

Natural Timbers

Softwoods are generally cheaper than hardwoods as they are more available, since they grow quicker.

But because man-made boards are manufactured they are cheaper than timbers. Man-made boards also come in a better variety of sizes since they don't depend on tree growth.

Stock forms for both include; sheets, dowel, planks, etc

Hardwoods come from Deciduous Trees . These trees lose leaves in winter and grow fruit and flowers in spring		
Material	Key info	Examples
Ash	Flexible, tough and shock resistant	Sports equipment Tool Handles
Beech	Fine finish, tough and durable	Toys, furniture and veneers
Mahogany	Easily worked, durable, high quality finish	High-end furniture
Balsa	Very soft and spongy. Light	Modelling
Oak	Tough, durable and hard	Flooring, furniture and veneers

Softwoods come from Coniferous Trees . These have thin, needle-like leaves and grow all year round. Often have pine cones and sometimes nuts and seeds		
Material	Key info	Examples
Larch	Durable, tough, good water resistance and finishes well	Furniture, flooring and used outdoors
Pine	Light, easy to work with but can split	Cheap furniture, construction and decking
Spruce	Easy to work with, high stiffness but can decay quickly	Furniture, musical instruments and construction

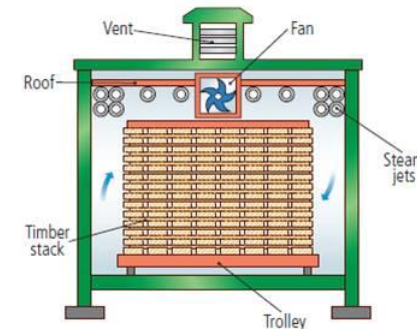
Man-Made Boards

Manufactured boards are made from wood chips/dust/ layers and glue.		
Material	Key info	Examples
Chipboard	Prone to chipping but good compressive strength. Not-water resistant	Flooring, low-end furniture, flat-pack
MDF	Rigid and stable. Easy to finish. Absorbs liquid easily	Flat-pack furniture and kitchen units
Plywood	Very stable. Exterior veneer can be used from more expensive woods	Shelving, furniture, toys

Primary Processing of Papers and Boards

Trees are cut then converted into planks by cut using saws
It is then seasoned to reduce the moisture in the wood. This is done by either:

- Air-drying** – Planks are stacked and air allowed to circulate; causing evaporation
- Kiln-drying** – Where planks are put into a kiln and dried rapidly. This process is more costly than air-drying



Manufactured boards can be either be made by lamination or compression

Lamination – Layers of woods and adhesive are layered and compressed together. Usually with a more expensive wooden veneer on the top

Compression – Wood is shredded, heated and compressed with adhesive under extreme pressure

Metals, Alloys and Plastics

Metals

Metals come from ores in the ground. **Stock forms** are sheets, bars and rods

Ferrous Metals contain iron and are magnetic and rust		
Material	Key info	Examples
Low Carbon Steel	Tough and ductile and easily machined and welded	Construction, screws, cars
High Carbon Steel	Hard and wears well	Tools, blades and knives
Cast Iron	Hard but brittle. Easily cast but hard to machine	Pots, pans, vices

Non-Ferrous Metals do not contain iron, aren't magnetic and don't rust		
Material	Key info	Examples
Aluminium	Light, high strength to weight ratio and ductile	Pots, pans, cars, cans
Copper	Ductile, malleable and good conductor	Plumbing supplies and cables
Tin	Soft, malleable and good conductor	Used as a protective coating

Alloys

Alloys are mixtures of 2 or more metals to get the best of their properties

Material	Key info	Examples
Brass	Malleable and easy to cast	Musical instruments, plumbing
Stainless Steel	Doesn't rust, hard and smooth	Cutlery, medical tools, etc

Plastics

Plastics come from crude oil. **Stock forms** are sheets, powders, granules and rods

Thermoplastics can be reheated and reshaped and infinite amount of times		
Material	Key info	Examples
PET	Easily blow moulded , food safe and easily recycled	Bottles, packaging, etc
PVC	Flexible, tough, easily extruded	Pipes, tape, hard hats
HIPS	Flexible, lightweight, food safe and easily vacuum formed	Containers and yoghurt pots
Acrylic	Tough, brittle, easily scratched	Car lights, baths, displays/ signs

Thermosets once heated and set cannot be reshaped		
Material	Key info	Examples
Melamine Formaldehyde	Food safe, hygienic, hard and brittle	Kitchenware and work surfaces
Urea Formaldehyde	Good insulator, hard and brittle	Electrical casings, buttons and handles
Polyester Resin	Strong, heat resistant, can be transparent	Coatings, casings

Primary Processing of Metals and Alloys

Metals are mined from the earth and then go through an extraction process. Extraction happens by putting the ore in a blast furnace. The metal is then separated from the waste material.

Primary Processing of Plastics

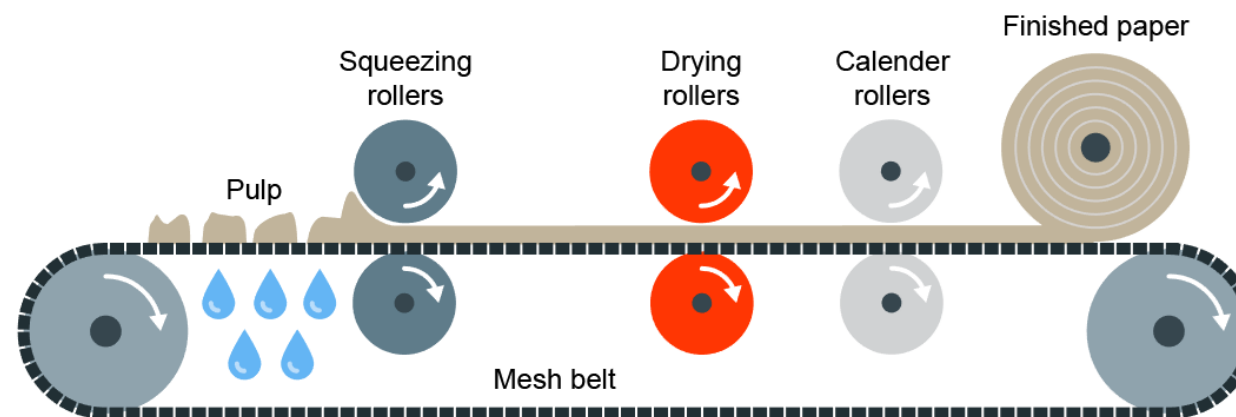
Crude oil is extracted from the earth and then processes into different types of fuels, etc. This is called **Fractional Distillation**. A process called **Cracking** then converts the large hydrocarbon molecules into plastics.

Modern Materials are materials that have been developed recently		
Material	Key info	Examples
Corn-starch Polymers	These are plant-based polymers that are a replacement for plastics that are biodegradable but cannot be recycled.	Plastic bottles, tubs, food containers, etc
Flexible MDF	Made in the same way as normal MDF but with grooves cut into the surface so it is flexible. Flexiply is the same but for Plywood. These can easily be shaped into curves	Modern furniture, interior walls and room dividers
Titanium	High strength to weight ratio. Doesn't corrode or rust. Suitable for medical use as its hypo-allergenic	Prosthetics, medical applications, sports cars, etc
Kevlar	A woven polymer with a high strength to weight ratio.	Bullet-proof vests, tyres, helmets, etc

Papers and Boards come from trees. The Stock forms for papers are: rolls, sheets, A4, A3, etc		
Material	Key info	Uses/ Examples
Cartridge Paper	Thick white paper, completely opaque and more expensive than photocopy paper	Sketching, ink drawings
Layout Paper	Light, semi-translucent, good for blending inks and artist markers	Sketching, drawing and some tracing
Corrugated Cardboard	Strong but light. Rigid triangles of card sandwiched between a top and bottom layer.	Outer packaging, food packaging
Duplex Board	Light card with white outside layers. Waxy coating can be added	Cheap packaging. If waxy coating is applied, can be used for food
Foil-lined Board	White card coated with a thin aluminium layer. Foil is great for insulation and water resistance	Takeaway containers
Solid White Board	High-quality white card with a smooth finish. Stiff and holds colours well	Greetings cards, packaging and advertising

Smart Materials are materials that change and react to the stimuli		
Material	Key info	Examples
Thermochromic Pigments	Change colour in reaction to heat	Kettles, baby bottles, etc
Photochromic Pigments	Change colour in reaction to light	Colour changing glasses, windows, etc
Shape Memory Alloy	Returns to its original shape, in reaction to heat	Braces and glasses
Polymorph	Granules that once exposed to hot water, become a modelling material (like a dough or clay)	Modelling and repairs

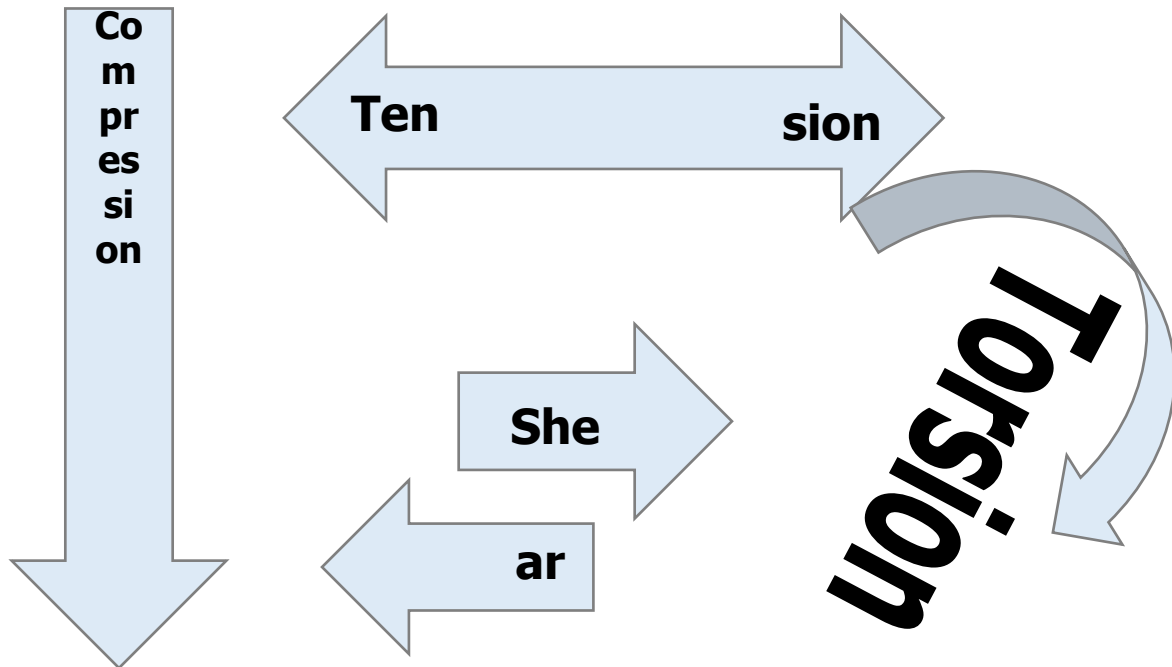
Primary Processing of Papers and Boards



Paper is made by first making pulp. Pulp is a mix of tree fibres and water. This is cooked and bleached white, and adding any other additives. The pulp is then drained and goes through **Calendering** where the pulp is drained and goes through rollers to convert it to its stock forms

Mechanical Systems

Forces



Motion

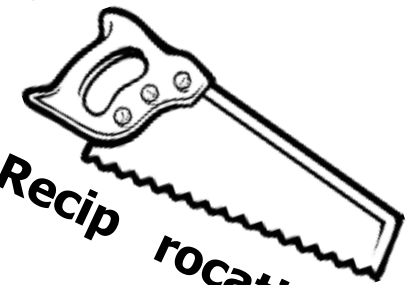


Linear

Rotation

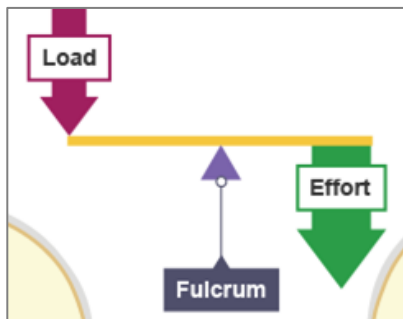


Oscillating

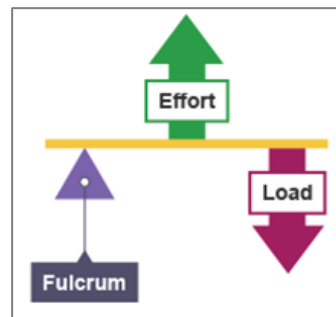


Reciprocating

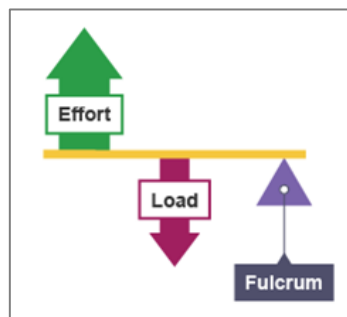
Levers



1st Class Lever:
Fulcrum in the centre
E.g. Scissors



3rd Class Lever:
Force in the centre
E.g. Lifting a dumbbell



2nd Class Lever:
Load in the centre
E.g. wheelbarrow

Gears and Pulleys

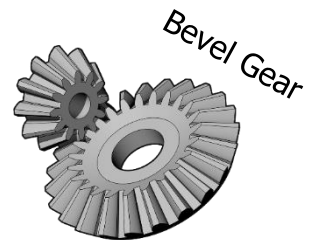


A Pulley is a grooved wheel, that has a belt running through it

This uses rotary motion and is often used to help with heavy loads, and transfer force from a motor to a tool in machines like drills, etc

Gears have teeth that mesh together with each other (like teeth on a zip)

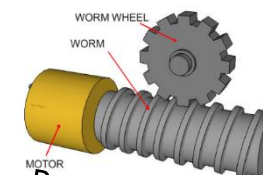
They mainly focus on rotary motion on tools and machinery e.g. car steering and pillar drills



Bevel Gear



Spur Gear



Rack and Pinion



Worm and Wheel



Non-Renewable Energy Sources	This is when certain sources of energy will run out eventually
Fossil Fuels	<ul style="list-style-type: none"> • Coal, Oil and Gas • Burned to create steam, turned in turbines to create electricity. • Burning creates CO₂ which adds to Global Warming
Nuclear Power	<ul style="list-style-type: none"> • Nuclear Fission controls the reactor (that creates the electricity). This requires Uranium which is non-renewable • Accidents and waste can severely damage the environment and cause radiation poisoning • Radiation poisoning can be fatal and cause physical deformations • Nuclear waste has to be disposed of properly and is hazardous for thousands of years.

Renewable Energy Sources	This is when certain sources of energy will not run out.
Solar	<ul style="list-style-type: none"> • Solar panels are used to collect light and convert it into electricity • There is no waste and a consistent supply • However, the panels are not effective at night or in countries where there isn't a lot of sunlight
Wind	<ul style="list-style-type: none"> • Turbines harness wind energy • Not effective on non-windy days • Some people don't like turbines as they are noisy, and not attractive to look at
Hydro-Electrical	<ul style="list-style-type: none"> • This harnesses energy from water held behind a dam • Has to be created by flooding land – damaging wildlife habitats • Tidal energy comes from using energy from waves
Biomass	<ul style="list-style-type: none"> • This is fuel from natural sources e.g. crops, scrap woods and animal waste • Growing biomass crops produces oxygen and uses up CO₂ • However, is a very expensive method

Storing Energy

Pneumatics: This is the production of energy using compressed gas or air. E.g. Pistons in an engine

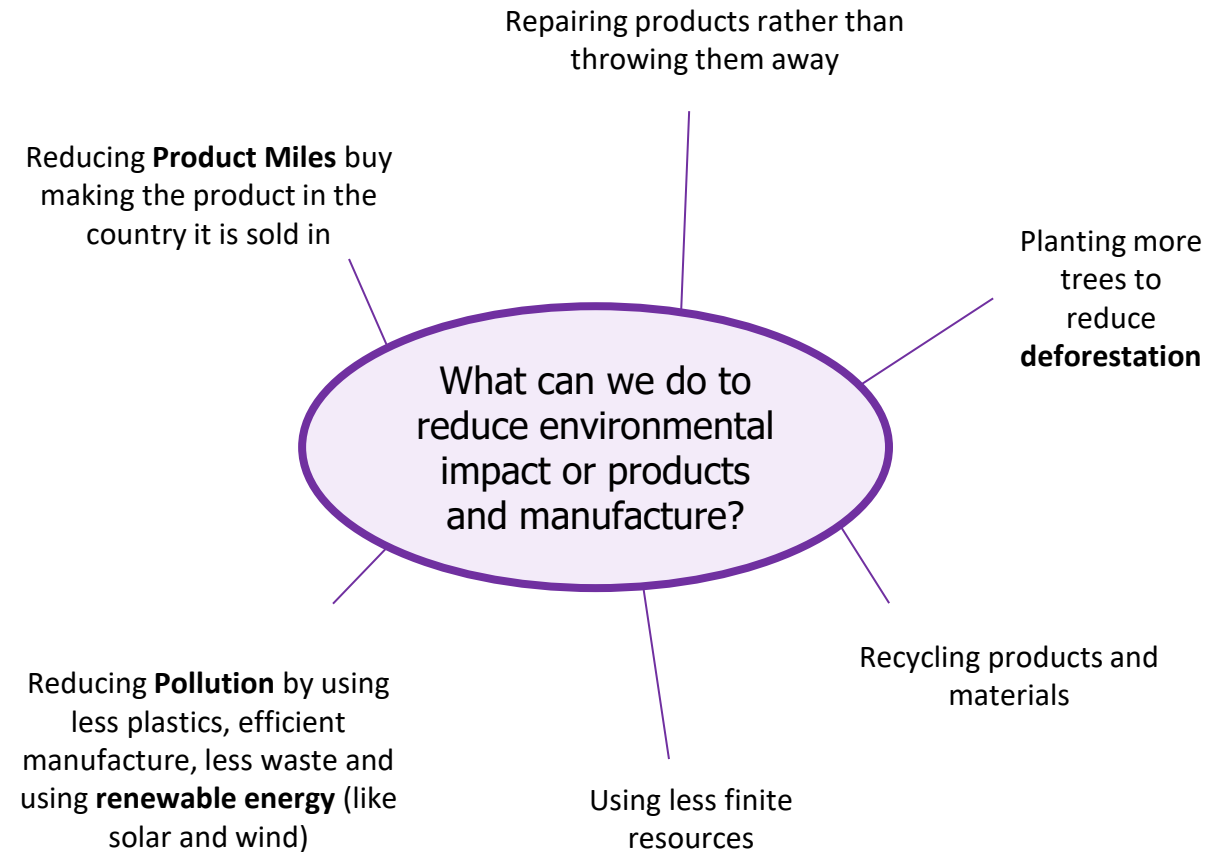
Hydraulics: Like a Pneumatic system, but uses water or oil under pressure. E.g. Wheelchair lifts

Kinetic: Energy that is generated by movement. This is stored by items like springs in a "clickable" pen or balloons,

Batteries: Electrical power can be stored in batteries. Rechargeable batteries are becoming increasingly popular.

Environment

The 6Rs	Meaning
Reuse	To use a product again either for the same purpose or a different one
Reduce	To have less of material/packaging/pollution when making products by making them more efficient
Recycle	Breaking down and forming the material into another product
Refuse	Customers not buying or supporting products that make an environmental impact
Rethink	Designers and customer rethinking their decisions when making and buying products.
Repair	Fixing a product rather than throwing it away. Extending its life rather than using more resources to make another Often products are Designed for Maintenance so can easily be repaired. E.g. Using screws so even non-specialists can take a product apart, or using components that can easily be replaced like fuses or batteries



Life Cycle Assessment



This is when a designer looks at the environmental impact a product makes over its life time and how it could be reduced. Including:

- Impact of materials
- Impact of processes
- Product Miles (how far a product has to travel to get from factory to consumer)
- Impact while in use
- Impact when disposed of (6Rs)

Sustainability is maintaining our planet and its resources and making a minimal negative impact

Finite Resources <i>Will run out of eventually</i>	Infinite Resources <i>Can be re-grown and re-bred. Will not run out of</i>
Plastics	Paper
Metals	Boards
Polymers (Textiles)	Natural Timbers
	Cotton
	Leather

Planned Obsolescence	This is where products “die” after a certain amount of time. E.g. Disposable cups, Phones, Lightbulbs, Printer Ink, etc This can have a big environmental impact as customers are throwing away lots of products, and resources are being used to create new ones.
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Industry and Enterprise

Automation

This is when machines and robotics help make products or make them for you.

Often this is done by **CAD (Computer Aided Design)** and **CAM (Computer Aided Manufacture)**

This helps products be made quicker, with more accuracy. Reducing errors humans make to products.

However, these machines are expensive to buy, need specialist training to use and need constant maintenance to keep them working properly

Virtual Marketing

This is when websites, social media and email are used to promote and sell products. This has become very popular in recent years, with big social media apps being funded by advertisers

Companies can also pay search engines to push their company further to the top of the results page, so customers are more likely to click it.

Cooperatives

A Cooperative is an Enterprise that is run by members that are part of the workforce or customers.

This means the organisation is democratic and often supports the local community. They are set-up to protect the rights of their members and ensure the same rules apply to everyone

Enterprise

This is when an idea is developed into a business and produces a viable product.

Often, one of the biggest enterprises in in apps for smartphones

To make sure ideas are protected from being copied, a **Patent** can be applied for. This legally protects your idea on invention from being stolen.

Crowdfunding

This is where ideas are funded by large groups of ordinary people.

www.Kickstarter.com is a good example of this.

Fair Trade

This is an organisation that promotes fair pay, working conditions and better trade with farmers in developing countries

You can tell when something is Fairtrade as it will often have the symbol on the product or packaging. Common Fairtrade items include; bananas, cotton and chocolate.



Market Pull and Technology Push

Technology Push is the development of new technology, materials and manufacturing methods to create new products or improve old ones.

Examples include; Smart Phones, Electricity, Mass Production, etc

Market pull is the demand from consumers for new products and improvements in old ones; this is often found via reviews, polls, surveys, etc

Examples include; Product **Aesthetics**, making products easier to use, etc

Cultures, Faith and Belief

Different groups of people have different interests and have to be catered for.

Different countries and cultures also react to products differently.

E.g. In India McDonalds don't sell beef burgers as it has a large Hindu population, and cows are seen as sacred – in contrast the UK sells its most amount of fish and chips on a Friday as it is a Christian tradition to not eat meat on that day.

Case Study: £5 note

Hindu, Sikh and some other faith-based communities may choose to follow a vegetarian diet, and this is part of their culture. In addition to not eating meat, many followers of these faiths, as well as vegans and vegetarians, take every opportunity to avoid using animal products in their day-to-day lives.

The revelation in 2016 that the new polymer Bank of England £5 note contained tallow, an animal fat-based substance, upset a number of communities. There was a prompt call for the Bank of England to find an alternative way to produce the note and in the first two days of an official petition well over 100,000 signatures were received.

Shortly after the Bank of England admitted that the new polymer £5 note contained the animal by-product, some establishments refused to take the notes as a method of payment. One café owner was repulsed by the idea that the note contained tallow and believed that her customers supported her view. They received no complaints.



The Bank of England say they currently have no plans to change the manufacturing process.

Fashion and Trends

Fashion and Trends will change quickly, and you can see major differences in fashions over decades.

Designers have to make sure their products meet the fashion and trends of the area they are designing and selling the product to.

The change of products over time is called **Product Evolution**. This is caused by Market Pull, Technology Push and Fashion and Trends.



Some products are seen as **timeless**. These products are called **Iconic Designs**. These products are timeless because they were innovative, set a bench mark for following products, changed their industry and are often copied. Examples include; iPod, iPhone, Angle-Poise Lamp, Swiss Army Knife, Converse Shoes, Levi's Jeans, Classic Mini Cooper



Inclusive vs. Exclusive Design

Inclusive Design: The aim to create a product that as many people as possible can use

Examples include; Cars, Doorframes, Adjustable Products, etc

Exclusive Design: The aim to create a product for a particular group and their needs

Examples include; Car seats for babies, Wheelchairs, Stair Lifts

Production Techniques and Systems

CAD Computer Aided Design	
Examples; 2D Design, Autodesk Inventor, Fusion 360, Photoshop, etc	
Advantages	Disadvantages
<ul style="list-style-type: none"> • Easy to change designs • Designs are easily saved and sent • Can be worked on by multiple people simultaneously • Can be used for virtual testing • Can produce high-quality designs 	<ul style="list-style-type: none"> • Complex and time-consuming to learn <ul style="list-style-type: none"> • Expensive to buy • PCs can crash or be hacked – causing work to be lost • Takes up PC memory

CAM Computer Aided Manufacture	
Examples; 3D Printing, Laser Cutting, CNC Router, Automated Machines and Robotics, etc	
Advantages	Disadvantages
<ul style="list-style-type: none"> • Faster and more accurate than traditional tools • Repetitive accuracy/ consistent outcomes <ul style="list-style-type: none"> • Machines can run 24/7 	<ul style="list-style-type: none"> • Expensive to buy the equipment, etc • Training takes cost and time • Need specialists to maintain and repair the machines • Dependence on CAM can cause unemployment

Flexible Manufacturing Systems
<p>This is where automated machines are adaptable and can produce different products if needed.</p> <p>If a manufacture is making a product with machines that are just dedicated to specific tasks they have to be reprogrammed and re-tooled before changing to a new task. This is time consuming and expensive.</p> <p>Examples include; CNC Machines, 3D Printers, Laser Cutters, Robotic arms, etc</p>

Just-in-Time (JIT) Manufacture	
<p>This is where manufacturers only order materials, parts, etc when needed. The customer's order triggers the production process and the resources needed for that order are the only ones bought.</p> <p>This can be used in any scale of production but is particularly useful for one-off production.</p>	
Advantages	Disadvantages
<ul style="list-style-type: none"> • Saves on warehouse and storage costs • Money is not tied-up in stock <ul style="list-style-type: none"> • Little/minimal waste • Customer often pays in advance so money is secure before production 	<ul style="list-style-type: none"> • All production stops if a part/ material is missing • Needs to have a fast, reliable and good quality supply chain to work properly • Can be time-consuming

Lean Manufacturing
<p>This is where waste and energy is kept to a minimum. This helps manufacturers save money and resources in production, as well as helping minimise the environmental impact of producing products.</p>

Scales of Production

Name/ Type	How many it makes	Key Info	Examples of Products
One-off Production	1	<ul style="list-style-type: none"> Also known as Bespoke or Prototype manufacture <ul style="list-style-type: none"> Custom-made products Specialist workers/ skills Specialist machines and materials High Quality but expensive 	<ul style="list-style-type: none"> Towers / Bridges One-off Houses Custom made clothes
Batch	10s-1000s	<ul style="list-style-type: none"> Uses a mix of workers and machinery Uses jigs, moulds and templates to help make identical products Stations of workers e.g. cutting station, painting station, etc Can have some variation e.g. colour, finish, flavour 	<ul style="list-style-type: none"> Baked foods Limited edition car <ul style="list-style-type: none"> Socks Chairs
Mass	10,000s - 100,000s	<ul style="list-style-type: none"> Big assembly lines (and sub-assembly lines) <ul style="list-style-type: none"> Heavily automated Standard and identical products <ul style="list-style-type: none"> Little worker input 	<ul style="list-style-type: none"> Cars Bottles Microchips Plain shirts
Continuous	100,00s +	<ul style="list-style-type: none"> 24/7 production Heavily automated Standard and identical products <ul style="list-style-type: none"> Little worker input 	<ul style="list-style-type: none"> Energy Water Paper Plastic

One-off Production	
Advantages	Disadvantages
<ul style="list-style-type: none"> Custom made High Quality Materials High Quality Craftsmanship 	<ul style="list-style-type: none"> Time consuming Specialist training for workers Expensive to buy

Batch Production	
Advantages	Disadvantages
<ul style="list-style-type: none"> Lower cost than one-off Jigs, moulds and templates help products look identical Can have some variety 	<ul style="list-style-type: none"> High storage costs Jugs, moulds and templates have to be checked Workers can become bored on their station

Mass Production	
Advantages	Disadvantages
<ul style="list-style-type: none"> Large amounts made at once All products are identical and to same standard Using automation reduced human error 	<ul style="list-style-type: none"> Initial starting costs are high If production line stops, the product can't be made Workers become bored monitoring machines and repetitive tasks

Continuous Production	
Advantages	Disadvantages
<ul style="list-style-type: none"> Large amounts made at once All products are identical and to same standard Using automation reduced human error 	<ul style="list-style-type: none"> Initial starting costs are high If production line stops, the product can't be made Workers become bored monitoring machines and repetitive tasks

Finishes

Finishes are used to improve the **aesthetics** and **durability** of products

Material Type	Finishes Used
Papers and Boards	<ul style="list-style-type: none"> Paints Varnishes Laminating Plastic coating Wax coating
Timbers and Boards	<ul style="list-style-type: none"> Paints Varnishes Wax and Polish Staining Oil
Metals and Alloys	<ul style="list-style-type: none"> Painting Lacquering Electroplating Galvanizing Polishing Plastic Coating Powder Coating
Plastics	<ul style="list-style-type: none"> Polishing Painting Decals (stickers)

Standard Components

Standard components are parts or components manufactured in the 1000s+ They are readily available, don't require specialist knowledge or tools to replace them and are universally recognised

Material Type	Components used
Papers and Boards	<ul style="list-style-type: none"> Staples Clips Split pins
Timbers and Boards	<ul style="list-style-type: none"> Nails Screws Panel Pins Hinges
Metals and Alloys	<ul style="list-style-type: none"> Nuts and bolts Screw Rivet Washer
Plastics	<ul style="list-style-type: none"> Plastic hinges

Tolerances

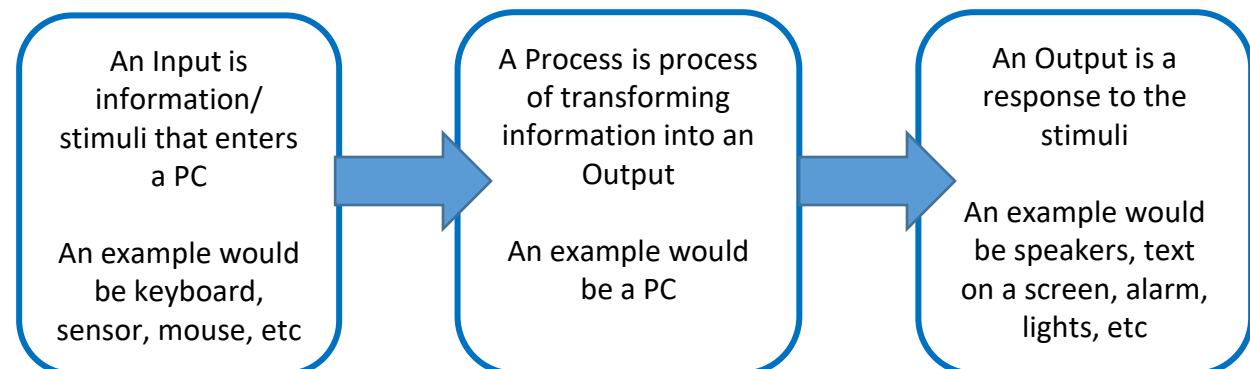
- The total amount a specific dimension or property is permitted to vary
This can apply to hole depth, length, angle, thickness, weight and elasticity
A gauge can be inserted into a gap or hole to check if the sizes fall within tolerance
If parts do not fit within the specified tolerances they are discarded or recycled

Quality Control and Quality Assurance

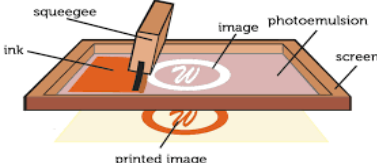
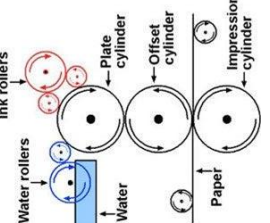
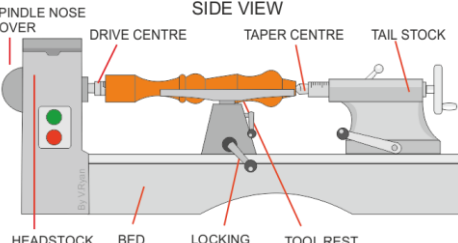
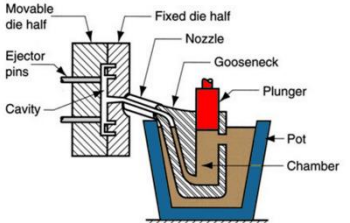
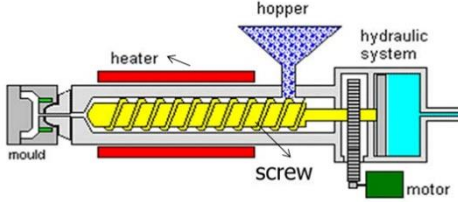
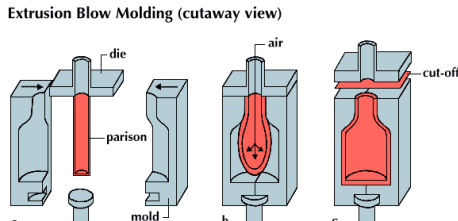
- QC is **product** oriented
Quality control is where products are regularly tested (during and after manufacture) to ensure they meet the defined set of quality criteria
- QA is **process** oriented
Quality assurance is ensuring that the processes used to test the product have been done correctly and consistently
You can test a product all you like, but if the tests are wrong/ inconsistent with each other than the results are invalid
- Below are examples of Quality Assurance symbols:



Process Orders

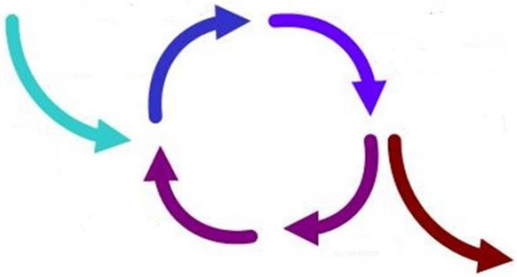


Production Processes

Name of Process	Diagram	Material	Products Made	Key info
Screen-printing	 <p>The diagram shows a squeegee moving across a screen that has a stencil. Ink is pushed through the stencil to create a printed image on a surface below. Labels include: squeegee, ink, image, photoemulsion, screen, and printed image.</p>	Papers and Textiles	Posters, signs and t-shirts	<p>Screen printing places paint on top of a screen. The screen has a stencil embedded in it, so when the paint is passed across it the desired shape is printed underneath.</p> <p>Good process in one-off and batch production as often done by hand</p>
Offset Lithography	 <p>The diagram illustrates the offset lithography process. It shows a series of rollers: ink rollers, water rollers, a plate cylinder, an offset cylinder, and an impression cylinder. Paper is fed between the rollers. Labels include: Ink rollers, Water rollers, Plate cylinder, Offset cylinder, Impression cylinder, and Paper.</p>	Papers and card (thin, flexible plastics)	Posters, newspapers, plastics bags	<p>Rollers containing the colours and water go onto the plate cylinder. The water stops the colours sticking to certain places, creating the shape. The shape is transferred between rollers and onto the material.</p> <p>Can be used at batch and mass production</p>
Lathe Turning	 <p>The diagram shows a lathe machine in a side view. Labels include: SPINDLE NOSE COVER, DRIVE CENTRE, TAPER CENTRE, TAIL STOCK, HEADSTOCK, BED, LOCKING HANDLE, and TOOL REST.</p>	Wood and metal	Chair legs, baseball bats (cylindrical items)	<p>Material is placed between the tail stock and the headstock and spun at high speed. The material is then cut using specialist tools (either by hand or by automated machinery) to the desired shape.</p> <p>Can be used in one-off and batch production</p>
Die Casting	 <p>The diagram shows a die casting machine. A plunger forces molten metal through a nozzle into a chamber between a movable die half and a fixed die half. Labels include: Movable die half, Fixed die half, Nozzle, Gooseneck, Plunger, Pot, Chamber, Ejector pins, and Cavity.</p>	Metal	Car parts, engine components, etc	<p>Molten metal is poured into a chamber and a plunger forces the metal through the nozzle into the mould. Unlike sand casting, the mould is reusable.</p> <p>Good process for both one-off and batch production</p>
Injection Moulding	 <p>The diagram shows an injection moulding machine. Plastic granules are poured into a hopper, then heated and forced into a mould by a screw. Labels include: hopper, heater, mould, screw, hydraulic system, and motor.</p>	Plastics	Chairs, toys, etc	<p>Plastic granules are poured into the hopper and onto the screw. The screw moves the material towards the heater where it turns into a liquid. The liquid is then forced into the mould, cooled and released.</p> <p>Great process for mass production as it makes 100s+ of products at once, to a identical standard.</p>
Blow Moulding	 <p>The diagram shows the extrusion blow moulding process in three stages: (a) extrusion of a parison from a die, (b) inflation of the parison in a mould with air, and (c) cutting off the finished bottle. Labels include: die, parison, mould, air, and cut-off.</p>	Plastics	Plastic bottles	<p>A Plastic parison is heated and put into the mould. The parison is then filled with air (like blowing up a balloon) and is forced to fit the mould shape. It is then cooled and then released.</p> <p>This is a great process for mass producing bottles.</p>

Design Strategies

Design Strategies are used to solve **Design Fixation**, and help develop creative design ideas.



Iterative Design

- A Proposal is made
- It is then planned and developed to meet the brief
 - It is analysed and refined
 - It is then tested and modelled
- Then evaluated against the brief – many versions fail but that then informs development to make the idea better
- The cycle then repeats and if the product is successful it is then made and sold on the market

Iterative Design	
Advantages	Disadvantages
<ul style="list-style-type: none"> • Consistent testing helps solve problems earlier <ul style="list-style-type: none"> • Constant feedback • Easy evidence of progress 	<ul style="list-style-type: none"> • Designers can lose sight of "the big picture" <ul style="list-style-type: none"> • Time consuming

User-Centred Design

- This is when designs are based on fulfilling the needs and wants of the Users/ Clients at every stage of the design process
- Questioning and testing is ongoing and is often found through interviews, questionnaires, surveys, etc

User-Centred	
Advantages	Disadvantages
<ul style="list-style-type: none"> • User feels listened to • Makes sure the product meets their needs 	<ul style="list-style-type: none"> • Requires extra time to get customer feedback • If focused on just one person it can limit appeal to others

Systems Approach

- Usually used for electronic products
 - Often uses diagrams to show systems in a visual way
- Planning the layout for the correct sequences e.g. inputs, outputs, timings, etc
- Electronics and mechanical systems need an ordered and logical approach

Systems Approach	
Advantages	Disadvantages
<ul style="list-style-type: none"> • Does not need specialist knowledge <ul style="list-style-type: none"> • Easy to communicate stages • Easy to find errors 	<ul style="list-style-type: none"> • Sometimes over-simplifies stages • Can lead to unnecessary stages

Collaborative Approach

- Working with others to share data and solving problems and coming up with design proposals can help with creativity
- Numerous companies work in teams, and has been shown to improve the range and quality of ideas produced

Collaborative Approach	
Advantages	Disadvantages
<ul style="list-style-type: none"> • Gets multiple opinions and a range of views • Working in groups can produce more ideas 	<ul style="list-style-type: none"> • Can be difficult to design ideas with opposing views • Can be difficult to find time to communicate with multiple people

Design Briefs

A Design Brief is the statement of how you will solve the Design Problem
It will often include:

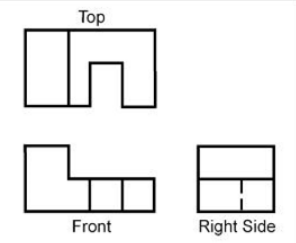
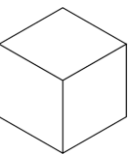
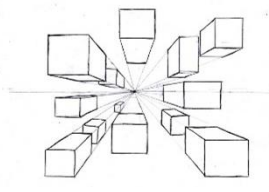
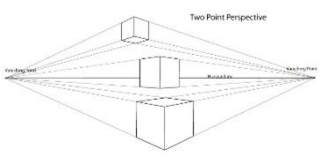

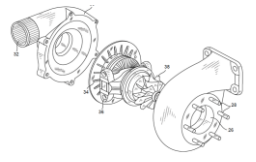
- Constraints/ limitations
- What the product is
- Materials/processes
- Any key information you know

Design Specifications

A Design Specification is a list of requirements your product has to meet in order to be successful

It is also useful for evaluation. If your product hasn't met the Spec then it gives you a starting point for improvements.

Aesthetics	What the product looks like? Style? Colour Scheme? Design Movement?
Customer	Who would buy it? (Age, gender, socio-economic, personality) How does the design appeal to them?
Cost	How much will it cost? (min-max) Why?
Environment	Where will it be used? Why? How will you make it suitable?
Safety	How is it safe? How will it be checked? Why must it be safe?
Size	What is the maximum or minimum size? Why?
Function	What does the product do? What features make it do that function well? How is it unique from similar products?
Materials	What is it made from? Why?
Manufacture	How might it be made? Why? What scale of production? Why?

Technique	Description/ notes	Diagram
Orthographic Projection/ Working Drawings	<ul style="list-style-type: none"> • Includes "Front", "Plan" and "End" 2D Views, and often an Isometric 3D View • Standardised method for scale, dimensions and line types • Great for manufacturing 	
Isometric	<ul style="list-style-type: none"> • Common 3D sketching method • Can be drawn free-hand or using isometric paper and ruler • Angles are at 30 degrees • Great for seeing most of the products 	
1-Point Perspective	<ul style="list-style-type: none"> • A 3D drawing method • Often used by interior designers and architects • Gives drawings depth • Only uses 1 vanishing point 	
2-Point Perspective	<ul style="list-style-type: none"> • Used for 3D designs • Exaggerates the 3D effect • Objects can be drawn above of below the horizon line but must go to the 2 vanishing points 	
Annotated Drawings/ Free and Sketches	<ul style="list-style-type: none"> • Quick and easy way of getting ideas down • Range of ideas can be seen • Annotation helps explain designs further 	
Exploded View	<ul style="list-style-type: none"> • Helps see a final design of a product and all it's parts • Can see where all the parts fit • Great for manufacturers 	

Modelling and Development

Modelling and development are key to testing and improving products
This can be done physically using materials like; card, foam, clay, man-made boards or virtually in **CAD**

Modelling helps the designer get feedback from the customer, check aesthetics, function, sizes and even materials and production methods and change them if needed