1.

Design and Innovation

1. DESIGNING and INNOVATION

AESTHETICS

Aesthetics play an important part in the design and marketing of products.

One of the main reasons for buying a product is often how it looks and the image it can give the user.

Designers have got to make sure that the product looks good.

This type of casual training shoe has been a successful product for Adidas regarding its unique visual appearance [Aesthetics]

MAINTENANCE

Can the product be maintained, is it possible to replace parts if things break. Dyson designed his vacuum cleaners so that it is possible to buy parts that break over the internet and replace them. The vacuum cleaners are designed so that the parts click on and off. Some customers would prefer a product that can be maintained.

Spare parts available for Dyson products so that the product can be repaired.

DISPOSAL

Customers are more aware of environmental issues so therefore most people would prefer products that can be disposed of in an environmentally friendly method or re-cycled. The designer must consider what materials would be suitable, also combination of materials used.

Products like this coffee table uses a combination of materials to make it aesthetically pleasing. Because the table is made from three different materials— glass, wood and metal fittings, it would be quite easy to disassemble and re-cycle.

Many products are made of different materials. These materials cannot be disposed or re-cycled in the same way. Cars are designed for disassembly— parts come apart eg plastics and metals can be disposed of or re cycled in different ways. Some mobile phones are designed with smart fastenings. These fastenings would release at a certain temperature so that different parts can be processed in a different way, ABS Casing, electrical components, battery etc.

Nuclear power is a good example of BAD DESIGN - Designers have still not thought of a method of disposing of nuclear waste. At the moment it is being buried deep under ground until they think of a method of disposing of it safely and at the moment is an environmental concern.

These products include a range of different materials therefore making them much more difficult to re-cycle.

MORAL ISSUES

Customers are becoming much more aware of moral issues regarding the products they buy. This can relate to

1. DESIGNING and INNOVATION

how and where the product is manufactured. Due to Global Manufacturing most of the products we buy are manufactured in Third world countries. More and more western companies design their products here but manufacture their products in the far east. This is due to a number of factors such as, cheaper labour costs, less legislation as far as regulation, health and safety laws, employees rights and working conditions.

Customers are quite often made aware of expensive football shirts or sports equipment for sale in this country that have been manufactured by children in sweatshops under conditions that would not be allowed in this country.

This is to enable the manufacturer to be able to sell the product to the customer as cheap as possible.

Apple proudly states that their products are "Designed by Apple in California". All of the manufacturing processes for Apple products are outsourced to China, Korea, Mongolia, Taiwan and Europe.

70 million iPhones were sold in 2011. Non were made in America.

In 2002 Dyson moved the manufacturing of their washing machines and vacuum cleaners from the UK to Malaysia.

Apple products are outsourced to China, Korea, Mongolia, Taiwan and Europe

COSTS

Designers have to consider costs.

How much will the product cost to manufacture, this will depend on components used, materials, labour and manufacturing process.

This has a knock on effect on how much the product will be sold in shops to customers. The product must be competitive with other similar products or it will not sell.

Due to high manufacturing costs in this country a number of companies are manufacturing their products in the Far East.

Customers will not necessarily choose the cheapest product. When Dyson launched his first vacuum cleaner it was one of the most expensive cleaner on the market—but still a best seller.

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FITNESS FOR PURPOSE

If a product is going to be successful it must be FIT for PURPOSE.

Considerations should be given to the following features for a product to be classed as FIT for PURPOSE:-

1. **Price**
2. **Performance**
3. **Aesthetic Appeal**
4. **Reliability**

AGPTEK Music/Media Player 16Gb £21.99

Apple iPod Nano 16Gb £149.99

MP3 - Comparing Customer Issues when selecting a product.

Which one of these MP3 players would you choose?

PRICE—Obviously the price of the AGPTEK player is considerably cheaper than the Apple iPod Nano. Would this be the main criteria—Budget?

PERFORMANCE—There are virtually the same features on both products—the screen of the IPod is slightly larger and has a touch Screen interface, whereas the AGPTEK has a selection pad. As far as sound and picture quality the AGPTEK is rather an unknown quantity. Would these factors be enough to pay the extra costs for the Apple product?

AESTHETIC APPEAL—This would be a matter of personal preference—Both products are available in different colours. The AGPTEK has a smaller screen.

RELIABILITY—Apple is a world wide well known brand, probably you have not heard of the AGPTEK brand. Customers associate well known brands such as Apple with reliability and being dependable. If something goes wrong then the customer would have the peace of mind that there would be a product guarantee and support. Customers would have confidence in the product. Therefore considering the price would customers buy the AGPTEK with reliability an unknown factor.

Would this be enough to but the Apple IPod is a much better seller than the AGPTEK.

Above the Line and Below the Line Features

Above the line features

Above the Line features are the visible attributes of the product - what the user can see.

These can be the shape of the product, colour or finish, user interface on mobile phone, feel and texture.

All of these features are very important because these are the first things a consumer would see and attract the consumer towards the product.

ABOVE LINE

- Modern Shapes
- Grey and Yellow colour
- Can see the dust been collected
- Buttons for switching ON and OFF easy to see and use

BELOW LINE

- ABS Plastic used for main components
- Plastic Injected moulded to form components
- Manufactured in China
- Parts can be re cycled
- Cyclone technology
- Electronic Circuitry

Below the line features

These are the features that the consumer would need no knowledge of to use the product effectively. These again are vey important for the product to be successful. These features could include, how the electronic circuitry works inside the product, the type of materials used, how the components were manufactured, which country the product was made in, how the product is assembled, was the product manufactured in a an environmentally friendly way.

1. DESIGNING and INNOVATION

1. PRICE

Is the product sold at a reasonable price? Will the consumer buy it? Is the product competitive compared to similar products on the market?

2. PERFORMANCE

Does the product do things as well or better compared to similar products on the market?

- **Storage capacity for songs**
- **Battery life**
- **Ease of use**

3. AESTHETIC APPEAL

Does the product look better and gives the user the correct image compared to similar products on the market?

- **Appearance / Finish**
- **Product make -- *Sony or Apple***
- **Different colours available**
- **Shape**

4. RELIABILITY

Will the product work for a long time without breaking down? Is there history of products not working properly? Is the product more reliable than similar products on the market? Gives the consumers confidence in the product through:

- **Features that work**
- **Ease of use**
- **Battery life**
- **Breakable features**
- **Will not let the user down**

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Iterative design

The process within product design can be divided into four distinct phases:

Discover – covers the start of the project where product designers try to look at the world in a fresh way, notice new things and gather insights....this is the insight into the problem.

Define – represents the definition stage, in which designers try to make sense of all the possibilities identified in the discover phase. Which matters most? Which should we act on first? What is feasible? The goal here is to develop a clear creative brief that frames the design challenge....this is the area to focus upon.

Develop – this is a period of development where solutions or concepts are created, prototyped, tested and iterated. This process of trial and error helps designers to improve and refine their ideas.... potential solutions are produced here.

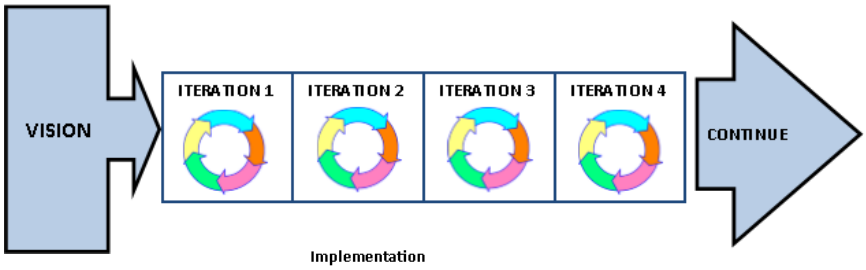
Delivery – this is where the resulting project i.e. a product, service or environment, is finalised, produced and launched....these are the solutions that work.

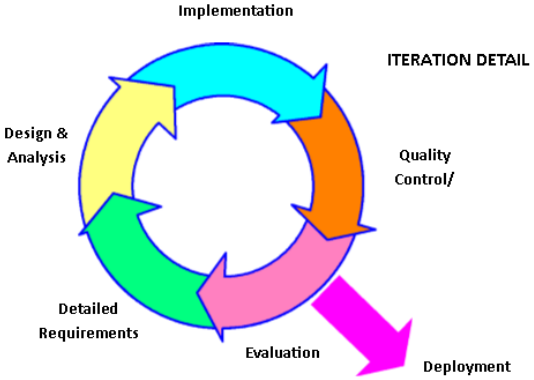
In all creative processes a number of possible ideas are created before refining and narrowing down to the best idea.

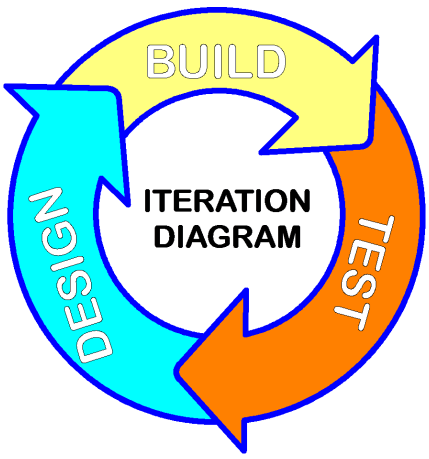
In order to discover which ideas are best, the creative process is iterative.

'*Iterative design is a design methodology based on a cyclic process of prototyping, testing, analysing, and refining a product or process. Based on the results of testing the most recent iteration of a design, changes and refinements are made'.*

This means that ideas are developed, tested and refined a number of times, with weak ideas dropped in the process. This cycle is an essential part of good design .







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Case Study –User centred design—investigation and analysis of a problem

James Dyson

You know the feeling when some everyday product lets you down. 'I could have designed this better myself', you think. But how many of us turn our thoughts into actions? James Dyson does. He is a man who likes to make things work better. With his research team he has developed products that have achieved sales of over £3 billion worldwide.

A new idea

In 1978, James Dyson noticed how the air filter in the Ballbarrow spray-finishing room was constantly clogging with powder particles (just like a vacuum cleaner bag clogs with dust). So he designed and built an industrial cyclone tower, which removed the powder particles by exerting centrifugal forces greater than 100,000 times those of gravity. Could the same principle work in a vacuum cleaner? James Dyson set to work. 5 years and 5,127 prototypes later, the world's first bagless vacuum cleaner from Dyson arrived.

The $2,000 vacuum cleaner

It may sound like taking coals to Newcastle, but James Dyson's bag less vacuum cleaner was first sold in Japan, the home of high-tech products. Known as the 'G Force', it won the 1991 International Design Fair prize in Japan. The Japanese were so impressed by its performance that the G Force became a status symbol, selling for $2,000 a piece!

The first Dyson

Using income from the Japanese licence, James Dyson decided to manufacture a new model under his own name in Britain. In June 1993 he opened his research centre and factory in Wiltshire, not far from his home, and developed a machine that collected even finer particles of dust (microscopic particles as small as cigarette smoke). The result was the DCO1, the first in a range of cleaners to give constant suction.

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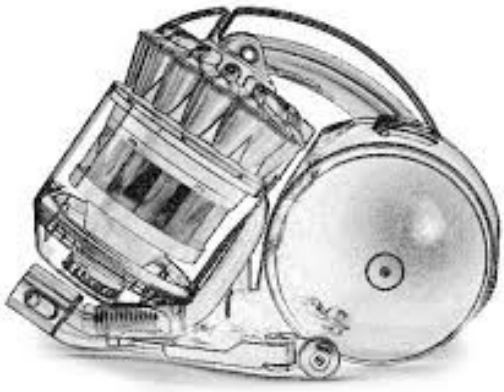

Another problem to solve

`I like your vacuum cleaners but when will you make one you don't have to push around?' This casual remark set James Dyson's mind working. Producing something that bounced aimlessly off the furniture and picked up very little dust would have been easy, but James Dyson insisted the Dyson DC06 robot should not only clean properly but should also guide itself more logically than a human would. It took 3 on-board computers, 50 sensory devices, and 60,000 hours of research to create efficient, methodical robot cleaning.

The patent nightmare

The Dual Cyclone™ was nearly never made due to patent and legal costs. Unlike a songwriter who owns the song he writes, an inventor has to pay substantial fees to renew his patents each year. During the development years when James Dyson had no income, this nearly bankrupted him. He risked everything, and fortunately the risk paid off. Then in 1999, Hoover tried to imitate a Dyson and James Dyson was forced back to court to protect his invention. After 18 months Dyson finally won a victory against Hoover for patent infringement.

Root Cyclone™

Dyson scientists were determined to create vacuum cleaners with even higher suction. So they set to work developing an entirely new type of cyclone system. They discovered that a smaller diameter cyclone gives greater centrifugal force. So they developed a way of getting 45% more suction than a Dual Cyclone and removing more dust, by dividing the air into 8 smaller cyclones, hence the name Root 8 Cyclone™.

For further detail on Intellectual property visit this link below:-

https://www.gov.uk/government/organisations/intellectual-property-office

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DESIGN SPECIFICATION

Specifications are used as guidelines for the designer to make sure that the product will be successful. The designer will try and answer all specification points and refer back to the specification when designing to ensure that aspects of the design answers the specification points.

Sometimes these are referred to as **PERFORMANCE CRITERIA**

Features of specification.

Primary Specification.

These are essential features a product must have to function properly eg A milk container must hold 1ltr of liquid. **ESSENTIAL**

The milk container must hold a specific amount of milk to answer its Primary specification [Essential Feature].

The container can be designed with different aesthetic appearances to attract customers or to stand out from competitors. This could be regarded as Secondary specification [Not an essential feature for the product to work]

Secondary Specification

These are desirable - nice to have but not essential for the product to function properly. Eg Milk container must look nice to attract customer

Specification points can be categorised into two different groups. **Quantitative** and **Qualitative.**

Quantitative specification.

These are specification points that can be measured.

Eg

- Weight of chair must be less than 3Kg
- Chair dimensions when folded must be less than 400mm x 500mm x 150mm so that it can be stored in a confined space
- Price of product must be less than £3.50 to manufacture
- Chair must be suitable for adult and must be comfortable to use
- Strap must be adjustable to enable adult to carry the chair over the shoulder

Quantitative specification can be tested and measured. All of the above points can be answered by facts.

Portable Fishing Chair

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Qualitative Specification

These specification points are more difficult to measure and mostly personal opinion.

Eg.

- The chair must look nice
- The colour of the fabric must be a natural colour**.**

Portable Fishing Chair

During the design process the designer can look back at the Specification to check if the design answers the requirements.

SPECIFICATION AS A DESIGN TOOL

Main feature of the use of the specification is as a design tool to judge the quality and performance of design ideas against the initial specification;

1. It helps the designer to keep focussed on the prime requirements of the design.
2. The designer can refer back to the specification during the design work - to check if he is on the right track - **ON GOING EVALUATION.**
3. The designer can refer back to the specification after the product has been made to evaluate or test the product - does the final product answer all of the specification? **FINAL EVALUATION.**

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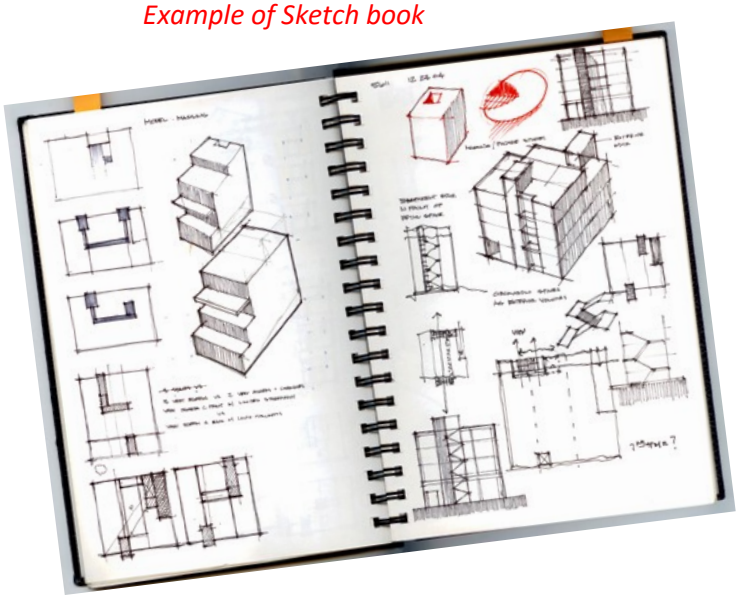
Use of Sketchbooks

Example of Sketch book



Sketching has its role in the **design process** and that role will vary depending on the end-product being created, the size and scope of the project, the individual designer's style, experience, and workflow.

Sketching can start loose, beginning with **basic concepts.** Then work on compositions or layouts. After those directions are chosen, the concepts can further be refined with detailed sketching.

Annotation is very important when sketching – this is the personal conversation a designer has in explaining for example basic and developed ideas, materials, components and surface finishes.

Sketching is an excellent way to **quickly explore concepts.** You can sketch for one or two hours and work out multiple possible solutions to the design problem at hand. It will save you time to work through concepts on paper before going to the computer. While it is possible to build sketches on the computer, it's not as fast as sketching multiple concepts on paper.

Product designers spend a lot of time sketching. If you're going to design the next sport shoe, piece of furniture, or bike, the idea doesn't start in a computer, it starts on paper.

Sketches are a quick way to create the basic composition of your illustration. You can make a series of **thumbnail sketches**, or they can be larger. As long as your sketches are good enough that they capture the necessary elements, drawing skill is unnecessary.

Showing sketched thumbnails or compositions to clients, will potentially save you an enormous amount of time.

Sketching can be used as a **research activity** to record and explore your interests. It can also be used to explore multiple options you could take in a particular design.

The process of creating a design or illustration at later stages involves **refinement.**

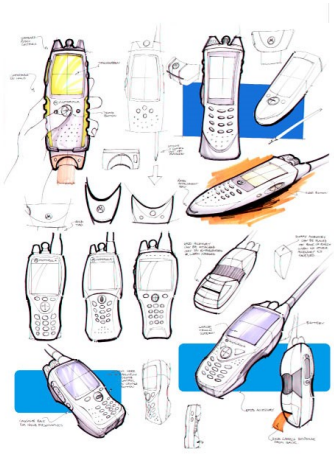
You may feel the desire to skip sketching and jump straight to the computer or work out your solutions as digital sketches. There is nothing wrong with that, especially for your own experimental work. There is no quicker method for exploring multiple visual solutions than sketching.

COMMUNICATING DESIGN

Designers can use different techniques to communicate their designs.

These can range from, 2D and 3D sketches, presentation drawings to CAD modelling

FREEHAND SKETCHING— Show how ideas are developed. Can be produced quickly and annotated to explain features of design, can be 2D or 3D

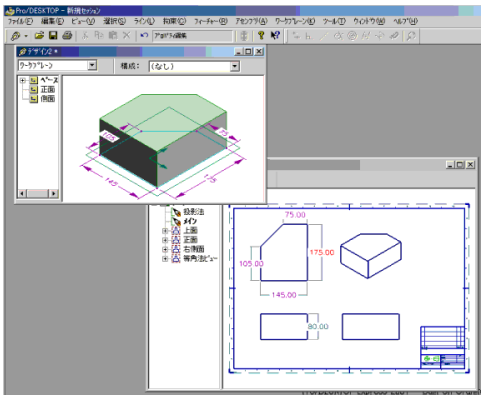


Freehand sketches for a mobile phone

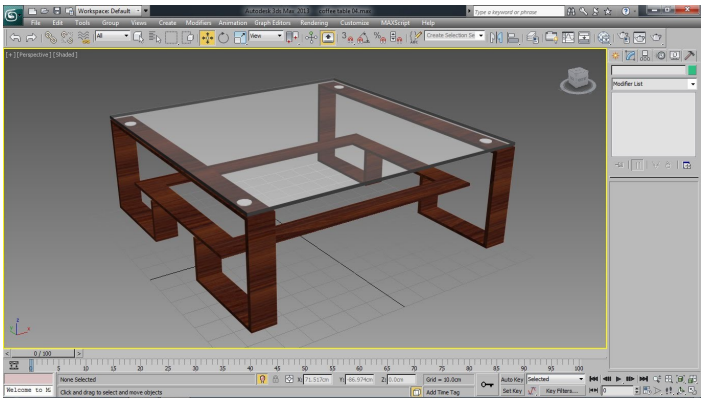
Final presentation drawings for an underwater camera and a portable drill.

PRESENTATION DRAWINGS— Good quality 3D drawings that show the client what the product will look like. Can also include dimensions and finishes

CAD MODELLING— Drawings can be created on computer to show clients what the product will look like from different angles, different finishes and materials etc. These will be high quality. Examples of the type of software that can be used to do this work would be Solidworks or Autodesk Inventor.



CAD Model for 3D block that can be displayed in orthographic form.



CAD Model of modern table in 3D that has been rendered with material effect.

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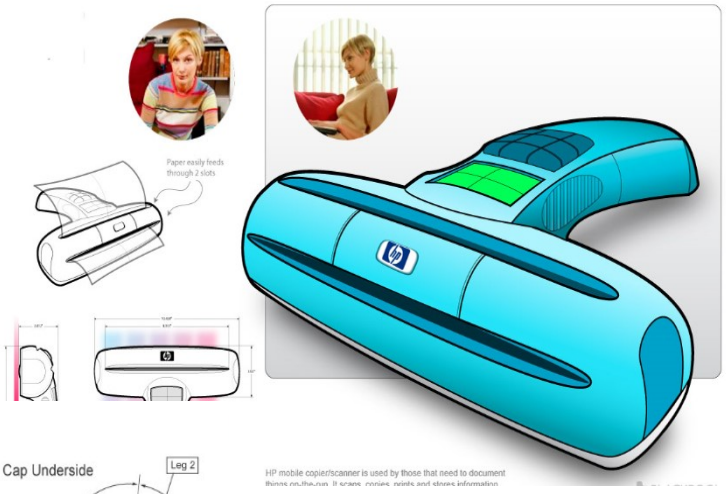
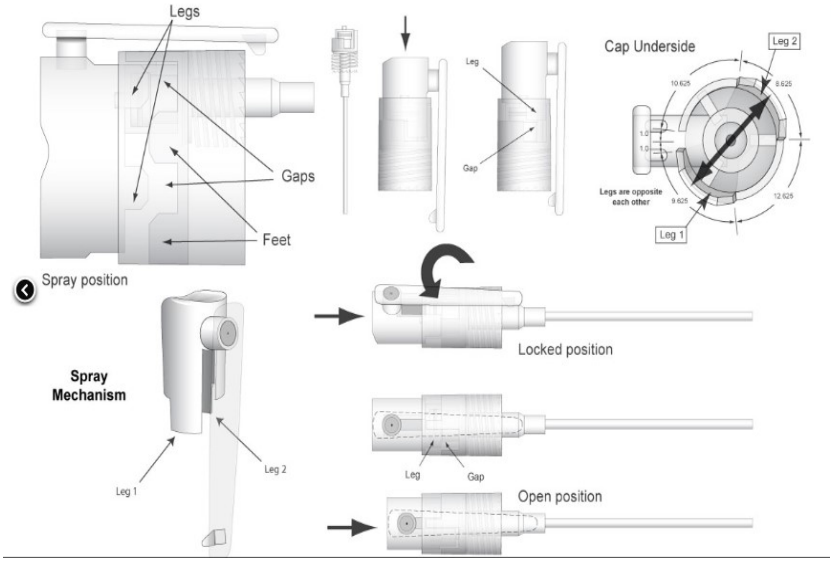
DETAIL DESIGNING





These drawings include details of materials used and construction methods that would help the manufacturer to produce the product.

Detail designing will detail the features of the product. The designs would show information such as:-

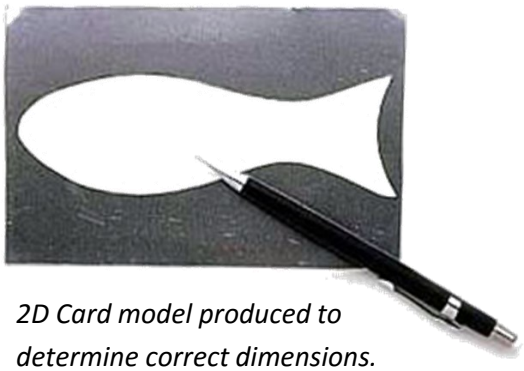
- MATERIALS TO BE USED
- DIMENSIONS AND SIZES OF COMPONENTS
- DETAIL OF HOW THE PRODUCT IS ASSEMBLED AND PUT TOGETHER

This would be very useful for the designer to pass over to the manufacturer. From these drawings the manufacturer can decide the following:-

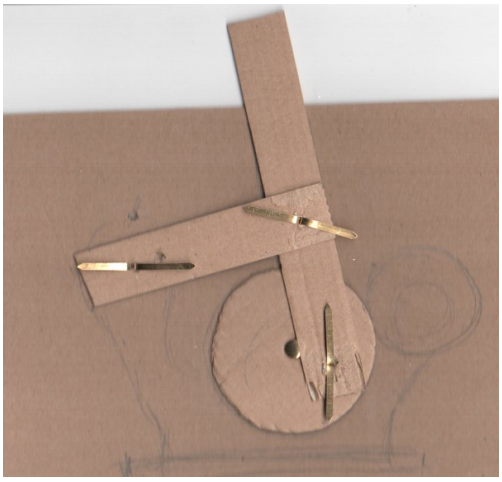
- MAKE SURE THAT IT IS POSSIBLE TO MAKE THE PRODUCT
- PREPARE OR PURCHASE EQUIPMENT OR MACHINERY READY FOR MANUFACTURING.
- PREPARE AND PURCHASE MATERIALS
- ABLE TO TELL THE DESIGNER IF HE CAN FORSEE ANY PROBLEMS WITH ASSEMBLY, JOINING OR MATERIALS USED

1. DESIGNING and INNOVATION

2D Modelling



2D Card model produced to determine correct dimensions.



2D Card model produced to test if the mechanism will work.

Simple type of modelling

1. This can be in a form of a drawing, sketch, template or pattern cut out.

2. You can only see TWO dimensions of the model.

3. Can show the designer the measurements or scale of a product Height, width and shape etc

4. Can test simple mechanical movements eg LEVERS etc

5. NO depth- might be difficult to test the model in use. Eg shape of a chair you could not sit on it.

6. You could Test the shape or size of a product.

7. 2D models can be made of sheet material, paper card, metal, MDF.

The main purpose of a model are:-

- So that the designer or target audience can SEE how the finished product will look.
- So that the designers can TEST the product to see if it will work
- Speed of being able to produce a prototype that can be seen and tested so that feedback is possible for improvements.
- Save material costs rather than use the proper materials

1. DESIGNING and INNOVATION

3D Modelling

1. You can see THREE dimensions of the model.

2. Can show the designer the measurements or scale of a product such as height, width & depth as well the shape and form the product

3. Testing can be carried out on the product, sit on it, strength, storing.

4. 3D models can be made of any 'Cheap' traditional materials material such as Styrofoam, card, clay, MDF, metal, plastics, foam board etc.

Card 3D Scale model of a chair

Styrofoam 3D model of a Walkie-talkie

Advantages

1. Materials easily available, cheap and can be worked with basic tools and machinery.

2. Ideas can be shown effectively in 3D.

3. Can be tested in the actual situation.

4. Simple models can be made quite quickly [saves time & money].

Disadvantages

1. A high quality model can take a lot of time and skill to produce [cost].

2. If the customer requires a different finish or shape, a new model will have to be produced which will take time to produce.

Foam board 3D Scale model of a modern storage unit

1. DESIGNING and INNOVATION

Rapid Prototyping / 3D Printers/Prototyping

Can produce models quickly.

This is the process of creating 3D models of products.

Able to evaluate proposals

- Feedback from clients
- Aesthetics—how it looks
- Mechanical performance—how it works

Complex components and prototypes can be produced with 3D printers

Saves Lead Time - manufacturers able to get products on the market quicker before competitors .

Complex shapes impossible to produce by human hand.

Used in the medical area. Where bone damage has occurred, the area can be scanned and computer would build up a 3D profile of shape that would fit the damaged area.

A 3D CAM machine would be able to produce the product very accurately.

3D prototype of Hand Drill

Embroidery on clothing - Very accurate work and in cases thousands of items required.

2D flat Laser cut Plywood that can be assembled to represent 3D objects

Work produced with CNC Embroidery Machine

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3D Printing

This relatively modern process has enabled product designers to create intricate and complex forms quite easily when developing and trialling ideas.

The process involves the design and creation of a 3D Computer model/ drawing which then can be sent to a 3D printer to be created.

Usually the product will be created from a polymer filament usually PLA [Poly Lactic Acid - Biodegradable Plastic] or ABS [Acrylonitrile Butadiene Styrene] filament which is oil based and requires a higher level of heat to melt.

PLA requires low heat to melt the filament so that the model can be created in an open environment within the 3D printer. This type of plastic is available in many colours and can produce a good surface finish and can be printed on a cold surface.

ABS requires a heated surface to print on and an enclosed environment within the 3D Printer to maintain a constant level of heat. The final product will be more durable and tougher than the PLA product but will take a longer time to print.

3D printer

PLA Filament available in various colours

This technology offers many advantages to the designer by being able to produce complicated models quickly without the need to invest in complex tooling and manufacturing processes. It also allows the designer to experiment with various models and prototypes which will be very accurate and quite cheap to produce.

This will enable the designer to develop ideas much quicker and get their products on market much quicker

The prices of these machines are very affordable and due to the cheap prices of PLA and ABS filaments they are quite cheap to run as there is no waste of materials.

3D Printed Remote Control prototype fascia

Products can be produced on demand to exact specification

Only drawback is that complex forms could take a long time to print.

For more examples of 3D printed modelling visit www.proto3000.com

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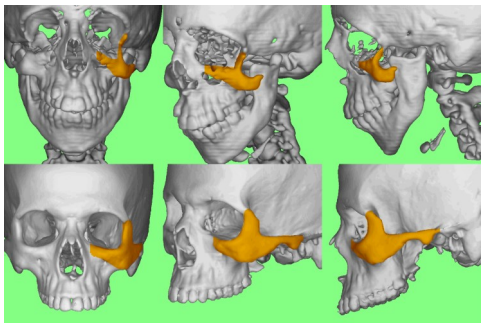
3D printing has created opportunities in the medical profession when damaged bones or limbs can be 3D printed to exact specifications for patients.

Orthopaedic surgeons are able to re produce damaged bones with 3D prints

Prosthetic limbs can be created to exact dimensions for the user.



Damaged bone structure can be created using 3D printing methods.

Prosthetic limbs printed out on 3D Printer

1. DESIGNING and INNOVATION

ICT Generated Modelling

Product designers, architects and engineers today face daunting challenges: structures, designs and workflows are becoming more complex, 3D modelling is beneficial in avoiding mistakes.

They give you the ability to test the stress factors and tolerances of a product before you build, saving time, money and potentially disastrous consequences. A 3D model also lets you see the end result before it's built, allowing you to correct issues before it's too late.

Advanced analysis tools can simulate the flow of fluid to measuring vibrations in key structural components. Simulating those environmental factors is critical to identifying design flaws and pinpointing serious build problems.

3D printing allow designers to quickly "print" prototypes and models—driving down prototyping costs.

In 2D CAD modelling, a lot of time and energy is spent ensuring that your plan, section and elevation agree. In 3D, designers, architects and engineers easily extract that 2D information from a completed model, leaving more time to focus on the design process.

With 3D CAD software, each individual component of a structure can also be isolated, analysed, tested, approved or changed. One of the major benefits associated with 3D software is its precision. Each component of a product, building, or machine can be analysed and measured individually.

Giving clients a virtual tour of their product or building is of great benefit as it can give an interactive visual representation of the final product.

Firms equipped with a 3D printer can go one step further and create a physical representation of their designs before meeting with clients—at a price far cheaper than factory moulding fees.

Software is built for customisation, where changes can be made quickly to for example form, surface pattern or texture and mechanical detailing.

CAD Produced 3D Models

3D Printed Hand Whisk Models

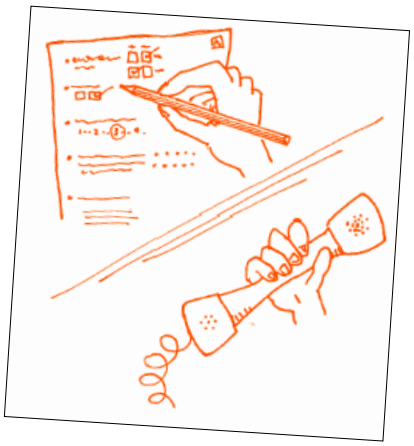
3D Printed Mobile phone case

1. DESIGNING and INNOVATION

Designers can use different methods to collect information to help them solve problems.

1. Primary Research

2. Secondary Research



Simple questionnaires or phone people up

Primary Research

This is research you will have to do YOURSELF directly. This research has not been done before by others.

1. Telephone people to ask opinion.
2. Visit people.
3. Test materials yourself.
4. Create your own questionnaire.

Interview customers or clients

Secondary Research

This research has been done for you.

1. Search the Internet.
2. Look in books/magazines
3. CD Rom's

ICT Sources

Designers can use ICT sources to aid them with their research.

Use of CD Rom's that contain information. DVD Encyclopaedias

Use of Internet search into materials or existing products. E mail people to find information about prices or measurements of a product, manufacturing techniques.

Send attachments of drawings to clients for their approval.

Internet usually means that the information is up to date but you have to be careful that the websites are trustworthy.

ICT Sources that could be used

1. DESIGNING and INNOVATION

Questionnaires

Can be created and sent out to thousands of people quite easy. Could be e mailed (ICT) much cheaper than paying for stamps. Therefore environmentally friendly.

Problems

- You don't know how many will be returned.
- You will only get answers to the questions that you have asked - no chance of finding something else out eg a conversation going on a tangent, and finding something else out.
- Data cannot be queried or questioned.
- To get the correct information - questions must be carefully planned.

Telephone calls

- Speak to the person and therefore be able to find out exactly needs of customers.
- Not very personal - face to face.
- People put the phone down because of nuisance calls.

Interview

- Must be carefully planned.
- Takes quite a long time.

Opinion Groups

Group of people that would give feedback on products. The group would use a product over a period of time and would gather their opinions on how the product performed. Feedback would be more general and accurate because the feedback would convey the thoughts of the group rather than personal opinion of an individual who might have had a bad experience using a product.

1. DESIGNING and INNOVATION

Databases

A database is a collection of information organised to provide efficient retrieval. The collected information could be in any number of formats (electronic, printed, graphic, audio, statistical, combinations). There are physical (paper/print) and electronic databases.

TOUGHNESS	BRITTLENESS	DUCTILITY	MALLEABILITY	RESISTANCE to CORROSION
Copper	*Cast Iron*	*Lead*	*Gold*	*Gold*
Nickel	*Bronze*	*Tin*	*Silver*	*Zinc*
Silver	*Brass*	*Zinc*	*Copper*	*Lead*
Gold	*Zinc*	*Gold*	*Aluminium*	*Aluminium*
Zinc	*Tin*	*Aluminium*	*Tin*	*Tin*
Lead	*Manganese*	*Silver*	*Lead*	*Nickel*
Iron	*Hardened Steel*			

Database of Metal properties

A database could be as simple as an alphabetical arrangement of names in an address book or as complex as a database that provides information in a combination of formats.

A collection of information organised in such a way that a computer program can quickly select desired pieces of data. You can think of a database as an electronic filing system.

Traditional databases are organised by fields, records, and files. A field is a single piece of information; a record is one complete set of fields; and a file is a collection of records.

Data is organised into rows, columns and tables, and it is indexed to make it easier to find relevant information. Data gets updated, expanded and deleted as new information is added.

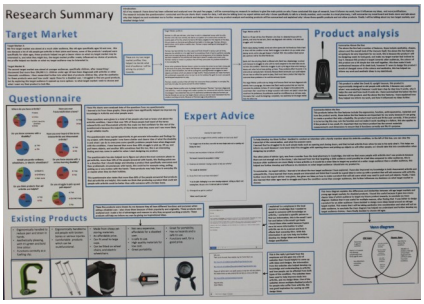
Example of Opinion groups Database of results

Database packages can be used to record and analyse survey data.

Spreadsheet software can be used to make Gantt or other planning charts, to produce graphs and charts, and to help with costing projects.

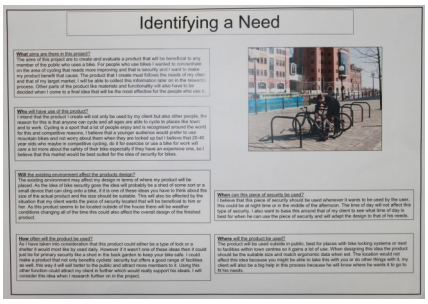
1. DESIGNING and INNOVATION

Analysing Problems

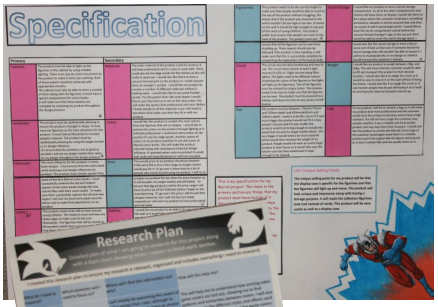


Designers often start by looking at the work of other designers and analysing the choices they have made. They consider how successfully the product meets these criteria and what could be changed to improve it.

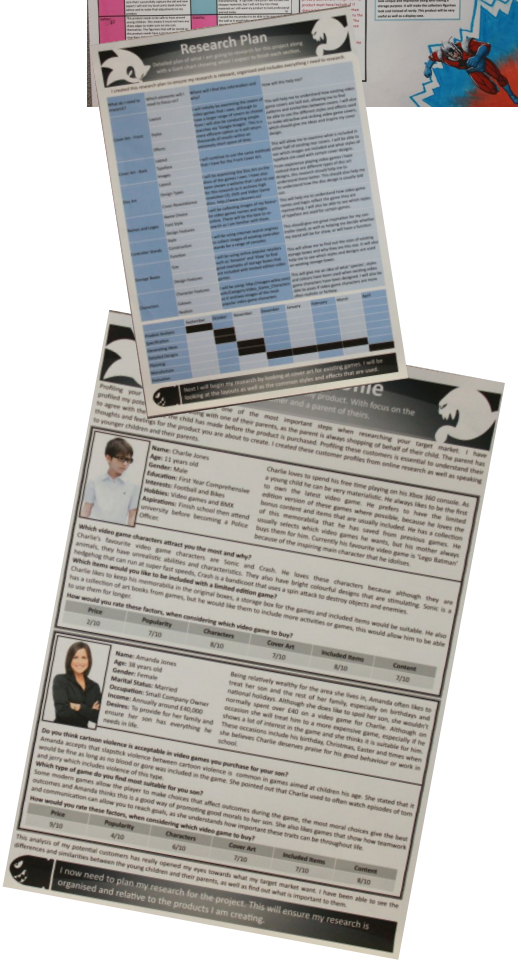
Designers and manufacturers evaluate on an ongoing basis during design development and while manufacturing. It is essential to compare against the design specification and to make and record judgements, improvements and users' views.



Analysis of design situations or contexts can begin by asking basic questions:



1. Is it fit for purpose?
2. Does it meet the needs of the target market?
3. How well is it designed and made?



Designers will consider these questions when analysing both their own designs and the work of other designers. Answering the three questions above will normally involve an evaluation of the following:

- The design specification, based on the requirements of the target market and the manufacturing facilities available.
- What are the target market needs?
- Product's **performance** and how suitable it is for its end use?
- The **quality of the materials used in the manufacture of the product?**
- The product's aesthetic appeal or **stylistic qualities**.
- Does the product give value for money?
- Any **safety, moral or environmental issue**. Does the product conform to safety regulations and what is its impact on the environment?

Design Strategies

Designers use methods to think of ideas

Inversion: -

Reversing the problem, looking at it in a different way. "How can I get to work?" turn the problem around - "How can I get work to come to me?"

Brainwriting:

A group of people approx 10—14 preferably from different backgrounds. One person will be a secretary that will note down all of the ideas suggested. Everybody will suggest a possible solution to the problem regardless of how silly or impossible the answer might be. **THERE SHOULD BE NO CRITICISM AT THIS STAGE.** Criticism might prevent people from saying anything - being too embarrassed of being made fun of. At the end of the session the group will discuss the answers and see which ones have potential to develop further.

Morphological analysis:

Identifying the key features of a product and then considering different ways of achieving the features. Eg Wheelbarrow might have a steel body with a steel frame, two handles, one pneumatic wheel that will be pushed. Many different combination can be considered to come up with hundreds of different solutions.

MORPHOLOGICAL ANALYSIS - Wheelbarrow						
	Body Material	**Frame Material**	**Handles**	**Wheels**	**Wheel Type**	**Movement**
Option 1	Mild Steel	Mild Steel	2	1	Pneumatic	Push
Option 2	Wood	Mild Steel	2	2	Solid	Push
Option 3	Canvas	Mild Steel	2	1	Pneumatic	Push
Option 4	Polypropylene	Wood	1	3	Ball	Push

Table giving different options for designing a wheelbarrow

1. DESIGNING and INNOVATION

Lateral thinking

Think of the problem from another angle. Eg. Edward Jenner when discovering the cure for Smallpox, everybody else thought “Why do people catch smallpox”? Jenner thought “Why don't some people catch smallpox” ? Eventually he established why some people didn't catch smallpox and found a cure. By lateral thinking and thinking of the problem in this manner a cure was developed.

Disassembly

Take things apart to see how things work, how it is made and assembled and then develop improved ideas.

IKEA Lamp taken apart to understand how components are manufactured and assembled

Above and below the line strategies

Above the Line

Analyse a product and note how the external above the line features work. External shape, appearance (aesthetics), colour, texture, user interface - buttons screens etc. This is **what the customer can see.**

Below the line

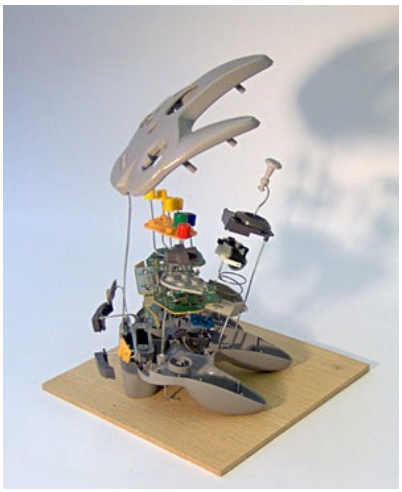
These are usually hidden features that are not apparent to the user. Inside of the product, How it works, the technology, type of materials used, how is the product manufactured, electronic circuits. All are very important for the product to be successful,

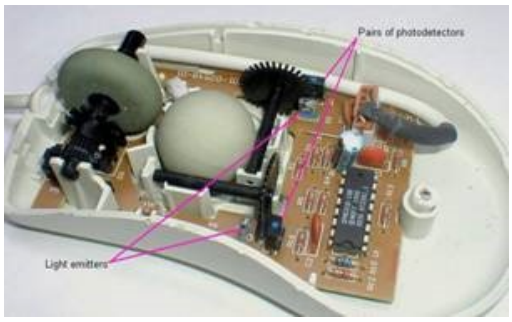
these features can be used by a designer to inspire or trigger his own ideas.

1. DESIGNING and INNOVATION

Reverse engineering

To take a product apart to understand how it could be re-built with slight adjustments or improvements. This would enable the designer to evaluate good and bad points of the product and see how things work. Dyson did this with old vacuum cleaners to see why they didn't work as efficiently as they should.





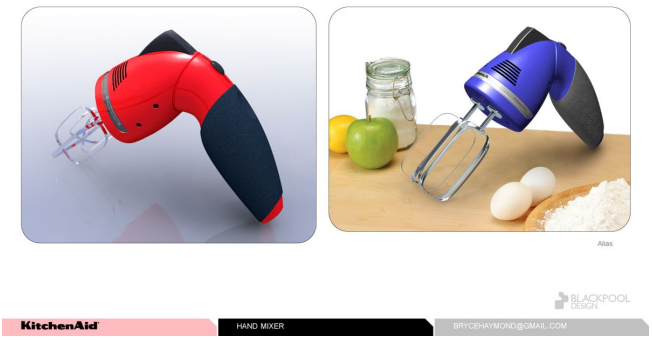
Computer mouse taken apart to understand how it works

Target Audience / Mood Boards / Concept Board

It is very important for the product designer to know which market or audience the product is aimed at. He can create a Mood Board to create a profile of the type of person that would buy the product.

From doing this the designer can establish the lifestyle and needs of the person. When promoting the product he will know where to advertise and what magazines or TV programmes this person will buy or watch.

Final Concept Drawings for Client



Final Concept drawings that the designer could show to a client for feedback before manufacturing

Jonathan Ive
iMac

Ive's team grabbed the world's attention in 1998 with the release of the first iMac. Selling over two million in its first year, iMac's design was cited as "one of the century's lasting images" by BusinessWeek. The iMac went on to win many design competitions.

Jonathan Ive is a British born designer that developed the iMac.

Apple computers were on the verge of going bankrupt and were struggling to compete with Windows based computers.

Jonathan Ive developed a new looking type of computer the iMac.

All computers in the past had been designed in beige coloured plastic. All the development that happened with computers was from the actual technology development - faster graphic cards, better hard drives, better memory etc. Basically the external appearance of a computer stayed the same. All development of computers was based on the 'Technology Push'. [technology determining how products are improved and developed]

KEY FEATURES

- Jonathan Ive considered the aesthetics [appearance] of a computer for the first time. Curved form that had a nice smooth shape to it.

"Sorry no Beige"

- Available in different colours, or 'flavours, Mint, Tangerine, Blueberry, these were colours that you could taste. [Aesthetics]
- The iMac was developed as one computer unit with built in monitor. One unit - no separate parts like a standard PC
- No floppy disk drive to backup or save work [Ive considered that the floppy disk was a thing of the past]. First computer with no floppy disk drive.
- This computer could be used in any room of the house, colours could be matched to decor and regarded the iMac as part of

every day life and a product that would be used constantly - the use of the internet, multimedia features and not confined to the office or study.

- Many manufacturers followed suit eg. Hewlett Packard, Epson offered peripherals like printers and scanners with same type of plastics and colour schemes to match.
- Apple have developed a range of different products that follow this concept. Apple G4, Mac Air Book

iPod

The consumer could choose a computer that fitted in with the decoration of a certain rooms. *Ive believed that a computer is part of day to day living and the computer should be situated in living rooms and not in study's or bedrooms. They should be nice to look at.*

Marketing slogans used by Apple 'Sorry not available in Beige'

This design has **influenced** a lot on computer designs. Most computers are now designed with aesthetics in mind, - shape and style. Even printers and scanners are available in different colours to match the colour of computers.

Apple have developed other products linked to the iMac, eg iPod, iBook etc.

iBook

Apple G4

Mac Air Book

ENVIRONMENTAL DESIGN

HOWIES - Clothing

A higher quality product will invariably last longer. It will keep on performing as it was designed to for longer before it finally needs replacing. And so over its lifespan it will have consumed less valuable resources than an inferior product that will have been replaced many times.

That's why we make the best quality products that we know how. Because ultimately the best thing we can do for the environment is to make our stuff last a real long time.

Jeans

Hemp Kaizen

£225.00

These jeans are made by mixing organic hemp with organic cotton. Hemp is twice as strong as cotton.

Functionality

We believe in making products that serve a purpose and that stand the test of time. We avoid the fashions of the day and just ensure our products are as functional and as simple as possible.
'That which has the greatest use, possesses the greatest beauty'.

Our Purpose

Why are we in business? For us it is not as simple to make a profit. Like any company we require a profit to stay in business. But it is not the reason we are in business. The thing that has not changed from day one is the desire to make people think about the world we live in. This is, and always will be, why we are in business.

Earth Tax

We pledge to give 1% of our turnover or 10% of pre-tax profits (whichever is greater) to grass-root environmental and social projects. To find out more about our donations, please visit the website. It is only a small amount but as our company grows we will be able to give more. Which gives us a nice reason to want to grow.

Fun

We are trying to get the balance right between work and play. Whenever a real nice day comes along, it'd be a shame to waste it. So if you phone up and no-one answers, don't worry.

1. DESIGNING and INNOVATION

We are out there doing what we love. So leave a message and we'll get back to you in a while.

The rocking chair test

Every product we make has passed the 'rocking chair test'. This is something we use to guide us along the path we are taking. So when we are old and grey and sitting in our rocking chairs, we can look back on the company we created with a smile. That's why we go to the trouble of using the best quality materials to make sure our clothing lasts longer. The longer our products last the less impact they will have on the environment, and the bigger our smile will be.

1. DESIGNING and INNOVATION

Case Study

Idea to Market

IT STARTED WITH AN IDEA – Trunki

Trunki is a brand of ride-on hand luggage for children, designed by Rob Law. Rob Law owes his success to sheer determination.....always take as much advice as you can and always understand your customers' needs to make sure you produce a product they want to buy. The most important thing about developing a product and getting it to market is understanding your consumer or user. Along the way you need financial advice, manufacturing advice, marketing advice, sales, logistics, supply chain (nobody know that stuff to start with, but you have to go out and find it out)

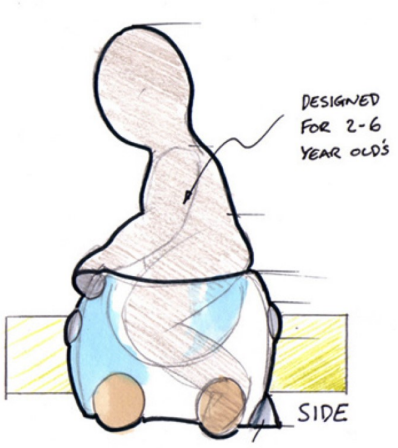
Rob Law CEO Trunki

Timeline.....

1997 Rob Law entered a university competition to design a piece of luggage. He visited a department store for inspiration and ended up looking at ride-on toys. He thought about how to utilise the wasted space, and the idea for Trunki was born. Rob went on to win the competition.

2003 Rob received a grant from the Prince's Trust to get his business off the ground. Later that year he signed a licensing deal with a Saudi Arabian toy company.

2005 The toy company went into liquidation, it wasn't the launch pad that Rob had hoped for and instead he decided to go it alone.



2006 Trunki was born again - the first container of Trunki ride-on suitcases arrived at Avonmouth completely unaware that they would revolutionise family travel.

1. DESIGNING and INNOVATION

2006 Rob Law took Trunki into the Dragon's Den but failed to find an investor.

2010 With a rapidly growing team, the company moved into a new office - a converted Chapel that is nicknamed the Mother ship, which comes complete with a games room and escape chute (or slide!)

2011 One Million Trunki ride-on suitcases sold.

2012 The first UK made Trunki rolled off the production line at the factory in Plymouth.

2013 Trunki entered into the world of TV advertising.

2013 Trunki scooped their 90th award from Sir Richard Branson and came 42nd in the Sunday Times FT 100, and picked up the coveted innovation award. Two Million Trunki ride-on suitcases sold.

2014 Hello Kitty Licensed suitcase is launched, which was a roaring success, especially across South East Asia. Trunki hits the USA!

The launch of Trunki Made4Me allows fans to go online and design their very own bespoke Trunki, with a billion colour combinations to choose from.

Boris the London bus zoomed into first place at *London Toyfair*

2015, picking up best speciality toy.

Still going strong - today the Trunki team in Bristol are working as hard as ever, distributing products to over 97 countries worldwide.

Product Evolution – Trunki

At every stage, Rob Law emphasises the importance of continually evaluating your product and the key considerations you should always

1. DESIGNING and INNOVATION

be thinking of on your design journey – the impact of materials and manufacture on cost, the functionality and safety of your product and, of course, your consumer should be at the heart of everything you do.

Product designers need to continually improve their product/s through consumer and retail feedback……..

Original Foam Model – understanding the user**.**

Trixie - one of the first versions, developing cost effective manufacturing methods.

Bernard the Mark 3 Trunki - stacking and developing safety features.

Mark 4 Trunki – additional features to allow for sales in America

Mark 5 Trunki – made in the UK, re engineered, no screws, innovative plastic catches, snap fit handles.

1. DESIGNING and INNOVATION

Case Study

Protecting Your Designs

Back in 1996, when Rob Law first drew his ride-on suitcase idea, little did he know he was sketching his way to the success the Trunki ride-on suitcase is today! Selling over 2 million in nearly 100 countries worldwide, Rob Law's University brainchild has achieved global domination.

However, although they say imitation is the highest form of flattery, for the product designer your creation is your livelihood. When people copy your valuable designs, it is damaging to your brand and sales, not to mention completely disheartening when you've worked so hard to pioneer the original and best.

Since launching in 2007, copies of the design are on sale on and offline globally, and more emerge every day. From the beginning, Trunki had the foresight to invest in different forms of Intellectual Property protection, meaning they have legal backing to fight the people stealing our ideas.

There are 4 main types of Intellectual Property:

Trademarks protect brand names, creating a brand for your product is a good way of adding value and helping people identify ideas. It can protect words and graphic symbols and trademark protection lasts 10 years.

Patents protect a novel technical solution. You can't patent the idea of a ride on suitcase but you can protect the element of technical challenges you've solved in a novel way, for example the new catch design on the Trunki is patented. Patents require renewal every 4 years from the date of filing.

Design rights protect the shape of a product. There are 2 kinds, unregistered and registered.

Unregistered designs are protected as and when you create them provided you have proof of the date created. Years ago, people used to send themselves their designs by registered post as proof they belonged to them! So, always date your drawings when you produce them.
Unregistered rights only protect your design in the UK and are valid for up to 15 years.

Registered designs can be registered just in the UK or across the whole of Europe via the Office for Harmonization of the Internal Market, OHIM. This provides much stronger protection than unregistered designs. Registered designs last up to 25 years but must renewed every 5 years.

Copyright prevents anybody from displaying your work – images, designs, photographs, graphics etc – without your prior permission and lasts anything from 25 years to a lifetime depending on the type of creation it covers.

Patents, Trademarks and Registered Designs come at a cost but they're invaluable to protecting the Trunki brand and products – past, present and future.

Reproduced by kind permission of Laura Breen (Crew Commander Trunki)

TESTING MATERIALS & PRODUCTS

QUALITATIVE TESTING

-Test finishes, model shapes aesthetics.

-Personal taste - can be difficult to measure.

QUANTITATIVE TESTING

-How strong is the material - can it support weight

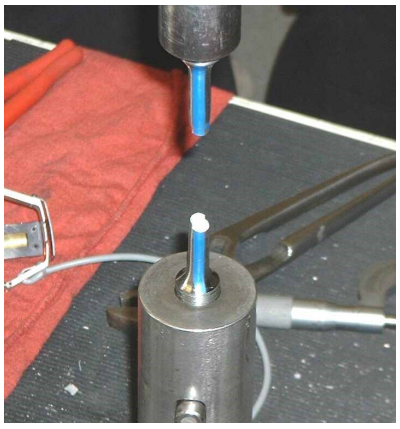
-Test the material under water to see for how long it will last outside

-Compare cost of materials

-Car withstanding a crash

-Can be computer testing—simulation model of bridge under stress

These tests can usually be scientifically proven.



Tensileometer

Tests how strong a material is under tension force [pulled]

1. DESIGNING and INNOVATION

Feasibility Studies

Feasibility studies ensure your design and development investment will be worthwhile

Our design feasibility studies are essential to reduce your development time & costs. Taking time to check costs and the investment required to complete the project ensures:

Reduced project risk by checking technical feasibility before any major investment is made.

If a project is commercially viable. It will also: identify areas for cost reduction, provide clear focus for an efficient design development stage and optimise your investment in research & development as a whole.

Identify suitable materials technology and production processes to ensure your concept is viable to develop and manufacture in the volumes expected.

Provide commercial confidence to your business that you have selected the most appropriate concept design to develop.

1. DESIGNING and INNOVATION

Performance Modelling.

This is the process of being able to test products to see how they would perform in a real life situation.

Simple tests can be carried out to see how strong a piece of wood is, how strong is a particular joint etc.

This is called **Quantitative Testing** the strength or weight that can be supported can be measured.

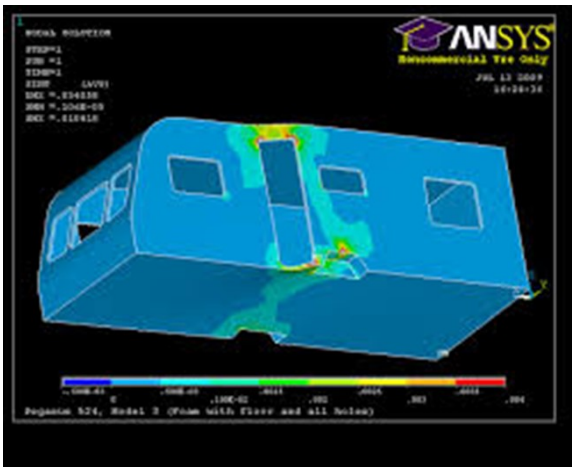
Testing how much weight a piece of wood can support before breaking

Computer Performance Modelling

This usually would be under simulation scenarios where computers would calculate different forces, stresses or strains on the product when in use.

This would enable the designer to recognise areas that need to be developed or improved to make the product safer or perform better.

This is a very important part of product development, to make sure that the product will perform well and be safe to use.



Computer Simulation of recognising weak/stress points in caravan body design

Using computers and test modelling materials would be much cheaper to discover issues that need to be eradicated rather than creating the proper final product and then discovering that the product is unsafe or not suitable for its function.

Quantitative testing. You can use computers to test products to see if they will work or suitable for the work.

Computer Rendering to see how a product would look with a different finish

Visual or Aesthetic Tests can be carried out on computer models - finishes or material appearance on a product can be changed so that the client can see how the product will look in real life.

ERGONOMICS

Man and his environments.

Products that have been designed with consideration to human senses.

Sight, smell, touch, comfort, sound, temperature.

Ergonomics: (Greek) **Ergos** - work, **Nomos** - Laws. Literally, the laws of work.

If a product is ergonomically designed the chances are is that it will be a successful product. The user will be able to use the product comfortably and better.

To ensure that products are comfortable and easy to use designers use **ANTHROPOMETRIC DATA** to make sure that the product is suitable for human use.

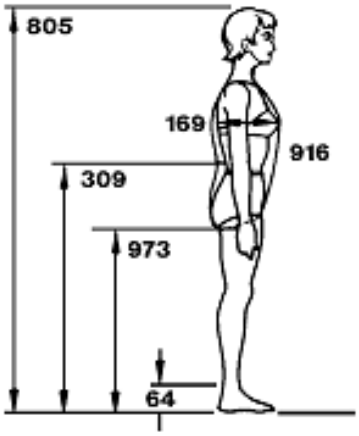
Shown are examples of products that the designer has used ergonomic considerations when designing the product;.

Comfortable to grip, handle, weight easy to carry etc

Ergonomic considerations on these products can be designed to be human friendly and be easier to use.

Hand and comfort of grip considered

ANTHROPOMETRICS.



Anthropometrics is the Science of collecting statistical data about body measurements. Data is collected for Adults and children.

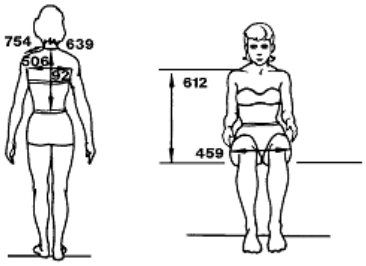
Toy manufacturers would use data from this book when designing products or toys for children.

Relation between Ergonomics and Anthropometrics

A designer would use this data to make sure that his product was ergonomically well designed:- comfortable to sit, comfortable to hold [Grip] etc.

Some people are outside of the Average range of body measurements. These are considered to be the 5th and 95th percentile, people who are bigger or smaller than average.

Designers in some cases have to consider these factors



Anthropometric DATA

5th percentile	AVERAGE	95th percentile

Look at the following products and consider what type of Anthropometrical data the designer would look at when developing these products.

Sunglasses

Childs desk & Chair

Scissors

Dyson portable Vacuum cleaner

Ergonomic Kitchen

Ergonomic Chair

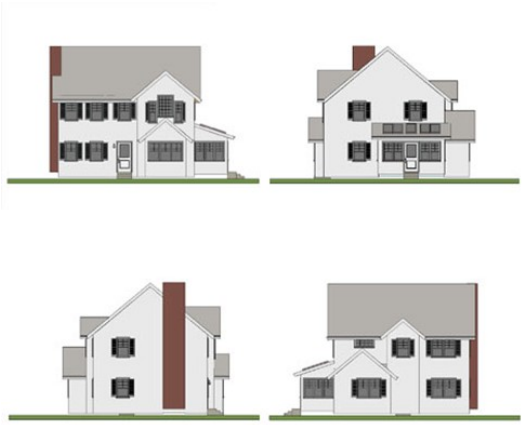
CAD - Computer Aided Design

Computer Aided design is the use of computer software to accurately draw products

Can be used in all types of Design fields:-

Architecture

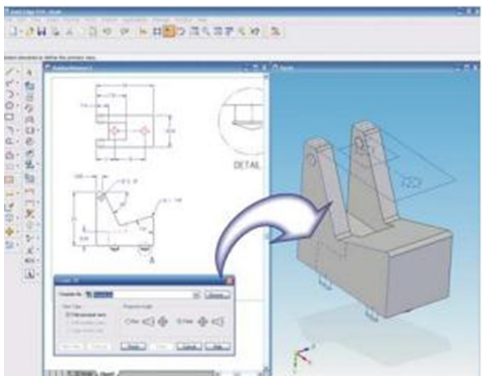
- Product Design
- Engineering
- Textile / fashion design

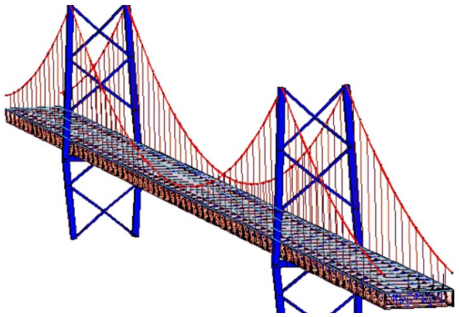


Architectural CAD Drawing

KEY FEATURES of CAD

- Can Edit drawings quickly compared to using paper based drawings
- Can view product from different angles—3D views
- Can change from 3D views to 2D views by clicking a button
- Apply different rendering or surface finishes to see how the product looks, client can select desired product quicker and get the product to market before competitors.
- Software can test virtual models for strength before manufacturing.
- Walk through—can move around inside a building, virtual tour.
- Can zoom in and out to see small details.
- Can create wireframe drawings to see hidden detail.





Stress CAD drawing to check performance

CAD drawings can be sent to CAM equipment for cutting out or creating 3D models.

CAD can be used for **Performance Modelling scenarios**. A model can be created on CAD and can be tested in various ways:-

Aesthetic visual tests - Model can be rendered with different finishes so that the client can decide which one is the more appealing.

Performance test - can be tested under working conditions to see how the product would perform in use eg—bridge design with weather and vehicle loading applied to it.

Innovative use of Materials

by designers in reaction to environmental issues

MacBook Air - GREEN MACHINE

Key Points in Design Features with consideration for environmental issues:-

Casing manufacturing.

Case stamped from sheet material, less use of materials and waste.

Aluminium Alloy Casing instead of Polycarbonate—Aluminium much easier to re cycle than Polycarbonate

Much more durable than previous plastic casings. (tougher - would not crack if dropped)

Aluminium a better conductor of heat - casing used as heat sink to get rid of heat from processor - no need for cooling fan to cool processor.

Battery life improved because of no fan- 7 hours working time much better than any other laptop, no need to charge as often

Packaging used for MacBook - re-cycled product, packaging 56% less than similar packages used for laptops.. No polystyrene or polythene.

Greener design key points.

All Card packaging that can be re-cycled

LED backlight for LCD Display - uses less energy than normal Laptop displays.

Uses Arsenic free glass.

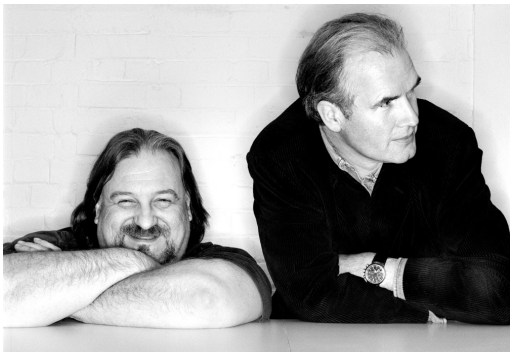
Environmentally friendly materials - aluminium alloy casing that can be re-cycled.

Poly Vinyl Chloride [PVC] plastic used in most products for wire insulation - Bromine used to create PVC - dangerous and not good for environment.

MacBook doesn't use any PVC in its manufacture - even in cabling and wire insulation. PVC free cables

INNOVATION

An **entrepreneur** is an owner or manager of a business enterprise who makes money through initiative and/or risk.
Product design entrepreneurship has traditionally been defined as the process of designing, launching and running a new product or business, which typically begins as a small business, such as a start up company, offering a product, process or service for sale or hire, and the people who do so are called entrepreneurs**.**



Richard Seymour and Dick Powell are entrepreneurs that have developed and designed products for numerous companies around the world.

'The entrepreneur is seen as a business leader and innovator of new ideas and business processes.' Entrepreneurs tend to be good at perceiving new business opportunities and often take risks which makes them more likely to exploit the opportunity. Rather than working as an employee, an entrepreneur runs a small business and takes all the risk and reward of a given venture, idea, or service offered for sale.

Interior layout for aeroplanes and trains. Kitchen appliances, cosmetic packaging etc. For more information on their products click on the link below

https://www.seymourpowell.com/

A **Product Champion** is a member of an organisation who has an entrepreneurial vision of a new good or service and seeks to create support for its commercialisation.
A product champion is someone who sees value in a product, and creates and develops the product and also entices decision makers to invest, sell or promote the product. The product champion also keeps the product in consumer's minds. A product champion's role doesn't stop once the product is established and on the market. Keeping the product fresh in the minds of the consumer is another role they take on.

Steve Jobs—APPLE is a good example of a Product Champion who had a vison to be able to market and promote his products on a world wide commercial basis.

1. DESIGNING and INNOVATION

Thomas Heatherwick

Innovators create *'new ideas, devices or methods.'*
Innovation is often also viewed as the application of better solutions that meet new needs, or existing market needs. This is accomplished through more -effective products, processes, services and technologies that are readily available to markets and society. The term 'innovation' can be defined as something original and more effective and, as a consequence, new, that 'breaks into' the market or society. It is related to, but not the same as, invention.

While a novel device is often described as an innovation and is generally considered to be the result of a process that brings together various novel ideas in a way that they affect society. Innovations are created and found in order to meet growing consumer demands. At the end of the day, a product champion is the pioneer of a new product; developing it, getting it in front of people.

New London Bus

Metal Spun Chair

2012 London Olympic Flame

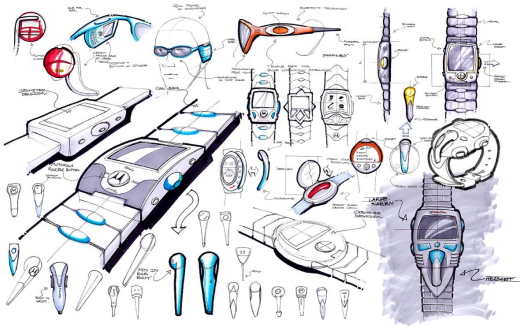
The Hive—Learning Hub University Singapore

Thomas Heatherwick is a good example of being an Innovator and is responsible for designing and developing numerous products from household goods, transportation to architecture.

www.heatherwick.com

DEVELOPING PROPOSALS

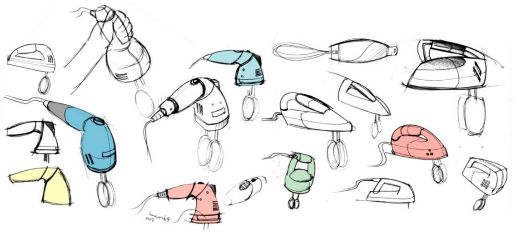
System approach to design



The principle goal of system design is to establish a design approach that provides the functions described in the system requirements document.

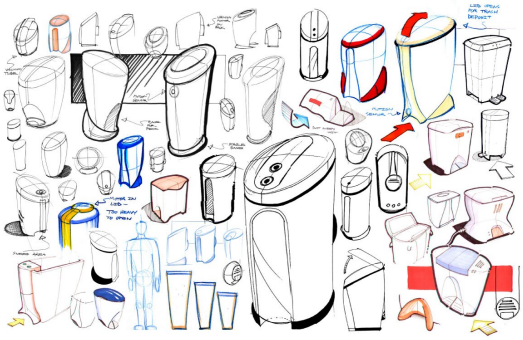
System design will establish a discipline integrated engineering plan for the proposed design, understand the technical risks, explore trade-offs, and determine estimates for performance and cost to completion.

The process starts with a System Requirements Document:



- Establish system functions and required performance
- Establish user needs and features
- Complete lifecycle considered – development and operations
- Starting point for developing a solution to meet needs
- All disciplines integrated

Using the systems approach



Applying the systems approach to the design and making of products saves time and effort, and reduces waste. For example:

When planning your work, you'll probably need to draw up a flow chart to make clear the logical sequence of jobs.

When you need to make multiple components, or several products that are the same, you will probably use batch production techniques.