Introduction to Manufacturing Process

What is “Manufacturing”?

The English word manufacture is several centuries old. The term manufacture comes from two Latin words, manus (hand) and factus (make). As per oxford English dictionary manufacture refers “to make or produce goods in large quantities, using machinery”.

Working definition of manufacturing

There are two types of working definitions available for manufacturing: as a technical process and as an economic process.

Technologically: 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 product as shown in Figure M1.2.1.

Economically: Manufacturing is the transformation of materials into items of greater value by means of one or more process and or assembly operation as shown in Figure M1.2.2.

Classification of manufacturing processes

Manufacturing processes can be classified as (Refer Figure M1.2.3) processing operation and assembly operation.

In processing operation the work material is transformed from one state to other advanced state. Through this operation value is added to the work material by changing the geometry; shape properties, appearance etc. of the starting work material. Usually processing operations are performed on individual component. But in some cases like aerospace industry, the processing operations are performed on assembled items also.
In *assembly operation* two or more components are joined to create a new entity. The new entity is called assembly, subassembly based on its state in the product. If the entity is an intermediate state of the product, it is called subassembly. Some other terms are also referred based on the joining process. The assembly created by welding operation is called weld met.

**Figure M1.2.1:** Definition of manufacturing in terms of technology.

**Figure M1.2.2:** Definition of manufacturing in terms of economic value
Figure M1.2.3: Classification of manufacturing process
**Job and Station**

In classical manufacturing, a job is defined as the total work or duties a worker performs. A station is a location or area where a production worker performs tasks and jobs. A job at an assembly station may consist of the following tasks:

1) Attach carburetor  
2) Connect gas line  
3) Connect vacuum line  
4) Connect accelerator rod.

Jobs and stations are now applied to unmanned machines also. A simple machine may have only one station. A complex machine may have multiple stations.

**Operation**

An operation is a distinct action performed to produce a desired result. Operations can be:

1) Materials handling and transporting  
2) Processing  
3) Packaging  
4) Inspecting and testing  
5) Storing

**Treatments**

Treatments operate continually on the work piece. These modify the product in process without tool contact. Some examples include heat treating, curing, galvanizing, plating, finishing, (chemical) cleaning and painting. These are often done in large tanks or furnaces or rooms, away from workers as they can be harmful.

**Basic Manufacturing Processes**

It is described as the manufacturing processes which create or add value to a product. The manufacturing processes can be classified as:
- Casting, foundry, or moulding processes
- Forming or metalworking processes
- Machining (material removal) processes
- Joining and assembly
- Surface treatments (finishing)
- Rapid prototyping
- Heat treating
- Other

Other manufacturing operations include inspection, testing, transportation, automated material handling and even packaging. In casting, the metal is heated sufficiently to make it into liquid and then poured into moulds of desired shapes. Various machining operations are turning, drilling and milling. Joining processes include welding, soldering, brazing and adhesive bonding. The process of heat treating is carried out to enhance various properties and include annealing and strengthening processes for metals and glasses. Surface processing includes cleaning, coating and thin film deposition, electroplating, anodising etc.

**Product Life cycle and life cycle cost**

Manufacturing systems are dynamic and liable to change over time. Thus there is a traditional relation between a product's life cycle and the kind of manufacturing system used to make it. The life cycle consists of the following steps:

1) Start-up: new product or new company, low volumes
2) Rapid growth: product becomes standardized in the market, higher volumes
3) Maturation: designs become standard, process development becomes important
4) Commodity: long life, standard of the industry type of product
5) Decline: product replaced by improved products.

**Manufacturing System Design**

A manufacturing system must consider two customers namely, the external that buys that the product and the internal that makes the product. The external customer may be global in scope, but the internal customer is critical in determining the design and manufacturing stages.
The complexity of the manufacturing system design where choices of system design trade off with parts variety.

**Summary**

Manufacturing becomes successful by understanding how the system works, how goods are controlled, the decision making at the correct level. Engineers must possess a broad fundamental knowledge of design, metallurgy, processing, economics, accounting and human relations.