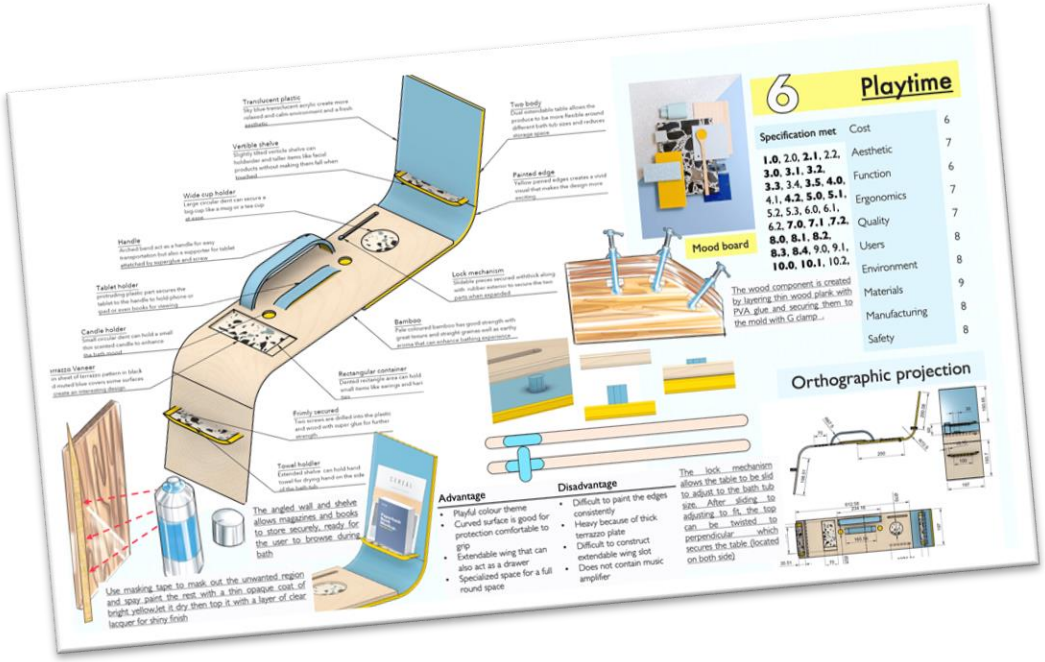
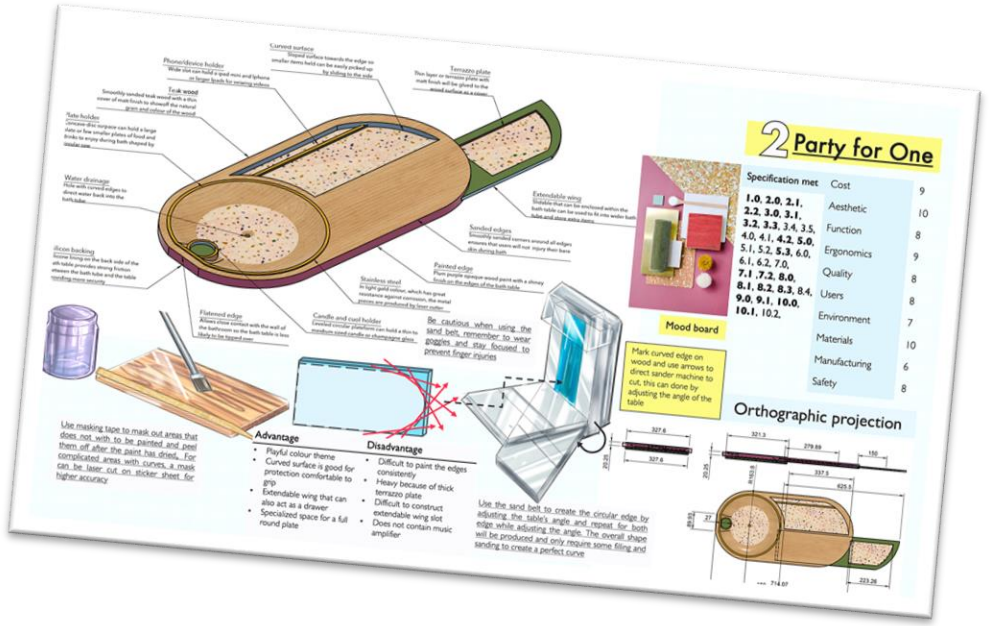
Introduction

AQA A Level Design and Technology

NEA (Non Exam Assessment)





The NEA is your **Design and Technology A Level Coursework**. You will have to complete a **Design Portfolio** in PowerPoint (approximately 45 slides) and manufacture a **Practical Prototype** of your final design. This work accounts for **50%** of your grade in this subject.

Every piece of work will **count** towards your **final grade**, so make them **GOOD QUALITY** and **DETAILED!**

Context for the Design and Make Project:

You will have to come up with your own context and Design Brief for your project.
Design and make a SMALL product – something you will be able to make in the school workshop or at home if required.
The product you design will need to solve a real-life problem and designed to be used by someone you know.
You WILL have to find a customer or client who can give you feedback and advice on your design ideas.
You will need to show the product being tested in its environment and by your client / user.

NEA (coursework) Marks

The NEA (DT Coursework) is marked out of **100 marks**.
It is made up of **5** sections.

Three AO split into 5 sections as follows:

	Section	Criteria	Maximun marks
AO1 (30 marks) **Identify, investigate & outline design possibilities**	A	Identifying and investigating design possibilities	20
	B	Producing a design brief and specification	10
A02 (50 marks) **Design & make prototypes that are fit for purpose**	C	Development of design proposal(s)	25
	D	Development of design prototype(s)	25
A03 (20 marks) **Analyse & evaluate**	E	Analysing and evaluating	20

Research into the problem, task and user needs / wants.

Writing a detailed Brief and Specification.

Sketching 8 – 10 design ideas.

Developing, testing and modelling your designs.

Manufacturing a practical prototype of your design.

Analysis and evaluation throughout your project.

Where to start: Section A: Identifying and investigating design possibilities (20 marks)

4.5.1 Section A: Identify and investigate design possibilities

Central to the success of the NEA is the selection, by the student, of a context that will provide them with the opportunity to challenge themselves as a designer. Care should be taken, and guidance sought, to ensure that the context chosen offers the student the scope and complexity for a piece of work that is worthy of consideration for the award of an A-level.

Having chosen their context and potential user(s) they then need to plan and carry out an extensive investigation into all aspects of the context in order that they might operate from a position of knowledge when making subsequent decisions.

The student will be expected to employ a variety of both primary and secondary methods of investigation. These might include visits organised by themselves or others, surveys and questionnaires could be used to inform. Useful and relevant material can be gained from others via the internet, books, magazines or interviews. Students should also be encouraged to undertake, where relevant, practical experimentation and disassembly as methods for further understanding and exploring the context and its related issues.

At this stage it is expected that the student will begin to explore their thinking on possible solutions by producing concept ideas that take into account the information collected. At this stage of the process these first concept ideas will merely demonstrate the student's initial thinking and should

Key Points:

- **Project based on a REAL LIFE problem.**
- **Identify a customer / client.**
- **Identify needs and wants from product.**
- **Primary and Secondary Research.**
- **Practical investigations.**
- **Initial concept sketches.**

Mark	Description
16–20	• Excellent rationale provided for the context selected, with continuous reference throughout the project to the end user and the constraints that need to be considered in formulating a final solution. • Student employs a comprehensive range of strategies and techniques, including both primary and secondary methods of investigation, practical experimentation and disassembly, to thoroughly explore design opportunities. All sources have been fully referenced. • First concepts are both fully relevant to the context and feasible for further development and are clearly communicated through a fully appropriate variety of methods and techniques. • All investigations relate directly to the design context, issues are identified and fully addressed and the student demonstrates a detailed and perceptive understanding of the information gathered.

Where to start: Section A: Identifying and investigating design possibilities (20 marks)

Pieces of work to evidence:

- **Identify problems and needs** around your challenge / brief.
- **Look at all issues around the problem** you are hoping to solve.
- **Customer / Client interview / needs / wants**.
- **Initial solution ideas** to help solve some of the problems you have identified.
- **Existing Product analysis**.
- **Existing product disassembly**.
- **Range of Research pages relevant** to the product you are designing. Research things that will help you to find a solution.
- **First initial design idea sketches and card models.**
- **Analysis and feedback** on your research and initial ideas concepts.

Key Points:

- **Project based on a REAL LIFE problem.**
- **Identify a customer / client.**
- **Identify needs and wants from product.**
- **Primary and Secondary Research.**
- **Practical investigations.**
- **Initial concept sketches.**

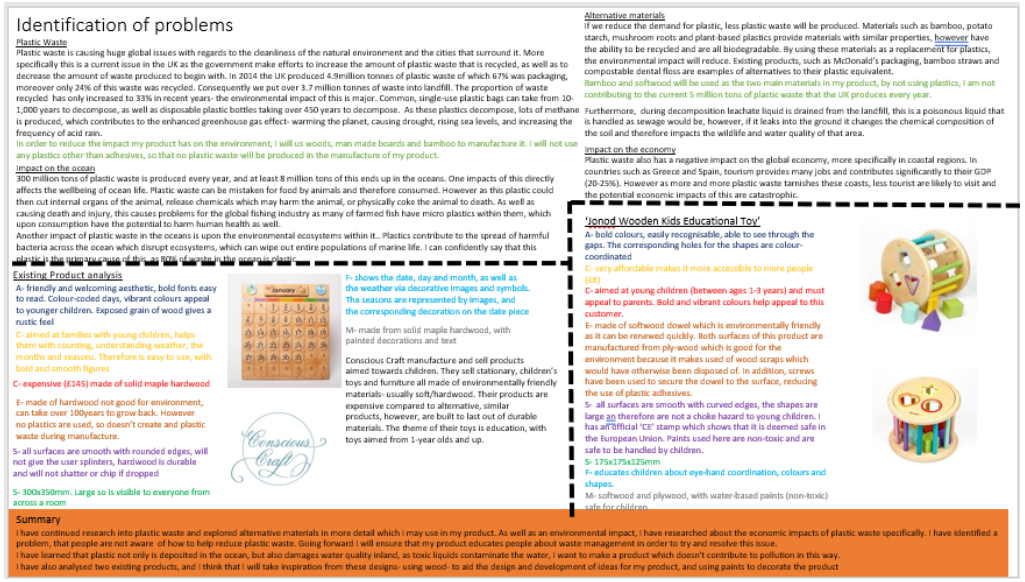
Where to start: Section A: Identifying and investigating design possibilities (20 marks)

1, Identifications of problems (1 page)

Research problems in everyday life around your chosen context. Summarise these issues. What did you find out? Is there a problem you can solve? Is there an issue you can help?

Do you or someone you know want to bring more wildlife and nature into your / their garden? What could you design and make to help with this? How would it help / benefit this issue you have identified? Do you or someone you know need sustainable lighting in their garden?

Find out some facts about these issues and explain why and how you think your chosen product will help. How will this product **impact on society including; economic and social effects**?



Identification of problems

Plastic Waste

Plastic waste is causing huge global issues with regards to the cleanliness of the natural environment and the cities that surround it. More specifically this is a current issue in the UK as the government make efforts to increase the amount of plastic waste that is recycled, as well as to decrease the amount of waste produced to begin with. In 2014 the UK produced 4.9million tonnes of plastic waste of which 67% was packaging, moreover only 24% of this waste was recycled. Consequently we put over 3.7 million tonnes of waste into landfill. The proportion of waste recycled has only increased to 33% in recent years- the environmental impact of this is major. Common, single-use plastic bags can take from 10-1,000 years to decompose, as well as disposable plastic bottles taking over 450 years to decompose. As these plastics decompose, lots of methane is produced, which contributes to the enhanced greenhouse gas effect- warming the planet, causing drought, rising sea levels, and increasing the frequency of acid rain.

In order to reduce the impact my product has on the environment, I will us woods, man made boards and bamboo to manufacture it. I will not use any plastics other than adhesives, so that no plastic waste will be produced in the manufacture of my product.

Impact on the ocean

300 million tons of plastic waste is produced every year, and at least 8 million tons of this ends up in the oceans. One impacts of this directly affects the wellbeing of ocean life. Plastic waste can be mistaken for food by animals and therefore consumed. However as this plastic could then cut internal organs of the animal, release chemicals which may harm the animal, or physically coke the animal to death. As well as causing death and injury, this causes problems for the global fishing industry as many of farmed fish have micro plastics within them, which upon consumption have the potential to harm human health as well.

Another impact of plastic waste in the oceans is upon the environmental ecosystems within it.. Plastics contribute to the spread of harmful bacteria across the ocean which disrupt ecosystems, which can wipe out entire populations of marine life. I can confidently say that this

Alternative materials

If we reduce the demand for plastic, less plastic waste will be produced. Materials such as bamboo, potato starch, mushroom roots and plant-based plastics provide materials with similar properties, however have the ability to be recycled and are all biodegradable. By using these materials as a replacement for plastics, the environmental impact will reduce. Existing products, such as McDonald's packaging, bamboo straws and compostable dental floss are examples of alternatives to their plastic equivalent.

Bamboo and softwood will be used as the two main materials in my product, by not using plastics, I am not contributing to the current 5 million tons of plastic waste that the UK produces every year.

Furthermore, during decomposition leachate liquid is drained from the landfill, this is a poisonous liquid that is handled as sewage would be, however, if it leaks into the ground it changes the chemical composition of the soil and therefore impacts the wildlife and water quality of that area.

Impact on the economy

Plastic waste also has a negative impact on the global economy, more specifically in coastal regions. In countries such as Greece and Spain, tourism provides many jobs and contributes significantly to their GDP (20-25%). However as more and more plastic waste tarnishes these coasts, less tourist are likely to visit and the potential economic impacts of this are catastrophic.

Existing Product analysis

A- friendly and welcoming aesthetic, bold fonts easy to read. Colour-coded days, vibrant colours appeal to younger children. Exposed grain of wood gives a rustic feel

C- aimed at families with young children, helps them with counting, understanding weather, the months and seasons. Therefore is easy to use, with bold and smooth figures

C- expensive (£145) made of solid maple hardwood

E- made of hardwood not good for environment, can take over 100years to grow back. However no plastics are used, so doesn't create and plastic waste during manufacture.

S- all surfaces are smooth with rounded edges, will not give the user splinters, hardwood is durable and will not shatter or chip if dropped

S- 300x350mm. Large so is visible to everyone from across a room

F- shows the date, day and month, as well as the weather via decorative images and symbols. The seasons are represented by images, and the corresponding decoration on the date piece

M- made from solid maple hardwood, with painted decorations and text

Conscious Craft manufacture and sell products aimed towards children. They sell stationary, children's toys and furniture all made of environmentally friendly materials- usually soft/hardwood. Their products are expensive compared to alternative, similar products, however, are built to last out of durable materials. The theme of their toys is education, with toys aimed from 1-year olds and up.

'Jonod Wooden Kids Educational Toy'

A- bold colours, easily recognisable, able to see through the gaps. The corresponding holes for the shapes are colour-coordinated

C- very affordable makes it more accessible to more people (£8)

C- aimed at young children (between ages 1-3 years) and must appeal to parents. Bold and vibrant colours help appeal to this customer.

E- made of softwood dowel which is environmentally friendly as it can be renewed quickly. Both surfaces of this product are manufactured from ply-wood which is good for the environment because it makes used of wood scraps which would have otherwise been disposed of. In addition, screws have been used to secure the dowel to the surface, reducing the use of plastic adhesives.

S- all surfaces are smooth with curved edges, the shapes are large so therefore are not a choke hazard to young children. I has an official 'CE' stamp which shows that it is deemed safe in the European Union. Paints used here are non-toxic and are safe to be handled by children.

S- 175x175x125mm

F- educates children about eye-hand coordination, colours and shapes.

M- softwood and plywood, with water-based paints (non-toxic) safe for children.

Summary

I have continued research into plastic waste and explored alternative materials in more detail which I may use in my product. As well as an environmental impact, I have researched about the economic impacts of plastic waste specifically. I have identified a problem, that people are not aware of how to help reduce plastic waste. Going forward I will ensure that my product educates people about waste management in order to try and resolve this issue.
I have learned that plastic not only is deposited in the ocean, but also damages water quality inland, as toxic liquids contaminate the water, I want to make a product which doesn't contribute to pollution in this way.
I have also analysed two existing products, and I think that I will take inspiration from these designs- using wood- to aid the design and development of ideas for my product, and using paints to decorate the product

Identification Of Problems – Substitution for Plastics

- Now in the world most products contain plastic in the as they are cheap and durable for the needs of a certain product but by using this material there has been a massive toll where habitats and the environment is being destroyed
- Things like light weight and one-use items can be substituted in that has similar attributes and can be better in many different ways. By using a material like Bamboo it can be used in the same way plastic is used In some products such as one time cutlery or a coffee cup, by using this product not only does this benefit the environment but can encourage people to use them again or it might encourage people to actually care about the environment as they will feel like they have contributed
- Bamboo sustainable as it is a plant and even if it was dumped it breaks down naturally which is the biggest benefit to using bamboo, it is very durable and is bamboo is found in places that qualify as tropical, sub-tropical, or temperate zones, these are places like Southeast Asia, South America, and the Southeast portion of the United States, some species of bamboo have been known to grow well indoors in less temperate parts of the world also it is a reliable source as it can grow really quickly

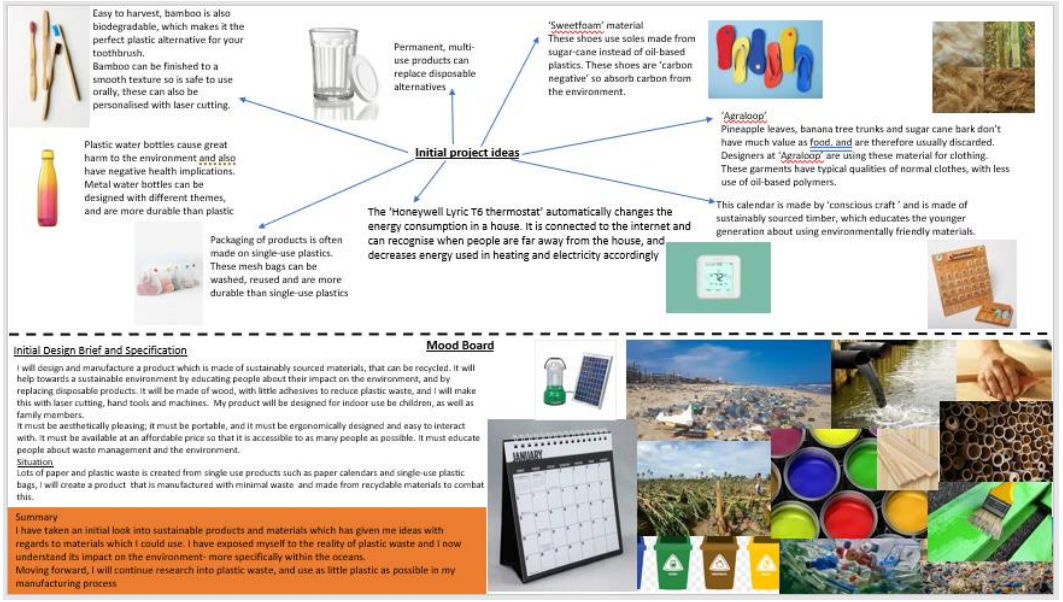
OLA Bamboo

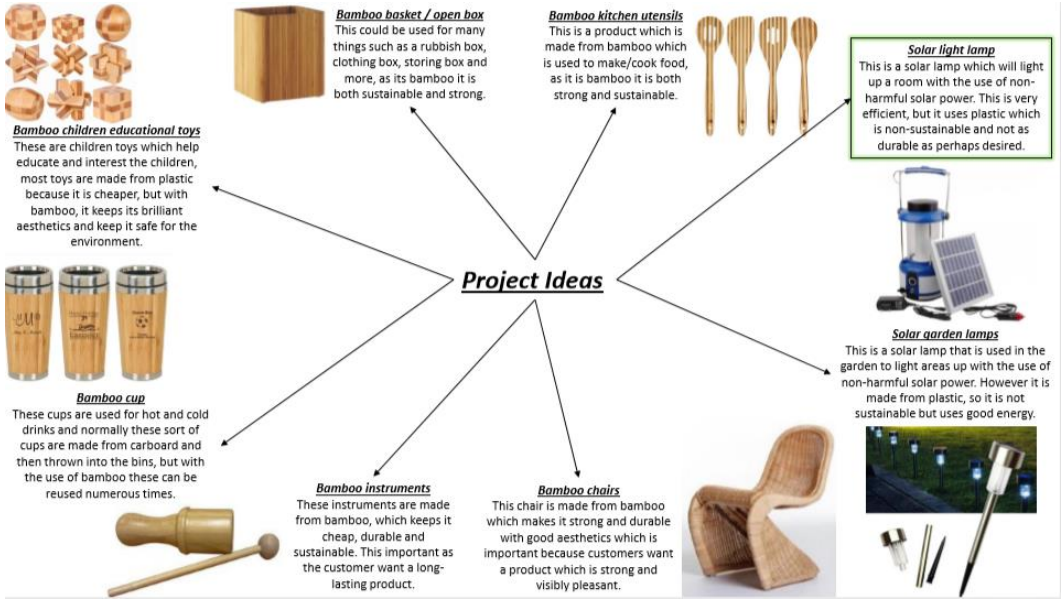
- This is a company which specialises in reducing the plastic usage and waste by making as many product out of bamboo that used to be plastic products
- They have many different products such as:
  - Reusable utensils
  - Straws
  - Toothbrushes
  - Eco-friendly dental floss
  - Toothbrush travel case
  - Toothbrush holders
  - Bamboo makeup remover pads

Where to start: Section A: Identifying and investigating design possibilities (20 marks)

2, Project Ideas (1 page) : Understanding the Context

- Create a **Mind Map** of as many project ideas around the context.
- Think of real-life problems around the context. What types of products could you design and make to solve these issues?
- Something for the garden - Bird Feeders, Bird House, Garden tool, Bug hotel, Planter, Garden solar light, Outdoor child's toy.
- A Sustainable product – Upcycling, Sustainable materials.
- Something to help people with disabilities.
- Something to keep people fit and active.
- Reduce plastic pollution?





Project Ideas

Where to start: Section A: Identifying and investigating design possibilities (20 marks)

3, Customer/ client needs and wants board (1 page) – inclusive design – (consider feedback throughout project)

You will need to identify a customer or client for your project – Someone you will design this product for. (It can be ANYONE).

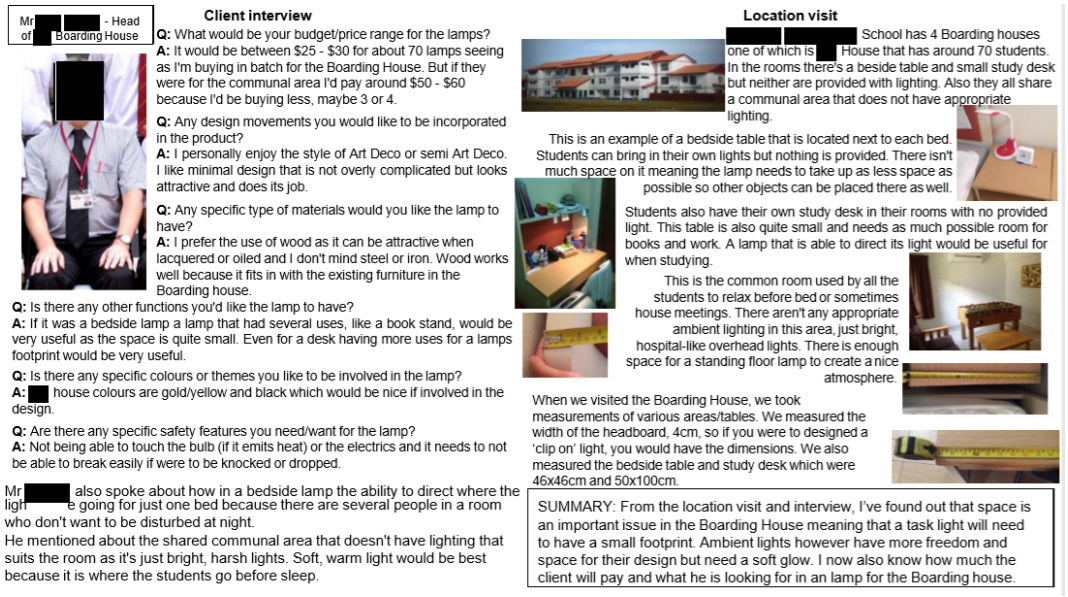
What do they want from the product? What should it do? Where will it be used? What features should it have?

Create a questionnaire or interview questions to find out what they would want – needs/ wants/ ideas/ suggestions etc./ how it would improve a real-life problem/ economic/ social.

Show the results / what they told you. **Include quotes**.

Where and who will use the product?

You **WILL** get feedback from your customer on your designs at various stages in the project.



Mr [redacted] - Head of [redacted] Boarding House

Client interview

Q: What would be your budget/price range for the lamps?
A: It would be between $25 - $30 for about 70 lamps seeing as I'm buying in batch for the Boarding House. But if they were for the communal area I'd pay around $50 - $60 because I'd be buying less, maybe 3 or 4.

Q: Any design movements you would like to be incorporated in the product?
A: I personally enjoy the style of Art Deco or semi Art Deco. I like minimal design that is not overly complicated but looks attractive and does its job.

Q: Any specific type of materials would you like the lamp to have?
A: I prefer the use of wood as it can be attractive when lacquered or oiled and I don't mind steel or iron. Wood works well because it fits in with the existing furniture in the Boarding house.

Q: Is there any other functions you'd like the lamp to have?
A: If it was a bedside lamp a lamp that had several uses, like a book stand, would be very useful as the space is quite small. Even for a desk having more uses for a lamps footprint would be very useful.

Q: Is there any specific colours or themes you like to be involved in the lamp?
A: [redacted] house colours are gold/yellow and black which would be nice if involved in the design.

Q: Are there any specific safety features you need/want for the lamp?
A: Not being able to touch the bulb (if it emits heat) or the electrics and it needs to not be able to break easily if were to be knocked or dropped.

Mr [redacted] also spoke about how in a bedside lamp the ability to direct where the light [redacted]e going for just one bed because there are several people in a room who don't want to be disturbed at night.
He mentioned about the shared communal area that doesn't have lighting that suits the room as it's just bright, harsh lights. Soft, warm light would be best because it is where the students go before sleep.

Location visit

[redacted] School has 4 Boarding houses one of which is [redacted] House that has around 70 students. In the rooms there's a beside table and small study desk but neither are provided with lighting. Also they all share a communal area that does not have appropriate lighting.

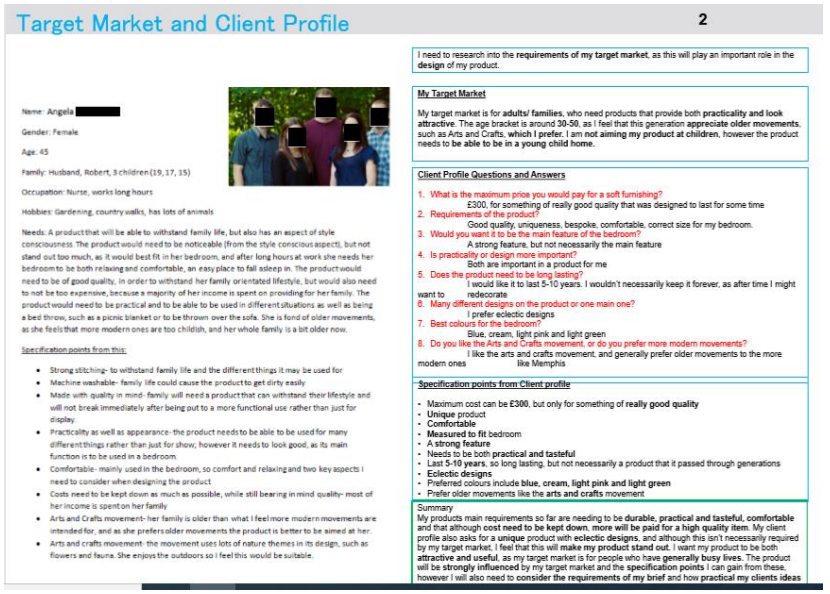
This is an example of a bedside table that is located next to each bed. Students can bring in their own lights but nothing is provided. There isn't much space on it meaning the lamp needs to take up as less space as possible so other objects can be placed there as well.

Students also have their own study desk in their rooms with no provided light. This table is also quite small and needs as much possible room for books and work. A lamp that is able to direct its light would be useful for when studying.

This is the common room used by all the students to relax before bed or sometimes house meetings. There aren't any appropriate ambient lighting in this area, just bright, hospital-like overhead lights. There is enough space for a standing floor lamp to create a nice atmosphere.

When we visited the Boarding House, we took measurements of various areas/tables. We measured the width of the headboard, 4cm, so if you were to designed a 'clip on' light, you would have the dimensions. We also measured the bedside table and study desk which were 46x46cm and 50x100cm.

SUMMARY: From the location visit and interview, I've found out that space is an important issue in the Boarding House meaning that a task light will need to have a small footprint. Ambient lights however have more freedom and space for their design but need a soft glow. I now also know how much the client will pay and what he is looking for in an lamp for the Boarding house.



Target Market and Client Profile

2

I need to research into the **requirements of my target market**, as this will play an important role in the **design** of my product.

My Target Market

My target market is for **adults/ families**, who need products that provide both **practicality and look attractive**. The age bracket is around 30-50, as I feel that this generation **appreciate older movements**, such as Arts and Crafts, **which I prefer.** I am **not aiming my product at children**, however the product needs to **be able to be in a young child home.**

Name: Angela [redacted]
Gender: Female
Age: 45
Family: Husband, Robert, 3 children (19, 17, 15)
Occupation: Nurse, works long hours
Hobbies: Gardening, country walks, has lots of animals

Needs: A product that will be able to withstand family life, but also has an aspect of style consciousness. The product would need to be noticeable (from the style conscious aspect), but not stand out too much, as it would best fit in her bedroom, and after long hours at work she needs her bedroom to be both relaxing and comfortable, an easy place to fall asleep in. The product would need to be of good quality, in order to withstand her family orientated lifestyle, but would also need to not be too expensive, because a majority of her income is spent on providing for her family. The product would need to be practical and to be able to be used in different situations as well as being a bed throw, such as a picnic blanket or to be thrown over the sofa. She is fond of older movements, as she feels that more modern ones are too childish, and her whole family is a bit older now.

Specification points from this:

- Strong stitching- to withstand family life and the different things it may be used for
- Machine washable- family life could cause the product to get dirty easily
- Made with quality in mind- family will need a product that can withstand their lifestyle and will not break immediately after being put to a more functional use rather than just for display.
- Practicality as well as appearance- the product needs to be able to be used for many different things rather than just for show, however it needs to look good, as its main function is to be used in a bedroom.
- Comfortable- mainly used in the bedroom, so comfort and relaxing and two key aspects I need to consider when designing the product
- Costs need to be kept down as much as possible, while still bearing in mind quality- most of her income is spent on her family
- Arts and Crafts movement- her family is older than what I feel more modern movements are intended for, and as she prefers older movements the product is better to be aimed at her.
- Arts and crafts movement- the movement uses lots of nature themes in its design, such as flowers and fauna. She enjoys the outdoors so I feel this would be suitable.

Client Profile Questions and Answers

1. What is the maximum price you would pay for a soft furnishing?
   £300, for something of really good quality that was designed to last for some time
2. Requirements of the product?
   Good quality, uniqueness, bespoke, comfortable, correct size for my bedroom.
3. Would you want it to be the main feature of the bedroom?
   A strong feature, but not necessarily the main feature
4. Is practicality or design more important?
   Both are important in a product for me
5. Does the product need to be long lasting?
   I would like it to last 5-10 years. I wouldn't necessarily keep it forever, as after time I might want to redecorate
6. Many different designs on the product or one main one?
   I prefer eclectic designs
7. Best colours for the bedroom?
   Blue, cream, light pink and light green
8. Do you like the Arts and Crafts movement, or do you prefer more modern movements?
   I like the arts and crafts movement, and generally prefer older movements to the more modern ones like Memphis

Specification points from Client profile

- Maximum cost can be **£300**, but only for something of **really good quality**
- **Unique** product
- **Comfortable**
- **Measured to fit** bedroom
- **A strong feature**
- Needs to be both **practical and tasteful**
- Last **5-10 years**, so long lasting, but not necessarily a product that it passed through generations
- **Eclectic designs**
- Preferred colours include **blue, cream, light pink and light green**
- Prefer older movements like the **arts and crafts** movement

Summary

My products main requirements so far are needing to be **durable, practical and tasteful, comfortable** and that although **cost need to be kept down, more will be paid for a high quality item.** My client profile also asks for a **unique** product with **eclectic designs**, and although this isn't necessarily required by my target market, I feel that this will **make my product stand out.** I want my product to be both **attractive and useful**, as my target market is for people who have **generally busy lives.** The product will be **strongly influenced** by my target market and the **specification points** I can gain from these, however I will also need to **consider the requirements of my brief** and how **practical my clients ideas**

Where to start: Section A: Identifying and investigating design possibilities (20 marks)

4, Existing Product Analysis (1 page)

Research existing similar products (2 or 3) to the one you are going to design and make. These could give you some inspiration for your own design.

Find images / take photos of the products.

Analyse the products in detail using ACCESS FM. Write about the features, materials, cost, safety, ergonomics, inclusive design, sustainability / environmental impact, size etc…

What do you like / don't like about each existing product? What things could you include in your own design?

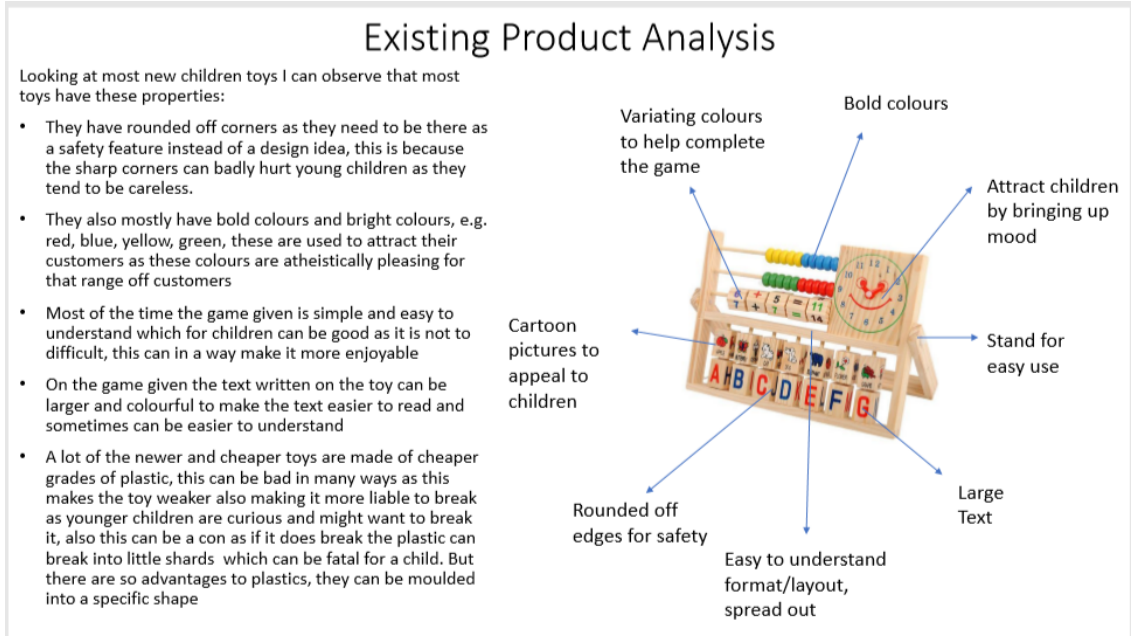
Little sun original ***Existing product analysis*** ***SM100***

ACCESSFM

This lamps is the little sun original and is known to be the first and most iconic solar lamp produced by Little Sun. The first impression of this product, for the appearance is the colour. The colour is a luminous yellow which allows users to easily be able to find this product on any background examples, table, floor, bed etc. The cost of this product is £22.55, which is a decent price for a portable light, but could be cheaper for audience to perhaps buy. Due to its appealing shape, as it is a sun, which could have been a decision to show their targeted audience as children, teenager and young adults possible to show who they are benefiting in energy-poverty countries. The environment for this is inside because it is used as a light to light a small area for work perhaps. The size of the product is 12cm in diameter and is 2.9cm in depth, with a weight of 96g. This product is rather small which allows this product to be easily portable and with a low weight which will benefit the portability. This product is safe to the user, the environment and the manufactures, it has no sharp edges which wont cause harm to the users, it uses renewable energy meaning it is beneficial to the environment and it is made through machinery cause less harm to manufacturers. This is a lamp which will emit a light source, it can be turned on by the press of a button, which is visible and easily reachable. This product is manufactured from recyclable ABS which means this plastic can be recycled, normal ABS is known for being rather expensive but with recycled ABS it is rather cheap for manufacturers.

This lamp is the SM100 and is sold by solar aid but created by Yingli Namene Solar, who are a company offering solar lights for people. The first impression of this product, for the appearance is the district colour. The colour is a gold yellow, which gives the product a good appearance with a easy way to be able to find the product. The cost of this product is £10.00, which is very good for a solar lamp, which allows numerous audience to purchase this product. With its rather plain streamline design, this product seems to be targeted towards adults which can be followed by the affordable price of the product. The environment for this is inside because it has a small light which will light an area, also there is a small lightweight stand which would not stand in windy conditions. The size of the product is 165mm x 105mm x 74mm with the stand but with the light faced down it reaches 143.5mm x 105mm x 74mm with a weight of 122g. This product is relative light for the size which allows the product to be very portable. This product is safe to the user, the environment and the manufacturer, all edges have been round so no harm can be inflicted to users, it uses renewable energy which means it is beneficial to the environment and it is easily made by machinery which allows the product to be harmless to manufacturers. This is a lamp which will emit a light source, it can be turned very easily as there is a visible button which can be pressed to turn on. The product is manufactured from plastic and this means that it is relatively cheap which help for it to be manufactured.

Overall, I like both products for the design and the functionality effectiveness, but I prefer the SM100 because I believe that it has a better design which allows it to have a better appearance. Also the ability to reduce the size by rotating the light allows it to have more portability. In addition, the stand comes with the product which allows it to stand by itself, unlike the little sun original it must be hung on something such as a wall or a neck. Plus, with the streamline design of the stand give it a better appearance and makes it look smaller, in conclusion I prefer the SM100.



Existing Product Analysis

Looking at most new children toys I can observe that most toys have these properties:

- They have rounded off corners as they need to be there as a safety feature instead of a design idea, this is because the sharp corners can badly hurt young children as they tend to be careless.
- They also mostly have bold colours and bright colours, e.g. red, blue, yellow, green, these are used to attract their customers as these colours are atheistically pleasing for that range off customers
- Most of the time the game given is simple and easy to understand which for children can be good as it is not to difficult, this can in a way make it more enjoyable
- On the game given the text written on the toy can be larger and colourful to make the text easier to read and sometimes can be easier to understand
- A lot of the newer and cheaper toys are made of cheaper grades of plastic, this can be bad in many ways as this makes the toy weaker also making it more liable to break as younger children are curious and might want to break it, also this can be a con as if it does break the plastic can break into little shards which can be fatal for a child. But there are so advantages to plastics, they can be moulded into a specific shape

Where to start: Section A: Identifying and investigating design possibilities (20 marks)

5, Economic, Social, Ethical and Environmental IMPACT of your product (1 page)

Use a mind map or titled boxes for each of the key headings. Include images and bullet points. Show your understanding of how your product impacts on these. Your ideas for how you can minimise the impact.

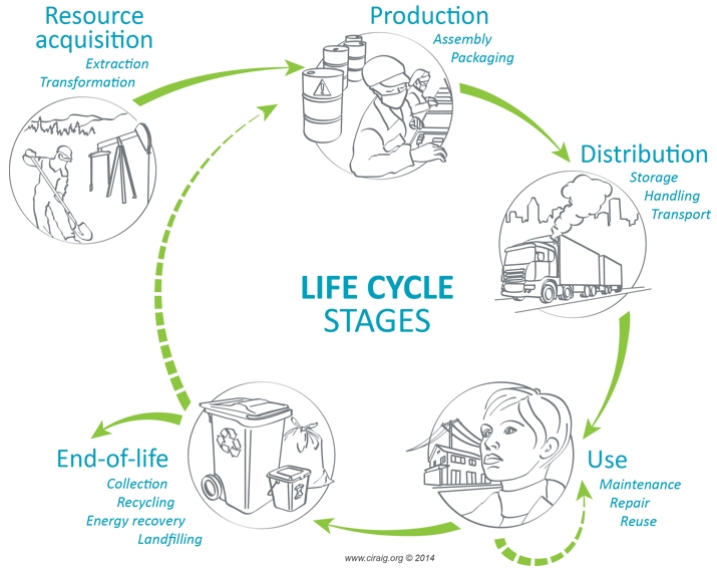
Environmental Impact - How does your chosen product impact on the environment – Positive and negative. Look at some ideas of how you can minimise or improve the impact on the environment. Look at similar existing products. How do they help the environment? Look at - Materials used, amount of material, power source.

Social benefits to the user – how can your product benefit your user. What should you consider in your design so that your product makes their lives easier or happier? Research similar products and think of things that will benefit the user.

Economic Impact – What cost are involved in your product? How could you reduce these? How can you make your product more economically viable? Look at similar cheaper existing products for ideas. What is the cost of similar products? What is your / customers budget for the product?

Ethical – Health and safety, Peoples beliefs, Ease of use, Inclusive design, Ergonomics. How will you consider these in your design? What is important? What ideas do you have? Look at existing products – how do they address these issues?

Summarise what you have learnt. What will you take from this? What will you try to include in your own design?



Where to start: Section A: Identifying and investigating design possibilities (20 marks)

6, Range of Investigation research relevant to your project

Begin to research things that will help you make design decisions in your project.

You will probably want to research things in greater detail during the development of your project when you know a bit more about how the product will look, work and the functions / features of your design.

At this early stage , you might want to research some of the following to help you create your initial ideas:

- Existing products.
- User needs and wants.
- Technology or components you could use.
- Sizes and dimensions.
- Materials, finishes and methods for how you could make your product suitable / function in its environment.

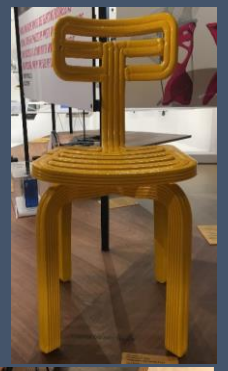
Primary Research is better than Secondary research!

Summarise what you have learnt. What will you take from this? What will you try to include in your own design?

trip

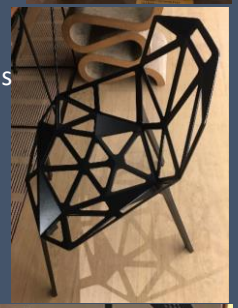
The chairs on the left-hand side were the entry panel for the museum of modern art low-cost furniture design competition. They were produced in 1948 by Charles and Ray Eames. The brief of this competition stated that entries should be "designed for flexibility and multiple use" using "the best available technological research in new materials and new manufacturing. The solution they produced was a range of furniture based around fibreglass-reinforced plastic seat wheels that could be combined with different bases.

I was particularly interested in how they had designed a variety of different bases with different styles of legs. As well as the smooth ergonomic seating which is very comfortable.



The Chubby chair was designed and made a lot more recently. It was produced in 2012 and is a result of digital manufacturing. Every chubby chair that is made is produced from a continuous strand of plastic squeezed from a nozzle which is attached to a robot arm. By combining different techniques, Dirk Vander Kooij designed an automated and flexible low-resolution 3D-printing process. This process was the first commercial example of manufacturing plastic furniture without injection moulding.

One thing that I really like about this chair is that all the plastic used is created by grinding down and recycling the interior components of discarded parts. This makes the chair more environmentally friendly than most even thought it is made from plastic and it is inspiring to see that designers are making a step towards a more sustainable future by recycling products which are made from non-revealed sources of energy



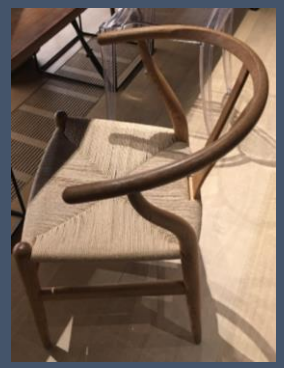
"Chair One" was designed by Konstantin Grcic in 2003 and it has been made entirely of aluminium. It has a striking design geometric design and is suitable for indoor as well as outdoor use, it is almost sculptural in its appearance. It is available to be powder coated in a variety for colours.

I really like how this chair is stackable with chairs like itself and how the geometric pattern ensures that less material is used then in a typical chair due to all its "gaps"

The sculptural form of the wiggle chair makes it stand out even though it is quite simple in its appearance. The structure has been made entirely from corrugated cardboard and the edges form hardboard. My favourite thing about this chair is how simple the design is yet it is still such a stand-alone piece because of the unique materials used

This is a Model B32 dining chair designed by Marcel Breuer in 1928. It is a refinement of some of Breuer's previous chairs. He added a wooden frame to the seat and back by doing this he removed the need for additional supports and created a lighter and more elegant structure.

This chair has an interesting structure which are been careful thought out to ensure it is stable. Typically chairs will have a solid back all the way from the back rest to the floor, however this one does not. The support has gone form the back rest to under the seat forward and then back along the ground making the chair aesthetically different to most.



Another chair which has been made from renewable sources is the "Wishbone Chair" which was made from wood and paper cord. When Hans J Wagner designed this chair his main challenge was to combine the back and arm rest so that the steam bent top could be given stability and be comfortable. The chair has over 100 steps required to manufacture it and it is because of the time taken for manufacture that the chair costs up to £150. Over time this chair as gained recognition as the ideal chair, capturing the essence of modern Danish design. I found it quite surprising that the chair required so many steps in its manufacturing process and it reminded me that my chair doesn't need to just be constructed using only a few methods of manufacture.

Like other designs produced y the Memphis collective, George Sowdens' Palace chair did not conform to the style at the time. It is quite typical of the Memphis movement and this can be seeming from the lacquered wood, intense colour combinations and standard shapes.

Personally, I think the chair has used some bold choice of colours whilst still ensuring that it still aesthetically pleasing due to the vast amount of black. In my opinion this chair could improve in terms of comfort for the user, but obviously the whole of the Memphis movement was about form over function.

Zig Zag chai was designed by Geraint Rietveld in 1932/33. He challenged himself to design a chair without 4 legs and he did this by using a series of sheet wooden planes. In the time it was built it would had been quite revolutionary

My trip to the design museum was very interesting and it gave me inspiration for my own chair designs. I found it particularly useful to learn about the manufacturing methods they used as well as the main challenges that the designers faced during the design and process.

Existing Products 2-Flatpack

Skandi is easy to assemble without any tools and comes flat-packed in a recycled box, which is convenient for storage when the chair is not in use. All parts slot together with the help of a metal connecting rod. Made of birch plywood with melamine, it's created by Finnish designer

Skandi chair by Finnish designer Topi Mäkinen for Italcomma

Aesthetics- It is a sleek white finish which looks quite sophisticated and modern
Customer- I could not find a specified target market which
Cost- This chair costs between $200-$233 (this is roughly £150-£176) This is not too expensive compared to the majority of chairs which are flatpack on the current market
Environmental/Sustainability- The chair has been made using birch plywood and melamine. Plywood is one of the most environmentally friendly materials as it a natural material made from a renewable source. The packaging has been made from cardboard which means it can be recycled when it is no longer needed. The only part that has not been made from cardboard is a metal connecting rod which can be easily separated from the rest of the chair at the end of its life cycle meaning it would be quite simple to be able to recycle it as well.
Materials/Manufacture- As previously mentioned the chair has been made from birch plywood and melamine. Birch plywood is very strong, it is stronger than steel in static bending strength. Plywood also has very high impact resistant properties which is very useful with being used for a chair design as it will encounter impacts a lot (e.g. From people sitting on it) All of the individual parts slot together with the help of a metal connecting rod
Safety- It looks like the chair has very straight edges which could possibly be a hazard for paper cuts or a similar minor injury. The metal rod will be very beneficial for safety purposes as it makes it more structurally sound.
Function- The chair has a box which it comes in, this makes it not only portable but also means it can be stored easily and whilst being stored it won't be harmed in any way. The box which it is stored in is 100% cardboard which is good for environmental purposes but could be an issue as it would not withstand any liquid being spilt on it. Which brings up the question of if it would be good as a box which is meant to protect the chair when not in use. It could had been a better idea to have made the box out of a waterproof more impact resistance material so that the chair could be stored away properly, and the user not have to worry about the chair being damaged as the box would definitely protect it.

Desile Folding Chair by Christian Desile

Aesthetics- It is a nice natural wood colour with minimal extra finished such as varnish etc, this gives it a very natural appearance which is appealing to a lot of people
Customer- The designer did not specify a specific target market for this chair however I can interpret from looking at what features were included in the product who the target market is; people who need extra seating occasional and need to be able to store it in smaller spaces.
Cost- This chair costs $335 (which is roughly £250) Bamboo is typically a cheaper material to but
Environmental/Sustainability- Bamboo may look and feel like wood, but its not actually wood; it's a woody grass. Much of its eco-friendliness comes from the plants' raid growth and the regenerative quality of the plants it is harvested from. Bamboo is a much more renewable source than hardwood trees, bamboo takes as little as 3-5 years to fully grow whereas hardwood trees can take 20 years and more to grow to full height.
Materials/Manufacture- The chair is available in natural bamboo or recycled PET. The two different material options are so that the chair can be used indoor or outdoors (the bamboo indoors and the PET outdoors) There are several advantages to using bamboo other types of hardwood. It is a very strong material especially in terms of compressive strength. Bamboo can generate 35% more oxygen than an equivalent planting of trees. So bamboo is not only a good choice because of the properties of bamboo but also because of its positive impact on the environment. This chair has been made from a singular sheet of bamboo so there has been minimal waste when making this chair.
Size- When closed the chair is less than an inch thick (0.8inches) this is not big at all which is very useful as it means that the chair could be stored in a variety of different places when not in use.
Safety- Even though this is a folding chair it has been designed in a way so that the chair cannot start folding together whilst you are sat on it which is very important. All the sides and corners have been smoothed over which is good as it means the user will not harm themselves on the chair.
Function- The chair has a hole at the top end so when it is folded it can be hung on a wall, this serves not just functional purposes, of making it more space efficient, but also aesthetic purposes as the chair could be a unique topic of conversation when the owner of said chair has friends round.

Where to start: Section A: Identifying and investigating design possibilities (20 marks)

7, Initial Design Ideas

Create a range of design ideas to show your customer and gather feedback on them.

6 – 8 Innovative and creative concepts that look at trying to solve the problem.

Sketch them neatly – This is A Level!

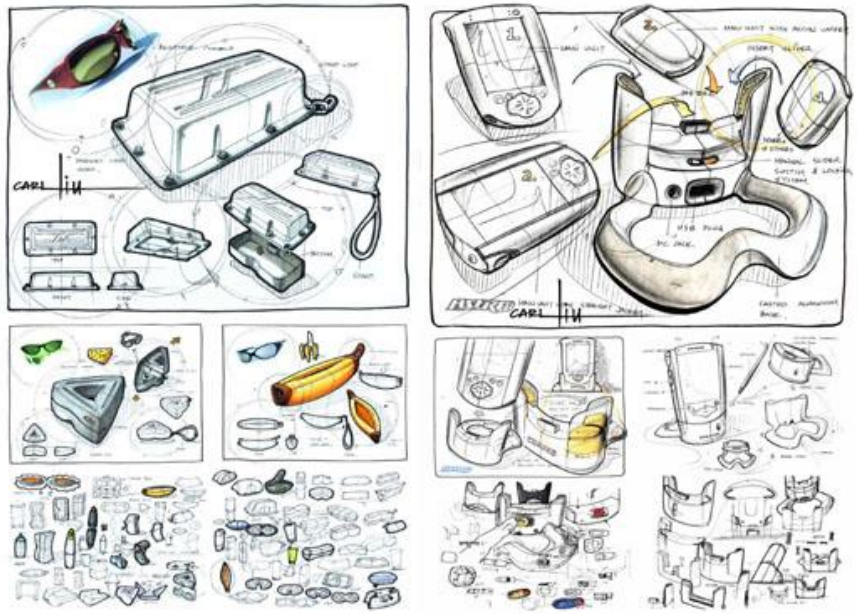
Add shading and colour so that the look as realistic as possible.

Show your designs to your customer / client and write down the feedback.

What do they think of your ideas?

What do they like / don't like?

Do they have any suggestions at this stage?



Feedback and analysis of your ideas is important!

Summarise what you have learnt. What will you take from this? What will you try to include in your own design?

Initial design ideas

The next thing which I needed to do was produce some initial design ideas. I produced 12 initial designs and with each one I summarised the key features of the design as well as highlighting where the design met or failed to meet the requirements from my specification

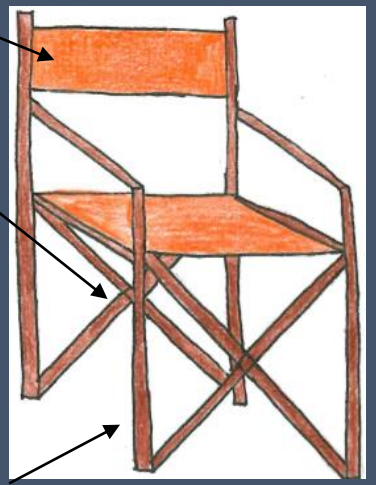
My first chair design is in a camping chair style. The chair is collapsible in the horizontal direction as shown by the second drawing of it

1

This chair has arms which makes the chair safer as it makes the user less likely to fall out of the chair, it also means there is a place for the user to place their arms

The decision to have a gap at the back of the chair and not have a full back was made because it means less material is used which makes the product more cost effective

The chair can be collapsible as the orange material will be some type of fabric?



Relatively neutral colours, could make the fabric any colour to accommodate to the customer

Could do cuboid tubes or spherical tubes for the wood- investigate which would be more suitable; cost? stability?

The cross part of the chair is good for the structure and it also looks more aesthetic. However it could also be a waste of material and as sustainability was one of the main focuses of my specification, they is not desirable

Can be finished in various ways for aesthesis purposes

Beech wood- cost effective, hard wearing, commonly used in, can be worked with easily

"Reminds me of a camping chair not a chair I would think of using permanently"

Wood could be too heavy? A possible issue if the chair is going to be collapsible

Hollow tubes? Would make it weigh less

"Seat may not be particularly comfortable due to the fabric to having anything holding it up"

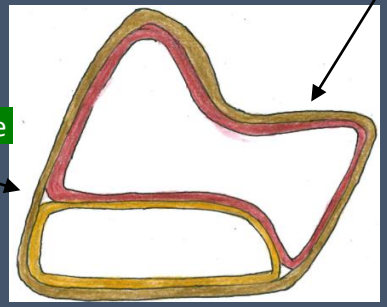
My second design is focusing heavily on being space efficient as well as multifunctional, both features which are desirable for my target market

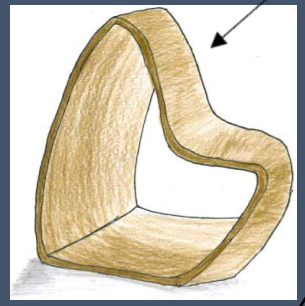
2

It would be made from bent wood; this would probably be steam bent which can be a complicated and time-consuming process

These pieces of furniture are all separate from each other, but they all come together and fit in the large brown chair. This makes the design space efficient

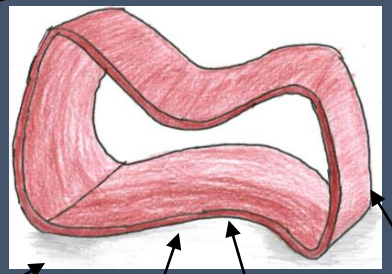
This is a three in one product and is not only two chairs but is also a table with a lot of storage space

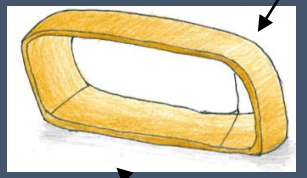




The two chairs and the table would all be in made with the same type of wood; this means I would only have to buy a bulk amount of one material instead of smaller amounts of a variety of different woods. However I would stain the wood different colours for each piece of furniture, so it doesn't look boring

In my design specification I talked about how the space efficient feature was going to be important in all my designs and I was not going to focus on a multifunctional feature. However this design is both things





The table is an added extra which the client hasn't asked for, but I included it as I thought it could be useful to use as extra surface space as well as storage

The shape of the two chairs was purposefully choose to fit to the shape of the human body; this not only makes the chairs comfortable, but they also look very sleek and modern which is appealing to my target market

All three of these pieces of furniture are hollow so this means they can all fit together, and it also means that a variety of objects can be stored inside the pieces of furniture

My client expressed an interest in the large availability of extra space which could be used for storage in the third design. They said *"the empty interior of the chair designs could solve the issue of lack of space for storage of books"*

The measurements and angles for this design would have to be extremely accurate because all the pieces fit together. If one measurement was incorrect it would throw off everything, this would make making this design quite challenging

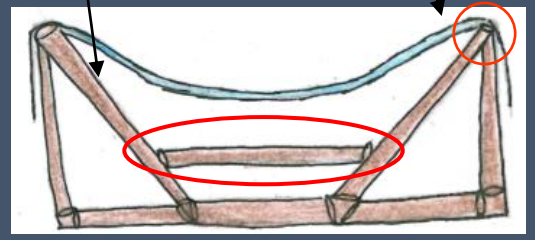
Initial design ideas

My third design was inspired by hammocks, and it has a large piece of fabric which is held in place by the structure underneath it

3

Possible size issues? In relation to the customer this chair idea could be too low to the ground so would be uncomfortable with where the user's legs would go

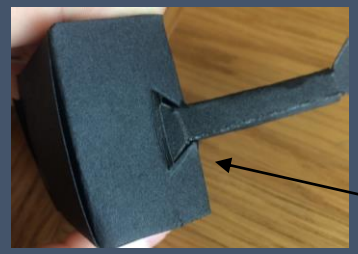
This design would work better for young children as they are smaller, the child could put their feet on the beam across the middle

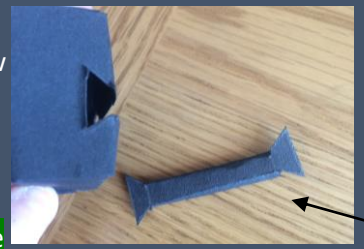


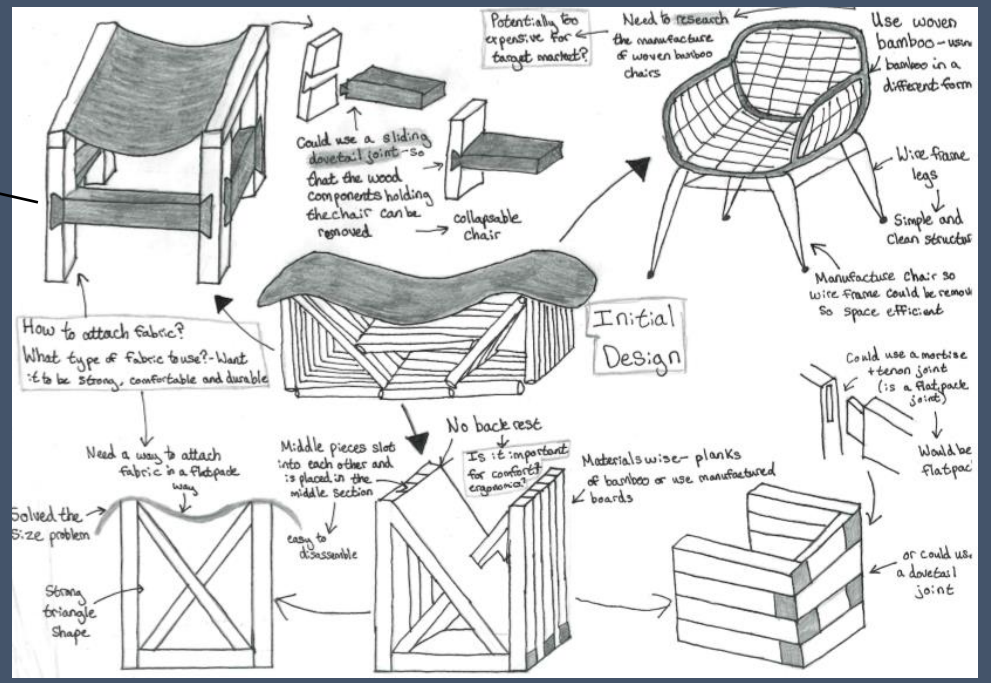
Need to research different ways in which fabrics can be secured to other materials safety

Strong fabric that can withhold the user

Need to secure the material at either end of the structural part somehow

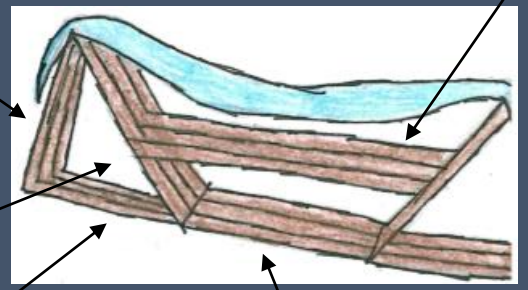






I made a model of one of the development sketches showing how the sliding dovetail joint would work. This joint would be used so that the chair could easily be disassembled by taking out this middle piece of wood between the four legs of the chair. This is crucial as the product being space efficient is one of my specification points

The chair has space to store things which makes it multifunctional, the client said they lacked space so this feature would be an advantage



I designed this chair with three layers so that is would be secure enough, also it needed to be wide enough so that the user could sit on the fabric which is laying over it

Cardboard is a very cost-effective material however it does have some structural disadvantages in comparison to bamboo

However because of the chair is low to the ground this means it could be easily be put under a bed or in the bottom of a wardrobe which makes it space efficient

"Unique design- I like the use of shapes"

The main structure would either be made of cardboard tubes or bamboo poles

Bamboo is a renewable source of material; in fact, the growth of a bamboo plant is helped by being cut/re harvested every 3 years

"Too low for someone my age to use"

Client Feedback:

- *"Idea of a flatpack chair which could be easily folded away and stored when needed sounds good*
- *"Two of these three designs don't have a back rest which I think could prove to be problematic when using the chair for prolonged periods of time"*
- *"Woven bamboo reminds me off a garden style chair however it could work effectively as a desk/longue chair due to its flexible nature"*

Summary:

- If carrying this design further need to investigate the different forms of bamboo and how it can be manufactured in these various forms
- Need to add a back rest for the comfort of the user
- Look at different fabrics and which one to use and how would it be attached in a flatpack way

Section B: Producing a design brief and specification (10 marks)

Introduction to Design Brief and Specification

4.5.2 Section B: Producing a design brief and specification

The student is required to produce a clearly stated and challenging design brief that addresses the context and meets the needs of the intended user(s).

The student should formulate a fully detailed design specification that is informed by their investigations and makes full use of the material collated. Statements in the specification need to be clear and unambiguous. There should be specific references to measurable outcomes as well as qualitative statements. Whatever format is chosen to present the specification it is expected that this will be a live and working document that will be constantly referenced throughout the process.

The specification should also include details on how the student intends to organise their time and activities in order to ensure a successful completion of the process.

It should be noted that it is not expected that the assessment criteria be seen as a linear process and aspects from this, and other assessment criteria, might be present throughout the student's portfolio. Wherever it takes place, it is expected that this work will be rewarded.

Key Points:

- **A Brief which clarifies what you are intending to design and make.**
- **Explains what your product must do / what problem it will solve.**
- **Specification – List of key targets and explain why they are important.**
- **Consider Time Management for project and quantities and cost of materials.**

Mark	Description
9–10	• A comprehensive, clearly stated and challenging design brief resulting from a thorough consideration of investigations undertaken, that fully addresses both the context and the needs and wants of the intended user(s). • The student has produced a comprehensive, detailed and well explained design specification which will fully guide the student's design thinking. • A detailed project management approach to prototype development, including time management and determining quantities and costs of materials, has been fully integrated into the specification.

Section B: Producing a design brief and specification (10 marks)

Pieces of work to evidence:

- **Specification Points –** List of key requirements (15-20)
  Rational behind each requirement – explain why it is important to try and achieve this requirement in your design.
- **Measurable specification points** – how will you measure to see if your design meets these?
- **Time management plan –** List of tasks to complete. Set yourself time scales for each task.
  Tick list.
  Hours or dates.
  Should be a working document – show whether met or not, changes, add ons etc…

Key Points:

- **A Brief which clarifies what you are intending to design and make.**
- **Explains what your product must do / what problem it will solve.**
- **Specification – List of key targets and explain why they are important.**
- **Consider Time Management for project and quantities and cost of materials.**

Section B: Producing a design brief and specification (10 marks)

Design Brief

6, Design Brief (1 or half page) – Summary of what you plan to design and make.

You will now write a few paragraphs explaining to the examiner, what you plan to design and make for this project.

Consider all the important elements you have found out so far:

- What are you designing/making?
- What will it enable your customer to do?
- What does your customer need it to do?
- What does your customer want it to do?
- How will it impact socially?
- How will it impact economically?
- How will it impact environmentally?

Sentence Starters:- Write in future Tense

- Having analysed the context.....
- I am going to design and manufacture.....
- My product will be aimed at .....
- My design will help my customer by....
- In relation to the environment my product will....
- My idea will help my customer socially because....
- My idea will help the economy because...

Project design brief

Aims: To create a safe, portable lightweight light which will light up an area that a child or person can perform acts for example, cook home/housework and organising and more.

Target audience: I believe that I should be help the people in need as they are the people that are suffering where we may take things just for granted. Some countries in Africa and Asia, like Kenya and Nepal are in need for help, especially the children where they have minimal time to study after the sun goes down. Children are vulnerable to many factors and simple light shouldn't be a worry.

Prices: With my product aimed towards the people that are in need for cheap but long-lasting and durable product I need to make my product cheap which allows people to not worry about saving up for a lamp where they can focus their income on needed properties. With all of this in mind, materials, functions and size will become important as I will need ,to save money will make the product cheap. Just like some charities selling a lamp to the public, taking a small amount of the sum so then it can be invested into the children in developing countries.

Environmental impacts: I will create a product that will both be beneficial to the environmental but also help the future as it will help the children educate themselves, helping creating a sustainable future. But also the product shouldn't create harmful emission as it can affect both the user and environment

Size and weight: As I want to create a product that can be portable and easily able to move, both the size and comfort/ability to move it will become an ideal factor. I want to make the product light for the amount light it can emit keeping a low light emission-product weight. In edition, I need to make the size of the product low, so the user can pick up the product and place in anywhere needed.

Appearance: I want to create my product with a sustainable products such as wood as it can be grown again, but being more sustainable I could use man-made board which allows me to save money and use sustainable material, I can paint or varnish my material which can give it a very stylish look, but I want to create a slightly streamline design which means that both the material, colour and size will be important because it can enhance the look.

In conclusion, my product would have to follow certain rules that make it both better for the user and the environment, for example the main aim is that it should help maintain a sustainable future, which can be by using less material or using more sustainable materials like word, then to be catered to a target audience for example being cheap. Also I will look at the environmental impacts such as looking at the material I use and how much pollution it may produce to create it, then looking at the size and weight where I want the size to be heavy enough so it can hold its weight on the floor and it wont topple over when own its own, but light enough so it can be carried to area to area. The size will directly correlate to the weight so the size will just be small enough so it can have all the function on the product and is still usable. Appearance will be the last and perhaps the least important aspect as it the audience shows that the functionality is the most important but for appearance you still must cater towards the audience .

Section B: Producing a design brief and specification (10 marks)

Specification

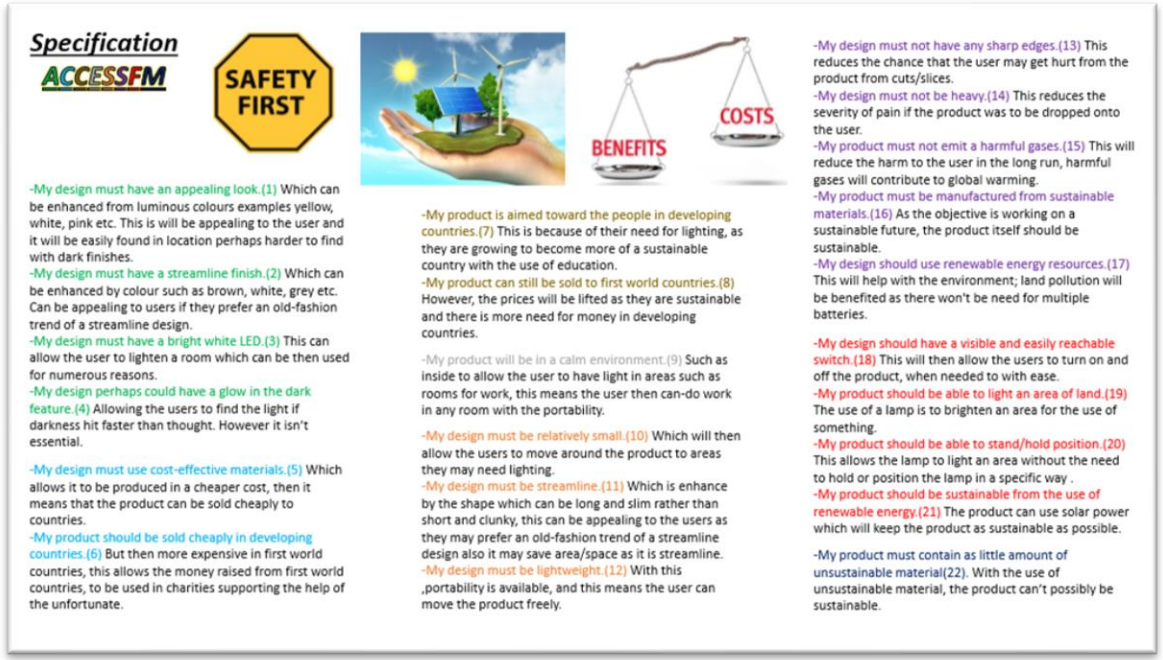
7, Specification (1 page) – List of KEY targets / requirements for the product you are designing.

Use ACCESS FM or a list of similar headings to write your specification. Your targets / requirements should be **SPECIFIC**, **MEASURABLE**, **ACHIEVABLE** and **RELATE TO RESEARCH SO FAR**.

For each heading, write two or three targets. These targets should be your focus when you start designing. E.g If you say… '**My bird feeder must have a removable container to refill the bird seed**', then your design ideas should have removable containers.

Aesthetics – What do you what your product to look like? Styling, colours, theme, finish.
Customer – What does your customer want? What must you include so product meets their needs?
Cost – How much should the product cost to make? How will you reduce cost?
Environment – What features should it have to fit / work in environment? How will you consider sustainability and the environment in its design?
Size – how big or small should it be? Any specific sizes for certain features?
Safety – How will you make it safe to use?
Function – what functions or features are important?
Materials – what materials might suit the product?

ALSO consider – Ergonomics, Inclusive design, Unique selling point, Social Impact.



Section C: Development of Design Proposals (25 marks)

4.5.3 Section C: Development of design proposals

Design proposals should reflect on first concepts and take full account of the design brief and design specification. The aim should be that the development of their design proposal(s) leads to a prototype that can be manufactured by the student given their skills and experience. In developing their proposals the student will be expected to make constant reference to their design brief and design specification, to identify if further investigations are required and to carry these out. Design proposals can be demonstrated through a variety of different media, but whatever methods are chosen, they should be of a high quality befitting this level of qualification and show evidence of analysis and annotation (although these elements are not assessed in this assessment criteria). Modelling is seen as a key element of this assessment criteria, whether this be part modelling, practicing of manufacturing and finishing techniques, the production of scale models or material experimentation. There is also the expectation that students will produce working drawings, plans and patterns to enable successful prototype manufacturing to take place. The use of CAD is encouraged, but this should not be the only form of design communication that is used.

It should be noted that it is not expected that the assessment criteria be seen as a linear process and aspects from this, and other assessment criteria, might be present throughout the student's portfolio. Wherever it takes place, it is expected that this work will be rewarded.

Mark	Description
19–25	• The rationale for design decisions is clearly documented and fully justified with constant reference being made to the design brief, specification and investigations throughout the development of their design proposal. • In the development of innovative design proposals the student will demonstrate clear evidence of originality, creativity and a willingness to take design risks. • Excellent use of a variety of modelling techniques to support ongoing development work throughout. This is supported by the use of drawings, sketches, annotations and notes showing clear evidence of design thinking. • Excellent ongoing development of design proposals, achieved through exploration of and experimentation with different materials, techniques and processes leading to an excellent quality design of a prototype for manufacture. • Comprehensive and fully detailed manufacturing specification produced which makes specific reference to relevant quality control checks and allows fully accurate interpretation by a third party. • Project management for manufacturing allows for further development of design proposals in response to ongoing evaluation, testing and full consideration of contingency planning as prototype development takes place.

Key Points:

- **Development of initial concepts showing originality and creativity.**
- **Design developments work towards meeting the Brief and Specification requirements.**
- **Range of sketches, CAD drawings, modelling, testing ideas.**
- **Client and customer feedback / evaluation of developed ideas.**
- **Further research to support development of a solution.**
- **Detailed plan for manufacture to include – Final Design (Annotated), Part and Assembly drawings, Orthographic (dimensioned drawings), Parts / Materials list, Step by Step plan for manufacture.**

Section C: Development of Design Proposals (25 marks)

Pieces of work to evidence:

- Sketches of ideas.
- Development sketches.
- CAD Drawings.
- Card models.
- Test pieces.
- Compare and evaluate development work against specification points and gain customer feedback. Focus group feedback.
- Further research to inspire solutions.
- Ergonomic and anthropometric data?
- Templates.
- Mockups.
- Final CAD design.
- Exploded drawing.
- Orthographic.

Key Points:

- **Development of initial concepts showing originality and creativity.**
- **Design developments work towards meeting the Brief and Specification requirements.**
- **Range of sketches, CAD drawings, modelling, testing ideas.**
- **Client and customer feedback / evaluation of developed ideas.**
- **Further research to support development of a solution.**
- **Detailed plan for manufacture to include – Final Design (Annotated), Part and Assembly drawings, Orthographic (dimensioned drawings), Parts / Materials list, Step by Step plan for manufacture.**

Example Design Ideas Work

Key Points:

- **Range of creative and original concept ideas that look at solving the problem you have identified.**
- **Ideas meet customer needs and wants and specification points.**
- **Analysed against the specification points.**
- **Feedback from customer / client.**
- **Annotated to help explain your idea.**
- **Neatly drawn and presented**

Initial design ideas

My fourth design combines two of the main points on my specification: sustainability and space efficiency

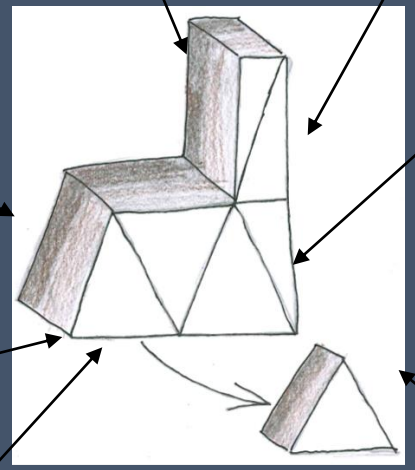
4

"I like the idea behind of an 100% cardboard chair"

This chair is made of several individual hollow cardboard 3D rectangular based triangular prisms

Each of the hollow parts will have thick sides to ensure the chair can withstand the weight of the user safety

This design has again been made from some form of cardboard for its sustainable property advantages as well as how cost effective it is



The triangle shape was deliberately used as it is one of the strongest shapes and I want the chair to be stable

Aesthetics wise cardboard is not very good, but this material can be used with a variety of finishes which could enhance its physical properties as well as make it look better

The main problem with the design is the fact that it is quite bulky so would take up a lot of space which is the opposite of what my client wanted as they wanted a space efficient chair

"Looks quite bulky and large- would not work very well in a small space"

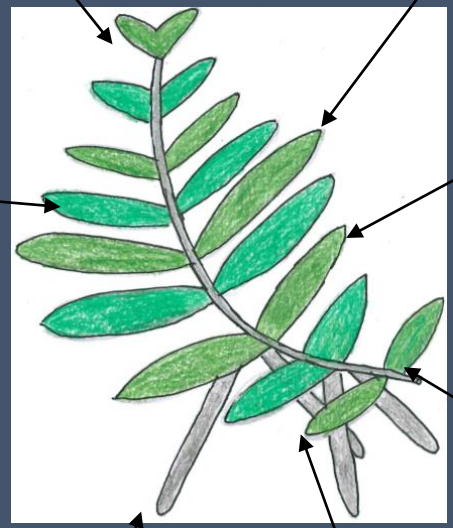
Because the design is multifunctional this could be it also being space efficient as it is essential being a chair as well as a space for storage

My fifth design is more of a feature piece of furniture in which I thought about form over function.

This chair design is very original and incorporates nature. I took inspirational from nature as my client expressed an interest in the natural environment from his vegetarian lifestyle and emphasis on sustainability

5

The "leaves" act as the back and seat of the chair, they can be bent out (as shown in the drawing) and they can be closed- good for when chair isn't in use. The "leaves" are also detachable so that it can be even more space efficient



The leaves would be made from a thick fabric with a metal back to reinforce it. I would use metal as the rest of the design uses metal so it would all tie in together. This fabric would make the chair very comfortable to sit on which is very important

The leaves are smaller nearer the top as that is where the users head will be. And larger in the middle where the persons torso and arms are.

The structural soundness of this design is questionable as the beam down the middle of the chair is the only real support. I designed the beam to be quite thin as I thought it could be uncomfortable on the users back. However using a beam this thin could compromise the stability of the chair

The decision to change the sizes of the leaves was somewhat an aesthetic one and to ensure that materials were not wasted

The legs will be made of metal, probably stainless steel as it is strong, readily available and cost effective compared to other metals. It can also be bent which would be necessary in this design

"Very different in terms of shape to what I would think of a typical chair"

Initial design ideas

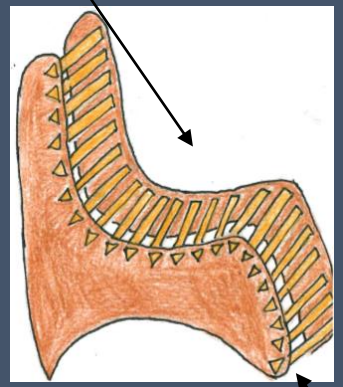
6

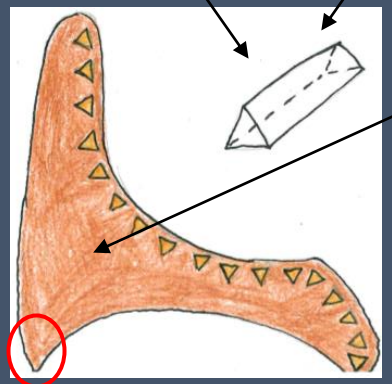
My sixth design focuses heavily on the sustainable element of my design specification hence it is constructed entirely of cardboard

The overall shape of the chair is curved to accommodate to the shape of the human body- makes it ergonomic and therefore very comfortable

If necessary, for space reasons, you could take apart the chair completely by taking out all the elongated prisms, but this would take a rather long time to do and therefore not be time effective

Overall this chair should be very stable; the use of solid elongated prisms should give a lot of support for the user's weight.





However the back legs have a very small surface area that is in contact with the force raising a safety issue of if the legs would break under the force of the user's weight

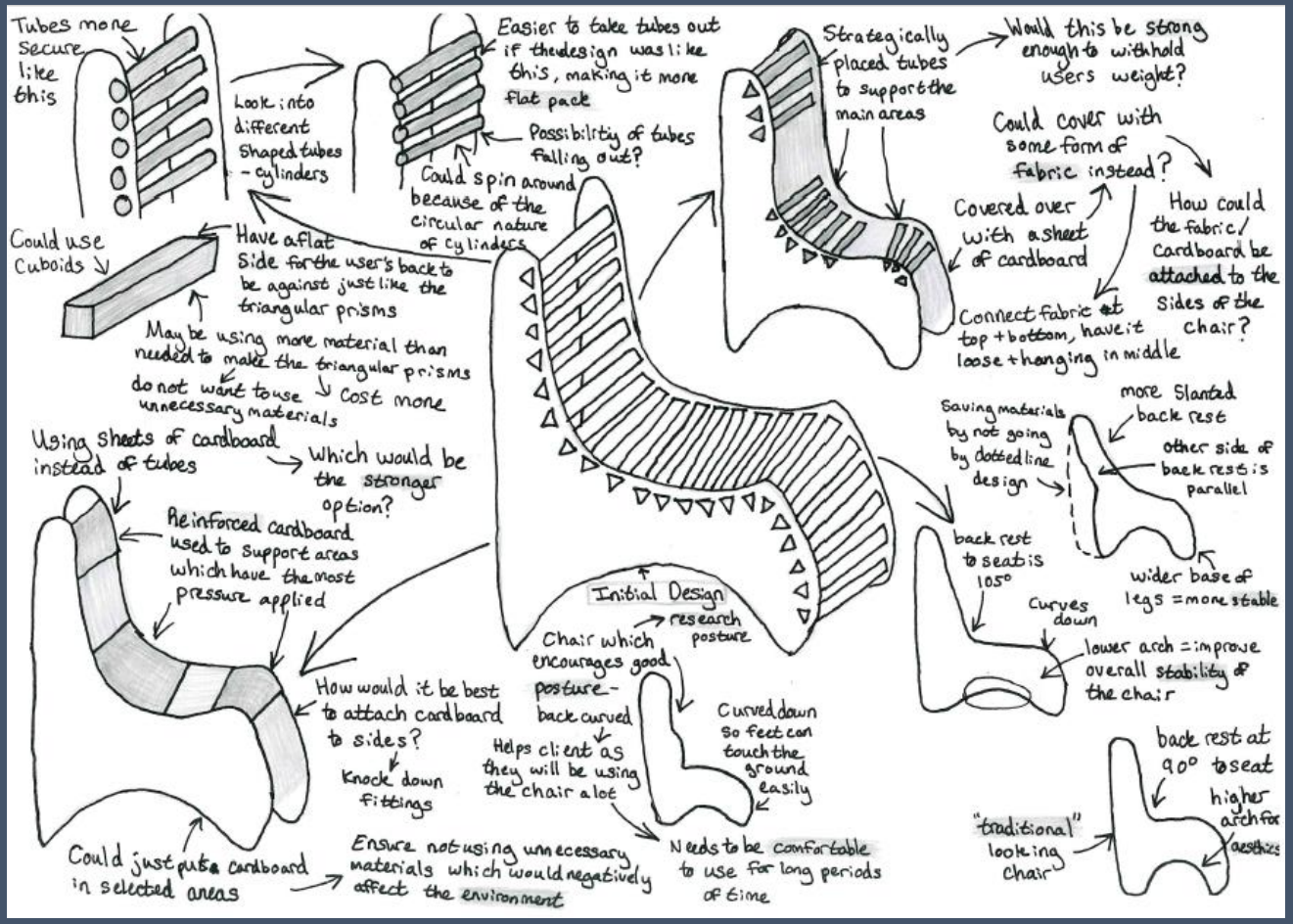
Cardboard is not one of the most aesthetically pleasing materials. However this was not one of the main aims on my design specification.

The main reason I chose this material was because it is 100% recyclable and sustainability is a big part of my specification. It is also a readily available material which doesn't use up any finite resources

This design is completely made of some type of reinforced cardboard. It consists of several solid elongated triangular prisms and two identical side pieces

"Ergonomic design looks very comfortable"

It is a rather cheap material compared to materials which are commonly used in the construction of chairs



Client Feedback:

- *" I like the idea of using fabric with the cardboard to make the chair more comfortable"*
- *"The possibility of using cardboard is very interesting, would make the chair unique"*
- *"Thinking about posture is important to me as I would ideally like to use this chair for prolonged periods of time as both a desk chair and a longue chair"*

Summary:

- Improved stability of chair with lower arch as well as more rounded legs
- Started to think more about the ergonomics; need to do research into posture
- Need to investigate the use of some form of tubes for the middle section

Initial design ideas

My seventh design focuses on sustainability, ergonomics and aesthetics.

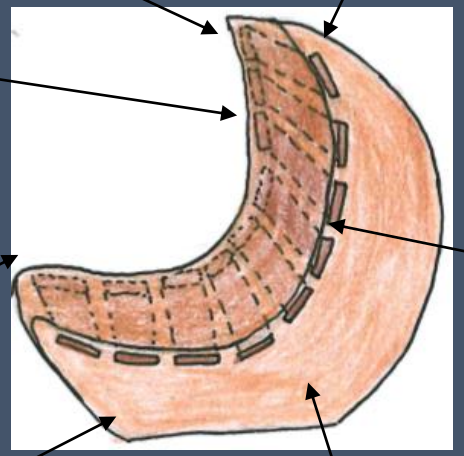
7

As this design would be made with cardboard, which is not a very aesthetically pleasing material, I decided it would be important to look at how to make it pleasing to the eye despite this

A curved arch back has been used to ensure maximum comfort for the user

Therefore I made the decision to have a singular piece of cardboard where the users back will be reinforced by elongated rectangular tubes

The curved back side of the chair mirrors the curved back rest which adds aesthetics



The end of the chair is curved so that the user's legs are comfortable it has been raised slightly and this is mostly for aesthetics reasons

Because the elongated rectangular tubes are only being used for structural purposes, I decided to have them horizontal rather than vertical as the weight they are having to carry is going to be pulling horizontally

The part of the chair which meets the floor is flat ensuring that the chair will be stable and not fall over

Cardboard is a relatively affordable material; however it could prove difficult to make the cardboard arch like the design of the back-rest displays

The whole of the middle part of the chair will have a curved arch of cardboard around it. This could be a possible waste of material, but I believe it is important for ensuring stability of the chair as well as aesthetic reasons

"I Like the curved design looks like it could be developed to be very ergonomic and have a unique appearance"

My eighth design focuses on ergonomics as well as space efficiency

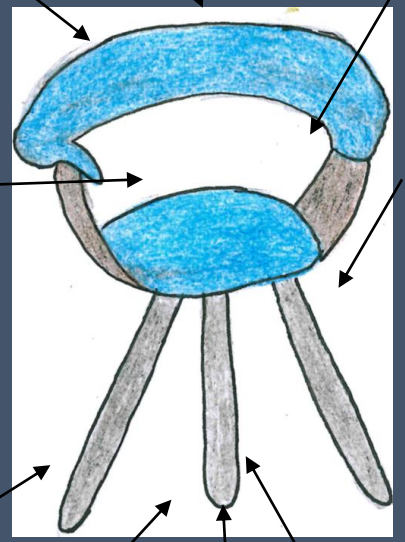
8

The curved back will make the chair more ergonomic and therefore comfy able for the user which fulfils the function specification point

I used two contrasting colours, black ad blue, this colours are quite bold and make the chair a stand out piece

The shape of the arms have been made with ergonomics in mind so that the chair is as comfortable as possible, fulfilling its main purpose of comfort

The gap in the back of the chair means that less material is being used so it is more cost effective



Could be an issue with the sizing and proportions of the chair as traditionally a bar stool chair has very elongated legs to compensate for the height of the bar

It can also be seen as a modern feature which would appeal to my younger target market aesthetics wise

This would probably not be suitable for my clinet as when I interviewed them, they said they would be using the chair at a desk or just to sit on so longer legs would be a disadvantage

The legs would be made from some type of hardwood, could make the legs hollow to ensure they are not too heavy

Bottom of the legs are curved, could be an issue with the stability of the chair? Will it be able to hold the users weight effectively?

The legs are detachable- good for making it more space efficient which was one of the specification points

Three legs was chosen for aesthetic reasons, as the seat is circular I felt it looked better with three angled legs

Legs are angled which adds stability to the chair

Initial design ideas

My ninth design focuses on the multifunctional feature as this was a feature which was desirable from my target market questionnaire as well as my client interview

The idea to have the structural support going above the seat of the chair was so that it could be used as an arm rest. However when the chair is used as a bed/multiple seats this structure seems to be in the way

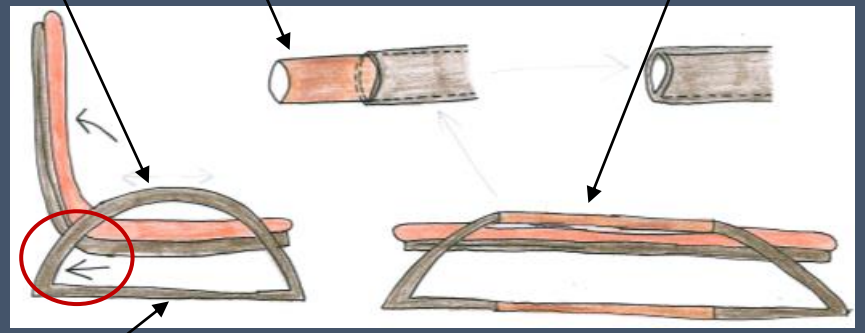
The inner tubes will be bent around the sides of the semi-circular structure when it is a chair and then pulled out and straightened when it is made into a bed

9

"Chair would have to be quite big to also be a bed; this idea might not work practically"

The orange back and seating part of the chair would be made of some type of fabric so that it is like the fabric used on swinging hammock. I designed it to be thicker than it would be on an average chair because it will be used as a bed as well and I want maximum comfort or the user

Ideally, I want the back of the chair (behind the fabric) to be made from wood as well as the semi-circular structural frame



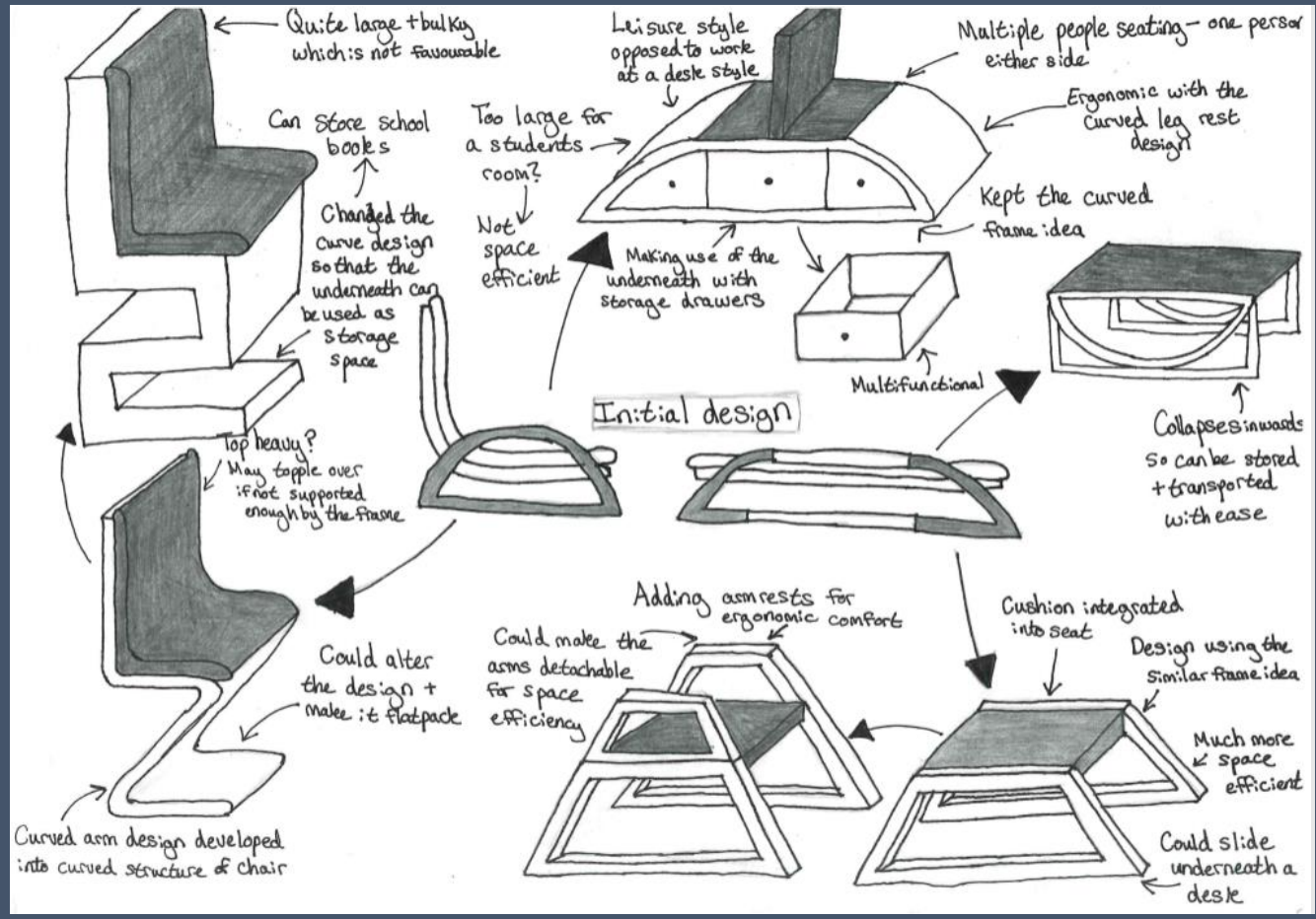
This design requires using a material which can be in pipe form and can bend with ease. I will need to research what material would be best for this as well as being strong and hardwearing. I believe hardwearing would be an important quality as the material would encounter the inner tube very frequency. Even though the pipes will be hollow I need them to be strong.

This could be an issue because the design requires the wood to bend out

"I like the multifunctional feature"

It is easy to turn the chair into a bed as the semi-circular shaped frame extends out and what was the back rest of the chair lays out

This chair is also a bed/seating for multiple people hence making it multifunctional

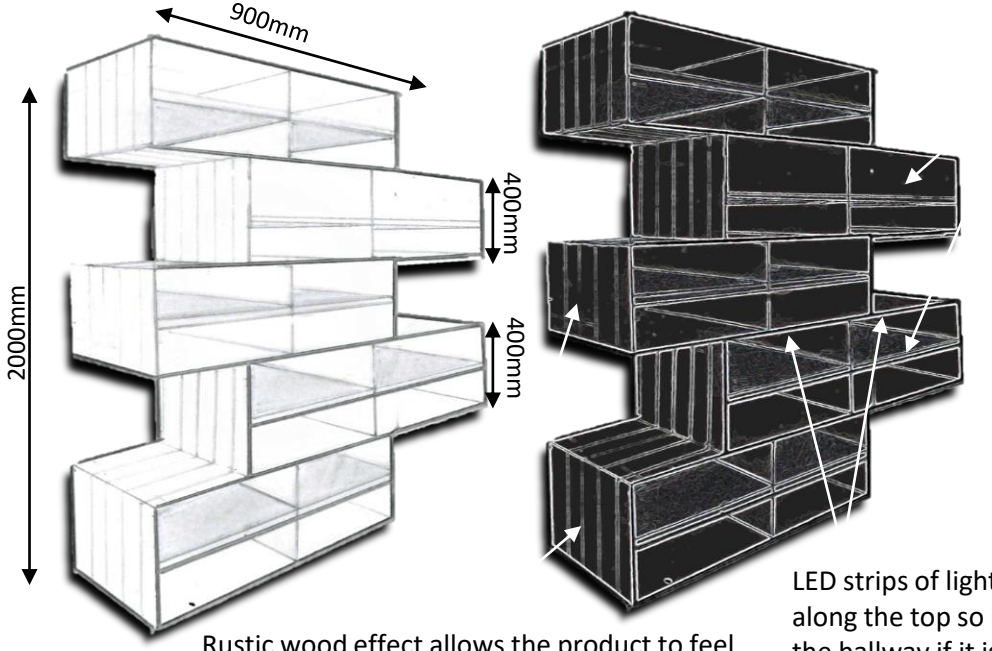


Summary:

- Storage options are a good idea
- Smaller, more space efficient designs are favourable over the bulky larger style chairs
- Curved designs or different shapes to make the chair interesting aesthetics wise

Client Feedback:

- *"I like the idea of having the chair be multifunctional in terms of also being able to store objects such as my schoolwork"*
- *"The stool like chairs which could be easily stored under the desk or my bed also look very simple and comfortable"*
- *"The larger chair which multiple people could use at once looks much more like a leisure style chair instead of a use at a desk type chair. I am looking for a chair which can do both but primarily for use at a desk"*

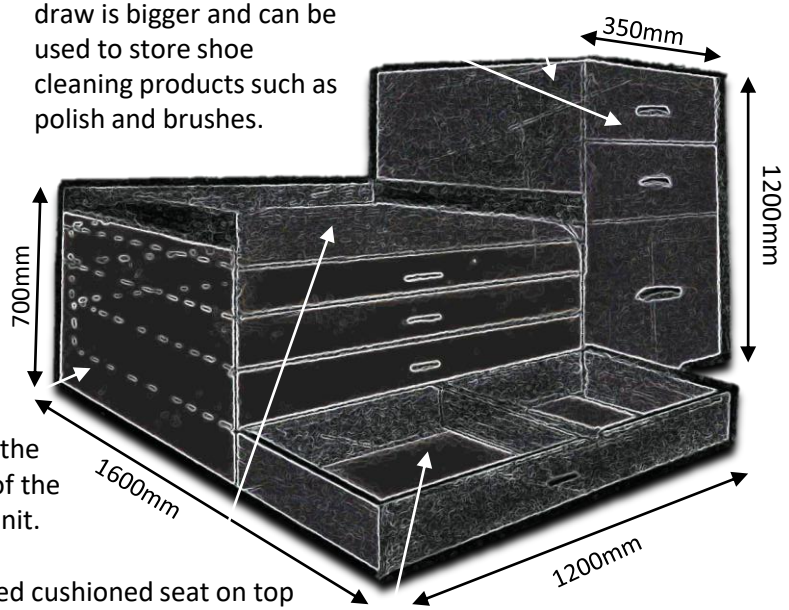


Shoes placed on shelves – roughly three pairs on each shelf. Also shoes are to be placed below each shelf .

Rows can be detached in order to fir all households off due to each row being on sliders. Furthermore for portable reasons such as moving house or selling the product on, then each box is detachable and can be reassembled easily as they all slot within each other rather than using permanent fixings.

Draws for everyday items such as car keys, bottom draw is bigger and can be used to store shoe cleaning products such as polish and brushes.

Made of a dark wood – mahogany or a veneer in order to reduce the cost.



Rustic wood effect allows the product to feel natural within many environments- the lines give off the effect of planks of wood along the side of the product.

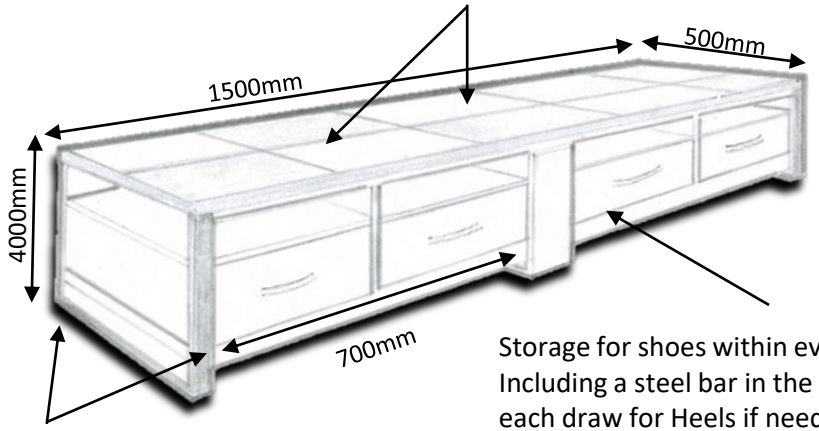
LED strips of lighting within each box along the top so if the lights are off in the hallway if it is late at night then you are able to still see where you are putting your shoes clearly.

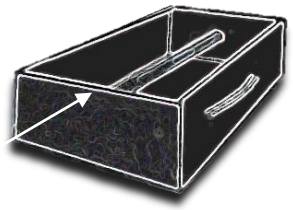
Dotted lines show the depth and height of the draws within the unit.

Curved cushioned seat on top for comfort for the user when sitting down putting their shoes on.

Space for multiple shoes, possibly put a bar in the middle of each draw for shoes to hang off such as heels in order to increase to the demographic.

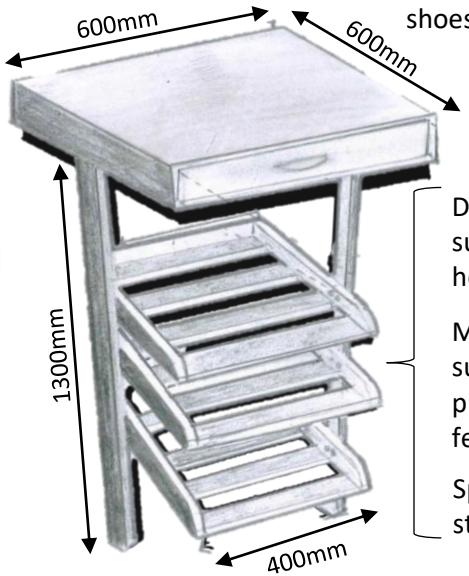
Seating on top, either acrylic squares on top for modern effect or wooden plates on top for a more traditional or rustic approach.





Steel bars along the side to support the weight of the unit with all the shoes in.

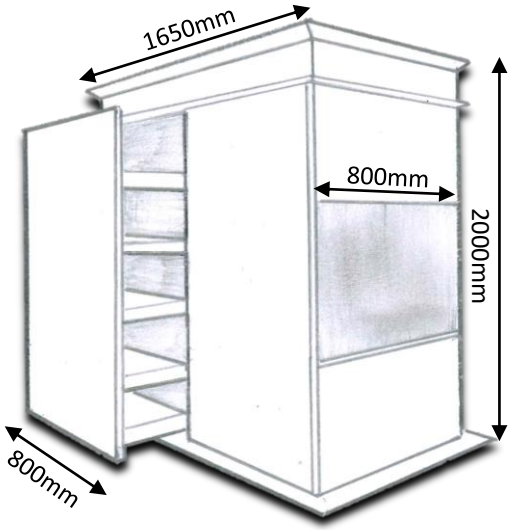
Storage for shoes within every draw. Including a steel bar in the middle of each draw for Heels if need be, this can be removed a it is simply attached through threading.

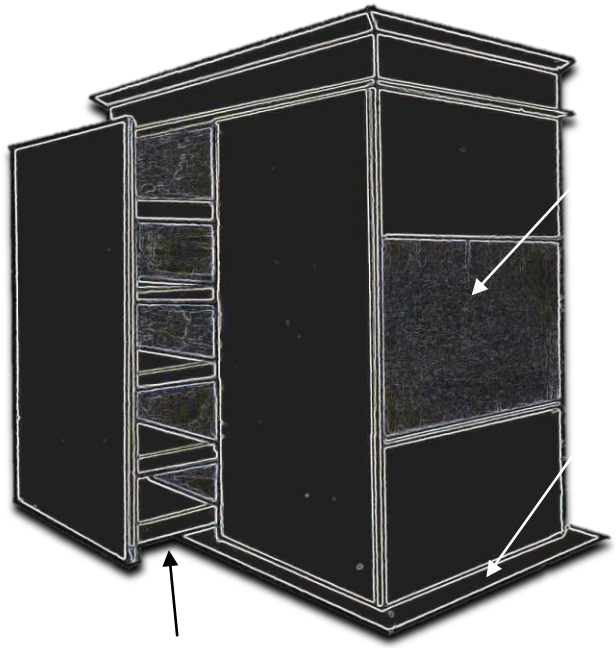


Draw on top to place everyday items one may place in a hallway such as keys, the purchaser may choose to keep shoe products in here to fit within the purpose of the unit.

Made out of hardwood preferably oak or mahogany to fit in the surroundings of the clients home and hallway where is it likely to be placed. Furthermore these woods would give the product a quality feel.

Space for a lot of shoes due to three levels, due to depth of storage space all shoe sizes can fit.

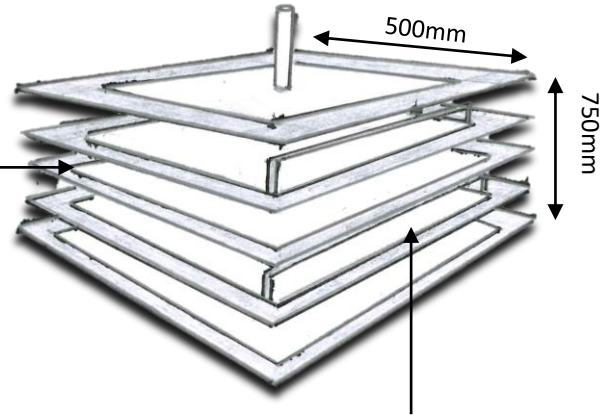




Foldable seat on side so that it can fit flush with the side of the unit and then therefore can fit against spaces which it may not of been able to if the seat wans't able to fold up. It will be made out of a strong wood such as oak, or using a man made board such as plywood to hold the weight of a person, carrying this design forward the support for the seat ,may have to be looked at and developed further.

Ensuring that there is the biggest possible surface area of material touching the floor for balance and stability whilst still keeping it aesthetically pleasing.

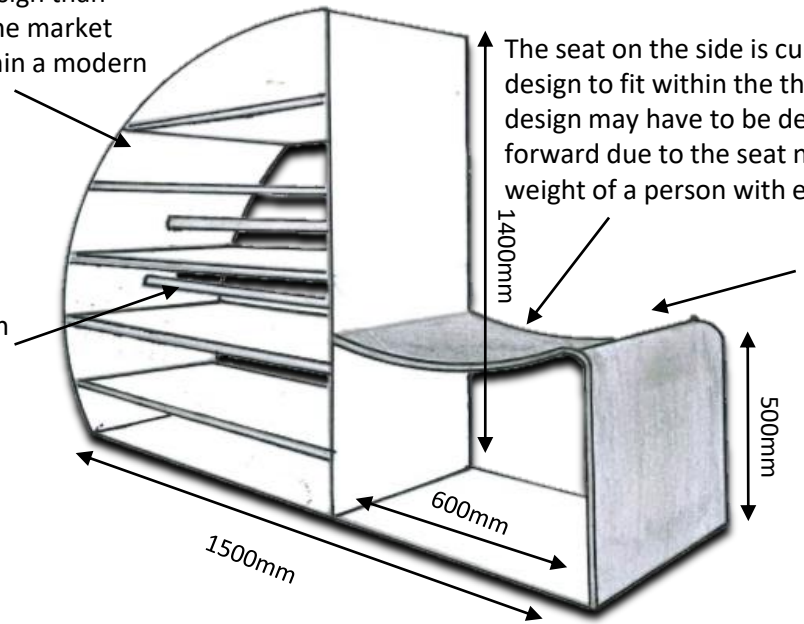
Rows can be detached in order to for all households off due to each row being on sliders. Furthermore for portable reasons such as moving house or selling the product on, then each box is detachable and can be reassembled easily as they all slot within each other rather than using permanent fixings.



The bars on the sides are for heels so they can hang over the edge which can create more space for other shoes on the shelves – efficient storage.

Curved Features for aesthetics to steer away from the square perpendicualar features on the other designs. Furthermore it it a more unique design than many others on the market and would fit within a modern household.

Lots of room for shoe storage, having them enclosed within the unit will also allow them to stay in better condition.



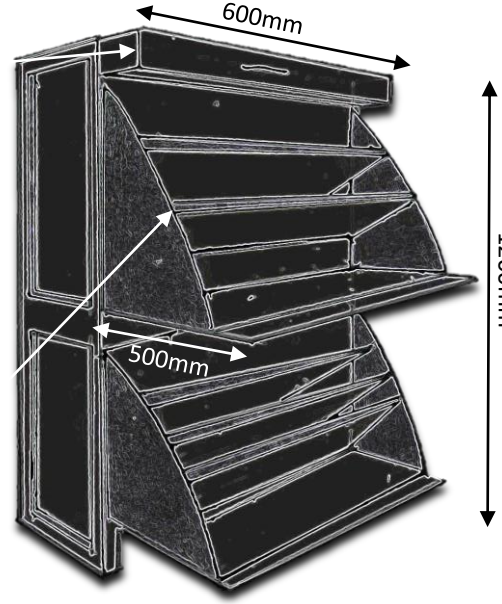
The seat on the side is curved in order to for the design to fit within the theme of the product, this design may have to be developed if carried forward due to the seat needing to hold the weight of a person with ease.

The seat would be made out of plywood as this is strong, it also keeps the cost down, the outside curve on the other side of the product will be made out of acrylic and laminated plywood or alternatively flexi ply.

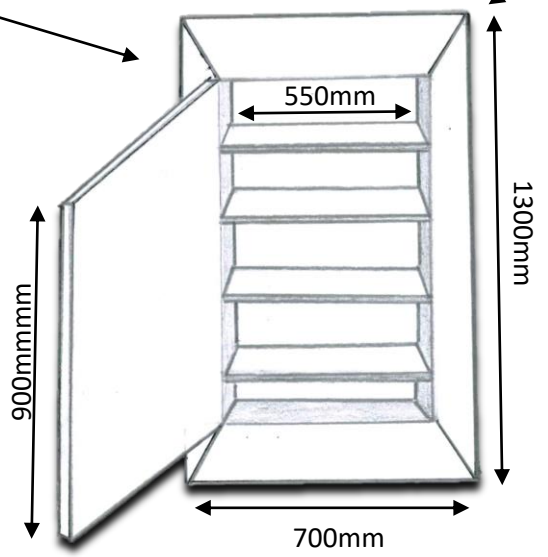
Poles in the middle of some of the shelves, this is for heels to be hung over so that they can sit at an angle which allows for more efficient storage as the shelf below still being used for flat soled shoes.

Draw on top to place everyday items one may place in a hallway such as keys, the purchaser may choose to keep shoe products in here to fit within the purpose of the unit.

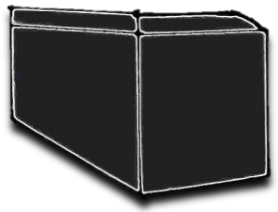
The shelves are opened by a handle on the outside which reveals the shoes inside and the storage space for the shoes - the shelving is at a slight angle so that it is easier for the user to pick up the shoes from the back by the inside heel which is ergonomically efficient and reduces stress/strain on the user. The predict will be made out of a combination of both pine and plywood.



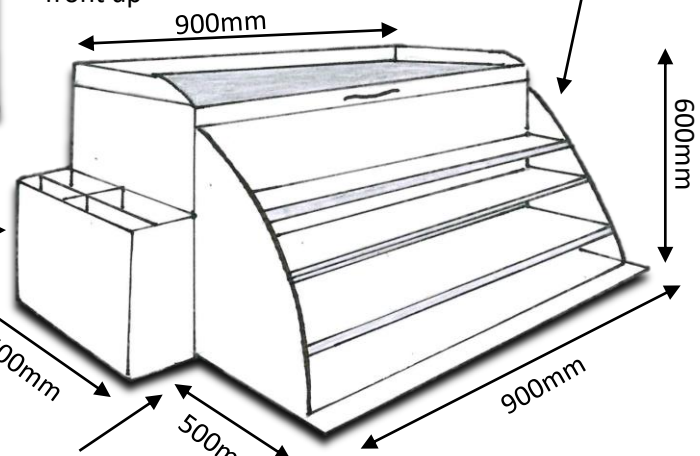
This product ahs been designed to hang on a wall with fixings on the back. It is best suited for family's with limited floor space. The product is likely to be made out of plywood to save weight and costs, there will also be LED strip lighting in the inside walls that will be turned on via the opening of the products door with a contact switch.



Rows can be detached in order to fit all types of shoes which 9the demographic I can be sold too and adds flexibility to the product. Furthermore for portable reasons such as moving house or selling the product on, it is flat packed and easily assembled via screws and fitting included within the packaging.



This is one of my favourite designs and is one that I am looking to carry forward through my design process. The front opens up and reveals the space for the shoes to be stored, these shelves are at a slight angle so that they don't fall out of place if there is a greater force applied when the user opens the front up



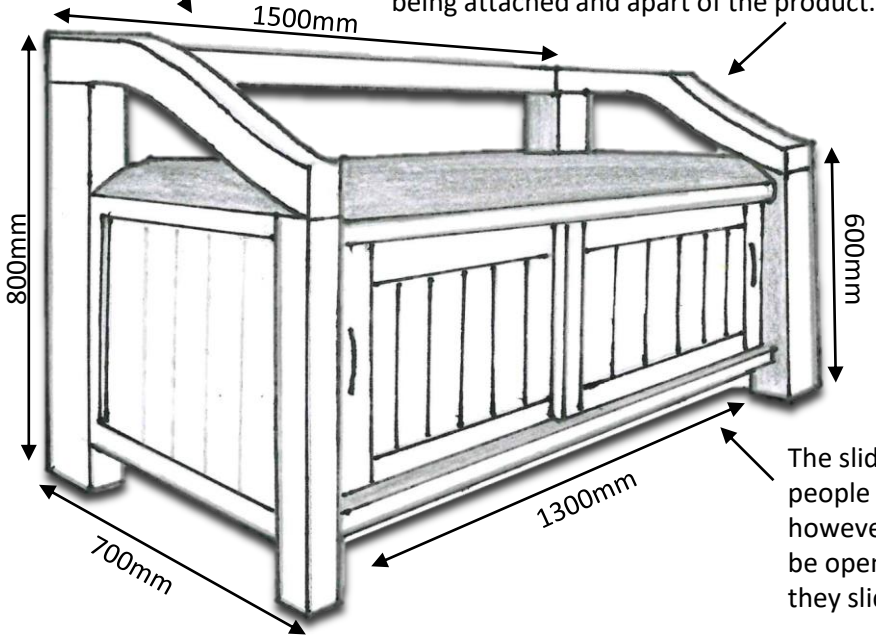
The product to the right has storage on the side for umbrellas or anything u may want to store such as shoe cleaning kits or even keys, however there is a draw just below the seat, this may be a more suitable place for keys and smaller shoes to be stored. The seat on top is ideal for the user when they want to put their shoes on and is the correct height in accordance to the anthropometric research that was previously carried out.

The outside frame will be made out of 10x10mm pine and will be assembled using dowel joints.

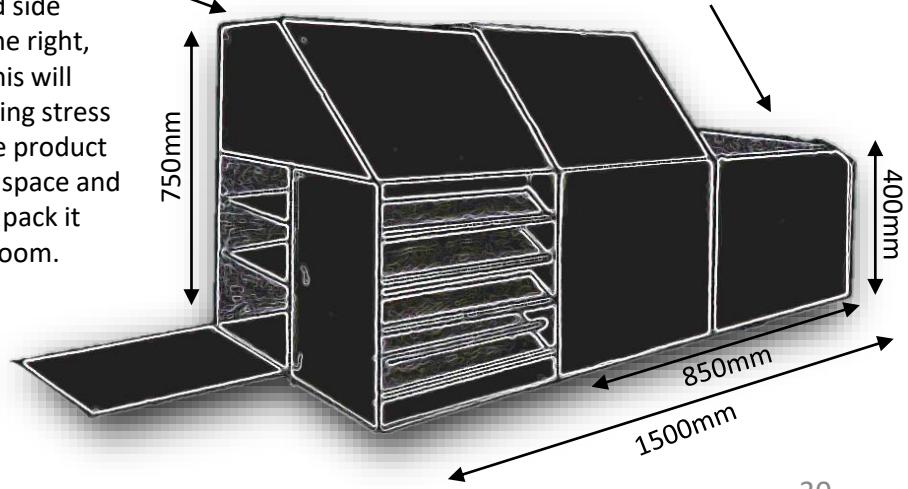
This product is influenced from an outside bench, it takes a similar to form but has features which make it unique and for interior use. This includes the leather seat on top which will be upholstered and stapled underneath a frame so create the look of the seat and cushion fully being attached and apart of the product.

The unit is a good size that fits within the initial specification and the clients set requirements.

The unit also has a seta here for practicality as It means the user has somewhere to sit when putting their shoes on, this will most probably be made out of a natural wood rather than a man made board to ensure the product is a good quality.



The product to the right is very inventive, the end section that is on show with the racks and side storage slides into the adjoining part to the right, this is done via runners on the bottom. This will make it easy for the user to slide in reducing stress strain due to its ergonomic efficiency. The product isn't only ergonomically efficient but also space and practicality efficient due to being able to pack it away into a smaller space taking up less room.



The sliding doors at the front mean that people can access their shoes easily , however one limitation is that they cant bot be open completely at the same time as they slide in front/behind each other.

Examples of Development Work

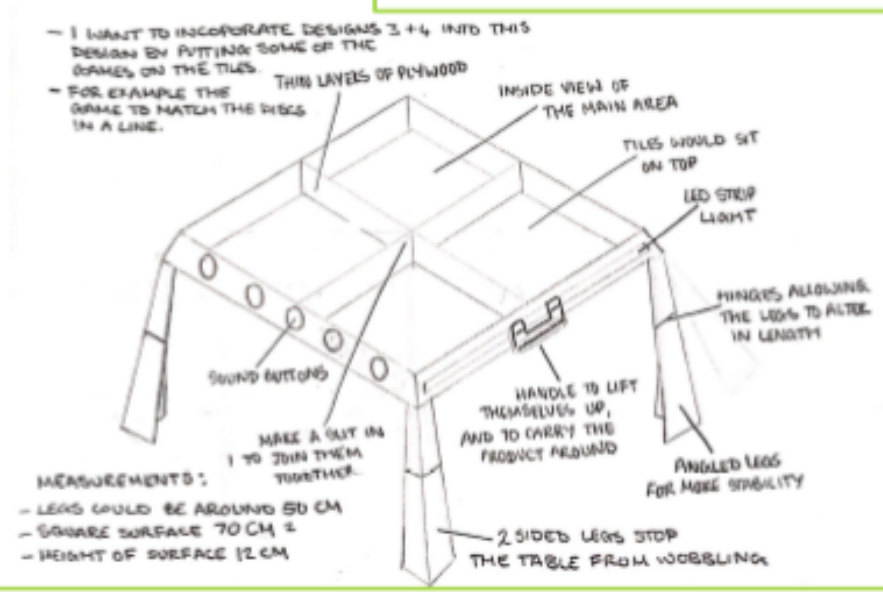
Key Points:

- **Development of favourite design concepts. Improvement and changes.**
- **Experimentation with ideas.**
- **Testing concepts – how / do they work?**
- **Modelling concepts – Size, scale, comfort, safety, functionality.**
- **Feedback from customer / client.**
- **Annotated to help explain your developed / tested idea.**
- **Hand sketches, CAD drawings, Card models, Clay models, Foam Models, Test samples or materials.**

DEVELOPMENT OF DESIGN 5:

Development:
Along the sides of the tables I have included buzzers as it is a simple way to include another sensory element into the design. Sound is such an important component and the buzzers will help distinguish between different sounds.

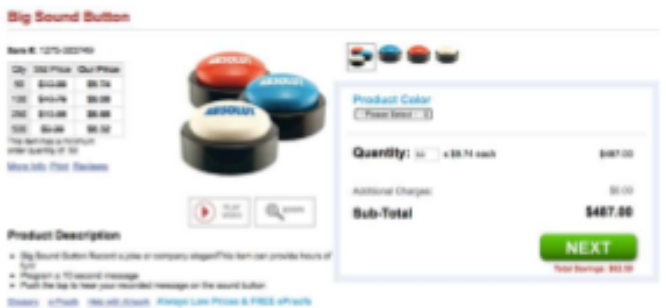
Design Choice:
After showing and explaining all my designs to my client which is evident in in the client feedback I chose to continue further with design 5. This is because it was the most interesting to the client and the one they thought would be the most unique and fun to play with.
It covered most of the spec points other then 3 and 5 because the design can be adapted to fit the criteria.



Development:
Some alterations I have made to the design include changing the angle of the legs this is because the user didn't like how unstable the product would be because, if a child leans on the frame, the table to get pulled over.
The handles will allow the children to hold them selves up and they can also be used to transport the table and move it around. These handles could be pre made bought components or the metal lathe could be used.

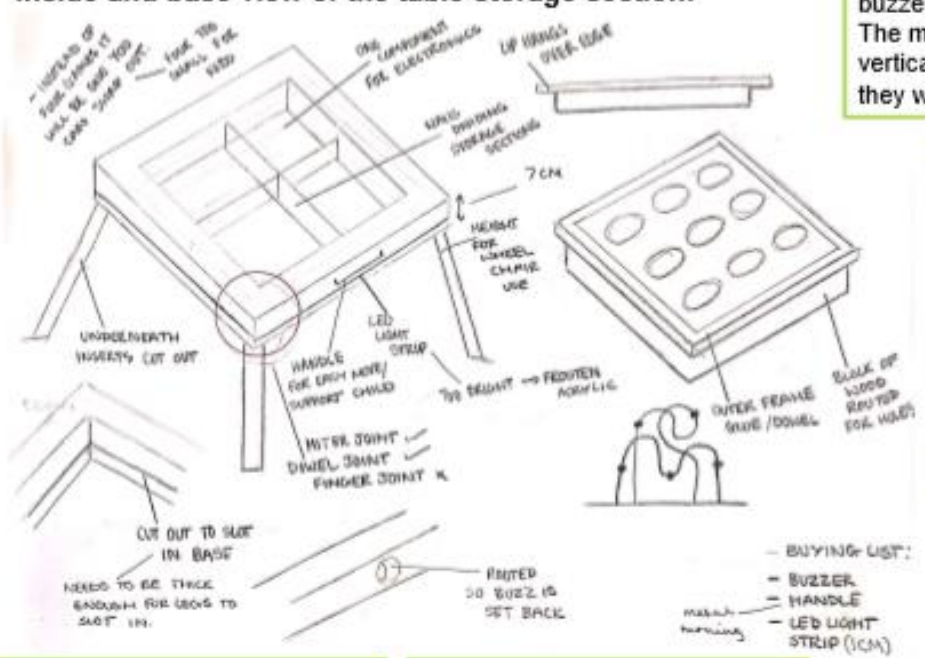
NEXT STEP...
FURTHER DEVELOPMENT INTO THE LEGS AND HOW THEY CAN BE CREATED AS WELL AS THE SHAPE AND MANUFACTURING PROCESS.

Noise Buttons:
To target the hearing senses I wanted to include some buttons which produce recorded sounds. I need to to further research into the type of sounds which are stimulating for children to hear. I have thought about animal noises, as well as buzzers.
When researching different types of buttons there are pre manufactured ones and also ones you can make yourself. I would want the buttons to be bright and bold so they stand out. They also need to be large enough so they are easy to press for the children. I will also need to take into account the force needed to press the button. The children don't have much strength but it also needs to be challenging for them.



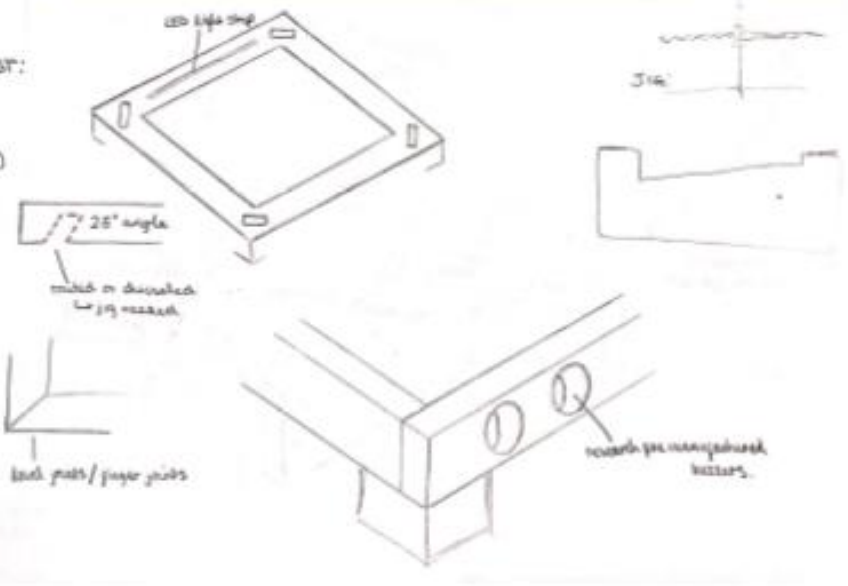
DESIGN DEVELOPMENT– LEGS AND TOY SURFACE

Inside and base view of the table storage section:



Updates and Adaptations:
When first creating the product or design I struggled with creating the legs so this is the first part of the product I started to adapt. On the previous slide I have a sketch of a new version of the table with added features, including the buzzers and handle.
The main issue with the legs was that they were going straight down vertically. The main issue with this is that the table is far less stable then if they were to angle outwards, making a wider and larger base.

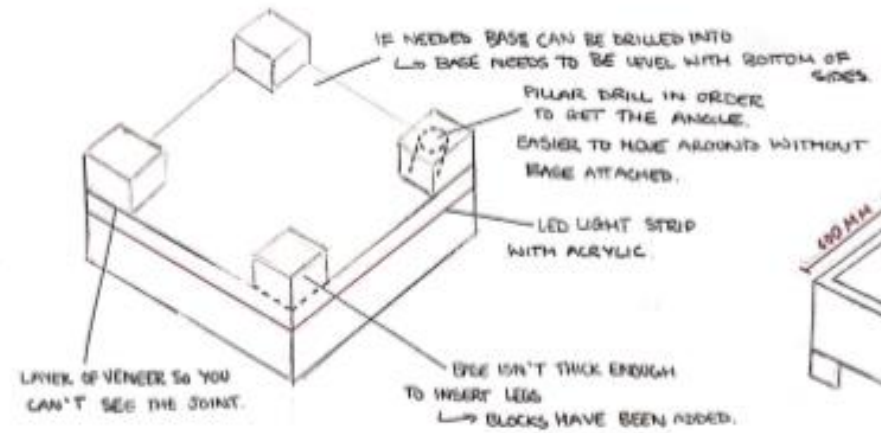
Removable legs:
When talking to the client their main concern was that the product wasn't going to be very mobile which is an important asset in this product. So I have decided to adapt the legs to be removable but this caused some issues as the base would need to be think enough for them to slot into. I started by look at using a rectangle ended piece of wood which would slot in at an angle so the table would be stable. The main aspect I have learnt from this development is that the base must be level with the sides and can't be higher up. Further development needs to be done into creating the legs.

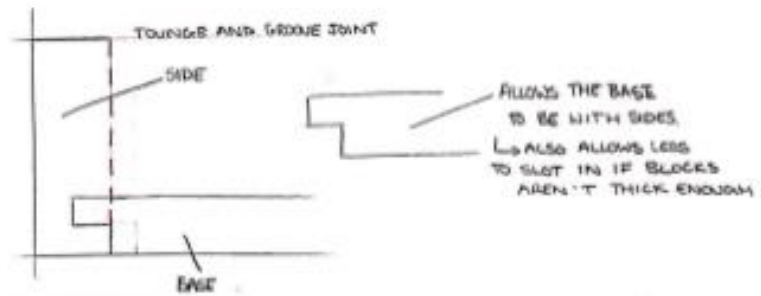


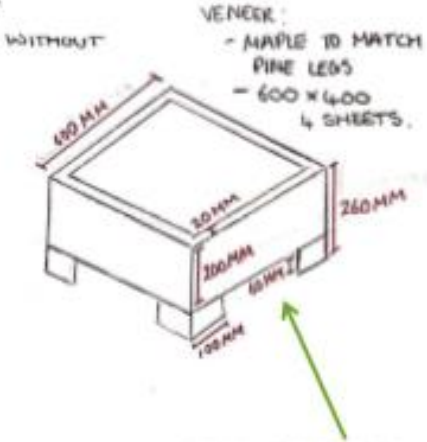
Adaptations:
One of the main functions for the table is to be a storage unit as well as a toy. When I first designed the table storage it was just one open section with tiles that slot on top to make the lid. But I have changed it to four compartments separated with two strips of wood which slot together. This makes it more orangised and stops everything getting mixed together.

The next step is to speak to my client as I the purpose of the removable table top is to access the storage as well as being able to interchange the the game tiles. I want to talk to the client and see if they want 4 tiles which make up the table or just one. This is simplify the design if I was to make it 1 large tile as I wouldn't have to thinking about slotting the tiles together and making sure they fit.

MODELING FOR LEG BLOCKS







DIMENSIONS

I needed to start thinking about how I am going to make these blocks for the legs to slot into. At first I believes I could just drill a hole though the blocks on the pillar drill but that means I wouldn't be able to create the angle I would want for the legs.
As I started to think of ways to create these blocks I worked out that they would need to be in two sections or I would need a pillar drill which could change the angle the drill bit goes down.

If I was to cut the block in half I could then chisel out the central section. First I would use the tenon saw to separate the center from the sides in order to chisel it out. To work out the measurements I am going to make a model out of blue foam it is easy to break apart and shape so I can make a life size model. This will allow me to test the leg with it and see if it fits and work. This will also show me the angle the leg would be at when attached to the table. I will then be able to adapt my design depending on what I want.
The outcome shows that I want a 5 degree angle for the legs in order for the table to be stable.

Introduction – this slide shows the two ideas I decided to create prototypes of, from sketches and simple CAD designs to prototypes displaying the assembly.

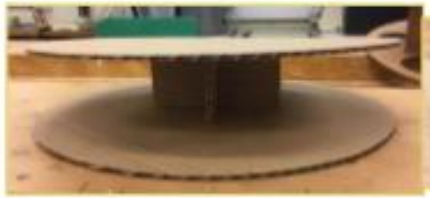
PROTOTYPING IDEAS 1 AND 4.

IDEA 1.

Sketch of idea 1.

CAD : I developed this idea to show a better representation of how the bottles would fit into the holes, and the whole design assembly.

Top: this was a to scale prototype of design 1, I completed this quickly to see how the bottles would fit together in the holes designed, I also did it to observe whether the number of bottles wasn't too large. The two layers were fitted together using a glue gun with slots of cardboard in a T shape to add to the stability of the fixture. I prototyped this as I had no idea how big it would be, from this I realised it would be too big so I chose to move away from this idea, as making it smaller would cause the bottles to be cluttered and only a few of them could be used.



Bottom: the base is the size of the middle of the circle at the top this was done to create an angled side of the cylinder shape. The cardboard slots in the middle are crossed over each other with slots in the middle, to add stability and space between the two pieces.

IDEA 4.

Sketch of idea 4.

Firstly when the prototype was pieced together, unexpectedly the hole at the top for the bottle did not fit, the hole was around 5mm too small. So to fit the bottle, I placed the assembled prototype into the laser cutter and used it to create a larger hole but calculating the maximum value of the X-axis and Y-axis.

Once the top was resized I was able to place in the lamp in where it was designed to go, from this we came across the issue that using a halogen lightbulb the wine bottle would have to be at least 200mm away due to warming up and heating the bottle. However we found a solution, if we use a LED bulb the distance wont have to be that large due to the LED lights not heating up. Another issue which needs to be resolved, is the lack of exit for the wires for the light.

Conclusion - from prototyping these two ideas I have come to the conclusion that I now need to find a way of fitting the light in a place where I will have an exit for the wires. I have also decided that idea 4 is going to be the final design I will use.

Introduction – here I will present all the sketches and initial ideas for a stand. As well some quick research for the different existing stands for lamps.

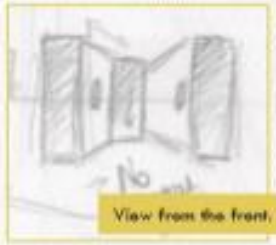
TRIPOD IDEAS AND PROTOTYPING.

TRIPOD – IDEA 1

I prototyped this idea from some scrap wood, I produced a slotting mechanism from two separate pieces. The top component had a 10mm gap in which the inner side sloped down to create the angle at which the bottom component will divert from the 90 degree angle. The bottom part of the leg has a slope at either side of the 10mm puzzle like piece, which ensures the angle at which the leg will fold out from the centre point.

View from the top.

View from the side.



View from the front.

TRIPOD – OTHER EXISTING IDEAS FOR TRIPOD LIGHTS

Different existing tripod light stands.

I looked closely at the designs which are focused on the idea of a tripod. I looked at a variety of different ideas for tripods, however I decided to pick the few interesting ones which I could use to come up with my own ideas for a tripod stand for my lamp.

TRIPOD – CAD DEVELOPMENT OF IDEA 1

Rendering of idea 1.

Final rendering.

I created a rendering of the first idea on SW, I used the prototype leg to come up with the right measurements in order to replicate this. The overall length of the tripod was 725mm without the light. I then changed the length of the top component of the tripod by reducing it by 10mm.

TRIPOD – PROTOTYPE IDEA 1

The shortest leg prototype.

The slotting mechanism.

Angle of the two joined components.

Idea for another joint mechanism.

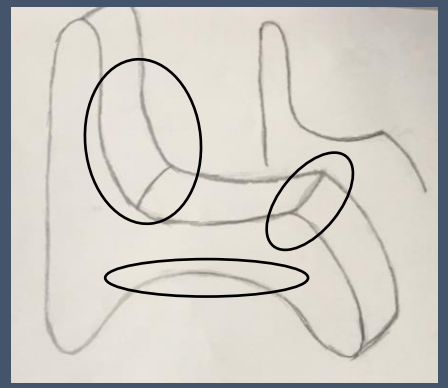
The puzzle piece on the bottom component.

The side view and top view of the top component.

Conclusion – as I am not completely satisfied with this design because it will not meet the spec point A4, which requires a sufficient combination of wood and steel to keep a modernist approach. I will need to come up with another idea and create a prototype compare and make a choice.

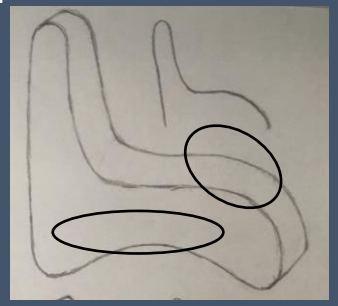
chair

After all my research I decided to come back to my design and develop it considering the information I have learnt in terms of ergonomic design and posture.

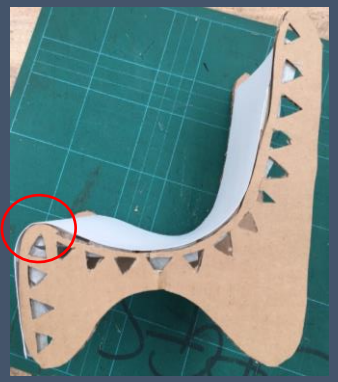


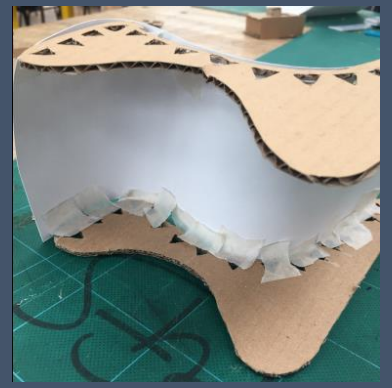
This chair has a more exaggerated curve on the end of the seat which gives it more of an aesthetic look. However this upwards curve where the back of the persons knee should be, would be quite uncomfortable. The curves overall on this design are quite sharp which gives it a defined appearance. The curved back was taken from the posture research where I discovered that a curved back can encourage the user to sit with better posture.

It is also important to mention that all these designs do not have tubes as the main support in terms of seat and back rest for the user. Instead a sheet of card has been used.
This sheet of card is shown by the chair I modelled and is only on the side that the user seats on. It proved to be challenging to bend the card at certain points in particular the main curve where the back of the user's knees would go. To make this piece of card more secure it would be a good idea to investigate different ways of securing it to both the side pieces as well as how it could be developed to being flatpack.

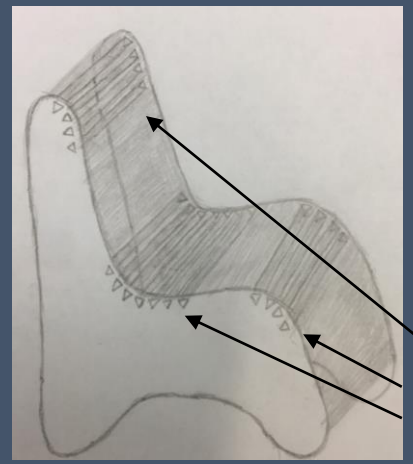


This design has the arch lower to the ground which would improve the overall stability of the chair, making it safer for the user. The curve at the end of the seated part of the chair is much more ergonomic and therefore comfortable for the user. It curves down at an angle, so the lower legs won't be at right angles with the upper legs





I showed my client both designs and we discussed the elements he liked of each. Feedback included *"I like the use of curves"* and *" I prefer the second design because the curves make it look very comfortable"* I drew up a design on 3D design taking elements from both of the designs above that the client liked; over 90-degree angle for back rest, a smooth curve angled just over 90 degrees for the legs and the singular piece of material all the way around the chair instead of tubes.



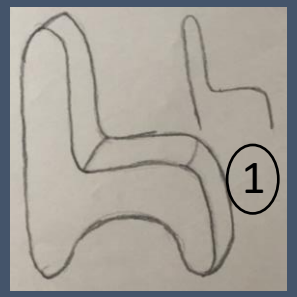
After careful consideration of using this singular sheet of card I have realised it would need some reinforcements so that it could withstand the weight of the user. This reinforcement could be having some tubes, like in the original design, underneath to support. However I would still need to find a way to attach the tubes to the seat as well as fix both ends of the card. I could potentially add the tubes as support underneath and then use some type of fabric over them. To the right is a sketch I made demonstrating this idea.

In this design you can see the tubes however this is just to show where they would be underneath the singular piece of material would cover them completely. The tubes have been placed where the most weight is put on chairs. The back of the seat, the front of the seat where the knees bend and the upper back.

Summary: A conservative approach to curves is favourable as it is best for the posture of the user, it is also the look which my client was looking for. It is important that I investigate how the chair could be made to be as stable as possible and ensuring that it will be able to hold the weight of the user

CAD

All these design developments are in relation to the over all shape of the chair. From the exaggerated curved inspired designs on the previous page and then my further research into anthropometric data. I have then changed the shape and sizes of different parts of the chair. The over all shape is keeping with the curved sides original idea but these developed drawings are more conservative in their use of curves than the hand drawn designs on the previous slide. All these changes will be made because of the client feedback I received about *"liking the curves"* and how *"comfortable the chairs looked"*

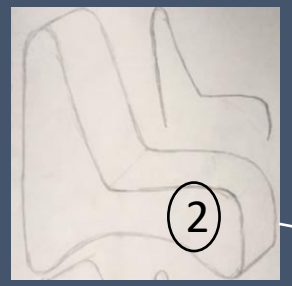


As can be seen from the cross-section view the chair has a straight back but still has curved leg, curve underneath of the chair and curved end where the back of the knees go. Between the back and the seat is a 90-degree angle, which I learnt from my research on posture, is a good angle for ensuring the user sits up straight and is in a comfortable yet not relaxed position. The arch on the bottom is curved up higher than the other designs due to aesthetics reasons, this way it resembles a more "traditional" chair. There are no issues with sharp edges as it is all smoothed over curves.

I then got feedback from my client on design 1 and 2.

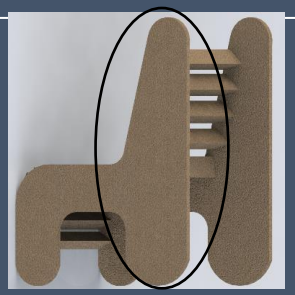
For design 1: *"The use of curves is definitely much more conservative, maybe too much"* and *"aesthetically I really like it but potentially need a backrest which isn't straight up right"*

For design 2: *"Like the higher arched, makes it look more like a normal chair"* and *"the back rest looks more comfortable"*



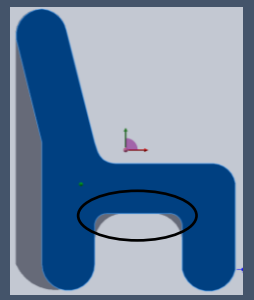
The differences between design 1 and 2 is the larger angle between the seat and the back rest as well as the higher arch of the legs. The larger angle will mean the user can sit back to some extent and this aids good posture which in turn makes the chair more comfortable for the user

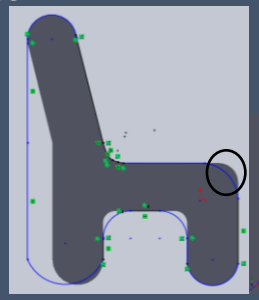
Drawing which I drew up on Solidworks

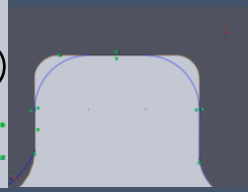


From the client feedback I decided to make a third design. This design focused on changing the areas of the previous design which the client didn't like as well as ensuring it fit the specification as well as possible.

I took screenshots of how I edited second design to make the third design. This included curving the end of the seat less as well as arching the underneath of the seat less, both for aesthetic reasons as they curvature was quite excessive.







I also got rid of the large amount of the back leg so that the back-rest sides were parallel. This large back rest made the whole back end of the chair look not in proportion. But on the other hand it did add more stability to the design, this strength is needed due to a large amount of the user's weight being situated here.

In addition to this, getting rid of the large back leg saves materials which saves cost and will reduce the price of the overall product which is favourable

Summary:

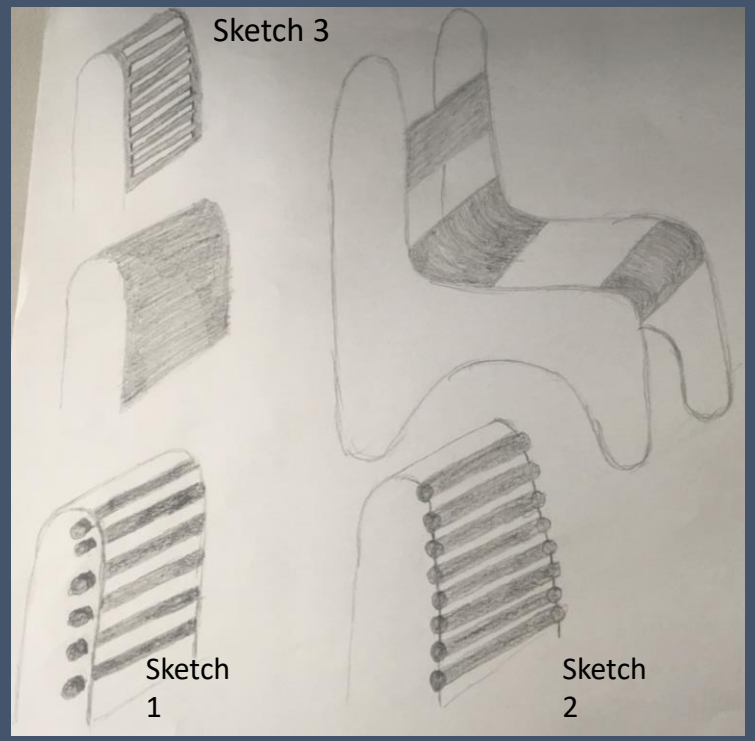
The developments which I have made on this page have ensured that the client is happy with the design and it is not only comfortable and ensures good posture for the user, but it is also aesthetically pleasing.

Now I need to specifically investigate how the two sides are going to held together, perhaps the tubes are not the best option

Development sketches seat + back rest

After my extensive research into the anthropometrics, ergonomics and posture I did some development sketches specially linked to the seat and back support for the user.

Having the connecting tubes between the two sides of the chair as shown in sketch 2 opposed to the first one means that they would be much easier to take out if the chair is going to be flat pack. Having my design be flatpack would make it space efficient which was one of my main points from my specification. However it could comprise the stability of the chair to some extent. With sketch 1, the tubes are secured a lot better into the sides of the chair and therefore will be able to withstand the weight of the user far better than sketch 2



Sketch 3 gives an appearance of the connecting tubes idea however it is a singular sheet of material with cut out rectangles to mirror the appearance of the tubes. Hence adding the stability that comes with using a singular piece of bent material. If I was just going to use a singular sheet of material, I would need to investigate how this could be bent; which would differ depending on what material I decide to use. I would also need to think out how thick this material would need to be to withhold the users' weight.

One of the main points of my specification was about the environment and ensuring I was not using unnecessary materials in my product. To meet this specification point I investigated only having parts of the back rest with support. I identified that the main areas which needed this support was the middle of the back, the lower back and top of the thighs and the knees. Therefore these were the three places where I kept the white card.
From constructing this model I became aware that it was more difficult to bend the individual pieces of card at the curves (which is really the only place where the card needs to be so that it can support the weight of the user)

I also sketched the design of only have three parts of the back/seat rest with the connecting tubes. This would be just as easy to make as the tubes do not need to bend like the sheet of paper does.

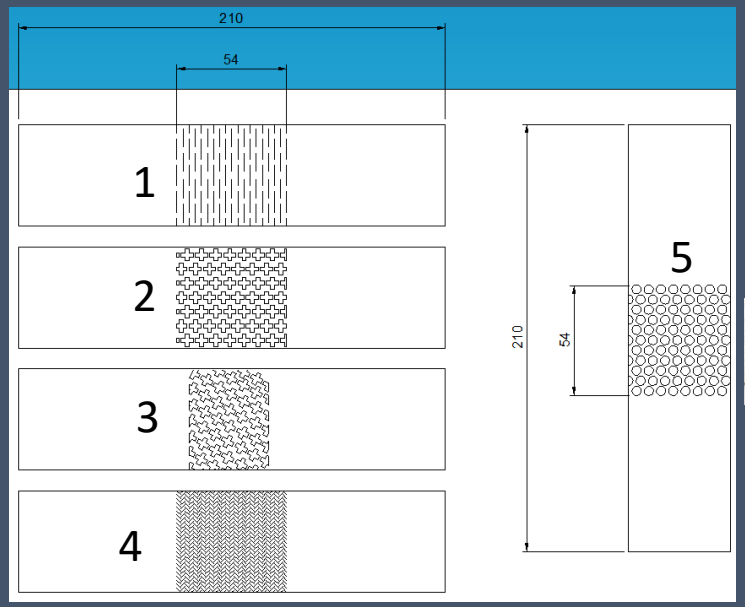
Summary:
To summarise, ensuring the stability and comfort of the chair are two very important aspects of the design. Stability of the chair could be provided various ways. The idea of using tubes as well as some material on top would add strength to the chair.
Need to investigate into adding storage into areas of the chair which aren't currently being utilised.

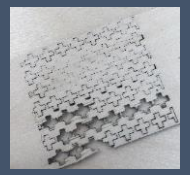
Manufacturing Methods research

Website used for research of patterns: https://www.martin-breuer.com/kerf-bending-patterns

Through research I discovered that the two main bending processes for wood are steam bending and kerf bending. Steam bending involves strips of wood which are steam heated in a steam box. The applied heat and moisture makes the wood pliable enough to easily bend around a former to create a specific shape. However steam bending is not a very time efficient process. Nor is it very accurate unless you have very specific equipment. Kerf bending is essentially strategically removing material to allow for flexibility. Some kerf bending techniques use a laser cutter but more commonly the cuts are made by hand using a saw. It is important to note that the overall strength of the piece of wood is then reduced because of the cuts and this is something to consider in relation to my product

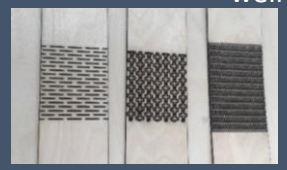
I decided to do an investigation where I tested 5 different patterns so I could see which ones bent the best as well as which ones looked the best. The 5 different patterns I drew up on CAD were: dashed patterns, herringbone pattern, medieval cross pattern, diagonal cross pattern and oval pattern.

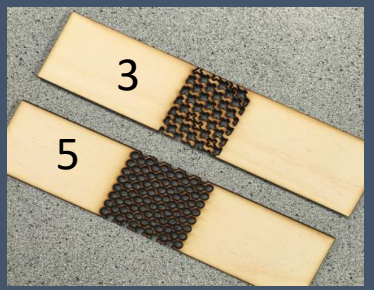




2) Herringbone pattern

- I used a much thinner plywood for this pattern and number 1 as the thicker plywood seemed to not being working as well as it should had been
- This pattern didn't cut out properly unfortunately
- However even when I started to bend it, it felt very weak and it snapped under a relatively low amount of force
- This pattern was probably the weakest as well as number 5



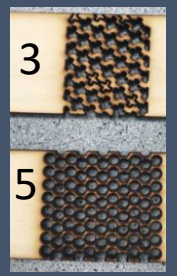


3) Medieval cross pattern

- Some of the crosses were not cut by the laser cutter
- Top side quite black
- Most resistant to wanting to bend
- Snapped with the least amount of force applied

5) Oval patterns

- Top side looks very black
- Less resistant to wanting to bend than 3) but still quite resistant
- Potentially too long of an area in comparison to the length of the wood



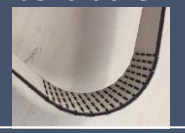
As previously mentioned, the main two materials that I am now considering to make my product out of is some form of reinforced cardboard, softwood or manufactured boards. Some of my previous designs talked about using a singular piece of material between the two side instead of tubes and this research is linked directly to these designs. On this page I am investigating the different ways in which I could bend wood.

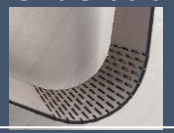
4) Diagonal Cross Pattern

- Top side is very black
- Bottom side not black and has a much more pleasant appearance
- Bent more than patterns 1-3; nearly 30 degrees each side, 60 degrees in total, angle between them is 120 degrees

1) Dashed Pattern

- This is another design which I used the much thinner Plywood for
- The front side did not burn nearly as much as number 3,4 and 5, so aesthetics wise it is also good
- This design bent the most, I also noticed that the more that I bent it the more flexible it did become





Summary: After trialling all 5 different patterns it was clear that the dashed and diagonal cross pattern worked the best. For this reason I then redid the diagonal cross pattern with the thinner plywood to ensure it was a fair test.

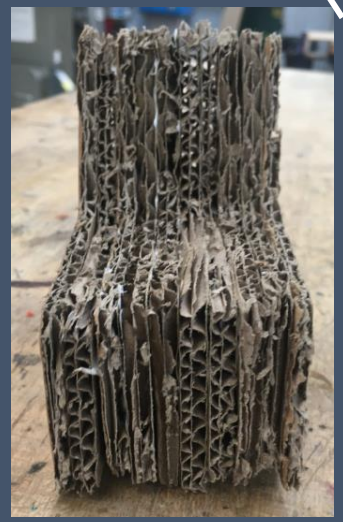
If I was going to use this manufacturing method in my design, I would have to investigate how to attach this middle section to the two sides. As well as work out exactly where the pattern would need to be on the design to ensure it bent where I wanted it to go. Even though two of the patterns did well at bending I am unsure whether or not they would be able to withstand the weight of a human

Model and weight testing

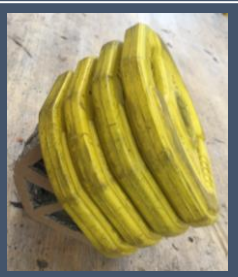
I made a model of my final design to a 1/8th of the scale at which I will construct my chair. This was so I was able to see how the process of making my product could work as well as testing how it handled weights. A main part my chair is that it needs to hold the weight of the user so weight testing was crucial to see if the current design I had would withstand the testing.

I cut out a template using the laser cutter and then traced around it 10 times on cardboard and cut each layer out using a pen knife. Because I had hand cut each of the layers this meant they were not quite identical to each other. Regardless, when I glued all 10 layers together, using PVA glue you could not tell that their dimensions were slightly different. The only place where you could tell was in the storage holes.

This inaccuracy is something which I need to consider when deciding what manufacturing methods will produce the best quality products and consequence which materials I should use.

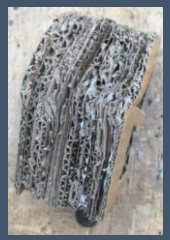


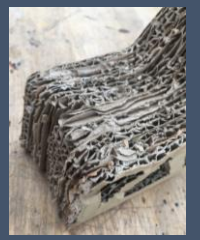
As the model is a 1/8th of the size I hoped it to would be able to hold an 1/8th of the expected weight. I am wanting the chair to be able to hold 80kg due to the average weight of the target market which I am designing for.



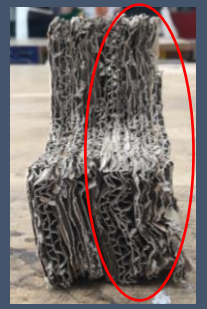
After making the model I started to add weights to it. When I placed the weights, I ensured that they were placed in accordance with where the user would place the most weight on the chair. I had released the importance of weight distribution of chair when I did my research on posture. First, I had 1.2kg (the black weight) and I saw no apparent change to the materials. Then I added 2kg weights (yellow) until I reached 10kg on the model. I stopped at 10kg as the entire chair had started slanting to one side and I could visibly see breaks in the corrugated card. I then removed the weights and took pictures of the model now to show the damage which has been done to the model. The main damages have been highlighted by red circles. These pictures clearly demonstrate how the damage mostly occurred on one side of the chair as the cardboard started to be crushed under the weights.

I read an online article titled *"The Art and Science of Pressure Distribution: How to make a chair that provides structural and dynamic support"* (https://www.hermanmiller.com/research/categories/white-papers/the-art-and-science-of-pressure-distribution/) It talks about how the challenge is to engineer a chair so its structure and materials provide dynamic support as this will then allow the users body to dictate pressure distribution rather than the chair's structure.





Good pressure distribution in a chair focuses peak pressure under the sitting bones in upright postures and in the lumbar and thoracic areas in reclined postures. Correct pressure distribution is critical to seated comfort. A high level of surface pressure can constrict blood flow which the user experiences as discomfort. However there is large variance in peak pressure patterns among people of different sizes. Chairs with backrests that exhibit pressure peaks in areas of the lower back away from the spine have been judged more comfortable than chairs showing lower pressure gradients in these regions.



Summary:

- The chair is quite unstable and permanently deformed after only 8kg of weight. This therefore leads me to believe that it is not very tough and won't be able to absorb possible impacts without fracture.
- Next, I will ensure my design is finalised, specifically with dimensions as well as making a final decision on the materials I will be using to manufacture

Design idea 8

This design does not have any exposed electrics, however due to the rectangular shapes it does include sharp corners which may be a health and safety issue. However this can be further developed to have rounded corners or rubber guards

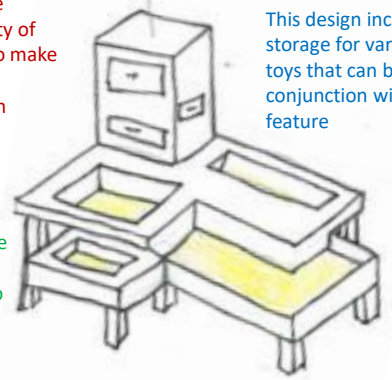
With my final design idea, I decided to expand its usability by including 4 different light features so that it can be used by multiple children at the same time

Includes a light feature making it appealing to all children, including autistic children

The design will be approximately 100cm at its tallest point, and 60cm wide at its widest point

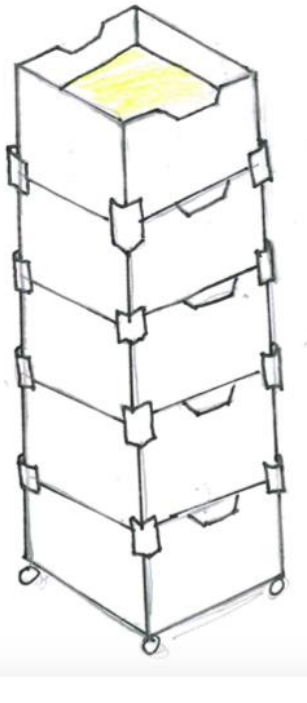
This design will be painted in a variety of primary colours to make it attractive for preschool children

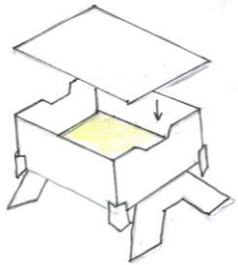
This design includes storage for various sensory toys that can be used in conjunction with the light feature

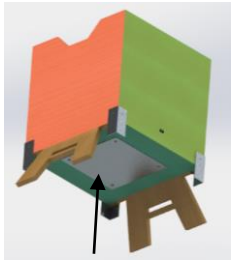


This design is the correct size to fit through the pre-school door and the light tables are at different heights so that it caters for all sized children.

Many components, could potentially be over the budget of £300 – yet this should be thought out carefully if further developed in order to keep under budget. (this is only an estimate)







Base plate to access electronics

DEVELOPMENT

After gathering feedback from my client, the client wants this idea to be further developed. The idea of this design was to have multiple light features in one design, with each light feature having a different function – e.g. a light feature with sand, a light feature with water, a light feature to draw on etc. . However the client brought to attention that the product is not very easy to transport and store. Therefore I completely redesigned this design with the same idea of multiple light boxes with multiple functions.

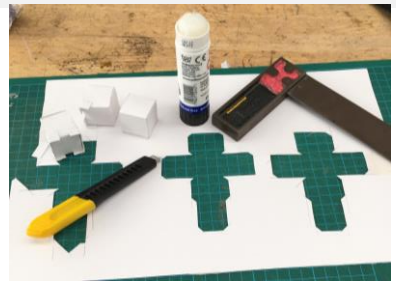
I decided to design a stackable box system, with each box being able to be removed and stand on its own. Each box has its own light feature and each box contains a different sensory toy. For example one box contains sand, one contains light catching acrylic shapes and numbers and one contains other toys and storage.

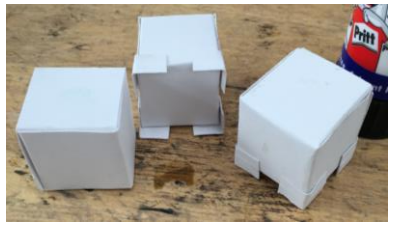
Each box can be taken off the stack, and placed on the floor, with each box containing foldable legs. The light is sourced from LED's and batteries, therefore no mains electricity is required. The boxes could be made from painted MDF, with each box being different colours in order to create a childish aesthetic, or the boxes could be made from various coloured acrylic or ABS.

For this design, I have constructed a card model in order to experiment and understand how the boxes can stack and how the legs can fold. I printed out 3 cube nets and cut them out in card with a Stanley knife. I then creased and folded the net together and glued it. I designed the boxes so that they slot over each other as shown in the photo. This model showed me that the structure of the boxes and how they fit together is a practical and realistic idea.

Specification check list

1) Childish aesthetic and seamlessly fit into the room
2) Durable
3) Inclusive
4) Easy to maneuver
5) Correct size
6) Safe
7) Functional with storage
8) Wood materials and a light source
9) Should be within budget





Client feedback (interview with Sheela – manager)

in terms of aesthetics, what are your pros and cons?

"I like the large variety of primary colours as this is appealing for our children and it will help the product fit in with the preschools current aesthetic, however I'm not so sure on the complex look as this could be overwhelming for the children"

In terms of functionality, what are your pros and cons?

"I like the large amount of light tables, as well as the storage ability. However the lack of portability is a con as I would like to be able to move it from room to room"

Is it the correct size/ shape for the environment its going to be used in?

"it's the correct size, although the complex shape may make it difficult to store"

Are there any features that interest you in particular?

"I am very interested in the multiple light tables, as we have a lot of children that will want to use it"

Are there any changes you would make?

"id like to see it more portable"

Overall, are you happy with the design and hence would like to see any further development?

"I really like the concept, and I would like you to develop this design further"

Conclusion on my initial design developments

After analysing the developed designs and considering the practicality, usability and aesthetics of each design, I have concluded that I am going to select and further develop the stackable box system. This is because it is the most practical and space efficient design, especially as the preschool have stated that they'd like the design to be easily stored and maneuvered. This design is the most functional as it has multiple functions and features and can be used by the most amount of children at one time. Furthermore, this design is the most aesthetically appropriate for the preschool as the boxes can be painted and themed easiest to fit the aesthetic of the preschool. And overall, this design is the best and most appropriate design. **This design meets the specification the closest.** Therefore I am now going to develop and research deeper into how I can improve this design to the best possible standard.

Further developments on chosen design – the stacking system

In this section, I am going to research, sketch and develop various ways of stacking the boxes together. As I am making 3 light boxes, they need to be stacked easily and safely without falling down or collapsing. Therefore I need to develop and test various ways of securing the boxes together.
After my initial paper model I completed earlier on in my development stage, I decided to create a wooden model in order to gain a more realistic insight to see if the design is safe and affective.

Construction

in order to construct the model, I drew out a box net on 2D Design that includes finger joints so the box can slot together. After I have drawn out the box net, I drew separate pieces that can be secured to the outside of the box so that the boxes can be stacked without sliding off each other, as shown in the photo on the right. I then copy and pasted the design 3 times.
After I had finished drawing on CAD I exported the file and imported it to laser 5.1 in the workshop. I then cut the CAD onto laser ply using the laser cutter.
Next I glued the boxes together via the finger joints using a hot glue gun. And I also glued the other pieces to the outside of teach box on the corners with a hot glue gun.

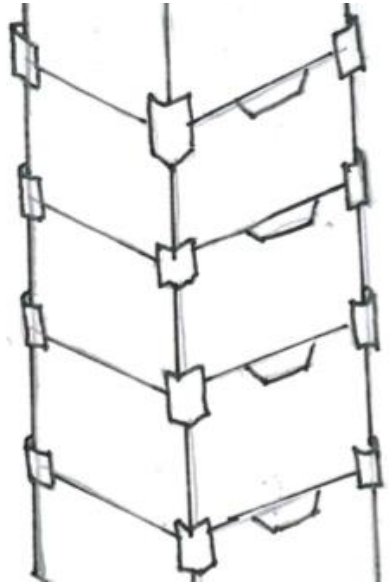
Limitations

there are a number of limitations with this model. Firstly the box isn't to scale and doesn't accurately represent the weight of my design and therefore not acutely represent how stable the boxes will be. However creating a wooden model is more accurate than my previous paper model and this model is going to be the closest representation to my final design and therefore is still a valid form of testing.
Secondly the locking system isn't accurate to what I would actually use in my final design. However it acts as a representation of what the lock would do in terms of function. And therefore is still a valid form of testing an modeling.

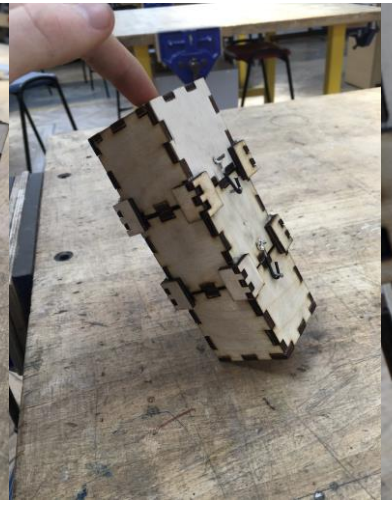
Testing and conclusion

i then proceeded to stack the boxes on top of each other to see how they'd fit. They fit together really smoothly, however it made me realize that they can be knocked over very easily, therefore I realised that I needed to add more security. Therefore I tried to test a locking system. I tapped in a very small nail into the bottom of each box on two sides (as shown in the photo on the right). i also tapped a small nail into the top of each box so the could be secured together. I then used a small wire to represent a hook as shown in the photos on the right.
I have concluded that my design needs a sort of locking system rather than just loosely stacking each box, which was represented by the nails and wire. For m actual design, I could use a variety of locks or hooks, which I will assess when drawing up my final design.

Sketch Test development



CAD Test development



Further developments on chosen design – The light feature

Construction of the model

For this stage of development for my design I have decided to do some practical research and testing in order to figure out the best and most convenient way to position the LEDs under the frosted glass table top. In order to take out my investigation I have selected my materials and electronics that will represent each component of the light feature in my final design.

Firstly I used a coping saw to cut a circle of clear acrylic. This will represent the glass table top of my design. In order to make the acrylic circle frosted I used white spray paint and applied a light coat on the surface of the clear acrylic. Secondly I made a circuit with one white LED and a battery pack, I used the soldering iron to secure the wire to the LED and powered it with AA batteries.

Finally in order to carry out the testing, I took my model to a dark room and held the LED light under the frosted acrylic at different angles in order to find the most appropriate position for my LEDs in my final design.

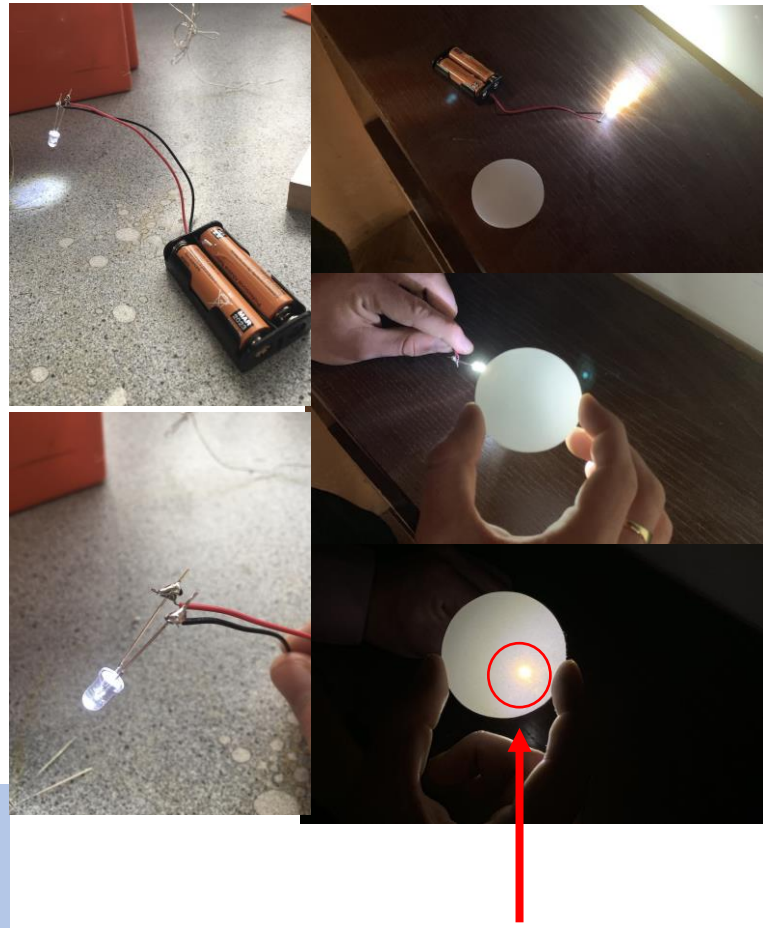
Limitations

As with all models and investigations, there are always limitations that are important to recognise and take into account when concluding the results. One limitation was the fact that I was using spray painted acrylic rather than glass (which I going to use in my final design). This could make my results invalid as he plastic might behave differently with the LED than glass would. Another limitation is the fact that I was only using one LED rather than multiple, therefore my results might not be valid as the results could be different if I was to use multiple LEDs together. Some of these limitation are difficult to avoid, therefore when it comes to my final design I am going to be open to further alterations and adjustments.

Results of the investigation

In conclusion, I have realised that having the LEDs directly under the surface will cause the light to spot, which I do not want in my final product. My initial hypothesis was that the best way to position my LEDs was directly under the acrylic but at a distance where they don't spot. However I realised that even if the LED is held directly under the surface at a larger distance, it still spots, and if I was to hold it at a distance where it didn't spot, the light wouldn't be bright enough. Therefore I decided to try some different positioning and placements of the LEDs.

I placed the LED parallel to the acrylic in order to illuminate the surface without the light spotting. I have concluded that this is the most affective way of illuminating the acrylic and I intend to incorporate this into my final design.



The LED has spotted on the transparent acrylic. This is due to the angle of the LED an the distance of the LED from the acrylic

Further developments on chosen design – The construction of the box

It is very important for me to research, test and develop different methods of constructing the box as the box needs to be secured efficiently, cost effectively and securely. I have chosen 3 different methods of securing the box and I intend to test each one in the workshop In order to decide on the best method for my design. I will be testing finger joints, metal brackets and butt joints as my options.

Finger joints


1.25KG

5KG

Firstly, I will be testing the idea of finger joints. Finger joints have advantages, which include the strength of the joint as there are may points of contact, however it is a very complex joint.

To test the practicality of this joint, I used my testing model previously used to test the stacking system. I have reused the model in order to save material and be as time and cost efficient as possible.

My previous model already used finger joints as it was an easy way to construct the box model. I used Hot glue to secure the box, however in my final product I will use PVA glue which will be even more secure than hot glue.

On a small scale, this joint has proven to be very secure. Therefore with the use of PVA glue on a large scale, based on the high amount of contact points between the panels of wood, finger joints would be a sufficient option for my final product.

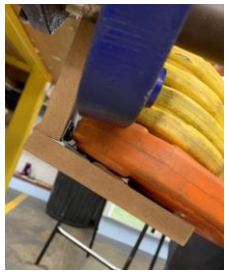
However based on the complexity of the joint, I am keen to investigate other options that might be less time consuming.

I have asked my client for her thoughts…

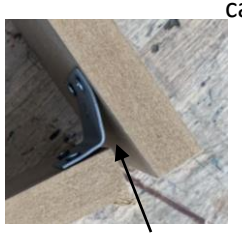
"I like the strength and practicality, however I don't like the aesthetic of the joint"

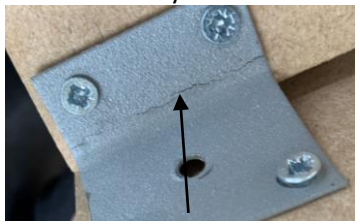
My client has mentioned the aesthetics of the joint isn't what she wants in her product, therefore I am going to investigate metal brackets as another option.

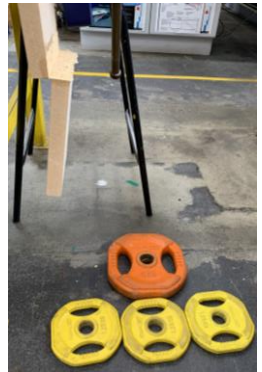
Metal brackets



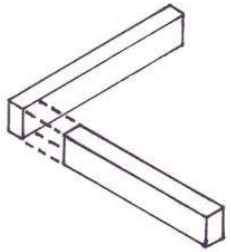
Metal brackets are a second option for the construction of my light box. Metal brackets, in theory, are a very good option as they are cheap to buy, easy to use and provide a clean aesthetic as the brackets will be hidden on the inside. However I intend to investigate the reality of using these brackets with MDF. My initial thoughts, based on the composition of MDF being wooden fibers held together by adhesive, were that the MDF would not hold the screws securely, especially with pressure applied. Therefore I have made a model test in order to investigate the strength of a metal bracket in MDF. I found 2 pieces of scrap MDF, a metal bracket and some star head screws. I then secured the 2 pieces of MDF together. I then proceeded to secure the model to a vice and apply weights onto the joint to test the strength. I had a collective weight of 10KG as this is all that was available to me. I then balanced the weights on the joint 1 by 1. I can conclude that the screws held very securely, and in fact, the only damage was a bend in the Bracket as well as a slight crack as Shown in the photographs below. Therefore confirming that screws can be held securely in MDF


Bend


Crack



Butt joint



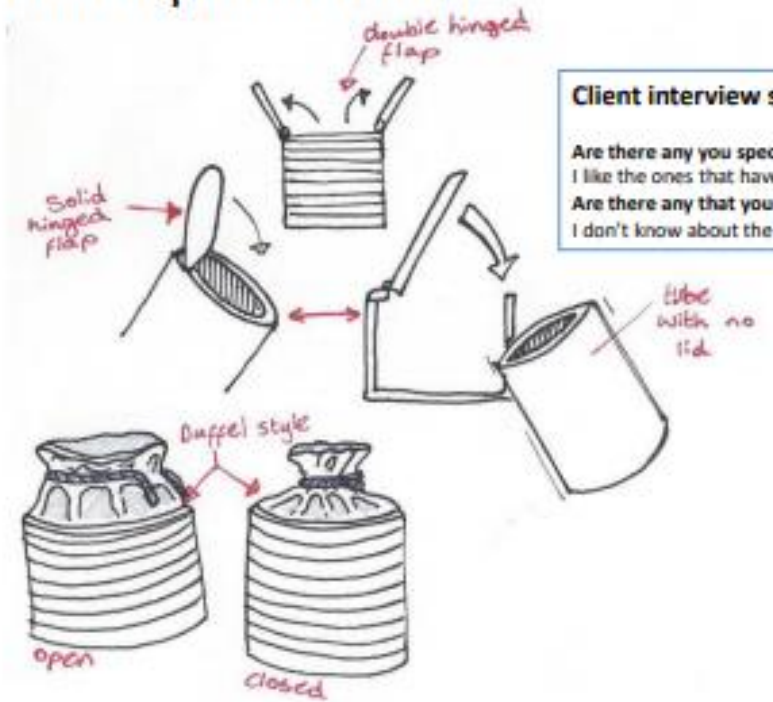
Finally, a third option for the construction of the light box is the use of Butt joints, which are simply gluing 2 bits of wood together with Poly-vinyl acetate. Using no specific bracket or cuts in the wood, as shown in the diagram to the right…

I decided to test this form of construction as I was keen to find out how strong the joint would hold with just glue. Therefore I found 2 more pieces of scrap MDF and proceeded to apply PVA glue to both pieces, I then clamped the pieces of wood together and waited a day for the glue to properly dry. Once the joint was secure, I clamped the wood into a desk clamp, as I did with my previous test, and began to add the same weights, in the same order, one by one in order to get a direct comparison. I can conclude that the butt joint was only able to support 7.5KG before breaking, therefore this joint is not as strong as using screws. However, the only damage to the joint was the surface of the MDF ripping, as opposed to the actual glue breaking, therefore the weakness is in the material, rather than the adhesive.

DEVELOPMENT CONCLUSION

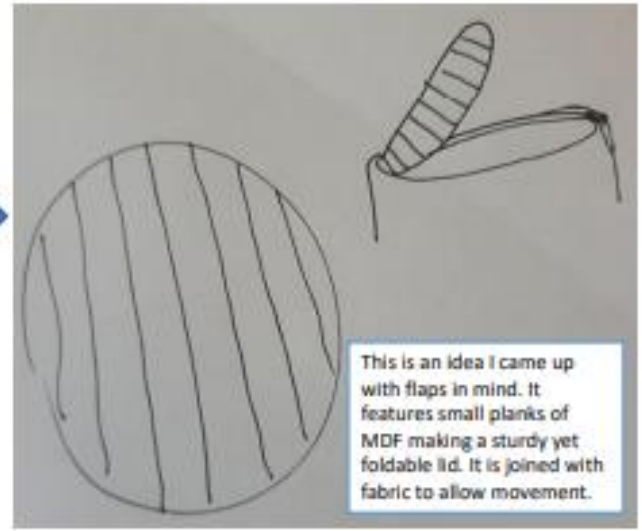
A conclusion to be made is that the material surface is too weak to use a simple butt joint, however a metal bracket is another component and therefore will increase the cost of production if I was to mass produce my product. A solution could be to change the material, however, MDF is the most sustainable material that is easy to work with and therefore I would like to continue to use this material. Therefore I will be considering another joint which I will test in my next slide.

Development of lids:



Client interview surrounding sketches:

Are there any you specifically like?
I like the ones that have a flap.
Are there any that you don't?
I don't know about the fabric duffel style.



This is an idea I came up with flaps in mind. It features small planks of MDF making a sturdy yet foldable lid. It is joined with fabric to allow movement.

This is a CAD model of my final flex lid design. I used 2x 3mm MDF panels that sandwich two elasticated fabric ribbons. I chose elasticated fabric to allow the flap to be more flexible.
I also added a hole to allow the user to open it easily.

Here is a cardboard model I made of the flex lid. It lies flat when closed.

This shows how the flap can be folded up to access lower section but also still hold some upper luggage in marked section.

This shows how the model can be completely rolled up.

My client approved of this design when I showed him it. He said he liked that the ridges of the tube match the ridges of the lid.

To conclude: I will include this in my manufacture because it satisfies the user and allows access to luggage which forms part of the brief.

Examples of Final Design

Key Points:

- **Final CAD drawing to SCALE.**
- **Rendered.**
- **Different views of product.**
- **Annotated to explain design**
  – Consider Specification Points and how final design meets them.
  - Materials and finishes.
  - Key parts and features of design.
- **Environmental snapshot with product in place.**

Final Design

Aesthetics:

Due to the situation which my client is in I decided to design my chair for a neutral aesthetic. I achieved this by finding materials which were available in neutral colours that could then be finished to change their colour whilst still fitting the other specification points

From client feedback I found out that the hardboard was unappealing aesthetically and therefore I made the decision to paint my chair once all the parts have been cut out

The curved sides of the chairs adds a modern element which is more interesting to look at than more conventional straight edges, this is also more appealing to the target market of young adults

The cushion shall be made from black double knit wall to constant with the bright vibrant colours of the chair,

The logo, made from pewter, shall be a metallic colour making it stand out from the rest of the chair which is ideal

Cost:

Conscious that in relation to my target market I need to keep the cost low I researched low cost materials which would also fit the other specification points

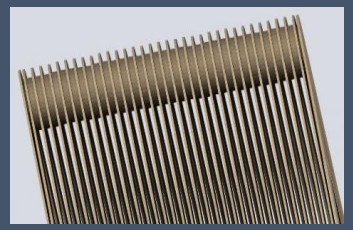
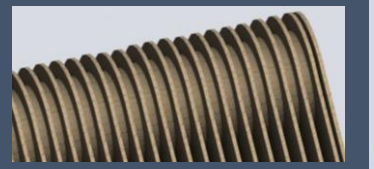
Hardboard is a relatively low-cost material to construct my product out of. This fits very well with my sustainable element of the design as it is reusing materials.

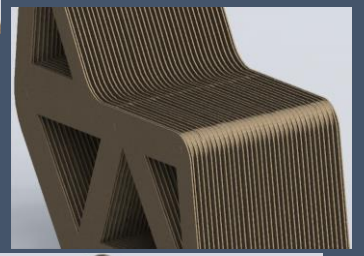
I looked at several different websites and shops to find the most cost effective way of making the cushion.

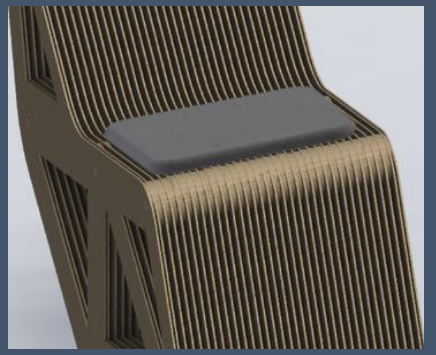
From the hardboard, dowels, cushion logo and paint the cost should come under the budget I set myself to ensure it could be sold for £50

Materials:

Through investigation and client feedback I choose hardboard for the main body as it is cost effective so I will keep to my £50 budget and through testing I have come to the conclusion that it is of a high enough quality to provide stability and ensure it fulfils its function. Materials for the cushion have been chosen for comfort of the user for prolonged periods of time; yarn and cushion pad.

Environment/Sustainability:

My client made it clear she wanted a product which was as environmentally friendly as possible, This led me to researching sustainable materials and how in general a product can be sustainable. I found hardboard to be the most sustainable material as it is 100% recyclable, biodegradable and comes from a sustainable source. Hence much of my design will be constructed from hardboard. I will also be using environmentally friendly paint to finish my product, using water-based paint not acrylic paint. I will ensure any excess material which I do not use it either put into recycling or reused in some way. I have tessellated my design and made parts fit closely together so not to waste any material.

The yarn, the cushion will be knitted from, has no negative impact on the environment as it iis made from plant based fibres. The pewter for the logo can be easily recycled due to its high melting point

Size:

Through various investigations of chairs, people and school equipment I found the precise measurements for each part of the chair.

The storage space inside is crucial as it is the solution to students not having enough storage in their studying environment. These triangles will be able to hold up to the standard size of the large lever arch folders

The anthropometric data I gathered greatly guided the sizes for the different parts of the chair

Function:

This chair functions as both a chair and as storage space, this solves the problem of lack of storage space in student accommodation as well as the problem of uncomfortable overpriced desk chairs.

From ergonomic research on desk chairs I learnt the best angles to use and how the user's posture can be improved by designing a chair which forces them to sit in a certain way.

It was made clear by my client that this chair was mostly going to be used for desk purposes but also generally as seating. Because of this I used a 110-degree angle between the back and the seat so that the chair could be used as both.

The lack of doors of the storage holes was a cost effective decision and it lost makes it easier to gain access to the objects stored.

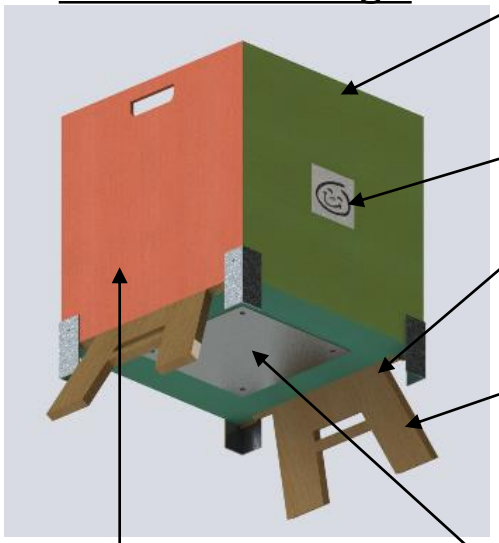
The cushion will provide extra back support for the user which is key for prolonged use.

The leaf logo successfully fulfils its function of making it clear the product is branded.

The final design of my chair has been heavily influenced from all my research and has gone through several changes from the initial design. The posture research to ensure maximum comfort for my user, researching potential materials made me revaluate what areas of the design were important for the client and then for this project and finally looking at manufacturing methods to figure at how I would be able to construct my chair.

Final design

The Main design



Non toxic paint makes it child friendly

It shouldn't exceed £300

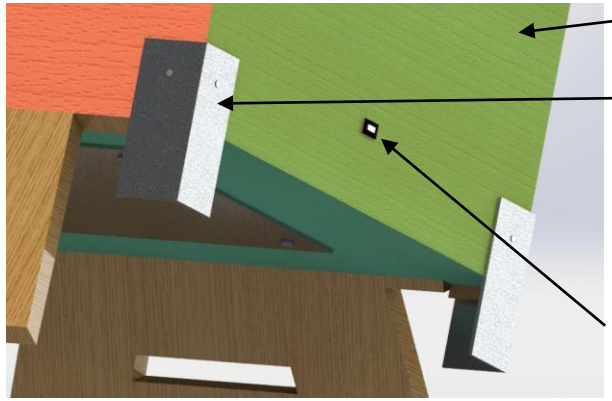
I will be using the silhouette feature on 2d design to create the Poplar Preschool logo and then exporting it to Laser 5.1 and etching it onto vinyl.

Metal hinges so the Legs fold up for storage.

Plywood legs, cut with a tenon saw. This is a sturdy and durable material. Therefore will be able to withstand heavy use in a preschool

Aluminum sheet (3mm) for the base plate, this will be screwed in so I can access the electronics. Provides ergonomic access to electronics

I will be using MDF as the main structure to every box, this is because it gives a smooth surface finish which can then be painted with a variety of different colours so that it fits the aesthetic of the preschool.



MDF is also light weight and has sufficient durability for its use

I will be using 3mm aluminum sheets and bending them around a right angle and screwing them into the MDF so that the boxes are able to stack securely.

The switch will be on the back of each box

Light feature can help children with autism calm down in stressful times

Handles on both sides make it easy to pick up, move around and stack

Bright primary colours to attract the children's attention

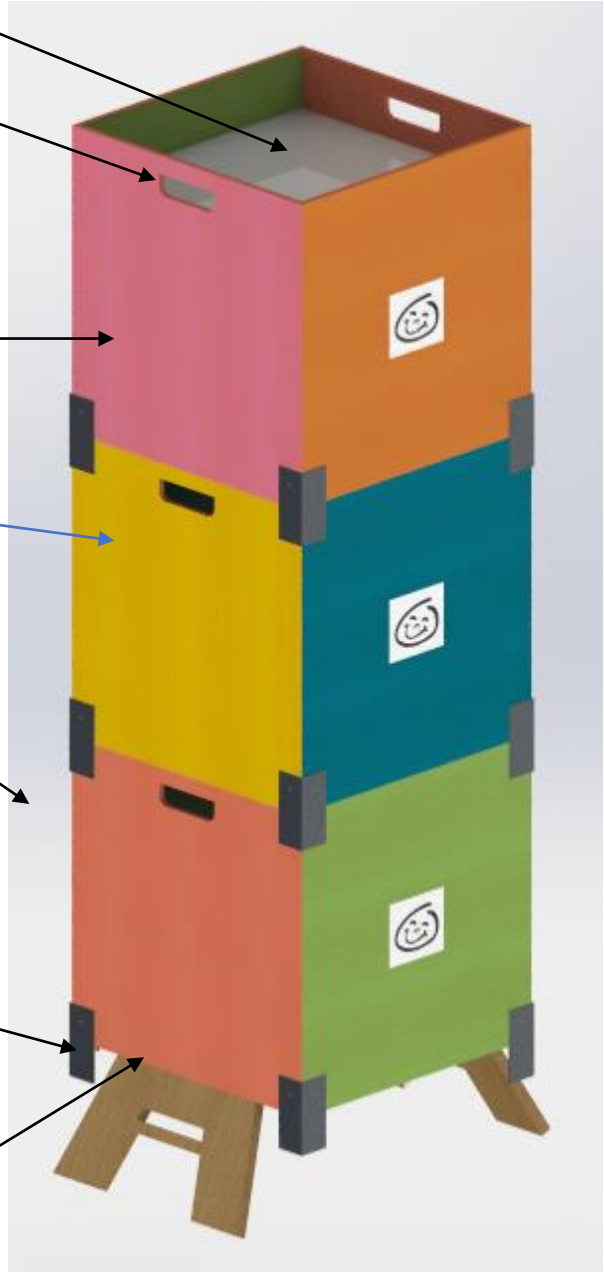
No exposed electronics, and no high voltage batteries or mains power. Makes it safe for the children

It will stand 60cm from the ground, this will make it an easily accessible height for the children

The boxes will be stacked and secured by aluminum extrusions

Not too wide, making it ergonomic to maneuver

The stacked boxes



"I am really pleased with the final design, this will fit perfectly in our preschool" - Sheela Fuller (Poplar Preschool manager)

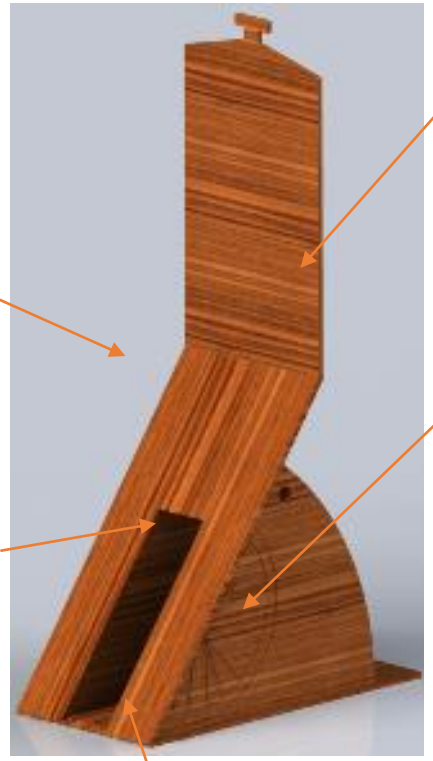
Specification check list

1) Childish aesthetic and seamlessly fit into the room
2) Durable
3) Inclusive
4) Easy to maneuver
5) Correct size
6) Safe
7) Functional with storage
8) Wood materials and a light source
9) It should be within budget

At the top of each box, LED's will illuminate the frosted acrylic to give the light box feature. After discussing with the preschool, they said "the best sensory stimulus is sand", therefore 2 of the boxes will both have different coloured sand in.

Final CAD design annotated

Bike stand looks aesthetically pleasing with a mix of curves and sleek edges. It is a modern design that would fit well within a home environment.



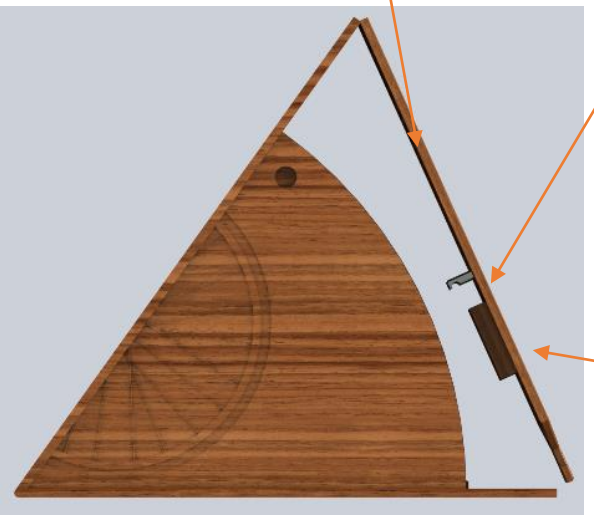
12mm ply will be used for the frame of the bike stand. This will be strong enough to hold the bike upright and would not break under stress. It can also resist any knocks without getting damaged.

The plywood frame would be coated with a varnish, and the edges will be covered in veneer to improve the aesthetics. This will also protect the bike stand from water and grease.

Because of how tight the angle of the frame is, the ply might not be able to bend. Therefore I may need to just cut the ply and sand a curved edge on the corner. This is a cheaper method of manufacture aswell.

A silhouette of a bike wheel is etched on to the side panel to add to the aesthetics of the bike stand.

Two hooks to hang cloths, jerseys, caps etc. This means all cycling equipment can be stored in one place. This increases functionality which is important to my customers



Fold-out magnetic tray to be used for storing parts while working on bike. This can be folded away to save space. Many of my customers surveyed work on their own bike

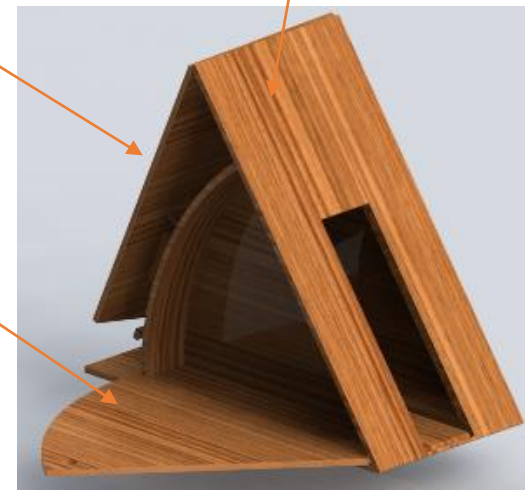
There will be a clamp inside the slot to hold the wheel in place.

This method of storage is cheaper to manufacture, lighter, and more efficient as it allows more storage space in an effective way. My customer liked that the tools were displayed on the floor

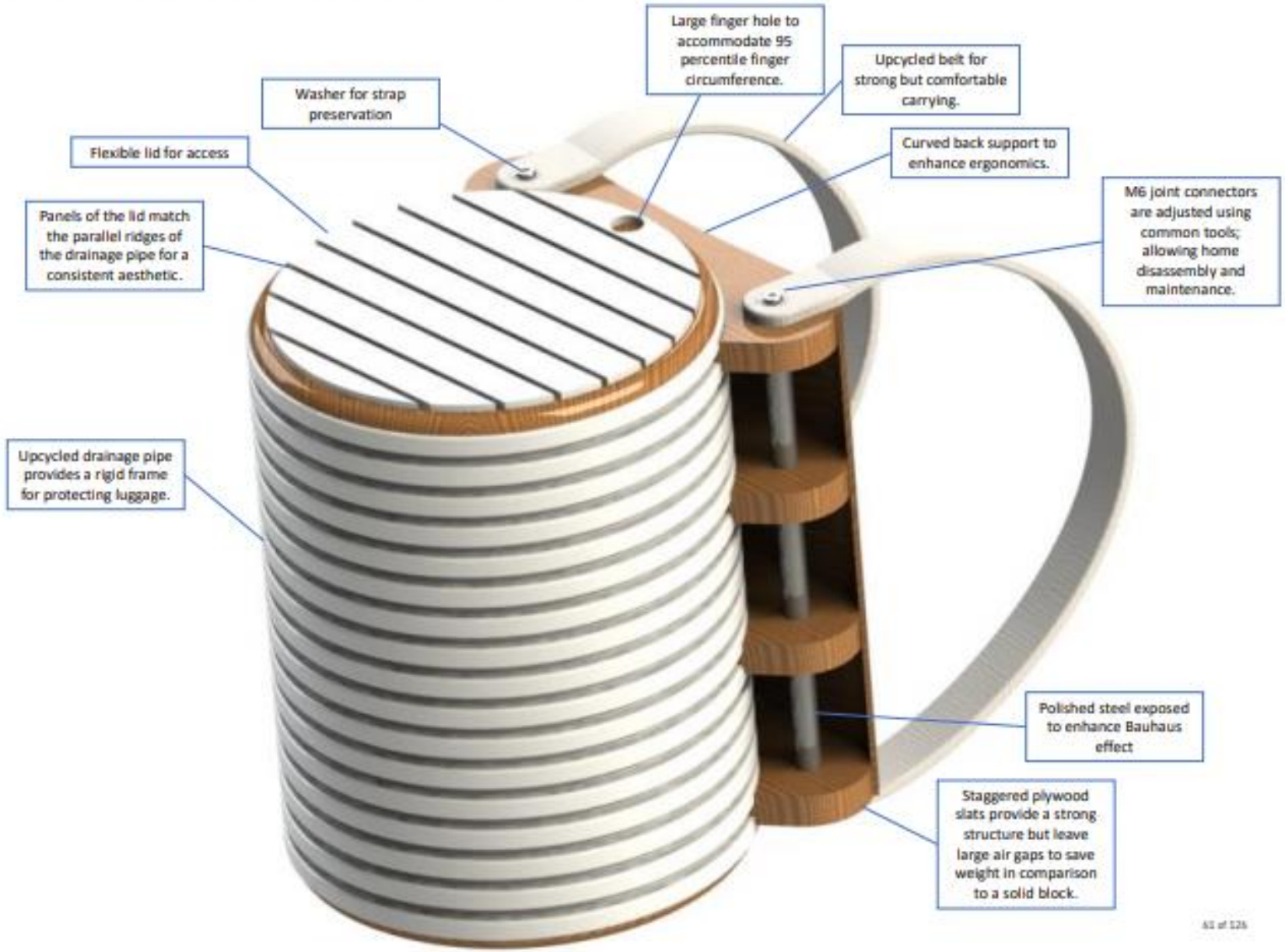
The tools will be secured using a range of methods including storage boxes, Velcro straps, and frames

I will attach a hinge to the frame to allow it to fold down. This will make it easier to store when it is not in use.

The whole side panel of the stand folds down, the tools would then be presented clearly on the floor making finding the correct tool easier for the user.



Perspective rendering of final design



Environmental snapshot

Section D: Development of Design Prototype (25 marks)

Pieces of work to evidence:

- Manufacture Plan
- Step by step explanation of how to make your design if you were to.
- Tools, Materials, components, processes.
- Quality Control checks – How would you ensure each part is made correctly – size, shape, finish, working?
- Health and safety – what health and safety checks will you make – PPE, extraction, remover sharp edges etc…
- Exploded diagrams.
- CAD drawings 2D or 3D to help explain how design will be made.
- Parts list – include size, number of and costings.
- Any test pieces, models or prototypes.

Key Points:

- **Planning the stages of your manufacture.**
- **Step by step.**
- **List materials, components, tools and machinery.**
- **What quality control checks will you need to carry out at certain stages?**
- **What Health and Safety measures will you take at certain stages?**
- **How will you consider the Environment and reduce impact on the environment during manufacture?**
- **A table or flow chart.**

Examples of Orthographic Drawings

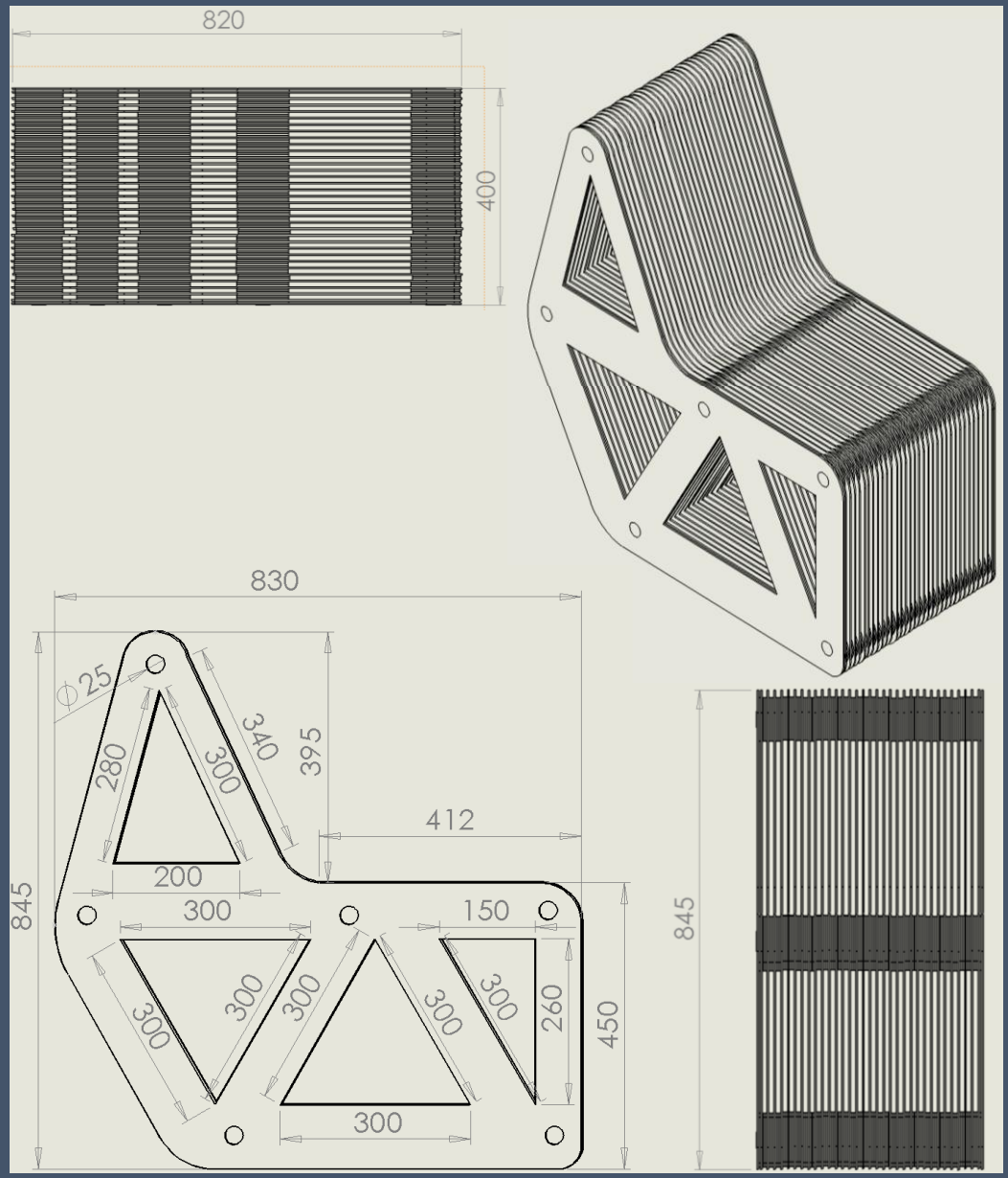
Key Points:

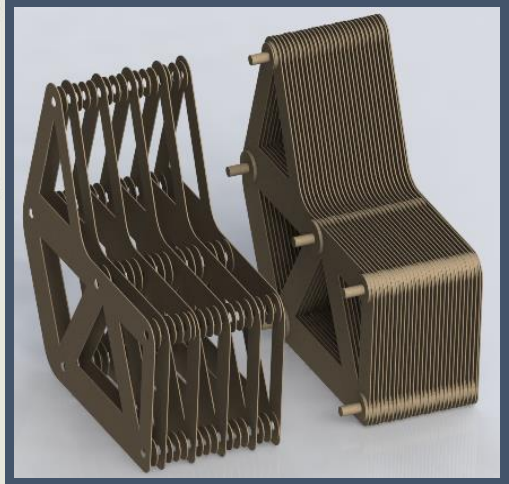
- **3rd Angle orthographic drawing. Min 3 views – Front, Side, Top.**
- **Scaled drawing showing all parts and features including hidden detail.**
- **All parts dimensioned – in mm.**
- **Orthographic can be completed on fully assembled product or individual parts.**
- **Another person should be able to look at this drawing and make the parts to the correct size.**

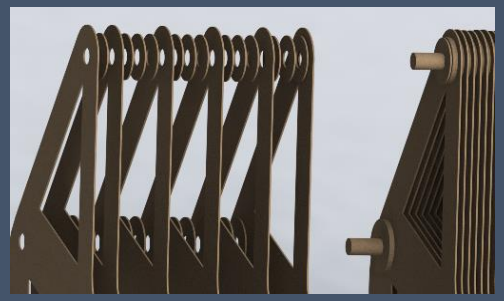
Orthographic drawing

This orthographic drawing clearly shows the dimensions of all the parts that I plan on using for the manufacture as well as a part list showing the sizes and quantities of each part.

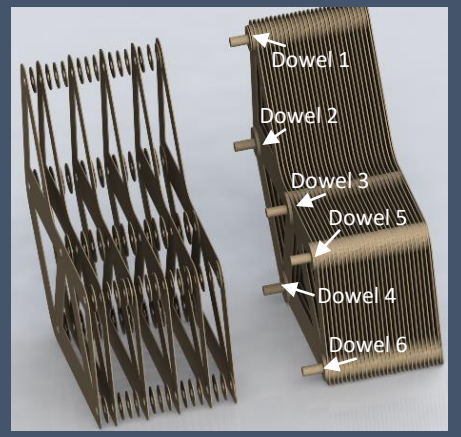
Part	Description	Length (mm)	Width (mm)	Thickness (mm)	Quantity
Design layer	The main layer of design	845	830	3	30
Dowels	Holding the layers + spacers together	400	25 diameter	25 diameter	6
Spacers for all the dowels	To go between the layers	28 diameter	28 diameter	3	624

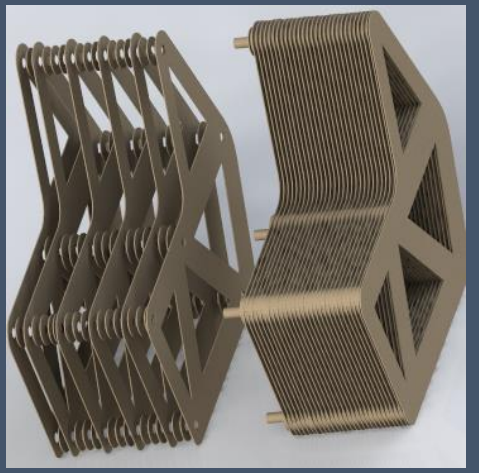




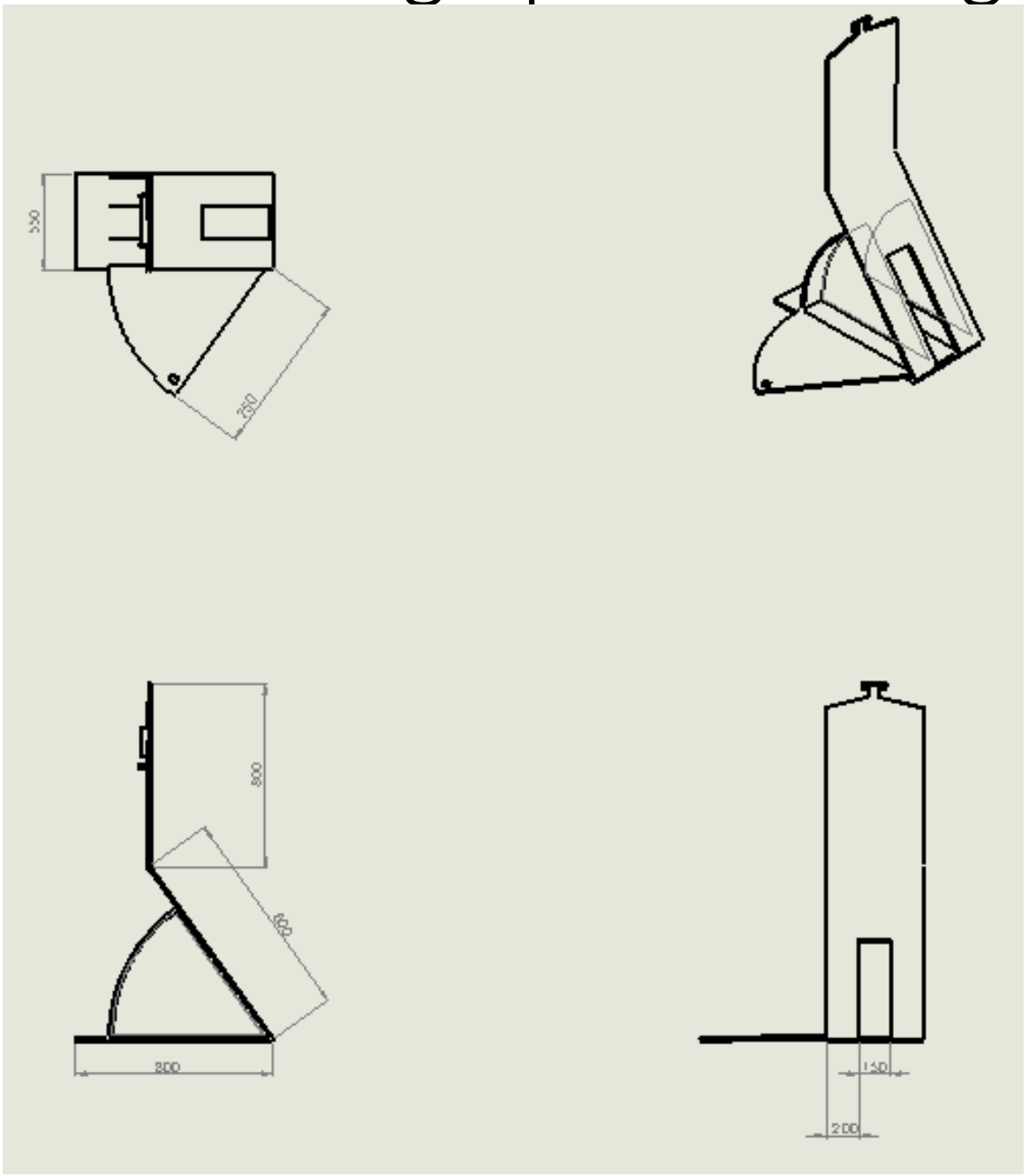


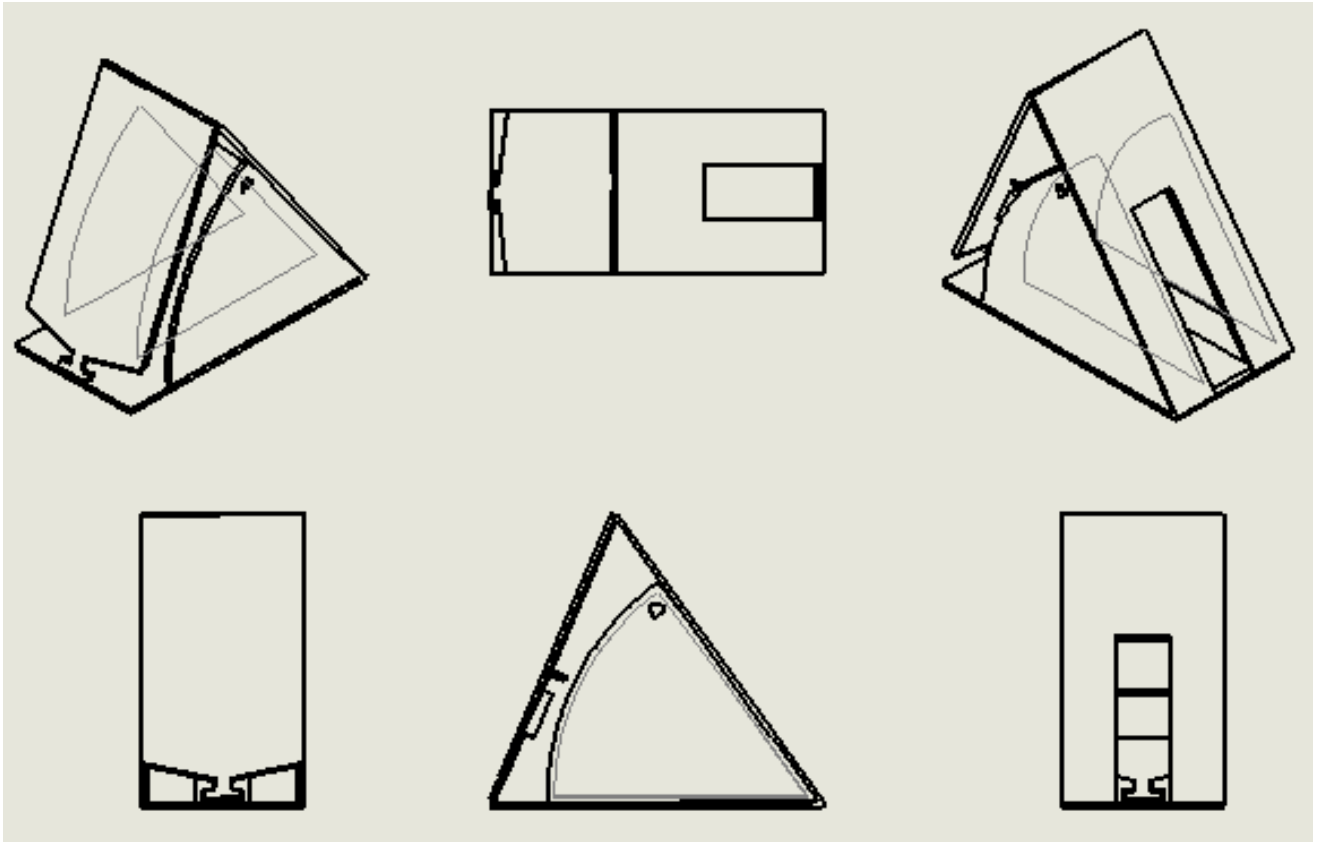
These are some exploded diagrams of my final design from SolidWorks. They show how the design will be slotted together as one of the main specification points, I had was for my product to be flatpack I will be using no glue or other permanent fixtures to hold it together





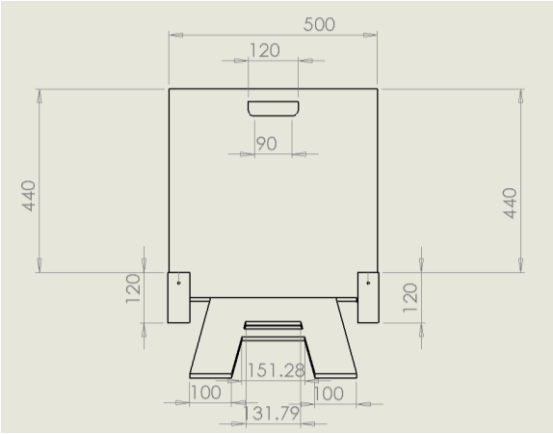
Orthographic drawing



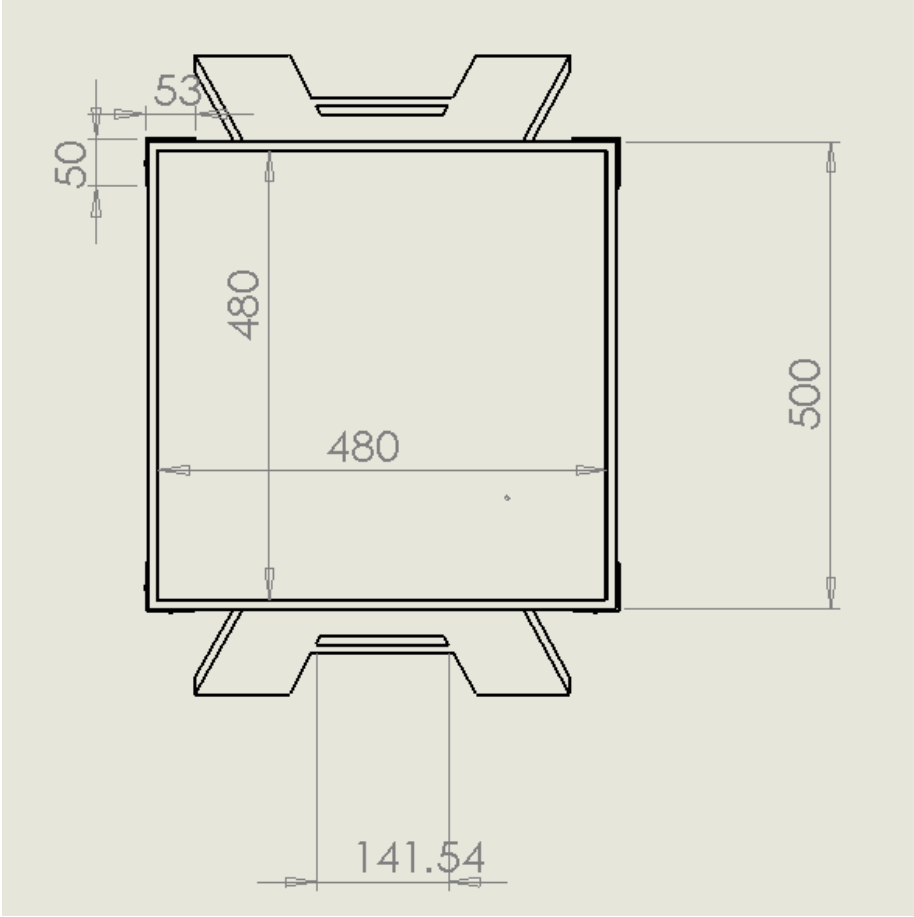


Orthographic drawing and exploded diagram

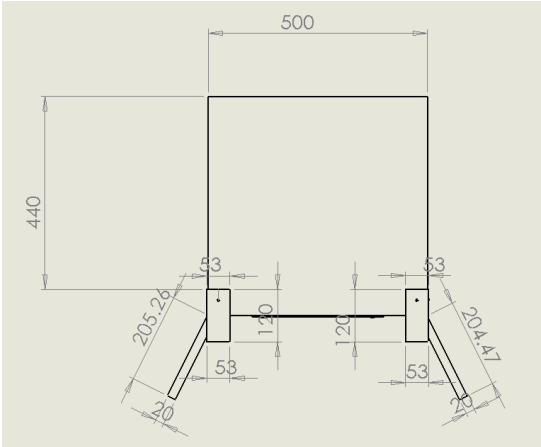
Front View



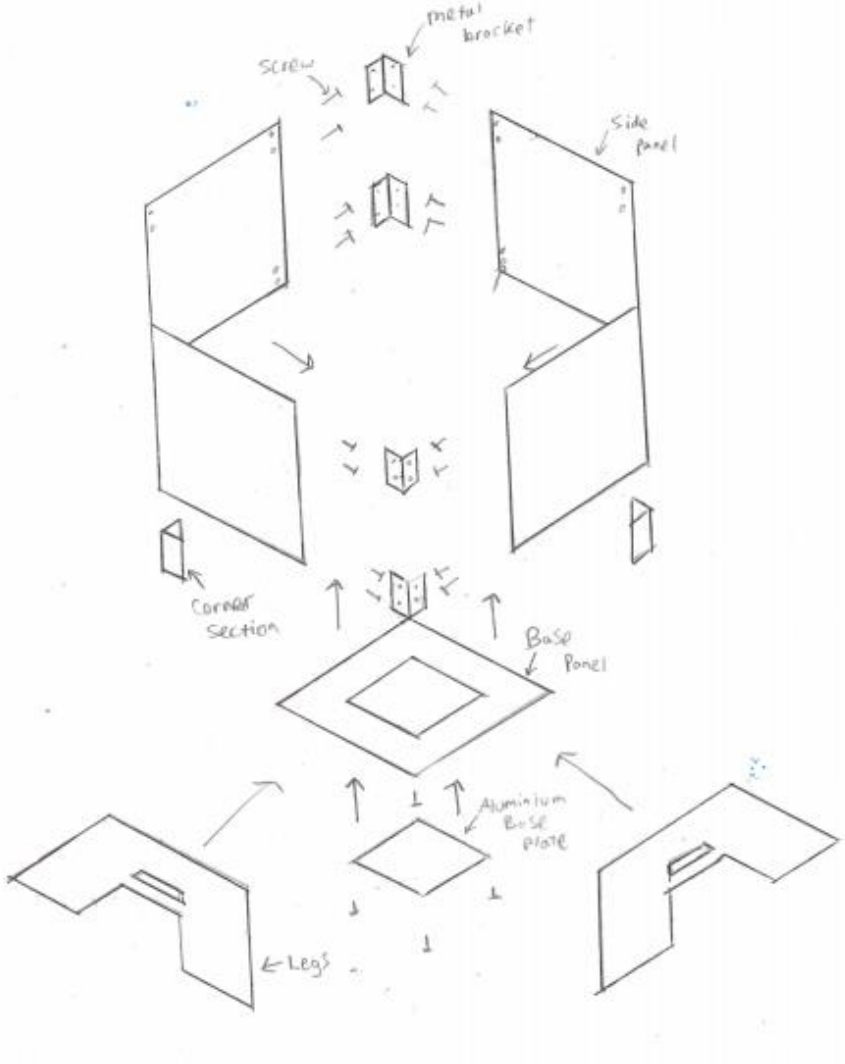
Top View



Side View



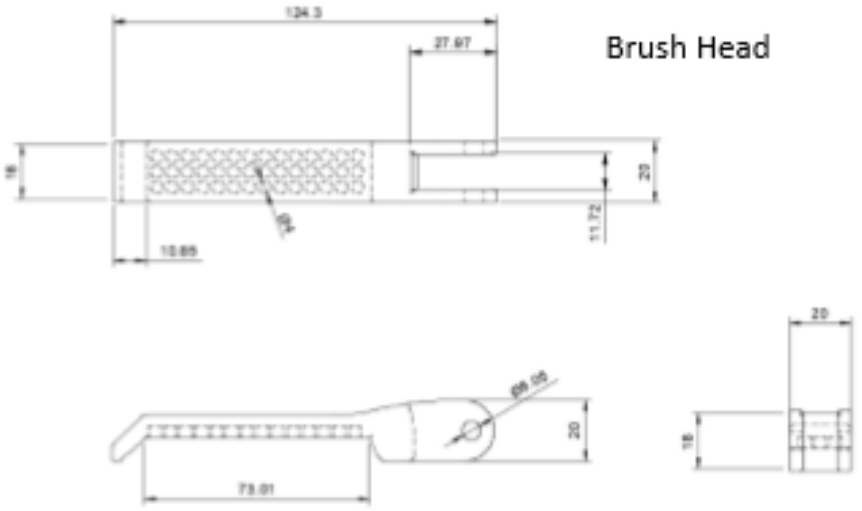
A visual aid as to how the product will be assembled



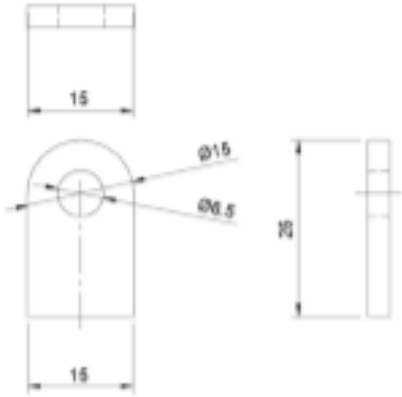
Orthographic drawing

Now I have got a prototype I'm happy with I can start to manufacture the final product. This page shows all of the orthographic drawings I have produced which I will be working from during the manufacturing process.

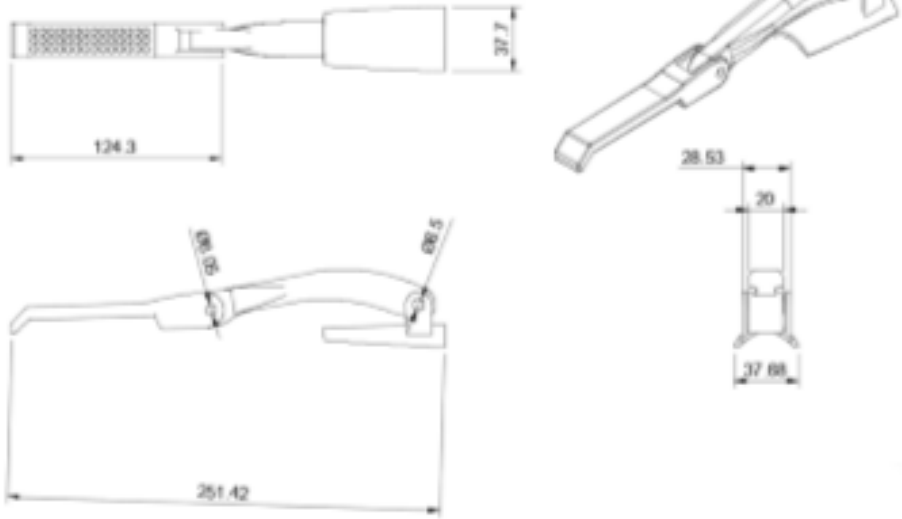
Brush Head



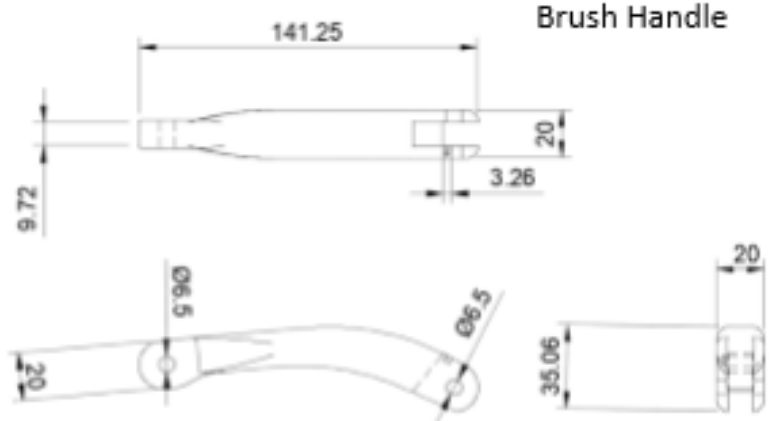
Part for clamp 2



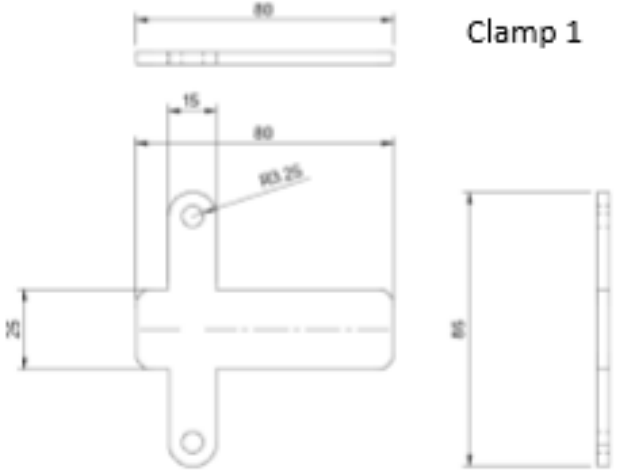
Assembly



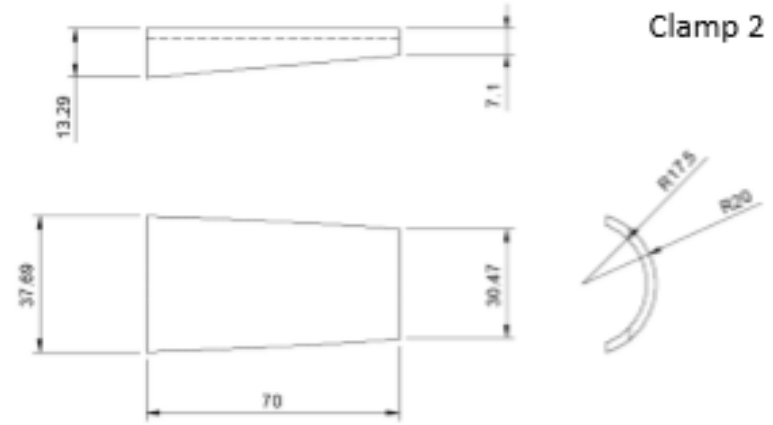
Brush Handle



Clamp 1



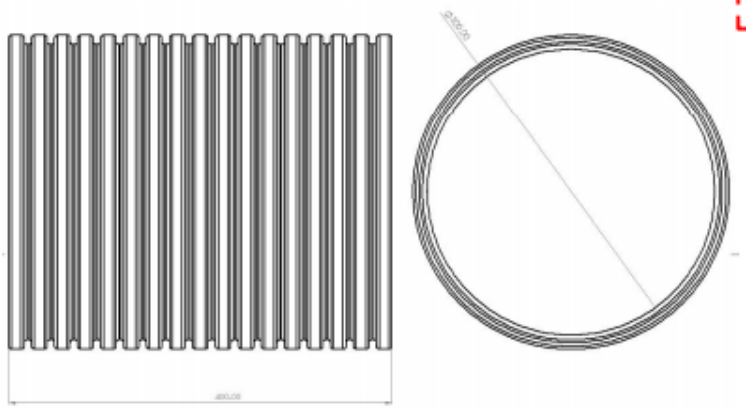
Clamp 2



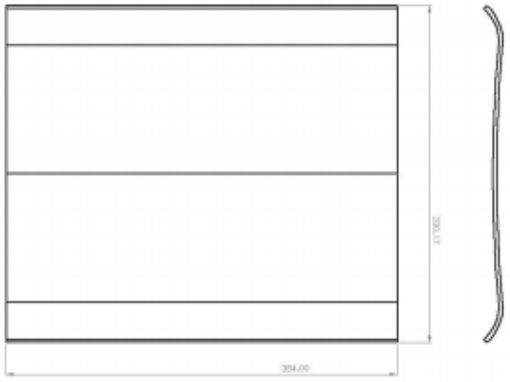
Orthographic drawing

Engineering drawings Drainage Tube:

This drawings should be used along with the manufacture plan to product an accurate design. During production, parts should have their dimensions checked against these engineering drawings as a quality assurance measure.

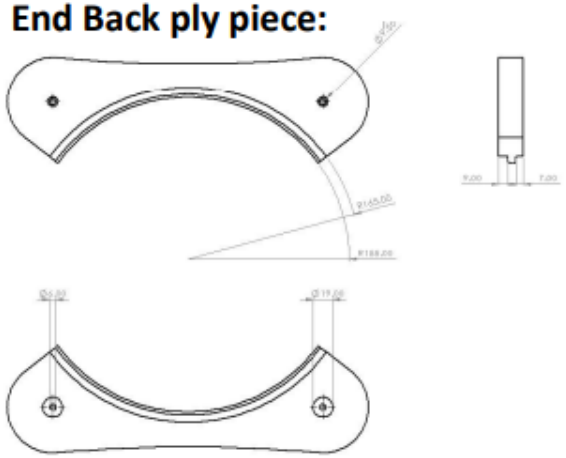


Flexi Ply

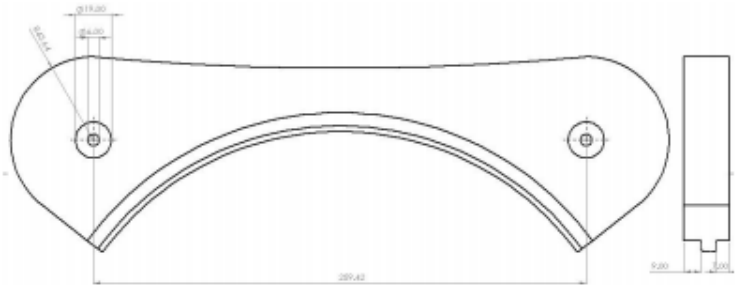


Engineering drawings End Back ply piece:

This drawings should be used along with the manufacture plan to product an accurate design. During production, parts should have their dimensions checked against these engineering drawings as a quality assurance measure.



Middle Back ply piece:

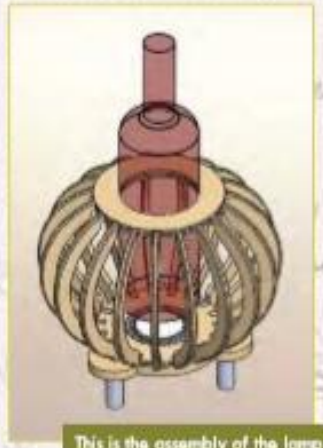


Examples of Exploded Diagrams

Key Points:

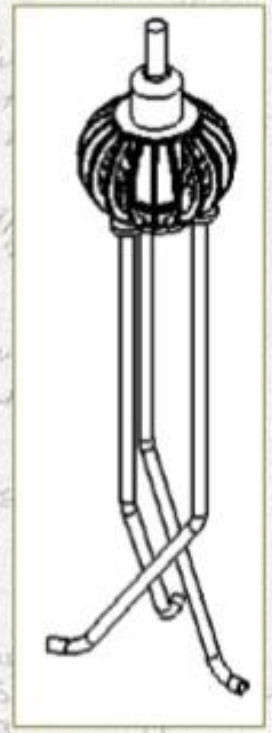
- **Show individual parts and components of a product.**
- **Show how parts join together.**
- **Shows hidden parts.**
- **Can be drawn in CAD or hand drawn.**
- **If using CAD, it's better to draw individual parts and then assemble them in an assembly drawing so that they can easily be exploded.**

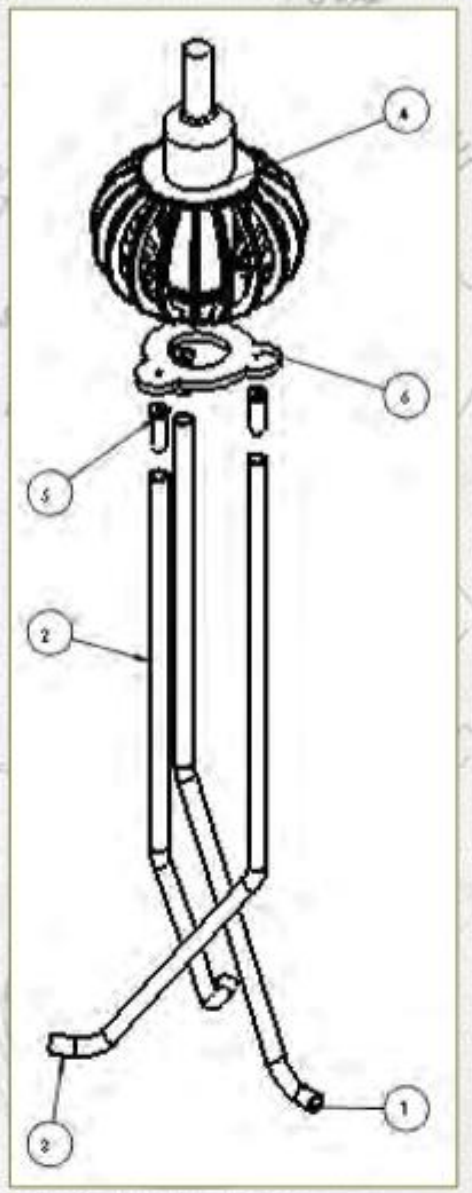
FINAL ASSEMBLY.



This is the assembly of the lamp and the part which will hold the lamp on the tripod using bolts, the exploded view shows how it will be assembled and the order of assembly.

GA DRAWING OF FINAL ASSEMBLY.





EXPLODED VIEW OF FINAL ASSEMBLY.

This image presents the attachment of the lamp to the tripod legs.

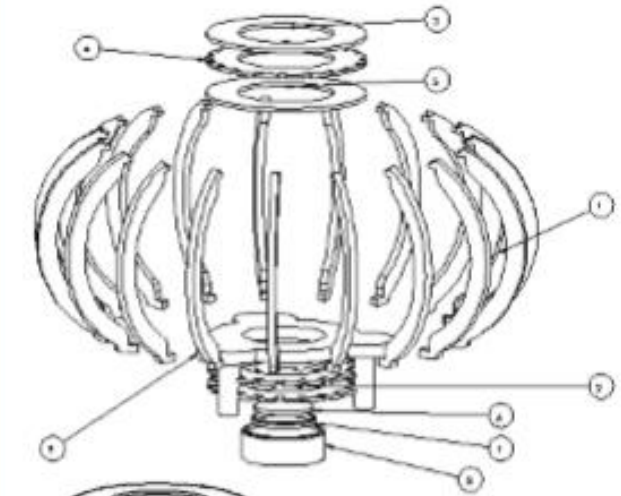
ITEM NO.	PART NUMBER	DESCRIPTION	QTY
1	LEG 1	25MM DIAMETER TUBE LENGHT 830MM 45 DEGREE BEND AT 350MM	1
2	LEG 2	25MM DIAMETER TUBE LENGHT 830MM 45 DEGREE BEND AT 400MM	1
3	LEG 3	25MM DIAMETER TUBE LENGHT 830MM 45 DEGREE BEND AT 450MM	1
4	LAMP		1
5	MILLED TUBE STOPPER	50MM MILLED TUBE WITH A 6MM THREAD	3
6	TRIPOD FIXTURE COMPONENT	12MM THICK CNC ROUTED PLYWOOD	1

Conclusion – I will now evaluate all of the designs from slide 10 against the spec to check if they meet the points specified, I will then create possible changes to designs which don't meet some of the point using the morphological analysis.

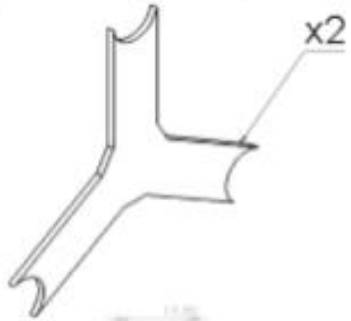
Introduction – this slide will show a GA drawing made from the assembly of the top part of the full product, this slide will also contain a table which will contain all the parts names, thicknesses of material, type of material, the process and the quantity of parts with isometric views.

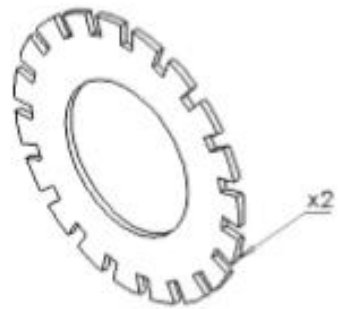
GA DRAWING LAMP.

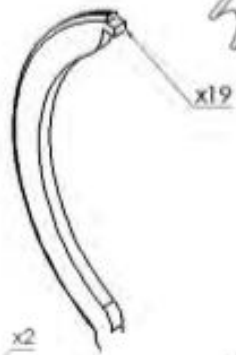
ITEM NO	PART Name	DESCRIPTION	QTY.
1	RIB	6MM LASER CUT PLYWOOD	19
2	BASE	6MM CNC ROUTED PLYWOOD	2
3	TOP PART OF TOP	6MM CNC ROUTD PLYWOOD	1
4	MIDDLE PART OF TOP	6MM CNC ROUTED PLYWOOD	1
5	BOTTOM PART OF TOP	6MM CNC ROUTED PLYWOOD	1
6	GLASS OVER BULB	2MM MATTE GLASS	1
7	Light inner part	CHROME PLATED TUBE	1
8	Light ring	CHROME PLATED TUBE	1
9	Light fixture and type stoppen	12MM CNC ROUTED PLYWOOD	1

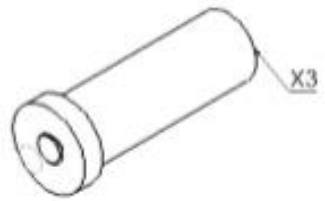


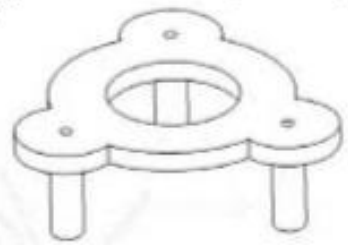
SINGULAR PARTS – ISOMETRIC VIEWS INCL. QUANTITIES











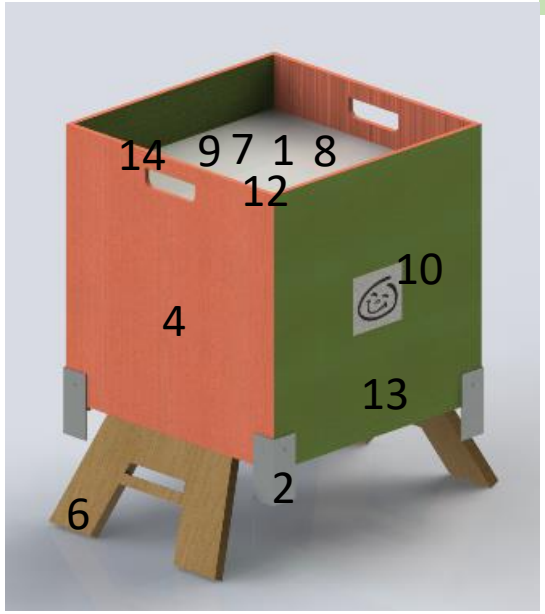
Conclusion – I can now use these to refer to during my manufacturing process. These engineering drawings will allow me to produce the parts using the CNC router, the laser cutter or hand produce the parts.

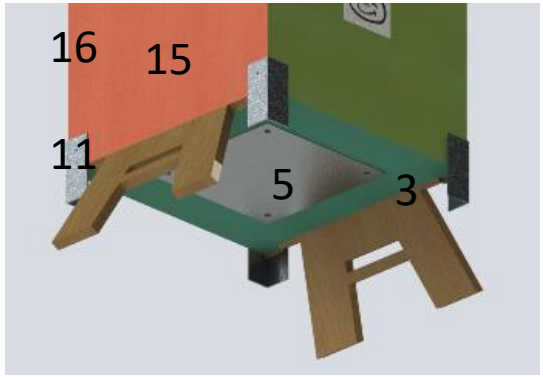
Examples of Parts / Cutting List

Key Points:

- **Detailed list of ALL materials and components required to manufacture your final design.**
- **Dimensions of materials and components in mm.**
- **Length, width, depth.**
- **Number of each component or material of same shape and size.**
- **Cost?**
- **In a table format.**

Cutting list – with price estimate



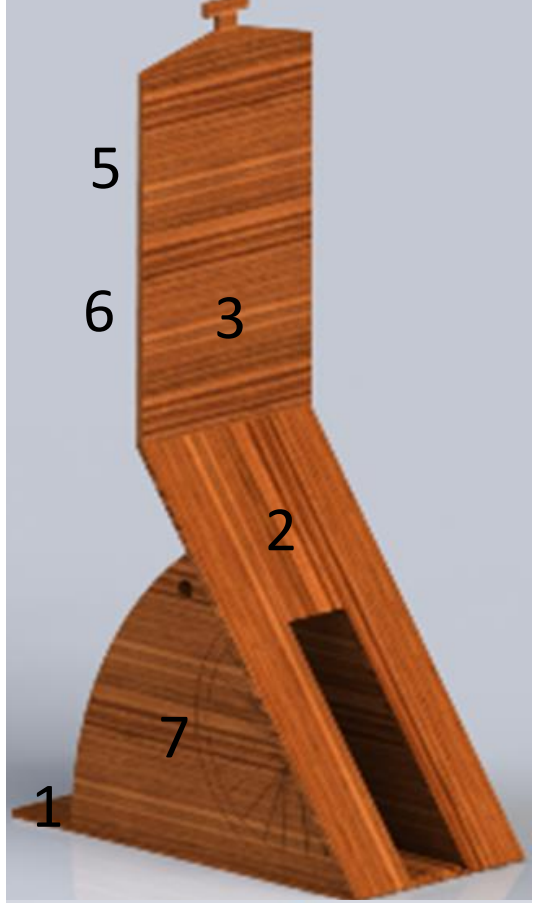


PART	MATERIAL	DESCRIPTION	LENGTH	HEIGHT	THICKNESS	PRICE PER PIECE	QUANTITY FOR 1 BOX	PRICE FOR 1 BOX	QUANTITY FOR 3 BOXES	TOTAL PRICE FOR 3 BOXES
1	LEDs	Strips	400mm	-	-	£9.99 per reel	4 cut LED strips	No more than 1 reel needed for all 3 boxes - £9.99	12 cut LED strips. 1 Reel	£9.99
2	Aluminum	Sheets	120mm	100mm	3mm	£2.50	4	£10	12	£30
3	Metal	Hinges	40mm	25mm-	-	£1.50	4	£6	12	£18
4	MDF	Boards	2.4m	1.2m	18mm	£40	1	£40	2	£80
5	Aluminum	sheet	250mm	250mm	3mm	£5	1	£10	3	£30
6	Plywood	sheet	400	200	18mm	£7.50	2	£15	6	£45
7	Clear acrylic	sheet	500mm	500mm	5mm	£20	1	£20	3	£60
8	Wires	wire	1M	-	-	£3 per reel	1	No more than 1 reel needed for all 3 boxes -£3	1 reel	£3
9	Solder	Solder	-	-	-	£7	1	No more than 1 reel needed for all 3 boxes - 50p	1 reel	£7
10	Vinyl	sheet	10cm	10cm	-	50p	1	50p	3	£1.50
11	Screws	Crosse head	20mm	-	-	5p	20	£1	60	£3
12	Battery	9 Volt	-	-	-	£3.95 for pack of 2	1 pack	£3.95	3 packs	£11.85
13	switch	switch	-	-	-	50p	1	50p	3	£1.50
14	Silicone sealant	clear	-	-	-	£3	1	£3	1	£3
15	Coloured paint	Blue, green, yellow, red	-	-	-	£25	4 cans	£100	4 cans	£100
16	PVA glue	Glue	-	-	-	£2	1 bottle	£2	1 bottle	£2

TOTAL PRICE FOR 1 BOX: £225.44 (if one singular box was manufactured) – HOWEVER, the cost of paint, silicone sealant, wires, solder, LEDs will be spread over all 3 boxes. Therefore with this taken into account, the price per box goes down to: £110.28 when 3 boxes are made, making this box £10.28 over the customer budget.

TOTAL PRICE FOR ALL 3 BOXES: $405.84, although as stated below, the paint price was split 4 ways, making my product cost £330.84 – this is £30.84 over budget

NOTE: Many of the components, such as the paint, was shared between students and the price for many of the materials was split, therefore in reality, the cost estimate above is an over estimate.



Cutting list

Part number	Usage	Material	Length (mm)	Width (mm)	Thickness (mm)	Quantity
1	Bottom plate	Plywood	900	600	12	1
2	Front plate	Plywood	900	600	12	1
3	Top plate	Plywood	900	600	12	1
4	Curved backs	Flexi ply	800	300	6	4
5	Hooks	Aluminium tube	250	30	30	2
6	Magnetic tray	Magnetic tray	200	250	30	1
7	Arcs	Plywood	1300	800	12	2
8	Hinges	aluminium	80	30	-	7
9	Storage doors	Plywood	1300	800	9	2

Examples of Plan for Manufacture

Pieces of work to evidence:

- Manufacture Plan
- Step by step explanation of how to make your design if you were to.
- Tools, Materials, components, processes.
- Quality Control checks – How would you ensure each part is made correctly – size, shape, finish, working?
- Health and safety – what health and safety checks will you make – PPE, extraction, remover sharp edges etc…
- Exploded diagrams.
- CAD drawings 2D or 3D to help explain how design will be made.
- Parts list – include size, number of and costings.
- Any test pieces, models or prototypes.

Key Points:

- **Planning the stages of your manufacture.**
- **Step by step.**
- **List materials, components, tools and machinery.**
- **What quality control checks will you need to carry out at certain stages?**
- **What Health and Safety measures will you take at certain stages?**
- **How will you consider the Environment and reduce impact on the environment during manufacture?**
- **A table or flow chart.**

Plan of manufacture

Below is a step to step plan about how I plan on manufacturing my chair. I have included details about how each step will be carried out and how I will be doing it in a safe way as well as quality assurance checks

Step Number	Machine/Tool	Materials	Process	Quality Assurance	Health and Safety
1- Getting materials	- N/A	- Hardboard - Dowel	- Gather materials listed in the "cutting list" on the previous page	- Ensure there are no defects in the materials (e.g. warping of the wood) - Check sizes of material are correct (e.g. check diameter of dowel with micrometer)	- Be careful about splinters when carrying the hardboard
2- Drawing designs to size	- Computer - 2D design program	- N/A	- Using the CAD program "2D design" draw out the layers of the chair design - Ensuring that I am not exceeding the limited size of the laser cutter (1200mm by 900mm) for each design	- Using CAD and CAM will ensure that each layer is identical in every way. This is important for comfort of the user and therefore the functionality of the product	- N/A
3- Marking out materials	- Pencil - Tape measure	- 8 x Hardboard sheets (2440mm/1220mm/3mm)	- Mark out the hardboard sheets 1200mm by 900mm, two of these size rectangles will fit on one sheet - The remainder of the wood will be used for the spacers which will go between each layer of the chair design, so no hardboard is being wasted	- Because the sheet I am marking out is very large, I need to be extra careful that it is being marked out correctly and that the wood isn't bending in any areas - To en-suite this doesn't happen I will mark the wood out flat on the floor	- N/A
4- Cutting out the main chair design	- Laser cutter	- 16 x Hardboard sheets (1200mm/900mm/3mm)	- Now that the material has been cut to size, I can put them each individually into the laser cutter and program the laser to cut out the pieces from the 2D CAD drawing I drew up previously on 2D design.	- Check the cut-out layers against the template to check the sizes	- To ensure I do not encounter any of toxic fumes from the laser cutter I will turn the extraction fan on whilst using the laser cutter and wait a minimum of 60 seconds before opening it to ensure that all the fumes have been extracted before I take my hardboard out
5- Cut out the spacers	- Laser cutter	- 16 x Hardboard sheets (300mm/200mm)	- Measure each remainder sections of hardboard to the correct size - Use the laser cutter to cut the spacer out	- Check the inside and outside diameter of the spacers by putting the spacers on the dowels and checking to see if there is a good amount of manoeuvrability	- Same as the above

Plan of manufacture Continued

Step Number	Machine/Tool	Materials	Process	Quality Assurance	Health and Safety
6- Cut the dowel	- Clamp - Hand saw - Pencil - Metre ruler	- 25mm diameter dowel of length 2400mm	- Mark out dowel every 400mm with a pencil - Cut the dowel using a hand saw. Ensure that the dowel is clamped in place so that it doesn't move whilst being cut	- As the total length of the dowel is 2,400mm it needs to be divided into 6 equal parts. So	- Clamp the dowel tightly enough so it does not move whilst being cut - Keep fingers a good distance away from the blade of the saw when cutting - Wear safety googles so no sawdust gets into your eyes - Wear an apron to protect the clothes you are wearing
7- Painting and finishing the hardboard	- Paint roller - Paint brush - String	- Different coloured Paint - PVA	- Mix the chosen colour of paint with PVA in a 10:1 ratio of paint to PVA	- I will do several layers of paint for every layer to ensure it covers the layers well and leaves a good strong finish	- Wear an apron to protect my clothes - No face mask will be needed as the paint is water based with no toxic chemicals/fumes to be inhaled
8- Pewter casting a logo	- Flame fast machine - Ladle - Metal vice	- Pewter - MDF Mold	- Make an MDF Mold using the laser cutting ensuring that there 3 parts; the cut out shape as well as 2 sides of solid MDF - Heat the pewter up to melting point using the flame fast machine and then pour it into the mold using the ladle - Sand down and polish the leaf logo until shinny - Attach logo to end layer of chair	- Fill the mould up slowly so that air bubbles are not trapped within the molten pewter as this would damage the aesthetics of the logo - Ensure the mould is fully filled by filling it with pewter until it starts to overflow	- Wear safety googles and an apron when dealing with the molten pewter as it may spit whilst it is being heated up - Use a ladle to transfer the molten pewter to the mold and keep yourself a safe distance away from it - Leave the pewter for at least 5 minutes to cool down before removing it from the mould
9- Knit a cushion	- Double sided loom - Hook	- Black Poodle wool	- Follow the steps for the loom knitting pattern using the hook, loom and wool - Knit until the cushion is just over 400mm long	- Keep the wool at a uniform tautness whilst knitting so that the pattern is maintained	- N/A

Plan of Manufacture

Task	Materials/ tools needed		Description of the process	Quality control	Health and safety
Marking out, cutting and preparing MDF box panels	MDF 12mm	• sand belt, • sandpaper, • tenon saw, • clamp, • pencil, • ruler, • hand drill, • drill bit, • pillar drill, • Bobbing sander • File (potentially)	This is the initial process I will have to complete for my manufacture. I will start by obtaining the 12mm sheets of MDF and begin to mark out 5 squares with a pencil and a ruler. I will mark 2 476x400mm squares, 2 500x400mm squares and a final 476x476mm square. Next I will use a clamp to clamp the wood in a work bench and proceed to saw down the markings with a tenon saw. Then, use the sand belt (if necessary) or sand paper to sand down the edges until fully satisfied. Then I will obtain the panel that measures 476x476mm (this will be the bottom piece) and use a pencil and ruler to draw a central 150x150mm square (this is the access to the electronics and where the aluminum square will be screwed over later on). Following this I will use a pillar drill and a large drill bit, begin to drill in a consecutive line slightly inside the 150x150mm square markings until the middle section is removed, leaving a hole in the wood. Thereafter, I will use the bobbing sander to sand the edges flat, so the cut out is as square as possible. After this I will obtain a second MDF side panel which measures 500x400 mm, I will use a pencil and ruler to measure a hole 150mm from the bottom of the panel, I will ensure the hole is central (250mm from the left and 250mm from the right) , and then use a 25mm forstner bit and a hand drill to drill a hole in this position. This will be the hole for the switch. Next, source the 2 panels measuring 476x400mm and use a pencil and ruler to draw the shape of the handles (see final design), ensure its drawn central and 30mm from the top and the handles are 120mm in length. Use the pillar drill to drill a chain link of holes on the inside of the markings, then proceed to use the bobbing sander to smooth the edges. ALTERNATIVE METHOD If the bobbing sander isn't working, use a file to smooth the edges. All 5 sides are now cut and ready. This includes 3 sides that have been cut and sanded, 1 side with a switch hole, and the base with a hole for electronics access.	Make sure the markings are drawn out accurately – double check before cutting out. Make sure the boxes are drawn close together – minimalize wastage. Saw down the lines accurately Make sure there's no rough edges. Make sure the square is central and accurate. Make sure the MDF is clamped and you drill in the hole for the switch, this is to ensure the hole is accurate. Double check the switch is the same size as the forstner bit. Make sure the drill is perpendicular to the surface.	Make sure you are wearing the correct PPE, this includes wearing an apron to prevent your clothes getting caught in machines, or dust/ harmful chemicals getting on your clothes. Make sure you are wearing safety goggles to protect your eyes from dust. Ensure the extractor is on when using the sanders. Ensure your fingers are a safe distance from the sand belt and bobbing sander. Ensure the drill is a safe distance from your fingers.
Marking out, cutting and preparing the acrylic	Clear Acrylic 5mm	• 2d design • Lasercut 5.1 • Laser cutter • Band saw (potentially) • Sand belt (potentially) • File/ sand paper (potentially)	The next component is the acrylic surface. I will start by loading up 2d design on a computer. Then I will draw a square using the line tool which measures 476x476mm. Following this I will export the 2d design document as a DXF file. This will be exported to my user area. following this I will load up Laser 5.1 on the laser cutter computer in the workshop and import the file from my user area. I will set the speed to 12, power to 100 and ensure the line is black, this means it will be a full cut, as opposed to an etch. I will then download the file to the laser. The next stage is to source a sheet of 5mm clear acrylic. I will try to use a scrap piece as opposed to a new piece in order to minimise wastage. Then I will put the acrylic into the laser, line the laser up with the corner of the acrylic, click 'test' on the laser to ensure the acrylic is in the correct place, then shut the lid and press start. This will cut out my square. After its finished cutting, I will wait 30 seconds for the fumes to extract and then remove the acrylic. ALTERNATIVE METHOD If there is a problem with the laser cutter, I could use a ruler and Stanley knife to scratch the dimensions directly onto the acrylic, and then proceed to cut it out using the band saw (the teacher would do this for safety reasons) following this I would sand the edges down. Once the acrylic is cut out, the next step is to frost the acrylic, I will be testing various methods during my manufacture. Now the acrylic is cut and prepared, ready to progress onto the next component (store acrylic in a safe place until needed)	Ensure the 2d design is correct and double check the units are in MM as opposed to inches. Makes sure the file has been exported as a DXF file. Test the laser to make sure the laser is lined up correctly. If I do the alternative method, ensure the measured markings are correct – double check with a set square that its an accurate square.	Ensure the laser extractor is on and you wait 30 seconds before removing the acrylic. For the alternative method: Make sure the teacher uses the band saw and that you're wearing safety goggles and an apron when using the sand belt.
Marking out, cutting and preparing the MDF support lips (to support the acrylic surface)	MDF 4mm MDF 18mm	• Pencil • Ruler • Fret saw • Sand belt • Band saw (potentially)	The next component is the support lip for the acrylic to sit on. In order to manufacture this, use a pencil and a ruler to draw 4 rectangles measuring 80mm in width and 440mm in length. Following this I will cut along these lines using a fret saw, I will then sand the edges until they are smooth and straight. I will use a scrap piece of MDF if possible in order to minimize wastage. Following this, in order to ensure the acrylic is supported with strength, I will cut out corner supports. To do this, obtain a piece of 18mm MDF and draw 4 rectangles measuring 18mm in width and 80mm in length. Then cut these using the fret saw, this should leave you with 4 square sections of MDF (18x18x80mm) these will go in all four corners for increased strength. ALTERNATIVE METHOD If the fret saw isn't working, ask the teacher to cut along these lines using the band saw. The support lips are now cut and prepared (store in a safe place until needed)	Ensure the measurements are accurate - re measure them to check, before cutting. Check that the rectangles angles are 90 degrees using a set square.	Ensure you are wearing safety goggles and an apron when using the fret saw. For the alternative method: make sure the teacher uses the band saw.
Marking out, cutting and preparing the hinged legs	Ply wood 20mm	• Pencil • Ruler • Tenon saw • Pilar drill • Bobbing sander • Crosscut saw (potentially) • File (potentially)	The next component is the hinged legs In order to manufacture this, I will be using ply wood as this is a strong and sustainable material. Draw the design onto the wood (as decided in my development section) it should measure 350mm at its widest point, and 200mm in width. Following this I will use a tenon saw and a bench clamp to saw long these lines. In order to saw the gap (see leg design on final design page) I will use a pillar drill to drill a chain of holes on the inside of the gap, and then use a bobbing sander to sand the edges until they are smooth. Finally: sand all edges until smooth. ALTERNATIVE METHOD: If the tenon saw isn't efficient or is difficult, use a crosscut saw, or the band saw (ensure its used by the teacher) If the bobbing sander isn't working, use a file. The legs are now cut and prepared (store in a safe place until needed)	Ensure the measurements are accurate – remeasure them to check, before cutting. Check that the design is correct: refer to final design. Ensure all edges are smooth to satisfaction.	Ensure you are wearing safety goggles and an apron when using the saw(s). For the alternative method: ensure the teacher uses the band saw.

Plan of manufacture

Start

I will take the bottom plate plywood and mark out the sizes using a ruler and pencil. I will use a protractor to measure the angle for the front side to be cut.

For all processes involving machinery, I will wear protective goggles and an apron

I will then cut the large bottom panel of plywood to size using the circular saw (making sure the extraction is turned on). I will use ear protection as this will be very loud. I will also wear goggles. This will be 20mm thick plywood. I will also cut the angle out of the front side for it to slot together with the wheel holder.

Next, I will take the plywood for the arc pieces on the back of the storage compartment. Using a ruler and pencil I will draw on the sides. I will then attach a pencil to a tight string, with one end connected on the arc corner to draw a precise curve.

These pieces will then be cut out using the circular saw and a handheld jig saw. Once cut out I will sand down the edges to make sure the curve is neat and the correct size.

Are the arc pieces the correct size?

I will take the large front panel of plywood and mark out the shape to be cut. Once measured correctly I will cut it out using the circular saw and jig saw (wearing goggles/ear protection). I will use the circular saw at an angle to cut the edge. I can then use the arc pieces as a guide to see if it fits correctly.

I can then move on to measuring out the top panel. For this I will use a pre-made template to draw on the helmet hook (I will draw a template on card and cut it out). I will use a ruler and pencil to measure and draw the rest of the sides

I can then cut out this panel, again using the circular saw (with the same protection), and I will use a jig saw to cut out the curved helmet holder on the top.

I will then cut out the storage unit fronts. These will be the parts that will fold down to access the tools and components. I will cut these out using the same template as the storage compartment backs.

Once they are cut out, I will use the laser cutter to etch the bike wheel pattern on to the side. This will add to the aesthetics of the bike stand. I will make sure to have the laser cutter on a low power, so it does not set the wood on fire.

For the curved side of the storage unit, I will laminate the wood myself. I will create a guide using a block of birch or other softwood and will cut out the shape of the curve. I can then laminate the wood using this guide, assembling the strips together to create the curve.

Are the 2 curved pieces identical to each other?

Once all these main pieces are cut out, I will sand them down using sandpaper. I will wear goggles while doing this. Some of these edges will be sanded to a slight curve to ensure they are safe for the user. I will also varnish them to improve aesthetics.

The first part of my design I will assemble is the storage compartment, I will use corner blocks to attach the back panel of the compartment to the sides. I will also use wood adhesive for extra security.

Next I will use hinges to attach the front panel. I will connect the hinges with screws, and then screw in a magnetic latch to the top of the compartment.

Next, I will connect the wheels to the underneath of each storage compartment. These will also just screw directly into the underside.

Next, I need to assemble the parts to the top panel. I will use two small hinges on each side of the magnetic tray. The hinges will be screwed directly to the top panel, and I will use a nut and bolt on the tray. I will attach a magnet to the top panel as well using adhesive, which will keep the tray in place when folded away.

The next part that needs to be assembled to the top panel is the hooks. I will screw these directly on to the plywood and use adhesive to make them stronger and more durable.

The next part I will have to manufacture is the wheel holder. I will use the sheet metal bender to bend two pieces of metal 90˚. I will then use a cordless drill and a jigsaw (wearing apron and goggles) to cut a slot in each piece. These can then be connected to another metal part which will be attached to the frame with a wingnut.

Using the storage units that I have assembled as a guide; I will then attach the actual frame of the bike stand.

I will attach the bottom plate to the two arc storage units with wood adhesive and screws. These storage units will act as a guide for attaching the larger wooden panels.

Next, I can connect the front panel for the wheel to slot in to. I will line this up with the storage units and the bottom plate to get it in the correct place. Once lined up, I can secure it with adhesive and screws using an electric screwdriver.

For the top plate, I will need to connect hinges and a locking system to the frame. I will screw a hinge on each side of the top plate and front plate. I will screw these directly to the plates, using a wood adhesive as well to make the bond stronger.

Once the hinges are attached, I can attach the locking mechanism. I will use a hacksaw to cut out two hooks. These will be attached to the front plate. There will be a catch on the top plate so the hooks can rotate and lock on to the catch. This will lock the top plate in place, and it can be put down when not in use.

Once the rollers are both cut out, I will cut 2 wooden planks to size for the frame. I will cut these using the band saw.

The final part I will have to manufacture is the wheel roller. I will mark out a circle on the end of a block of pine using a compass. I can then use the lathe to create the roller shape.

I can then add the final touches to the bike stand. The leather handle will be attached to the bottom plate using screws.

I will then use a hole saw bit on the pillar drill to cut a bearing slot into the rollers. I can then slot a bearing into the slot and connect the rollers to the frame using

The rods will be held in place by curved metal brackets attached to the frame. I will assemble these with screws, and then my project will be complete.

End

Manufacture Plan – Preparing the Drainage Tube

Introduction – This slide will show how to shorten the drainage tube to desired length.

Figure 1.

Shows mark being on the side of the ridge closer to the unused portion of pipe.

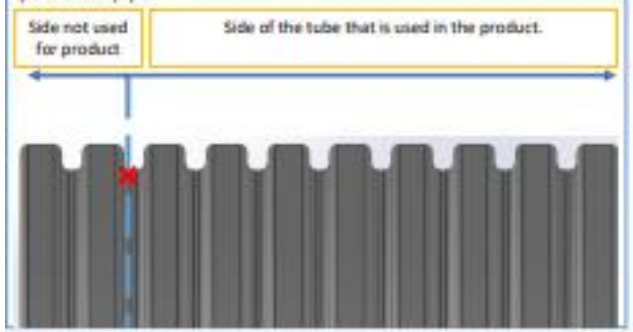
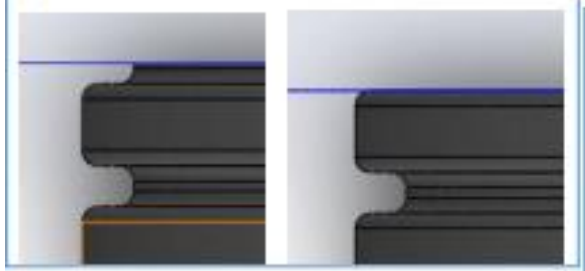


Figure 2.

On the left, is an example of an unfilled end I created using solidworks. Edges should be taken down to where they are on the right-hand picture. This is so the plywood pieces sit flush to the surface of the pipe.



This is a picture of me cutting the drainage tube. You can see my hand holding the part of the tube that I'm using firmly while I watch the blade to ensure it is in the right place.
I tilted the tube round once I cut through the side so I could work on different sections in this, the stance most likely to produce a clean accurate cut.

Preparing the drainage tube

Stage No.	Processes	Machinery/ Equipment	Specific Settings	QA	QC	Health and Safety
1	Mark in whiteboard marker the 17th ridge along.	- Whiteboard marker.	N/A	- Mark towards the side of the tube that will not form part of the product. (See fig 1) This will ensure the used section is not damaged during the wastage process.	-Wipe and try again if mark is made incorrectly.	- Solvents in some pens may make you feel faint so don't inhale pen fumes.
2	Cut tube: -Cut tube with a handheld saw. Using the mark as starting point.	- Saw	N/A	- Keep saw upright to ensure a straight cut.	- If cut goes wrong stop and reposition at a different angle.	- Keep fingers away from sawblade to avoid cuts.
3	Smooth edges: - File the ends of the tube. - Sand off until smooth.	- File - Sandpaper 240 grit	N/A	- Don't file too far (see figure 2).	- Check every so often to ensure filing hasn't gone too far.	- Keep hands away from the rough part of the file to avoid cuts.
4	Paint tube appropriate colour: - Using a spray gun, apply a layer of primer to the tube. Leave 25 minutes then repeat until primer layer totally covers the pipe. - Apply colour in the same way.	-Spray gun - Spray booth	- Correct paint in the gun.	- Spray from 20cm away in smooth up and down motions. - Avoid applying too much in one layer, this would cause cracking. - Rotate pipe regularly during each layer for an even finish.	- If paint cracks when it dries, gently sand it down.	- Ensure spray extraction is on. - Wear goggles and spray mask.

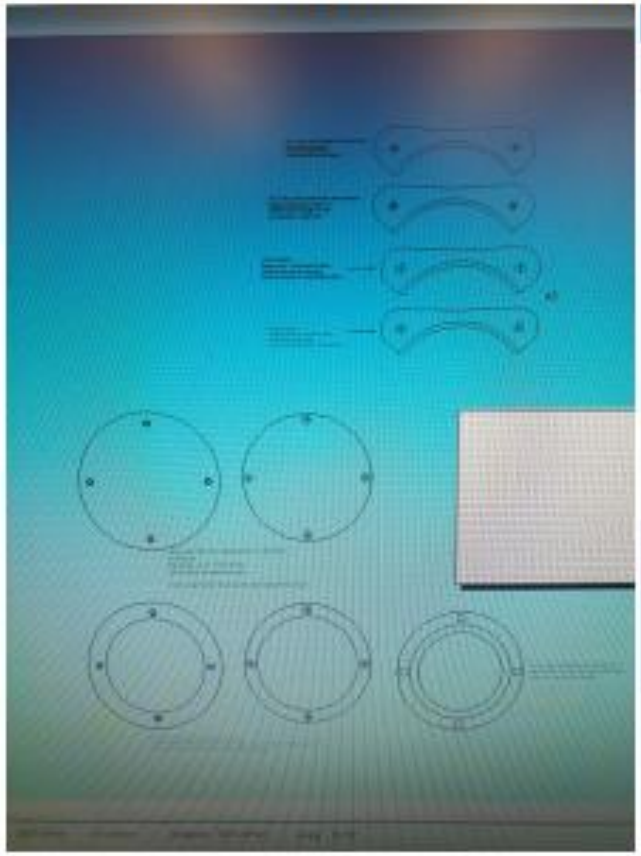
This closeup shows the saw as it cuts along the marked line. The line is bold to ensure I can see it all the way round and I stick to it.

This is me sanding the tube using the belt sander. I am holding the tube firmly to ensure the tube doesn't sand in the wrong place. I am also watching the base carefully to observe the cut as it happens and stop sanding if tube is at risk.

To the right, a closeup picture shows what the tube should look like after sanding. The aim with sanding down was to allow the ply pieces to sit flush with the tube edge (marked in red) so the scratches as a result of the process will be hidden and don't matter as they don't affect function.

Manufacture Plan – Plywood Parts

Introduction – This slide will show how to route the plywood components of my project.



Routing Plywood Parts

Stage No.	Processes	Machinery/ Equipment	Specific Settings	QA	QC	Health and Safety
1	Routing parts: - Design parts on 2D design. - Fill in shapes with appropriate colours (explained in 'specific settings') - Export the files onto the router and route the ply.	- 2D design - Bosford router	Colours for cut type: - Red 9 mm deep - Green 7mm deep - Yellow 4 mm deep - Blue 12 mm deep (all way through) - Black 12 mm deep (all way through) Other router settings: - Material set to 'hardwood'. - 6 mm cutter put in the router.	- When designing parts on 2D design use the attach tool to create shapes the router can use. - Use the router vacuum to remove sawdust or other debris from the router before placing the timber in. This is so the sheet can lie flat and the cut will be clean. - Ensure the MDF router bed is in good condition to protect the real router bed. If MDF is damaged route a new MDF protection sheet and use it instead. - Ensure High Vac and Woodworking extraction is on. - Order cutting colours so that outside cuts are at front. This ensures they are done last and the pieces don't slide about during production.	- Watch routing from start to end and stop production if it goes wrong; to avoid damage to pieces. - If router doesn't cut fully through use a file to get them out.	- Supervise at all times so nothing goes wrong. - Ensure extraction is always on.
2	Remove pieces from plywood board: - Use a file to split the thin remaining layer of wood and free the pieces. - Use a rat tail file to remove wood from the small holes.	- File - Rat tail file	N/A	- Use the file on the opposite side to what the router cut; pushing inwards. This avoids splitting of the wood. - When removing holes with rat tail file hold pieces up to the light so you can see the lit areas that require cutting.	- Ensure complete removal of excess wood.	- Keep fingers away from areas being worked on to avoid cuts. - Avoid touching splintered surfaces to avoid cuts.
3	Make pieces smooth: - File large bits of excess wood from edges. - Sand pieces to create smooth surfaces.	- File - Sand paper	N/A	- Remove all chips before sanding	- Check all surfaces and edges when you think you've finished to make sure a smooth surface is achieved.	- Keep fingers away from file and sandpaper when in use.

An example of an old router sheet where the cutter has taken chunks of MDF out and therefore decreased the suction of the bed.

(QA) Vacuuming the router to remove debris.

Routing in progress. (Note: in order to save materials and therefore cost I shared a sheet with another student; whose pieces can be seen in the bottom of the picture.

An example of pieces after routing. Filing should be done in the direction of the arrow to avoid chunks of ply being torn away from the piece.

Me running a simulation before starting the router. This is to ensure spacing is right and that all the shapes can be cut out.

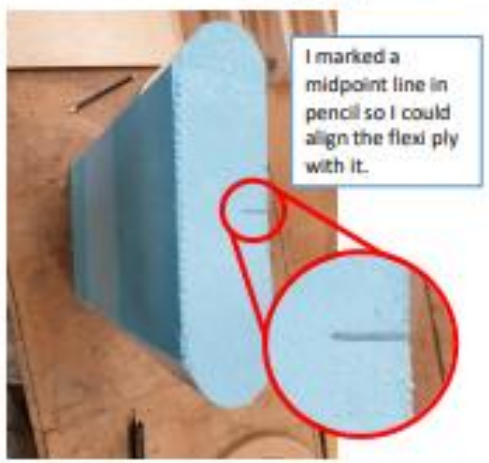
Manufacture Plan – Aero ply backrest former

Routing Plywood Parts						
Stage No.	Processes	Machinery/ Equipment	Specific Settings	QA	QC	Health and Safety
1	Using the laser cutter, cut a template for the curve in corrugated card.	-Laser cutter -3mm card	- Corrugated card - Layout set to 580 x 480. - Red lines mean through cut.	- Ensure the laser bed is free of debris so the cardboard sits flat. - Ensure the cardboard flat before manufacture. If not bend the cardboard gently as it may be misshapen though storage. - Ensure the laser is set to the top left of the bed by directing it with the arrows and red dot. This ensures designs are cut where expected so they all fit.	- If card sets alight immediately stop production. - Check template is identical to ply parts so that the eventual aero ply is too.	- Ensure laser ventilation is turned on. - Stop production if card catches fire. - Don't look directly at the laser.
2	Trace round the template onto 3 pieces of blue foam that are 150mm deep.	-Pencil	- N/A	- Ensure the templates bottom surface is flat with the foam so each block comes out the same dimensions. - Ensure to use a sharp pencil and keep it tight to the card so the template is accurate.	- -If template slips, cross the line so you know it isn't right and go again.	- Do process on a stable surface to void slips with the pencil.
3	Cut the foam on the bandsaw using the pencil line as a guide.	-Bandsaw	- N/A	- Ensure the foam is flat to the bandsaw surface so shape has a constant profile in the correct shape.	- If cut goes wrong, slowly reverse back through the cut and carry on the correct course. - Check blue foam shape against card template, if not identical repeat steps 2 and 3 for incorrect pieces.	- Wear goggles and work coat - Ensure woodwork ventilation is on. - Avoid putting fingers close to the blade to avoid cuts.
4	Stick foam together using double sided carpet tape. Trim off excess tape with a scalpel.	-Carpet tape -Scalpel -Cutting board.	- N/A	- Line up foam before you press them together so they line up correctly when stuck.	- If alignment is wrong. Prize apart with a scraper and repeat this process.	- Keep fingers away from the blade of the scalpel to avoid cuts. - Cut downwards to avoid cutting yourself.
5	Use 3 strips of carpet tape to add polyurethane to the surface of the former. Using a scalpel to trim excess tape off	-Carpet tape - Scalpel	- -N/A	- Ensure strips of tape are spread evenly apart so plastic is fixed securely in. - Ensure surface of plastic is clean to make sure the product is not stained or altered by artefacts.	- If plastic has any folds or is out of place, peel back carefully start again.	- Keep fingers away from the blade of the scalpel to avoid cuts. - Cut downwards to avoid cutting yourself.

This picture shows the cardboard template stuck to the blue foam before cutting.

This is me cutting the former out on the bandsaw. I made sure to keep my hands away from the blade as a health and safety issue.

This is the former stuck together with plastic layer applied. Notice, tape is evenly spaced to make sure entire plastic sheet is stuck down properly.



I marked a midpoint line in pencil so I could align the flexi ply with it.

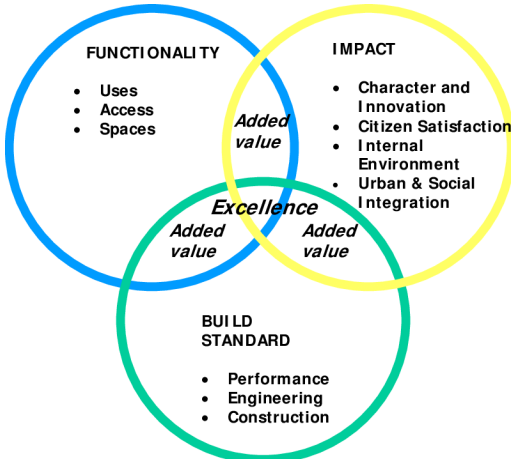
Section E: Analysing and Evaluating (15 marks) – this year only

Continuous Testing and Evaluating of:

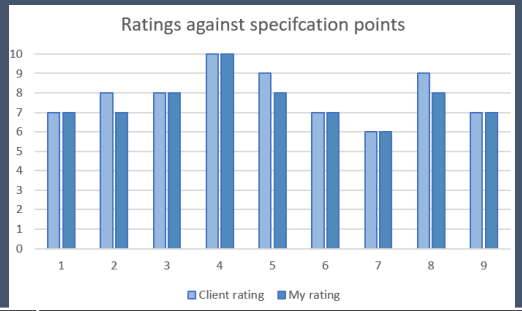
- Design Ideas.
- Models.
- Final Prototype.
- CAD Drawings.

Pieces of work to evidence:

- **Testing and evaluating final design** – Compare final design against your specification points. Score them out of 10. Explain the areas of strength and weakness in your design. Costs. Timescales.
- **Testing any CAD models, card models or prototypes you have made.** Stress / strain test. Environment Impact / Carbon footprint. Weight. Suitability of materials. Size. Comfort.
- **Client feedback and analysis** – Feedback from you customer / client on your design.
- **Modifications and improvements** – how could the design be further developed improved? Drawings to show what this might look like.
- **Commercial Manufacture** – If you had to manufacture 1000 units, what methods could you use to improve accuracy and efficiency in the manufacture of your product? Templates, jigs, CNC machines.
  Would certain industrial processes be better suited?
- **Product Lifecycle Assessment** – Cradle to the grave assessment of your design. What impact will your product have at each stage? Standards and legislation.



Evaluation



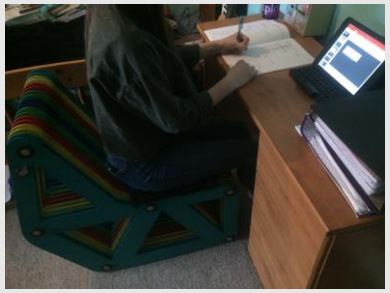
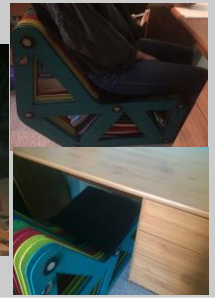
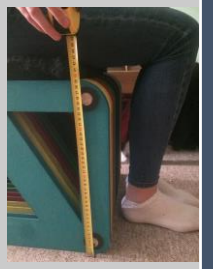
The overall average rating I gave my final product was 7.5/10 and my clinets was 8/10. I am happy with both scores but now looking at the final product I can see areas where I would be able to improve the product to meet the specification points more.

From looing at both mine and my clinets ratings I can see the points that I did not fully fulfil was having a chair that is comfortable to use for prolonged periods of time (6 hours) as well as the space efficient and suitable materials specification points. These are areas I will look at for my further modifications.

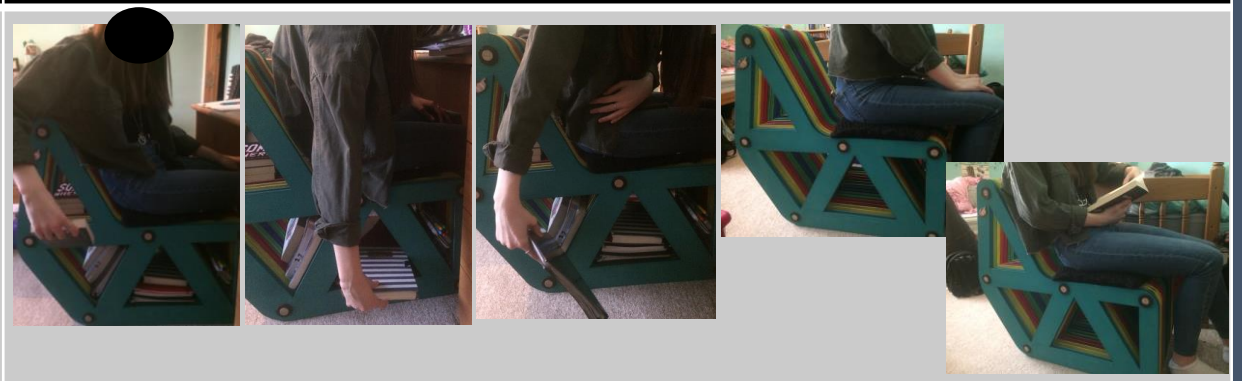
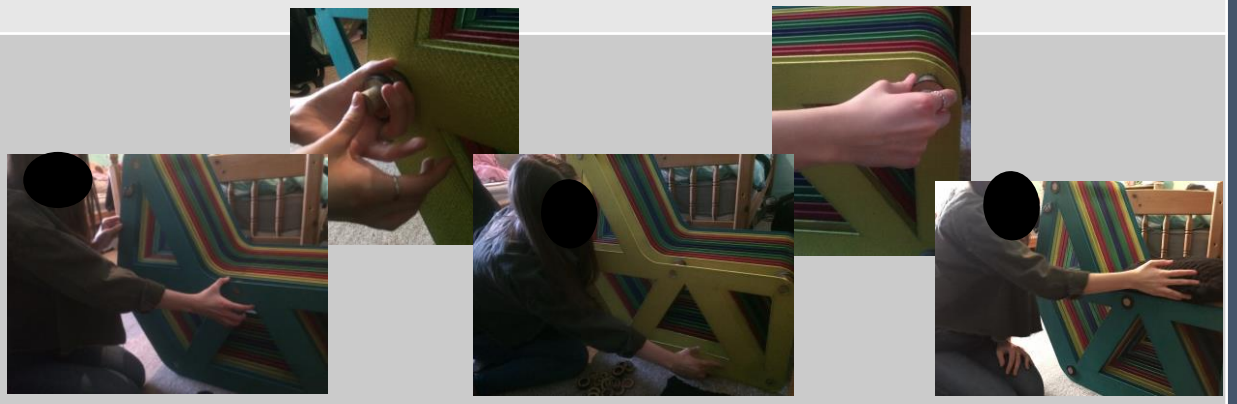
Specification point	Measure of success	Client rating
1. Make a product that would stand out within the surrounding environment	The shape of the chair is unique because of the storage options within it and that makes it stand out in its environment.	7/10
2. Due to the target market of my product I am going to ensure that my chair could be sold for £50 or less	I spent £45 on hardboard, £13 on the dowel, £2 on paint and £2 on yarn. This comes to a total of £62, my goal was so stay below £50 however my client was understanding and willing to pay more than this if I incorporated space efficiency or storage options to the chair which I did both of.	8/10
3. Use materials as well as manufacturing processes that make a product which will have a minimal negative effect on the environment through its entire lifecycle	This specification point was considered repeatedly through out the design as well as manufacture of my product, everything right until the finish of the chair. The only part which I would consider to have a negative effect on the environment would be the use of the laser cutting due to the fumes realised from it.	8/10
4. Ensure that my product fits the size restrictions of a standard student room.	The final chair fit within the size restrictions, which were 500mm by 900mm by 1000mm, that I had set out in my diary of manufacture hence this specification point was completed fulfilled.	10/10
5. Ensure that the chair functions first and foremost as a comfortable chair that can be used by a student, primarily for studying	The product functions as a chair very well. It is stable and is comfortable to sit on, so this specification point has been achieved. The only negative is that sometimes the cushion can move because it is completely detachable from the chair itself.	9/10
6. Make the chair as space efficient as possible	I made the chair space efficient in two different ways. I made it flatpack as well as multifunctional as storage space. The chair being flatpack means that it can be easily assembled and disassembled when needed (for example when a student is moving to a new house) I will be testing how easy it is to disassemble and reassemble as well as if it was time effective.	7/10
7. Have a chair that is comfortable for use for prolonged periods of time (6 hours)	This will be tested.	6/10
8. Suitable for use by a student between the ages of 16 and 25	This chair fits for a 16 to 25-year-old and would also probably suits older adults as well	9/10
9. Suitable materials for making a chair	The main reason why the chair was uncomfortable for prolonged periods of time was because of the material choice and how the material was used in layers which were, after some time, uncomfortable to sit on even with the use of the cushion. The cushion was relatively thin and	7/10

Testing final product

All the tests which I will be doing on my final product will be to evaluate how well I have met the specification points which I set out to achieve at the beginning of this project.

Test name	Test method	Result and comments	Picture
Weight testing	To test how much weight my chair could withstand I put weights on the seat area to see at how much weight it could withstand I also had several different people ranging from 18-25 years old sit on my chair including the client.	I had several different people, all within my target market, sit on my chair so that I could see how the weight of different people was handled. I had one person of 58kg, one of 69kg and one of 87kg. The chair withheld all this weight with no problem at all. In addition to this the chair easily withheld the weight all the books, folders and textbooks which were being stored in it as well as the user sitting on it.	   
Environment testing	To evaluate how well my final product fits in with the surrounding area I took it to environment in which it will be used by the client. This is the clinets bedroom which she has at university, the chair will be used mostly at his desk so this is where I will test the chair.	I had the client use the chair in several different ways. Using it as a chair at a desk to do schoolwork and well as using it leisurely to read a book. As you can see from the pictures the chair was easy and comfortable to use in its desired environment. Aesthetics wise it also fit in with the environment as the room had standard natural wood furniture as well as the teal coloured walls.	 
Size test	I will access how well the chair physically fits into the environment. In my updated specification I made it clear the chair could be no larger than 500mm by 900mm by 1000mm. If it can be comfortably used with a standard sized desk as well as if it fits to the shape of the human body.	I measured the height of the chair in relation to the height of the desk as well as the width of the chair in relation to the length of the desk to show that the chair can be used comfortably at the desk. I also looked at how the user's legs were sitting on the chair to see if it was at a comfortable height, which they were. *"The chair was definitely a comfortable height to use with my desk and it fit the shape of my body well"*	    
Durability of materials	I will let the client use the finished product for several weeks and then come back and inspect it to see if any of the parts had been worn away or damaged during use.	After use of the product for some time I checked different areas of the chair to see if any damage had been done to any of the parts. I saw that some of the paint had started wearing away on one of the teal layers. This is possibly due to when the spacers were being taken off an put back off and they were rubbing against the layer. The materials themselves are still very high quality and have shown no signs of wear or tear	   

Testing final product

Test name	Test method	Result and comments	Picture
Ergonomic test	I will observe the user sit on the chair and see how they take books and other objects out from the storage underneath the chair.	I asked the client to sit on the chair and try to take objects out of the chair from the different areas. The feedback I got from my client was that *"It was easy enough to the books out of the storage holes however it proved difficult to put the folder but in the far-left bottom hole because of the shape of the hole and the other books which were already in the hole"*	
Lightweight for portability	I am going to get the client to try and move the chair into the desk and push it backwards to see how easy to be would to move a daily basis.	I had assumed because of the thin materials that I was using that my finished product would be lightweight so that the user would be able to move it when sitting on it. However it proved hard to some extent to move the chair as it was dragging along the floor and difficult to lift the whole chair due to the weight of the chair itself as well as the objects stored in it.	
Disassemble with ease	I wanted to test how long it would take for the user to disassemble the chair as the idea behind not using any glue or other permanent fixtures was so that the chair could be disassembled and then re assembled in another place if it was being moved to another house/ area. I also wanted to access how easy it was to assemble and disassemble.	It proved to be difficult to some extent to both disassemble and reassemble the chair due to how tightly some of the spacers were on the dowels. *"Some of the spacers were much harder to take off then others and it was fairly time consuming to disassemble. I would say it was simple to do as you are just moving circles off a dowel, however time consuming*	

Feedback

After testing my final product I sat down with my client to talk about what specific feedback they had about the final product and asked them what they would change so I had client input before I started doing my modifications

Sitting down with the client:

Positive feedback:

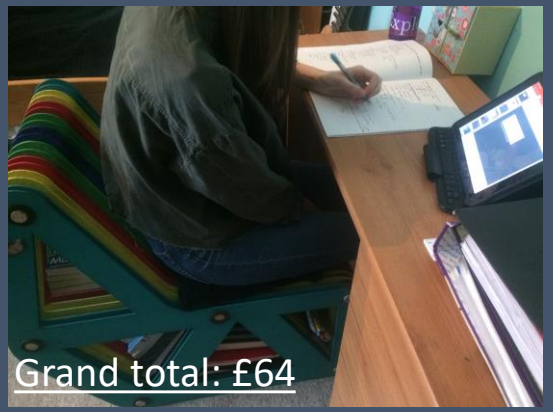
- *"The overall aesthetic of the chair with the curved edges and unique shape really appeals to me. It is not like any other chair I have seen before. The shape also compliments the storage sections well and these parts don't look like they have just been put in randomly but thought out to work with the shape of the chair"*
- *"The price for the quality of chair you are getting is fair in my opinion. I would be more than happy to pay £65 for this considering the incorporation of storage, being completely flatpack and the environmentally friendly element being maintained through out"*
- *"The product is the perfect size for me to use"*
- *"The shape of the back and seat really compliment to natural state of the human body, I found it very comfortable to use at a desk doing work as well as using it as a longue chair"*
- *"Very simple to assemble"*

Negative feedback:

- *"Use for prolonged periods of time"*
- *"The design of the layers of the material makes it uncomfortable to some extent perhaps a different design would be better whilst still having the use of the environmentally friendly materials"*
- *"Due to the high number of parts it was quite tedious to take part and reassemble"*

Material	Total cost
Hardboard sheets (18 layers- 4 layers = 1 large sheet)	4.5 x £10 = £45
Dowel	£13
Paint	£2
Pewter	£2
Poodle Wool	£2

I worked out the total cost of the final product, factoring in the amount of materials I used in each case for example I did not use all of the wool I brought because of the small quantity I needed.



The main bulk of the cost was on the hardboard as well as the dowels. One of the things which I noticed during testing of the final product was that the chair was quite wide and the overall width could had been reduced form 400mm to 350mm. This reduction in width would had meant less layers of hardboard which would had reduced the cost by roughly £10 as 4 layers could be taken off which took one sheet of hardboard

Another way to cut the cost in relation to materials would be to use a dowel with a smaller diameter which would had cost less money. I opted for a larger dowel for aesthetic and structural reasons but seeing the final product being very strong I think a smaller dowel would had been sufficient.

What would the client would change:

"Through general use of the product these are some suggestions I would make.
After using the product for several consecutive hours it started to become uncomfortable despite the addition of the cushion. So I would suggest changing the product in some way to improve prolonged use of it.
Another issue was with how time consuming it was to disassemble and reassemble the whole product. Perhaps reducing the number of total parts somehow would be useful so that it would be more time efficient"

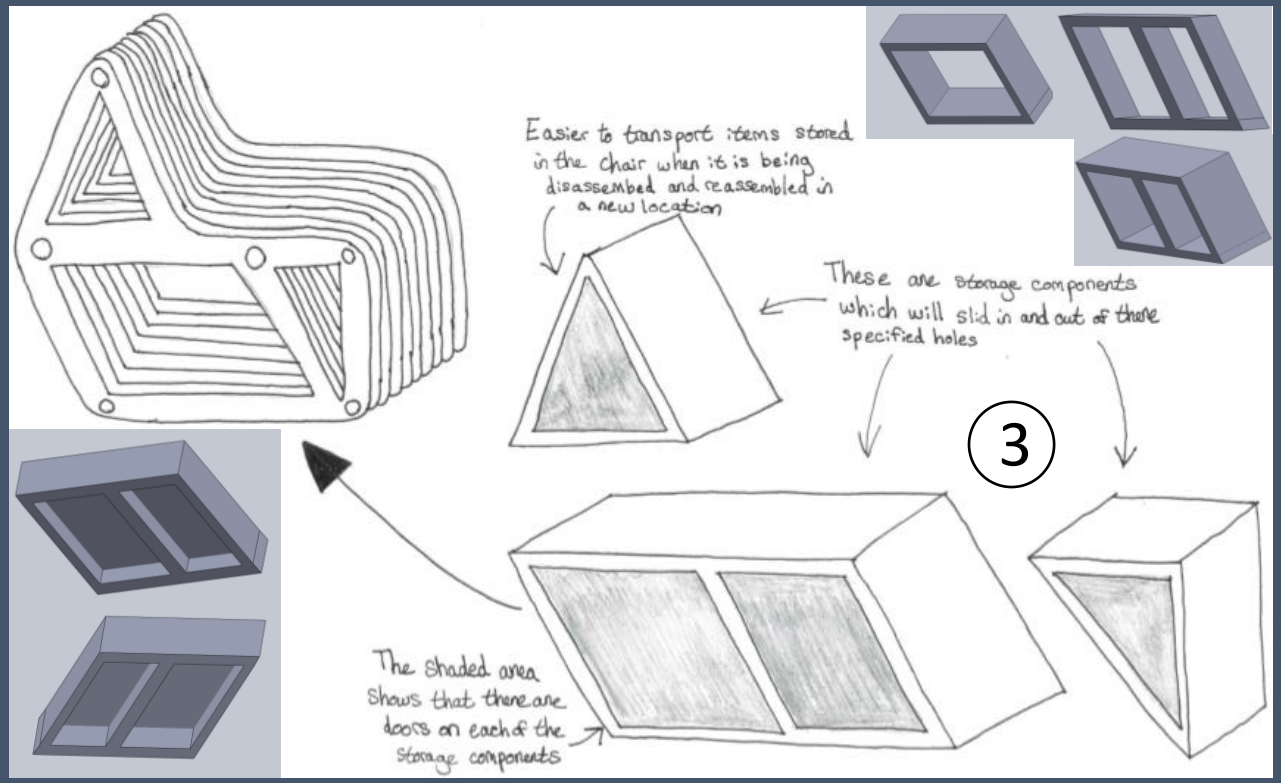
For my modifications I am going to consider some of the areas of my chair that myself and my client felt could be improved. I will look at the issues and then make modifications in terms so solve these problems.
Two areas which my client brought up after using the product for a few weeks were the comfort after prolonged periods of time as well as the amount of time it took to disassemble and re assemble. Even though the chair is flatpack it isn't very time effective when disassembling it, so this is one of the issues I aim to fix.

Modifications:

1. Add integrated cushion on the seat using thicker material to make the chair comfortable for prolonged periods of time
2. Change the design so it can be made of less parts so can be assembled and disassembled more time efficiently
3. Add storage components so that a wider variety of objects can be stored and taken in and out of the chair with ease
4. Making the chair more portable within the environment it is being used in

Modifications

These are two of the modifications which I made to my final product after talking to the client and testing my final product against the specification points.



3) During the development phase of my design before reaching my final design I was concerned about the structural integrity of my product which is why I opted to use triangle shaped storage for the whole of the design so that there was enough material supporting the seat which is where most of the users weight would be situated when in use.

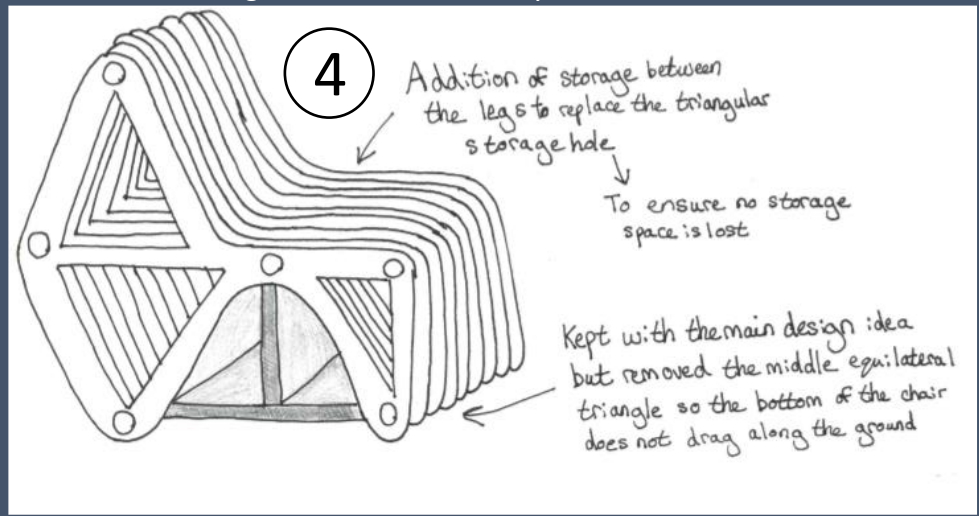
With this modification I have swapped the two equilateral triangles at the base of the chair to a much larger parallelogram to keep with the angled design. But to ensure I keep the strength of the design I have added separate storage component boxes which will be able to slide in and out of the chair freely when needed. This will add some weight to the overall chair but will also allow for the items stored in the chair to be transported much easier when the chair is being disassembled as well as give the opportunity to add doors to the storage holes so that none of the items being stored can fall out of the holes.

I did some CAD Solidworks designs of the main parallelogram storage component showing how I would keep it as two separate areas because of the size of the objects needing to be stored in this area

From my user testing ergonomic test it was clear that it proved somewhat difficult to put the items back into the holes because of the gaps between layers of the chair. It also meant to smaller items such as stationery items could not be stored due to them falling through the gaps to the bottom of the chair and not being able to be reached by the user

4) Another issue which arose during the testing of the final product was how it wasn't very lightweight. This was an issue as the user needs to move it in and out to sit down on it at a desk for work. My user also wished to move the chair around the room regularly for when she was using it for more relaxing purposes opposed to doing work at her desk.

The issue was with the chair dragging along the ground as it doesn't have the traditional "legs" of a chair. So for this modifications I gave my chair the more traditional "legs" However I wanted to still utilise this space between the legs; I had the ideas of adding a plank of wood between the legs so that items could still be stored here but there would not be the issue of the large surface area touching the ground making it difficult to move around the room.



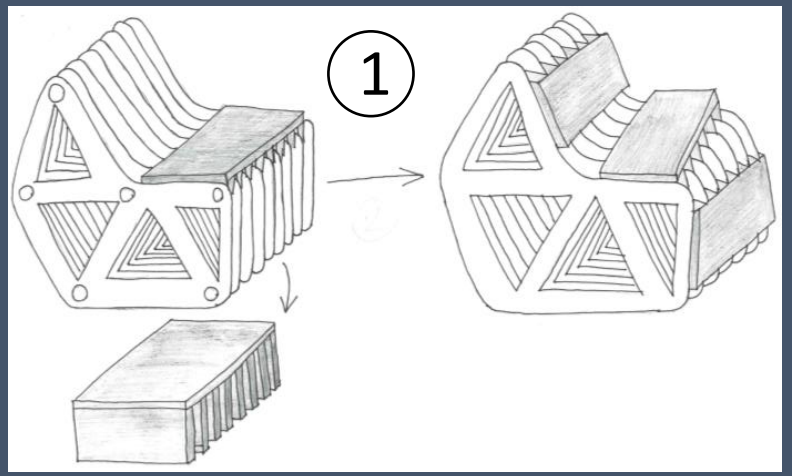
Modifications

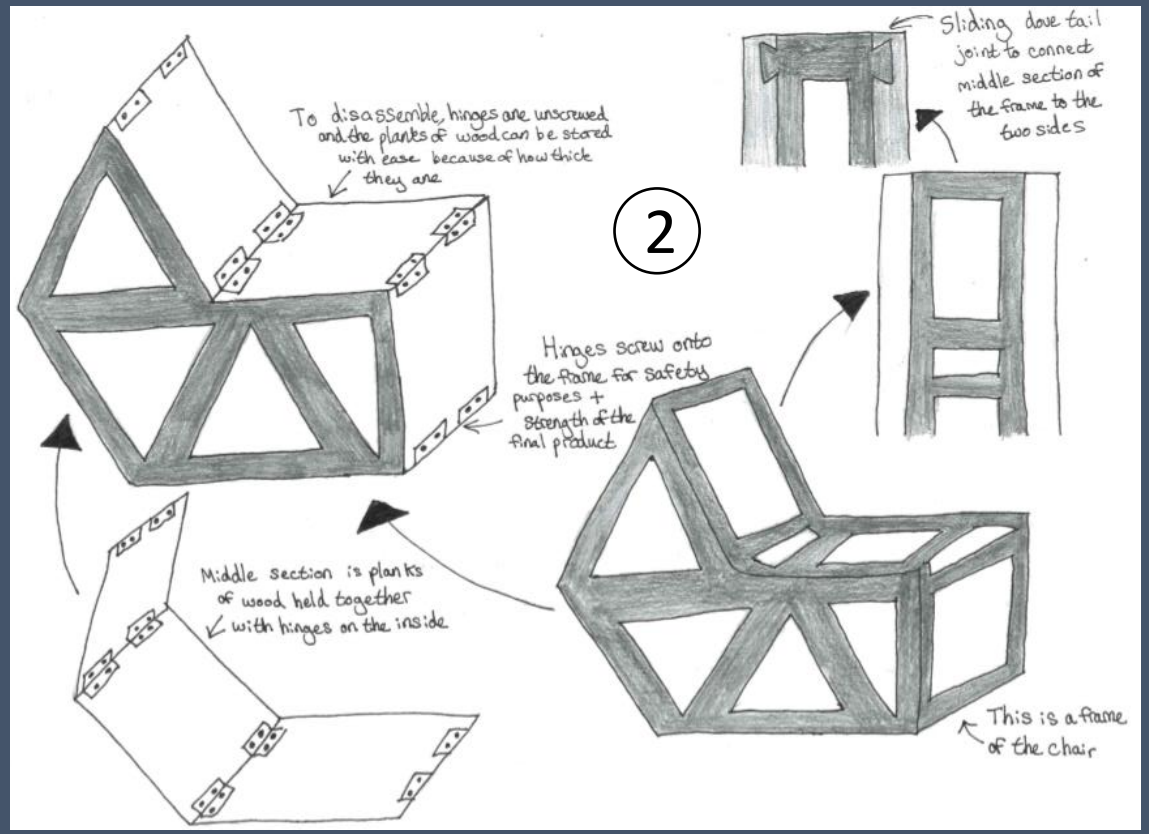
Here are a further two of the modifications which I made to my final product after talking to the client and testing my final product against the specification points.

1) Integrating the cushion into the main design of the chair was important to ensure the user would be able to use the chair for prolonged periods of times. Initially I just had the cushion on the seat just like I did for my final product.

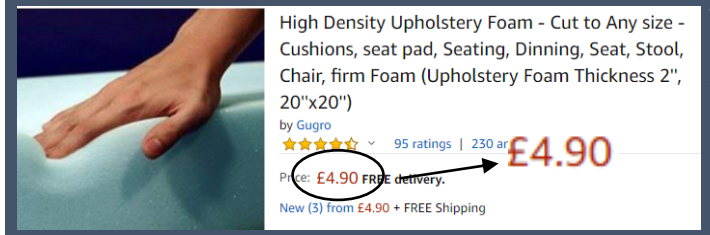
However I then had the idea of adding cushions to the back rest as well as the back of the users' leg area to maximise the comfort. Also with this idea the cushions may be able to hold the layers together so there would be no need for the dowels and excessive number of spacers. Which would solve the issue of the chair having too many parts for it to be time efficient as well.

I would have the main frame part of the "cushion" be hardboard which would slot between the layers and then the actual cushion part which the user would sit on be filled with high density foam so that it would be firmer and the user would not sink into the cushion as much as the current one I manufactured. This is good because then the user would not feel the uncomfortable nature of the gaps between the layers which is what the user reported as being the source of the discomfort after prolonged periods of time.





I had opted to knit the cover and fill it with a standard cushion pad. However after seeing the results of this I would now change the inside of the cushion to memory foam. This would increase the cost of the cushion drastically but would also increase the level of comfort for the user, particularly over long periods of time



The addition of the frame part is so that the cushion will not move when in use but can still be removed from the chair when it needs to be disassembled and reassembled. Hence why adding it into 3 different areas of the chair could mean that the chair would not need dowels to hold it together. However this would have to be tested before I could confirm if this could work or not.

2) Another issue I found during the testing stage of my evaluation was the point about being able to disassemble it with ease. Due to the numerous parts of the final product the user found it very time consuming to disassemble as well as assemble which was not favourable.

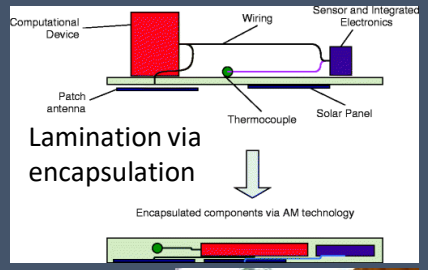
To solve this I had the idea of constructed a frame for the chair out of hardwood with sliding dovetail joints connected the two faces of the frame with the middle section where the user would sit so that the product would still be flatpack. On top of this frame would be several planks of wood held together with hinges that would go the whole way around the chair. They could be easily and quickly disassembled by taking the screws out of the hinges that attach this section to the frame and then sliding the middle frame section away from the sides. This will be much more time efficient than my current chair design with the numerous spacers between each layer which the user must take off by hand.

Modifications for industry

On this page I will be looking at how I could make my product for commercial use. In this project I used one off production which is ideal for bespoke handmade products when only one is being made. However if I was looking to produce this product on a larger scale, such as batch production, I would need to make some changes to the manufacturing process and materials used. This product took 6 weeks to manufacture however with the use of automated machinery this time could be greatly reduced. Batch production is much more reliant on machinery as it takes less time and is more accurate.

Some of the core points which my chair was trying to achieve was for it to be as environmentally friendly as possible. The main way in which I found it hard to avoid negatively affecting the environment was with using the laser cutter. And it is the same in industry, the very large majority of products are made using automated machinery which cause massive amounts of water and air pollution every year. This pollution is mainly caused because of how the machines are powered; with fossil fuels.


Die cutting




Staining wood via spray with a machine


Staining wood via spray

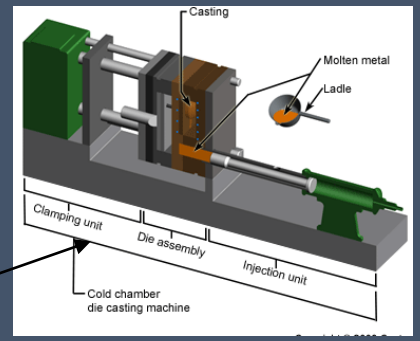
Main layers:

I would use die cutting to stamp out the shape onto the sheets of hardboard using a steel stamp. This would be much less time consuming than using a laser cutter as well as better for the environment as using a laser cutter can be fairly damaging to the environmentwith the toxic fumes that it emits as it is a CO2 laser

It would not be efficient to paint and finish every single layer by hand like I did in my project. In industry you could laminate each layer via en capsulation which would seal the hardboard in a polymer sheet, this sheet could be a variety of colours. One of the issues with laminating each layer is that the lamination cannot be taken off so at the end of the products lifecycle it would not be able to biodegrade or be recycled. Lamination also adds weight to the product which could be a problem as the chair was already quite heavy. Another option, which would be environmentally friendly, would staining the wood however there are problems with this in industry as a stain can only be applied by hand using some form of brush/cloth. Perhaps some form of machine could be used to spray stain on the layers but it would need to be at the correct pressure as wood stain is much thinner than paint and excess use can led to heavy runs and drips. However using a stain would work as you can get waster based ones which would means the hardboard can be recycled at the end of its life.

Logo:

There are several ways in which this logo could be manufactured in a way to better suit batch production. I could still use low temperature pewter casting but I would need to produce a longer lasting mould. Making a mould out of aluminium or steel would be ideal as they have a higher melting point than pewter.
Another option would be to use pressure die casting as this is ideal for casting items quickly in high volumes. However you would not use pewter for this but instead a metal with a higher melting point, which could cause an issue with recycling the logo and the end of its life cycle.
A final option could be injection moulding. Injection moulding uses plastics which typically have a negative impact on the environment but if some type of synthetic bio-polymer was used this would solve the issue. Using a bio-polymer would not only aid the eco-friendly part of my project but it would also mean that the logo would not need any polishing or finishing after being injection moulded as it is a self finishing process



Pressure die casting process


Flat line knitting machine

Cushion:

For a cushion cover to be made in batch production it would be priced using a flat line knitting machine, The machine would be programmed to knit a certain pattern with specific dimensions and then once both sides were kitting it would be stuffed with either a standard cushion liner or perhaps memory foam (as discussed on the previous page) and the rest of the sides sown up by hand. This would be a lot less time consuming as it took for me to hand knit the cushion, in total it took around 6 hours to hand knit and with this machine it would take 30 minutes maximum. Meaning more cushions could be made in a quicker time which is ideal for commercial use

Product lifecycle evaluation

One of the core values of my product was it being as environmentally friendly as possible. On this page I am going to discuss the ways in which my product was conscious of the environment, and how I considered the different stages of the products footprint, as well as the ways in which I could improve the product to make it more environmentally friendly.

Manufacturing:

Laser cutting: The use of the laser cutter was the biggest way in which my product to some extent failed to be environmentally friendly. There are certain aspects of the laser cutter which are helpful to the environment, such as CAD software which allows for minimal wastage of material and with the recent development of fibre lasers they are more efficient by 200%and save 70% electricity compared to CO2 lasers making it a technology with one of the lowest running cycles. Unfortunately the laser cutter I had access to used a C02 gas laser so I did not have these advantages.But these figures show how laser cutters and moving towards being more environmentally friendly, however for the current time using some form of jig process like die cutting would had been favourable in this case.

Pewter casting: I used low temperature pewter casting to mould the leaf logo. This method was quite environmentally friendly as the flame fast machine only heated the pewter to approximately 245°C which is relatively low for a melting point of a metal. This low melting point meant to machine used less energy to heat the pewter up than another metal.

Recycling:

Hardboard: Will be used as biofuel at the end of its lifetime as it has already been recycled from natural wood to be produced

Pewter: Can be melted down and reused

Poodle wool: Will biodegrade into the ground

Raw Materials:

Hardboard: The material which the majority of my chair was made from was hardboard. Hardwood is a man made board and is made from wood fibre which has been extracted from chips and pulped wood waste. Heat and steam is applied to leave a the fine brown fibres. The sheets are held together with light and pressed together to give a grain less, smooth texture. Man made boards are typically more sustainable to use as they are constructed from the waste parts of hardwoods.
At the end of the chairs lifecycle the hardboard will be recycled. Hardboard is classified as a grade C wood and as such would be used as biomass fuel at the end of its lifecycle. The hardboard in my product was As the paint I used was water based it could be recycled with no problem at all.

Pewter: Pewter was used for the leaf logo. It is a tin alloy and therefore has a low melting point which is useful for when it is being casted and also useful at the end of its lifecycle when it can be melted down and recycled into another product.

Poodle wool: Even if wool cannot be recycled it is important to recognise that the wool fibre is naturally biodegradable, so at the end of its lifecycle it will decompose over a relatively short period of time.

It is evident that I thought very carefully about the "footprint" of my product through out my product. From where my materials were sourced to how the manufacturing methods affected it all the way to what would happen to the materials at the end of the products life. The only area where I could had improved the products footprint would have to be with the use of the laser cutter and the laser cutter I used did have a CO2 gas laser and because of this it did emit toxic fumes will in use

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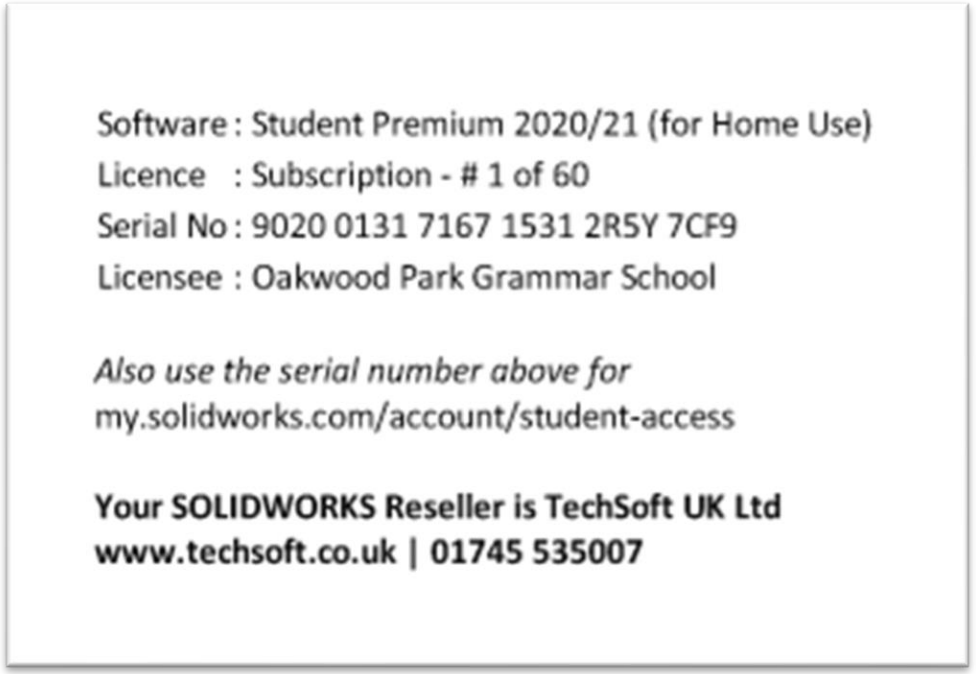
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