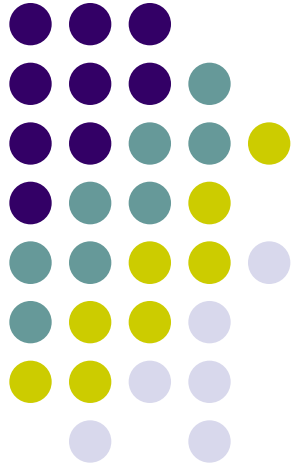
ME 482 – Rapid Product Development and Manufacturing

Chapter 1

Introduction, Scope and Basic Concepts



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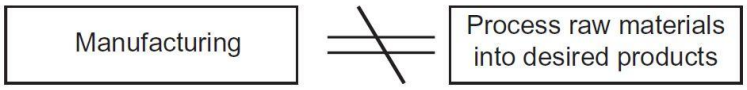
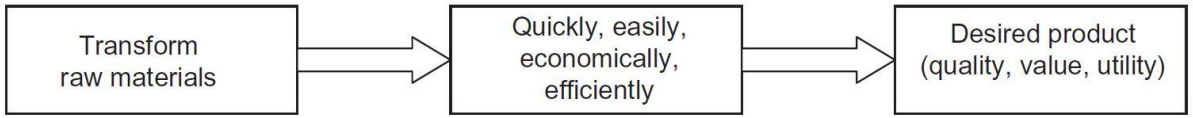
Manufacturing

- Historically, manufacturing has been defined narrowly as the conversion of raw materials into desirable products.
- The conversion process requires the application of physical and chemical processes to change the appearance and properties of the raw materials.
- A combination of machine tools, energy, cutting tools, and manual labor is applied to produce various components that, when put together (assembled) with the aid of manual effort, robots, or automated equipment, **result in the final product**.
- Therefore, manufacturing was considered simply as a means to add value to the raw material by changing its geometry and properties *(physical and chemical)*.

Modern Manufacturing

- In the present-day context of economic survival and prosperity, it is insufficient to simply process some raw material into desired product shapes.
- The transformation must be accomplished **quickly, easily, economically,** and **efficiently**.
- Resulting product must not only be of acceptable quality but must be desired by the end user, the customer.
- Efficiency and economies of scale are critical for **competitiveness** in the global market. A product should be **innovative** and **have value** and **utility** for the customer; a "me-too" product has a low probability of survival in today's global market.





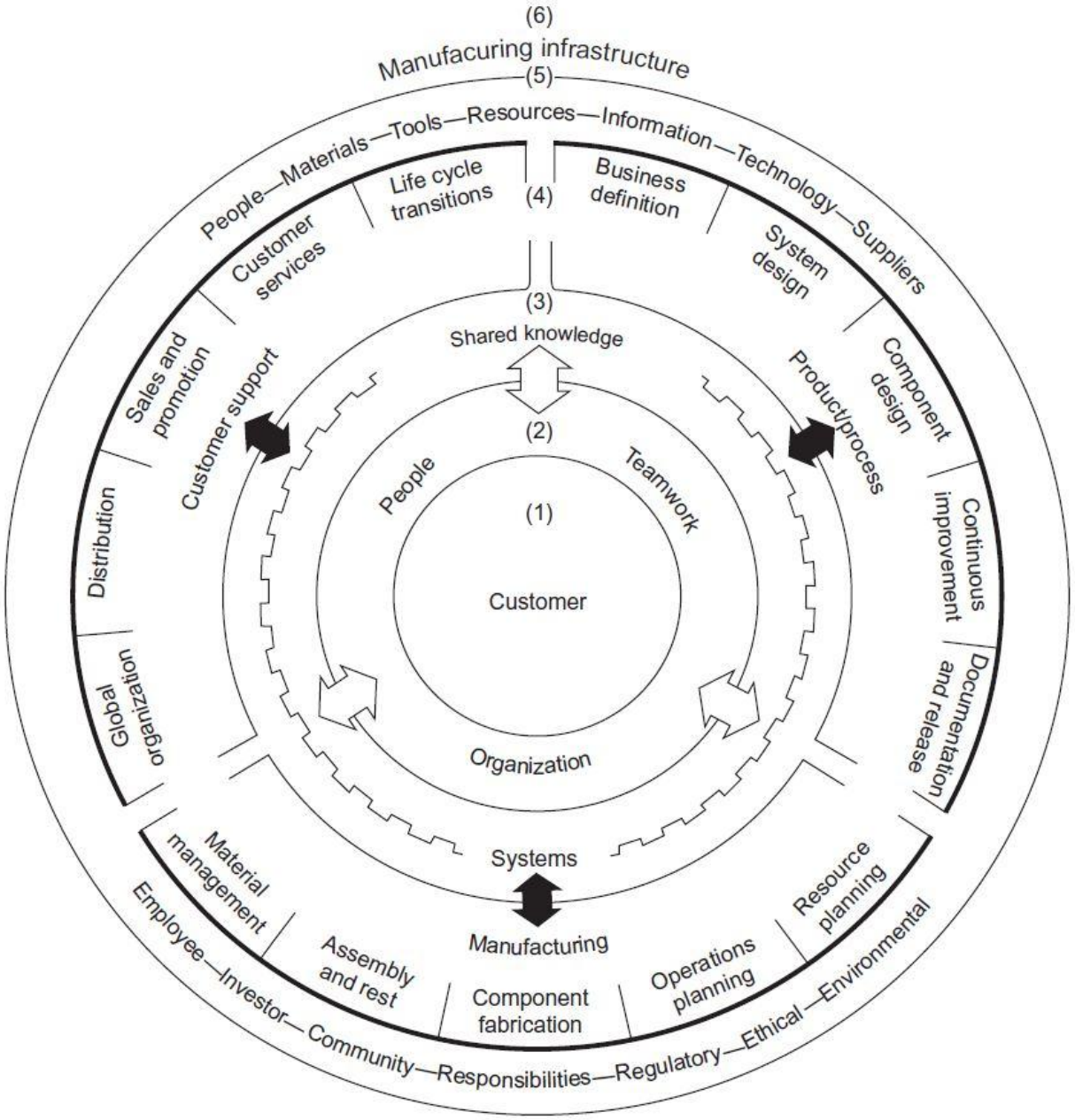
Manufacturing & Production

- Although these term are often used interchangeably, are not the same.
- **Manufacturing** generally refers to activities that convert raw materials into finished products *by using various shaping techniques.*
- **Production** is a general term associated with output and can apply to the *output of coal mines and oil fields as easily as to power plants and farms*.
- The type of products generally are classified into two broad categories: consumer products (consumer goods) and producer capital goods.

  Consumer products: such as *automobiles, coffeemakers, lamps, and televisions*.

  Producer capital goods: such as *drilling machines, lathes, railroad cars, and overhead cranes.*
- Whereas consumer products are directly consumed by the public at large, producer goods are used by enterprises to produce consumer goods.

Manufacturing Enterprise Wheel



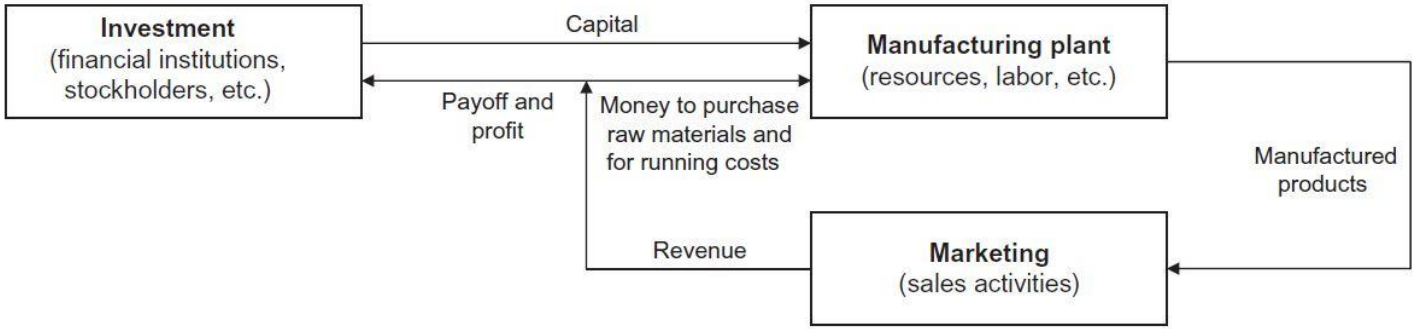
Manufacturing is the use of the appropriate and optimal combination of design, machinery, materials, methods, labor, and energy to produce desirable products **quickly, easily, economically**, and **efficiently**.

The customer is the **center** of the manufacturing infrastructure. Whatever technologies and resources are utilized and whatever activities are undertaken, it is with the understanding that the customer is the center of attention.

Manufacturing Objectives

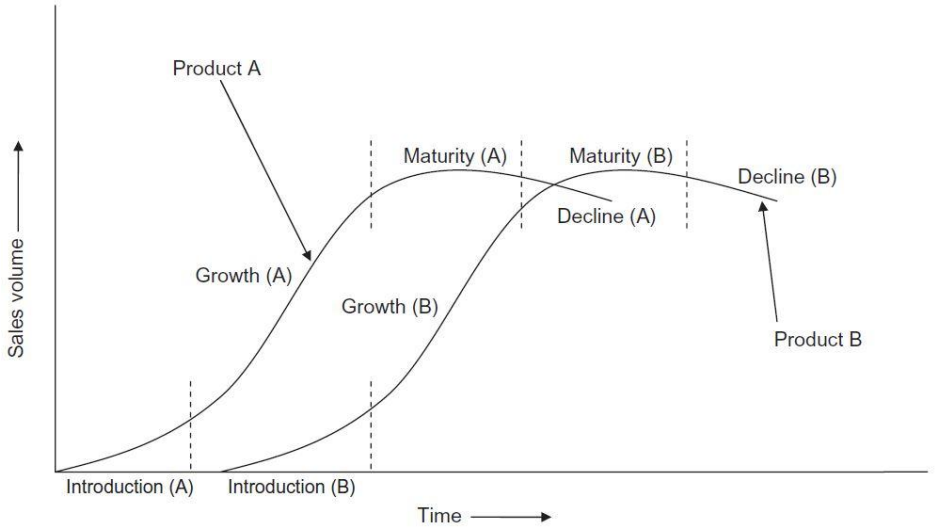
- Increase the output of high value-added products
- Produce high quality goods and services, *economically and quickly*
- Produce goods that are needed and wanted
- Minimize the production of greenhouse gases
- Maximize recycling, eliminate waste, and conserve raw materials
- Minimize consumption of energy during production
- Minimize consumption of energy during product operation
- Reducing industrial water consumption and increase water recycling.

- **Capital circulation or the production turn:** Capital is utilized to acquire the means of production with the assistance of labor, produce goods that are sold. The proceeds from the sale are used to accumulate capital *(profit)*. The cycle works most efficiently when the cost of production is minimized *(profits are maximized)* and goods are produced and sold quickly.



- **Manufacturing capability:** The combined limitations on the size and weight of products that can be processed, the manufacturing processes available, and the volume (quantity) that can be produced in a specified period of time are collectively referred to as the manufacturing capability of a manufacturing plant.

- **Mass production:** Production of large quantities of the same kind of product for a sustained or prolonged period of time. The production quantity has to be in at least thousands *(preferably millions)* and is unaffected by daily fluctuations in sales such as *television sets, computers, and automobiles.*
- **Interchangeability:** Some products requires that parts must be able to replace each other and, as much as possible, be identical. *When the tires of a car wear out, we simply go to a tire shop and replace the old worn-out tires with new ones.*
- **Product life cycle:** The time period between conceiving a product and the point at which manufacturing it no longer is profitable.



- **Simultaneous or concurrent engineering:** Design and manufacturing functions must be closely associated if the low cost - high quality product goals are to be met. The design of a product is based on concurrent integration of the following major activities.
  - Design conceptualization and design axioms
  - Identification of product functions
  - Product modeling and CAD (graphical and analytical representation of the product)
  - Material selection (material properties and associated manufacturing processes)
  - Design for efficient manufacturing (minimizing positional requirements and considering assembly)
  - Specification of dimensions and tolerances (selection of machinery).
- **Design for "X":** Competitive manufacturing requires clearly understanding the needs of customers, how to utilize materials and processes so that high quality products can be manufactured quickly and economically, and how to design and fabricate products that are safe, usable, and easy to inspect and maintain.

- **The engineering problem-solving process:** The basic engineering problem-solving process has five steps:
  - Formulate the problem
  - Analyze the problem
  - Search for alternative solutions
  - Decide among the alternative solutions
  - Specify the solution