

MANUFACTURING PROCESSES (SME 2713)

Introduction 1

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Outlines

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2. What is Manufacturing?
3. Manufacturing System
4. Manufacturing categories
5. Examples of Manufacturing Industries
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1. General Introduction

- *Manufacturing* is an industrial activity that **changes the form of raw materials to create products**. To be profitable, an enterprise establishes and nurtures a ***manufacturing system*** that facilitates the flow of information to coordinate **inputs, processes, and outputs**.
- Development of modern manufacturing, for example, is dependent on research in materials that may require a variety of new production processes. Success demands implementation of robust ***manufacturing processes and systems***.
- This chapter gives students a good understanding of the ***manufacturing enterprise as a system***, a view that is needed to excel in today's competitive markets

1. General Introduction

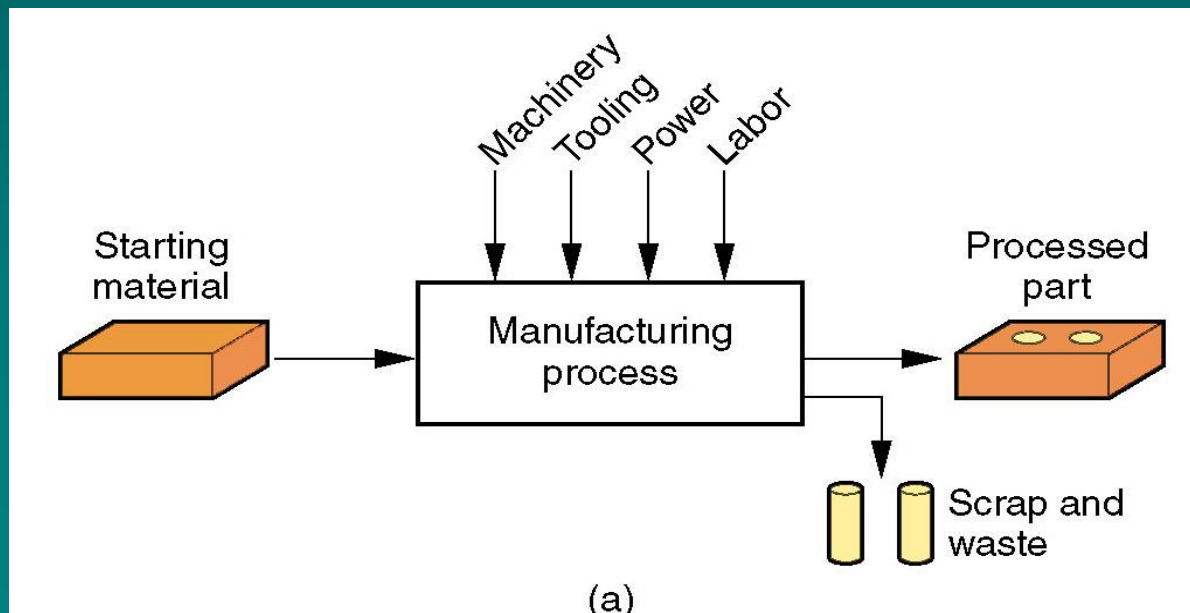
- **Manufacturing** (from **Latin** *manu factura*, "making by hand") is the use of tools and labor to make things for use or sale. The term may refer to a range of human activity, from **handicraft to high tech**, but is most commonly applied to **industrial production**, in which **raw materials are transformed into finished goods on a large scale**.
- “Made by hand” accurately described the manual methods used when the English word “manufacture” was first coined around 1567 A.D.
- Most **modern manufacturing** is accomplished by automated and computer-controlled machinery that is manually supervised.

1. General Introduction

- Modern manufacturing includes all intermediate processes required for the production and integration of a product's components. Some industries, such as **semiconductor and steel** manufacturers use the term **fabrication** instead

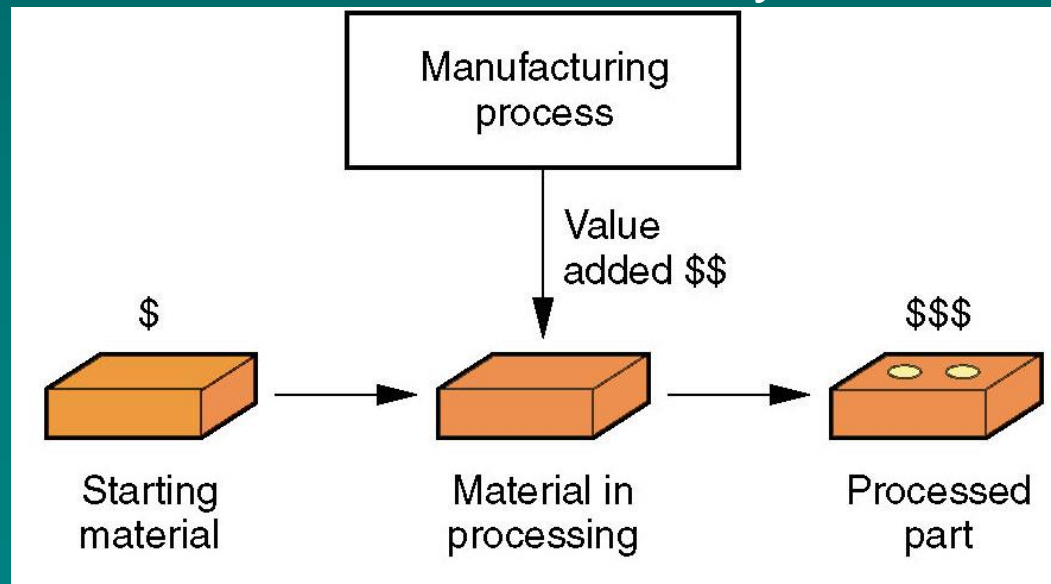
2. What is Manufacturing?

- Manufacturing as a technical process
 - **Manufacturing** is the application of physical and chemical processes to alter the geometry, properties, and/or appearance of a given starting material to make parts or products; **manufacturing** also includes assembly of multiple parts to make products



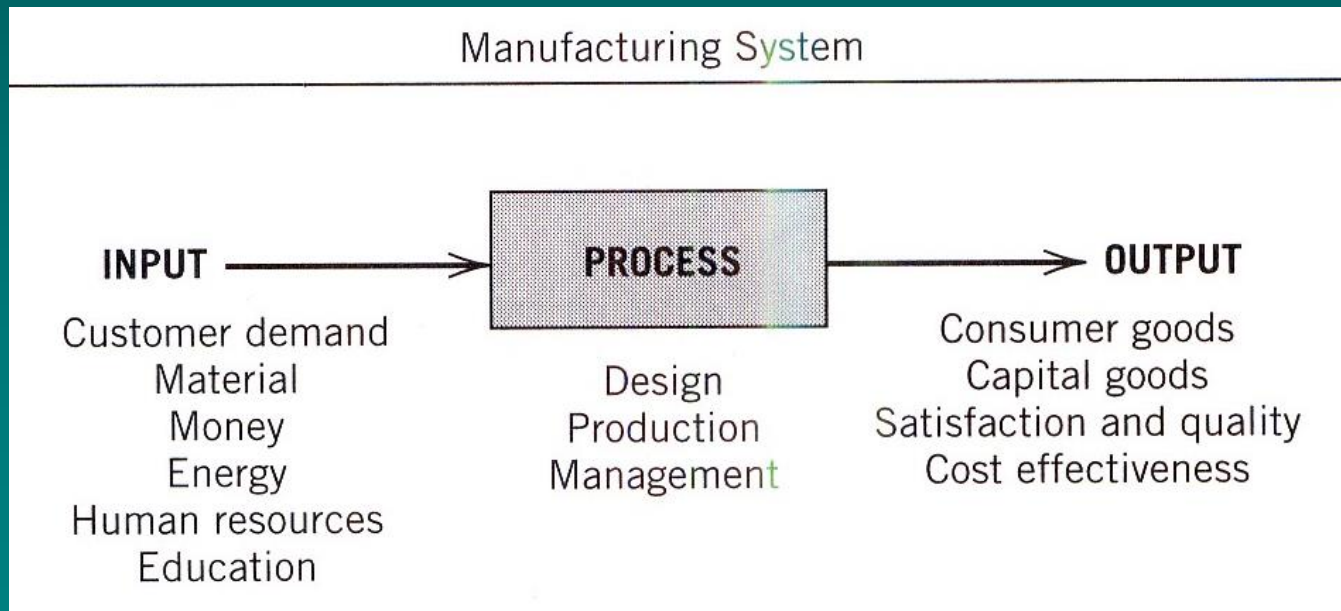
2. What is Manufacturing?

- Manufacturing as an economic process
 - **Manufacturing** is the **transformation** of materials into items of greater value by means of one or more processing and/or assembly operations
 - Manufacturing **adds value** to the material by changing its shape or properties, or by combining it with other materials that have been similarly altered



3. Manufacturing Systems

- To understand the manufacturing system, we can describe it as having three essential elements: *input, process or transformation, and output.*



3. Manufacturing Systems

- **INPUT**

- In a free enterprise system, **consumer demand** serves as the stimulant to encourage business to provide products. **Materials** are converted into these products. It takes financing and money, gained from bank loans, from capital investments from stockholders, or from plowback of profit into the business, to sustain this activity.
- *Working capital* is money used to buy materials and pay employees. *Fixed capital* is the money for tools, machines, and factory buildings. A manufacturing enterprise needs **money** for these and other requirements

3. Manufacturing Systems

- **INPUT**

- **Energy** is an important input to manufacturing because it exists in many different forms, such as electricity, compressed air, steam, gas, or coal.
- **Human resources** – professional, managerial, technical supporting staff (skill, semi-skill, un-skill)
- **Education/training/retraining**

3. Manufacturing Systems

• PROCESS/TRANSFORMATION

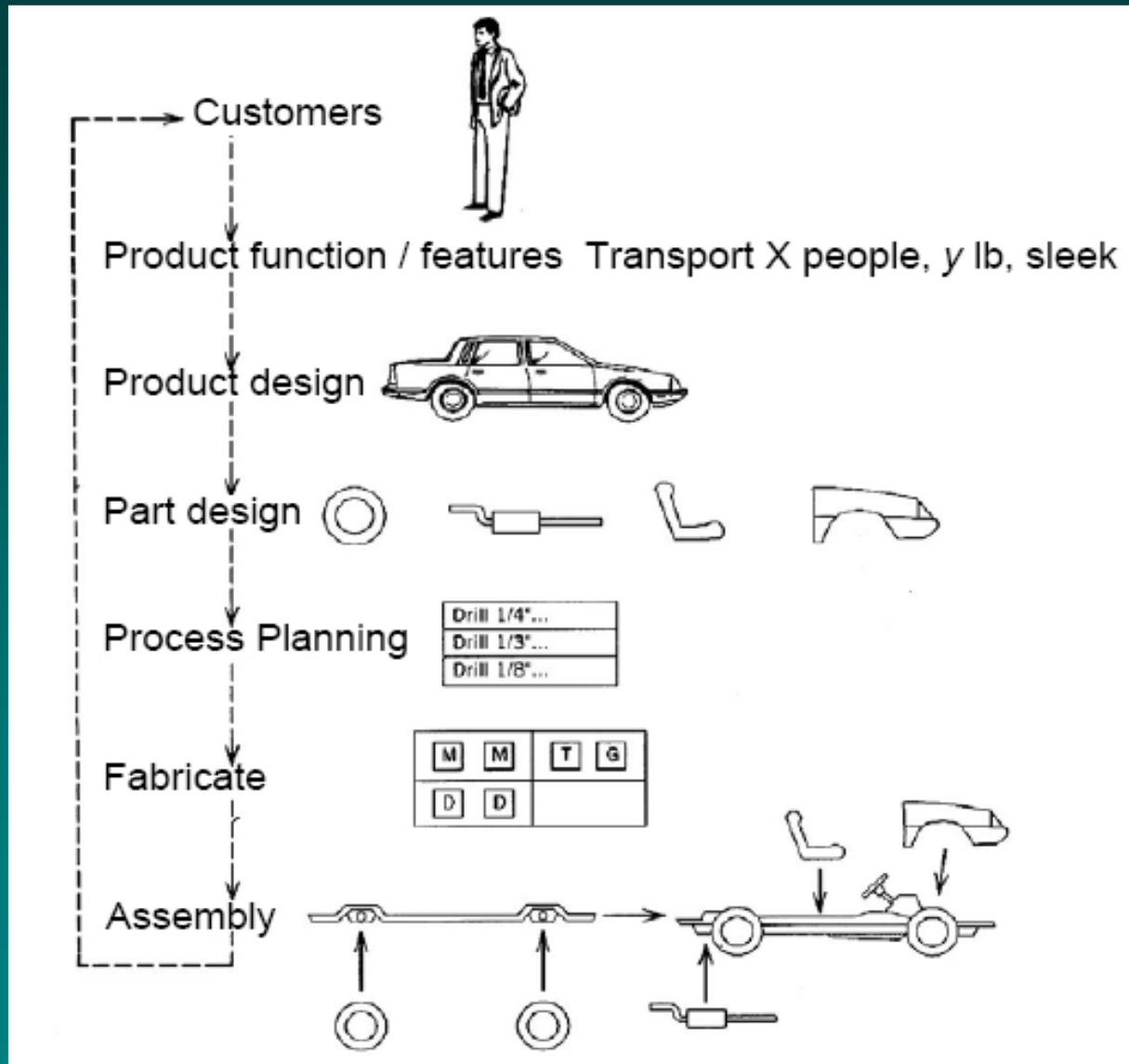
- **Processes** are the next step of the enterprise. **Management** provides planning, organization, direction, control, and leadership of the business enterprise to make it productive and profitable. Managers have responsibilities to the owners, employees, customers, general public, and the enterprise itself. It is essential for the business enterprise to make a profit or it will fail.
- The **design** element consists of creating plans for products so that they are attractive, perform well, and give service at low cost. Manufactured products are designed before they are made. They may be designed by workers in the shop, drafts persons, or engineers, but design is usually handled by trained engineering specialists.

3. Manufacturing Systems

- **PROCESS/TRANSFORMATION**

- The third element is **production**. The processes needed to manufacture a product must be designed and engineered in great detail. General plans for the processes are recognized during the design stage, and now the techniques of **manufacturing engineering** are used.
- The best combination of machines, processes, and people are selected to satisfy the objectives of the firm, shareholders, employees, and customer.

From Design through Manufacturing



3. Manufacturing Systems

• OUTPUT

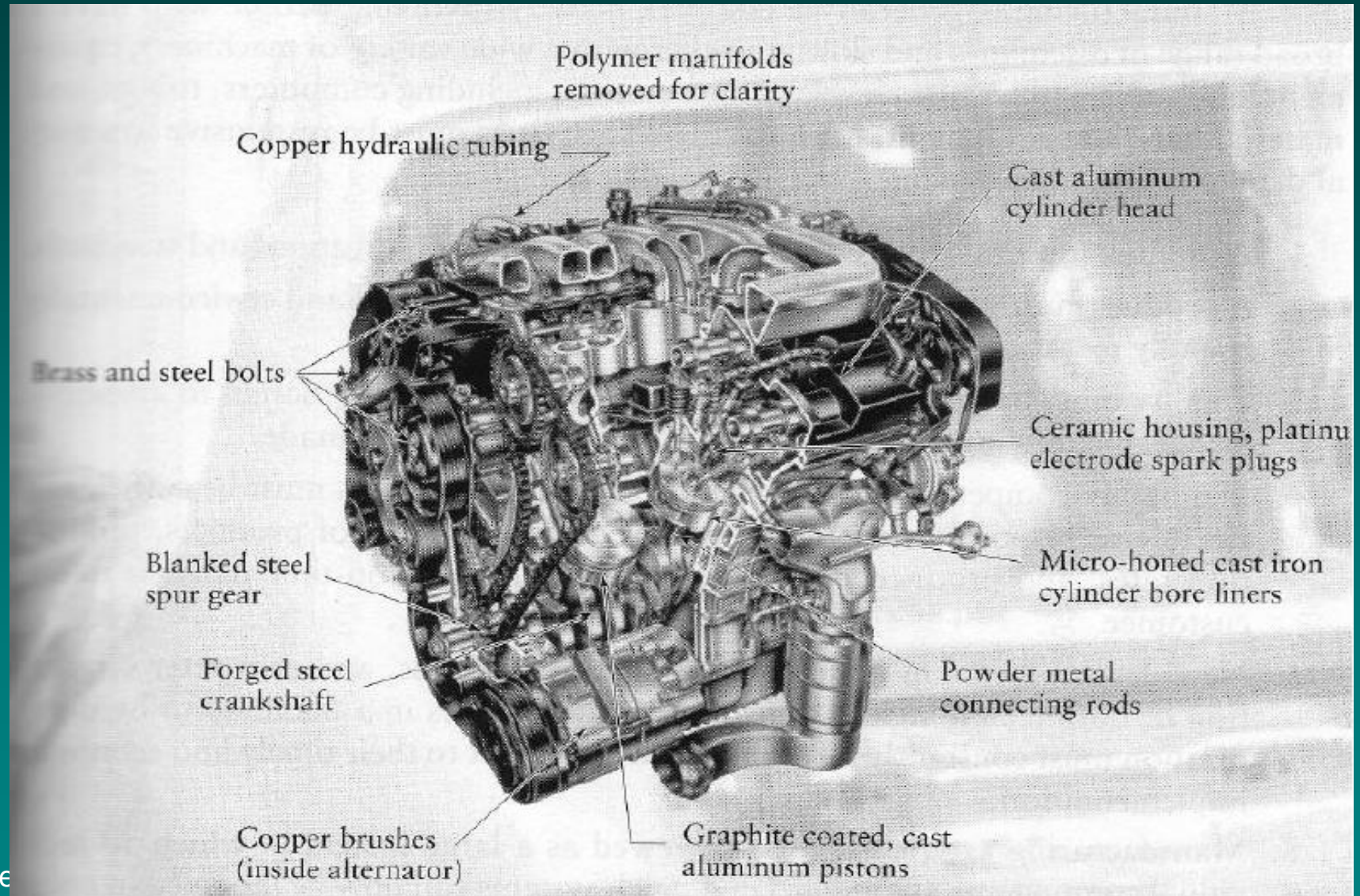
- The **output** of a manufacturing system is a product. Look around you; products of manufacturing are everywhere.
- Classes of goods can be divided into consumer or capital goods. **Consumer goods** are those products that people buy for their personal consumption or use, such as food or cars. **Capital goods** are products purchased by manufacturing firms to make the consumer products. Machine tools, computer-controlled robots, and plants are examples of capital goods

3. Manufacturing Systems

- **OUTPUT**

- *It used to be that processes were critical to efficient operation.* Although they still are, they are not the only factor.
- International competitive markets, changes in consumer quality values, concern for the environment, and new ergonomics and safety standards demand a more global view to manufacturing practices that only a systems approach (the study of all the components and their relationships) can give.

3. Manufacturing Systems - Output



4. Manufacturing Categories - USA

- Aerospace manufacturing
- [Agribusiness](#)
- [Alternate energy](#)
- [Automobile manufacturing](#)
- [Biotechnology](#)
- [Brewing industry](#)
- [Cognotechnology](#)
- [Chemical industry](#)
- [Clothing industry](#)
- [Construction](#)
- [Electronics](#)
- [Engineering](#)
- [Emerging technologies](#)
- [Energy industries](#) including the production of [petroleum](#), [gas](#) and [Electric power](#)
- [Ethanol](#)
- [Food and Beverage](#)
- [Fuel Cell](#) technology
- [Injection molding](#)
- [Industrial design](#) design & styling of products
- [Machine Tools](#)
- [Nanotechnology](#)
- [Metalworking](#)
- [Pharmaceutical](#)
- [Plastics](#)
- [Steel](#) production
- [Semiconductor](#)
- [Steel industry](#)
- [Telecommunications](#) Industry
- [Tire manufacturing](#)
- [Tobacco industry](#)

4. Pengkelasan Industri Pembuatan Di Malaysia

Dikelaskan kepada beberapa sektor mengikut jenis produk yang dihasilkan berasaskan pelan induk perindustrian negara 1986.

- industri produk getah
- industri produk kelapa sawit
- industri pemprosesan makanan
- industri perkayuan
- industri kimia
- industri logam bukan ferus
- industri produk galian bukan ferus
- industri elektrik dan elektronik
- industri peralatan pengangkutan jalan
- industri pembinaan dan membaikpulih kapal
- industri jentera dan kejuruteraan
- industri logam ferus
- industri tekstil dan pakaian

5. Manufacturing Industries

- Any **industry** that makes products from raw materials by the use of manual labour or machines and that is usually carried out systematically with a division of labour. In a more limited sense, manufacturing is the fabrication or assembly of components into finished products on a fairly large scale.
- Among the most important **manufacturing industries** are those that produce aircraft, automobiles, chemicals, clothing, computers, consumer electronics, electrical equipment, furniture, heavy machinery, refined petroleum products, ships, steel, and tools.

5. Manufacturing Industries

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

- Industries can be classified as:
 1. **Primary industries** - those that cultivate and exploit natural resources, e.g., agriculture, mining
 2. **Secondary industries** - take the outputs of primary industries and convert them into consumer and capital goods - manufacturing is the principal activity
 3. **Tertiary industries** -service sector of the economy

5. Manufacturing Industries - continued

- Most secondary industries are companies that do manufacturing; others are construction and power generation
- However, manufacturing includes several industries whose production technologies are not covered in this course; e.g., apparel, beverages, chemicals, and food processing
- ***For our purposes, manufacturing means production of hardware, which ranges from nuts and bolts to digital computers and military weapons, as well as plastic and ceramic products***

Example of Industries

- *Aerospace*

- Typically, complex, three-dimensional shapes, exotic materials, medium-volume to low-volume production quantities
- Military and space technology filters down to industrial applications
- Pioneered work in NC machining, CAD/CAM, composites and flexible manufacturing system applications
- Goals: energy efficiency, high strength-to-weight ratio

Example of Industries

- *Aerospace*



Example of Industries

- *Automotive*

- Relatively large production quantities, multiple options: automated assembly is difficult
- Traditionally, primary processes were metalworking: machining of power train parts, forming and bending sheet metal; assembly by spot welding and mechanical fasteners; finishing by spray painting and plating
- New materials: plastics, fiberglass
- Increasing automation: robots for spot welding and spray painting
- Improved quality with production groups that assemble large portions of the automobile

Example of Industries

- **Automotive – cont.....**
 - Around 787,000 people are employed in design and manufacture of vehicles/components, or the supply and distribution chain. Those employed in manufacture number 243,000.
 - The UK provides a manufacturing base for seven leading volume vehicle manufacturers, nine commercial vehicle production facilities, 17 of the top tier suppliers and around 20 leading independent automotive design firms.
 - The UK is home to the world's most successful motorsport industry and is increasingly becoming a centre for engine production. The industry is the UK's largest source of manufactured exports.
 - In recent years, car production and sales in the UK have reached record levels.

Example of Industries

- *Semiconductor*
 - Large volume industry
 - Emphasis on design and production of low-cost integrated circuits
 - Smaller size and more stringent requirements for cleanliness
 - Process requirements have forced automation
- *Chemical*
 - Chemical processes for man-made fibers and plastics, oil distillation and pharmaceutical industries
 - Continuous flow of product and byproducts; some batch processing
 - reasonably easy to automate

Manufacturers

- Examples of major manufacturers in the United States include General Motors Corporation, Ford Motor Company, Chrysler, Boeing, Gates Rubber Company and Pfizer.
- Examples in Europe include France's Airbus and Michelin Tire. Modern proponents of Fair Trade policy and a strong manufacturing base for the U.S. economy include economists like Paul Craig Roberts, Ravi Batra, and Lou Dobbs.
- Other examples – Japan, Korea, Malaysia??

6. The Importance of Manufacturing

- The largest manufacturing countries in the world are the most powerful, e.g. USA, Japan
- Manufacturing is the major indicator of the economic health of any country - An economy cannot exist without some type of manufacturing.
- Most jobs exist either to support the manufacturing process, or to “add value” to the manufactured product.
- Manufacturing is important
 - Technologically
 - Economically
 - historically

6. Manufacturing Is Important *Technologically*

Technology can be defined as the application of science to provide society and its members with those things that are needed or desired

- Technology provides 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

6. Manufacturing Is Important *Economically*

Manufacturing is a means by which a nation creates material wealth

- In the U.S. manufacturing constitutes ~ 20% of GNP
- Government is as much of GNP as manufacturing, but it creates no wealth

U.S. economy:

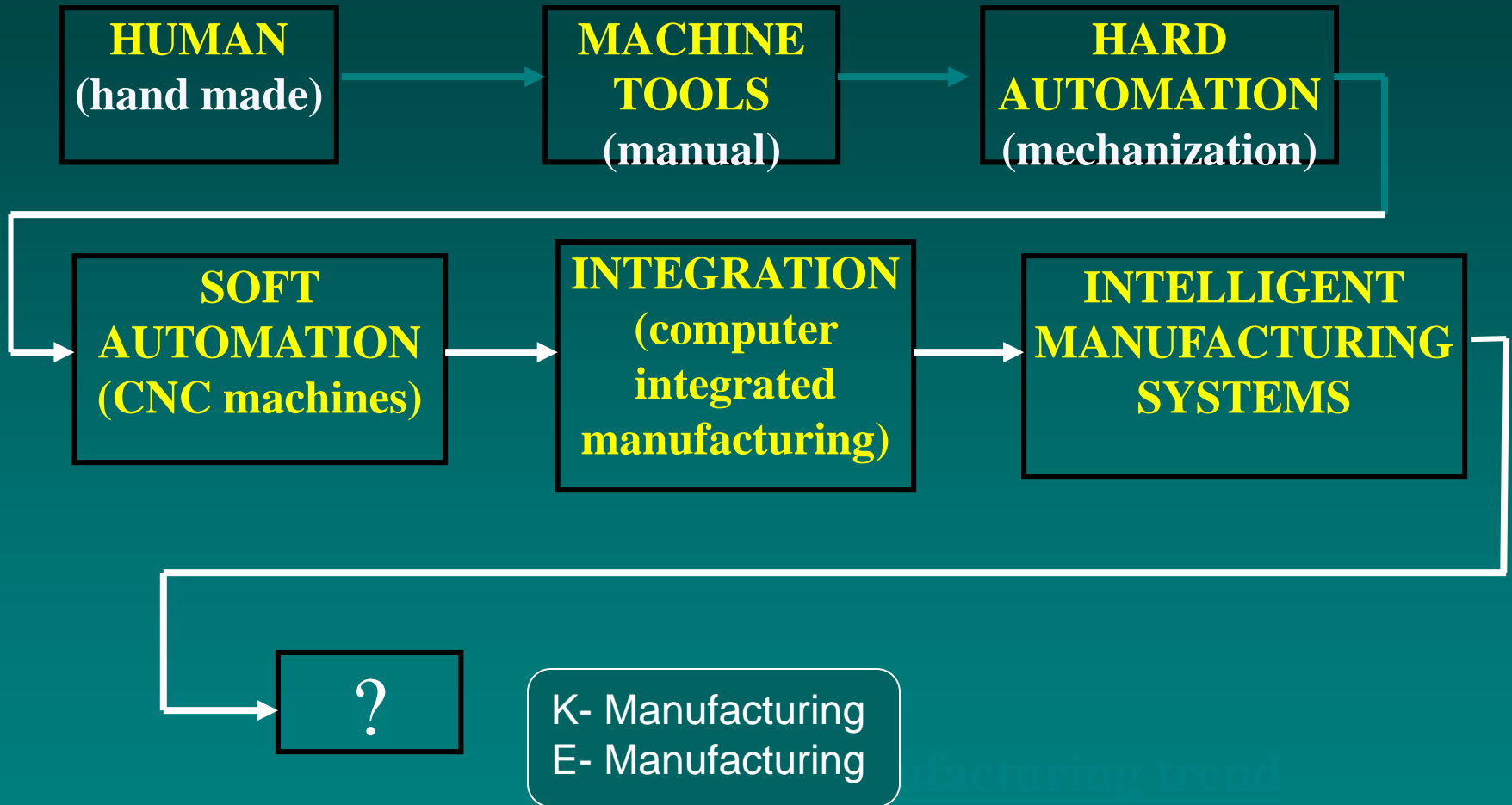
Sector	% of GNP
Manufacturing	20%
Agriculture, minerals, etc.	5%
Construction & utilities	5%
Service – retail, transportation, banking, communication, education, and government	70%

6. Manufacturing is Important

Historically

- Historically, the importance of manufacturing in the development of civilization is usually underestimated
- Throughout history, human cultures that were better at making things were more successful
- Making better tools meant better crafts & weapons
 - Better crafts allowed the people to live better
 - Better weapons allowed them to conquer other cultures in times of conflict
- To a significant degree, the history of civilization is the history of humans' ability to make things

7. TRENDS IN MANUFACTURING





Customization Focus

**Mass Customization Era
1995–2005**

- Globalization
- Internet
- Enterprise Resource Planning
- Learning Organization
- International Quality Standards
- Finite Scheduling
- Supply Chain Management
- Agile Manufacturing

Quality Focus

Cost Focus

**Early Concepts
1776–1880**
 Labor Specialization
 (Smith, Babbage)
 Standardized Parts (Whitney)

**Scientific Management Era
1880–1910**
 Gantt Charts (Gantt)
 Motion & Time Studies
 (Gilbreth)
 Process Analysis (Taylor)
 Queuing Theory (Erlang)

**Mass Production Era
1910–1980**
 Moving Assembly Line
 (Ford/Sorensen)
 Statistical Sampling
 (Shewhart)
 Economic Order
 Quantity (Harris)
 Linear Programming
 (Dantzig) PERT/CPM
 (DuPont)
 Material Requirements
 Planning

**Lean Production Era
1980–1995**
 Just-In-Time
 Computer Aided Design
 Electronic Data Interchange
 Total Quality Management
 Baldrige Award
 Empowerment
 Kanbans

Manufacturing Theme for the 2000's and Beyond

- Low cost manufacturing
- High quality (reliable) products
- Increased productivity (better use of limited resources)
- Reduced environmental impact

Strategic objectives for manufacturing

REDUCE Manufacturing Cost
REDUCE Manufacturing Lead Time



Improve QUALITY
Improve SERVICE



Lower PRICE



Increase Market Share (\$)



Increased PROFITS
Increased WAGES
Increased JOB SECURITY