

CO1- Introduction and Overview of Manufacturing
Sub: MT (3151912)

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Chapter 1

1- What is manufacturing?

“act of making something (a product) from raw materials”

Chapter 1- Part 1

What is Manufacturing?

The word **manufacture** is derived from two Latin words **manus** (hand) and **factus** (make); the combination means “**made by hand**”

- Most **modern manufacturing operations** are accomplished by **mechanized and automated equipment** that is supervised by human workers

Chapter 1- Part 1

Manufacturing is Important

- Technologically
- Economically

Chapter 1- Part 1

Manufacturing - Technologically Important

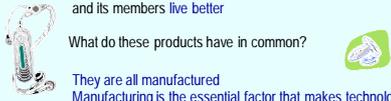
What is technology?

Technology - the **application of science** to provide society and its members with those things that **are needed** or desired

Technology provides the products that help our society and its members live better

What do these products have in common?

They are all **manufactured**
Manufacturing is the essential factor that makes technology possible



Chapter 1- Part 1

Manufacturing - Technologically

Application of physical and chemical processes to alter the geometry, properties, and/or appearance of a starting material **to make parts or products**

- Manufacturing also includes **assembly**
- Almost always carried out as a **sequence of operations**

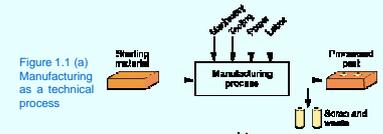


Figure 1.1 (a) Manufacturing as a technical process

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Manufacturing - Economically

Manufacturing **adds value** to the material by **changing its shape or properties**, or by combining it with other materials.

Figure 1.1 (b)
Manufacturing as an economic process

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Manufacturing Industries

Industry consists of enterprises and **organizations that produce or supply goods and services**

Industries can be classified as:

- Primary industries** - those that **cultivate and exploit natural resources**, e.g., farming, mining
- Secondary industries** - take the **outputs of primary industries and convert them into consumer and capital goods** - manufacturing is the principal activity, other examples: construction, and electric power generation
- Tertiary industries** - **service sector**, e.g. banking

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Engineers in Manufacturing

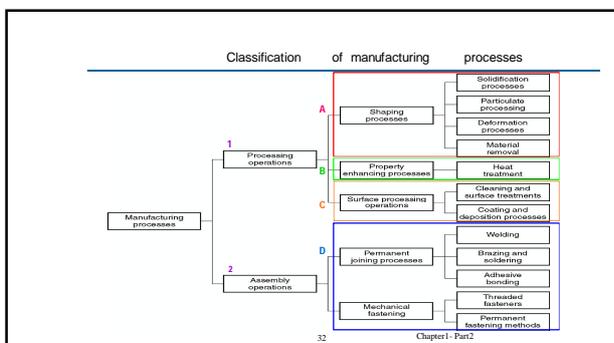
- Manufacturing Engineer**
Select and coordinate specific processes and equipment
- Industrial Engineer**
Responsible for the manufacturing system design
- Materials Engineer**
Develop and select materials based on desired material properties and manufacturing processes

Manufacturing Processes [Mfg process classification_SHOW.mp4](#)

Two basic types:

1. **Processing operations** - transform a work material from one state of completion to a more advanced state
Operations that change the geometry, properties, or appearance of the starting material
2. **Assembly operations** - join two or more components to create a new entity

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Processing Operations

Alters a material's shape, physical properties, or appearance in order add value to

- Three categories of processing operations:
 1. **Shaping operations** - alter the **geometry** of the starting work material
 2. **Property-enhancing operations** - improve **physical properties** without changing shape
 3. **Surface processing operations** - to **clean, treat, coat or deposit** material on exterior surface of the work

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A

Shaping Processes – Four Categories

1. **Solidification processes** - starting material is a **heated liquid or semifluid**
2. **Particulate processing** - starting material consists of **powders**
3. **Deformation processes** - starting material is a **ductile solid** (commonly metal)
4. **Material removal processes** - starting material is a **ductile or brittle solid**

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A

1- Solidification Processes

Starting material is heated sufficiently to transform it into a liquid or highly plastic state

- Examples: **metal casting**, **plastic molding**

Diagram (1) shows metal being poured from a ladle into a mold. Labels include: Pouring ladle, Molten metal, Parting line, Mold (sand), and Downspout. Diagram (2) shows the solidified part being removed from the mold. Labels include: Core and runner (to be trimmed) and Solid casting.

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A

2- Particulate Processing

Starting materials are powders of metals or ceramics

- Usually involves **pressing and sintering**, in which powders are first **compressed** and then **heated to bond** the individual particles

Steps: Pressing and sintering

Diagram (a) shows a pile of powder. Diagram (b) shows a powder being compressed between upper and lower punches in a die. Labels include: Upper punch, FMC, Lower punch, and Powder. Diagram (c) shows a sintered part. Labels include: Sintered part and Workpiece sintering in furnace. A text box explains: Sintering is a method for making objects from powders by heating the material (below its melting point) until its particles adhere to each other.

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A

3- Deformation Processes

Starting workpart is shaped by application of forces that exceed the yield strength of the material

- Examples: (a) **forging**, (b) **extrusion**

Diagram (a) shows forging. Labels include: Forging, Die, Flash (to be trimmed), and Anvil. Diagram (b) shows extrusion. Labels include: Extrusion die, Extruded shape workpart, Die, and Exit. A text box notes: A press machine performs extrusion.

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A

4- Material Removal Processes

Excess material removed from the starting piece so what remains is the desired geometry

- Examples: machining such as **turning, drilling, and milling**; also **grinding** and nontraditional processes

Diagram (a) shows turning. Labels include: Workpiece, Spinning wheel, Abrasive, Chuck, and Workpiece. Diagram (b) shows drilling. Labels include: Drill bit, Workpiece, Hole, and Chip. Diagram (c) shows milling. Labels include: Milling cutter, Workpiece, Chip, and Material removed.

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Property-Enhancing Processes

Performed to improve mechanical or physical properties of work material

- Part shape is not altered, except unintentionally

- Examples:
 - Heat treatment of metals and glasses
 - Sintering of powdered metals and ceramics

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Surface Processing Operations

- **Cleaning** - chemical and mechanical processes to remove dirt, oil, and other contaminants from the surface
- **Surface treatments** - mechanical working such as sand blasting, and physical processes like diffusion
- **Coating and thin film deposition** exterior - coating surface of the workpart



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D

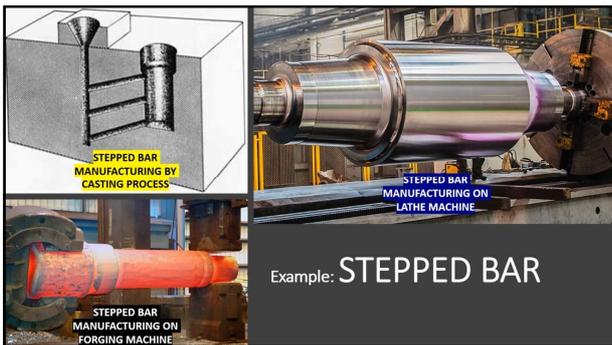
Assembly Operations

Two or more separate parts are joined to form a new entity

- Types of assembly operations:
 1. **Joining processes** – create a permanent joint
 - Welding, brazing, soldering, adhesive bonding and
 2. **Mechanical assembly** – fastening by mechanical methods
 - Threaded fasteners (screws, bolts and nuts); press fitting



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STEPS BAR MANUFACTURING BY CASTING PROCESS

STEPS BAR MANUFACTURING ON LATHE MACHINE

STEPS BAR MANUFACTURING ON FORGING MACHINE

Example: **STEPS BAR**

Basically, Selection criteria are classified into the two-separate part:



PRODUCT FEATURES



COST OR ECONOMICS

CRITERIA FOR SELECTION OF MANUFACTURING PROCESS

- Cost of manufacturing
- Quality and Quantity of the product
- Time required for processing
- Level of skilled labour required
- Process supervision
- Energy consumption
- Availability of material

CRITERIA FOR SELECTION OF MANUFACTURING PROCESS (CONTINUE.....)

- Capabilities required to processes material
- Product dimensions and size
- Surface finish required
- Design tolerances
- Waste produced by the process
- Maintenance costs
- Other costs

CRITERIA FOR SELECTION OF MANUFACTURING PROCESS (CONTINUE.....)

• **COST OF MANUFACTURING**

A central black bag with a white Indian Rupee symbol (₹) is surrounded by four blue ovals: 'MATERIAL' (top-left), 'TOOLING' (top-right), 'MACHINES' (bottom-left), and 'EQUIPMENTS' (bottom-right). Blue arrows point from the central bag to each of these four ovals.

CRITERIA FOR SELECTION OF MANUFACTURING PROCESS (CONTINUE.....)

• **QUALITY AND QUANTITY OF THE PRODUCT**

A wooden balance scale is shown with a stack of five grey stones on the right pan and a single grey stone on the left pan, illustrating the concept of quality and quantity.

CRITERIA FOR SELECTION OF MANUFACTURING PROCESS (CONTINUE.....)

• **TIME REQUIRED FOR PROCESSING**

A simple black and white illustration of a clock face with hands, representing the time required for processing.

CRITERIA FOR SELECTION OF MANUFACTURING PROCESS (CONTINUE.....)

• **LEVEL OF SKILLED LABOUR REQUIRED**

A hand is shown writing the word 'SKILL' in blue on a whiteboard. Surrounding the word are various terms: 'EXPERIENCE', 'ABILITY', 'GROWTH', 'ADVANCED TRAINING', 'KNOWLEDGE', 'LEARNING', 'COMPETENCE', and 'TRAINING', all connected by arrows to the central 'SKILL' word.

CRITERIA FOR SELECTION OF MANUFACTURING PROCESS (CONTINUE.....)

• **PROCESS SUPERVISION**

A cartoon character wearing a white shirt and tie is holding a large magnifying glass over a circular object, symbolizing supervision or inspection.

CRITERIA FOR SELECTION OF MANUFACTURING PROCESS (CONTINUE.....)

• **ENERGY CONSUMPTION**

A green industrial machine, possibly a lathe or mill, is shown, representing energy consumption in manufacturing.

CRITERIA FOR SELECTION OF MANUFACTURING PROCESS (CONTINUE.....)

- AVAILABILITY OF MATERIAL



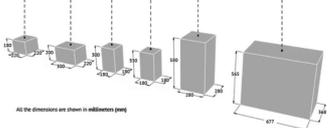
CRITERIA FOR SELECTION OF MANUFACTURING PROCESS (CONTINUE.....)

- CAPABILITIES REQUIRED TO PROCESSES MATERIAL



CRITERIA FOR SELECTION OF MANUFACTURING PROCESS (CONTINUE.....)

- PRODUCT DIMENSIONS AND SIZE



All the dimensions are shown in millimeters (mm)

CRITERIA FOR SELECTION OF MANUFACTURING PROCESS (CONTINUE.....)

- SURFACE FINISH REQUIRED

GRINDING	1.6	0.8	0.4	0.2	0.1	0.05
TURNING	12.5	6.3	3.2	1.6	0.8	0.4

CRITERIA FOR SELECTION OF MANUFACTURING PROCESS (CONTINUE.....)

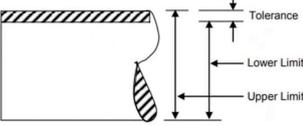
- SURFACE FINISH REQUIRED



STEP 1: Rough grinding
STEP 2: Sanitary finish
STEP 3: Fine finish
STEP 4: Mirror finish

CRITERIA FOR SELECTION OF MANUFACTURING PROCESS (CONTINUE.....)

- DESIGN TOLERANCES



CRITERIA FOR SELECTION OF MANUFACTURING PROCESS
(CONTINUE.....)

- **WASTE PRODUCED BY THE PROCESS**
 - Chip
 - Burr
 - Coolant
 - Grease
 - Flash

CRITERIA FOR SELECTION OF MANUFACTURING PROCESS
(CONTINUE.....)

- **MAINTENANCE COSTS**
 - Periodic machine maintenance

CRITERIA FOR SELECTION OF MANUFACTURING PROCESS
(CONTINUE.....)

- **OTHER COSTS**
 - Administration cost
 - Design documentation cost

Products and Manufacturing

Product Creation Cycle
Design → Material Selection → Process Selection → Manufacture → Inspection → Feedback

Typical product cost breakdown

Category	Percentage
Manufacturing cost	40%
Admin, sales, marketing	25%
Profit	20%
Engineering	15%

Manufacturing Process

A sequence of operations and processes designed to create a specific **product**

The process of turning materials into a product

Manufacturing System Designs

Job Shop

- Small quantities of products
- Large variety of products
- Products move through the shop to various machines
- General-purpose machines

Manufacturing System Designs

Flow Shop

- Larger quantities of products
- Production line
- Special purpose machines



Manufacturing System Designs

Linked-Cell Shop

- Manufacturing and subassembly cells connected to final assembly
- Lean production system
- One piece flow system



Manufacturing System Designs

Project Shop

- Product being manufactured **cannot** be easily moved during production
- Production processes are brought to the product

Examples: Bridges, ships, large airplanes, locomotives, large machinery



Manufacturing System Designs

Continuous Process

- Large plants
- Utilized in the manufacture of liquids, oils, gases, and powders



Creation of goods can be increased by utilizing

- Natural resources
- Man power
- Machine tools
- All of the above

The sectors where demand for miniaturization is high

- Chemical & Cement industries
- Food processing & leathers
- Electronics & Medical
- Textiles & Mining

Casting is found to be more suitable for the metals having

- a) Low melting point
- b) High melting point
- c) High viscosity
- d) High thermal conductivity

The correct option for deformation based approach of manufacturing is

- a) Cold deformation below the recrystallization temperature, hot deformation above the recrystallization temperature
- b) Cold deformation above the recrystallization temperature, hot deformation below the recrystallization temperature
- c) Cold and hot deformation both above the recrystallization temperature
- d) Cold and hot deformation both below the recrystallization temperature

CNC machines, robotics systems and AGVs are used for production using

- a) Agile manufacturing
- b) Lean manufacturing
- c) Flexible manufacturing
- d) Just in time manufacturing

The newer manufacturing process based on organizational aspects which deals with fast change in demand of market is

- a) Lean manufacturing
- b) Flexible manufacturing
- c) Just in time manufacturing
- d) Agile manufacturing