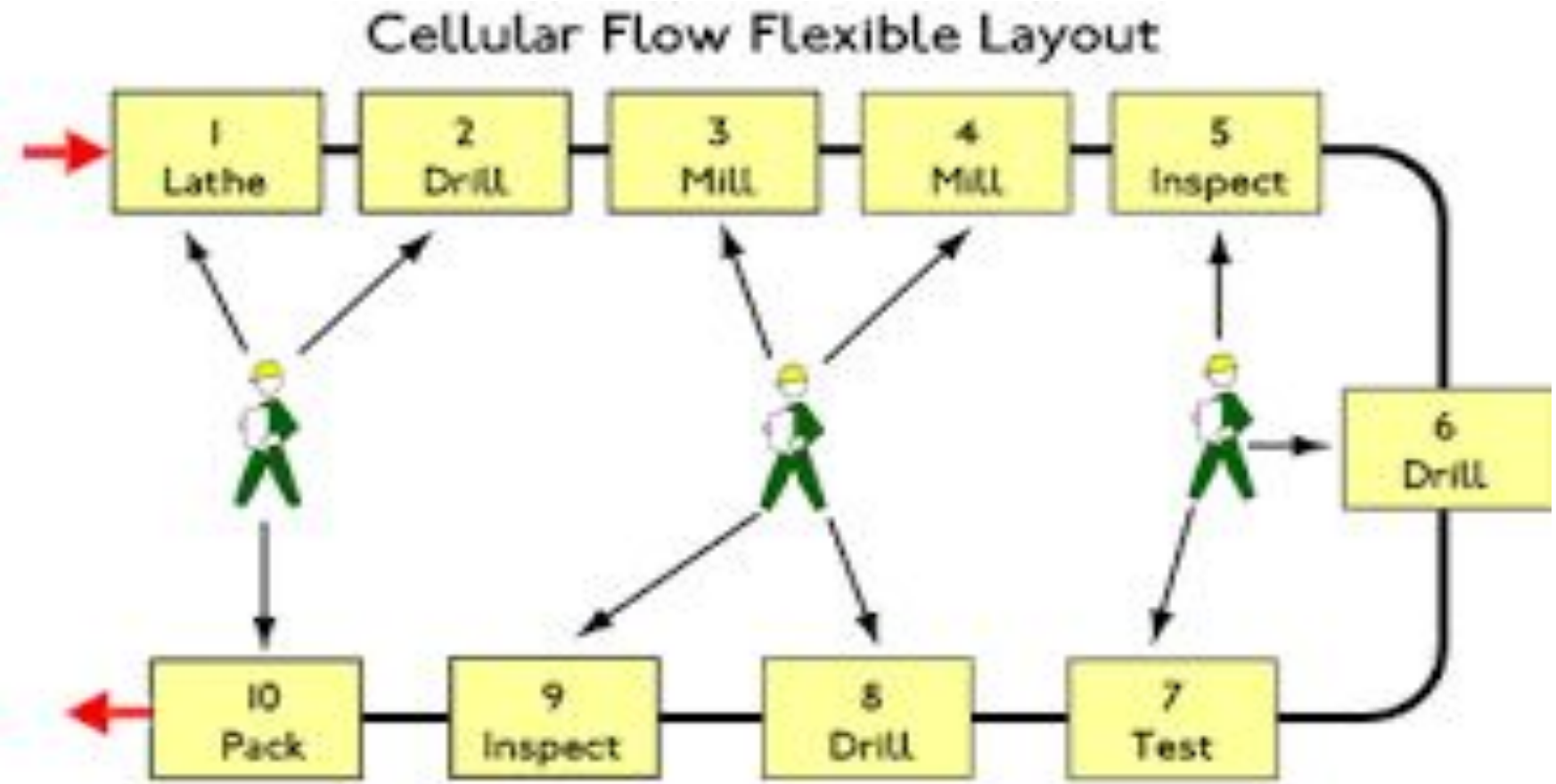
- **Advantages:**
  - Identical products made quickly
  - Reduction in costs
  - Interchangeable parts

7.C.10.4

Cellular manufacturing

- Cellular manufacturing is a process of manufacturing which is a subsection of just-in-time manufacturing and lean manufacturing encompassing group technology. The goal of cellular manufacturing is to move as quickly as possible, make a wide variety of similar products, while making as little waste as possible

Cellular manufacturing



Production planning and scheduling

- Planning and scheduling is about finding the answers to 10 questions:
- **What**, **how many** and **where**…
- would you like to **sell**, **make** and **buy**?
- If you distribute products across multiple depots,

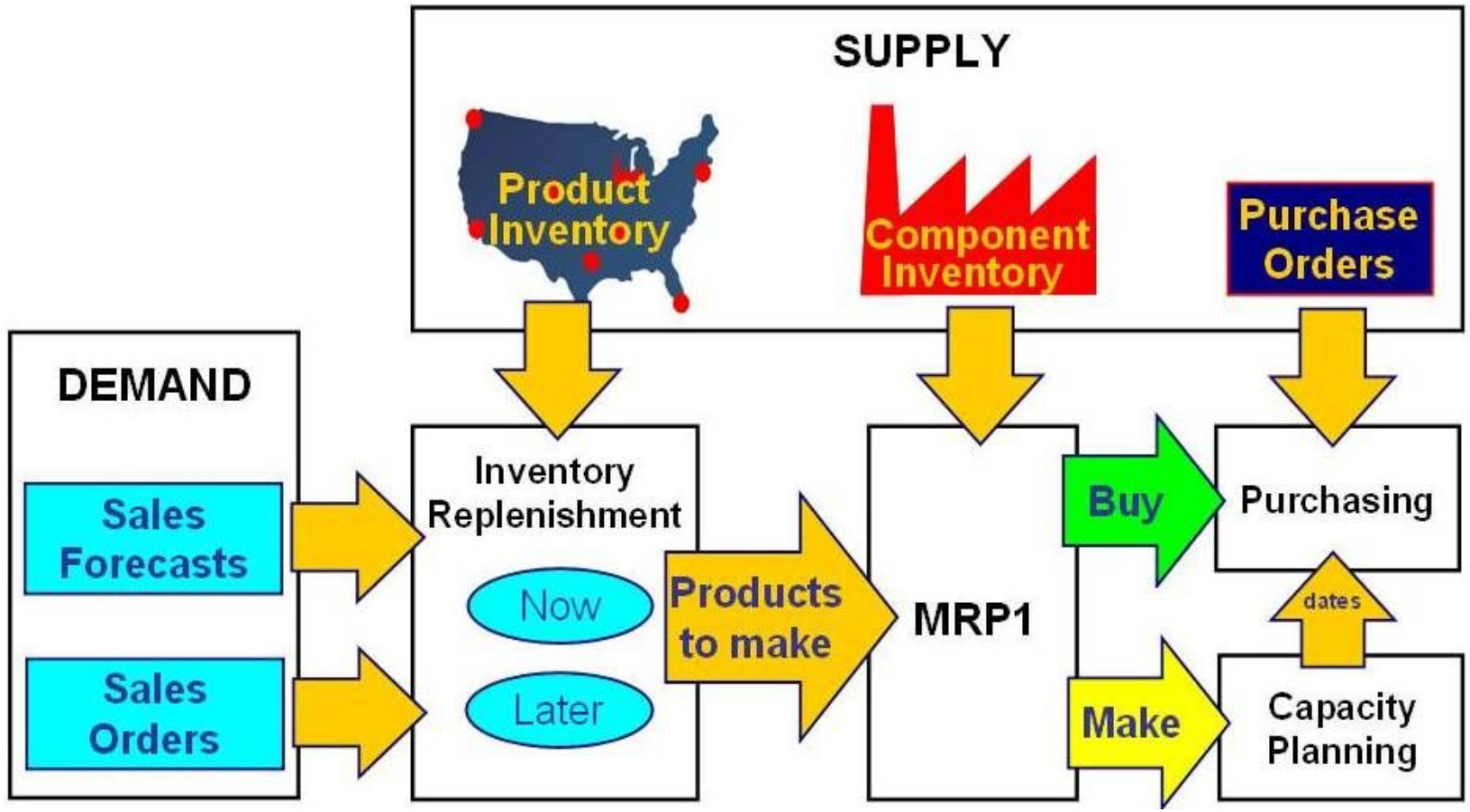
there is a 10th question
– **where** to send product to?

	What	How many	When	Where
Buy	?	?	?	
Make	?	?	?	
Send	?	?	?	?

Production Scheduling

- Scheduling is the process of arranging, controlling and optimizing work and workloads in a production process or manufacturing process.
- Scheduling is used to allocate plant and machinery resources, plan human resources, plan production processes and purchase materials.

Production Scheduling



Planning Data Flow

- **Planning Data Flow**
- The physical movement of material through a factory is buy, make, sell. With production planning, you work in the opposite direction to the material flow. First you plan what you are going to sell, then what you are going to make, and that determines what you are going to buy. All the time you consider the inventory buffers that you want to keep in between.

Integrated Planning

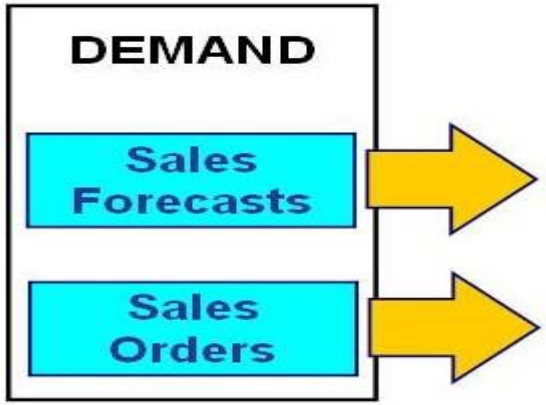
- **Integrated Planning**
- Integrated planning involves the balancing of supply and demand to answer the 10 questions. If you are just a buy/sell company, it is quite simple, but for a manufacturer, it is more complex.

Demand Management

- **Make-to-Order** companies typically do not use sales forecast for production.
- **Make-to-Stock** companies do not use sales orders to raise work orders.
- **Configure-to-Order** companies will forecast sales of the “base” product
- **Outstanding Sales Orders** – are maintained in your ERP system.

sales Forecasts

- **sales Forecasts** – are often maintained outside the Enterprise Resource Planning software system. Companies with established products, use sales history as the basis for the forecast. **Forecast Accuracy** – forecasts can never be 100% accurate,, but better accuracy, or “demand predictability”, improves your ability to deliver high service levels with low inventory.

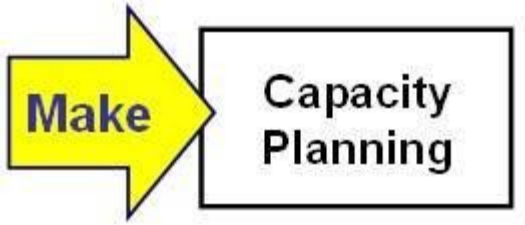


Inventory Replenishment

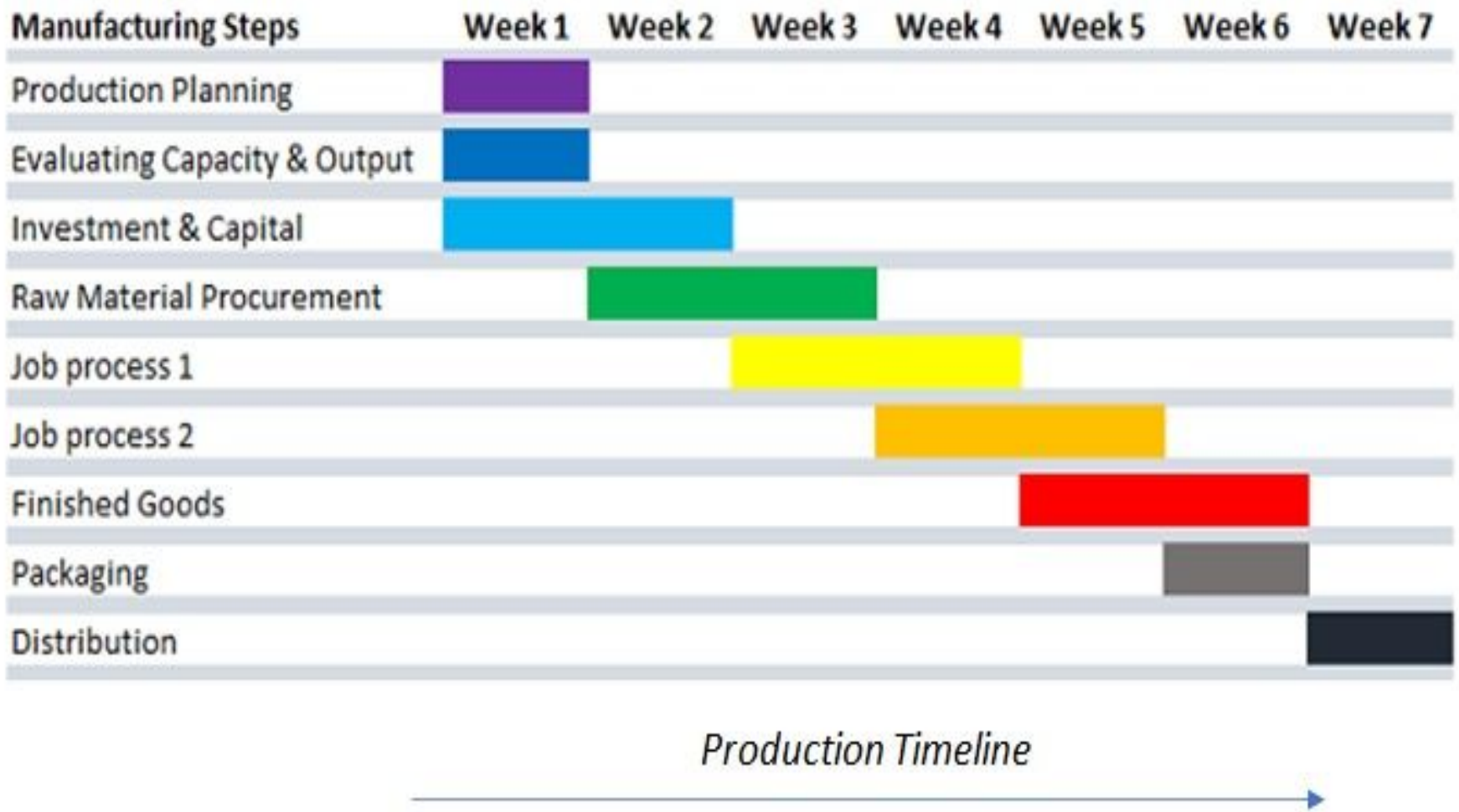
- **Inventory Replenishment**
- Inventory holding policy is expressed in days or weeks of cover. The policy is influenced by:
- Demand predictability
- How quickly manufacturing can respond
- Supply lead time
- Supplier reliability

Rough-Cut Capacity Plan

- A **Rough-Cut Capacity Plan** – assesses whether there is approximately enough capacity to manufacture what is needed, and gives an indication of how lumpy the demand on manufacturing is.
- The list of components to make, is combined with the Routings to calculate *the number of hours required at each work centre. This is then compared with the hours available*. In this example, if we did some of November's work in October, we should be able to make everything that we need.



Production Scheduling




SUCCESS
SWOT
TRAINING
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MANAGEMENT
BUSINESS PLAN
LEADER
ACTION
MISSION
TEAM
TIMELINE
ANALYSIS
MARKET
SEARCH

Module 3 Technical Profile

- Type of raw material to be used
- Demand and supply position of raw material
- Availability of substitutes of raw material
- Details about production process and production methods
- Technical details about production technology and availability of substitutes
- Costs involved in operation and maintenance of technology.

What are the factors that affect demand?

- Product price
- Buyer income
- Buyer preference
- Buyer expectation
- Available substitutes
- Complementary products
- Market size

Product price

- As the price of a commodity increases, the consumer demand for it decreases. People will buy fewer items of the pricier commodity and look around to find other less expensive options.

Buyer income

- The buyer's income will determine their purchasing capacity and the demand for a product. An increase in income will lead to a higher purchasing capacity and a rise in demand, while a decrease in income will lower purchasing capacity and demand. There is also a correlation between income and quality of commodities.

Buyer preference

- Changes in trends affect buyers' preferences for a product, as do changes in societal customs and habits. Popular products will experience rising demand, but that can change swiftly when trends change.

Buyer expectation

- The demand for a product can rise if buyers think it is going to be scarce, unavailable or more expensive in the near future. Going by their expectations, they will buy and stock more of it in the present time, so there is a definite connection between current demand and future pricing.

Available substitutes

- If a particular commodity becomes pricier, the demand for substitute commodities will increase. For instance, if you have always bought a specific type of cereal and its price increases to the point it becomes unaffordable, you may begin buying a similar, less expensive type of cereal. As a result, the demand for the less expensive and available cereal will increase.

What is supply?

- Supply is the relationship between the prices of products and services and their availability in the market. If the prices go up and stay high, the sellers will supply the product in larger quantities to make a profit. Supply depends on demand and price changes and quickly adjusts to these. The changes in demand and price may be seasonal, temporary or permanent, and the seller must adjust their supply accordingly.

What are the factors that affect supply?

- Production capacity
- Production costs
- Competitors
- Availability of materials
- Supply chains

Production capacity

- Production capacity is the product output compared to resource input. If there is a rise in market demand, the manufacturer will increase the output to provide more supplies.

Production costs

- Production costs are manufacturing expenses like materials, employee wages and utilities like electricity and water. If the production costs are high, the product market prices will increase. If the market can sustain high prices, the supply will increase. If it can't, there will be a decrease in supply.

Competitors

- Competitors are any companies that produce the same product or service in a similar price range. Competitors could make it difficult for a company to continue producing a supply of products at a reasonable price if consumers choose alternatives. They may reduce production or diversify to other goods to get a better market outcome.

Availability of materials

- The availability of inexpensive raw materials can help increase production and the supply of products. If the raw materials are not easily available or are too expensive, the production will decrease and result in a lower supply to the market.

Supply chains

- The producer should have a well-managed, affordable and reliable supply chain in place at every stage of the production process, from procuring raw materials to producing the product to moving them in the market-bound phase. That will ensure an efficient market supply to meet consumer demand.

Availability of substitutes of raw material- Material Substitution

- Materials that are developed or promoted to substitute another due to e.g. functional, environmental, ethical, legal, economic or cultural concerns and the possible changed practices due to material substitution.
- A common material substitute is that of vegan alternatives to animal-based products such as meat and leather.
- Material substitution is a result of an ever-changing dynamic society.
- Here the availability of different material substitutes can both challenge and stabilise markets.

Challenges

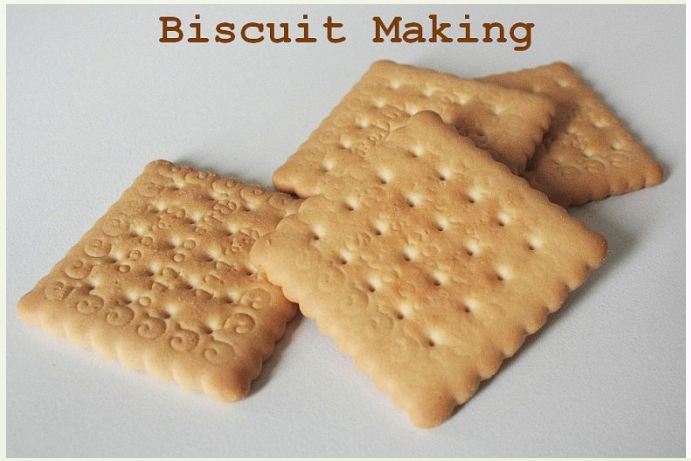
- A material's technical, functional and emotional aspects can be compromised.
- Material substitutes can be more expensive and difficult to get hold of.
- Lack of transparency/information may contribute to 'green washing'.
- It is necessary to have a holistic approach to material substitution as other aspects may become problematic.

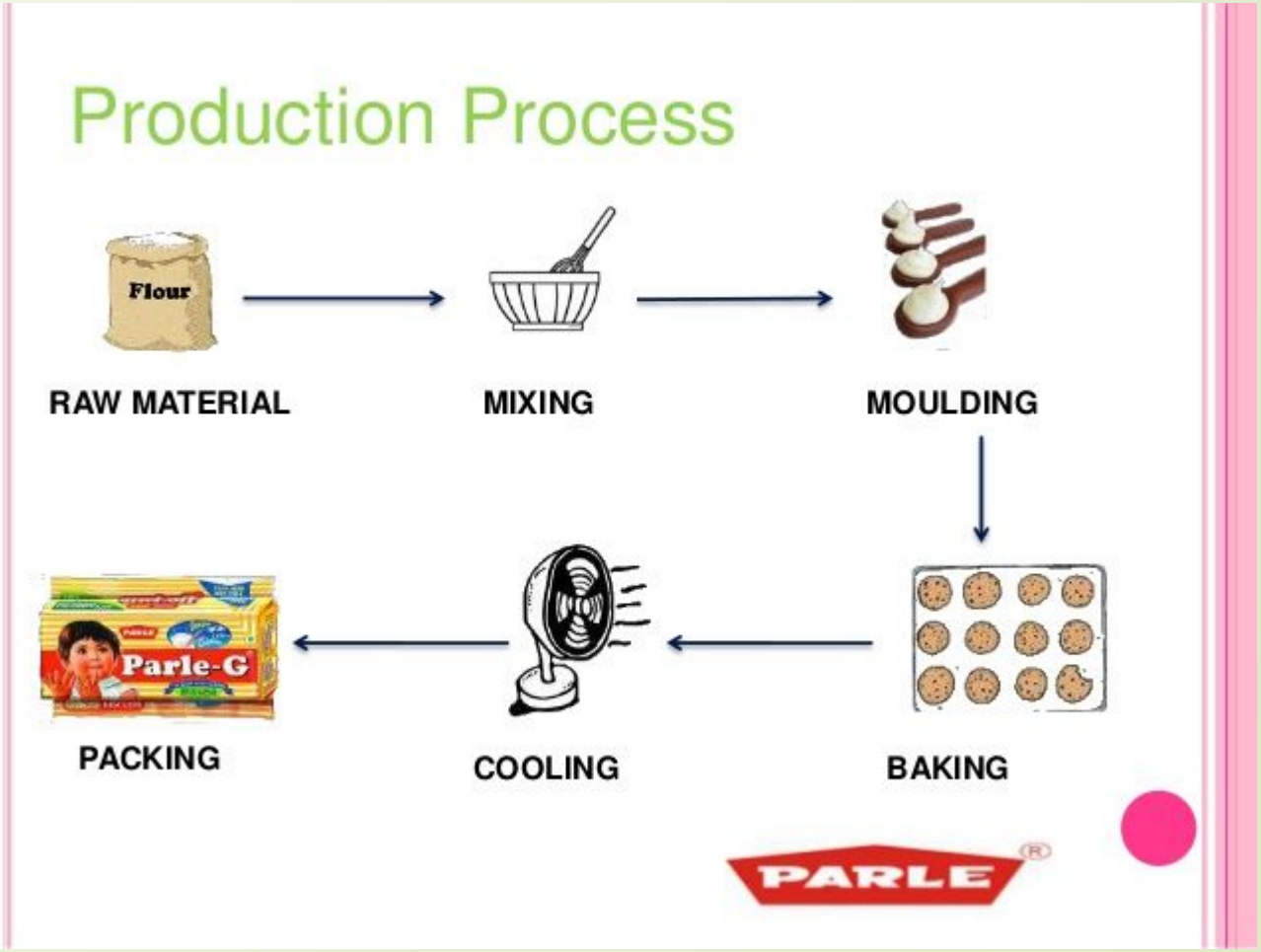
production process

- The production process is defined as the process in which the factors of production, i.e. inputs of resources, are turned into beneficial outputs.
- **Factors of production** means capital, labour, technology, land, and other resources that are used to create output, or goods and services.

The factors of production are explained in detail below:

- Capital
- Labour
- Technology
- Land





Capital

- Capital includes the amount invested in the process of production. Investment can be in terms of monetary investments or assets like machines, vehicles, etc.

Labour

- Labour refers to the people involved and the time and efforts that were put into the process.

Technology

- The technology that is used, whether the kind of machinery, the programming of machinery, the capacity of machinery, etc.

Land

- Natural resources such as land, energy, etc. that are used in the process of production are counted under the category ‘land’.

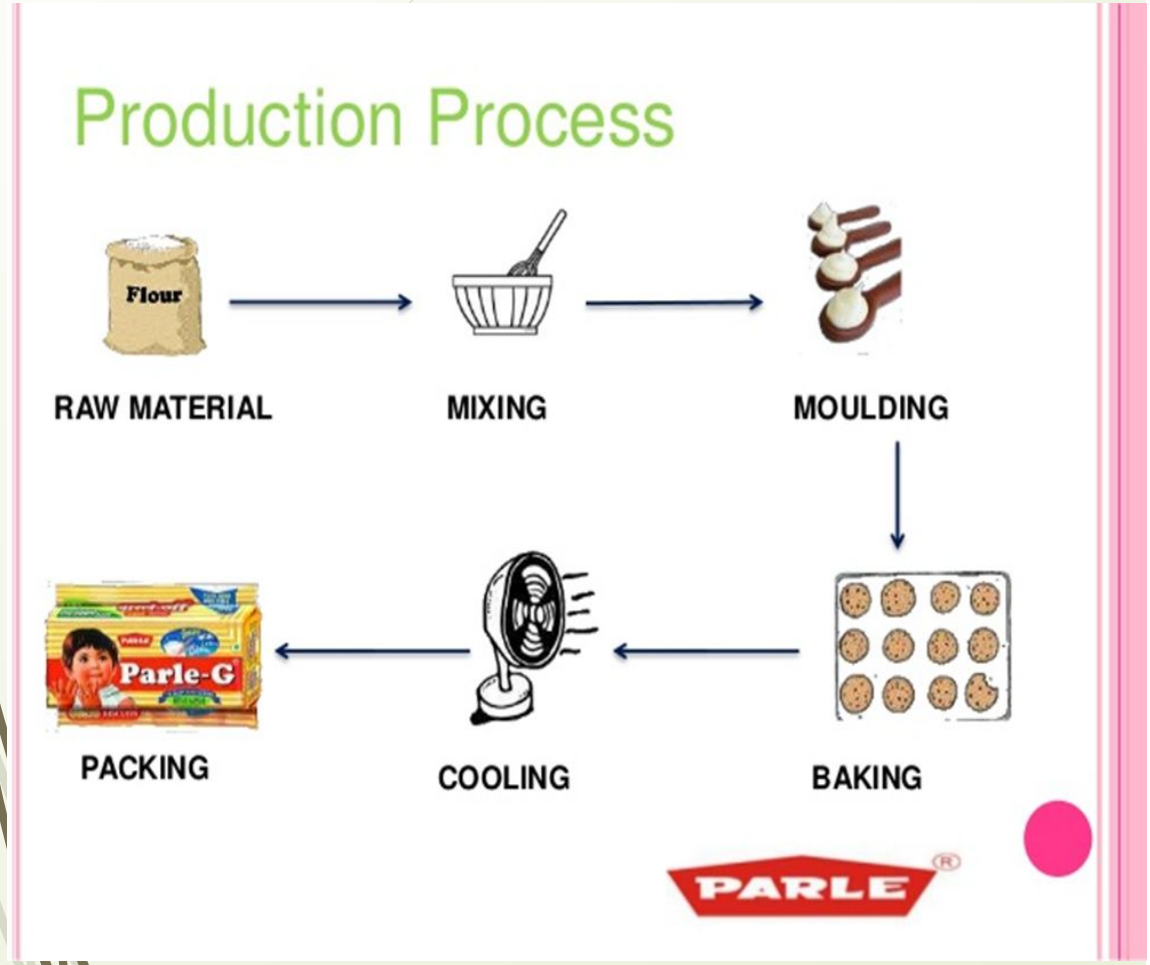
Examples of the production process

- Let's explore the production process with the example of biscuit production. To set up this production process, the company requires a **place or land** to set up the whole production unit.
- Secondly, in the production of biscuits, the organization will need the machines to mix all the necessary ingredients. It will also need an oven to bake the biscuits. In addition, it will need machinery for making the biscuits' packaging and labelling, which will all become **capital investment** for the company.
- The company will also need **labour** to mix all the ingredients together, separate them into batches of production and different flavours, set the output levels of the machines and temperature of the ovens, decide on the labeling function, and oversee the overall production system.

Examples of the production process

- Another important function and need of the production process is **technology** to ensure the labels are correct, the names of the product are rightly mentioned, the temperature is set correctly, and all other necessary technical aspects that do not require human intervention.
- If all of the above factors of production are in place, the production process of biscuits runs smoothly and can match the requirement of the business and customers.

Production process flow chart



Production process flow chart

- Planning: usually the basic requirement of all production processes. This stage helps to define the purpose and how the goals of production can be achieved properly.
- Routing: This is the next stage in the production process where the raw materials may be procured, processed, finished, quality checked, and distributed. Decisions are made regarding the quantity and quality of goods and services as well as on the place of production. This is a crucial stage in the production process.
- Scheduling: Scheduling means deciding the timings of the production process. For example, how much time should each stage of production involve? How long should each person work on a particular workflow?
- Dispatching: This stage is the actual start of the production. It may involve the provision of necessary items, the maintenance of records, the monitoring of workflows as planned, the recording of the number of times a machine works, machine idling time, etc.
- Follow-up: Follow-up is the last stage of the production process. Follow-up measures the actual versus the expected productions. Follow-up helps to detect the problems and remove them to help with the smooth functioning of the process.

Mass-customised Production

Mass-customised Production

- Mass-customised production is similar to craft production. However, the customised selection is produced in mass quantity. The customisation may be on the basis of shape, colour, pattern, product material, etc.
- For example, Coca-Cola may have custom 500ml bottles in glass produced in larger quantities according to need. Generally, production processes may share similar factors of production with land, labor, capital, and technology. The process may change relative to demand. The stages of production remain more or less the same from planning to routing, scheduling to dispatching, and finally, follow-up. The types of production, however, may change as per demand for the product and/or the requirements of the organization, in terms of sizes, colour, customisation, etc.

Availability of Substitutes

Availability of Substitutes

Availability of Substitutes

- The price elasticity of demand for a good or service will be greater in absolute value if many close substitutes are available for it.
- If there are lots of substitutes for a particular good or service, then it is easy for consumers to switch to those substitutes when there is a price increase for that good or service
- Substitute products offer consumers choices when making purchase decisions by providing equally good alternatives, thus increasing utility. However, from a company's perspective, substitute products create a rivalry.

Impact of Substitute Products

- A product with several substitutes is hard to price
- Customers are given a wide variety of products to choose from
- High competition
- Low-quality products

A product with several substitutes is hard to price

- Since every producer of the substitute product is trying to sell more, the only things they can rely on are branding and pricing.
- Thus, the prices of products with many substitutes are highly volatile.
- In a market where there are fewer substitute products, there is a higher probability of earning greater profits.

Customers are given a wide variety of products to choose from

- The availability of more products can lead to a higher utility. No one single product can satisfy all consumers of a particular type.
- Therefore, the greater the number of substitutes, the higher the probability of every consumer getting what is right for them.

High competition

- The greater the number of substitute products in the market, the more rivalry exists in the industry.

Low-quality products

- In a bid to be the lowest seller in the market, companies try to use the least amount of resources in their manufacturing process to reduce costs.
- However, this works against the welfare of the consumer, as it sometimes leads to the production of low-quality products.

Factors that Increase the Risk of Substitute Products

- Low switching cost
- Price of the product
- Quality of the products
- Product performance
- Availability of the substitute product

Low switching cost

- Switching cost is the loss or the extra cost you incur from leaving the option you were using for another. For example, if you have been taking notes with a pen but now you want to take them using a video recording device, the switching cost here is high since you will have to buy the video recording device. As a result, you are likely to stick with a notebook and a pen. On the same note, you can switch from one pen to the other easily since the switching costs are low.

Price of the product

- If a product is priced comparatively, for example in the case of writing pens, there is a higher risk of consumers switching from using one pen to the other unless they are loyal to the particular brand they have been using.

Quality of the products

- If substitute products are highly differentiated and are of high quality, a consumer is likely to switch to a product that offers better quality. For example, users of aesthetic products like skin lightening creams are very sensitive to quality. They will discontinue using a product once they realize there is a higher quality substitute in the market.

Product performance

- If two substitute products perform differently when subjected to various conditions, the customer will choose the option that is most beneficial for the particular prevailing condition. For example, in the transport sector, while traveling for shorter distances, most people prefer small vehicles.
- On the other hand, while traveling for long distances, commuters may prefer big buses and trains. Many factors may contribute to the preference, but it is mostly due to comfort.

Availability of the substitute product

- If substitute products are readily available in all corners of the market, there is a likelihood of consumers switching more often.

Operating Costs

- Operating costs are associated with the maintenance and administration of a business on a day-to-day basis.
- Operating costs include direct costs of goods sold (COGS) and other operating expenses—often called selling, general, and administrative (SG&A)—which include rent, payroll, and other overhead costs, as well as raw materials and maintenance expenses.
- Operating costs exclude non-operating expenses related to financing, such as interest, investments, or foreign currency translation.

How to Calculate Operating Costs

- Operating cost=Cost of goods sold+Operating expenses
- From a company's income statement, take the total cost of goods sold, or COGS, which can also be called cost of sales.
- Find total operating expenses, which should be further down the income statement.
- Add total operating expenses and COGS to arrive at the total operating costs for the period.

Types of Operating Costs

While operating costs generally do not include capital outlays, they can include many components of operating expenses, such as:

- Accounting and legal fees
- Bank charges
- Sales and marketing costs
- Travel expenses
- Entertainment costs
- Non-capitalized research and development expenses
- Office supply costs
- Rent
- Repair and maintenance costs
- Utility expenses
- Salary and wage expenses

Types of Operating Costs

Operating costs will also include the cost of goods sold, which are the expenses directly tied to the production of goods and services. Some of the costs include:

- Direct material costs
- Direct labor
- Rent of the plant or production facility
- Benefits and wages for the production workers
- Repair costs of equipment
- Utility costs and taxes of the production facilities

Fixed Costs

- A fixed cost is one that does not change with an increase or decrease in sales or productivity and must be paid regardless of the company's activity or performance. For example, a manufacturing company must pay rent for factory space, regardless of how much it is producing or earning. While it can downsize and reduce the cost of its rent payments, it cannot eliminate these costs, and so they are considered to be fixed. Fixed costs generally include overhead costs, insurance, security, and equipment.
- Fixed costs can help in achieving economies of scale, as when many of a company's costs are fixed, the company can make more profit per unit as it produces more units. In this system, fixed costs are spread out over the number of units produced, making production more efficient as production increases by reducing the average per-unit cost of production. Economies of scale can allow large companies to sell the same goods as smaller companies for lower prices.
- The economies of scale principle can be limited in that fixed costs generally need to increase with certain benchmarks in production growth. For example, a manufacturing company that increases its rate of production over a specified period will eventually reach a point where it needs to increase the size of its factory space in order to accommodate the increased production of its products.

Variable Costs

- Variable costs, like the name implies, are comprised of costs that vary with production. Unlike fixed costs, variable costs increase as production increases and decrease as production decreases. Examples of variable costs include raw material costs and the cost of electricity. In order for a fast-food restaurant chain that sells french fries to increase its fry sales, for instance, it will need to increase its purchase orders of potatoes from its supplier.
- It's sometimes possible for a company to achieve a volume discount or "price break" when purchasing supplies in bulk, wherein the seller agrees to slightly reduce the per-unit cost in exchange for the buyer's agreement to regularly buy the supplies in large amounts. As a result, the agreement might diminish the correlation somewhat between an increase or decrease in production and an increase or decrease in the company's operating costs.
- For example, the fast-food company may buy its potatoes at $0.50 per pound when it buys potatoes in amounts of less than 200 pounds. However, the potato supplier may offer the restaurant chain a price of $0.45 per pound when it buys potatoes in bulk amounts of 200 to 500 pounds. Volume discounts generally have a small impact on the correlation between production and variable costs, and the trend otherwise remains the same.

maintenance of technology

- The term "maintenance" refers to those **preventive, diagnostic, updating, replacement, and repair procedures that an organization undertakes to keep its technology working effectively and efficiently**.

maintenance of technology - Types

- Corrective maintenance.
- Preventive maintenance.
- Risk-based maintenance.
- Condition-based maintenance.

Corrective maintenance

- Maintenance is carried out following detection of an anomaly and aimed at restoring normal operating conditions. This approach is based on the firm belief that the costs sustained for downtime and repair in case of fault are lower than the investment required for a maintenance program. This strategy may be cost-effective until catastrophic faults occur.

Preventive maintenance

- Maintenance carried out **at predetermined intervals** or according to **prescribed criteria**, aimed at **reducing the failure risk or performance degradation** of the equipment.
- The maintenance cycles are planned according to the need to take the device out of service. The incidence of operating faults is reduced.

Risk-based maintenance

- Maintenance carried out by integrating analysis, measurement and periodic test activities to standard preventive maintenance.
- The gathered information is viewed in the context of the environmental, operation and process condition of the equipment in the system. The aim is to perform the asset condition and risk assessment and define the appropriate maintenance program.
- All equipment displaying abnormal values is refurbished or replaced. In this way it is possible to extend the useful life and guarantee over time high levels of reliability, safety and efficiency of the plant.

Condition-based maintenance

- Maintenance based on the equipment **performance monitoring** and the **control of the corrective actions** taken as a result.
- The real actual equipment condition is continuously assessed by the on-line detection of significant working device parameters and their automatic comparison with average values and performance. Maintenance is carried out when certain indicators give the signaling that the equipment is deteriorating and the failure probability is increasing.
- This strategy, in the long term, allows reducing drastically the costs associated with maintenance, thereby minimizing the occurrence of serious faults and optimizing the available economic resources management.