Product Design
Scales of Production and Manufacturing Systems
Learning objectives

- To consider the manufacturing process when designing a product.
- To understand the different scales of production: one-off, batch and mass, as well as continuous flow and just-in-time production systems.
- To understand economy of scale and how it affects product design.
- To consider quality assurance and control, health and safety and the environment when planning manufacturing.
Introduction

As well as the function, ergonomics and aesthetics of a product, designers also need to consider how it will be manufactured.

It would be a drain on money and resources if materials arrived at the start of the production line and little thought had been given as to how it was going to be made.

Designers must carefully consider the scale of production against the economic viability of the product.

I hope I’m not expected to make two hundred of these on my own!
Designers and engineers will make one product at a time.

Often these are bespoke (made to order).

One-off production items can be quite original and unusual.

Production time is normally long and therefore has significant cost implications.

Typical one-off products include shop interiors and hand-crafted furniture.

Labour is specialist and highly skilled.
Batch production differs from one-off production because more than one item is manufactured.

A specific number of identical products are made at the same time.

Batches of products are repeated as many times as necessary in response to market demand.

The tools, equipment and machinery, as well as the labour, are used for a variety of products. Typical batch produced products include folding furniture, self-build house kits and bicycles.
In mass production much of the work is automated and requires little human interaction.

The product is made on a production line and passes through the various stages of manufacturing and assembly.

Huge volumes of the product are made using extremely specialist equipment. Often only one product can be made using this arrangement.

Each manufacturing task is broken down into simple jobs and the factory floor is arranged around the flow of the product.

A large, unskilled workforce is needed as tasks are repetitive and straightforward to learn. Typical mass produced products include many electrical items and cars.
# Scales of Production

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![Bridge Image](image-url)
Continuous flow production is normally associated with mass or high volume production.

The product is made continuously for extended periods of time with no interruptions.

The production line is almost completely automated, requiring little, if any, unskilled labour.

Because the equipment is specialized and very expensive, it is not cost-effective to stop production as downtime results in a drop in production rate. Essential products such as petrol, oil and chemicals are examples.
JIT was a principle developed by the Japanese to improve efficiency within a manufacturing environment.

- All of the parts for a product arrive in the right place at exactly the right time.
- Manufacturers do not have to hold large stocks of materials or components, saving money on storage space.
Just in time production (JIT)

Production flow is more efficient with fewer parts being fully manufactured at the same time on site.
Economy of scale is a term describing the relationship between the cost per product (unit) and the volume made.
Product designers aim their products at particular markets or user groups. Companies which manufacture products for use by the public spend significant amounts of money researching the needs, wants and desires of the focus market.

Workforces are recruited according to specific roles, which they are then organized into. They are qualified professionals who have been trained in the skills they need for the job. Each person is part of a team and each team forms part of the overall company system.

How many different potential target markets can you think of?
Developing specialist accommodation

Any company which manufactures products will have some kind of production and assembly factory or plant. Buildings will be developed to respond to the needs of the workforce and the product so that manufacturing is cost-effective. Areas will be specified to respond to different needs, such as:

- raw material storage
- assembly
- finishing
- packaging
- material processing
- recycling.
Introducing communication systems

Communication is an important part of the designing process but it is even more important when designers and engineers work as part of a large team. Information flow and the control of sensitive information (for product confidentiality) can ensure the success of products in the marketplace.

Effective communication is achieved through using the following technologies:

- e-mail
- telephone systems
- video conferencing
- faxes
- instant messaging
Manufacturing systems

How do you think all of these new communication forms will affect the product design process?
Organizing specialist resources

Depending on the product and the levels of investment and technology required, companies may invest in different types of manufacturing systems to produce their product:

- Computer aided design and manufacturing (CAD/CAM).
- Flexible manufacturing systems (equipment that can be adapted to manufacture more than one product).
- Concurrent engineering (all aspects of the design and make process feed into each other and inform each other at the same time).
- Production lines (mainly automated, unskilled labour used for assembly).
- Cell production (teams working together to produce parts).
Developing effective working practices

In any successful business, time equals money. Leaders and managers of manufacturing companies must balance the need to make a quality product against the need to make profits for the main stakeholders in the business. They must consider:

- economy of scale
- sourcing of raw materials
- reducing waste and recycling rubbish
- maintenance of specialist equipment and resources
- overheads (bills for utilities, rent, employers, insurance etc)
Quality assurance (QA) and quality control (QC) are vital in today’s manufacturing market. Consumers are protected by legislation and laws which hold manufacturers accountable to high levels of safe manufacturing.

**QA**: A system of planned procedures designed to ensure that the product and organization meet strict quality standards.

**QC**: Techniques and physical checks used to assess the quality of the product against international standards and within specific tolerances.

What implications do QA and QC have for product designers?
Health and safety is everyone’s concern. Employees should follow guidelines specific to the industry they work in. The Health and Safety at Work Act protects all employees and provides a framework which employers must maintain. One aspect of this is that employers should provide the necessary personal protective equipment (PPE) for workers so that they can carry out their roles with minimum risk.
All designers will work to the 3Rs of environmental consideration. They have a social responsibility to design products that minimize waste, both during manufacture and while in use.

Discuss how the 3Rs relate to your school.
The different manufacturing processes include one-off, batch, mass, continuous flow and just-in-time.

Many factors should be taken into account when choosing the manufacturing method, such as:
- target market
- workforce
- accommodation
- communication systems available.

When manufacturing a product, you must take quality assurance and control, health and safety and the environment into account.