Year 11 – Design & Technology / Briefs, Specifications, Ideas, Development

Briefs, Specifications, ideas and development

Design Briefs

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

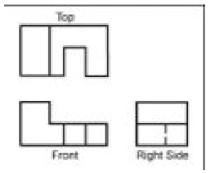
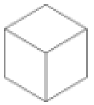
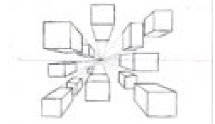
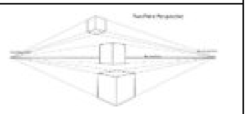
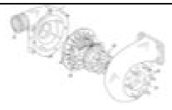
- Constraints/ limitations
- What the product is
- Materials/processes
- Any key information you know

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	• 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	• 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	• A 3D drawing method • Often used by interior designers and architects • Gives drawings depth • Only uses 1 vanishing point	
2-Point Perspective	• 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	• Quick and easy way of getting ideas down • Range of ideas can be seen • Annotation helps explain designs further	
Exploded View	• Helps see a final design of a product and all it's parts • Can see where all the parts fit • Great for manufacturers	

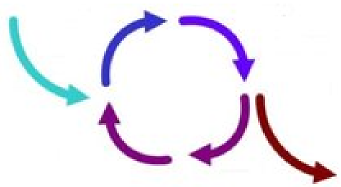
Modelling and Development

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

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
• Consistent testing helps solve problems earlier • Constant feedback • Easy evidence of progress	• Designers can loose sight of "the big picture" • 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
• User feels listened to • Makes sure the product meets their needs	• 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
• Does not need specialist knowledge • Easy to communicate stages • Easy to find errors	• 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
• Gets multiple opinions and a range of views • Working in groups can produce more ideas	• Can be difficult to design ideas with opposing views • Can be difficult to find time to communicate with multiple people

Identifying Requirements D&T Knowledge Organiser

How can exploring the context a design solution is intended for inform decisions and outcomes?

Where and How the System or Product Is Going to Be Used

The **environment** that a product is going to be used in has to be explored by the designer to ensure the product operates as intended.

Is it sandy?	Moving parts could become clogged with sand particles. Polished plastic finishes may get scratched.
Is it in direct sunlight?	Thermoplastics can relax and deform. Metals can reflect.
Is it really cold?	Metals can be uncomfortable to touch in freezing temperatures.
Is there water or moisture?	Ferrous metals rust, while untreated wood can warp and rot. Plastic can be slippery.
Is it dark?	Poor visibility may heavily affect the use of the product.
Is it really hot?	Some fabrics perform badly in hot climates.

The **way** a product is going to be used is crucial for the designer to understand if they are to design a product which is fit for purpose.

How often will it be used?	Products designed for public use need to be much more durable than domestic products.
How many people will use it?	The ergonomics should suit the intended user, even if this is multiple groups.
How will it be handled?	In activities such as sports, products experience heavy impacts.
Will the user access the product on their own?	If it is designed for young children, the product must be intuitive and easily accessed.

Identifying the Primary User and Wider Stakeholder: Requirements

The **primary user** is the target user group that a product is intended for at the design and marketing stage. Iterative design identifies the needs of the user to begin to develop the product. The function, style and price are all determined by who the product is aimed at.

How much will they pay?	Every market group has an upper limit to what they can pay for a product.
Where will they use it?	Studying the user's habits will tell you a lot about the locations that the product might get used in or taken to.
What styles would they like?	Look at the intended user's lifestyle. What other products do they own? What brands influence them?
How will they use it?	Will the intended user make typical use of the product, or do they require something with different features?

Wider stakeholders are other groups of people who may be directly or indirectly affected by a product.

Who else sees the product?	The physical appearance of the product may be offensive to viewers in some way.
Will lots of people use it?	A medical tool may be primarily used by a doctor, but may also be handled by patients.
Who changes the batteries?	Products such as fire extinguishers need to be serviced by qualified professionals.
Who is responsible for buying it?	Most toys are not bought by children themselves.

How can exploring the context a design solution is intended for inform decisions and outcomes?

The more investigation a designer can do into the wider context of the needs and usage of a product, the more accurate they can be in the development of an effective solution.

Social Factors

A designer must work to understand the needs of the user of their product, including wider social factors such as religion, gender, family members, wealth and multiculturalism. These factors can influence:

- cost of the product;
- where the product can be used;
- who can use the product;
- how the product will be looked after.

Cultural Factors

It is important to an ethical designer to consider the different conventions of the cultures in which the product may be used, which may include:

- colours that may be associated with nationalism;
- the use of icons that may have multiple meanings;
- the use of materials, including animal products;
- people's perception of the product or its use.

Moral Factors

Designers have to consider how a product or its use may affect the moral values of the user, or the society in which it will be used. This might include:

- potential misuse of the product;
- sustainability issues;
- environmental impact of manufacturing and use;
- knowledge of pressure groups associated with the above factors.

Economic Factors

Every stage of a product's lifecycle has a cost attached to it. The more the designer understands about this, the better informed their designing will be. Factors may include:

- material costs and availability;
- manufacturing costs, including outsourcing;
- employment/unemployment data in area of intended use;
- poverty data in area of intended use.

Smart & Modern Materials Knowledge Organiser

Awareness of developments in new materials to aid design decisions.

As advances in technology create added functionality, new demands are placed on manufacturing to create materials that can complement the sophisticated electronics that are available.

Grapheme

Technically not a new material, but only used in commercial production since 2017, this 'material of the future' is the strongest material ever tested. Made from 100% carbon, the wonder of grapheme comes from the fact that it is an incredibly thin sheet material – it is one atom thick! The material is an excellent semi-conductor, making it useful for micro-electronics and touchscreen technology. It can be used to coat other materials, providing strength and protection to products such a helmets whilst reducing weight.

Super Alloys

This family of metals are alloys with enhanced properties. Nickel, chromium and aluminium are often used in the production of super alloys to give the resulting metals high performance capabilities. Applications tend to be in areas where weight, strength and durability are important factors, such as jet engines, space travel and energy production.

Biopolymers

These are polymers produced by living organisms and are considered important future materials, as they are sustainable, carbon neutral and renewable. Most biopolymers come from non-food agricultural crops, including sugar beet. Cellulose acetate can be produced from sugar starch and used in a wide variety of packaging applications. Its main advantage over oil-based polymer packaging is that it bio-degrades.

Nano-Materials

This family of materials are tiny particles that are designed to be added to products to give enhanced properties or characteristics. They can be found in many applications, such as cosmetics, paints, healthcare and filtrations systems. Engine lubricants make wide use of nano-materials to provide protection and longevity to moving parts.

Quantum Tunnelling Composites

QTCs are a new and novel product developed in the 1990s. The composite material is a type of semi-conductor. Electrons are able to pass through the material when it is compressed; as such is it used in clothing to allow wearers to control electronic devices beneath the material. The NASA Robonaut used QTC on its fingertips whilst in use at International Space Station. Some believe that materials such as QTC lend themselves to 'artificial skin' uses.

Smart Materials Used in Schools

Nichrome

Nichrome wire is made from an alloy that allows it to heat up without melting. It does so because it does not conduct energy well. It has many uses as a heating element and can also be used in ignition systems and detonators.

Shape Memory Alloy (SMA)

These metals can be deformed and will return to their original form when heated. This principle means design engineers can predict particular forces that the material will exert under heat and use this feature in a design solution. Most commonly available as wire and rod, they are useful in systems control projects as actuators when used in combination with electronic circuits.

Polymorph

This novel polymer is interesting to use because, although it is a true plastic which is resistant and machineable, it becomes malleable, like clay, between 30 and 60 degrees Celsius. It is useful in projects because durable iterative models and prototypes can be made quickly; because it can be shaped by hand, ergonomic solutions can also be created. Available in granular form, it becomes a soft solid when hot water is added.

Electroluminescent Material

These materials emit light when a current is applied. Available as a coated wire, easy-to-cut sheet, adhesive tape and in paint form. It has lots of potential for systems and control and textiles projects.

Thermochromic/Photochromic Materials

Photochromic pigment changes colour in strong sunlight or UV light, making it useful in situations where the user needs to be aware of the dangers of direct sunlight.

Thermochromic pigment changes colour dependant on ambient temperature.

Smart & Modern Materials Knowledge Organiser

Composite Materials

These materials are a combination of two or more different materials, brought together in such a way that the key properties of all materials work together to give a higher performing composition. Creating and using composites is almost as old as building and construction, but as new technologies in manufacturing and science advance, new ways to bring materials together are developed.

Concrete

Concrete is a mixture of cement (powdered limestone and clay), sand, stones and water. A chemical reaction occurs when the water is added that leads the concrete to set hard. This method has been used since at least the times of the Roman Empire. In the twentieth century, steel manufacturing techniques allowed thin rods or mesh to be made and set into the concrete, giving the material a much higher tensile strength. This enabled engineers, architects and builders to use concrete's quick-casting properties with much larger, adventurous forms, such as bridges, high-rise buildings and skate parks.

Manufactured Sheet Timber

Engineered timber products such as plywood, MDF and particleboard are constructed for particular uses by combining and fixing different timber elements with resins or adhesives. Almost exclusively manufactured in sheet form, most composite wood is used in construction and furniture production.

- Plywood: thin sheets of solid wood known as veneers are glued together to create stiff and light sheet material.
- MDF: fibres of timber are turned into a pulp and fixed with formaldehyde resin. The lightweight product is used extensively in flat-pack furniture.
- Particleboard: wood chips recycled from timber processing are bonded together into sheets. Whilst it has a relatively low tensile strength, it has good compressive strength and insulating qualities, so is often used in flooring and loft cladding.

Fibre-Reinforced Plastic

Commonly known as glass-fibre, this family of materials is versatile and important in large-scale product design. Traditionally, fibres of glass, which are strong and flexible, are set into a polymer resin and it put into a mould. In more recent times, carbon fibre has been used instead of glass, as it has the advantage of being much lighter and stronger, albeit more expensive. Some applications include car bodywork, boats, children's playground furniture and bicycle frames.

Robotic Materials

This field of composites are materials that incorporate sensing, communication, computing and actuation (movement). Highly sophisticated and expensive to produce, the materials are often developed to fulfil one specific role in a product. There are numerous robotic materials in existence, including plastic coatings for vehicles that allow them to camouflage themselves, as well as 'skin' for prosthetic limbs that sense touch.

Technical Textiles

Activities where physical performance is paramount, such as sports and dance, have always driven the need for not only better designed clothing, but better performing fabrics. Elastane (commonly known as Lycra™) has been a dominant material in cycling and many other sports since the 1970s, but before that, wool was considered a high performing material. As people's lifestyles change and more adventurous pursuits can be accessed by a wider audience than ever before, the demand for new fabrics that perform to exact requirements increases. Technical fabrics can also be driven by occupation; many outdoor jobs involve working in extreme conditions and technical clothing solutions can serve to improve working conditions or help make the wearer more effective at their job. Whatever the need is, what makes true technical textiles stand out is that they have outstanding properties which are particular to the context in which they will be used.

Softshell Jersey

Usually has two textile layers, most commonly polyester and polyester fleece, bonded together producing a heavy but very flexible fabric. Breathable and waterproof, softshell jersey is found in mid-season outerwear.

Airflow Mesh

This mesh fabric is 100% polyester but ingenious manufacturing makes it a very different fabric. A mesh is knitted into a lattice, giving it a strength and elasticity, as well as making it ideal for areas where structural integrity is important. Given it is a loose mesh, it is lightweight and breathable.

PowerNet

Typically a blend of polyester and Lycra, this lightweight, breathable fabric is often used in underwear owing to its body sculpting abilities.

Neoprene

A synthetic rubber, Neoprene is most commonly recognised as the fabric of wetsuits. The expanded foam textile has excellent insulating properties- meaning swimmers body heat is absorbed by the fabric along with the water, locking out cold water. It is flexible and easily bonded, which makes Neoprene useful in other applications including laptop bags, mouse mats, pipe insulation and gloves.

Ripstop

A specially woven nylon that prevents rips from spreading and ruining the fabric. Lightweight with excellent strength, the fabric has a distinctive checked pattern as a result of the heavy yarn used to reinforce the thin fabric. Used in tents, outerwear linings and bags.

Breathable Waterproof

There is a growing range of brand-named fabrics in this field of lightweight outdoor textiles. Depending on weight, these fabrics give a waterproof rating – which covers everything from showers to torrential downpours. Well-known examples include Gore-tex, Isodry and DryVent.

Early Modelling Knowledge Organiser

Graphic Packaging

Working with paper and boards naturally lends itself to the use of modelling materials.

Designers use early modelling to:

- check how graphics 'wrap' around the package;
- check the contents are contained securely;
- check storage/stacking issues;
- check structural strength;
- calculate the amount of material required.

Furniture Design

Working with natural wood and timber products for the finished product, a designer will often use paper and board to produce scale models which are quick and comparatively inexpensive to create.

Designers use early modelling to:

- ensure the product is suitable for use (anthropometrics);
- calculate the amount of material required;
- research joining solutions;
- check structural strength;
- check the overall style.

Engineering Design

Creating a full size mock-up helps the designer to understand more about how the technology works and fits together.

- Designers use early modelling to:
- check the overall function of the product;
- investigate how components function together;
- research the size requirements of the product;
- investigate the use of different materials;
- research joining and fastening methods;
- electronics designers use simulations in specialist cad packages, as well as vero-board, to create a functioning circuit.
- modelling products such as Lego and Meccano are used for early engineering design.

Automotvie Design

Many individual components make up a large product, such as a car – but the overall shape of a vehicle is sculpted in clay, which is called a 'maquette'.

Designers use early modelling to:

- check the aerodynamics of the product in a wind tunnel;
- make calculations to do with the overall size of the product;
- develop and modify the aesthetic style of the product (clay can be wasted and re-formed).

Product Design

Product designers use paper, card and foam to create models, as well as using CAD software to develop designs without the need for a workshop. Using CAD can also support the use of 3D printers, or rapid prototyping machinery to create three-dimensional models.

Designers use early modelling to:

- check the ergonomics of a product;
- make calculations to do with the overall size and weight of the product;
- check structural strength;
- develop and modify the aesthetic style of the product.

Fashion Design

Designers of clothing often use paper toiles to realise and develop their ideas on a tailor's dummy.

- Designers use early modelling to:
- check the fit of a product;
- make calculations for the overall size and weight of the product;
- research how different panels are joined or fastened;
- make calculations for the amount of fabric or other material required;
- develop and modify the aesthetic style of the product.

Topic Knowledge Organiser

Year 11 – Design & Technology / Early Modelling

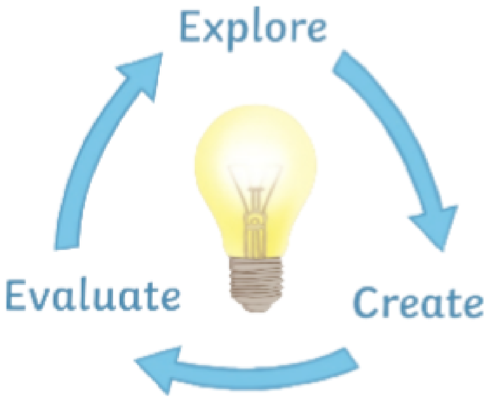
Early modelling- Why it is important to iterative design.

At all stages of designing, designers us paper models, toiles or maquettes to test the feasibility of their work. It is part of the cycle of iterative design.

This is different to prototype manufacturing, where a designer or modelmaker will produce a functioning version of the final design.

Early modelling allows the designer to:

- design in three dimensions;
- better understand their own design thinking;
- communicate their ideas to others;
- explore construction considerations;
- explore technical considerations;
- make modifications to their ideas.



Design Dictionary

aesthetics: the look or style of a product.

anthropometrics: the use of human measurements in relation to our environment - for example, a café chair must be able to allow a range of people, short and tall, to sit down.

compliant material: can be shaped, wasted and deformed easily.

ergonomics: how a product fits with its user – for example, how comfortable a handle on a hairdryer is depends on its ergonomics.

fastening: a temporary or non-bonded way of joining two parts of a product – for example, buttons, nuts and bolts and cable ties.

maquette: a scale model made from clay, built with the purpose of examining and developing the form and aesthetics of the product.

scale model: a model or prototype which is proportionally identical to the full-sized product, but scaled down to a practical size for initial making.

toile: an early version of an item of clothing, made from paper or inexpensive cloth.