

Section Eight — Knowledge Organiser

These pages summarise all the key principles of designing and making that you need to know — but don't forget to do your own research into two designers and two companies as well. Now, without further ado...

User Needs

Products should meet the needs of the **target market**.

- Ergonomic design** — size and proportions of product are comfortable and appropriate for the user.
Designers use **anthropometric data** → **Measurements** of human body parts, taken from a wide range of body types.
- Products should be **accessible** for people with **disabilities** or physical limitations, and for different **age groups**.
- Manufacturers aim to design products **suitable** for **90%** of the **target market**.

The target market is the group of people that you want to sell to.

Market Research

Identify a **target group**, then discover what sort of product they want.

Questionnaires & Interviews

Closed questions: limited answers, easier to analyse.
Open questions: detailed answers, harder to analyse.
Interviews usually get more **detailed** answers than **questionnaires**.

Focus Groups

Group interviews: guided discussions, **in-depth feedback**.

ICT

Analyse and **present** results using spreadsheets/graphs, or collect **more data** on the internet.

Design Strategies

Systems Approach — breaking down design process into step-by-step stages.

User-Centred Design — user needs prioritised at every stage.

Iterative Design — circular process of testing, evaluating and improving. Repeated until all design problems identified and fixed.

You'll use iterative design in your non-exam assessment.

Basic Design Process

Design Brief
Client writes **design brief**, which tells designer:
• **what** product is needed
• **why** product is needed
• **how** product is used
• **who** target market is

Research
Designer researches product:
Market Research **Conclusions** can cause design brief to change.
Product Analysis

Design Specification
Design brief agreed and **design specification** made.
Shows **design criteria**: e.g. size, function, cost, materials, safety, sustainability...

Product Analysis

Research/evaluate **existing products** to give you ideas.

Function	What does it do ? How does it work ?
Form	How does it look ? What are the aesthetics ?
Sensory Analysis	How does it feel , look , smell or taste ?
Ergonomics	How does the design fit the users' needs ?
Competition and Cost	Does it offer value for money ?
Sustainability	How harmful to the environment is it?
Materials	Which materials does it use, and why?
Manufacture	How is it made? What processes are involved?
Impacts	What are the social and environmental impacts?

Environmental: toxic, recyclable, sustainable, biodegradable materials? Polluting/wasteful processes? Ethical, renewable, non-renewable sources?

Social: fair pay for workers? Safe working conditions?

Fairtrade: makes sure producers get a fair price. Benefits producers, workers, environment.

Every design strategy involves **collaboration** with e.g.
• the client • the target market • experts

Design fixation — getting stuck on an idea. **Avoid it** by collaboration, thinking of new solutions and sticking to design strategy.



Developing a Design

- Develop your initial, freehand sketches into **more detailed** versions.
- **Make a model** of your design.

Models: practice versions of design — **experimental** stage for problem-solving. Use **easy** materials, **CAD/CAM** for 3D printed models and **data** for mathematical models.

Toile: model of **clothing design** — uses **cheap** fabric, **similar** to the planned fabric, easily **marked up**.

Breadboard: model of **circuit design** (board with holes for components) — **no soldering** needed, so circuit can be **easily changed**.



Test/evaluate your model and improve until it meets the design criteria.

Manufacturing Specification

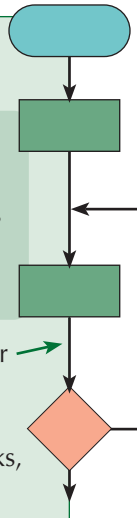
A fully detailed plan explaining to a manufacturer exactly **how to make a product**.

It should show, either in **words** or **diagrams**:

- construction details
- materials
- sizes/dimensions
- tolerances
- equipment
- finishing details
- quality controls
- costings

Work Order chart — flowchart showing order of tasks. Includes **processes** and **decisions**. Can cover tools, quality checks, safety, etc.

Gantt chart — shows **timing** and **order** of tasks, and if tasks can **overlap**.



Drawing Techniques

Freehand sketches — drawn without equipment. Show ideas only (can be annotated with details).

Perspective drawings — show 3D perspective, with 1 or 2 **vanishing points**.

Isometric drawings — best at showing **dimensions**.

System diagrams — flowcharts with input, process, output boxes.

Schematic diagrams — show layout of a system.

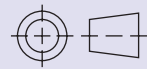
These two are used for electronic and mechanical systems.

Scale drawings — smaller, **proportional** versions of large objects.

Exploded diagrams — **assembly drawings** that show how parts fit together in 3D.

Orthographic projections — 3D object shown as 2D **scale drawings**, viewed from different **angles**:

- **plan view** (from above)
- **front view**
- **end view** (from the side)



The lines used in projections follow a key.

	outlines
	construction lines
	centre lines
	hidden details
	dimension lines

Using Materials Efficiently

Mark out materials with appropriate **tools** so products are made accurately.

Best practice: measure things **twice**, use **thin** marks in **hidden places**, cut on the **waste side** of lines, **remove** marks when you're done with them.

When cutting shapes, **tessellation** or **nesting** will reduce waste — **CAD** can help with layout.



Developing Prototypes

Prototypes — **full-size, fully-working products/systems**, made in the **same way** as the final version will be made.

They allow you to **evaluate**...

- 1 The **manufacturing process** — any problems with materials or processes? Are **costings** accurate? Costs include:
 - materials/components
 - labour
 - packaging
 - equipment
 - energy
 - waste disposal

- 2 The **design itself** — are all criteria in **design specification** and **design brief** met?

Identify any **improvements** or **alterations** needed, make a **new prototype**, **test** it, **improve** it, and so on...

Keep a record of any changes you make.

Working Safely

- **Wear protective clothing/equipment** — e.g. goggles, face mask, protective gloves.

- **Be careful with tools/machinery** — e.g. secure work, use guards, switch things off.

- **Handle materials sensibly** — e.g. store materials safely, dispose of waste properly.

Risk assessment — done for product/manufacture. Identify **hazards**, come up with **precautions**.

Safety tests on product — done by designer.



Stick to these principles to design and make a product successfully...

The designing and making process is full of so many small stages that it's quite easy to get them confused. Make sure you know what happens at each stage, so that you carry everything out in the right order.