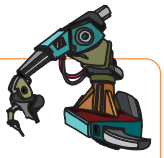
Section One — Knowledge Organiser

From machines and manufacturing to ethics and the environment, this section summarises the key ideas in design and technology. So knuckle down and get stuck in...

Manufacturing and Technology



Automation — machines/robots do tasks automatically with little/no human input.

Automation

- ✓ faster, more accurate and more consistent than people
- ✓ cheaper to use than people
- ✓ can do things not safe for people to do
- ✗ can't do tasks needing human judgement
- ✗ robots are expensive to buy
- ✗ replacing people = fewer jobs

	Effect of technology
Manufacturing	Smart technology lets machines communicate and share data — e.g. to manage tasks and stock efficiently.
Tools and equipment	Tracking devices help monitor location and use.
Communication	Smart machines exchange information. Workers use tablets, calls and online messages to communicate efficiently.
Buildings	Modular factories easily added to or rearranged. New tech can reduce space needed.

Manufacturing Methods

Flexible Manufacturing Systems (FMS) — different machines do different stages of production. Easy to adapt for new products, processes or quantities.

Lean Manufacturing — aims to minimise resources used and waste produced. Minimum cost, maximum efficiency. Uses JIT stock control.

Just-in-Time (JIT) stock control — materials/components delivered when needed and used right away. Saves space and money but needs fast, reliable delivery.

CAD and CAM

CAD = Computer Aided Design — using computer software to help design a product

CAM = Computer Aided Manufacture — using computers to help produce a product

- Computer numerically controlled (CNC)
- Additive (material added to build object) or subtractive (material removed to form object)
- E.g. routers, laser cutters, 3D printers

Product Sustainability

Sustainable — no permanent damage to the environment and does not use up finite resources.

Sustainability of a product depends on:

- what it's made from
- how it's made
- how it's used

Carbon footprint — amount of greenhouse gases (e.g. carbon dioxide, methane) released when making, using and disposing of a product.

Global warming — rise in global temperatures caused by release of greenhouse gases.

Recyclable materials can be processed and remade into something else.

Biodegradable materials rot down naturally.

Social footprint: product's impact on people — e.g. working conditions and health impacts.

Design Principles

Design for Disassembly — product taken apart at end of life. Parts recycled or reused. Sustainable.

Design for Maintenance — product is durable, parts are maintained, repaired or replaced as needed. E.g. modular electronics. Sustainable.

Planned Obsolescence — product designed to become obsolete (useless) quickly. Needs to be scrapped and replaced. Unsustainable.

Continuous Improvement — design constantly updated to improve product, e.g. by using new technology. Can both increase and decrease sustainability.

Life Cycle Assessment (LCA)

Material

- How does it affect the environment?
- Is it sustainable?
- How much energy is used to get it?

→

Manufacture

- How much energy does it use?
- How much pollution/waste does it cause?
- How to dispose of waste?

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Use

- How does use affect the environment?
- Does product cause pollution?

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Disposal

- Will it be recycled or go to landfill?
- Will it cause pollution?

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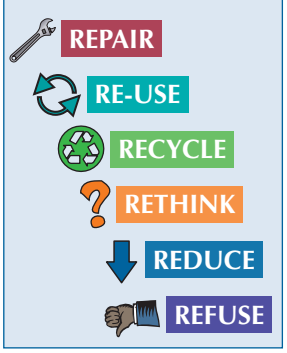
The Six Rs



Products and Society

Market pull — when a product is designed to fulfil consumer demand.

Designs consider needs of specific groups. E.g.

- Disabled people — e.g. larger text or voice commands for the visually impaired.
- Elderly people — e.g. larger buttons for people with reduced dexterity.
- Faith groups — e.g. avoid use of religious symbols in a way that causes offence.

Technology and Design

Technology push — when advances in technology drive design of new products and redesign of old ones.

Technology can affect **jobs**:

- Automation means fewer people needed for manual tasks.
- Creates new jobs for people to develop, use and operate new technology.
- Changes how existing jobs work — e.g. delivery drivers using sat navs for route planning.

Technology can affect **culture**:

- New technology can be unpopular with some groups, e.g. vegans wouldn't buy a new material made from animal products.
- New technology can change fashion (e.g. new materials) and trends (e.g. through social media).

Enterprise — identifying new business opportunities.

Crowdfunding	Promoting a design to the public on the internet and asking them to invest money to get the product made. Backers are rewarded for their investment when product is funded.
Virtual marketing	Using the internet to promote a product — e.g. social media, emails.
Virtual retail	Using the internet to sell a product.
Co-operative	A business owned and run by its members. Decide together how the business is run and share profits. Cooperatives are a feature of Fairtrade.

Energy Resources

Fossil Fuels

Finite (non-renewable) resources. E.g. coal, oil and gas.

In a power station:

Fuel burnt to boil water and make steam.

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Steam drives turbine.

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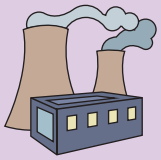
Turbine drives generator to make electricity.



- ✓ reliable
- ✓ low extraction and running costs
- ✗ will run out
- ✗ cause pollution
- ✗ negative social and environmental impacts

Nuclear Power

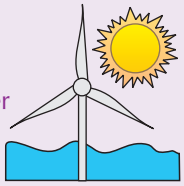
Finite resource. Generates electricity through nuclear reactions.

- ✓ reliable
- ✓ cheaper to run than other sources
- ✓ low greenhouse gas emissions
- ✗ will run out
- ✗ expensive to set up
- ✗ dangerous waste
- ✗ risk of disaster

Renewable Resources

Non-finite (renewable) resources. E.g.

- wind power
- solar power
- tidal power
- hydro-electric power
- biomass



- ✓ low pollution
- ✓ low emissions
- ✓ low cost after set-up
- ✗ can be unreliable due to external factors
- ✗ expensive to set up
- ✗ can have negative social impact
- ✗ can change environment around them

Storing Energy

Hydro-electric power stations use "**kinetic pumped storage**" to store energy.

- Spare energy from power stations is used to pump water up from lower reservoir to higher one.
- Water flows back down to make more electricity when demand is high.

Batteries store chemical energy. Chemical reactions create electric voltage to power portable devices.

Alkaline batteries

- disposable — only use once
- recyclable
- last a long time
- power output decreases until flat

Rechargeable batteries

- used repeatedly
- recharged using electricity
- expensive to buy, cheaper to use in the long term
- constant power output until flat

There's lots to consider when designing a product...

Designing a product isn't just about having a good idea. You have to think through how you'll make it, where the materials and energy come from, how it'll be used, and even how it'll be disposed of in the end.