Manufacturing process

What is Manufacturing Process?

A sequence of operations, often done on a machine or at a given area.

Examples:

welding, casting, cutting,

assembling, etc.

During a manufacturing process, we add, subtract, or form materials in order to give a desired property/shape to the workpiece. Therefore, different manufacturing processes, manufacturability of a material, processing tools, environmental aspects etc., have become important issues for manufacturing processes.
Manufacturing process

Manufacturing Processes
- Material Modifying Processes
  - Property Modifying
    - Heat treatment
    - Surface treatment
  - Shape Modifying
    - Material removal
    - Material addition
    - Material retention
- Joining Processes
  - Permanent
  - Non-permanent
  - Semi-permanent
Factors affecting the location of firms

- The quality and availability of raw materials and infrastructure
- The cost and suitable labor
- Population density
- Government rules and regulations
- The availability associated industries “knowledge networks”
Key success factors in manufacturing

- Low cost production efficiency (achieve scale economies, capture experience curve effects)
- Quality of manufacture (fewer defects, less repair)
- High utilisation of fix assets.
- Access to adequate supply of skilled labour
- Low cost locations
- High labour productivity
- Low cost product design and engineering
- Ability to manufacture or assemble products that are customised to buyers specifications
Profitability analysis

What is ROI?

Return on investment calculation results in a value that represents the benefits received from a project against the total costs of the project.

\[
\text{ROI (\%)} = \frac{\text{Total benefits} - \text{Total costs}}{\text{Total costs}} \times 100
\]
Factory location and layout

The efficiency of a manufacturing facility depends on a number of factors, including the layout of machinery and departments.

Typical plant layout procedures determine how to arrange the various machines and departments to achieve minimization of overall production time, maximization of turnover of work-in-process, and maximization of factory output.

In general, there is strong relationship between the amount of material flow and the proximity of departments when one of the facility planning procedures is deployed. That is, the larger the amount of flow between two departments,.
Factory location and layout

- There are four types of arrangement of the facilities or plant of the conventional factory:
  1. Static or fixed position layout
  2. Process based layout
  3. Cell or group layout
  4. Product based layout
Fixed position layout

The fixed position layout describes the type of manufacturing where the process are brought to the product and not the product to the process.

In general this type of layout is used for product that has constraining characteristics such as being very large, heavy or has some other constraint that prevents its location from being altered while under manufacturing.

Production equipment and personnel are transported to the product and generally involves low volume products with small lot sizes.

Example: Airplane manufacturing, shipyards, railway systems.
Fixed position layout is used to construct airplanes. Why wouldn’t you want to build airplanes using assembly line layout? At least 3 reasons:

1. The plant would be very large and therefore very expensive.
2. The planes are very heavy and therefore expensive to move, and
3. When only partially built, the planes are very fragile. If the wings bounced up and down while they moved down the assembly line, you might damage delicate hydraulic or electrical lines which could compromise the plane’s ability to fly safely.
The process based layout is used in manufacturing and arranged according to the particular process type. All machines are grouped according to their function (process) such as lathes, mills, injection moulding, drilling etc.

Machines with similar functions are grouped together. This type of layout is used from job shopping or batch production companies such as different types of car production and even in service industries.
Products with similar process requirements are assigned to the same manufacturing cell
Product layout

The layout conforms to the sequence of operations required to produce a product.

An example is automobile assembly, where almost all variants of the same model require the same sequence of process.
Types of flow in product layouts

- Straight line
- Serpentine flow
- Circular flow
- U-flow
The decision as to which layout type to adopt will be influenced by the understanding of their advantages as disadvantages. The volume variety characteristics of the manufacturing operations would narrow the choice down to one or two options.

Source: MAS fact sheet: the dti manufacturing service
Cost implications of various layout types are a significant factor. As shown in the Figure below, the total cost, fixed and variable will depend on the volume of products produced.

Source: MAS fact sheet : the dti manufacturing service
## Advantage/disadvantage of layouts

<table>
<thead>
<tr>
<th>Layout</th>
<th>Advantage</th>
<th>Disadvantage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fixed</td>
<td>Large parts can be handled</td>
<td>Less flexibility</td>
</tr>
<tr>
<td>Process</td>
<td>High mix and product flexibility, easy to supervise equipment</td>
<td>Low utilisation of machines, complex flow can be difficult to control and can have high work-in progress</td>
</tr>
<tr>
<td>Cell</td>
<td>Good compromises between cost and flexibility for high variety operations, fast throughput.</td>
<td>More machines needed, can give lower plant utilisation</td>
</tr>
<tr>
<td>Product</td>
<td>Low unit costs for high volume, equipment can be specialised, improving efficiency.</td>
<td>Low flexibility</td>
</tr>
</tbody>
</table>
Advantage/disadvantage of layouts

4. MAS fact sheet: the dti manufacturing service