Manufacturing Processes

- Producing the design is a critical link in the chain of events that starts with a creative idea and ends with a successful product in the marketplace.
- With modern technology the function of production no longer is a mundane activity.
- Rather, design, materials selection, and processing are inseparable.
- There is confusion of terminology concerning the engineering function called manufacturing.
- Materials engineers use the term materials processing to refer to the conversion of semi-finished products, like steel blooms or billets, into finished products, like cold-rolled sheet or hot-rolled bar.
- A mechanical, industrial, or manufacturing engineer is more likely to refer to the conversion of the sheet into an automotive body panel as manufacturing.
- Processing is the more generic term, but manufacturing is the more common term.

- A manufacturing process converts a material into a finished part or product.
- The changes that take place occur with respect to part geometry, or they can affect the internal microstructure and therefore the properties of the material.
- For example, a sheet of brass that is being drawn into the cylindrical shape of a cartridge case is also being hardened and reduced in ductility by the process of dislocation glide on slip planes.
- Manufacturing Process are classified into:

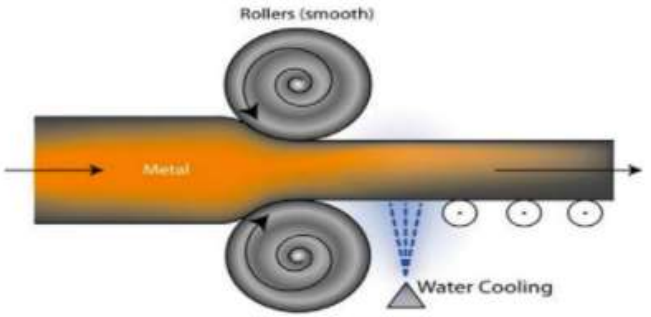
1. Primary shaping process
2. Machining process
3. Joining process
4. Surface finishing process
5. Process affecting change in properties

1. Primary shaping process

Two types:

- One which produce finished product (deforming process) i.e. requires no metal removal Examples: casting, forging, rolling etc.
- One which requires machining operations (material removal process)

Casting



Rolling Process

2. **Machining Process**

✓Machining is any of various processes in which a piece of raw material is cut into a desired final shape and size by a controlled material-removal process.

✓The processes that have this common theme, controlled material removal, are today collectively known as subtractive manufacturing, in distinction from processes of controlled material addition, which are known as additive manufacturing.

Metal Cutting

Lathe Turning

Drilling

3. Joining & Surface finishing process

Welding

- In the welding process, two or more parts are heated and melted or forced together, causing the joined parts to function as one.
- In some welding methods a filler material is added to make the merging of the materials easier.
- There are many different types of welding operations, such as the various arc welding, resistance welding and oxyfuel gas welding methods.

Brazing

- During the brazing process a filler metal is melted and distributed in between multiple solid metal components after they have been heated to the proper temperature.
- The filler metal must have a melting point that is above 840 degrees Fahrenheit but below the melting point of the base metals and the metal must also have high fluidity and wettability.
- No melting of the base metals occurs during brazing.

Soldering

- Soldering is similar to brazing; the only real difference being that in soldering the melting point of the filler metal is below 840 degrees Fahrenheit.
- Again, no melting of the base metals occurs, but the filler metal wets and combines with the base metals to form a metallurgical bond.

Buffing

- Polishing and buffing are finishing processes for smoothing a work piece's surface using an abrasive and a work wheel or a leather strop.
- Technically polishing refers to processes that use an abrasive that is glued to the work wheel, while buffing uses a loose abrasive applied to the work wheel.
- Polishing is a more aggressive process while buffing is less harsh, which leads to a smoother, brighter finish.

4. Process effecting change in properties

- Heat treating is a group of industrial and metalworking processes used to alter the physical, and sometimes chemical, properties of a material.
- The most common application is metallurgical.
- Heat treatments are also used in the manufacture of many other materials, such as glass.
- Heat treatment involves the use of heating or chilling, normally to extreme temperatures, to achieve a desired result such as hardening or softening of a material.
- Heat treatment techniques include annealing, case hardening, precipitation strengthening, tempering, normalizing and quenching.
- It is noteworthy that while the term heat treatment applies only to processes where the heating and cooling are done for the specific purpose of altering properties intentionally, heating and cooling often occur incidentally during other manufacturing processes such as hot forming or welding.

Job production & Batch production:

- **Job Production** is used when a product is produced with the labor of one or few workers and is scarcely used for bulk and large scale production.
- It is mainly used for one-off products or prototypes (hence also Prototype Production), as it is inefficient; however, quality is greatly enhanced with job production compared to other methods.
- Individual wedding cakes and made-to-measure suits are examples of job production.
- New small firms often use job production before they get a chance or have the means to expand.
- Job Production is highly motivating for workers because it gives the workers an opportunity to produce the whole product and take pride in it.
  - ✓ Small number of pieces produced only once - Prototype
  - ✓ Small number of pieces when need arises- Parts of stopped models
  - ✓ Small number of pieces periodically after time interval – Raincoats

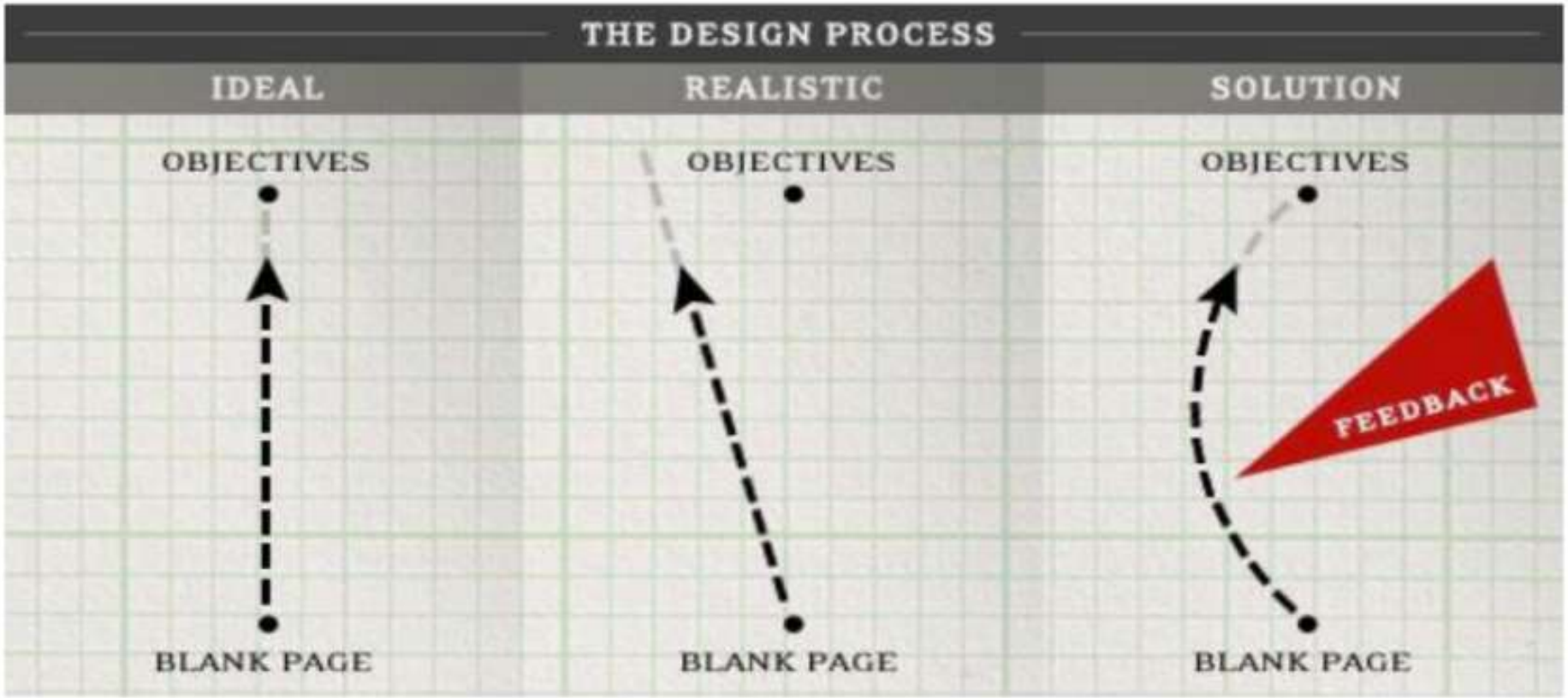
- **Batch production** is the method used to produce or process any product in groups or batches where the products in the batch go through the whole production process together.
- An example would be when a bakery produces each different type of bread separately and each object (in this case, bread) is not produced continuously.
- Batch production is used in many different ways and is most suited to when there is a need for a quality/quantity balance.
- This technique is probably the most commonly used method for organizing manufacture and promotes specialist labor, as very often batch production involves a small number of persons.
- Batch production occurs when many similar items are produced together.
- Each batch goes through one stage of the production process before moving onto next stage.
  - ✓ Batch produced only once
  - ✓ Batch produced repeatedly at irregular intervals
  - ✓ Batch produced periodically at non intervals to satisfy continuous demands
- So job production involves less quantity and more varieties while batch production involves large quantity of identical parts.

Feedback on Design

- ✓At a project's start, the possibilities are endless.
- ✓That clean slate is both lovely and terrifying.
- ✓As designers, we begin by filling space with temporary messes and uncertain experiments.
- ✓We make a thousand tiny decisions quickly, trying to shape a message that will resonate with our audience.
- ✓Then in the middle of a flow, we must stop and share our unfinished work with colleagues or clients.

The critique as a collaborative tool:

- When we embrace a truly collaborative process, critiques afford the incredible intersection of vision, design, strategy, technology, and people.
- The critique is a corrective step in the process that allows different ways of thinking to reach common ground—for example, compromising on visual vs. technological requirements.
- Critiquing an unfinished design mitigates the risk of completely missing a project's ultimate goals.
- Acting as a wedge in the creative process, good feedback can readjust the design message and help us figure out what we're really trying to say.
- It's important to remember that critiques are meant to improve output rather than hinder process.
- Encouraging the overlap of ideas from multiple people, as in critiques, facilitates these breakthroughs.


THE DESIGN PROCESS
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OBJECTIVES
FEEDBACK
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For a designer, a good feedback can:

- ✓prevent a meandering design from veering too far from timeline, budget, scope, or other project constraints.
- ✓allow others to help, teach, and guide when there are weaknesses or confusion, accustom others to the shoddy state of unfinished designs to talk about bigger ideas and strategy.
- ✓familiarize colleagues, managers, and clients with the design process, invest everyone in the project early on, circumvent alarming change requests by responding immediately as a team.
- ✓distribute responsibility for developing creative output.
- ✓help build team trust, and eliminate destructive ego.