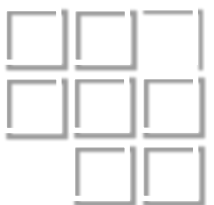




N4/5

DESIGN PRINCIPLES

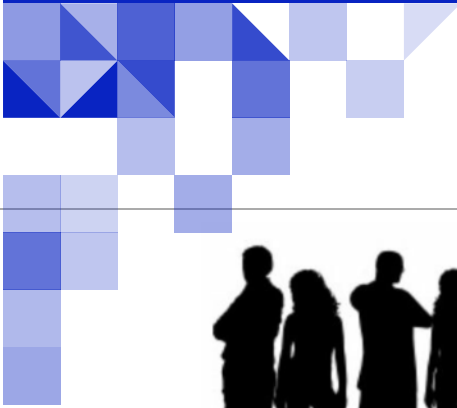


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Designer

The designer is the member of the design team you will be most familiar with. It is their job to create solutions by styling and working out how products should function, to best suit the needs of their client. The designer is responsible for generating the idea, as well as producing detailed drawings or models which he can use to communicate ideas to the rest of the design team.

Consumer

Although the consumers are not directly involved in designing or manufacturing a product, the designer must consult them and understand them if he/she expects them to buy the product. If it is not up to the consumers expectations, suitable to their needs and likes or affordable, it is unlikely they would buy the product.

Market Researcher

Although a product has to be designed and manufactured well, it will not sell if it is not pitched correctly at the target market. Market researchers are important as they can talk to the consumers for the designers. Market researchers provide information which help the designers understand the market he/she is designing for. Researchers use a variety of strategies to gather information, including researching sales figures and trends, surveys and questionnaires.

There are many ways the market can differ. Below is a list of some aspects the researcher would need to identify and report back.

- Gender
- Geographic location (country/area/global)
- Age range
- Disposable income
- Lifestyle (hobbies and interests)
- Style /fashion
- Culture or beliefs
- Status (single married, children, etc)
- Shopping habits
- Needs and wants

All these are essential for the designer to understand fully who they are designing for.

The market researcher might also identify a gap in the market where a certain group have specific needs and are not being catered to. This is known as a market niche.

Accountant

The Accountants role is to look after finances. They advise the design team on funds available and any budgets they need to work to, as well as monitoring money spent and money earned.

Engineer

The Engineer works with the designer to ensure that the new product can in fact be made successfully. The engineer advises the designer and ensure materials, components and structures used are suitable for safe and functional use of the new product.

Manufacturers

The designer will work with the manufacturer to select the best way to produce the product. This will vary depending on the volume of production and the cost of the product. Manufacturers will also communicate with designers and engineers to ensure that the materials, assembly and form ensure the product is safe and fit for purpose. The manufacturer may also be responsible for packaging or have to transport the goods for packaging purposes.

Marketing Team

The marketing team are responsible for raising awareness of the product, bringing it to the consumers attention and enticing them to buy it. There are many strategies the marketing team can use to do this including:

- TV, radio and magazine advertisements
- Using celebrities to endorse a product
- Packaging and point of display(in store)
- Free trials
- Promotions, giveaways and other incentives. The marketing team are important as they know how to make the product available to the intended target market.

Ergonomist

The ergonomist looks at how we as humans interact with the with products and the world around us. The ergonomist advises the designer on aspects relating to ergonomics and anthropometrics. It is the ergonomists specialism to identify correct clearance, reach, strength, size and psychological aspects to ensure the product is safe ,comfortable and easy to use for the intended target market.

T.E.A.M

Together everyone achieves more

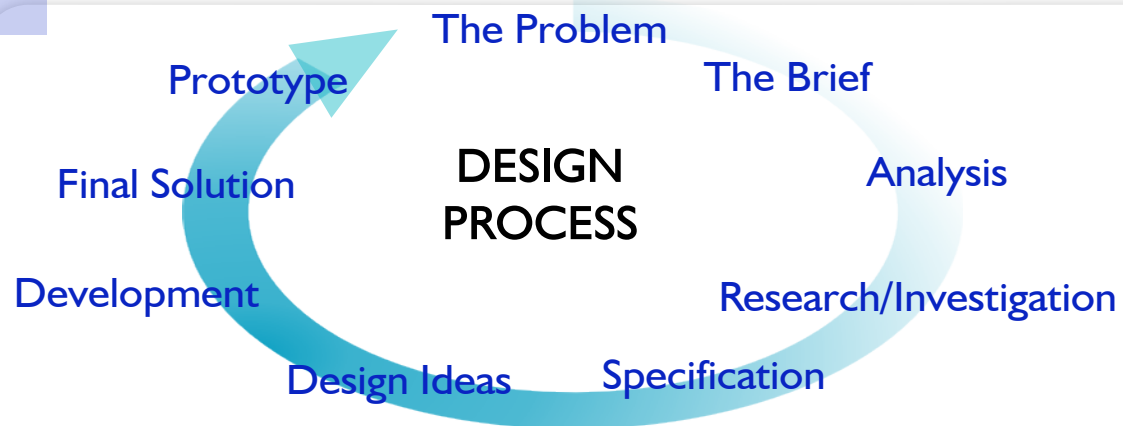
Retailer

No product would succeed without a retailer. Nowadays retailers are not just on the high street. Consumers buy via mail order and online stores. Regardless, the retailer not only sells the products for the designer, they can also inform the designer of current trends , volume of sales and market demand for new or improved products. The retailer will communicate with the marketing team and agree on suitable point of display which can help promote sales of the new product and result in profit. The retailers also have links with the manufacturer, who supply the product.

Economist

The economist keeps track of what is happening with the economy and how this might affect the consumers want or ability to buy a new product. For example if the cost of living (petrol food and rates) rise, consumers on a lower income might struggle to buy food. If a family can't afford to eat they won't pay a lot of money for new luxury products.

The economist will predict trends and patterns helping the designers identify the price range for the new product.



The Process

Often the design process is not a linear one. (This means that the sequence the designer uses may not be the same every time, however you should remember the order of the steps shown above.)

Every design problem is unique, as is the research and processes the designer undertakes to ensure a good solution is reached.

The Problem

The design process starts with a problem. Without a problem, the designer has no needs to meet. Often a client will come to the designer with a problem that they have identified and need a solution to. A problem can also be recognised by experience of using and trying existing or similar products, or from Consumer demand. Consumer demand is when the markets are seeking a particular aspect, style or function in a product. Regardless of the problem source, the designers role is to produce a solution that enhances the life of the consumers.

The Brief

The Brief is the first specification the designer gets from the client. A good brief will indicate the problem or scenario, and have some information about the desired solution. It gives the designer a starting point for his research.

Analysis

The Analysis stage allows the designer to better understand the problem, by breaking it down into more manageable chunks that they can explore. Often by mind maps and thought showers.

Research/Investigation

The Research and Investigation stage allows the designer to find out useful information that will help him/her design a successful solution. Research could include the style and look of the product, relevant ergonomic data, materials selection or anything else identified in the Brief or Analysis, the designer feels he/she needs to know more about.

Specification

The Specification is a detailed list of criteria, that states what the product **MUST HAVE** and **MUST DO** do to be fit for purpose. This is usually written between the client and the designer.

Design Ideas

The designer can generate initial ideas by sketching or modelling. At this stage ideas can be vague. The designers task is to begin with a variety of **DIVERSE** ideas.

Development

The Development stage will normally involve some form of modelling to test scale, ergonomics and even aesthetics. At this stage the designer needs to identify the final solution and annotate them.

Final Solution

The Final Design will be communicated to the client, therefore it must be presented to sell the key features. Any modelling or sketching at this stage will include details and sizes of all the parts and their assembly detail.

Prototype

The Prototype is the first fully functional product ever made. It is in the companies interest to create a prototype to allow them to test the quality and suitability of manufacture, materials, construction, durability, safety etc.

Evaluate

The designer will evaluate the product, to see if any further improvements can be made before commercial manufacture.



Identification of a Problem

Before the Designer can design anything, they need to identify a problem or a need. You need to know three of these methods of identifying problems/needs.

Situation Analysis is when the designer will study a situation or environment. e.g. observing people interacting with products to identify any difficulties they might have .

Needs and Wants are important and linked very closely to the target market. Needs are essential requirements like food and shelter, or basic product functions. e.g. a kettle needs to boil water. Wants on the other hand are luxuries. Consumers can live without luxuries , they will not WANT to

Design Brief

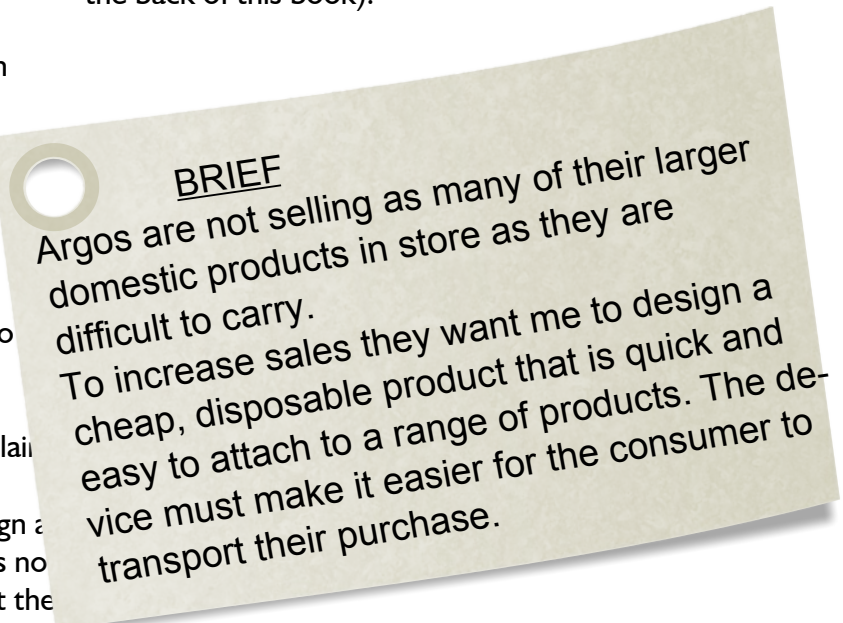
The Design Brief is the starting point in the Design process. A good design brief will detail a clear **statement of the problem or situation** demanding new product and what is needed as a solution.

The Brief is often written by the client and is important to designers because it gives them a starting point for the project. The brief should also indicate who the **target market** is.

The brief must include enough information to explain the problem clearly. This could mean creating a situation like an untidy room. To say you will design a container is too open. An open Brief like this does not have enough guidelines for the designer e.g., what the container should be able to hold, meaning the designs may not be what the client is looking for. spend money on luxury products if they do not have basic survival needs met.

Regardless of the intended market, the designer must know what consumers need and what they want. A designer might find this out through market research, speaking to clients or retailers about sales and demand. Consumers have a lot of choice now and the designer needs to meet their demands to sell products. (There is more information on **Market Research** later in the book).

Product Evaluation is when the designer will try to identify problems with existing products. They will do this by comparing and testing products and observing other people using the products and taking feedback about any relevant issues. (There is more information on product evaluation in the section at the back of this book).



If the client said they wanted a box to hold one pair of shoes, this is very specific and known as a closed brief. Using the word box rules out the possibility of using other storage methods from the beginning.

The designer will **analyse** and discuss the brief with other members of his design team, the client, the intended users and the manufacturer.

Analysis

The Analysis stage is used to explore the problem/ Brief by breaking it down into smaller parts to allow the designer to identify all the things he/she needs to think about. A lot of information can be extracted from the Brief as shown in the example below. This shows just some of the aspects the designer might explore.

Analysis is important to the designer as it can reveal issues and ideas that would influence the design, that may not otherwise be considered. So how do we Analyse things? There are several methods to do this. Creating a Mind map, using a series of thoughtful questions exploring who, what, why, where, when and how and using a morphological analysis is amongst the most common methods

BRIEF

The client: Argos are not selling as many of their larger domestic products in store as they are difficult to carry.

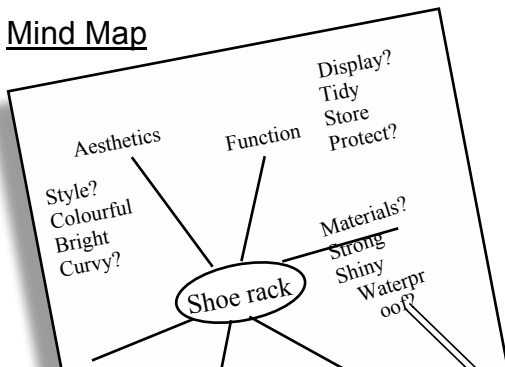
Low cost Use once (Will impact material choice): To increase sales they want me to design a cheap disposable product that is quick and easy to attach to a range of products. The device must be safe and make it easier for the consumer to transport their purchase.

Ergonomics - why are they hard to carry? Weight, size? Handle?

Function- What are the products?

Function- How Will it work?

Mind Map



Morphological analysis

Table design	Where	Legs	Shape	Material	Style
Bedroom	1	Square	Wood	Art deco	
Hall	2	Round	Metal	Retro 60's	
Kitchen	3	Abstract	Plastic	Traditional	
Living Room	4	Triangle	Glass	Futuristic	
Room	None?	Star	MDF	Pop Art	

Questions?

Function? What will it do?
 Hold things
 Display things
 Protect
 Tidy

Ergonomics? Who will use it?
 Parents
 Me
 Visitors

What sizes will I need?
 Hands
 Heights people can reach
 Size of items to store.

What will it hold?
 CDs
 DVD's
 Aftershave?
 Photos Remote control?

RESEARCH



Research or investigation is the designers chance to find out necessary information that will help design a product that is fit for purpose and suitable to use, by the intended target market.

Appropriate Research

When designing a new product the designer might research suitable Materials and Construction, Ergonomics, the Market, Aesthetics and or Existing products. The issues and quantity of research a designer carries out will vary depending on the design task. Research takes time and costs money, therefore it is important that any research carried out is RELEVANT to the design task.



Internet

Using the Internet or books is known as Secondary Research or Desk Research, because you are using data collected and presented from someone's previous research activities.

The Internet has endless amounts of information. It is important that you are as specific as you can be and select only the information related to your design problem, rather than copying entire pages. You should always record the address of any web site you use for research.

Measuring & Recording

There are numerous ways to measure and record results. You should always aim to make your findings clear and explain why you have made your decisions. Research can be recorded in a table, by using tally charts or measured using a ranking scale (e.g. score 0-5) but should always be complemented with supporting comments.



Asking Questions/Surveys

Getting the opinion of a range of people from the target market is essential to ensure they want or need your product. Questionnaires and surveys can be face to face or using websites like survey monkey.

Notes for asking questions:

- Max ten questions (people get bored/less willing)
- Is Gender/age important? (If so use age bands e.g., (30-40))
- Closed questions (yes/no answers) are easy to organise for results but provide limited information.
- Open questions: Why, What, When etc. Are more difficult to compare but give better customer opinion.
- Use a large sample of the target market to ensure your results are reliable.

USING DATA

Finding Data is easy, extracting the relevant data is a skill. You must be able to choose the relevant data, to use, and explain why this is the best option. Graphic representation like charts , colour coding and star ratings can enhance the presentation while making the results easier to read.

Specifications

The specification is a list of criteria that stating the requirements. There are different types of specification. You will need to know a **PRODUCT DESIGN SPECIFICATION** and a **MATERIAL SPECIFICATION**.



Product Design Specification

The Product Design Specification (PDS) covers all aspects of the design. It is a list of criteria that state what the design will be and must do. Products like the torches above share the primary function of providing light, but their intended market ,look and use are very different. The PDS is important to both the client and the designer . It is agreed by both parties and provides clear guidelines for the product ensuring that if the designer meets the criteria, the product will meet the clients approval.

Any statements in a specification must be definite and include key words like "it will" or "it must".

Statements should not include the word and. This suggests there should be two separate statements. They should contain words like either, as this is not definite, as specification statements should be.

A specification should always start with the primary function. It is also important to include points from all areas of the analysis ensuring that all the design factors are covered.

P.D.S

FUNCTION

- It must hold at least three toothbrushes
- It must be wall mounted

SAFETY

- It must have no loose parts
- It must be made from non toxic materials

ERGONOMICS

- It must be easy to get the brushes out
- It must be easy to clean.

AESTHETICS

- It must have a modern look

Materials Specification

The Materials Specification concentrates solely on the requirement of the materials, generally focusing on material properties. A good specification will be detailed, specific to the product and broken into significant areas. For example, If you were designing a toaster, you might write the following specification.

Outer Case:

The case must withstand temperatures over 200 degrees

The case must be durable against bumps and knocks in the kitchen

The case must be easy to clean

Buttons/lever

The controls should have adequate grip

The materials should feel expensive and well made

Idea Generation

Idea generation is the process of creating, developing and presenting new ideas. Good ideas rarely just happen. There are many techniques, used by designers to help spark their creativity. You will be expected to use a range of methods throughout the course.



Lifestyle Boards

Lifestyle Boards are an excellent tool, enabling the designer to visualise their markets interests, style and needs. They are a collection of images that the designer can use to generate ideas based on the colours, shapes, and interests taken from the lifestyle board. A good lifestyle board would allow the onlooker to identify the persons age, gender, style, employment, lifestyle and other interests. A good final design would not look out of place if it was added to the image board.

Morphological Analysis

Imagine you have a product that could be made of three types of material, in five possible shapes, and with four kinds of fittings. Theoretically there are 60 ($3 \times 5 \times 4$) potential combinations of material, shape and fittings. Some of these combinations may already exist or may be impossible or impractical. Those left over may represent prospective new products. This method can be extended to virtually any problem area that can be broken down into lists of attributes relating to the product.

Mood Boards

A mood board is different from a lifestyle board. A mood board focuses on communicating the theme or style of the product, as opposed to communicating the lifestyle and interests of the market. The images on a mood board show shape, colour, texture, material or environment. These provide the designer with a theme and other criteria to inspire their design.

Lateral Thinking

Lateral thinking is when you approach a problem from a different angle or perspective. For example, if you were designing a toaster, most people would produce a design with two or four slots in the top, as seen in the majority of current models. When laterally thinking about the toaster design, the designer may think about slotting the toast in from the front or having the toast rotate. Lateral thinking is any ideas about solving a problem that is not the norm.

Technology Transfer

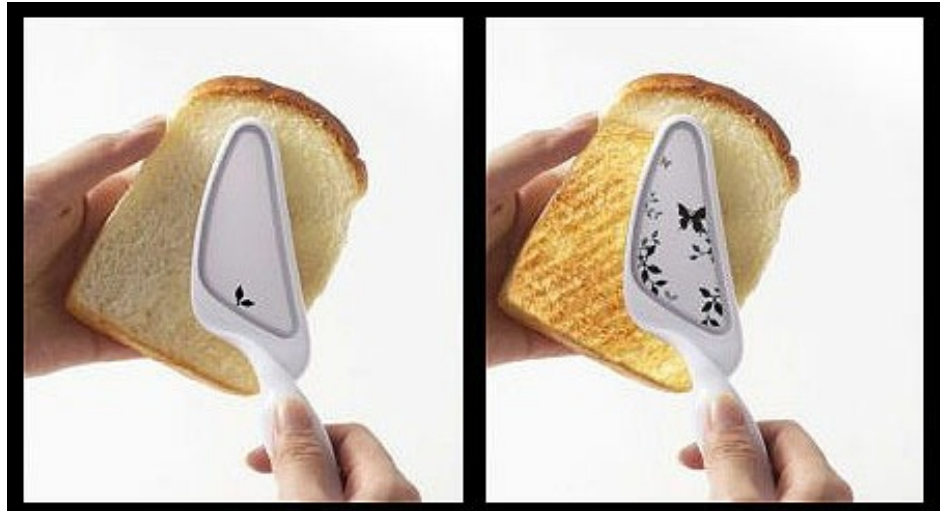
This the process of transferring skills, knowledge, technologies, methods of manufacturing to ensure that scientific and technological developments are accessible to a wider range of users who can then further develop and exploit the technology into new products, processes, applications, materials or services. The Dyson Vacuum is a good example of this. James Dyson used the already existing cyclone technology to produce a better performing vacuum cleaner. The existing technology came from an air filter in a factory. Dyson was able to TRANSFER this technology to a new application in a different product.



Analogy

An analogy is a comparison between two things. A designer can use analogies to generate unusual ideas by finding connections between their design problem and other products or the environment around them. For example when designing a new toaster, you might think about all the different ways heat can be generated or transferred or how things pop up in both the built and natural environment. This can inspire radical thinking, creating unique and exciting products.

The concept toaster above, uses the analogy of spreading butter. The toaster is handheld and toasts the bread as you wipe over it, similar to how you would use a butter knife. A brilliant and unique idea.



The world around us is full of inspiration. Many great designs have been inspired by nature. Aeroplanes were inspired by birds because we wanted to fly. The common honeycomb structure is used frequently in architecture and packaging because it is strong and light weight. CAN YOU THINK OF ANY MORE?

Designers often look at nature and the engineered world for shape, form, materials, existing solutions or alternative methods to carry out tasks. Current pressures for environmental reform has increased the use of natural materials for sustainable design.

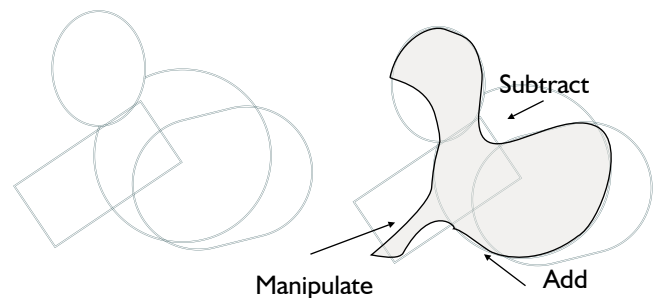
Thought Showers

Thought showers can be an individual or group activity. Thought showers enable people to gather quickly a large range of ideas towards a potential solution to a problem. There are no right or wrong suggestions during a thought shower activity. The idea is to accumulate a variety of ideas, including the weird and obscure which often turn out to be the very successful solutions.

Thought showers are recorded randomly on paper. There is no need for branches etc, as used when mind mapping.

SAM Technique

The SAM technique is a method often used to create new and interesting shapes for design work. The method is simple. Sketch some overlapping shapes, then outline the final shape by Subtracting, Adding and Manipulating the shapes as shown below.



Existing Products

Product design is all about making things better. If there are existing solutions or products that can be used in similar ways, it is essential for the designer to explore these. This will enable the designer to recognise any strengths the good products have as well as identifying the flaws and areas for development or redesign. The designer might carry out tests or user trials or simply create some image boards with a range of existing products.

Development and Refinement of Ideas

Once you have selected the idea generation technique you are going to use, the initial ideas you generate should be quick and rough in nature. Ideas can be generated and communicated through SKETCHING or QUICK CARD MODELLING.

Your initial ideas should be quick, to allow you to explore many different concepts in a short time. Designers will tend to pick out the better designs and explore the further adding additional sketches to explain how it works etc. You can see this by using colour, annotations and diagrams in the example opposite. The designer has started to refine (clarify, detail, improve) their designs towards more successful design concepts.

Refining and developing a product involves evaluation against the Specification to select initially, ideas or elements with the potential for the greatest success. To be successful, the development or refinement which follows, should fully explore all areas of the product, considering more than one solution each aspect of the product. For the example, the designer has looked at wheels, handle shape and position, bag form etc.

Synthesis

There will always be ideas which appear to be more successful at this early stage, but DO NOT automatically rule out all your other ideas.

Synthesis is the process of taking the best elements of several different designs and combining them together into a superior idea.

You may have a wacky or silly idea, but taking the risk and combining an element of that idea with another idea could potentially create a successful, unique and creative idea.

Justification and Recording of Decisions

The path and thoughts through a folio of design work should be clearly marked and easy to follow. Simple use of arrows, helps the reader to follow the progress of the design and development work. Written annotations are equally important to allow the reader to understand a little more about the design, including how it operates or what materials it might be made from as well as being a record of the decisions the designer has taken to influence the changes being made.

During your design work, your knowledge and understanding of design factors and materials will be assessed. It is important that you clearly justify all your decisions by giving sound reasons for your choices.



<http://skookum.com/blog/its-all-product-design/>

Alternative Idea Generation

Some designers prefer to create one or two very detailed design concepts rather than a lot of quicker ideas. When developing and refining a concept, the designer would need to explore fully different aspects of the product, looking for diverse and innovative solutions to improve each area of the original concept.

It can sometimes help to use symbols or a traffic light colour code to highlight good and bad aspects of the design work.

Any decisions, justifications and evaluations being made should all be based on the available PRODUCT DESIGN SPECIFICATION.

It is good practise to keep the specification to hand always. Check regularly that your design is improving and getting closer to best meeting all the specifications

Presentation Techniques

Communicating the information about the proposed product is important and should be suitable for the stage in the process and appropriate for the target market, client or manufacturer.

Many techniques can be used to communicate a design proposal. Over the course you will experience a variety of methods and aim to further develop those which you have strengths in to communicate your Course Assessment design work, to the best of your ability.

Detail

The level of detail you include in a presentation will depend on whom it is for.

- Do you need to show assembly detail?
- How can you communicate size or scale?
- Are there key features that you need to highlight?
- Can the product be stand alone or does it need to be put into context?
- Are additional views needed to enhance the communication?

Identity/Unity

Identity is important for any design work. Consumers buy into products, brands, lifestyles etc.

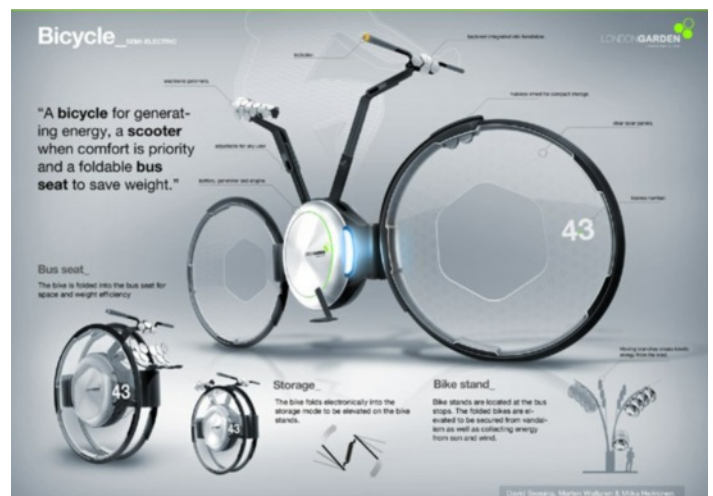
Your presentation will appear more professional if you are able to give your product some identity. This can be simple borders, icons, logos or colour schemes that tie your work together.

Try giving your product an imaginative name. (Remember any identity should be appropriate for the target market and should enhance, not dominate the design proposal.)

Layout

Layout is very important in presenting a design proposal. The layout should be clear and easy to follow and should not clutter or dominate the page.

Good layout is simple and effective. (Minimal colours, clean lines and free from unnecessary items.) There should always be a focal point and additional details. See the sample layouts for examples.



omni[®]
Portable Medical Lighting

Warm Ambient Light
• Calms and soothes patient before procedures such as childbirth
• Adjustable brightness - conserves battery power



Multi-Use Stand
• Easy to use on uneven ground
• Folds away to be used as torch
• Ability to hang with carabiner



Additional Features
• Carbon fiber components
• Customized front and rear fenders
• Redesigned LED tail light
• Newly designed 17 spoke wheel
• Integrated spoiler
• Blacked hood with invisible vertical LED fog light

Features and Benefits

Medical Light
• Tri configuration - reduces shadows during medical procedures
• 500 lumen white light - certified for medical procedures
• 360° fully adjustable - light where medical staff need it



Red Emergency Light
• Flashing road traffic accident warning

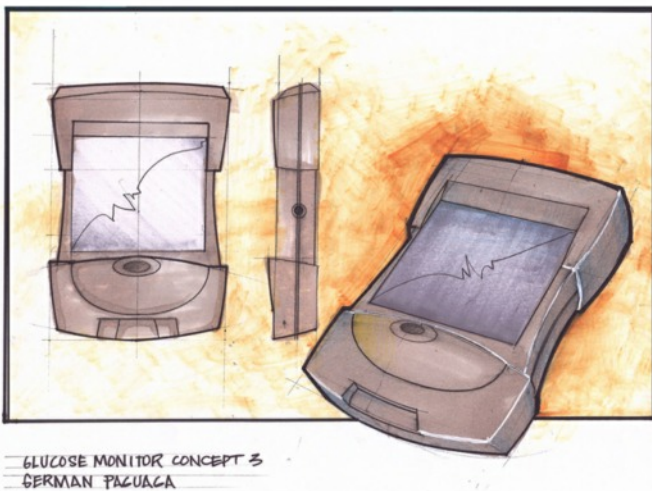


Presentation Techniques

Line and Texture

Learning to apply thick and thin lines, broken lines and outlines appropriately can greatly enhance your presentation, turning an average graphic into a great graphic.

Texture pads can be used to enhance the surfaces of your design work.



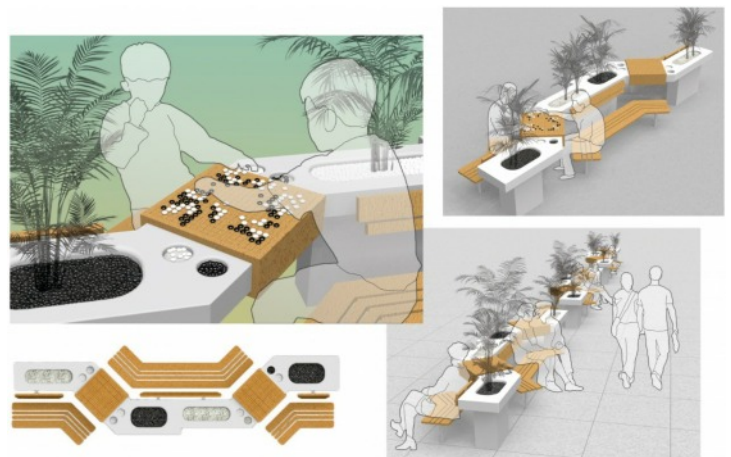
Manual Rendering

You can render in pencil, coloured pencil, spirit marker, pastel or any other medium you see fit. Your rendering should communicate the material form and texture of the product. This means you will need to consider areas of shade and highlight. You will have had the opportunity to try a variety of methods and should choose ones appropriate to the product and best matched to your strengths.



Silhouettes

Silhouettes can be used to put the product in context or to communicate operation on scale. The silhouettes are subtle and do not dominate the presentation.

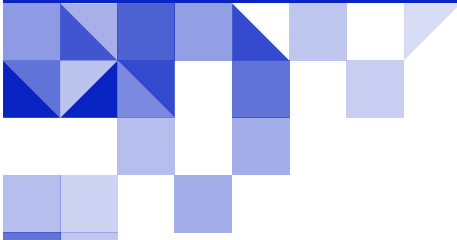


CAD and Modelling

CAD or manual models can be used to enhance the communication of a design proposal. If a computer model is generated, it is important that it accurately reflects the materials as well as the parts of the product.

Photographs of, or good quality models can be used for communication. Models can also help if you are designing something which is difficult to draw. You can trace photographs of the models, which you can then annotate, render or edit.

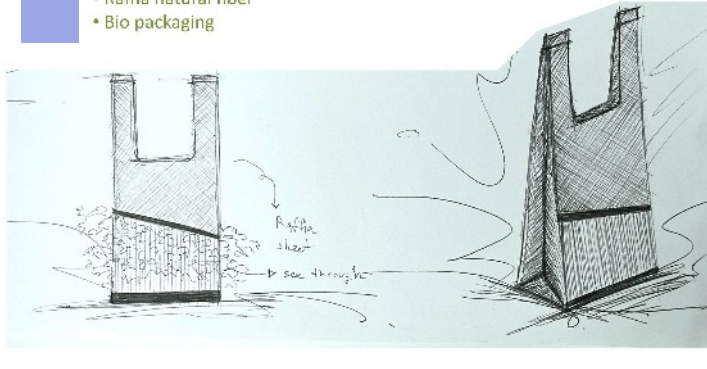




Proposal 2 Green Packaging

Materials...

- Raffia natural fiber
- Bio packaging



Other Presentation Examples

FINAL DESIGN

The final presentation model was made from urethane foam with finer details such as the vents and release button being a combination of Res-shape and styrene plastic.



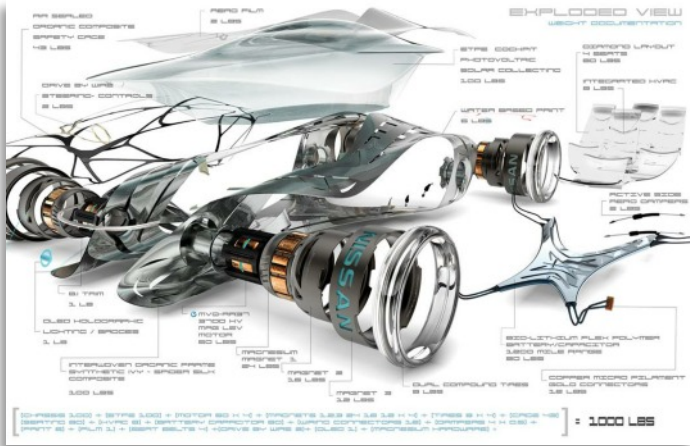
What position in the case of this product is not specifically a health issue as a hand use is not a highly repetitive or long use item. This aside, proper hand/hand position is essential to the use of the product. After tests were done using a simple sketch model, a slight raise towards the user proved most comfortable over the greatest spectrum of use.



Weight is a major issue with cordless tools. The weight from multiple NiCad batteries is far too much to be countered by the weight of the motor to balance the tool. For this reason, the battery pack was kept as close to the users wrist as possible to minimize negative leverage. At the same time, the battery was placed off the hand to balance the weight of the motor/fat assembly.



Removal of debris/fiber was a noticeable and delicate issue with the Ryobi use and numerous other hand tools. In the case of the Ryobi use, removing debris turned into a multi-step process with a nearly impossible to remove without applying extra dirt. For this design, a simple release button allows a trigger 'nose' which can be emptied in one simple motion and back to returning in seconds.



GOBANDIT GPS HD 2ND GENERATION ACTION CAM

Product design & skin proposal



Every weapon needs a master

PROFESSIONAL VIDEO RECORDING EQUIPMENT COMPANY SINCE 1988

patient bedside table
final prototype model

Duggdale Designs

"If hospital equipment and furniture is designed to be easy to clean and easy to use, it will stay cleaner." Design Bugs out Design Council

Loio

DESIGN 003

MAX POWER
rhythmic technology

Model Types and Techniques

You will come across a range of modelling types and techniques. You need to familiarise yourself with them and understand the purpose of each, the materials and processes and the benefits of their use during the design process.

Sketch Models

Sketch models are generated during the initial ideas stage. This means they are rough and ready. They are made to allow the designer to begin to visualise their design in 3D. They are made quickly, roughly in proportion and from materials that are inexpensive, quick and easy to work with.

- Paper
- Card
- Clay

Block Models

Block models are created during the development stage. They are made to visualise the product in 3D. A block model generally has no working or moving parts. They focus on getting the aesthetics proportions and position of parts of the model correct. These can be made to scale.

- MDF
- Balsa wood
- Blue Foam

Scale Models

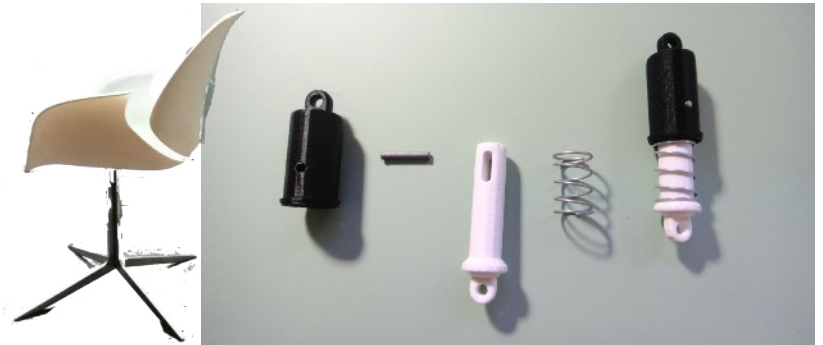
Scale models are made during the development stage. They can be time consuming as the sizes at this stage need to be accurate. Depending on the size of the final product a designer may choose to scale a product up or down for detail or convenience, rather than making it 1:1. For example an architect would never build a full size model of a building.

A scale model can show detail of parts of a design or the full product. These help the client visualise the final product and understand if the proportions are correct to ensure good ergonomic design, aesthetics and functionality.

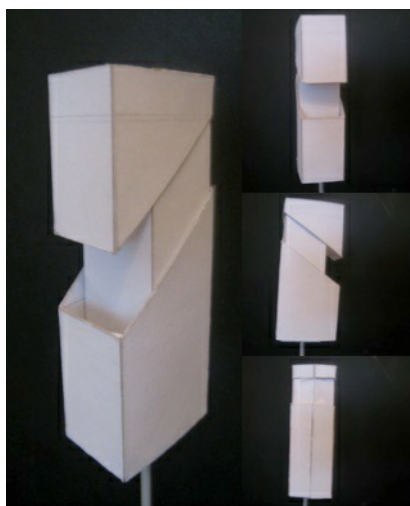
Part Models

Part models are created during the development stage. The designer may choose to make a model of a particular aspect of their design rather than the whole product. This is useful and time saving, e.g., if the designer is trying to work out how a part moves, collapses or attaches, it is only necessary to model the mechanism to solve the design problem.

Part Model



Sketch Models



Block model



Scale model



Model Types and Techniques

Prototype

The prototype is a final model with all working parts and generally made from all the correct materials and processes. These are expensive as it is the first one made. So the designer must make sure their product is well designed before producing a model of this type.

Prototypes allows the designer to identify any final problems with the product or manufacturing process before the product is put into commercial manufacture.

- Detailed
- Scale 1:1
- working



CAD Models

CAD (Computer Aided Design) models are used to communicate a design concept without the expense of using materials to manufacture. CAD models can be used to discuss an idea with a client, helping them visualise the product. CAD models can be edited quickly without the expense or time required to update a physical model.

Computer programs like Inventor can now run simulations and applications to test that all parts fit together well, will be strong enough or can be successfully manufactured. This helps identify any problems with the product before it goes into production.

- PC/Mac
- Specialist Software



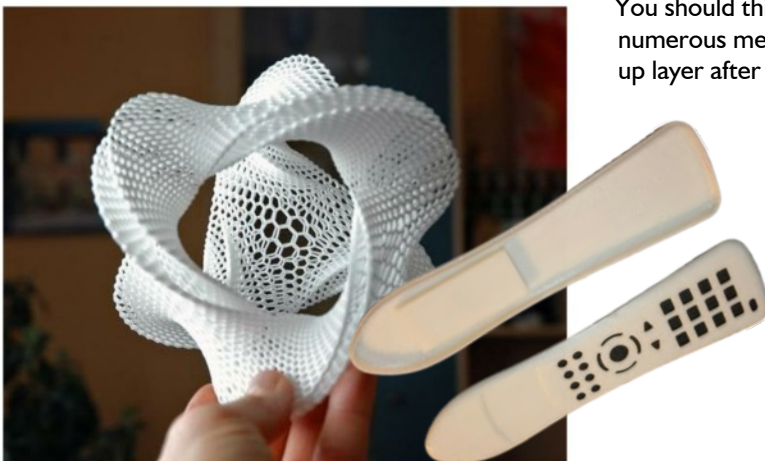
Rapid Prototype

A rapid prototype is a physical model which has been generated from CAD.

You should think of rapid prototyping as a way of printing in 3D. There are numerous methods available but the principle is the same. Material is built up layer after layer by a special machine, with the ability to create intricate 3D forms and components with moving parts.

Although the name is RAPID, the speed depends on the process and the size of the part. Prints can take over 24 hours, but rapid prototyping is still quicker than manufacturing the part by hand.

You can print in a variety of materials including ABS and some metals like titanium, which allow the parts to be used. Less durable materials are also available for visualisation type models.



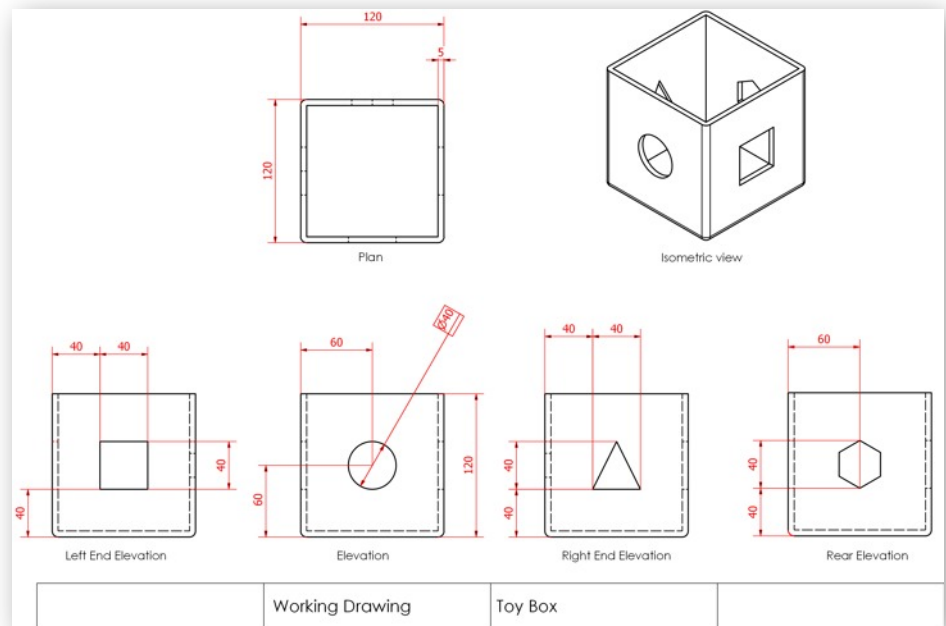
Planning for Manufacture

A good plan for manufacture will be clear and easy to understand. The designer must include all the information required to allow the manufacturer to make the product accurately and as the designer intended. The plan for manufacture is split into three parts:

- Working drawing,
- Cutting list and
- Sequence of operations.

Working Drawing

The working drawing is usually an accurate scale drawing with details such as the dimensions and will show the assembly, parts or joints included. It contains all the dimensions the manufacturer will need to work from. It usually consists of orthographic drawings such as a front elevation, end elevation and plan view.



Cutting lists

The cutting list is a table which give details of the material required to manufacture the product. Every cutting list should include the following:

- PART: The name of the parts
- MATERIAL: The material each part should be made from
- DIMENSIONS: The Length, Width and Thickness of each part and
- QUANTITY: How many of each is required.

PART	QUANTITY	MATERIAL	LENGTH	WIDTH	THICKNESS
base	1	pine	110	30	10
cabin	1	pine	40	40	30
skip	1	pine	60	30	30
wheel	4	pine	20	-	5

Sequence of Operations

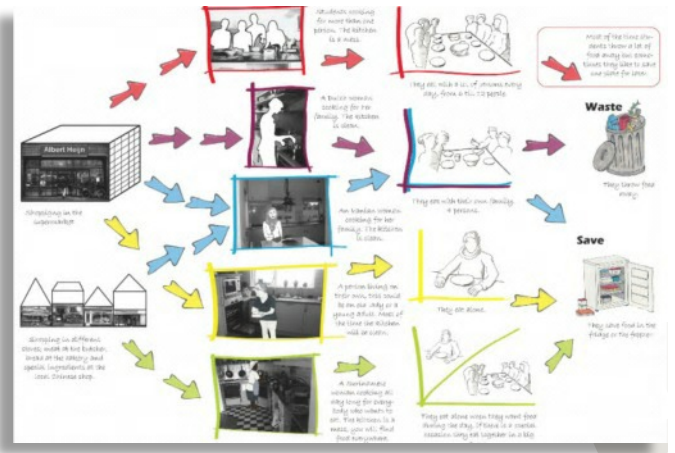
The sequence of operations or procedure, is a detailed list of all the steps needed to make the model. It should cover four main stages: marking out, cutting, drilling and shaping, assembling and then finishing. Each main stage should have three or four steps. Each step should be numbered clearly and the tools, machines and processes used should be listed.

The steps should be clear and provide sufficient information related to the tools and processes needed to best carry out the tasks, including methods of finishing and assembly and the best order to carry them out. A well planned sequence of operations could save costly mistakes during manufacture.

You could do this in a variety of ways:

- Like a story board using a combination of simple sketches and writing to help illustrate the key stages required for manufacture.
- Writing a detailed list, thinking carefully about the correct order of the tasks and the equipment needed to carry them out.

Story board



SEQUENCE OF OPERATIONS

List

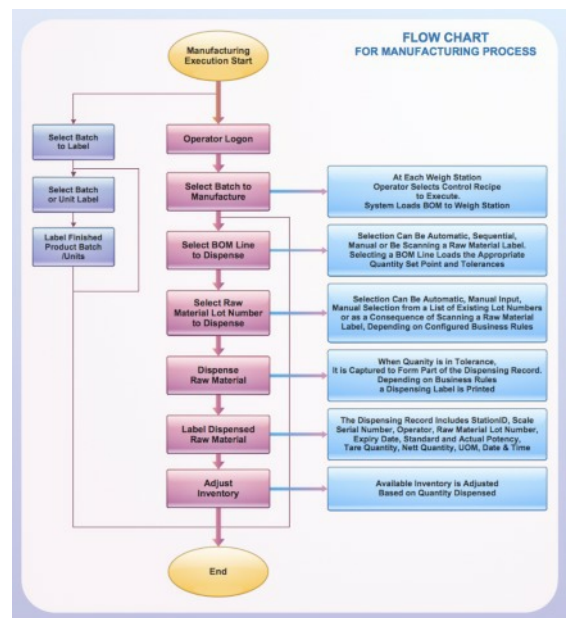
1. I will join my pieces of wood in pairs to create the outside of my cabinet.
2. I will then measure my wood to the correct size using a hand rule and a set square. I will use a sander for the top and bottom parts and 125mm of the sides. The side wood will be cut off using a hand saw.
3. After that I will mark out my details for the inside of my cabinet. They will be 25mm at the top and bottom of the bottom.
4. My woodwork will then be cut by the hand saw and I will also cut them using a strong saw.
5. The sides of the cabinet will then be marked using the electrical sander for my cabinet sander to cut exactly the base of my cabinet and also be sanded for the corner-bushing joint to sit on.
6. Then I will mark out a cross-bushing joint on the front for the internal shelf divider. This will be done on the front end.
7. A sheet of plywood 125mm x 125mm will then be cut using the table saw. This will be for the back of my cabinet.
8. On the plywood I will cut a hole for the top of the door. This will be done using a hand saw cut on the plywood with the purpose of these holes is so that the top part of the door can be attached to the cabinet.
9. I will then cut my doors in the shape of the front of a drawer. This will be done using a hand saw. I will cut it off these out of wood.
10. Once they are cut I will then sand them up by gluing them and then clamping them together with quick clamps.
11. I will then put my cabinet together including the internal shelves. Then I will dry clamp it together with hand clamps to be sure that the wood is the correct size and it fits in the joints and accurate.
12. I will then take my cabinet apart and hand sand every piece of wood until it is really smooth.
13. Then I will use the electric sander to put a nice finish onto the wood.
14. After that I will clamp my cabinet together but this time with glue at the joints.
15. The screws used at the drawers will then be taken off with a drill under each one I will sand the cabinet with the electric sander for the final time.
16. After that I will join my woodwork onto the cabinet using half inch push pins and a hand pin hammer.
17. Once this is done I will then cut the correct length of panels to use for my doors and mark on the cabinet and the doors what the joints are going to go.
18. Whenever the joints is on the doors I will make a 25mm hole for a 25mm screw to go in so the door doesn't split when the screws are inserted in.
19. I will cut the doors marking them they are a little too long for the holes so they can be sanded down to the correct size.
20. Once that is done I will then screw on the doors at the marked points on the wood.
21. Once that done I will then put masking tape around the edges of the cabinet. That way when it is the doors I will then paint all of them as well.
22. Once that paint is done I will put masking tape on the outside ones of both doors and then on my 'front' and 'back' legs.
23. I will then cut some 'legs' out using a hand saw.
24. Then I will paint the 'back' legs orange and the 'front' legs yellow. I will give each leg 3 coats each.
25. Once that paint is almost dry I will carefully put the masking tape off, making sure none of the paint touches any part of the cabinet.

Flow diagram

- Create a flow chart, again showing the order of tasks any bottle necks in production.

Whatever method you chose, you must ensure you include all the required, to allow someone else to use your sequence to manufacture the product as you intended.

Some examples can be seen below. Your teacher can give you more information about these.



Evaluations and Recommendations

A good designer will continuously evaluate their design work throughout the design process. You will need to carry out evaluations at two stages. 1: at initial ideas and 2: after manufacture. It is important to refer to the design specification on each occasion.

Initial evaluations and methods

When you are creating your initial ideas it is good practice to annotate your ideas based on the information given in the specification, saying if the idea does or doesn't satisfy those needs at this stage. This will be classed as evaluation as long as you give reasons in your annotations.

There are many visual methods for evaluating ideas which make it easier to see the better performing ideas. Some of these are shown bellow. Your teacher will show you how to use them. NOTE: These methods should be used with the annotations, not in place of. Your evaluations should provide a clear direction for the next stages of development in your project.

Star Ratings



Simple star ratings indicate how well aspects of a design is meeting areas of the specification.

Final evaluations and recommendations

During your final evaluation you will be required to consider your craftsmanship as well as your success at meeting the various aspects of the Brief and Specification.

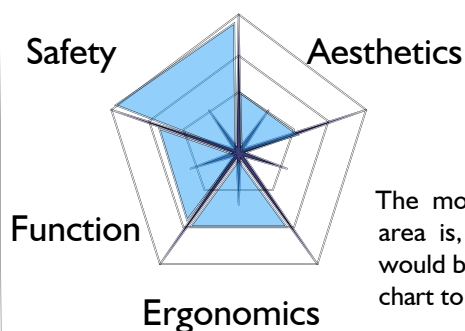
In your evaluation you will need to write about your successes, difficulties and also make recommendations and suggest any changes that would be necessary to allow commercial manufacture of your design.

Traffic Lights



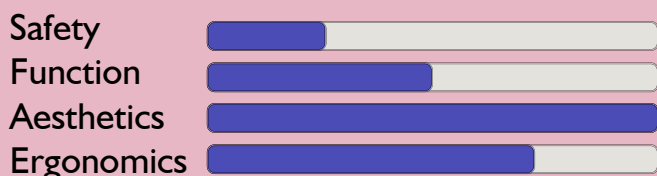
Using colour like a traffic light system is another way of drawing attention to good and bad aspects of a current design.

Star Charts



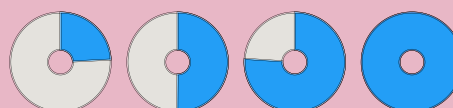
The more successful an area is, more segments would be coloured in the chart to represent this.

Sliders and Charts



Sliders and charts can be another good way to show current progress or success, but remember,

“a good evaluation needs good annotation”



Domestic Kettle



Urn



Camping Kettle



FUNCTION

All products have an intended purpose. This is the main thing/things it was designed to do. Due to competition and consumer demand, companies often produce products with additional features and functions.

Functions can be split into two groups. Primary functions and secondary functions.

The **PRIMARY FUNCTIONS** are those that are vital for the design to do its job while the **SECONDARY FUNCTIONS** are those which although important could be compromised for the benefit of the primary functions. Secondary functions are often the added extras that can influence the consumers choice to buy, assuming the product can effectively perform its primary function.

You should always think about this when working with a specification. Breaking it up in this way helps you to prioritise, especially in the early stages of designing where you should only concern yourself with the important aspects of the design.

FIT FOR PURPOSE.

Above are three products with similar primary functions, to boil water, However they are not all fit for purpose in different scenarios. A product can be functional but not necessarily fit for purpose. We all know a kettle boils water, however it is designed specifically for domestic use. A kettle would not be fit for purpose in a work canteen or staff room as it would not hold enough hot water. In this instance an urn similar to the one above would be used. It connects to the mains, so does not need to be lifted to fill, it holds much more water and can regulate its temperature making this one fit for this specific purpose.

The domestic kettle, again suitable for home use, would be no use camping as it is bulky and requires access to electricity. The urn would also be too heavy. The camping kettle is fit for purpose because it is light, compact and can be used on an open fire.

The primary functions of a kettle is as follows:

- It must hold 1.5 L of water.
- It must boil the water.
- It must have a spout and a handle to allow easy pouring.

These functions will allow the designer to produce a range of sketch ideas without getting bogged down with such things as water level indicators.

Think about kettles you are familiar with.

What secondary functions do they have?



PERFORMANCE

Ease of Maintenance

Maintenance of a product is a factor that can easily be overlooked. At the forefront of the designer's mind will be function and aesthetics. Although maintenance is an aspect of function, it comes second to the more important aspects of function in use.

Consideration of maintenance depends to a large extent on the **life expectancy** of the product. A cheap down-market product will often sacrifice maintenance to cost. In this instance the designer intends that the product will be thrown away when it ends its useful life. In contrast, more expensive up-market products will generally have much longer life expectancy and therefore may require periodic maintenance to maintain optimum efficiency of the product.

Building in maintenance obviously adds to the cost of the product but can be justified in **higher cost** products. An example of maintenance can be replacing batteries for in iPad or lap top or replacement legs for a chair.

Strength and Durability/Material Selection

Durability of a product or component depends on a number of factors:

- Material selection and construction
- use of product

- Size of the product

The durability of a product/component depends directly on the materials chosen, the manufacturing process used and fixing methods used. Designers can use temporary joining methods like screws and knock down fittings, which are easy to maintain with basic tools (Screwdrivers and Alan keys). More permanent joins such as welding and gluing make products impossible to maintain by the average consumer.

Durability will also be affected by how the user **uses or abuses** the product. E.g. swinging on or standing on a chair may weaken or break it, shortening its life span. Dropping a product in water or forgetting to switch appliances off could also affect the performance of the product.

Size is of great importance. If products are too big or too small they may be difficult to use or maintain. The size must also be correct and fit for purpose. For example, when taking a chair camping or to the beach, you would expect it to be compact yet comfortable to sit on. If it was similar to a dining chair or arm chair, it would be too bulky and heavy for its intended use.

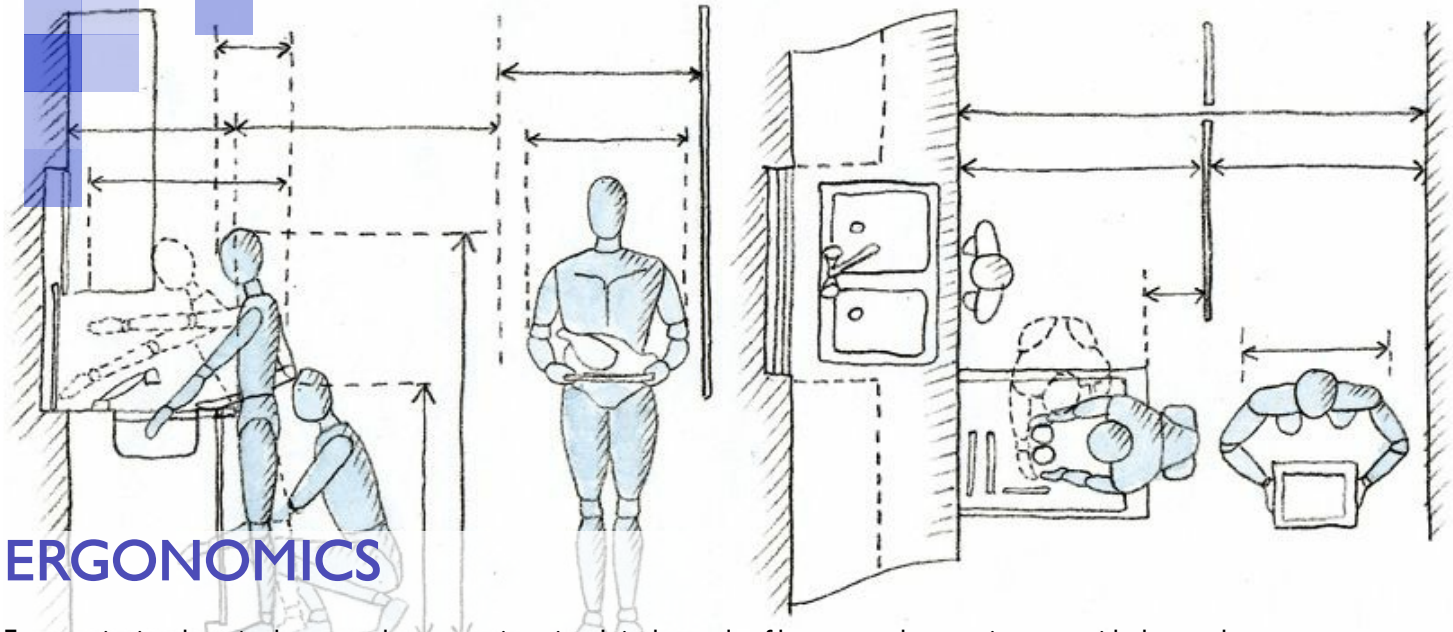
Planned obsolescence

This is a key factor in performance. Designers and can design a product to have a set life span. This can be done by parts wearing out, going out of fashion or technology dating. Obsolescence means that consumers will often throw away perfectly workable products as there are faster, smaller, better ones available on the market and they have the desire to upgrade. We see this a lot with technology. As the new iPhone comes out, the older models become less expensive to buy. Consumers investing on the new one expect improved performance.

Ease of use

For any product to be considered to perform well it **MUST** be **EASY TO USE**.





Ergonomics is otherwise known as human engineering. It is the study of how we as humans interact with the products and environments surrounding us.

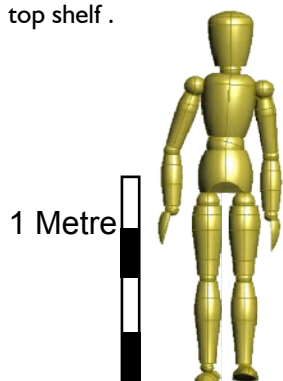
How People Interact with Products

People come in all different shapes and sizes so their needs and requirements may differ. Any system, product or environment that has taken ergonomic design into consideration will be safe, comfortable and simple to use.

Look at the kitchen example above. A kitchen is the place where much daily activity takes place: we store, prepare and cook food and then we eat it. All this is easier if we have everything at hand and we can move freely and comfortably without getting tired. But that is often impossible because our kitchen furniture doesn't meet our physical needs. Units can be at the wrong height and have difficult to reach spaces. Stiff or awkward to open, tight spaces and poor layout can cause us injury, stress, strain harm or discomfort.

Think about a kitchen for wheelchair users. What aspects would need to be changed to make it good ergonomic design?

Designers often use scaled down figures called "ergonomes" during the design process to help them work out sizes to achieve this. Ergonomics is an important factor for any product or space. Using this scale in the situation below, would allow the designer to find the optimum height for the seat or top shelf.



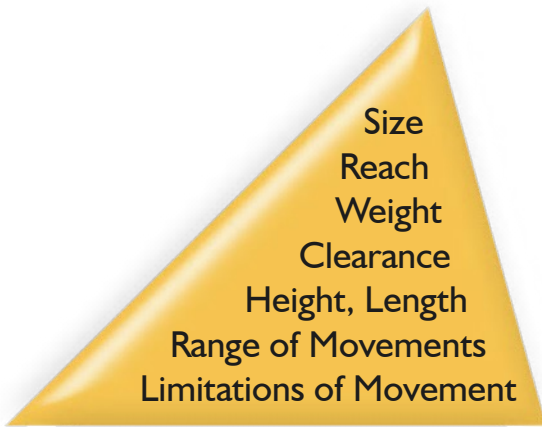
For a product like a mobile phone, the aspects of ergonomics to be considered are very different to designing a kitchen.

Nowadays, phones tend to be touch screen. The designer must ensure that the icons are suitably spaced out to allow them to be pressed individually. As there is no actual button to press, the designer has to find some other way of reassuring the user they have in fact pressed the button. Typical solutions include vibration, sound alerts or lights and moving icons. As this affects how the consumer interacts with the product, it is also ERGONOMICS.



Another aspect could be the weight of the product. If it is too heavy, it may cause the user to tire when using it, however if it is too light, the consumer would not be able to feel the weight of the phone in their pocket and could potentially lose it.

There are many things to consider as well as the Critical Sizes.



Anthropometrics

Anthropometrics is a special aspect of ergonomics concerned with the measurements of peoples shapes and sizes, range of movements and their limitations.

This can include sizes, e.g., like standing height or reach i.e., How far people can stretch up or across. A product will always work better if it is designed to fit the sizes of the intended user.

Collecting the data:

The designer could gather a sample of people from the target market and take the sizes and measurements needed, or they could refer to an anthropometric data table like the one shown below.

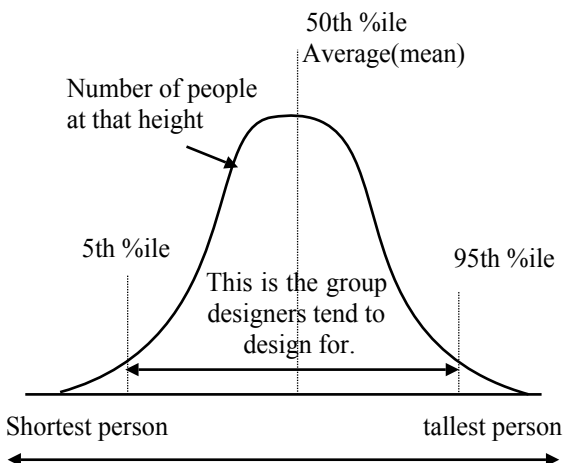
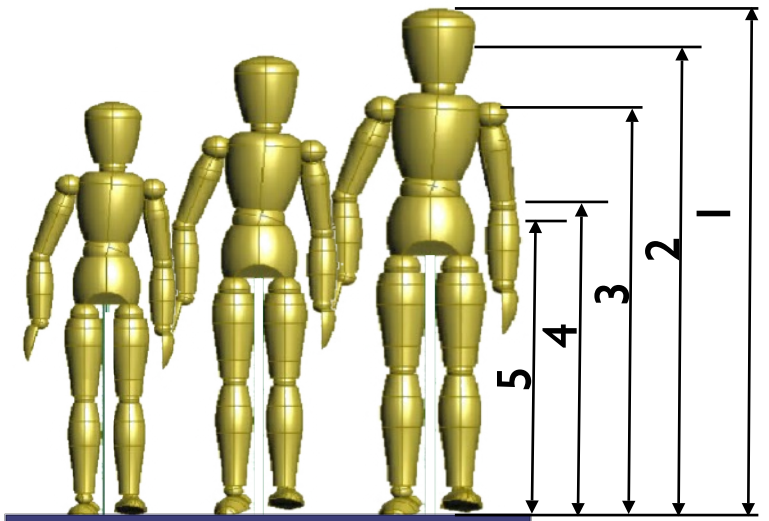
Dimensions (mm)	Men 5th %ile	Men 95th %ile	Women 5th %ile	Women 95th %ile
1- 1725 Height		1641	1869	1514
2- 1612 Eye		1525	1751	1409
3- Shoulder height	1351	1559	1230	1431
4- Elbow height	1023	1189	951	1097

Critical Sizes: The critical sizes are those which will allow the product to be used by the majority of the intended target market.

Gender is an important factor to consider. When designing a doorway the height of people would be considered to ensure most people can pass through easily.

The 95th %ile height of males would be used because the 95th %ile male is taller than all women and most men. In general terms, men are typically larger than women, however if you look at the table opposite you will see that the elbow height of the 5th %ile male is smaller than the elbow height of the 95%ile female. This is why we cannot make assumptions. Designers must know exactly who they are designing for.

All men are not the same size, neither are all women. Hence the 5th—95th percentile. There are less people in the 5th and 95th %ile. The 5th%ile includes those with the smallest measurements, lets say men with size four feet, and the 95th %ile are those with the largest measurements, for example women six foot 6” tall. Designers tend not to cater for these extremes as they do not represent the majority of the target market. Products cannot be designed to suit everyone, instead the designer establishes the critical sizes and aims to make the product suit 90% of the population within the target market group, the 5th-95th percentile.



There is nor really such a thing as an average person (the 50th %ile man or woman) Even if people are the same height it is likely that their waste size, arm length, hand size etc. will be different.

If we designed a door for the 50th %ile male height, then 50% of man would fit under it and 50% would be too big.

Safety



International
Organization for
Standardization



Many products have to be designed to comply with regulations laid down by law or by recommendations made by organisations such as BSI (British Standards Institution) and ISO (International Standards Organisation). Often ISO, BSI and the Government work together to set standards. The government will for example state that car seat belts must be fitted to all cars and that the belt design should be to BSI/ISO standards. When a product is manufactured to these standards it will be clearly indicated that this is the case somewhere on the product with a number and the BSI/ISO logo as shown above.

The designer of a product is responsible for ensuring that products are safe to use. There are a number of well documented cases where designers have been sued for negligence, i.e. designing a product which proves to be unsafe and causes injury to the user. The driver was badly burnt, sued the designer and won. As a consequence of such cases designers must make every effort to design products that will be safe in use by carrying out stringent functional tests. Occasionally products are found to be unsafe after they have been put on the market and have to be redesigned, e.g. plastic pen tops such as those manufactured by BIC caused a number of deaths in young children when accidentally swallowed. The pen top was modified so that it is open at both ends so that if swallowed the airway does not become blocked. Cases like these have made consumers more aware of their rights and of safety in products. As a designer you must also DESIGN THE RISK OUT.

Designing Risk Out

As a designer you now know you have a responsibility to ensure that your product will not cause injury to the users. For a kettle there are obvious safety considerations for the designer.



- Insulate the electricity from water
- The user isn't burned by steam when pouring
- Good grip to prevent dropping
- Controlled pouring from spout.
- Made from non toxic materials.

Other than the obvious safety aspects that occur from normal/intended use, the designer must also be able to anticipate how the product might be misused to ensure the user will still be safe. E.g.

- If the user forgets it is switched on, it will automatically turn off.
- If the user forgets to put the lid on, or forgets to put water in the kettle, it wont boil
- If the user drops the kettle it wont shatter.

These are not ways you would recommend the product be used, just like the pen lid. The designer of the pen lid, did not consider the risks if it was put in your mouth as it had nothing to do with the functions or operations of the pen. The lid was not designed for this at the time and sadly resulted in death.

It is these unintended uses that often result in the injury of consumers and it is your job to anticipate them and design them out.

Have a go.

Look at the bike below and do the following.

- Analyse all parts of the product. (1-12)
- Write down what each bit needs or has to make it safe.
- Write down any hazards, risks or injuries that may occur if the product is miss used or isn't designed well.



Alternately you can write "A day in the life of" summary which should get you thinking about all the worst case scenarios of using and misusing a badly designed product.

Aesthetics

The term “Aesthetics” relates to our senses and their response to objects that we consider beautiful or pleasing to the eye. How a product looks is often a big decider on whether the product is bought or not. “This is why companies invest money in Point of sale displays and packaging”.

Aesthetics is not an exact science. What one person finds attractive, can be viewed very similarly there is not a right or wrong. When dealing with Aesthetics you must remember have different tastes and preferences. You must understand the style of your target apply the basic principles about aesthetics that can influence GOOD DESIGN.

is important as we all have different taste and the designer must be sure they can create something in a style that the intended users/target market will find attractive. There are many aspects that affect how a product looks. You should familiarise yourself with the aesthetic aspects below and consider all of them in your design and development work.

“Have nothing in your houses that you do not know to be useful or believe to be beautiful.”

– William Morris

differently by another, two things: 1- Consumers market, and 2- You should

Colour-



Colour is something that we are all drawn to and our preferences will differ depending on individuals tastes. Colour can reflect fashions and trends as well as convey a theme or feeling. For example vibrant colours like orange and yellow are bright fun colours, where as cool blues are more calming. A good choice in colour should suit the taste of the target market and the perceived value. (Does it/should it look expensive?, Should it attract children? Does it suit the theme?)

Contrast/Harmony

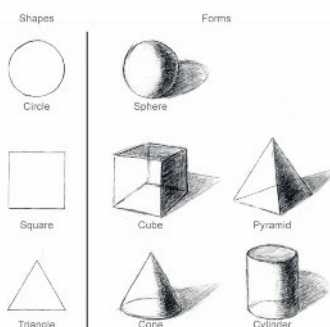
attention to a design. Harmony: It may be desirable to create a product that fits in with the surrounding environment. This means the designer must use colours and styles that blend in. The trike is an example of harmony. The colours are in harmony as they are all similar Pink/lilac tones . The materials harmonise as they are all matt plastic and the form is in harmony as all parts are curved or rounded. The other object illustrates contrast. The form contrasts circular holes and straight edges and the warm wood grain contrasts with the cold concrete texture.

Contrast is using two very different things like black and white or shiny metal and matt wood. Using contrast in materials colours or shapes we can add interest and attract



Shape/Form-

Shape is 2D like a circle or square. Using different combinations of shapes can be used to create contrast or harmony.



Form: Form is 3D and is developed from the 2D shapes e.g. cylinders, spheres, cubes or cones.

These are all geometric shapes and forms. Complex organic shapes and forms can be created through design activity or by looking at nature for inspiration.



Aesthetics cont.

Size/Proportion-

look difficult to use or insignificant. The function and purpose of the product will influence the designers decisions relating to size. Proportion is how sizes look in relation to the size of other items around them. Look at the diagram of people opposite.

Changing proportions can change our response to what looks correct. Proportion and size can affect how stable, sleek or elegant a product looks. Just small changes in shape and size can improve the aesthetics of the overall design.

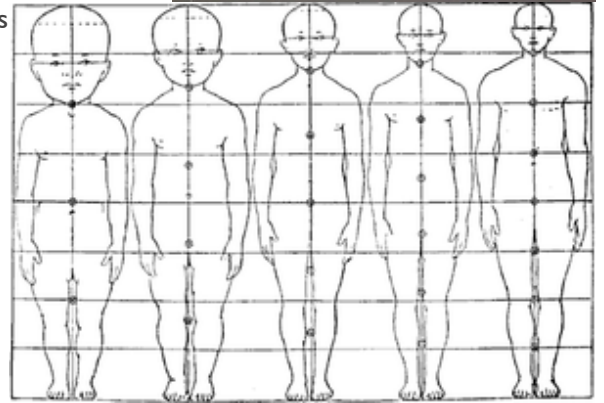
Balance- Furniture and products are not always symmetrical but are visually balanced. This visual balance helps a product

look good.

Look at the following product examples. In product 1, visual balance has been achieved by colouring one leg on the right to balance up the darker left hand side of the unit. This unit is also longer than it is tall which makes it appear more stable. In picture 2, visual balance is achieved through colour. The contrasting red wall is complimented by red cushions in the room. In image 3, the low wide base allows the large chair to look stable on such a small frame. The straight lines on the frame also balance out the curved form of the chair, so as not to make it too overwhelming.



3



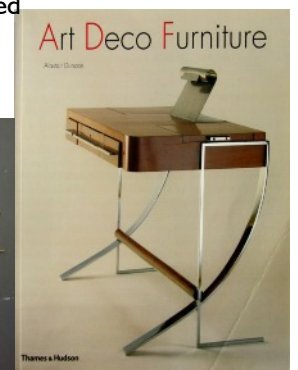
Texture/materials-

When a designer refers to texture they are speaking about the surface quality of a material. Every surface has a texture whether it be smooth or rough, bumpy or flat. Our perception of texture is also influenced by the textures of surfaces near by. For example, rough surfaces seem more textured next to smooth surfaces, or when viewed when lit from the side). Texture can be tactile (we can feel it) or visual (we can see it). Textures will be determined by the designers choice of material and finish for a design. Although you are taught in the workshop to finish wood and other materials with a smooth texture in the workshop, you should remember that rough texture and grip is essential for some products. As well as affecting function, texture of a product can also affect the ease of maintenance. Rough textures can be difficult to clean and therefore deteriorate the look of the product quicker.

Fashion/Style-

short lived and can change for reasons like current seasons colours or the latest trend in technology. Style, on the other hand, is unique to everyone. This is the person's own opinion, their own choice in clothes, furniture, products and accessories. Style is something that has been modified and customized on an individual level to suit each person's own personality and lifestyle. Style is something that doesn't date. E.g. Art deco is a style from the early 1900's where geometric forms and sunray designs, like the mirror shown, were very popular. These kind of products are still sought after by consumers. They are not "old fashioned" They belong to a design style.

Fashion is what is currently in right now, what is being featured in magazines, on TV and sweeping through the high street stores. Fashion is what is trendy right now. Fashions are



Market

Market can be defined as a group of people who are potential buyers for a product or service. The size of the market will depend on the number of buyers for a particular product. A designer never expects their product to be suitable to everyone as consumers all have different needs and wants. Instead, the designer chooses identifies a range of people with similar needs, income, interest and access to the product. This is a segment of the market.

Market Segments

There are numerous ways to split a market into segments.

Geographic factors such as country of origin, or residence, language and culture are important in matching the product to the market.

Economic & Demographic factors also affect peoples needs and interests. These include differences in age, income, gender, Education and social status.

There are also **Psychographic** factors. These are the factors that define the individual or motivate consumers to buy, including lifestyle. Goals, media usage/exposure, peer status. Attitudes and expectations.

A market can be split in any way as long as the consumers within a segment share a common interest in the product.

Once the designer has established the correct market segment, there will still be differences amongst the individuals in that group.

Innovators:
Want whatever is new and different.
Desire to set trends and stand out

Early adopters:
Willing to try something new after some good reviews

Observers: sceptic about new products. May not want to invest.



Experts and lead users:
Know their products inside out and want technical detail

Followers:
Follow the crowd. Don't want to be different

Brand Evangelists.
Labels and brands. Looking for status.



Target Market

The designer will target a certain group within the market segment. This is known as the **Target Market**. By doing this the designer can focus on a narrower range of needs and interests to ensure the product is desirable and available to that consumer group.

Niche Marketing

A niche is a focused, targetable part of the market. A designer is a specialist providing a product or service that focuses on a specific client group's need, which cannot or are currently not addressed in such detail by mainstream providers.

It is important to understand that there is a difference between your niche and your target market:

Apples niche is in clean simple design. They produced the iPad to cater for a new market they identified. Those with no need for a PC or laptop to write, game or create spreadsheets, but who enjoyed browsing the Internet and using their phone for entertainment. The iPad was a niche product that provided this market with a larger screen to surf the web, wifi, and entertainments apps. Although there are other similar devices on the market, Apple's operating systems, applications and iTunes remain their niche, as they refuse to allow any other devices or manufacturers to access their products.

Why is it important to have a niche?

- The more unique the product or market is, the less competition they have.
- Fewer competitors means more repeat business
- You cant design for everybody. Designers find a specialism and do very well developing expertise and reputation in that area.

Colgate for example have a niche in dental care. What if they manufactured a TV? What expertise would they have?

Consumers like to make safe purchases, buying into reliability and familiar brands.

- Marketing becomes easier and more efficient. You know the product, how to price, place and promote it successfully.

Demand or No Demand?



Consumer Demands

A designer can create a brilliant product but if there is no demand, it won't sell. It is important to understand the patterns of consumer behaviour that affect buying decisions. Consumer demand is influenced in various ways. Psychologists and marketers have identified three important factors affecting buying decisions:

- **needs**, which are things we must have, such as food
- **wants**, which are nice to have but not essential, such as a new car, shoes or phone upgrades;
- **and motives**, such as keeping up appearances, needing to be accepted or admired.

Other factors that influence demand include gender, age, social grouping, education, location, income, culture, and the seasons. In the UK the demand for warm and waterproof clothing increases in the winter and decreases in the summer.

NEEDS AND WANTS

There is a huge difference in demand from the Consumers in the west, to those in developing countries. Lack of basic needs such as clean water, food and clothing, leaves no demand for games consoles or other luxury items. Needs must always be satisfied first.

How many pairs of shoes do you own?

How many do you need? We actually only need one pair to protect our feet while walking, however we want different shoes for different outfits and different weather. These additional shoes are not necessities. This needy way of thinking is due to the UK obsession with shopping.

Look at Abraham Maslow's hierarchy of needs. Basic Psychological needs must be satisfied first. This is the need for water, food, and air to breathe. Then the consumer needs to feel safety, this can be shelter, employment, health and family. Then there is a need for social acceptance, friendship and family. Once these three are satisfied, the consumer will move to Esteem needs, where the need respect and acceptance. Self actualisation, creativity and knowing ones self will only be achieved if the other factors have been satisfied. This applies to marketing. Without safety and health, consumers will change their purchasing habits. Those seeking acceptance purchase products which they believe will make them popular or envied.

Social / Consumer Expectations

Consumers are now spoiled for choice. They are now much more aware of good design, than they have ever been before. Access to consumer watchdogs, reviews etc through TV, radio and Internet has heightened the average consumers awareness of product safety, competition and consumer rights. Consumers now expect products to:

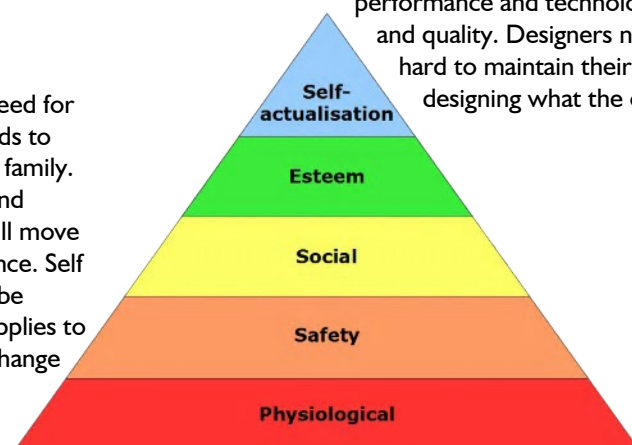
- Function well
- Be reliable
- Be safe and easy to use
- Look good and
- Be good value for money.

There is now also an expectation that products will be environmentally friendly.

- Can it be recycled
- Is it from sustainable sources

Consumers now expect to have a choice. In the 1960's there was a rise in individualism which has stuck with us today. Consumers express themselves through their purchases. Function focused, fashion or style, gadget and technology, Price, Brands and colour are all expectations of today's consumers.

Consumers are no longer happy with the basic features of a product. There is a growing expectation that their product will offer additional features to make it stand out from the crowd. Consumers expect change, variety, advances in design, performance and technologies alongside value and quality. Designers need to work hard to maintain their market share by designing what the consumer expects.



Introducing New Products

When a company introduces a new product there are many important things to consider to ensure the product is a success.

Market research: without market research you are flying in the dark, with no idea what your consumers want, who they are or what they need.

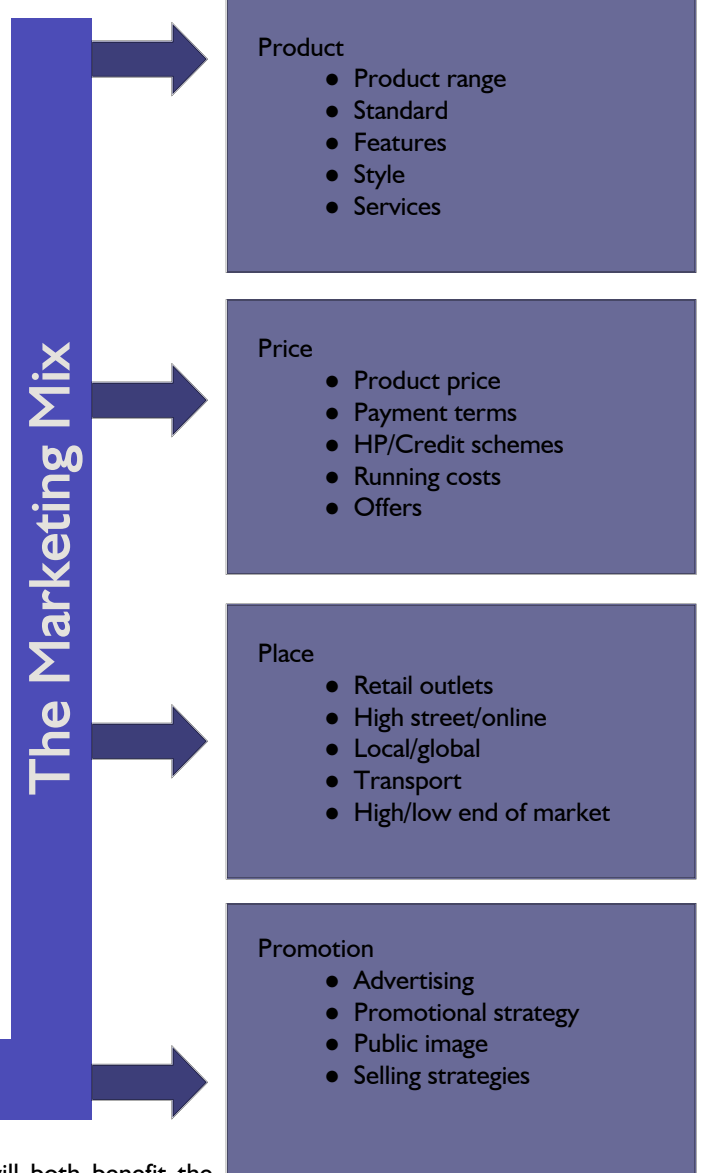
Timing: bringing your product to the market at the wrong time, later than you announced its release or in the wrong season or economic climate can be financial suicide. As consumers may have other purchasing needs or you could be beaten by a competitor

Volume: having too many or too few can also create issues when releasing a new product. The companies must promote the product and understand the level of demand.

The risks associated with a new product depends on the company's experience with both the target market and the product. Approaching a new market segment can be risky as their interest, income and availability will differ. Approaching a new technology is also risky as there will be a lack of product expertise and more research and development needed.

To help with the introduction of new products, designers and market researchers use a Marketing Mix strategy.

The Marketing Mix



The marketing mix helps the designer ensure that the product will both benefit the consumer as well as meet their expectations in terms of being affordable, and accessible.

Product: The product needs to satisfy the designer's needs and wants. If it is not their style, of a sufficient standard or does not meet their expectations in any other way they will NOT WANT IT.

Price: The price of the product needs to be affordable and competitive. Cheapest is not always the best as the consumer may think the product is in some way inferior, yet if it is overpriced, they will not believe they are getting value for money. Research should indicate what the consumer is likely to pay and whether the product is viable and will generate profit.

Place: The product must be accessible to the target market. Market research will show which stores the consumer shops in, if they buy online, when they buy etc. They need to know if it will be at the high, mid or low end of the market to enable them to establish the correct retail outlets.

Promotion: More market research will highlight the lifestyle and interests of the target market. What papers and magazines they read, what TV they watch, and knowing where they go ensures that advertisements and promotions will reach the consumer and have a visual presence generating their interest and demand for the product.

Technology Push

Technology-push is not based on an existing need, it is an attempt to bring an innovation to create a new need. It's a brilliant R&D not based on any expressed consumer want, resulting into a new product which the company sells as desirable and essential.

Technology push involves great risk as it takes huge amounts of time and money to research and develop something new, without knowing if consumers will want it or buy it.

A great example a successful technology-push innovation is Sony's Walkman in the 1970's. This portable entertainment device that allowed people to bring their music everywhere they go is the original groundbreaking product that changed the music listening experience in its generation. Before that there was no real portable music systems and little desire or need to bring music everywhere, but the technology-push brought it about. The product and benefits were sold to the consumers, starting a new lifestyle, creating a new market and competition where consumers decided that there was indeed a need to bring their music with them. This then became part of the market trend as it became part of people's lives.



The Mini-disc was an example of failed technology push. Although these products were smaller than CD's. They were compatible with less products and were not competitively priced. The Mini-discs didn't offer a significant improvement to the consumer so there was low demand and the product was eventually removed from the market.

A more recent development would be digital music. Consumers didn't ask for it. They didn't know it existed.



"You can't just ask customers what they want and then try to give that to them. By the time you get it built, they'll want something new."

Apple CEO Steve Jobs

Market Pull

The term 'Market Pull', refers to the need/requirement for a new product or a solution to a problem, which comes from the market place. Those needs are generally identified through market research, feedback from retailers or from potential consumers asking for improvements to existing products. A product or range of products will then be generated to satisfy that need,

A good example of market pull is the design of the digital camera. In the 1990's consumers were becoming frustrated with the expense of developing camera spools, being limited to 14 or 21 photographs per spool and of course having no idea if their photographs were worth printing until they had been developed. The technology of the time did not lead to the manufacture of such a device. Technology improved as designers researched and developed to meet the Market Pull, eventually leading to the development of the digital camera. As the cameras performance, size and capacity continued to improve, Market pull then changed to photo editing software and accessories.

Although there is a waiting market, competition is high as other companies rush to be the innovator in the market.



Sometimes the market 'calls' for an innovative new product, but the technology does not exist to support its development / manufacture. Currently consumers are seeking fuel alternatives and electric cars. To date battery technology is not advanced enough to provide the consumer with a car that performs equivalent to a petrol car, that offers the same convenience, and ease of use. There are insufficient charging networks and long charge times making it only suitable for short commutes. Market pull has begun to influence investment in research and development, ensuring that big manufacturers are beginning to take on the challenge to find a solution/alternative transport to meet the market needs.

Surveys

Survey is the name given to the process of finding out information relating to people or a product. There are several ways you can conduct a survey.

Questionnaire

Questionnaires are often used in surveys. These can be paper forms or electronic questionnaires which are issued to a group of individuals to gather their opinions etc.

As a designer it is important to keep any questionnaires short and to think carefully about the questions you will ask (including the wording) and the type of response you are likely to get to ensure the questionnaire generates the type of information you are looking for, and are filled out accurately.

You should consider the following if you are going to use a questionnaire.

Is it important to know the age or gender?
(Use age bands: 25-30 etc)

Closed Questions. These questions generally have simple Yes/No, Agree/Disagree answers. The answers are from a selection set by you and are easy to collate.

Open Questions. These questions generally have less predictable answers. They allow the group to express their opinion however you can get a vast array of responses that could be difficult to collate.

During a questionnaire you might also use multiple choice or images for comparisons.

Always have someone read over your questionnaire before you issue it and ALWAYS keep the language simple and appropriate for the general public to understand.



Observe and record

Surveys can also be carried out by observing or speaking to your target market. Rather than issuing individual questionnaires, you might keep a tally of the various responses you get. An example of this might be showing consumers a product in a range of colours and asking them what one is their preferred colour or how much they would pay.

Surveys are a very important tool to allow the designer / market researcher to understand the needs, wants and preferences of their potential target market. Surveys can also be used to establish consumer demand via retailers.

A good survey

A survey will only generate useful results if :

- A large sample of people are involved
- A full range of people within the target market is included (genders, ages, ability etc)
- Activities or questions are carefully thought out to only generate useful information.



User Trial

A user trial is when a range of people from the intended target market are given the opportunity to test a product and/or carry out a series of tasks.

The designer can either observe the trials taking place or gather information from the users after their trial.

Observing a trial, allows the designer to look for and identify any difficulties with the product and how people interact with it. An example of this might be observing how an infant uses a cup to design something which is easy to lift and use, or to understand how people with limited ability like the man in the picture above move and interact with products.

In the case of toilet roll, cosmetics, medication or even a car, the trials require privacy or extended periods of time to allow the users to be able to build a full and detailed opinion of the product to pass onto the designer.

A successful user trial

Like a survey, there are a few things you should consider to ensure you can generate effective results from your user trials.

Think about the range of users, in terms of age, gender and ability. Is it important for you to include all these people in your trial?

Have a clear idea about what you want to find out. Ensure the instructions you give are well planned and allow you to observe useful activity. Ensure the questions you ask are relevant to the information you are trying to gather.

Be consistent. Ensure each user involved in the trial is given the same instructions to allow the results to be compared.

Comparisons

Comparing products is an useful way to identify the good and bad aspects of existing products, noting the areas for development and consumers opinions.

A comparison can be made using physical products or comparing images or information. You could compare a range of kettles by testing them for ease of use and actual boiling time. Alternately you could compare a range of similar kettles online, focusing on aesthetics, volume, brand and price.

A designer might carry out a product comparison looking for facts on his own, however if the comparison is opinion based, it would be conducted with a range of people as a survey.

BUYER'S GUIDE: CHILD TRAILERS
Show your kids cycling is fun—drag them along

TRAILER	PRICE	RATING	WEIGHT (lb)	MATERIAL	WHEELS	HEIGHT (in)	WHEELS (in)	SEAT (in)	STROLLER (in)	Color(s)	INITIAL ASSEMBLY	REASSEMBLY	COMMENTS
YAKIMA CADDY YAK	\$475	★★★★★	25	Aluminum	Handy	18.5	20	18	58	Blue, Yellow, Red	Yes	Yes	Easy to assemble and disassemble. Good for long trips.
BURLEY D'LITE	\$429	★★★★★	30.5	Aluminum	Handy	18.5	20	18	58	Blue, Yellow, Red	Yes	Yes	Lightweight and easy to use. Good for long trips.
WIKO MOONLITE	\$389	★★★★★	22	Aluminum and Plastic	Handy	18.5	20	18	58	Blue, Yellow, Red	Yes	Yes	Lightweight and easy to use. Good for long trips.
CHARLOT COUGAR 2	\$420	★★★★★	22	Aluminum	Handy	18.5	20	18	58	Blue, Yellow, Red	Yes	Yes	Lightweight and easy to use. Good for long trips.
TREK TRANSIT DELUXE	\$449	★★★★★	22	Aluminum	Handy	18.5	20	18	58	Blue, Yellow, Red	Yes	Yes	Lightweight and easy to use. Good for long trips.
INSTEP TURBO ELITE	\$300	★★★★★	22	Steel	Handy	18.5	20	18	58	Blue, Yellow, Red	Yes	Yes	Lightweight and easy to use. Good for long trips.
ICYCLOTOTE	\$495	★★★★★	14	Aluminum	Handy	18.5	20	18	58	Blue, Yellow, Red	Yes	Yes	Lightweight and easy to use. Good for long trips.
KOOLOP PAPOOSE CABOOSE	\$399	★★★★★	27	Steel	Handy	18.5	20	18	58	Blue, Yellow, Red	Yes	Yes	Lightweight and easy to use. Good for long trips.

The rise of Consumerism

Consumer habits have changed drastically over recent decades. This is due to changes in lifestyle, society and technologies.

In 1948 life was very different. People often lived in the same house or town for their entire life with 1/4 of British homes having no electricity. Many couples had more than three children so spent their money on the necessities. Women stayed at home to cook and look after the children, while men worked and provided for their families. Rationing was still in place due to the war. This meant food and products were all in short supply. Choice was not an option. People took what they could get their hands on. Items were bought mainly from local shops.

From an entertainment point of view, there was only one radio station and only 14,500 TV sets in the entire UK which is why 1/3 of people went to the cinema at least once a week. Children would play outside with basic toys.

So what has changed?

After the war Britain was broke. New government set out to abolish Wants, Disease, Ignorance, Squalor and Idleness". Money was invested in new housing, welfare and permanent employment. Immigration increased as did the population.

The impact of Consumerism.

Nowadays the church has less influence on the population of Britain. Rise in cultural diversity, gay rights and the individuality and enthusiasm of youth has replaced experience and traditions.

Christmas is a perfect example of something taken over by consumerism. The modern day Santa Clause we are all familiar with was invented by Coca Cola in 1931. The event has become a time for excessive spending and exchanging gifts, shops displaying products and trees from October to CASH IN on what was once a more traditional religious celebration.

Nowadays most households have at least one TV, adults and even primary school children own mobile phones, iPads etc. The majority of households have fewer children now than before. The typical family has at least one car and there has also been an increase in single/divorced parents and career mums.

The ability to download films, watch TV on demand, game online, chat via skype has greatly changed society and how we spend our time. Pressure and exposure to advertisements has

Consumerism :
The preoccupation of society with buying goods.

created a want in society. People buy things to give them status, to make them feel good or to be accepted or admired or envied by society. Consumerism supports the economy as it keeps people in jobs manufacturing, retailing and designing. Consumerism is the belief that everything can be bought and sold, an unhealthy habit nowadays, which the majority of families cannot afford to sustain. Irresponsible consumerism is also the source of many sustainability and environmental issues.

So what caused this consumerism?

Affordable and accessible

In short, products became more affordable and accessible. **Advances in Technology** have continued to impact the manufacturing industry allowing them to bring products to the market for cheaper prices. **MASS PRODUCTION:** the ability to produce products en masse has made them more affordable. Workers are now more skilled in programming machines than hand crafting. A rise in **global manufacturing** of cheap products has also led to the increase in consumption.

High street stores like Primark, or Ikea, produce low cost Fashion items in mass. Consumers are able to stay in fashion but tend to buy more often.

MEDIA: Growth in communications via satellite, TV, Internet and radio have increased consumers awareness of products.

The addition of the family car and improved transportation has seen the development of large retail parks. Similarly, access to the Internet and TV has also increased the consumers choices to shop from the comfort of their home.



FINANCE; The introduction of Credit Cards, Store Cards, Catalogues and Hire Purchase, has made many products accessible to consumers on low incomes. Unfortunately societies growing need to "keep up appearances" has left millions of consumers in Debt with impossible interest rates.



Affordable and accessible products

Advances in materials and manufacturing technologies have had a major impact on the affordability of products. Mass production has allowed companies to produce high volumes of products to sell for lower prices to consumers. Mass produced products are made by automated machines so the company pays for less skilled workers.

COMPETITION: Consumers are now more savvy and know what they want. This means that manufacturers need to ensure they are meeting the needs of the consumer in price and product. Price wars among competitor companies ensures that products are affordable as businesses strive to keep their customer base.

DISCOUNTS, SALES AND OFFERS:

Consumers are frequently persuaded or enticed to buy things because of special offers. People buy things in sales that they don't need, or never use, because they see their purchase as a bargain. Sales and offers like Buy one get one free (BOGOF) are becoming more common as stores struggle to keep business as shoppers are moving more and more to the convenience of online retail. Stores can unrealistically raise the price of a product for a limited time to allow them to later promote the product with a massive discount.

VIRTUAL SHOPPING:

Online stores are often more affordable as the company does not need to pay for showroom equipment, rates or staff. Shopping from home makes buying more accessible for people with disabilities and the elderly, it also allows consumers to avoid long queues, busy shopping centres and the weather and the commute.

CREDIT/HIRE PURCHASE:

The availability of Store cards, Credit cards and Hire purchase has contributed significantly to the rise of consumerism. Consumers with low disposable income can obtain products using various buy now pay later options. Although this can be a good thing as it allows consumers to budget and pay over a

longer period of time, many families in the UK have continued to spend on luxury "affordable items" and are now struggling with high interest and repayment plans.

PLANNED OBSOLESCENCE: The fact that products are not designed to last forever, means that companies expect repeat business from their consumers. If phones were designed to last forever and consumers bought one and kept it for their entire life, the sales of phones would fall dramatically.

This means if consumers only bought one phone in their lifetime, companies would charge a lot more money for them as they would get no repeat business.

The fact that products fail, go out of date and fashion, creating repeat business, allows the manufacturer to sell products for a lower cost.

GREEN PRODUCTS: The use of Biodegradable and Recyclable materials reduces the cost to make the product and the price it is sold to the consumer. Designers are looking at other ways to lessen the cost of products by changing packaging, selling refills etc. **VALUE ENGINEERING,** is the term used to find cheaper ways to manufacture a product without affecting the quality or performance. If the company can save money in production, those savings will be passed down to the consumer.

Is it a good thing that products are more affordable and accessible?

Make a list of the advantages and disadvantages.



Impact of Design Decisions on Sustainability

There has been a significant shift in societies awareness of environmental impact. The benefits of Sustainable Design include cost savings, legislative and regulatory compliance and customer satisfaction or loyalty.

The Designer can have a huge impact on the sustainability of the product. During the Design Process, the environmental impact should be considered at every stage in the life-cycle, from the raw material extraction through to the end of the products life. For example, when manufacturing a mobile phone and looking at the consumer behaviour, we can see that it is often only used for twelve to eighteen months before it is replaced. As one of the biggest impacts is disposal, the designer or company may choose to do one or more of the following to reduce impact:

- design a product that can be easily disassembled for recycling
- use materials which are easier to recycle
- Use fewer materials to make recycling easier
- Consider how the components are assembled. Make it quicker an easier to take apart to increase recycling.
- Offer a take back scheme
- Standardising components like chargers, to work with newer models
- Use eco packaging,



Design for recycled content

Most modern materials can include high levels of recycled content, for example cardboard boxes, metals and most plastics. Choosing to use recycled products is better for the environment but also cost effective for both the consumer and the designer.

Bio Plastics

Many plastic like products have been created from natural products like potato and corn starch. As you can see in the pens shown opposite, the biodegradable plastic looks just the same as a normal plastic. Both are colourful and smooth textured. The benefits are it behaves like traditional plastic but decomposes naturally generating no pollution.



Design for transport efficiency

If a product is to be transported then packaging is important. The designer needs to figure out how to get the largest number of products into the smallest possible space. This will minimise the journeys and in turn reduce pollution. An additional consideration is, whether the display packaging can be the same as the transport packaging?

Design for longevity

Historically, some companies have been accused of planned obsolescence, which is deliberately planning or designing a product with a limited useful life, so that it will become obsolete or outdated after a certain period to ensure consumers re-purchase products. This on one hand is necessary as it allows products to be affordable as the companies know they will get repeat business, but it has fuelled consumerism and caused a growth in throwing away products which are still functional. Designers are looking at whether the product can be designed to last longer. For example, less products are being produced with sealed batteries, meaning the consumer can replace the battery when it no longer holds a charge. Another example includes companies like Apple. They allow old and new customers to update to their new operating systems, without buying the latest product.

Design for energy efficiency

Products that use energy are starting to be covered by new regulations and all have an efficiency rating. The designer can look at ways to reduce energy used. This could be something simple like having a one cup alert on a kettle to prevent people wasting energy boiling a full kettle for one, or by reducing the weight in a car to make it more efficient.

The designer is in control of the design. The decisions they make will always impact society, the economy and the environment. It is the designers job to ensure that those are all positive impacts.

Sustainability

Sustainable design (also called environmental design, environmentally sustainable design, environmentally conscious design, etc.) is the philosophy of designing physical objects, the built environment, and services to comply with the principles of social, economic, and ecological sustainability.

ECONOMIC SUSTAINABILITY: the ability to support a level of economic production indefinitely.

ENVIRONMENTAL SUSTAINABILITY: the ability to maintain rates of renewable resources, materials, and reduce the use on non-renewable sources and pollution to ensure the planet and resources can be continued indefinitely without compromising the future.

SOCIAL SUSTAINABILITY: the ability of a social system, such as a country, to function at a defined level of social well being indefinitely. (Growth into the future)

GLOBAL MANUFACTURE:

The rise of consumerism has had both positive and negative impact on sustainability. Although the economic climate has benefited from increased retailing, local economies have suffered job losses as big companies trade Globally, using over seas manufacturers. Although cheaper to produce and sell, the choice to manufacture over seas also adds to pollution as the goods have to be transported back to the UK for sale.

CONSUMERISM: Changes in society, why we buy and the need to keep up appearances or be accepted has made lifestyles for many consumers difficult to sustain as they are in debt and spending beyond what they can afford. Consumerism and lifestyle changes have caused a concerning increase in



pollution. Increases in production and transportation including global trade has created masses of air and

waste pollution. Similarly, the changes in lifestyle has seen the increase in time saving products like fast food and ready meals and disposable nappies. Disposable nappies alone have contributed to 8% of the UK landfill. The mobile phone is another example of this as consumers replace good functioning products with more impressive, fashionable or advanced models.

The cycle of sourcing materials, manufacturing a product, selling it, using it and disposing of it is known as The product that is disposed then goes to landfill

So what are the problems with going to landfill?

- Landfill sites are filling up.
- The materials we are throwing away are not sustainable. Once the planet runs out of oil for example, we will not be able to produce any more plastic.
- Many of the things we send to landfill, contaminate the soil or produce gasses and air pollution.

Concerns over the environments sustainability including global warming has led the government to create new laws and taxes to target pollution. Carbon Footprinting or Life-Cycle Analysis (LCA) have become commonplace approaches adopted to identify the impact of a company and its activities in terms of the environment. LCA is, very simply, just looking at the life- cycle of a product, service or process from raw material extraction, through manufacture and distribution to ultimate disposal.

As a designer you should think about sustainability from the very beginning of the design process. This is now referred to as eco design, green design or sustainable design.

Designers and manufacturers following these design models are now working on a **CRADLE TO CRADLE** life cycle model.

A true cradle to cradle approach means there is no waste as everything is fed back into the cycle. Although this is not currently achievable for all products, advances and changes in approaches mean more and more products are

- Using sustainable materials
- Reducing waste/energy consumption
- Being designed for disassembly

Can be Recycled, Reused, Reclaimed for future use.

At the End of Life stage....

Cradle to Grave: All products go to landfill

Cradle to Cradle: materials are recycled and put back into the production cycle, possibly for a different product or service.



Other than learning about Designing, Materials and Manufacturing, you need to know how to answer the questions correctly. You will need to identify the command words in the questions and then understand what is required in your answer.



Explain

If you are asked to Explain, you requires an answer that offers a rather detailed and exact account including reasons. Use these to ensure you get the detail in your answer. What? When? Who? Where? How? Why?

E.g. Q: Explain how a designer would ensure a wheelbarrow had good ergonomic design.

A: The designer would need to consider many things to ensure good ergonomic design. He would need to know **Who** the users were in terms of age and gender as this would affect **How** strong and how tall they are so it is the correct height and easy to lift. It is important to consider **What** the users will put in it and **When** and **Where** they are going to use and store it. The designer needs to know this to ensure the product is easy to grip and lift in wet, cold and warm conditions, compact and easy to move for storage and a suitable height and angle to make loading and tipping possible

State

If you are asked to **State**, you are only required to give an answer that expresses the relevant points briefly and clearly without lengthy discussion or minor details.

E.g. Q: State the name of the material used to make a Spatula.
A: The material used to make a Spatula is Beech.

Justify

If you are asked to **Justify** you must provide an answer that gives the reasons for a position or argument.

E.g. Q: Justify why the designer must consider safety when designing a baby high chair.

A: The designer must consider safety when designing the high chair because the parent would not use it if it caused any risk or danger to the baby. It is important to consider because the baby may wiggle about or try to get out and the product needs to hold them securely and remain stable. It should not have any toxic materials either in case the baby licks it. It is important the product does not poison them.



Describe

If you are asked to **Describe** your answer must say what something is like, how it works and so on, to allow someone to visualise it in their minds eye.

E.g. Q: Describe the problems a person might have using a traditional wheelbarrow.

A: When using a traditional wheelbarrow, the user might struggle to lift it if there is no grip or padding on the round metal handles. The height of the handles may also be a problem. If the user is very tall, they may need to bend down to reach the handles. If they are very short they may struggle to lift the handles and barrow up high when it is full. A final problem might be material falling out of the barrow. This would happen if tall people lifted the handles up too high, causing material to slide down to the lower wheel end and possibly out of the barrow.

Compare

If you are asked to **Compare**, you require an answer that sets items side by side and shows their similarities and differences. A balanced (fair, objective) answer is expected where you make a range of observations.

E.g. Q: Compare the two wheelbarrows in terms of function and aesthetics.

A: Both products are very similar in function. They both have two handles for lifting, one wheel for moving, stands for resting and a space to hold items. In terms of aesthetics they are very different. One barrow is made entirely of wood, including the wheel, while the other is a mixture of metal and plastic. The wheel on the wooden product is much bigger and has a slim design compared to the smaller solid looking wheel on the metal barrow.

