

Introduction to Manufacturing Technology



**Bachelor of Industrial Technology Management with Honours
Semester I Session 2013/2014**

TOPIC OUTLINE



- **What is manufacturing?**
- **Historical development of manufacturing technology**
- **Economic role of manufacturing**
- **Manufacturing as a technical activity**
- **Manufacturing organization and enterprise**
- **Standard measurement and measurement inspection**

LESSON OUTCOMES



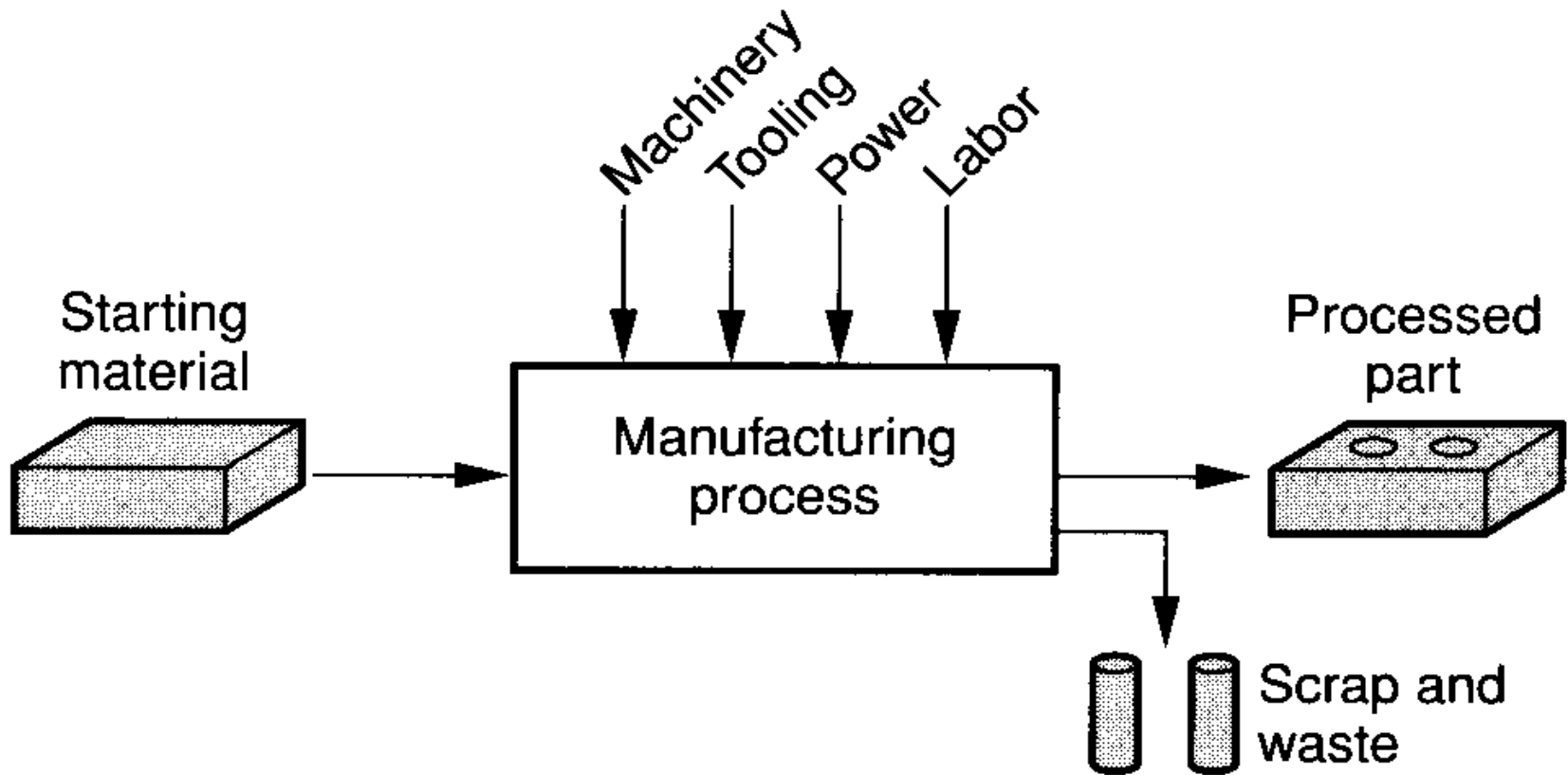
- 1. Able to describe what the manufacturing technology is and its role in a country economy**
- 2. Able to explain the interconnected activities involved in product realization**
- 3. Able to identify the use and method to take reading of basic measuring instruments**

What is manufacturing?



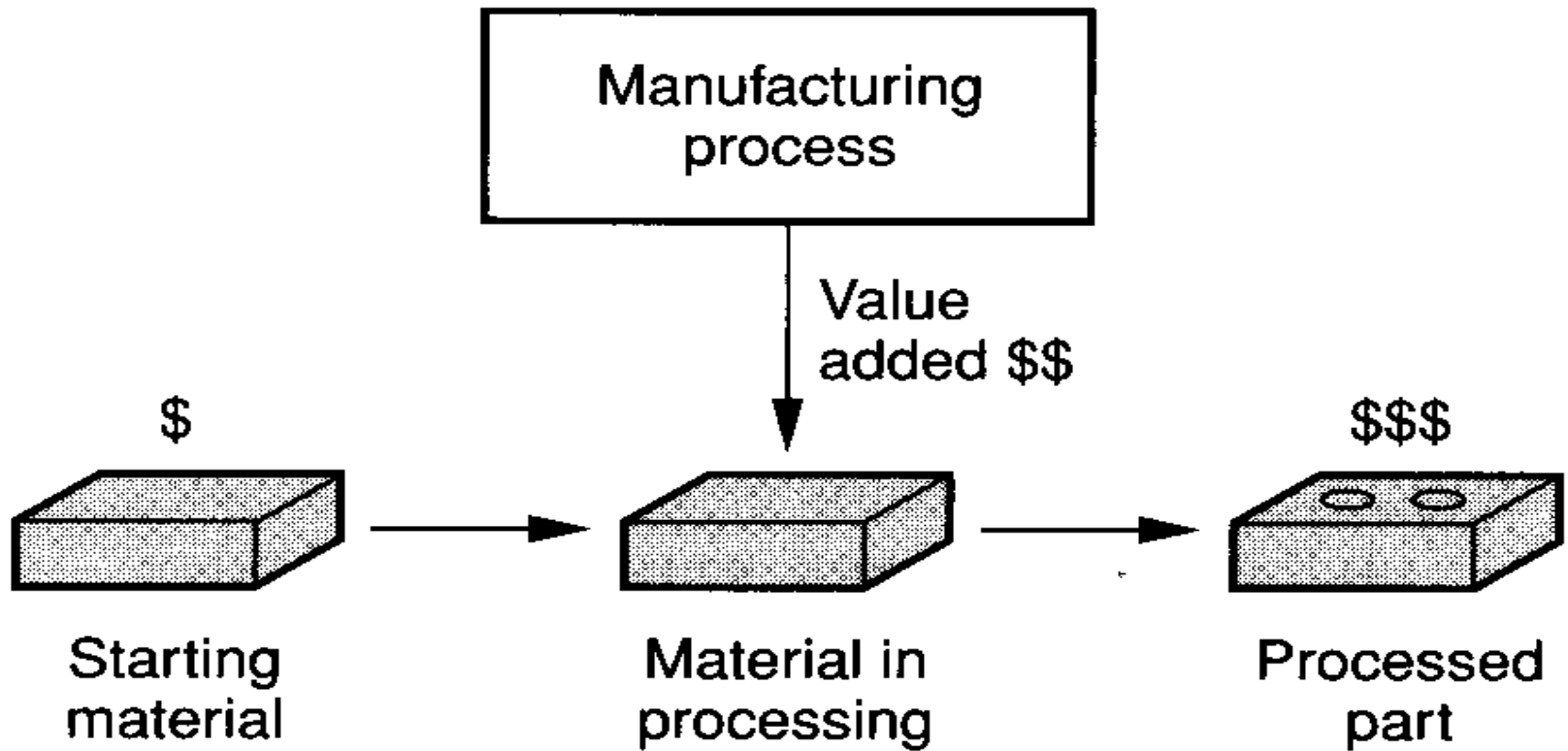
- Literal: Manufacture = Manus (**hand**) + Factus (**make**) → Made by hand
- Technological: Application of physical and chemical processes to make parts or products, including assembly of products.
- Economical: Transformation of materials into items of **greater value** by means of processing and/or assembly operations.
- CIRP definition: Design + production + assembly
(CIRP = International Academy for Production Eng.)

What is manufacturing?



Representation of 'manufacturing' in a technological way

What is manufacturing?



Representation of 'manufacturing' in a economical way

Importance of Manufacturing



- Manufacturing is an important mean to create material wealth!!!
- One job in a manufacturing plant generates about four other jobs else!!! Question: How?
- Data from the USA:
 - Manufacturing : ~ 20% of the GNP
 - Agriculture, mining : < 5% of the GNP
 - Construction, public utilities : ~ 5% of the GNP
 - Service sector : ~ 70% of the GNP

(GNP = Gross National Product)

Question: What are the figures for MALAYSIA?

Historical Perspective (1)



In broad outlines:

- Man's discovery and invention of materials and processes to make things, **since 6000 years ago**
- Principle of division of labour → Adam Smith (**~1750**)
Industrial Revolution (**1770 – 1850**), **steam engine, machine tools, machinery for textile industry**
Factory system, UK
- American system, interchangeable parts → Whitney (**~1800**), **guns (muskets)**, USA
- Second Industrial revolution → mass production, scientific management, assembly lines, Ford (**~1915**), **cars**, USA

Historical Perspective (2)



Manufacturing materials and processes:

- Neolithic period (~8000 - 3000 B.C.) in Mesopotamia Mediterranean, Asia; hammering, gold
- Bronze age (3500 - 1500 B.C.), extracting copper from ores, casting, hammering.
- Iron age (since 1000 B.C.), heating, quenching
- Industrial Revolution (1770 - 1850), machining like boring, turning, drilling, milling, shaping.
- Assembly methods (since ancient cultures), ships, weapons, tools, farming equipment
Fusion welding (around 1900)
- Rubber and polymer shaping, vulcanization (1939)

Industries and Products



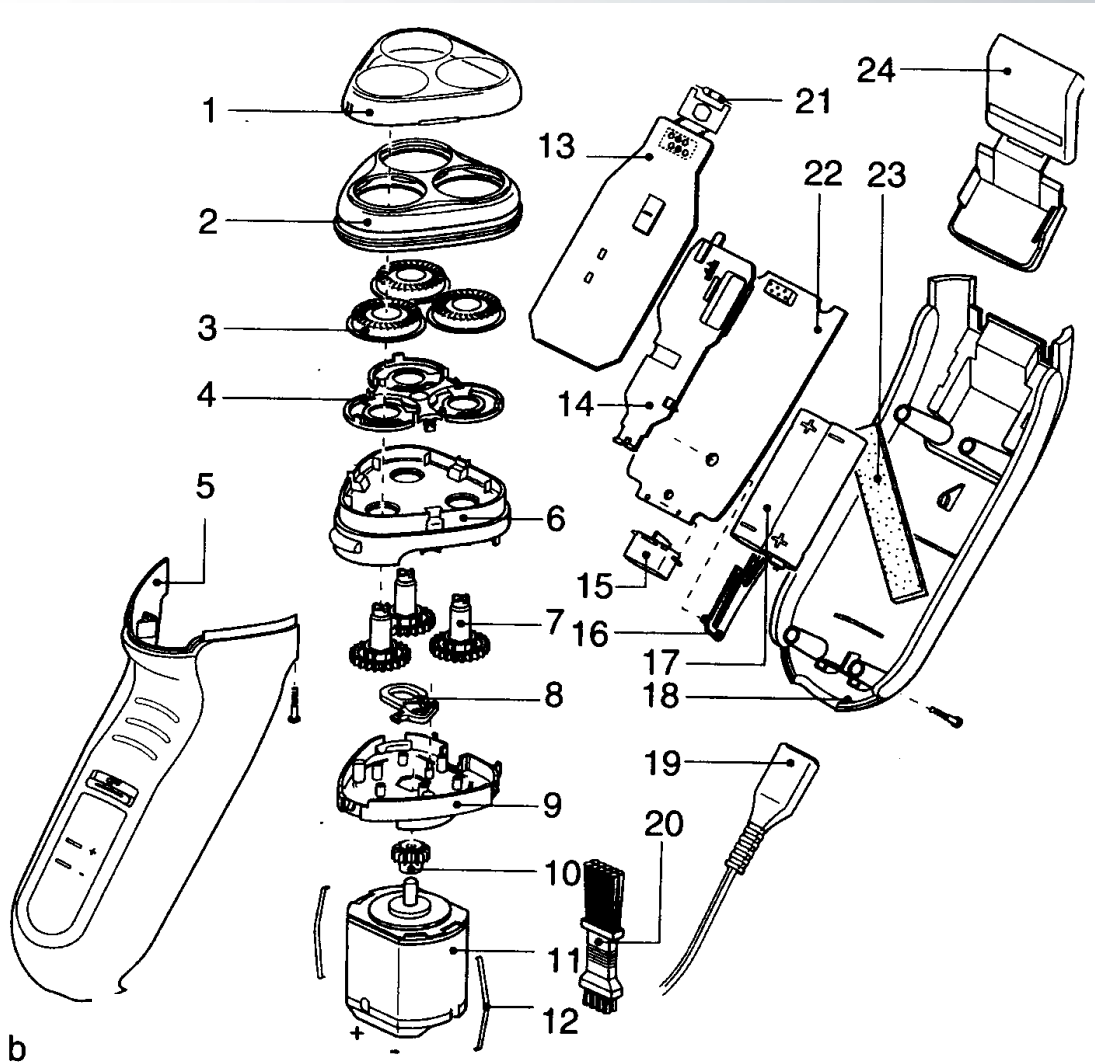
Manufacturing industries

- Primary industries: natural resources as mining, fishing, agriculture, petroleum
- Secondary industries: automotive, computers, electronics
- Tertiary industries (service): banking, tourism, education

Manufactured products

- Consumer goods: cars, TV's, tires, tennis rackets
- Capital goods: aircraft, machine tools, machinery
- Discrete products: pumps, shavers, coffee makers
- Continuous produced products: sheet-metal coils

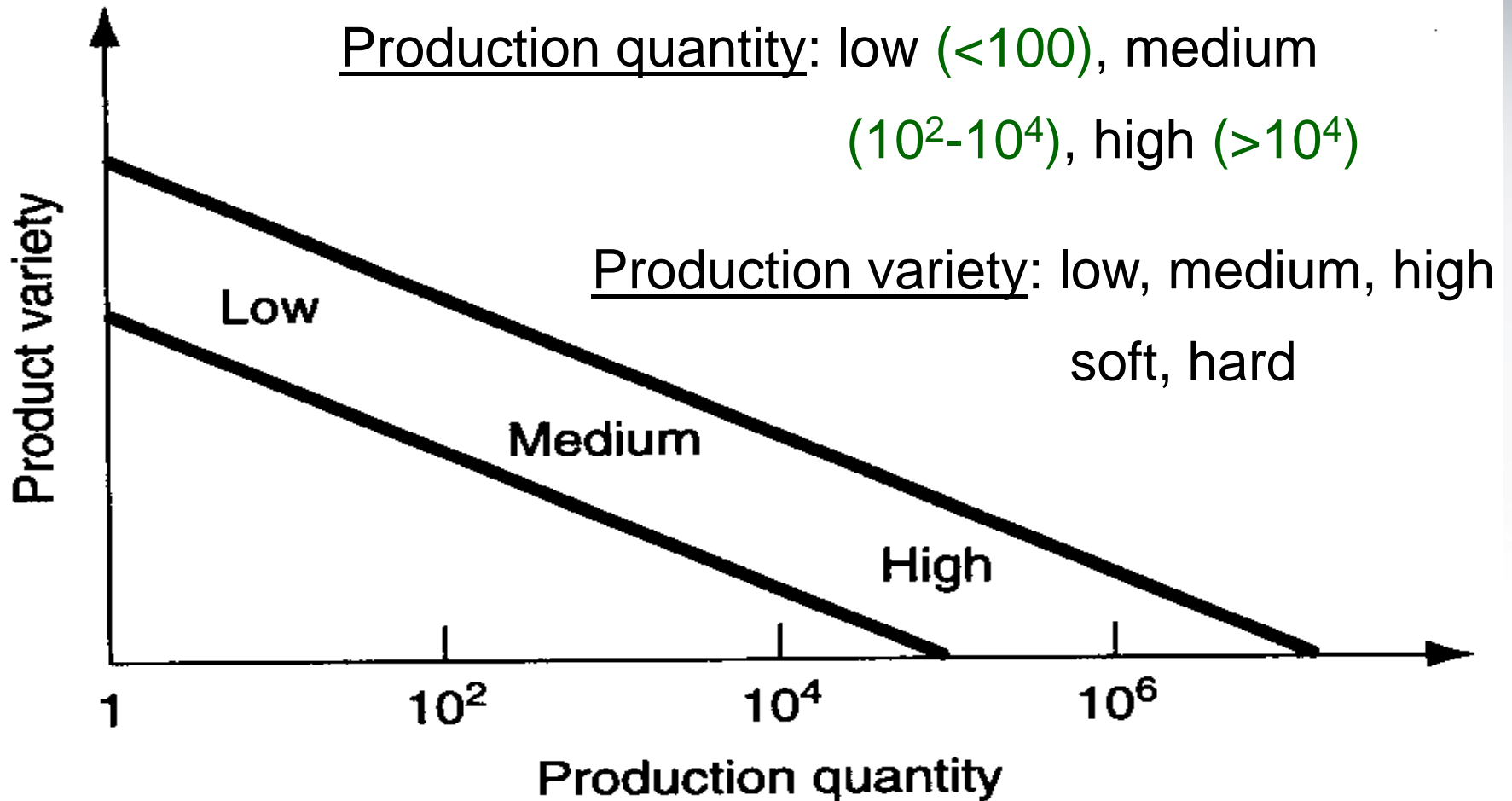
Product Example



Electric shaver

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Production Quantity & Variety



Manufacturing Capability



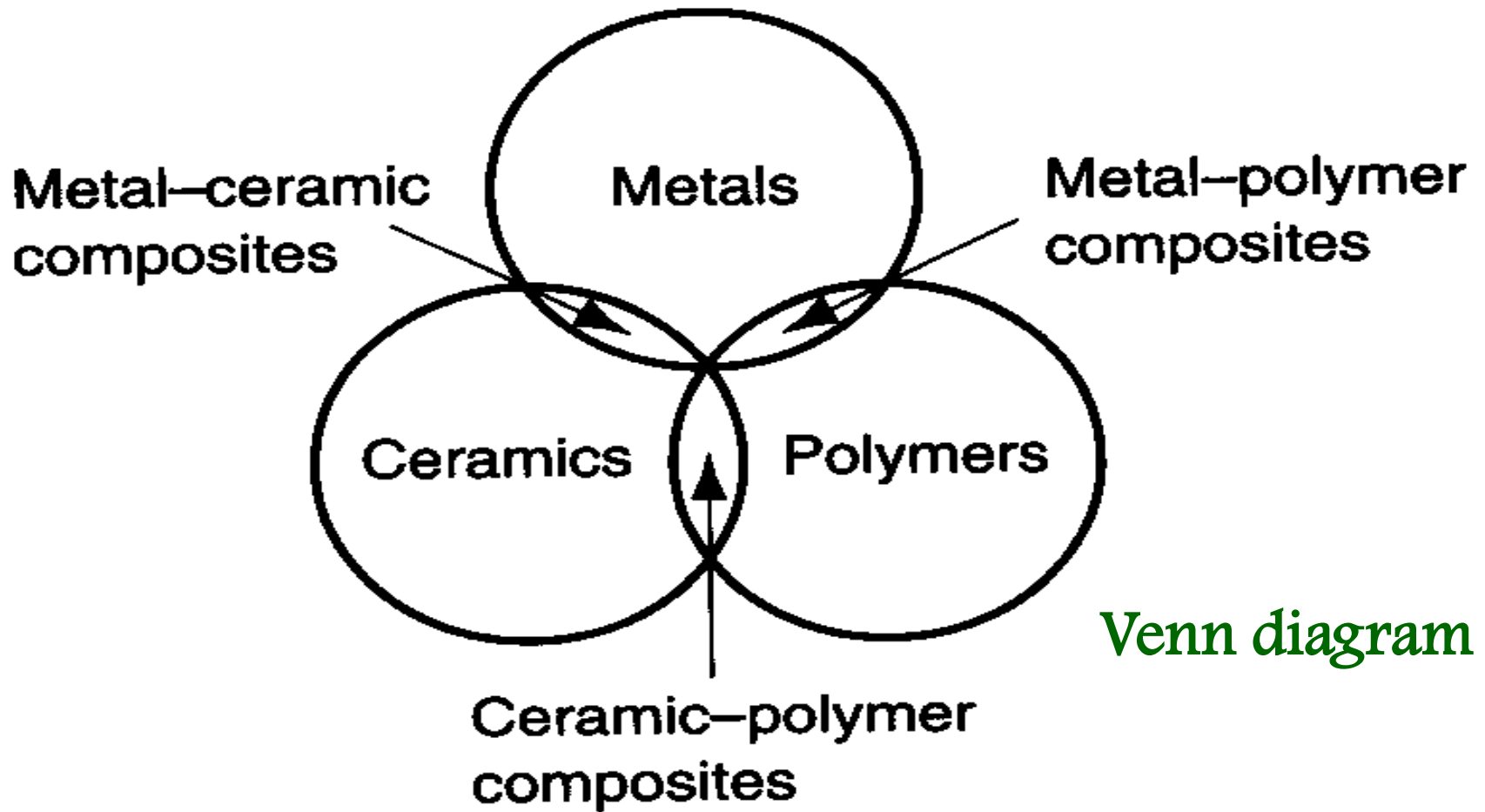
- Technological Processing capability
 - Available processes and machines
 - Outsourcing of some operations (casting, heat treatment, etc.)
- Physical product limitations
 - Size, weight
 - Machine dimensions, handling
- Production capacity (Plant capacity)
 - Production quantity in a given time, output

Materials in Manufacturing

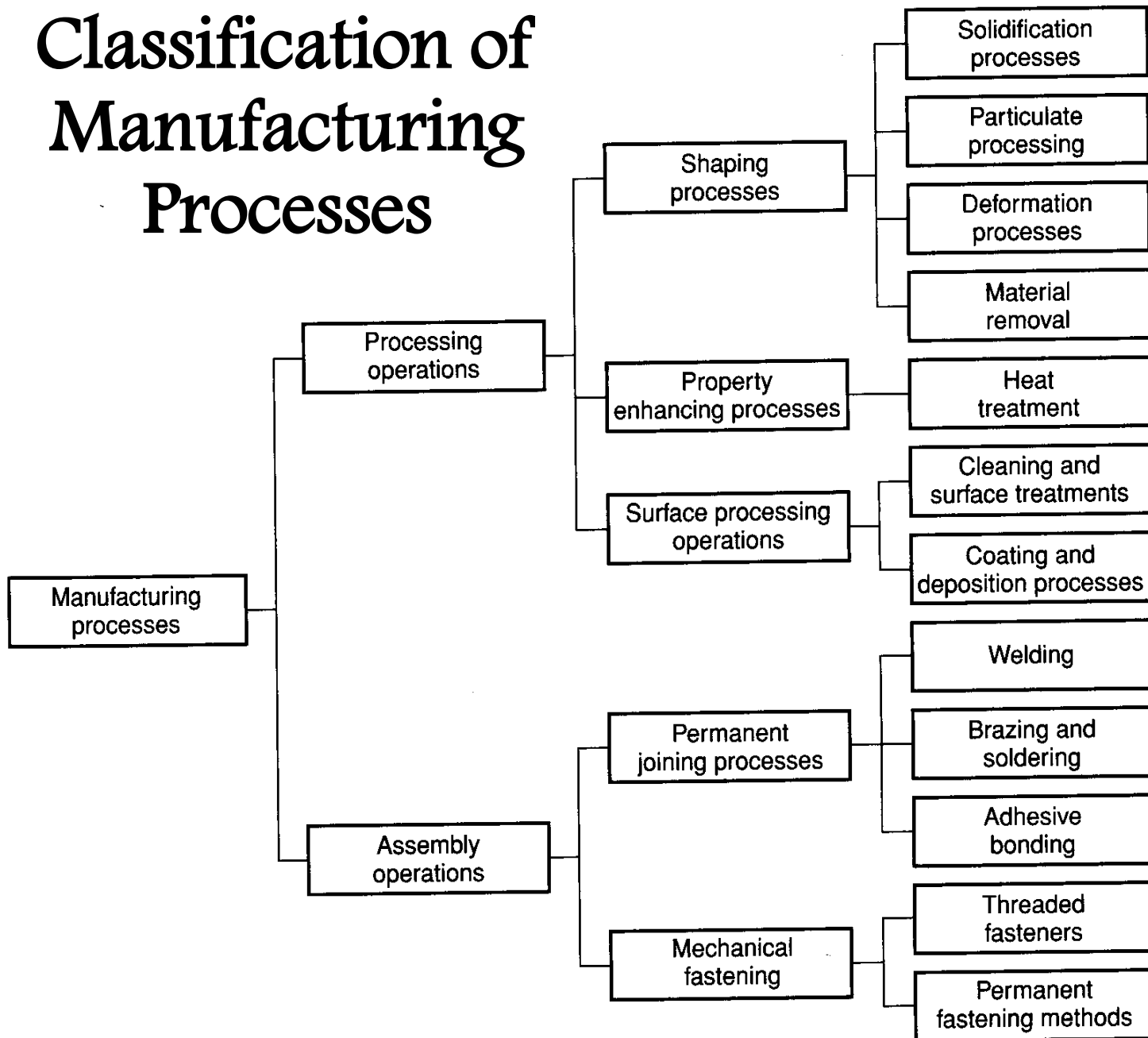


- Metals
 - Ferrous: Steel (iron-carbon, 0,02% - 2,11% C)
Cast iron (iron + 2% - 4% C + silicon)
 - Nonferrous: copper, aluminium, nickel, alloys
- Ceramics: clay, silica, carbides (Al, Si), nitrides (Ti)
- Polymers
 - Thermoplastic polymers: PE, PP, PS, PVC
 - Thermosetting polymers: phenolics, epoxies
 - Elastomers: rubber, neoprene, silicone, PU
- Composites: more phases, particles/fibres + matrix
glass reinforced plastic, Kevlar, WC in cobalt

Materials in Manufacturing



Classification of Manufacturing Processes



Manufacturing Processes



1) Processing operations

2) Assembly operations

- Permanent joining: welding, brazing, adhesives
- Mechanical assembly: bolts, screws, rivets, etc.

3) Production machines and tooling

- Machine tools: lathe, milling machine, etc.
- Presses, forge hammers, rolling mills
- Welding machines and equipment
- General and special purpose equipment
- Tooling

Processing Operations



1) Shaping operations

- Solidification processes → casting of metals, moulding of plastics
- Particulate processing → powder metallurgy
- Deformation processes → forging, extrusion
- Material removal processes → machining, non-traditional, grinding

2) Property enhancing processes

- Heat treatments, sintering

3) Surface processing

- Cleaning, coating, plating

Production Systems



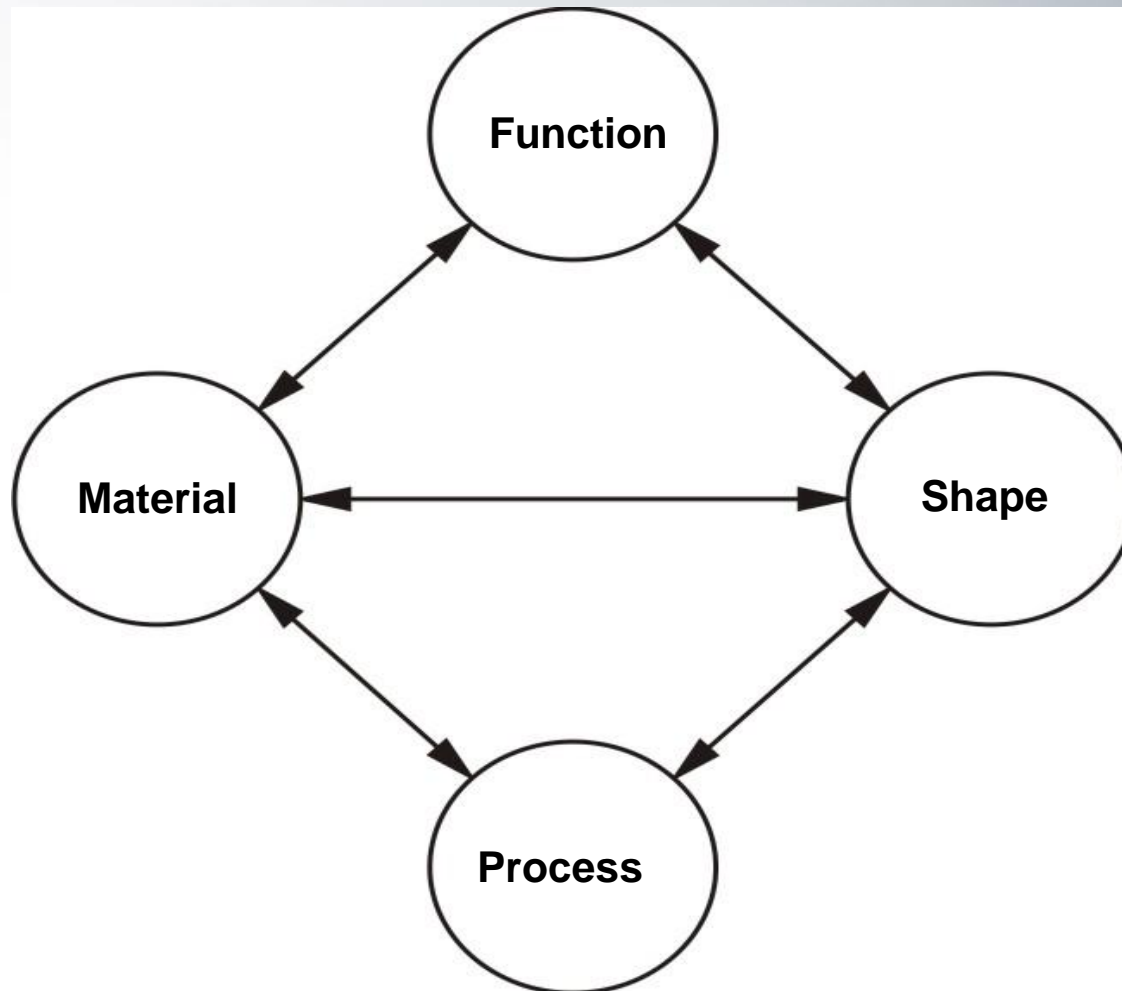
- Consist of people, equipment and procedures
- Production facilities: factory, production equipment
material handling equipment
 - Plant layout + Manufacturing systems
 - Influence of production quantity (low, medium, high)
- Manufacturing support systems
 - Manufacturing engineering → process planning
 - Production planning and control → logistics, ordering materials and parts, scheduling
 - Quality control

Influence of Production Quantity



- Low quantity production (1 – 100 units/year)
 - Job shop → maximum flexibility, fixed-position layout and often also process layout
 - Examples: aircraft, ships, heavy machinery
- Medium quantity production (10^2 – 10^4 units/year)
 - Batch production → process layout or cellular layout, usually make-to-stock
 - Examples: pumps, lathes, gear drives
- High quantity production (> 10.000 units/year)
 - Flow line production → product layout
 - Examples: cars, household appliances

Mutual Relationships



Product Attributes



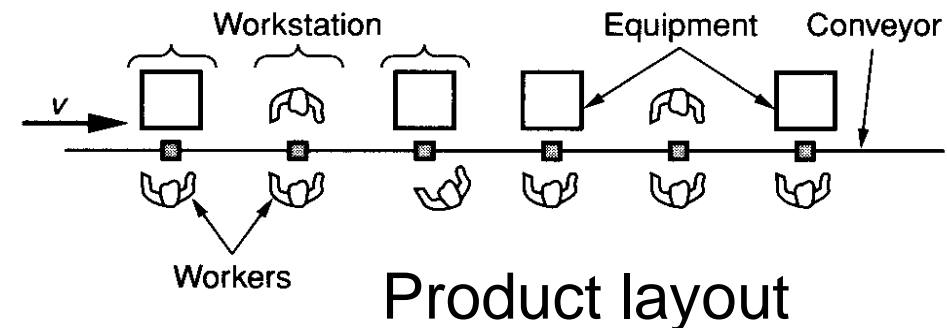
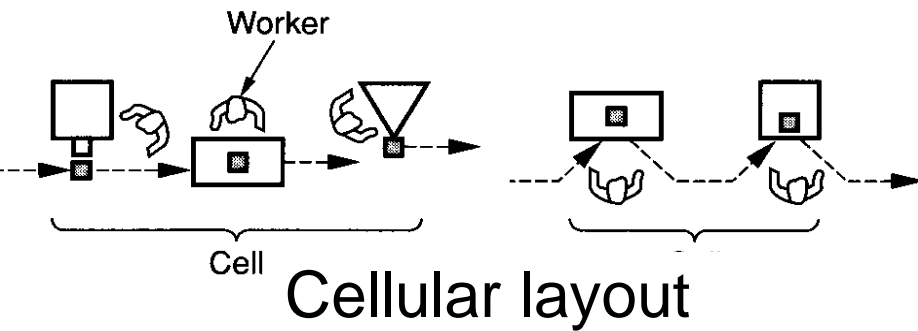
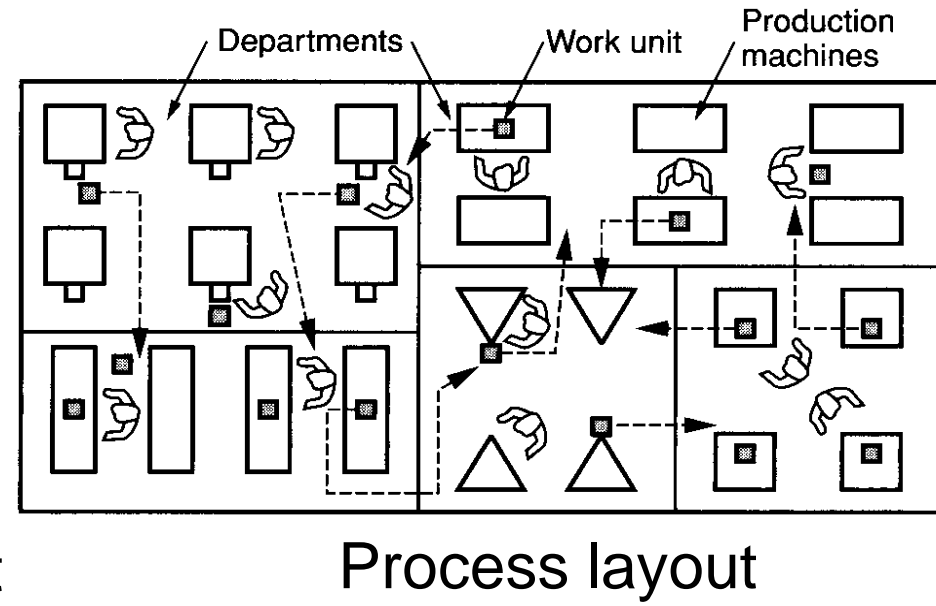
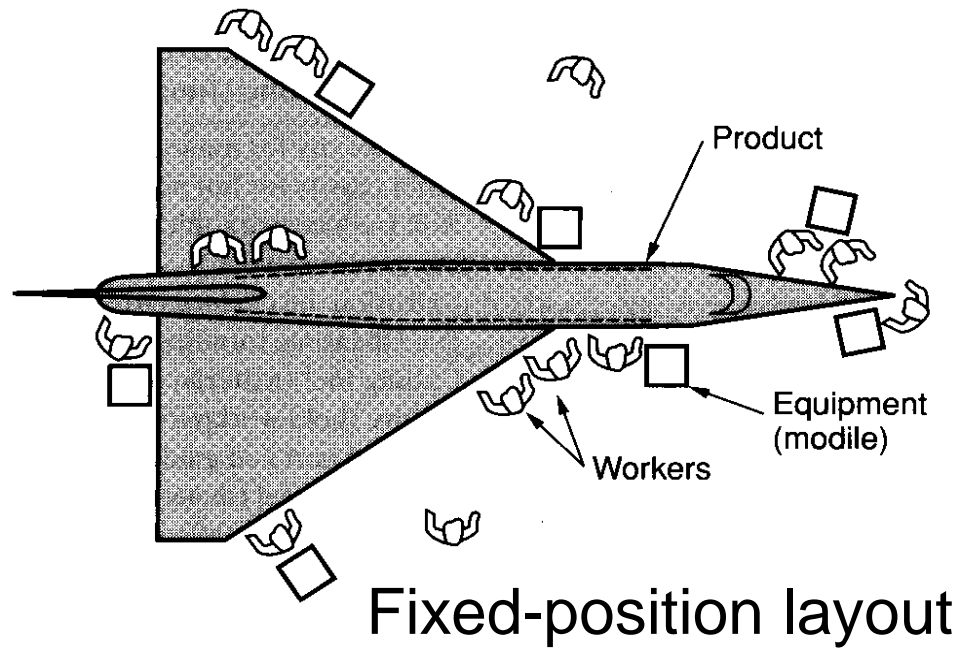
- Mechanical properties, e.g. tensile strength
- Physical properties, e.g. thermal expansion
- Dimensions, e.g. mm
- Tolerances: bilateral, unilateral tolerances
limit dimensions
- Geometric attributes: angularity, circularity, concentricity, cylindricity, flatness, parallelism, perpendicularity, roundness, squareness and straightness
- Surface quality, e.g. roughness

Types of Manufacturing Processes



	PROJECT	BATCH	MASS	CONTINUOUS
Product	<i>Unique</i>	<i>Made to order</i>	<i>Made to stock</i>	<i>Commodity</i>
Examples *	<i>Aeroplane, shipbuilding</i>	<i>Machine shops, printing</i>	<i>Autos, TV's, fast food</i>	<i>Paint, chemicals, food</i>
Customer	<i>One-at-a-time</i>	<i>Few individuals</i>	<i>Mass market</i>	<i>Mass market</i>
Demand	<i>Infrequent</i>	<i>Fluctuates</i>	<i>Stable</i>	<i>Stable</i>
Volume	<i>Very low</i>	<i>Low to med</i>	<i>High</i>	<i>Very high</i>
No. of different * products	<i>Infinite</i>	<i>Many, varied</i>	<i>Few</i>	<i>Very low</i>
System *	<i>Long-term</i>	<i>Discrete, job</i>	<i>Repetitive, assembly lines</i>	<i>Process industry</i>
Equipment	<i>Varied</i>	<i>General-purpose</i>	<i>Special-purpose</i>	<i>Highly automated</i>
Type of work	<i>Contracts</i>	<i>Fabrication</i>	<i>Assembly</i>	<i>Mix, treat, refine</i>
Skills *	<i>Experts, craftspeople</i>	<i>Wide range of skills</i>	<i>Limited range of skills</i>	<i>Equipment monitors</i>
Advantages *	<i>Custom work</i>	<i>Flexibility</i>	<i>Efficiency, speed, low cost</i>	<i>Highly efficient large capacity</i>
Dis- ** advantages	<i>Nonrepetitive, small customer base, expensive</i>	<i>Costly, slow, difficult to manage</i>	<i>Capital investment, lack of responsiveness</i>	<i>Difficult to change</i>

Plant Layouts



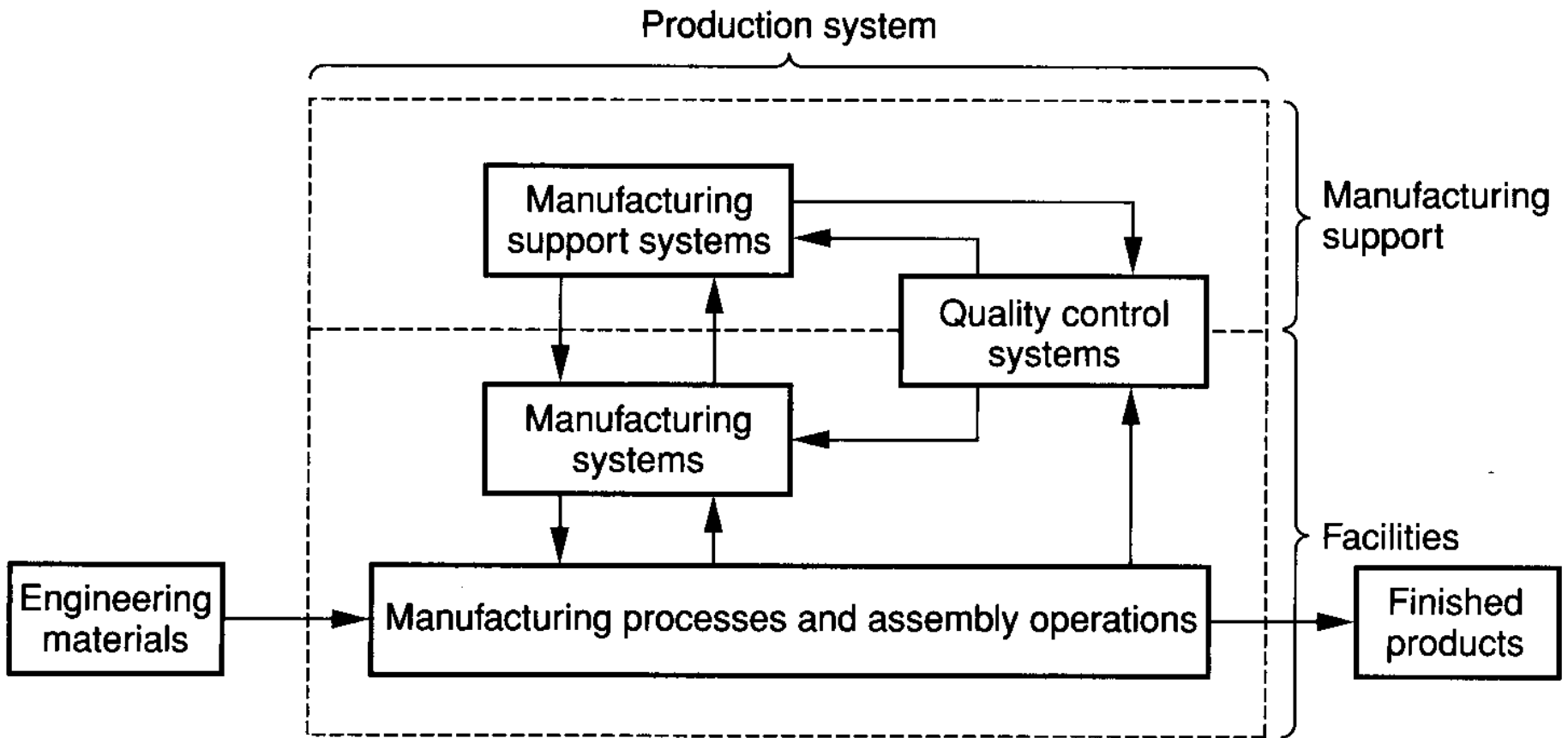
Manufacturing Process Selection



Aspects:

- Batch size: Single product, medium size or mass production
- Geometric requirements: Shape and tolerances
- Manufacturing phase: Primary or secondary
- Tools: General purpose or product specific
- Assembly: Pay attention to assembly aspects during process selection for part manufacturing
- Minimize costs: Costs per product + Costs per batch + Once-only costs

Production System



Interfaces with Other Courses



- Product design: Selection of the product material and the manufacturing process is related to the product shape and product function.
- Production systems: Selection of a manufacturing process is related to the optimum batch size and has consequences for the plant layout.
- Management and cost accounting: If more manufacturing scenarios are possible, the final choice will be made based on minimum costs.
- Total Quality Management: All decisions related to manufacturing are dealing with quality aspects.

