Product design coursework

Joe Guilford

Candidate number: 9070

Centre number: 62451

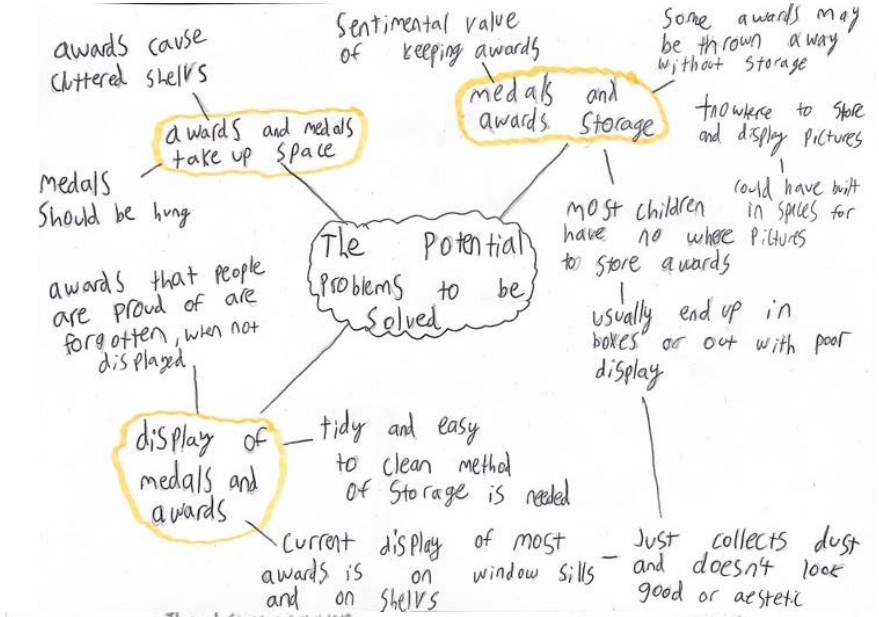
Feedback

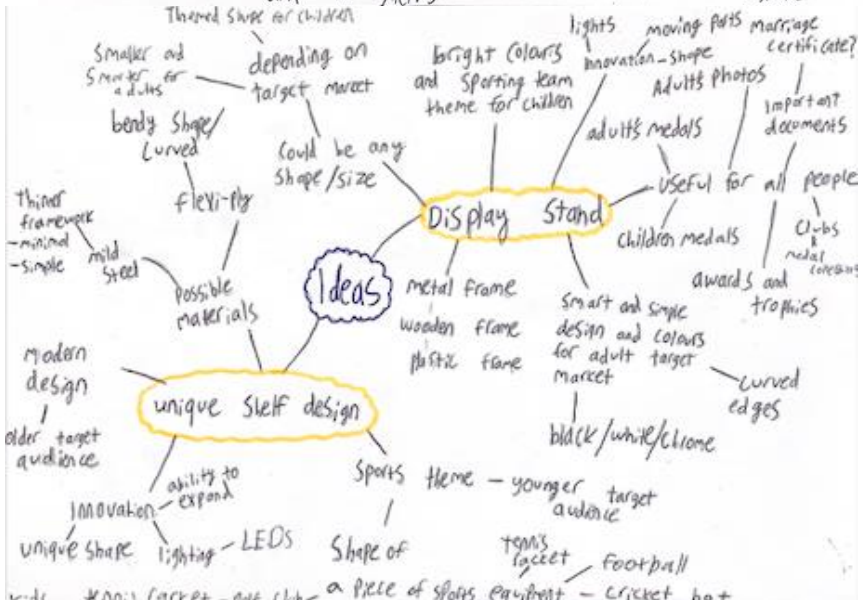
Primary research

Secondary research

1. Investigation of the context

I have investigated some ideas for what my innovative product could be:





Innovative features

Products are designed with innovation in mind to be more popular with consumers and profitable for the company. This is achieved by having a design different and superior to competitors. Some specific features to make a product innovative include:

- Lights (LEDS)
- Unique design
- Innovative features such as clips to hold medals at specific heights
- Specific unique theme
- Intricate shape
- Useful function compared to current designs such as more space for medals and awards

Current issues to address

In my investigation into the potential problems, I found that the issues my product could fix include:

-medals wasting space
-nowhere to store/display medals
-unorganised storage
-clear space on windowsills and surfaces
-de-clutter

Conclusions drawn from the page

One conclusion drawn from this page is that my product will be related to storage and display of awards. Also my product will be made innovative by features such as a unique design and using clips to adjust medal heights. Another conclusion drawn from this page is that I would like to use sustainable materials for my product.

Environmental considerations

One aspect to consider in my design is using recycled materials in the construction, however this may not be possible for some aspects, such as timber components. Another environmental consideration is using materials that can be recycled when the product is disposed of. This can be done by creating joints that can be broken and are not fixed permanently, for example nuts and bolts rather than glue. Also the ability to repair the product is important as it reduces the amount of products that are thrown away and replaced. An environmental advantage of a medal holding product is that fewer medals will be thrown away or unused as people will make best use of medals. Having them on display and somewhere to keep medals and awards reduces the need to get rid of them .

Next steps: continue investigating similar products and conduct a questionnaire on the thoughts of consumers

Mood board of product style inspiration

This mood board was created from browsing google to find similar products that have features I could adapt for my idea. Looking at pictures of products inspired some ideas of how my idea could be different and innovate in the market.

Opportunities for further consideration

My investigation into ideas produced numerous possible products that could be designed to address the problems to be solved and issues to address. The main ideas are:

- Display stand (medals)
  - Useful primarily for children with lots of medals
- Display stand (trophies)
  - Also primarily designed for children who play sport
- Shelf (various awards/items)
  - Useful for all people, not an innovative idea
- Medal hanger
- Sports equipment based storage solution
- Custom trophy stand for specific demographics and sports
- Free standing shelving unit

Feedback – Ed Carpenter (Stakeholder)

Q)Do you believe that a piece of furniture for holding medals and awards could be profitable?

A)Yes, however it is a quite niche product so think carefully about the market and where is best to promote / sell something like this.

Integrated lighting is a nice idea – my advice would be to keep it simple though.

1. Investigation of existing products

Research on current market

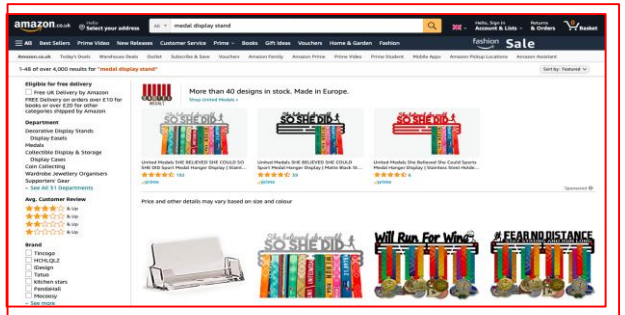
Current display stands for medals are simple and basic in design

Some designs have quotes relating to the sport

Potential for designs directed at other specific demographics – for example, children, elderly, genders

Current designs are more specific to sports rather than specific demographics

Most designs that appear first from online searches are similar

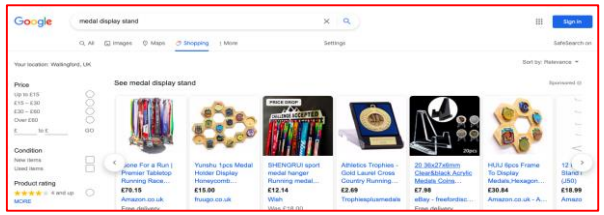


Most current designs and products are themed around running or football

Metal, coated, flat shape with writing in bold lettering along the top

No designs that I have seen online have been able to reduce the visible length of the ribbon on the medals

No design jumps out as a design that everyone can use



This feature would reduce the amount of space taken up and also make the medals look neater in a more compact format

For example, for many products, companies such as Ikea will have a very inclusive and affordable design that will take up much of the market

Prices vary from £12-£40 for simple metal designs on sites such as Amazon UK

Some specific unique designs can cost far more, some seen around £70 and designer shelfs with similar properties can cost

Amazon products tend to be cheap and mass produced on an industrial scale. Many of the products found were very similar metal designs for a low cost.

Types of awards

These are the types of award that the product should be able to hold and display :

Medal
- Professional medals weight between 450g and 550g and ribbon length is usually around 4 inches

Trophy
- Come in many different shapes and sizes
- Kept on flat surfaces

Certificate
- Often kept in frames and can be hung with a nail or can stand on a worktop/flat surface

Primary research – quick questionnaire on current situation

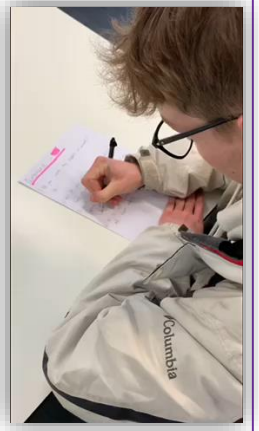
I asked some people I know in 6th form some questions about what medals and awards they have and what kind of product they would be interested in purchasing.

1-Do you have any medals or awards?
2-How do you store/display your awards?
3-Would you consider purchasing a piece of furniture to display your medals/awards?
4-If so, how would you imagine it looking and what feature would you like to see?

Rory Tidmarsh (Wallingford School 6th form student) :
1-Yes, European champion for dog agility + more
2-I have them hung on my doorknob in my room
3-Yes possibly, if it is cheap
4- Simple design and features to hold all types of awards

Toby Bucknell (Wallingford school 6th form student):
1- Yes
2- Around my room
3- Yes if it is a good price
4- A wooden design that can hold lots of medals

(video to play of Rory Tidmarsh completing the questionnaire)



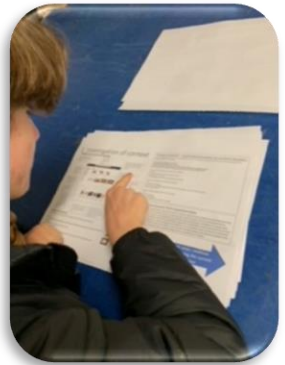
(video to play of Toby Bucknell completing the questionnaire)

Conclusions from questionnaire

The questionnaire has shown that 17-18 year olds do have medals and awards that they have won and kept. Also it is clear that the students given the questionnaire had no proper way to store medals in an aesthetic and practical way. Another conclusion that can be drawn from the questionnaire responses is that there is demand for a product for storage of small items such as medals. Some opinions on technical specifications that can be taken from the data include people wanting the product to be: simple, not bulky and a wooden design that can hold lots of medals.

Feedback on design brief statement– Luke Rayner (primary user)

I quite like the Amazon products because they are cheap and simple. However I didn't like the writing at the top of the product that say motivational sports quotes.



next steps: continue investigating the current situation

1. Investigation of existing products

When searching on google for how to display medals these examples are shown

Various solutions are shown but no design that would fit the aesthetic of a bedroom or a living room effectively

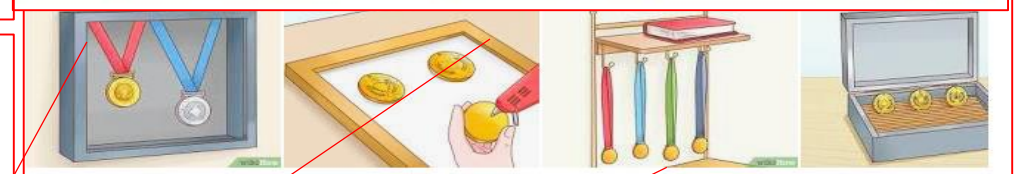
I like the medal holder made from the bat as it could be specific for baseball or rounders players

This small product displays the medals in a different way to any others seen but the metal ribbon would need to be removed or it will look messy.

Specific sports based designs

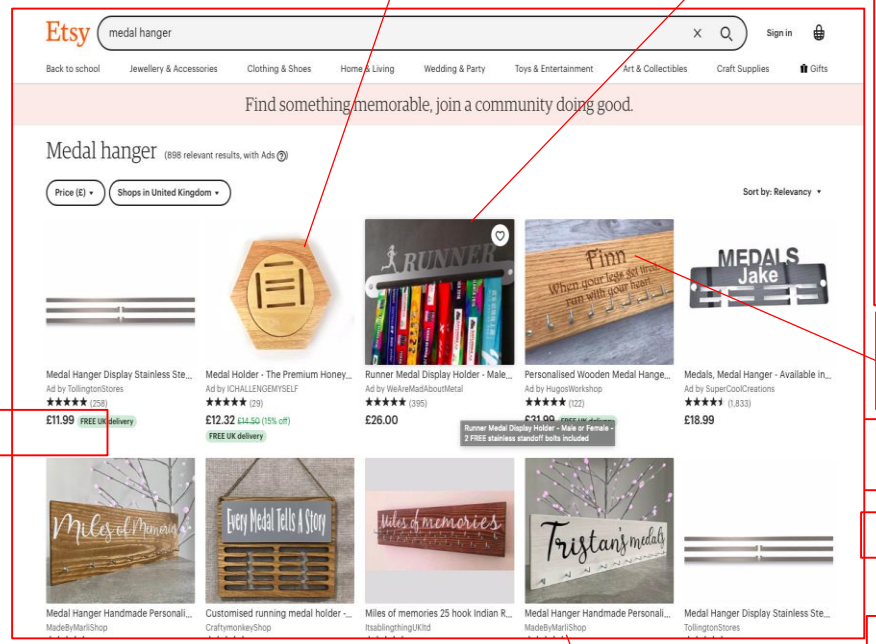
Running is a popular activity that many people take part in for competitive competitions, for fun or for health reasons. Therefore there are many people with an interest in running that may be interested in purchasing the product

The box design does not use space effectively as it will have to sit on a surface rather than on a wall



Hanging Your **Medals**. Hang your **medals** from a display shelf with hanging hooks. Purchase a display shelf with hanging hooks that are attached to a wooden strip that runs underneath the length of the shelf. **Medals** with ribbons can be hung from the hooks, while **medals** that cannot be hung can be placed on the above shelf.

On an Etsy search for medal hanger, various different styles and designs can be seen



More personal , individual wood designs

The frame based design has a sleek, professional look but the practicality is minimal because the number of medals that can be held is low

Materials used such as metals for cheaper designs

Rustic wooden designs could look aesthetic in bedrooms and living rooms

Possible gap in the market for other sports and activities

Simple metal designs

Finished metal products mass produced

The frame based design with medals glued on is not a good design as the ribbon colour and design is key to the look of the medal but in this design the ribbons have all been cut off

This design is practical as numerous medals can be hung and there is a shelf space above that can be used for books and other items such as trophies

The designs shown are all to be built at home by consumers and therefore do not have an especially polished or well finished appearance when built in real life

Designs are built with household items such as picture frames, boxes and wood products

Cursive writing gives handmade, homely feel

Good functionality with the ability to hold many medals

Customised designs with names

Useful but could be cluttered because of many different medals in a small place

Could be mass produced with different common names

None of the suggested designs fill the role as a complete piece of furniture for storage of medals and other items while also having a good visual appearance

None of the suggested designs fill the role as a complete piece of furniture for storage of medals and other items while also being aesthetic and having a good appearance

Different websites gave very different styles of medal holders, aimed at very different target market and demographics, e.g. Etsy sellers are 85% women and a high proportion of consumers are millennials

Summary of conclusions drawn from the investigation of context

There are many different ways of storing medals and other awards but no one product sticks out as more successful. This is because no existing product is cheap, practical and aesthetic. A new product that meets these requirements could be successful and popular with consumers. Some products designed to hold awards are very simple and would not look good as a part of an interior design and do not compliment the look of awards. Some of the products that I have seen while investigating the existing products could be useful for design inspiration for features of my own design. For example the materials that are used such as woods and metals such as steel.

Next steps: Conduct primary research to find if similar products exist

Primary research

I have looked for similar products at places such as museums (such as at Silverstone), local businesses (such as Waitrose and the Body Training Studio gym) but I could not find any sort of product that resembled my design brief. It is clear to me that this type of product is rare to find and therefore there is a gap in the market for a small product to display medals and awards. However another conclusion that could be drawn from the fact that I could not find a similar product is that this type of product is not something that people need or want. However the research I have conducted from talking to people has lead me to believe that the product idea would be popular and commercially viable.

At the Silverstone museum I expected to see a similar product holding medals and trophies but there was nothing similar. The medals and trophies were displayed in a very neat and professional way in glass cabinets. The fact that a museum with many medals and trophies did not have any similar products to my design idea shows that the idea is innovative and has not been done before. However I understand that a museum setting is a different type of area to a bedroom or living room, i.e. where my design brief is more aimed towards.

A product that meets my design brief could be useful in a place like Silverstone to efficiently hold medals and awards that they wish to display in both the museum and also in the café, for example, to display any medals won for food or service

Waitrose supermarkets have won many awards such as 2 top prizes at the international wine challenge awards in 2021 so I expected there to be awards displayed. However no awards were displayed at the Wallingford branch. This suggests that similar types of products do not exist. This is because if similar products existed they would likely be used to display the supermarkets awards. Also in Waitrose products to display medals and awards were not sold on the shelves, even in the John Lewis section. This all suggests that products designed to display medals are not common.

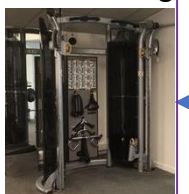
A product that meets my design brief could be useful at a supermarket to display the food awards won, which will show customers that the products sold there are high quality and this could improve sales and therefore profits.

Next steps:

Create a design brief using research on the current market and continue researching the current situation

I expected the gym to have some medals because it is a sporting facility where athletes train, however no medals were displayed. This suggests that it is possible that a product for holding awards is not available or affordable. Awards from winning gym quality competitions would also likely be stored at the gym. The fact that no products to display medals are present could suggest that no awards have been won but it is also possible that they have no way of displaying any awards that they have won.

A product similar to my design brief could be useful at a gym such as The Body Training Studio for storing gym quality awards if they win any, which would improve peoples perception of the gym and could increase profits for the business. Another use of a product that matches my design brief is for holding pieces of equipment such as handle attachments, these are relatively light and small pieces of equipment that are hung. In many gyms there is not enough space for all of the attachments, so they end up not being properly put away. My product could be a method of holding this equipment.



This image shows some of the attachments in BTS Wallingford, the equipment is sometimes overflowing off the areas where it is stored.

2. Design brief

Design brief statement

Many people play sports and complete activities that produce medals and awards that they are proud of and would display but there is currently a lack of practical and aesthetic products that fulfil this role of medal and award display/storage.
Producing an innovative product that can hold many medals and awards would be commercially viable, especially for children because children tend to have more awards that they want to display.
A sleek and minimal design solution could save lots of space if it attaches to a wall.
Challenges of creating this product include: cost, capacity it can hold, ability to be flat packed for transport, aesthetic and having a minimal look.
A user focused design process will be achieved by me keeping in regular contact with end users and stakeholders.

Feedback on design brief statement– Luke Rayner (primary user)

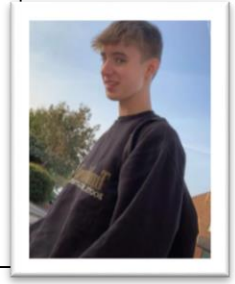
"I like the idea of creating a piece of furniture to hold medals, this could be very useful to me and lots of people I know. I agree the design should go for a minimal look."

Primary users

Ben Guilford

- Year 9 student at Wallingford School , aged 13
- Member of cadets and Crowmarsh Football Club
- Has many medals and trophies, none of which are on display

Luke Rayner



- Year 13 6th form student at Wallingford School
- Ex member of Crowmarsh Football Club and Wallingford Rowing Club
- Has many medals and trophies displayed

Stakeholders

-Ed Carpenter

- CEO at Very Good and Proper (a London based furniture company)
- Ed is a 47 year old designer who has been involved in many successful designs, including the 'Pigeon Light' produced by Thorsten Van Elten in 2002, which since it's launch has gone on to become an international best seller.
- Some clients he has had include: Authentics, M&S and the British Council

Challenges and technical considerations

One challenge and consideration is cost to manufacture as the cheaper the product is to manufacture, the lower the price can be and making a product cheaper to manufacture increases profit.
The weight of the product also needs to be considered in the design stage as lighter products are cheaper to transport, easier to assemble, and will be easier to secure on a wall.
How the product will be secured on a wall is a challenge that needs to be solved because the product needs to be held securely but also in a way that anyone can do at home with basic tools and equipment.
Another challenge to overcome is the assembly of the item as it can either be fully prebuilt and ready to use or not assembled and flat packed for people to assemble the product themselves. If the product is fully assembled the cost is higher as workers are needed to assemble the product and also transport/deliveries are more costly as the shape will be less efficient to stack.
Material type is another consideration as it affects the looks, weight and cost of the product.
The strength and product lifespan of the product should be good as this type of product will be expected to last a long time.

Flat packed furniture

Flat packed furniture

Pre built furniture delivery

Other stakeholders

-Sports clubs
Sports clubs earn trophies and medals when members of the club win in tournaments or leagues. For example Crowmarsh Football Club.
-Parents
Parents often keep awards that their children win as a reminder of the child's childhood and success.
-Athletes
Competitive a amateur athletes often earn awards from competing in or winning events. An example in marathons because anyone who competes gets an award in the form of a medal.

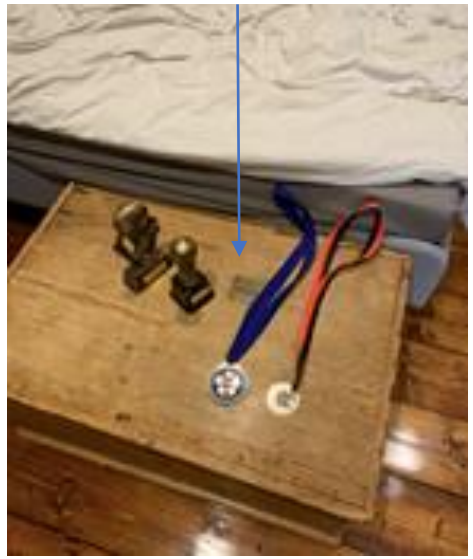
Other stakeholders

-Waste management workers
Waste management companies and works will be disposing and recycling parts of the product so they are an important stakeholder. Working with waste management representatives could allow them to give advice on what materials are best for being recycled and what materials should be avoided because of bad environmental impact.
-Shop owners
Shops will be the places that sell the products, so it is important to listen to what shop workers believe will make the product successful as they have seen which products have been successful and unsuccessful in the past.
-Manufacturers
Manufacturing companies and workers are important stakeholders to consider because they will know what materials and techniques are cost effective to use and what is possible for them to produce.

Next steps: Investigate the needs of the primary users

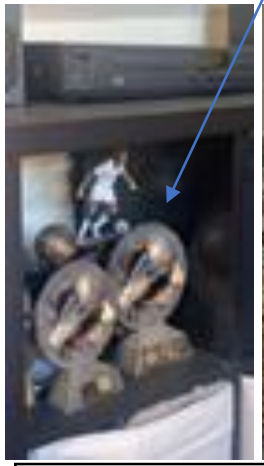
Investigation into needs of primary users

Ben's awards
Ben has trophies and medals mainly from football but also from school. He has no specific place to store them so they are usually spread out in places such as on doorknobs, on shelfs around the house and on surfaces in his room.



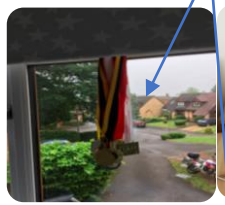
What kind of product would be useful
For Ben a small wall mounted award display product able to hold 4 medals and 3 trophies would be most useful. Having more capacity for medals than he currently has out is a benefit because he may win more awards and will want to display them all together. Ben needs a product that will display his awards for years so they are visible but not in the way.

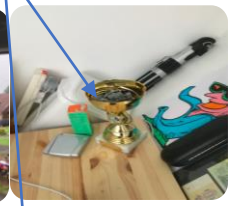
Luke's awards
Luke also mainly has awards from football but also has some rowing and tennis medals from when he was younger. Luke has a shelf to store his awards, however there is not enough space to hold all of them and it is unsuitable for holding medals.



What kind of product would be useful
For Luke his trophies are already displayed in an adequate place but his medals are not because they are hanging off a standing light in a way that is not aesthetic or a good use of space. Therefore the main focus for him is displaying medals in a better way. Also it could be beneficial for him to have somewhere to put some trophies so that the trophy shelf can be less cluttered.

Louis Holden's awards
Louis Holden has medals and trophies around his house. The medals are kept hanging on a window frame and a trophy is kept out on a table. These storage solutions are not efficient uses of space and are not aesthetic to look at.





What kind of product would be useful
I believe that a wall mounted product with the capacity to hold medals and trophies would be a good design solution to solve the issue of the Louis' awards having no permanent place to go.

People tend to have more medals than trophies as medals are cheaper for competitions and clubs to buy for competitors. For example at kids' football tournaments the medals are awarded to all winners and trophies are rarely used.

The two primary users shown have a higher proportion of trophies than what I would expect from most children and teenagers. Most people of these ages would have fewer medals and fewer trophies. This is something to keep in mind when thinking about the target demographic and target audience.

I have found that most children store their medals in their rooms or around their houses in various places but rarely in a way that looks good or is an efficient use of space, for example on windows or window sills and on shelves. In all of these current situations medal ribbons are fully on show even though in my opinion medals look most aesthetic with most of the ribbon covered up. Also in the current situation I have found no users with purpose built products.

Next steps:
Reach out to all stakeholders and primary users to find out all needs and requirements

3. Investigation of users and stakeholder needs and wants and outlining the stakeholder requirements

The non-technical specification also links to my stakeholder feedback as Ed Carpenter recommended the product was kept simple and also that the product is easy to assemble.

Non technical specification

Through researching around the product options, similar products and investigating the situation, I have found that the specification I need to meet to create an innovative and commercially viable product includes:

1. The product must not be an overcomplicated design
2. The product must be easy to assemble, install and use
3. The product should not cost a consumer more than £40
4. The product must be able to hold numerous medals (at least 10)
5. The product must be able to hold other awards, such as trophies (at least 3)
6. The product needs to be innovative, which will be achieved with a unique design and the ability to hold medals and trophies in a better way than normal medal holders

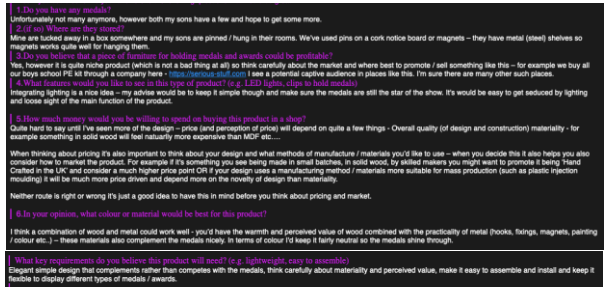
Questionnaire information

The questionnaire and feedback has all been done online, through email, snapchat and WhatsApp so my primary users and stakeholder could have access to the PowerPoint and then message me with feedback and responses to my questions / questionnaire. This was done online because it is a quick and easy way of sharing information and also because of social distancing, especially when I had coronavirus.

Questionnaire

1. Do you have any medals?
2. (if so) Where are they stored?
3. Do you believe that a piece of furniture for holding medals and awards could be profitable?
4. What features would you like to see in this type of product? (e.g. LED lights, clips to hold medals)
5. How much money would you be willing to spend on buying this product in a shop?
6. In your opinion, what colour or material would be best for this product?
7. What key requirements do you believe this product will need? (e.g. lightweight, easy to assemble)

Ed's responses



Ben's responses

1) Yes
2) Some medals and trophies are on a storage box at the end of my bed
3) Yes, it could be useful
4) Lights could be good
5) £20-£50
6) Blue
7) Clear instructions about how to make it

Luke's responses

1) Yes
2) Some are hanging from a light in my room
3) Yes, I currently have no organised way to display medals
4) A feature that holds medals so they can hang all at the same length would look good
5) £15-35
6) Metal or wood
7) Lightweight and a relatively simple

Analysis

This questionnaire has shown that lots of people do have medals, especially younger people and some of them have no way of displaying medals at the moment. Also, the answers to question 3 have been supportive of the product idea and how successful it could be, which is good for carrying on and developing this specific idea. For features, responses were not all the same but Ed makes a good point about keeping the design simple. However in the design development stage, if there is a way of including lighting in a subtle and elegant way I may consider it as both Ben and Ed agree it is a 'nice idea' and 'could be good'. For pricing I will try and meet the end users requirements by keeping the cost relatively low (under £40 per unit). The combination of wood and metal was mentioned and this would certainly create a more elegant product, however if it is going to be specifically designed for children, a colourful appearance could work well. The requirements given by the primary users and stakeholders are: 'elegant simple design that compliments rather than competes with the medals', 'easy to assemble and install', 'keep it flexible to store different types of medals/awards', 'clear instructions about how to make it', 'lightweight' and 'relatively simple'.

Discussion with Luke

We discussed his existing medal storage and both agreed that it could be better so there a product that stored all his awards would be useful.

Click on this for the video clip

Next steps: research current products on sale online (secondary research) and in use in real life (primary research)

4. Investigation of existing products and design practices

Main points

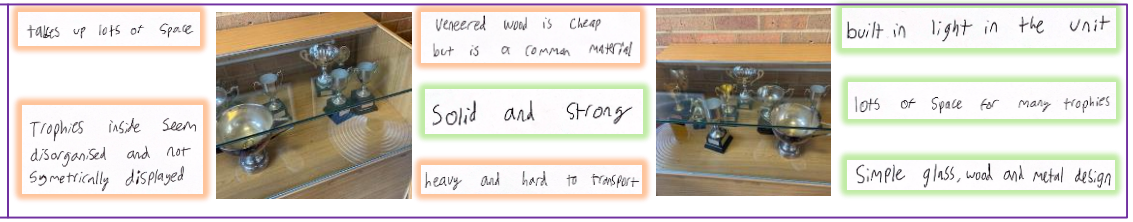
- Products with medals that are symmetrical and neat look more aesthetic
- Designs with less medal ribbon showing look more aesthetic
- Current related products are not interesting or innovative

Primary research

When doing primary research I found that no people I know have any similar products that meet the specification of my design brief. This shows that there could possibly be a gap in the market for this type of product. However it could also show a lack of interest in this type of product.

Feedback – Luke Rayner (primary user):
"I think that the products that can hold lots of medals are more useful but product 2 looks the best and most neat."

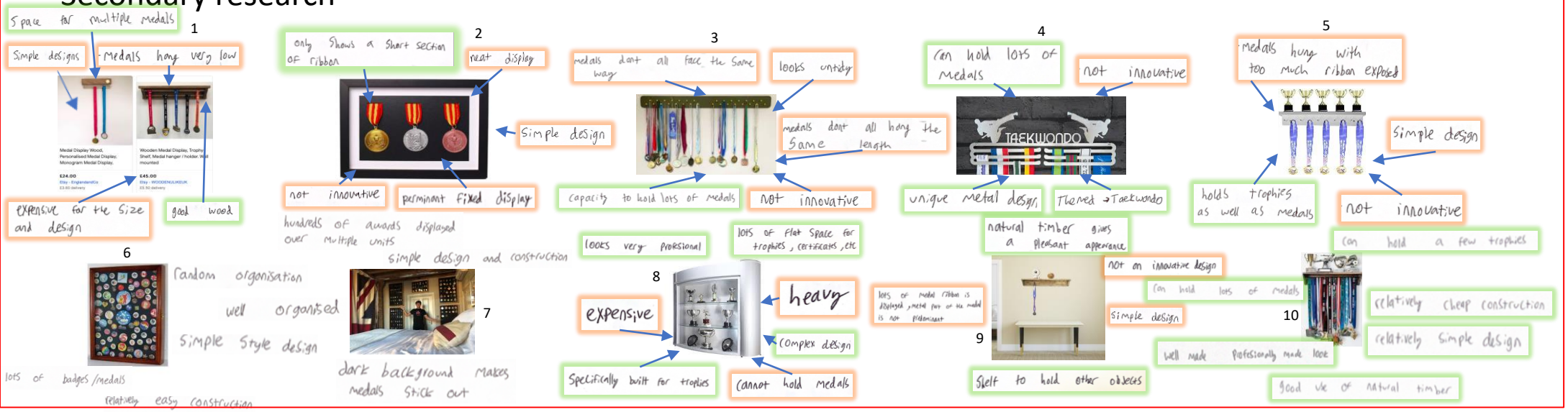
This trophy display stand found at Wallingford School is an example of a product with the role of displaying awards and has features that are useful to consider for my product.



How it will be innovative

- A way of only displaying part of the medal's ribbon
- Lighting (LED lights)
- Unique shape

Secondary research

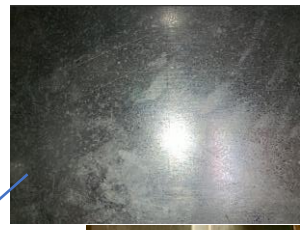


Next steps: research all possible materials that could be used in the product. Research will be done online and in real life

5.Materials and possible technical requirements

Metals

- Mild steel
  - Could be used for the framework or even all of the product
  - Heavy and not cheap
  - Recyclable material (reduces carbon footprint)
  - Can be bent, braised or screwed into
  - Available in the school workshop and strong

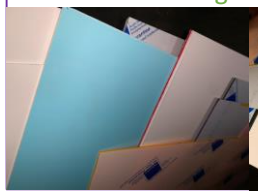


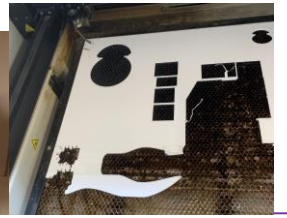
- Stainless steel
  - Could be used for framework but will likely not be used because stainless steel is less available to use at school and I have no experience working with stainless steel
  - Heavy and expensive
  - Harder to source and work than mild steel
  - Expensive looking chrome appearance
  - Strong and good corrosion resistance

- Aluminium
  - Could be used for framework
  - Not cheap
  - Difficult to work and aluminium braising is not possible at school
  - Lightweight and durable
  - Being lightweight is an advantage for a wall mounted piece of furniture as less stress will be caused on the wall and fixings

Plastics

- Acrylic
  - Could be used for parts of the product, including as a self or panel
  - Brittle and not very strong
  - Cheap and easily available at school
  - Can be laser cut into many intricate shapes and can be engraved
  - Bright colours available, excellent for products targeted at children

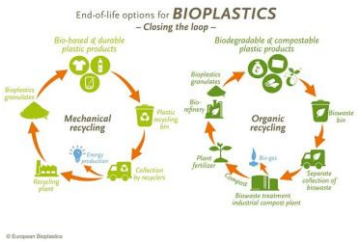




Innovative materials

- LED lights
  - Innovative because no current available products use any form of lighting and could create an interesting looking design

- Bioplastic
  - A more environmentally friendly alternative to conventional oil based plastic



Specific and appropriate technical requirements

- Materials must be lightweight
- Materials must be strong enough to carry the weight of numerous medals and trophies (up to 10 medals (up to 8kg) as well as weight from other items such as trophies (up to 8kg) without any damage to the wall or the product itself.

Evaluations from the page

Stainless steel will not be used because it is not suited to my design brief and specification. Also it is not available within school for prototyping, testing or manufacture. I believe that mild steel is a better option for my product because it is easy to use and available at school. I would like to use bioplastics because it is a modern material but I don't have equipment or expertise to use it. Aluminium is not a material that I will use because it is harder to work than mild steel and also I have no experience with it. Acrylic is an interesting material that could be used and I may use it in my initial ideas.

5.Materials and possible technical requirements

Timbers

- Oak
  - Could be used for the whole medal stand or used in panels or as a shelf
  - Heavy and expensive
  - Good looking grain and colour
  - Strong

- Pine
  - Could be used for the whole product or used in panels or as a shelf
  - Lots of knots and can be hard to work with
  - Lighter than other woods
  - Relatively strong

Manufactured boards

- Plywood
  - Could be used for all of the product
  - Cheap and accessible at school in many sizes
  - Easy to cut and connect to other materials (glue, screws)

- Flexi-ply
  - Could be used to make part of the shape of the product but could need a frame
  - Not rigid or strong, needs other materials to support it
  - Cheap and easy to use and bend into intricate shapes

Next steps:
Talk to primary users about what materials they think would work best and research possible technical specifications

Feedback – Ed Carpenter (Stakeholder):

"I think a combination of wood and metal could work well- you'd have the warmth and perceived value of wood combined with the practicality of metal (hooks, fixings, magnets, painting / colour etc) – these materials also compliment the medals nicely.
If your design uses a manufacture method / materials more suitable for mass production (such as injection moulding) it will be much more price driven and depend much more on the novelty of design than materiality."

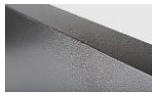
Response to feedback
I will design most ideas to use a combination of metal and wood. I will not design any injection moulded products because I will not be able to produce any injection moulded products within the school workshop.

5. Materials

Chosen materials

I have decided (using stakeholder and primary user feedback) that a combination of wood and metal is the best option for the product. The metal that fits the requirements best is mild steel. Mild steel is the best option as it is very accessible for prototyping and making because it is available in the school workshop. Also mild steel is affordable for a metal and easy to cut up, bend and braise together. I have personal experience working with mild steel on numerous projects, including my desk I made in 2020 and the portable bar I worked on in 2021.

Mild steel can be coated in a powder coating to protect from damage and rusting and creates a finish that makes all of the metal look the same and clean. Many different style powder coatings are available, including different metallic colours and many textures.



Another option for sealing mild steel is painting, this allows the product to be colourful and better suited for a young audience. Painting can also be done with simple colours such as white or black for a grown up adult demographic.

An expensive hardwood could be used, such as oak for panels and shelf components of the product. This type of timber gives a pristine look while also being very strong and durable.

One concern of using oak with steel is that if the materials are left untreated it is possible that the woods will corrode the metal. This is not a problem if the metal is coated and the wood is treated.
Some possible wood treatments include oils such as teak oil or danish oil. Wood treatments preserve woods and help to keep the natural colour and reduce rot.

Feedback – Luke Rayner (primary user):

"As I said in my questionnaire, I like the idea of using metal and wood.

I think it would work well designed for adults or children but for me personally I'd rather buy a less colourful, sleeker looking option."

Target audience

This product could be designed for many different demographics or could be designed inclusively for lots of people. One demographic that could be very interested in a medal display product is children (under 16s) as this age group tends to do lots of sports and activities that give out medals and other awards. A medal display could be themed and colourful for a child's bedroom.

Another demographic that the product could be aimed for is adults who do sport (e.g. running, tennis, cricket, football or cycling) as they earn medals to be proud of and often take a lot of work to earn. A medal display for adults should be simple and clean looking. As Ed Carpenter said the design should be an "Elegant simple design that compliments rather than competes with the medals". For adults a simple, subtle design would be most appropriate.

Teenagers could be another demographic to aim the product for as many teenagers have medals they have collected as a child and also awards earnt more recently for sports or academic awards (such as certificates). Many people between the ages of 13 and 19 have awards that could be displayed. Some examples of awards that they could have include: maths challenge certificates, football trophy awards, swimming certificates, trophies or medals and running medals from in or outside of school. The appearance that would be most popular for teenagers would likely be a modern, simple design.

Elderly people are a demographic that would have very different requirements to the younger groups previously mentioned. For a display product the design would need to hold different types of awards such as sports awards earned throughout their lives, pictures of family or even awards and certificates earned at work. Older people would likely be more interested in a less sleek and modern design and more interested in a intricate wooden design.

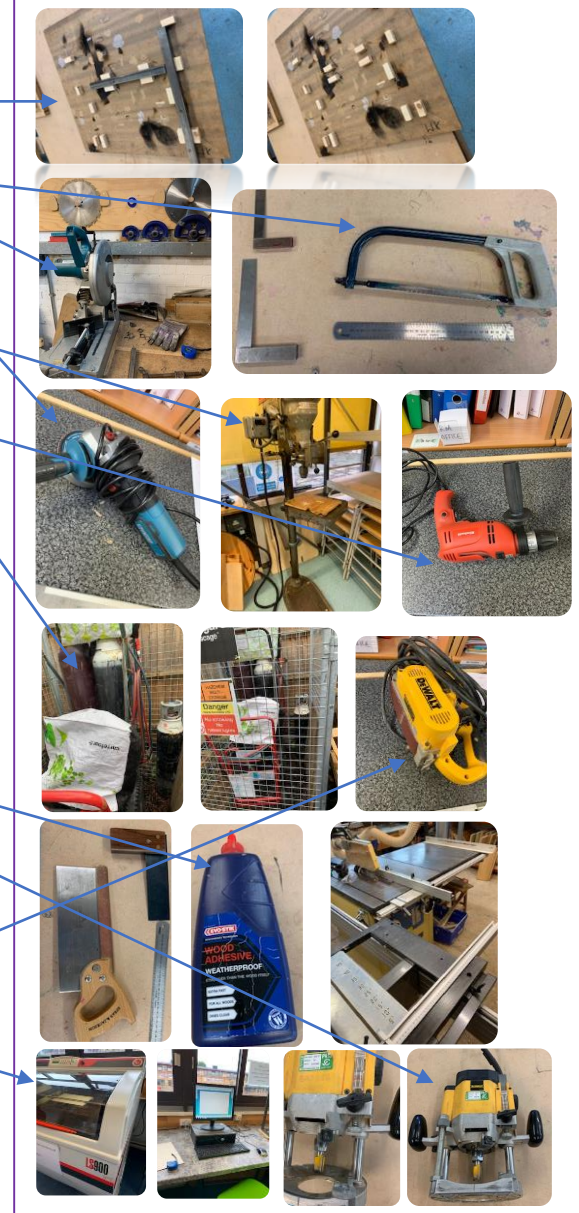
Which demographic is chosen to be the final target audience will influence the final specification and appearance.

Next steps: research and plan the use of different manufacture techniques and how the materials relate to the goal of sustainability

5. Materials

Manufacture techniques

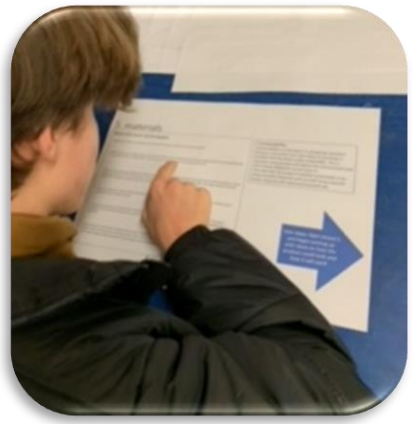
- Jigs can be used for assembling mild steel frames when the metal is cut and then braised.
- Mild steel can be cut using an electric machine metal saw or a hand held hack saw but using the machine saw would be best for manufacturing the medal holder. This is because it is a quicker and more accurate process. I also have experience of angle grinding mild steel to clean joints and flat areas. Drilling holes can be done using a pillar drill, for very accurate straight holes and for thick metal that requires lots of energy to cut. Handheld drills can be used for quick drilling of thin metal. Handheld drills are more convenient for some projects because they can be used at any angle.
- Another manufacturing method that could be used is braising because it is an easy way to join metal with strong joints. I have braising experience from my GCSE project and also in a project done throughout A-level years. I am able to braise well and efficiently so braising is a good option as a manufacturing method.
- I have less experience with woodwork but the processes that could be used include cutting on a wood saw, routing using a router and gluing using wood glue.
- I have some experience of routing from a portable bar project done in year 12 so I know how to use a router. Therefore routing is a manufacturing method that I could use for my product without spending any time learning or practising the technique. Sanding was also used to help finish wood.
- Laser cutting is a manufacture method that is used to create very accurate shapes and engagements in thin plywood and acrylic. I have some experience of using a laser cutter and the CAD software needed to use it but I will gain more experience on the laser cutter during this project on the design and prototyping phases



Sustainability

Sustainability is a key factor in designing a product because consumers are more likely to purchase a product that has been made sustainably. This is because many people care about the environment and their moral obligation to not harm it.
One way that my product could be sustainable is by using recycled materials such as MDF that contains recycled wood, using recycled mild steel and using recycled oak.
Designing my product to be long lasting is another way to make it sustainable because less materials and energy needs to be used to replace the product often.

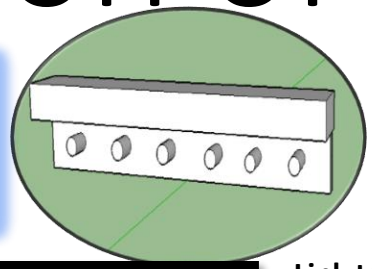
Feedback from primary user Luke Rayner:
"Sustainability and being environmentally friendly is important for me when thinking about buying a product. Using quick and easy methods in your product would probably make it cheaper."

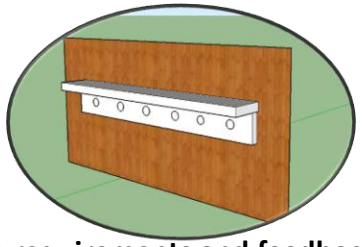


Next steps: Start strand 2 and begin coming up with ideas on how the product could look and how it will work

Generation of initial ideas

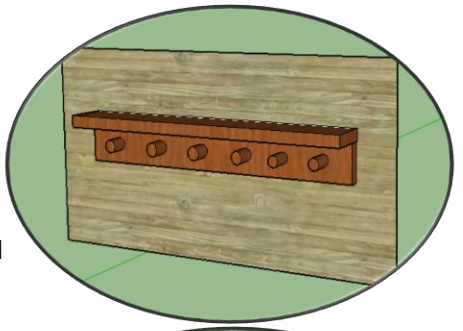
These designs are not aesthetic in terms of appearance, and are not innovative so they do not meet the requirments

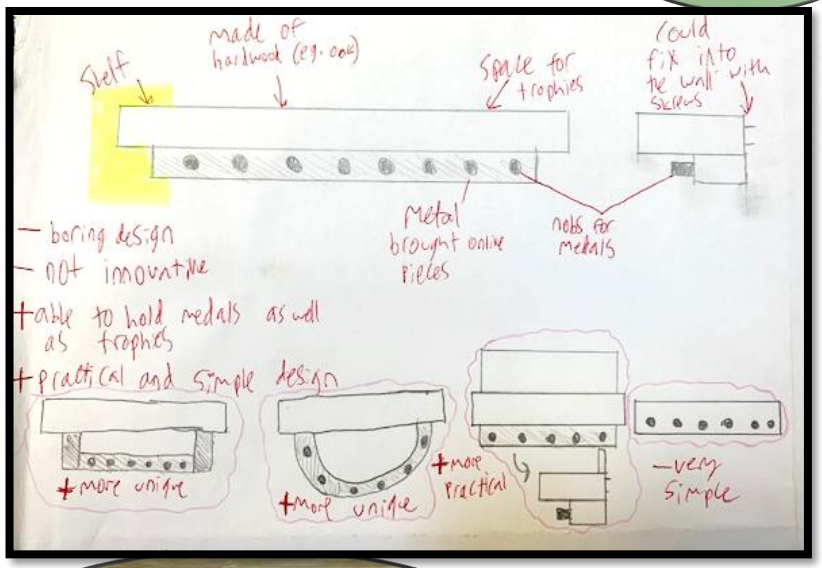




Build

This design would be constructed from gluing two wooden components together with screws. The metal **knobs** could be attached by routing holes through the back piece of wood and then gluing in the metal to secure it in.



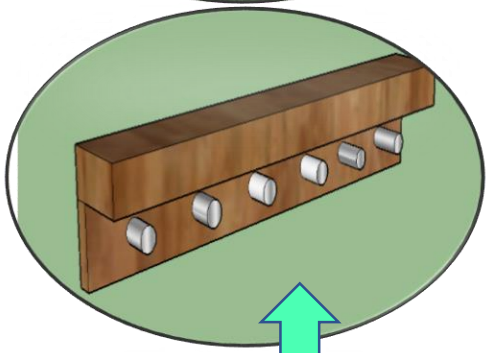


Link to requirements and feedback

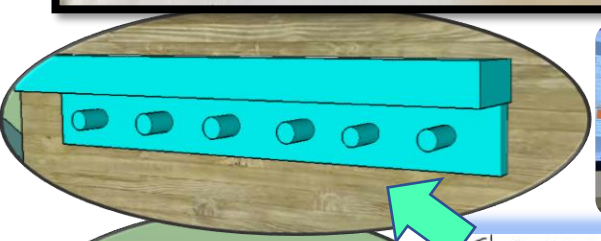
The main design shown meets non-technical specification point 1 as it is a simple design with only 3 different sized components and is not overcomplicated. The sub sketch designs also meet the requirement as they all have simple frames and a simple appearance. These designs also meet spec point 2 because they would be relatively easy to assemble, install and use, due to having few components. In addition, it is a simple solution. Spec point 3 is also met by the designs shown if affordable materials are used, such as MDF, plywood or a cheap natural timber. However, if an expensive timber was used (such as oak), the price would likely exceed the £40 budget. In the designs shown, 9 medals was the maximum number that could be held, but more knobs could easily be added to hold more to meet spec point 4. Spec point 5 could be achieved with the designs as the shelf seen in the cad models can easily hold the weight as well as having the space to hold 3 additional awards. The main drawback of this design solution is that it is not an innovative design and is not an interesting product.

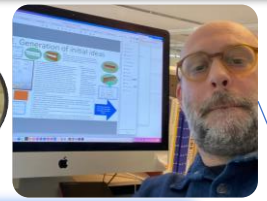
Finishes

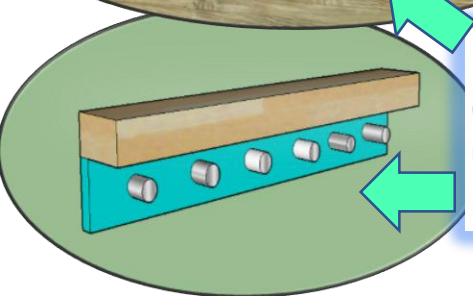
- Natural timber could be treated with a clear finish such as a wax, danish oil or shellac
- Natural timber could also be stained or dyed during the finishing process to give a richer colour
- Any wooden material, especially cheaper materials such as MDF, work well painted any colour. Plain colours such as white, black and grey can create a sleek modern finish and colours can give an interesting, unique look



This CAD model shows how natural wood could be used, as the stakeholders prefered natural wood and metal for the product







This CAD model of the main design shows how colour could be used in the design

Feedback from stakeholder Ed Carpenter:

Pros – "This design is clean and simple and relatively easy to manufacture. Its also possible to add / combine different finishes and materials. I personally think if executed well and with premium materials this could work. The hooks are a good opportunity to add a touch of personality / colour."

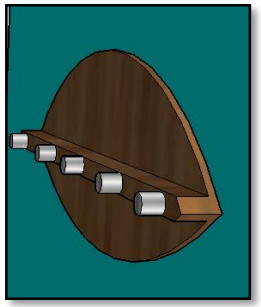
Cons – "As you say perhaps a bit too basic for people to appreciate and not the most efficient use of space."

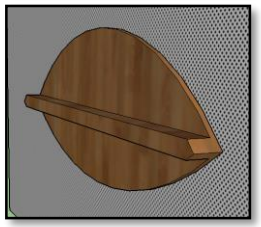
Response to feedback:

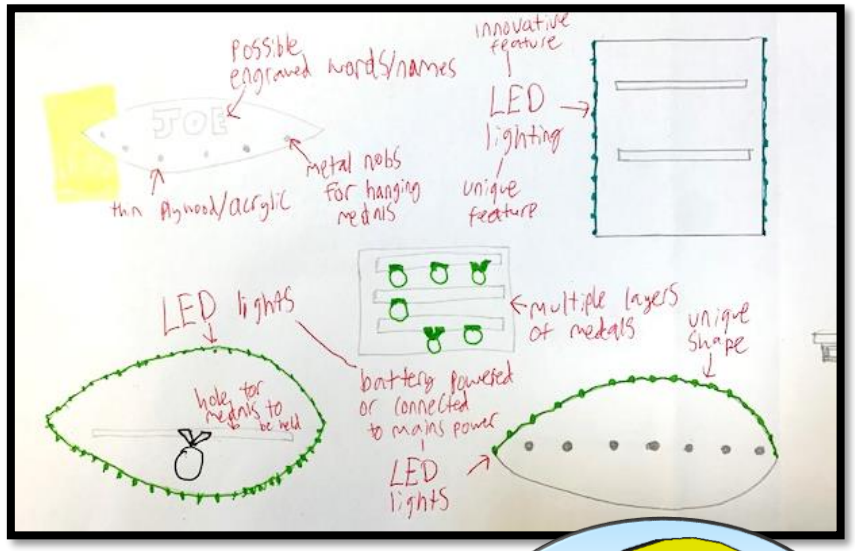
I will take feedback on positive and negative aspects of the design into consideration for other designs. I most likely will not develop this idea further due fact it is too basic.

Next steps: Generate more initial ideas with annotations and CAD designs.

Generation of initial ideas



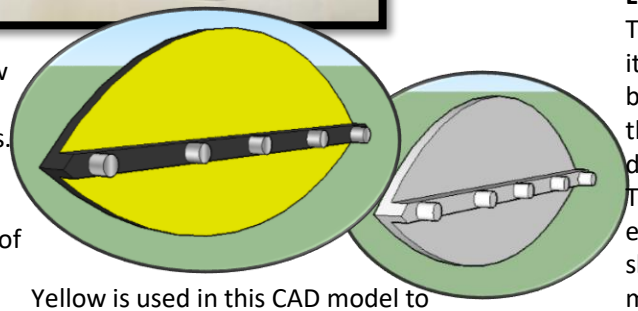




The designs shown above use a natural timber colour as suggested by the stakeholder. I believe the natural wood colour works better than a colourful style for this idea.

Engraving is shown in a sub-sketch and is a good way to customise a product to a specific demographic (engraving a picture relating to a sport or tv show) or targeting the product at a specific individual (engraving a name). Engraving a specific name does cut down the number of people that will want to buy the product (only people with that name) however if units were engraved specifically with what customers ask to be engraved that could be successful.

The sub–sketches shown show versions of the idea with LED lights around in different ways. If I choose to develop this feature further I will either have LEDs around the outline of the whole product or just on the edges as these designs work best. I will likely not use LEDs because spec point 1 is to not make the product overcomplicated.



Yellow is used in this CAD model to show the effect of colour on the idea. I believe an element of colour works well in this idea. The plain white CAD version was made just to show the simple shape of the design.

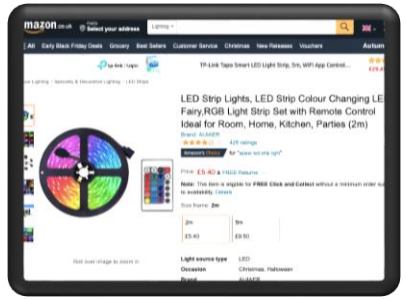
Materials

This idea could be manufactured using a few different materials. One option is plywood as it is cheap, easy to cut and work. Plywood can be painted any colour and is a strong material. Another material that could be used is Flexi-ply, it is thinner than regular plywood and is still strong. However it is not stable and will bend if not reinforced by many layers. Like regular plywood, it could be painted but also could be treated by a clear finish such as an oil.

Idea

I designed this idea to incorporate LED lights with a unique oval shape. The different sub sketches show the design with and without a shelf and in a square, simple shape. One design also shows how engraving of a name would fit within the shape.

One feature of the idea is LED lights, they could be stuck around the shape to give a glowing appearance to the product. Glow gives the product a futuristic modern feel and LEDs are relatively affordable on websites such as Amazon. LED lights colours and brightness can be changed by the user using a remote, which gives customisation to the user.



Another feature seen on some of the designs is gaps to fit medals through, this allows the ribbon of the medal to be hidden as much as the user wants so the display can look fully symmetrical and aesthetic.

The oval shape of the idea is unique as it is not commonly seen on similar products and allows medals and trophies to be displayed with the product colour behind them as a kind of backdrop.

Link to requirements and feedback

The main design shown in these CAD models meets non-technical specification point 1 because it is a relatively simple design and because of this it also meets spec point 2. This product could be made using affordable materials such as man-made boards to keep the cost down, therefore the price for consumers could be kept low and spec point 3 could be met. In diagrams this design is only designed to have 7 medal holding components and in CAD models it holds only 5. This does not hold enough medals to fulfil spec point 4, unless numerous medals were held by each medal holding component, which is possible but would not look as aesthetic. The shelf shown in CAD models would be too short to hold normal size trophies so the design does not meet spec point 5, however the design could be easily adjusted for a shelf that extends further to hold trophies and other awards. This idea has an innovative shape and also the sub sketch showing a different way of holding medals (hanging from a gap) is an innovative design feature so spec point 6 is met.

Feedback from primary user Luke Rayner

"I like the idea of the rounded design because it looks very professionally designed. I would consider purchasing a product like this but the engraved name design looks quite childish to me."

Response to feedback

I agree, the shape could look aesthetic on a wall and the engraving of a person's name is a feature for a younger demographic.

Next steps: Make model medals to help test models of initial ideas.

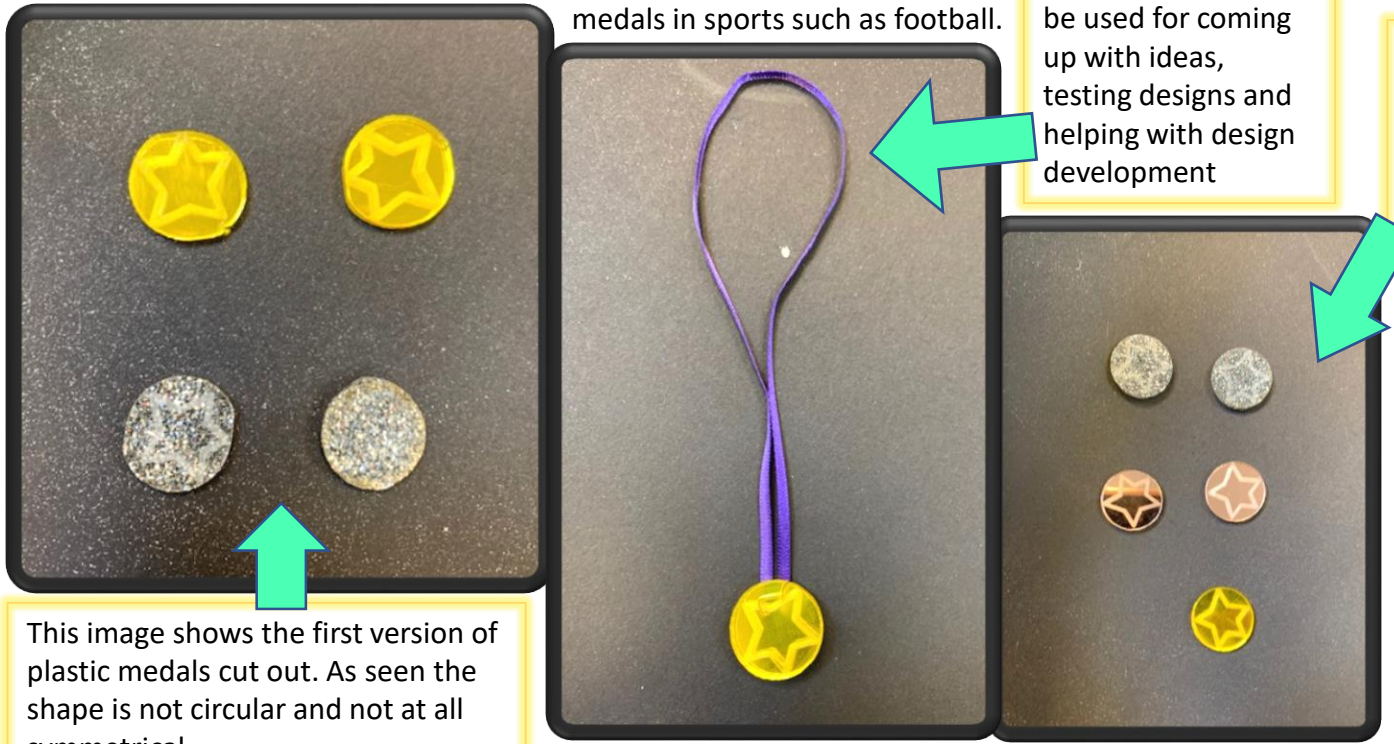
Creating laser cut medals

When modelling my initial ideas I laser cut some plastic models in the scale of my models (around 1:2). These would help me get an idea of what designs look best with the medals on them and also how medals would be displayed from each design.

I used the CAD software, 2d design to design the shapes to be cut and also the shapes to be engraved. I then used the laser cutter in school to cut them out in 2 batches. The first set of medals were not cut or engraved perfectly so they didn't look aesthetic. Then I recut them after adjusting the laser cutter and produced the second batch. The ribbon was cut and attached to the plastic using a hot glue gun. I made different sizes of medals to use on the models because people tend to have different sizes and shapes of medals to display. The different sizes can be used to show how a mechanism to hold medals at different heights can be useful because it can hold them all at the same height.

One of the colours of plastic that I used was gold because medals for the winner are often a yellow-gold colour. The gold colour is used because gold is expensive, so it shows wealth and success.

I used purple ribbon material to show the ribbon part of the half scale medals because it is a colour often used for medals in sports such as football.



This image shows the first version of plastic medals cut out. As seen the shape is not circular and not at all symmetrical.

This image shows a finished medal with the ribbon ready to be used for coming up with ideas, testing designs and helping with design development

Using the laser cutter to create these models of medals was useful because it gave me valuable experience using the laser cutter, which will be very useful if I choose to use a laser cut design for my final design.

I chose to engrave a star shape on the medals because it gives me more experience using CAD and a laser cutter and also it makes the medals look more aesthetic and therefore realistic.

This picture shows the second batch of medals cut out after the laser cutter was adjusted. They are more accurately cut and are good for using with models.

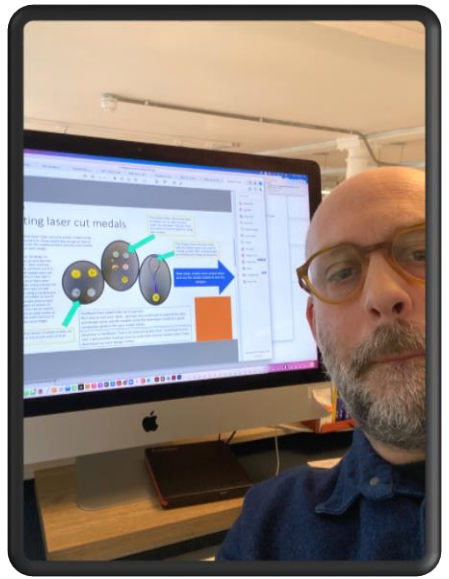
Next steps: create more unique ideas and use the medal models to test the designs.

Another colour of plastic that I chose to use for these half scale medals was a glittery silver colour. This style of medal is not common but it works for the purpose of demonstrating how a medal would look on different designs of my product.

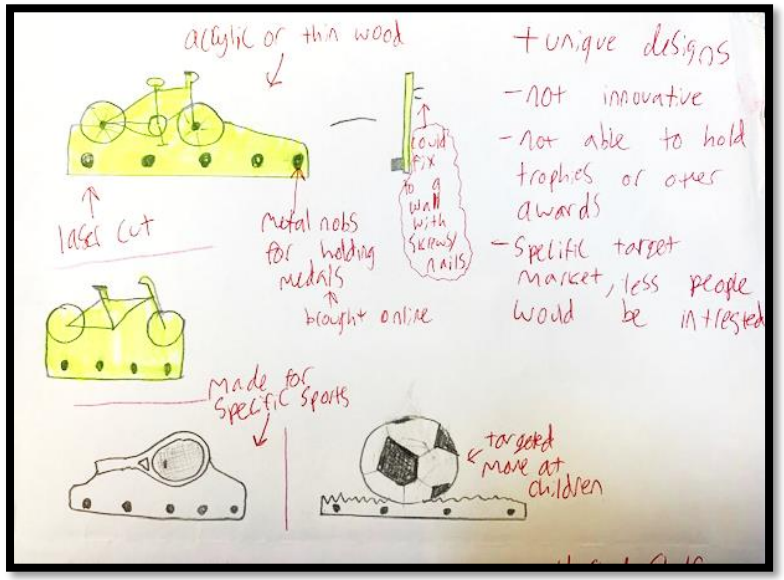
The final colour of plastic used to make the test medals is a rose gold colour. This colour is similar to bronze, which is useful because many medals, especially 3rd place medals use a bronze colour. The medals were attached to the ribbons by using hot glue from a glue gun because it is a quick and easy process that is strong enough for a model.

Feedback from stakeholder Ed Carpenter:
"Nice way to test your ideas - perhaps you could look to expand this idea and design some specific medals using this technique. Could be a good companion product for your medal holder."

Response to feedback: That is an interesting idea that I could look further into. I will consider making some to scale laser printed medals once I have developed my main design further.



Generation of initial ideas



This picture of a model made shows how medals would be hung. As seen, the medals do hang from the product successfully and there is enough strength to hold them with this idea but with larger and heavier medals the product may break. Also the medals shown have different length ribbons so they don't hang at the same length. This idea has no features to level out the lengths of ribbons so the display is not very aesthetic.

Idea

This overall idea was inspired by existing ideas from amazon.com because it is themed on a specific sport (cycling) like many of their designs are. This idea also could work for other sports, as seen on the sub sketches.

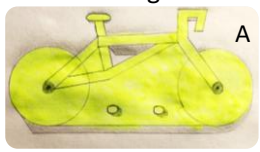
Link to requirements and feedback

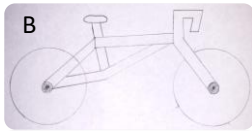
The idea reflects many aspects of the non-technical specification that was developed with stakeholder feedback and based on research. The idea meets spec point 1 because the design is simple to make and to look at, even though cutting and engraving on the design could be very intricate and complex. Spec point 2 is also met because the product only requires 2 different types of components, the wooden back and the metal knobs. The design does meet the requirements of spec point 3 because manufacture and assembly of this style of product is very cheap and quick as it should be produced on a large scale on machines such as a laser cutter. The designs shown as sketches and models will not meet spec point 4 as is shown there is not enough space to hold 10 medals. This idea does not currently have any space or shelf to fit any trophies at all. Using the materials suggested, it would be difficult to add a shelf large and strong enough to hold 3 trophies so it is not possible for this design to meet spec point 5. This idea is not innovative, However this idea could be used to create a shape that is different from current designs. An example of how this can be done is with a very intricate design of a bike or tennis racket.

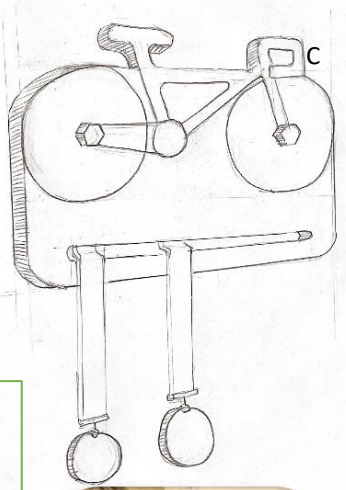
Materials

Various materials could be used in the construction of this product for different parts. For the tubes/rods to hold medals thin, hollow (15mm) mild steel could be used but this material would likely be too heavy and expensive to be appropriate for the product, also it is more time consuming to prototype or work compared to other options. Another option that could be used is wooden dowels, they are far lighter and cheaper and easier to work with. For the other part of the product (the laser cut sheet) laser ply (6mm) or laser MDF (6mm) could be used. Both can be cut by laser cutters and can made into intricate shapes. Also laser cut acrylic could be used because it is a relatively strong and easy to use material available in various different colours and thicknesses and patterns. All of these materials are relatively cheap and available.

This model shows how the main design can be made using 2 different types of parts, a flat piece of laser cut wood and circular ended metal/wood rods. The rod is cut up into short sections to stick out and hold metals. As seen by this model, the fixings between the different parts are very weak. For the prototype, card straws and card sheets were used, which are similar to materials that would be used in manufacture as all of the materials are all very weak are also very thin. If this idea is developed then a solution would need to be found, for example using a thicker wooden panel that can be drilled into so the rods/tubes go through into the panel and are better supported. Screws and strong wood glue could be used for fixings.







Sketches A and C show how the design could look. Sketch A was drawn quickly and coloured to show the concept and then sketch C was drawn accurately to show the detail of the idea. Sketch B shows the shape that could be engraved on the product.

Feedback from primary user Ben Guilford:

"I don't have much interest in cycling but I like the idea of a laser cut design that is simple. A theme like football or gaming would be better for me."

Response to feedback:

I will likely not develop this idea further but I will keep in mind themes you prefer.

Next steps: Generate more initial ideas with annotations and models.

Generation of initial ideas

Next steps: Generate more initial ideas with annotations and CAD designs.

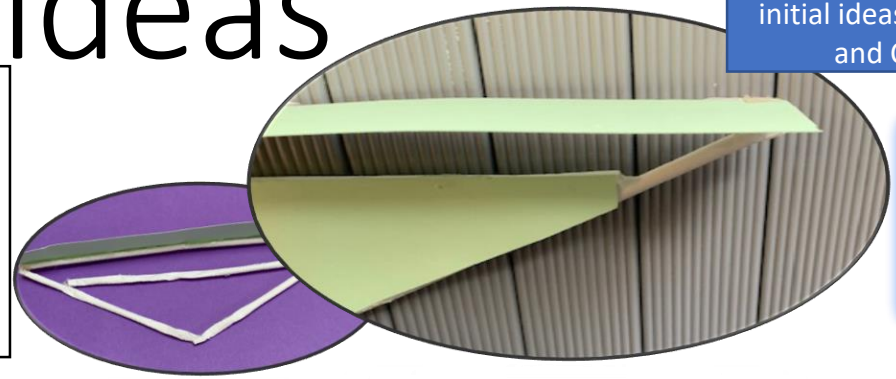
For my initial product designs I came up with 8 different main designs that are each developed with sub-sketches and variations. The purpose of having lots of different ideas is to avoid design fixation and have unique ideas to develop further.

a

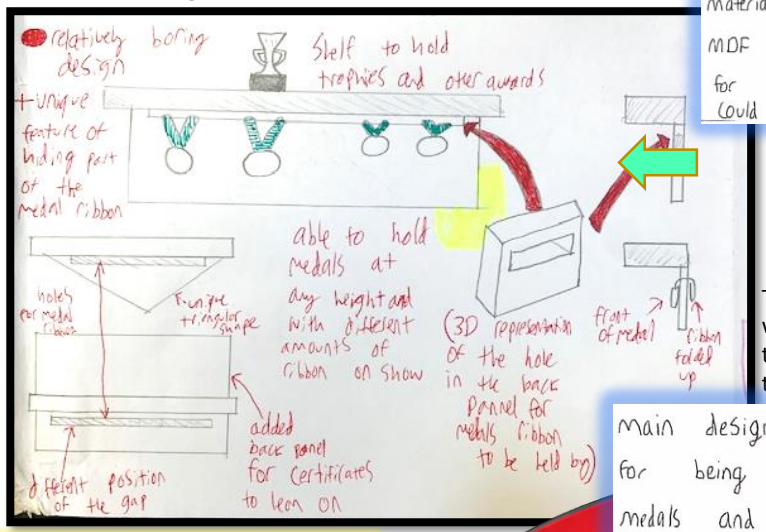
I designed a simple rectangular product that can hold medals by having a gap for them to be passed through. Then I developed a design with the same style of gap but in a triangular shape, which looks more aesthetic and is a more innovative design.

Stakeholder requirements
For the design, stakeholder requirements include:

- **Not being overly complicated**
- **Able to hold 6+ medals**
- **Able to hold trophies**
- **The design needs to be innovative and unique.**

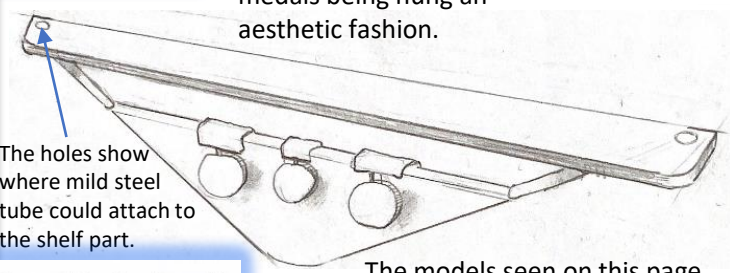


This image of a model shows the design against a wall with a large gap



materials such as plywood or MDF could be used for these ideas and could be painted

This sketch was produced accurately and in 3D to show how the idea would look. This sketch shows 3 different shape medals being hung an aesthetic fashion.

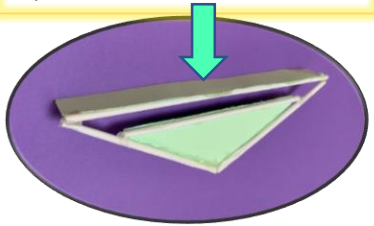


The holes show where mild steel tube could attach to the shelf part.

The models seen on this page were created based off of this sketch.

main design meets requirements for being simple, able to hold medals and also trophies

Frame
As seen in this model, the frame is a simple triangular shape that could be made out of mild steel and baized together. The frame could be square or round but square would be easier to make.



Link to requirements and feedback

In the non technical specification requirement 1 of the design is to not be overcomplicated and that is met in these designs because the frame is not complicated for the original idea or the triangular version and also the design does not involve any extra parts such as LED lights. The rectangular design could be constructed from just 2 pieces of timber, which would make the product very easy to assemble and install, while keeping the cost down (meeting 2 non technical specification points, 2 and 3). The triangular version of this design could be made in a similar way, with just 2 parts but the models made using a tube frame behind the timber components. This could still meet the non technical specification points: 2 and 3 because the frame is relatively simple and the amount of materials used should be low enough to keep the product within the budget of £40. All designs seen on this page will not meet specification point 4 because there is not enough space to hold 10 medals in the gaps shown, especially on the triangular version as on the scale model 2 scaled medals are being shown and it is clear that only 3/4 would fit neatly in the space. The design meets spec point 5 as the shelf has the space to fit 3 other awards. The designs shown also meet spec point 6. The innovative features include the ability to change the length of ribbon on show and also this design idea could have an innovative shape.

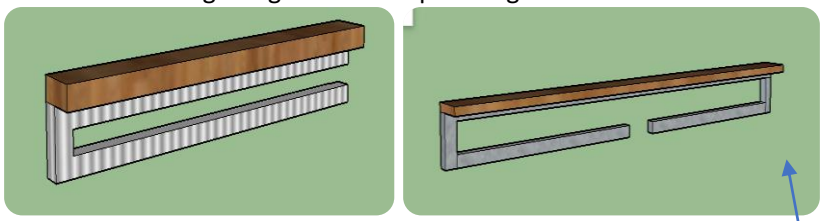
Feedback from end user Luke Rayner:
Pros – "Clean simple design that would sit well in many different environments. Nice use of colour. Hides the ribbons well."
Cons – "Not the most efficient use of space, however this could be resolved."

Response to feedback:
I will develop this design further to make it more space efficient and capable of holding more medals.

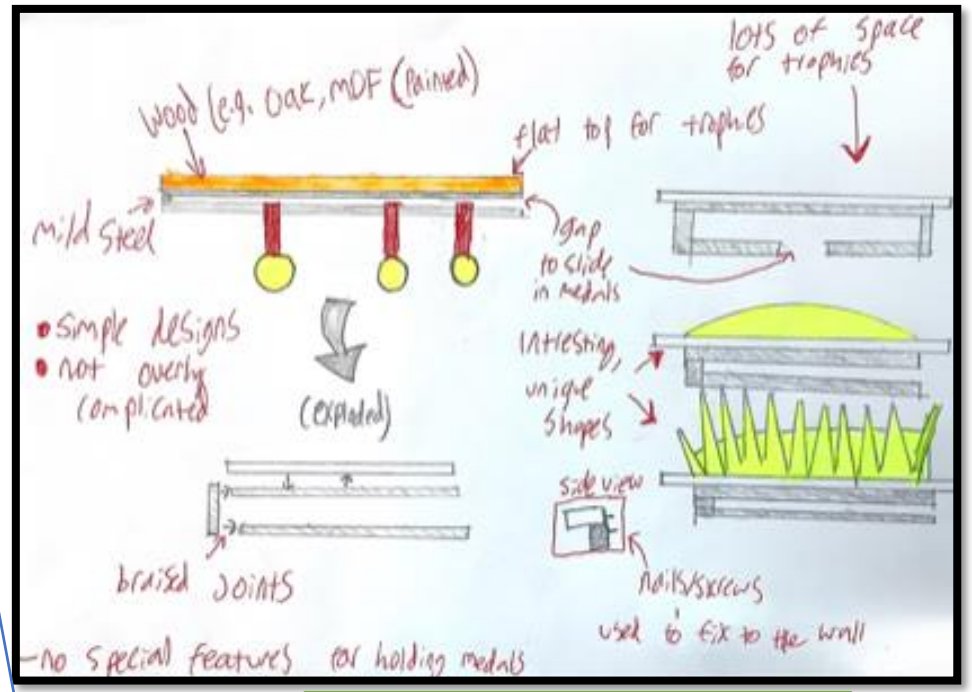
Generation of initial ideas

Idea

The idea shown on this page aimed to have a simple but unique design using a metal frame and a rectangular shaped wooden shelf. The sub sketches have more interesting designs, including colourful backboards against the wall behind where trophies go. I believe the spiky and curved versions are more successful designs because they look aesthetic and as a consumer I would be more likely to purchase a more interesting design over a simple design.



3-d CAD models were created in SketchUp to show how the idea will look and the CAD also helps with visualising problems and solutions. The difference between the CAD models shown above is that the the left idea is only supported on one side but the right idea is supported on both sides, which makes it stronger but a less unique and innovative idea. However I still prefer the less innovative shape idea (right design) because I prefer the symmetrical shape. Another difference between the 2 CAD models is that they use different metal colours.



I prefer the colour of the right idea because darker metal looks aesthetic.

Link to requirements and feedback

The idea meets spec point 1 because it is a simple design and doesn't have many components like lighting or clips that other ideas include. Spec point 2 is also met as assembly will all be done in a workshop/factory so there is no assembly required at home for consumers. Therefore the product would also be very easy to use as all that needs to be done is to attach it to a wall and then it can be used. This idea might be able to be made for £40 to meet spec point 3 but mild steel with a finish such as powder coating can be expensive, and also timber such as oak is expensive and would likely take the cost over £40. Spec point 4 is met because there is lots of space on the mild steel to fit many medals along the product. Specification point 5 is also met by the design as the wood shelf could be made relatively large to fit as many trophies as the consumers would like to display. The idea does not contain any specific innovative features but the shape of the structure is a unique design. This means that spec point 6 is met to some degree but this is not the most innovative design idea. Overall lots of the requirements are met with this design but it is not the most interesting design.

Feedback from primary user Ben Guilford:

"I like all of the designs on this page. I particularly liked the ones with yellow coloured-in backs. The one that resembles the shape of a cartoon sun is a particularly interesting shape. This type of product is what I would consider purchasing for my own room. I do not really like the colour of wood seen in the CAD models."

Response to feedback:

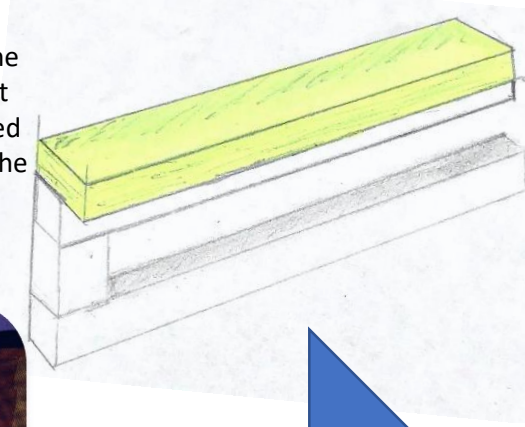
I also like the designs seen on this page and will take aspects such as the size and style into my design development.

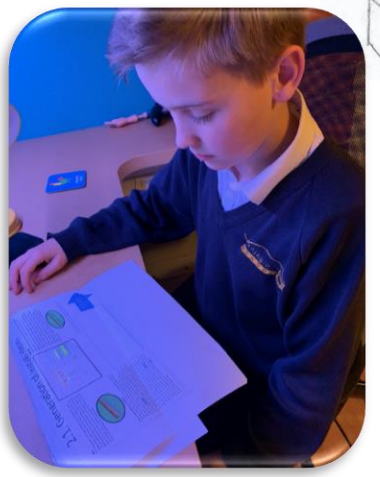
Materials

Materials used for the frame would have to be a metal such as mild steel to be strong enough for the angles shown in the sketches. One other metal that could be considered is aluminium because it is lightweight and has a good looking texture. However aluminium is more expensive and far harder to work, which makes it unsuitable for my project. For the wooden top manmade materials could be used such as MDF, which could be painted for a very smooth pristine finish. Another option for the top is a natural timber such as Oak or Beech. These could be finished with an oil treatment to reduce wear.

The sketch shown below is an initial idea drawing that inspired the CAD versions shown on the left side of this page. The sketch uses the colour yellow to show the different material that makes up the shelf of the product. This drawing shows which bits are made up of different pieces of metal.

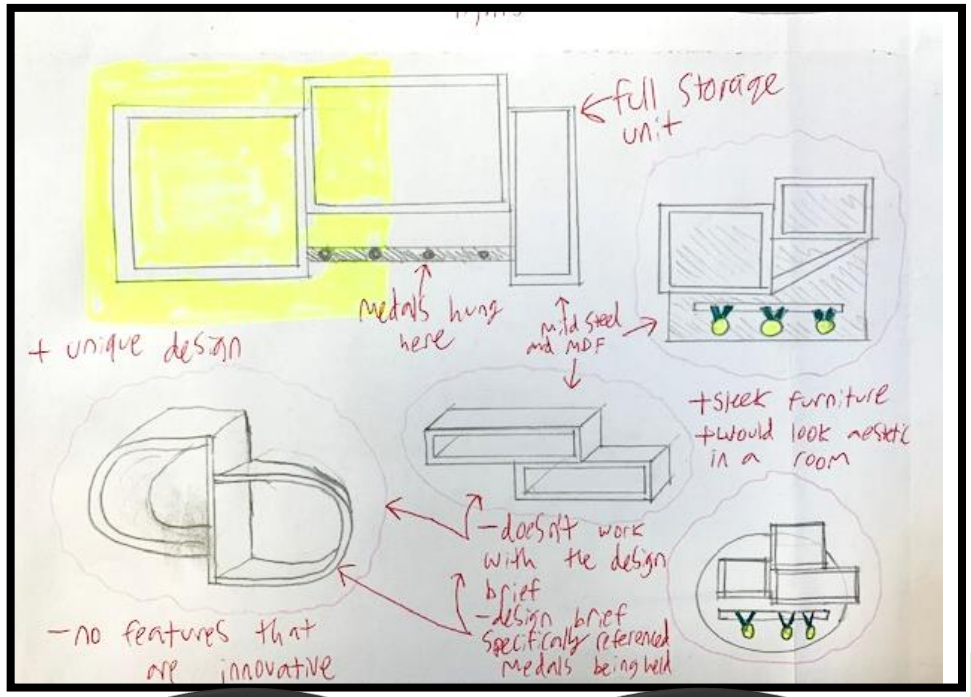
A problem with the design seen is that medals would need to be hung from the frame with the entire ribbon visible.





Next steps: Generate more initial ideas with annotations and CAD designs.

Generation of initial ideas



Idea

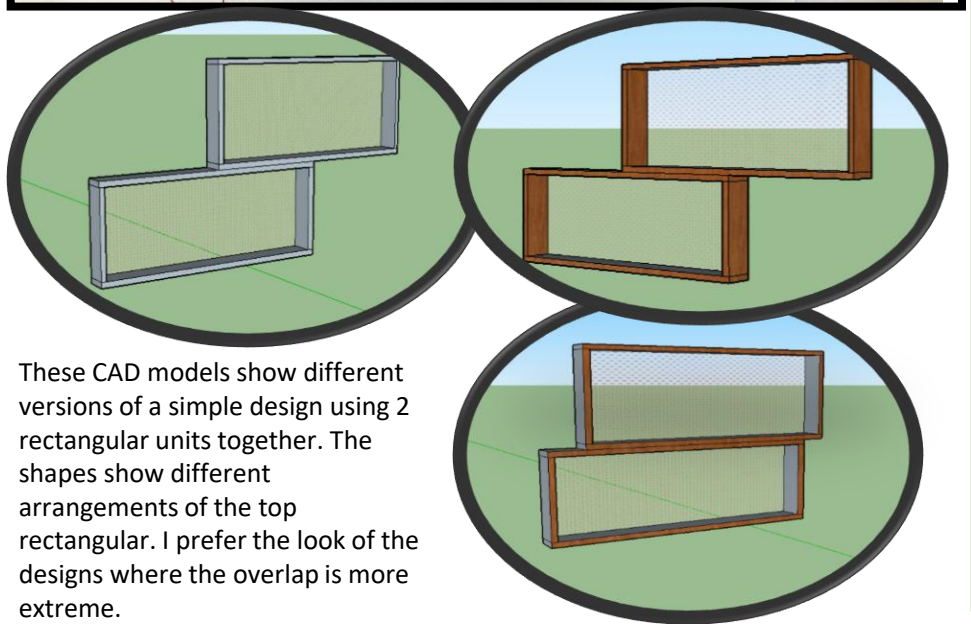
The idea behind the sketches shown is to create a larger unit for storage of medals and also to hold other items and large awards. Big trophies can fit in the type of unit drawn as the main idea. And this would not be possible in most other initial ideas.

Materials

Materials that could be used include MDF or thin plywood for the wooden panels. These should be painted to reduce wear and also give the product a smooth finish. The panels could be joined with nails or screws and also wood glue. For the metal bar used in the main sketch, powder coated mild steel could be used with mild steel tube sticking outwards to hold medals. The steel components should be joined by braising.

Link to requirements and feedback

The first specification point is met because the product is relatively simple in terms of features and construction because it is all made of flat wooden panels and a metal tube. The idea would be difficult to transport all together because it is larger than the other ideas so it would likely have to be flat packed. Flat packing this product means that the consumer will have to assemble the product themselves, which is a hassle for consumers without any experience. Therefore this idea is not easy to assemble and install and does not meet specification point 2. The idea would not be able to meet spec point 3 because it is a larger design so more material are required than would be possible on a £40 budget. Even though the idea is a large size, there is not much space for medals specifically so 10 medals won't fit on any of the designs shown. Therefore specification point 4 is not met with the idea. Specification point 5 is completely met with the idea because there is more than enough space for 3 trophies. The idea behind the product type is not innovative, however the sub sketches with curved shapes and angled beams are innovative in their design.



These CAD models show different versions of a simple design using 2 rectangular units together. The shapes show different arrangements of the top rectangular. I prefer the look of the designs where the overlap is more extreme.

Feedback on images by stakeholder Ed Carpenter:

Pros – "Clean simple geometry which allows the materials to shine through. I like the idea of 'framing' your trophies to make them feel even more special. This could also appeal to people with collections of objects - not just trophies. Keep the wood natural as this will age much better than a painted finish. Self assembly is not an issue at all (look at IKEA) people are used to doing this so don't let that hold you back."

Cons – "It will be more expensive to make due to the amount of material, however I think a more premium offering using quality materials is not a bad thing. After all who will be actually buying this - the children or their proud parents....."

Response to feedback:

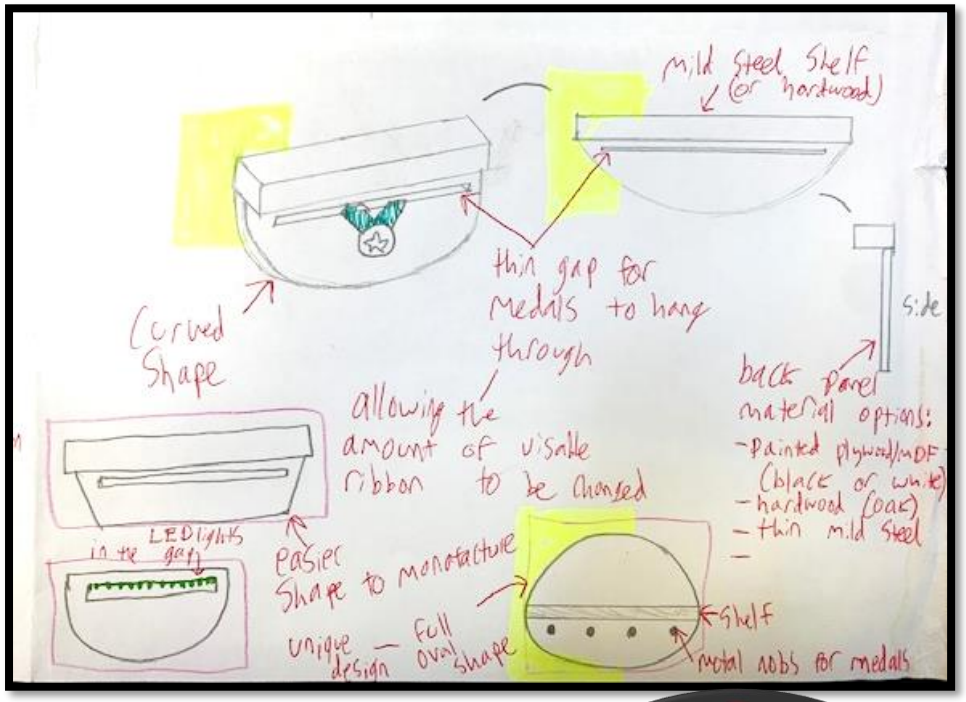
Natural timber is a good idea that I hadn't considered before due to cost constraints but if I develop this design further than I will look at natural timber. I will likely not develop this idea further due to the fact that it is not a unique idea and there are similar products available.

Next steps: Generate more initial ideas with annotations and models.

Generation of initial ideas

Idea

The designs shown incorporate a round shape with features such as a shelf, a gap for medals to be held by and LED lights. The curved shape is shown for the main design and 2 sub sketches because it gives the product an aesthetic appearance. A more simple shape is seen in the sub sketch without rounded corners that could be developed to speed up manufacture and reduce cost. The gap to hold medals would need clips on the back to actually hold the medal ribbons and stop them falling from the product. There is space for these components in the design shown and they will allow medals to be held in a far more aesthetic and space efficient way.



Link to requirements and feedback

The idea is not overcomplicated so the non technical specification point 1 is met well. The main design shown only contains 2 main parts, which will make it easy to assemble, install and use so spec point 2 is met. Depending on what materials are used, spec point 3 may be able to be met but if more expensive materials are used such as hardwoods, metals and LED lights then the £40 budget will be exceeded. Specification point 4 is not met by the designs shown in sketches and models because they are too small to hold 10 medals, however the idea could be developed to be bigger and able to hold more medals. Specification point 5 is met, the surface area on the shelf is adequate for holding trophies and other awards. This idea is made innovative from the curved shape, method of holding medals and possibly LED lights shown in sub sketches. With these design choices and features the idea could meet spec point 6, however if a version without these features was developed from the idea then it would not be innovative.

The laser cut medals were used to test this idea because they allow me and my stakeholders to see how the medal holding mechanism could work and whether it is successful. It also allows me and my stakeholders to evaluate if the design is aesthetic and whether it is a successful innovative design. The laser cutting was a good idea and has helped support the designing and testing processes.

Materials

For the shelf part, materials such as natural timber and manmade boards could be used. If timber is used then oak or beech could be used. Manmade boards that could be used include painted MDF, veneered MDF/chipboard or plywood. For the back panel against the wall a manmade material should be used because it would be easier to work and cheaper. A metal frame could be used as shown in the models with thin wooden panels, this could be done to increase the strength and make joints stronger. Brazed metal joints are far stronger than wood joints using glue and screws so the 90^0 angles could need to be braised to support weight of trophies.

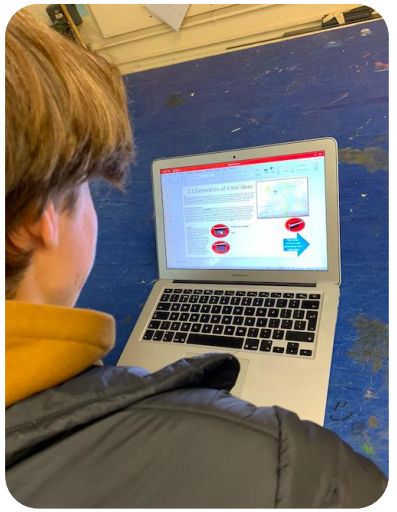
Feedback from end user, Luke Rayner:

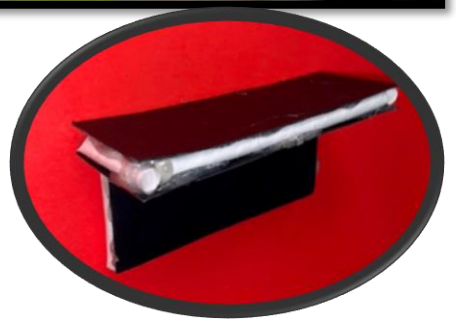
"I think this design is ok but it is not very interesting. Out of all the designs that I have seen I think other ones would look better and would make the medals look better. I much prefer the second design in the initial ideas section because it looks more aesthetic. Out of all of the designs on this page, I like the rounded ones the most."

Response to feedback:

I will not develop this design further as it clearly is not interesting or unique enough.

The red background shown in the pictures is the red walls in the DT classroom at school because to test this model I used blue tac to fix it to the walls. This allowed me to see how successful the idea is in a real situation.

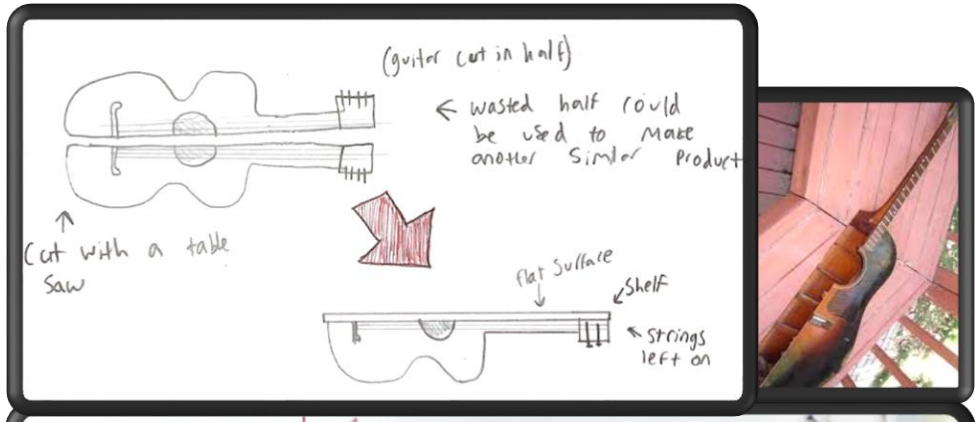


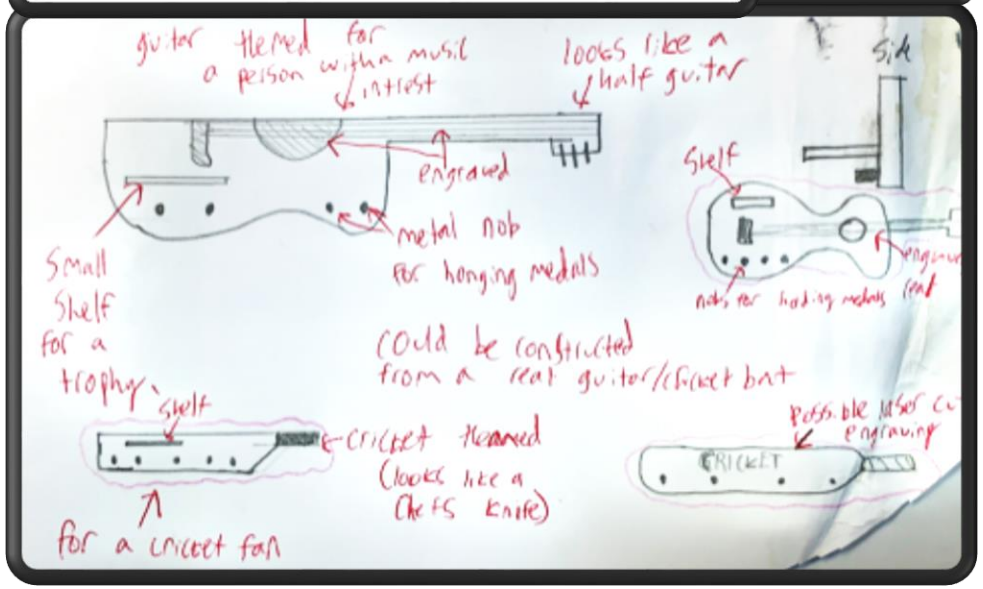


This model is very simple to make models of and making real products in this style would be relatively quick and easy, especially compared to some other more innovative designs.

Next steps: continue with generating more initial ideas

Generation of initial ideas



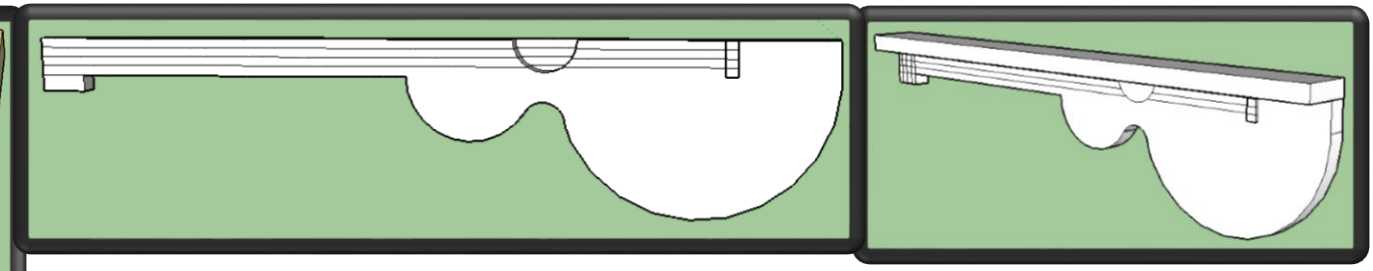


Idea

The idea behind the designs shown is for a heavily themed product specifically targeted towards people who play the guitar/enjoy music or people that enjoy cricket. My first thought with this design was to cut a real guitar in half and then build a shelf on top of that. The lower designs on this page (without using a real guitar) are a development of the original idea (that does use a real guitar). Not using a real guitar or cricket bat makes the design lighter weight, cheaper and less complicated. Also using a real guitar is a waste of a real instrument and also would be harder to cut and work than a design using materials such as plywood or flexi-ply.

Link to requirements and feedback

The idea could meet non-technical specification point 1 because the designs shown do not use any complex mechanisms for holding medals and are relatively simple to manufacture, mainly using CAM. However engraving and laser cutting is complex to design on CAD and could be time consuming. The product would be assembled for the consumer so all they need to do is put the product up on the wall. Therefore specification point 2 is met. If the design was made using a real guitar then specification point 3 wouldn't be met because the guitar would make the product more than £40. However if the design was made from cheaper materials then the spec point could be met. The idea would not meet spec point 4 because only a few medals can be held by the metal knobs. Specification point 5 is met by the idea because the shelf is big enough to hold numerous trophies. This product idea is innovative because it is an idea I have not seen before. Therefore specification point 6 is met well and this is the most innovative design I have generated.



Materials

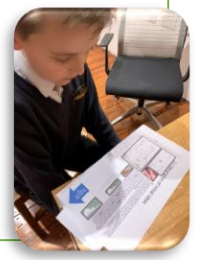
One material that could be used for the body of the product is plywood because it is affordable, easy to work and strong. Also plywood is a similar shade of wood to a guitar and a cricket bat, which are 2 themes that could work well for the idea. Therefore the product could be given a clear coat or no treatment at all. Another material that could be used is flexi-ply because it is light, easy to work and a good colour for the themes that I have based ideas on (cricket and guitar). However flexi-ply is not rigid so it will need a solid frame to hold the pieces in place so they don't flex and break. The wood could be cut and engraved in a laser cutter to make it more accurate and also laser cutting reduces the time taken for the product to be manufactured. On a large scale of manufacture this could be very useful in increasing efficiency.

Feedback from primary user Ben Guilford:

"I think this idea is very interesting and something that I would consider buying. I play musical instruments and am interested in music so this is a good theme for me."

Response to feedback:

I also think that this design is interesting, however it is a more time consuming and expensive product.



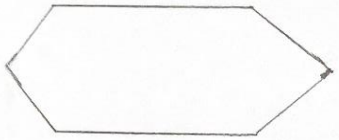
Next steps : begin development of the initial idea that I am going to use

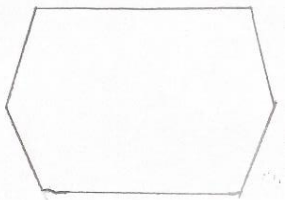
Design developments – idea and clips mechanism

I chose this initial idea to develop further because it meets the non-technical specification points well and is an aesthetic, simple idea. The parts of this idea that I will develop are the shape because I like how the medals are hung and also how the idea would be made of a metal frame and wood parts.

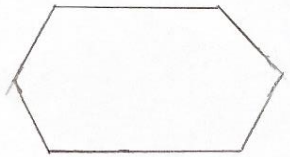
The current triangular shape shown as the initial idea is too simple

A hexagon shape could be used to hold more medals and make the product more interesting.



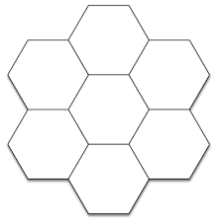


Changing the angles at different corners changes the appearance of the hexagons.



A hexagon product could be combined with more of the same identical product.

Hexagons can be regular or irregular and each different hexagon has a different appearance and style.



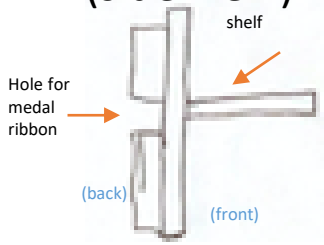
The mechanism of holding medals with this idea could be improved with the use of clips such as clothes pegs. The clips could be used to hold medal ribbons behind the back of the product. This means that medal height would be adjustable and also medals would be far less likely to slip out of the product.

Clips could be used to hold the ribbon of medals in either permanent positions or temporary positions (on the back of the product). The medals could hang with the metal part displayed on the front of the product and the amount of ribbon displayed can be changed and adjusted easily by pinching the clip and sliding the medal ribbon further up or down.

Hexagon shapes could be cut out of many materials, such as woods (MDF, plywood, oak or even pine) or the hexagons could be cut out of a metal such as mild steel

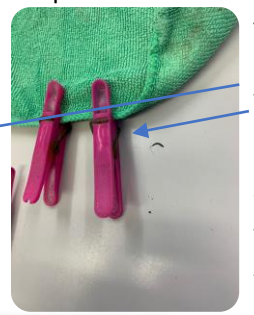
Feedback from primary user Luke Rayner:
"I like the design you have developed here because I liked the original triangular shape but I also think that a hexagon could also look good. The clips could be useful to have but I don't like the appearance of them. Maybe you could use less brightly coloured clips and cut off the end of them so they are shorter."
Response to feedback:
When developing this idea I will look at finding a more aesthetic way of clipping the medals.

(side view)



This page shows the idea in many different shapes but the one that I will develop further is the hexagon shape because hexagons fit together and also it is an interesting look for a product. The image in the top right has given the inspiration for having a shelf and also a gap for medals to hang through.

This diagram above shows my first ideas on how the hole could have medals pass through the product, however this is a bad idea because there is not much space for the ribbon to be held in and also lots of material is used on the back of the product.



These images show that clothes pegs can hold thin fabric. They are designed to hold fabric in a stable position without letting the fabric slip out and fall. Also clothes pegs have not creased this fabric. They are well suited for holding medal ribbon.

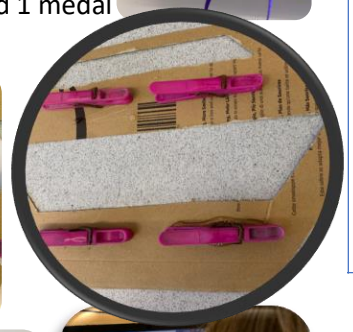
Next steps: continue development of how the clips could work

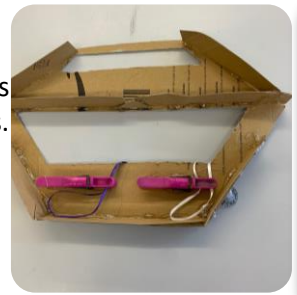
Design developments - clips

Different clips
I investigated different options for the clips used to hold the medals because my primary user, Luke Rayner, didn't think the pink clothes pegs looked aesthetic. Also the pink clothes pegs are larger than they need to be and the long shape takes up more space than the clips need to.
I found that there are many different types of pegs and clips that could be used. I experimented with pink clothes pegs and metal clips on a model of the product.

How clips could work
Depending on the size of the clips, 4-8 clips will be attached to the back of the product to hold medals at whatever length the user wants. To hang a medal or change where it hangs to, the whole product needs to be removed from the wall. Clips are squeezed to allow the ribbon to be put in.

Clothes pegs and metal clips
The pink clips only have a small contact area to hold ribbon so each clip can only hold 1 medal. The metal clips could hold more than one medal because they have a larger contact area. However it may look cramped on the product if each clip held multiple medals, so if the clips can only hold 1 medal each that could be fine





Other clips

More metal clips are available in different shapes and colours for affordable prices on websites such as Amazon

Coideal 30 Pack Small Metal Clips Mini Hinge Paper Clip for Pictures Photos, Office (Black, 22mm)
Visit the Coideal Store
3,025 ratings
-13% £6.99
& FREE Returns
Find out if you're pre-approved for a thinkmoney Credit Card in 60 seconds. Apply now. Amazon EU S.a.r.l (credit broker).Capital One is the lender.
Learn more
Note: This item is eligible for FREE Click and Collect without a minimum order subject to availability.
Details
Colour Name: Black

Coideal White Small Bull Clips 30 Pack 0.87 Inch Metal Hinge Paper Clips for Photo Pictures, Tags Bags, Shops, Office and Home Kitchen (22 mm)
Visit the Coideal Store
3,025 ratings
-22% £6.99
& FREE Returns
Find out if you're pre-approved for a thinkmoney Credit Card in 60 seconds. Apply now. Amazon EU S.a.r.l (credit broker).Capital One is the lender.
Learn more
Note: This item is eligible for FREE Click and Collect without a minimum order subject to availability.
Details
Colour Name: White

Phoetya 30Pcs Stainless Steel Clothes Pegs, Multifunctional Non-Slip Metal Laundry Pegs Clothes Pins Clips for Sock, Shoes, Towel,...
104
Save 5%
£11.99

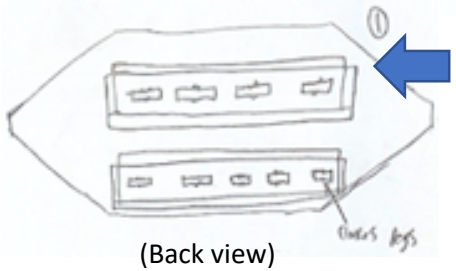
120 Pack Foldback Clips 4 Sizes Metal Paper Clips Clamp 32mm 25mm 19mm 15mm Binder Clips Black
127
£7.99
Get it Tomorrow, Feb 10
FREE Delivery on your first order shipped by Amazon

Design developments – hexagonal shape

Some different designs of the idea are shown in this area, using a hexagon shape. These different variations show the support pieces in different places and where medals hang from is different in each variation.

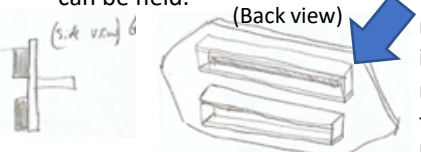
In these design I kept the feature of medals passing through the product through a hole because it is a better way of holding medals than metal knobs sticking out.

The sketches shown are designed to be made out of materials such as MDF because they are cheap and easy to use but they could also be constructed out of more high quality materials such as oak. For my final design a high quality material should be used but time constraints, material shortages in school or cost may mean that the product needs to be made of a man-made board.



(Back view)

This variation of the design uses separate holes for each medal because it makes the idea more neat and organised. However I will not use this design as it is less aesthetic and also reduces the amount of medals that can be held.



(Back view)

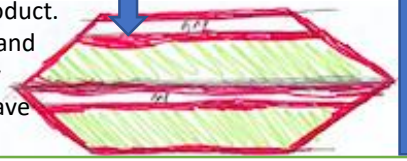
The back view here shows how boxes of thin wood could be used to hold the medal ribbons behind the product. The idea is useful because it stops the medal ribbon from hanging lower than the front of the product, which would not look aesthetic. This is a concept that I will develop further in my design development.

Next steps: develop the shape of the product

Feedback from primary user Luke Rayner - (for the left half of this page)
"I think this is quite a clever idea, I like it."

There is a lot of metal framework on this design, which will make the product heavier than the original initial idea. However lots of metal looks good in terms of appearance and my stakeholders would like metal to be used in the product. The combination of metal and wood will work well for my product so that is what I have chosen to use.

The colours here show the different materials used together. (Pink=metal frame) (green=wooden panels).



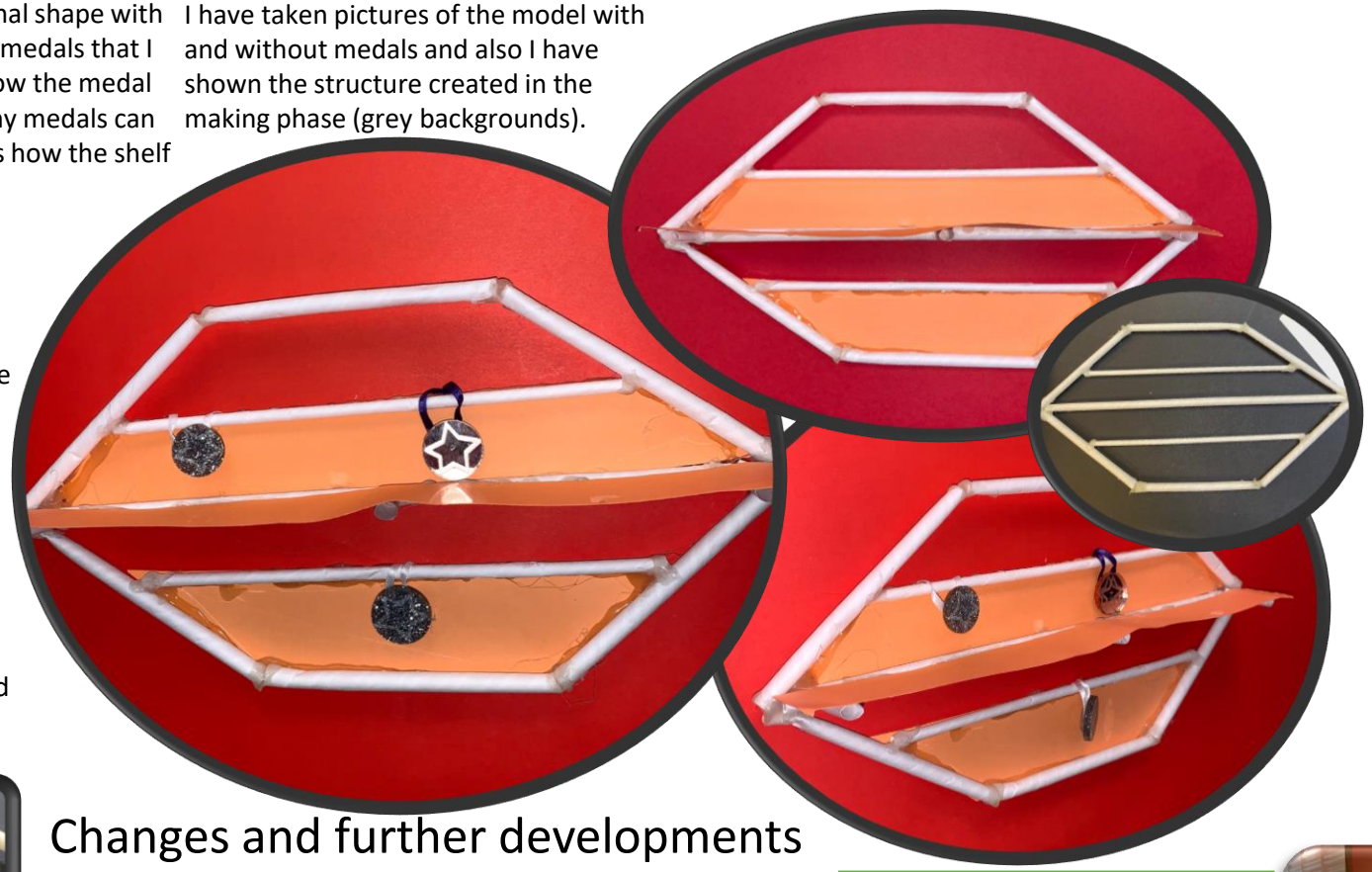
Next steps: make models of possible designs based off the shape development

Feedback – Primary user Luke Rayner:
"I like the hexagonal design. Also I like oak but most of my furniture is made of manmade boards anyway so that would fit with my current furniture if it is made well and looks professionally made."
Response to feedback:
I will consider existing furniture with my final design so that it matches.

Design developments – model

I made this model to test the hexagonal shape with real medals on it. I used the laser cut medals that I made. This is useful for testing how low the medal ribbon would hang and also how many medals can fit on the shape. This model also tests how the shelf could be supported.

I have taken pictures of the model with and without medals and also I have shown the structure created in the making phase (grey backgrounds).



Positives

The hexagonal shape looks aesthetic on this model. The metal frame was easy to construct and not confusing because lots of the parts are the same length and also the shape is symmetrical. The card straws show the framework well because they are the correct size and shape for the scale of the model.

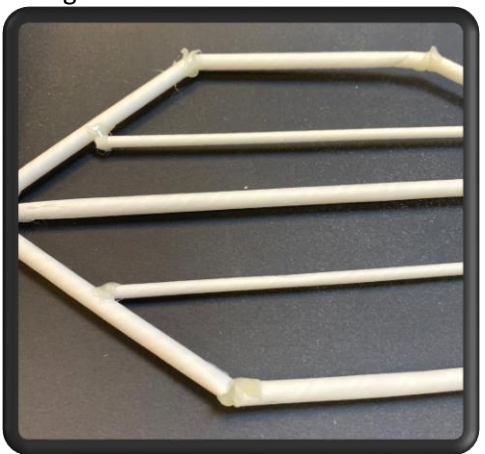
The orange and white colour scheme is a vibrant style for the product and could be particularly successful with children. This is because children tend to be attracted to more colourful designs.

Negatives

This model has no long term way of holding the medals, I used blu tack on the back to keep the ribbon in place. I did this to just show where medals could possibly go. The model shows that my design will definitely need a long term mechanism for holding medals in place. Solutions such as balancing the medals, letting medals sit on the shelf or using blu tack are clearly not solutions that would meet the demands of consumers.

Another negative of this model in terms of demonstrating my design ideas is that the materials used are not realistic. In this model the card that simulates wood is thinner than the wood that would need to be used. Also the card used in the model are all not realistic colours to what would be used for the real product. The model would be more realistic if the orange card was replaced by a thin wooden board, treated with a clear coat or painted. Also to make a more realistic prototype thin metal could be used instead of the paper straws.

Another negative of the model shown is that the medal ribbons are not boxed in, so the ribbons would not be held out of sight. How medal ribbons could be boxed in has been seen on previous design pages in the form of sketches such as the hexagonal shape development section and in a model in the design development of clips section.



Changes and further developments to be made

I need to next develop how clips would fit onto the hexagonal shape in a neat and aesthetic way.

Also I need to box in the ribbon going out of the back of the product so it is trapped in one specific area and cannot move.

The model I created had no way of fixing to a wall permanently, I used blu tack to display it but that is not a good solution, especially when the product is made out of heavier materials. Therefore a strong and simple solution for how to hang the product is needed.

Feedback from primary user Ben Guilford:

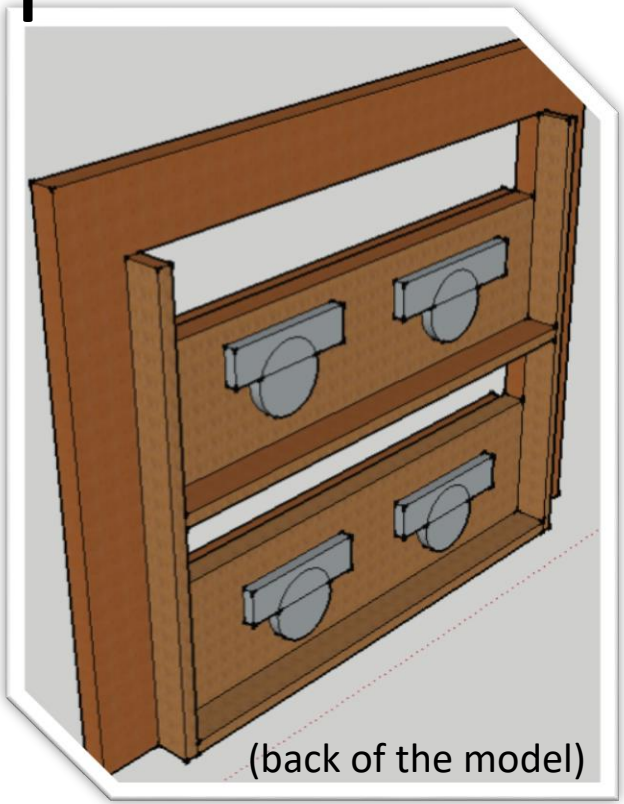
"I think that this design is good because it is a good shape. I would consider buying this sort of product for me."

Response to feedback:

I will develop this design further later in my development.

Next steps: develop how the back of the product will work and how it will look with the clips

Design developments – back of the product



Back of the product

On previous models, there was no way to stop ribbon from hanging down lower than the bottom of the product. This meant it was possible for the medal ribbons to be visible in the middle gap and also under the product. The product will look more aesthetic with no ribbon visible in the wrong areas.

The CAD drawing shows the different sections boxed off with thin wooden panels because this will keep medal ribbons in the correct areas. I made this CAD drawing purely to show the boxed off sections so the shape is a simple square shape. When I develop the boxing idea to the hexagonal shape, the boxes will need to be a different size and shape.

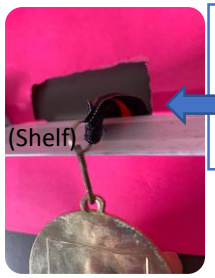
Negatives

The boxing idea brings the product far off the wall because the boxing pieces stick out backwards. This will mean there is a gap between the product and the wall. This could make the product look less aesthetic. Also having part of the product off the wall makes it more difficult to fix to the wall. Another piece of wood would need to be fixed to the back for a screw to go through to the wall. The boxing in idea also makes the product weight increase, which makes it more difficult to attach to a wall because the risk of it falling is higher and the risk of damaging the wall is higher.

Also this development will increase the amount of materials used so the cost of the product will increase.

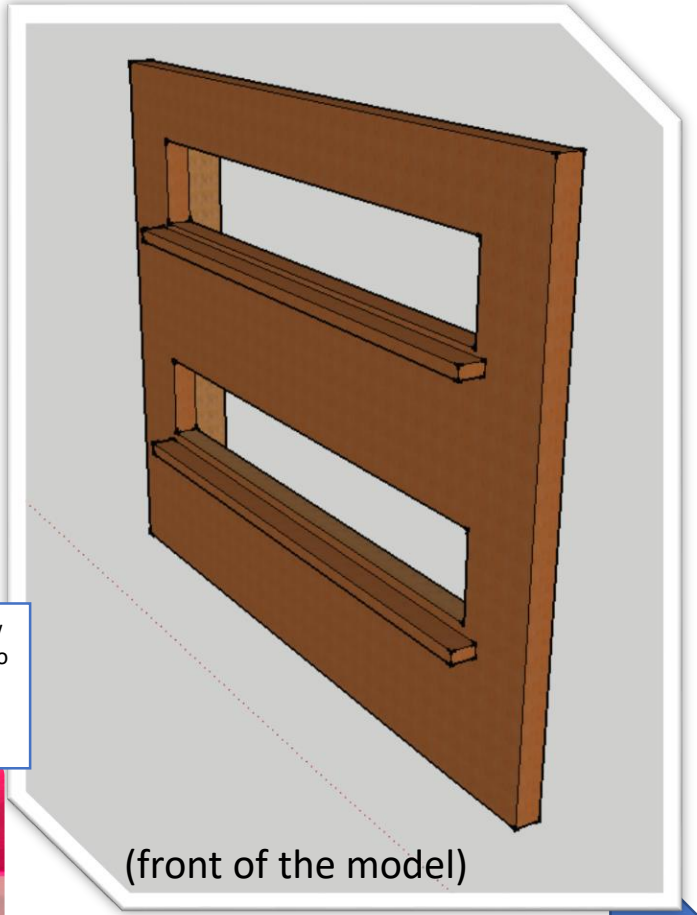
Front of the product

The front of this CAD model was purely created to demonstrate how shelves could be above an opening so that medals can hang next to trophies. However it has been made clear by making the model that this is a bad idea. This idea will not work because the medal ribbon would have to stick out over the shelf in a way that is not aesthetic. For this reason the shelf components of the final design will need to be kept separate and away from the gap that medals are hung through.



This picture shows how the medal ribbon has to stick out over the shelf with this design and how it is not aesthetic.

(Gap for medals)



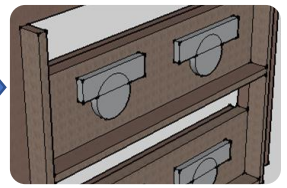
Feedback from stakeholder Ed Carpenter:
"Some great ideas in the presentation well done and very well thought through."

Response to feedback:
As you like this style of designing I will continue creating CAD work and presenting ideas it in this way.

Evaluation

Overall the development on the back of the product with boxing the medals and the clips in compartments will improve the design by making the medals neater so I will use it in my final design. The design feature of the shelf being just below the medal gap will not be used in the final design because it is not a good looking or practical development.

This CAD shows what parts are meant by the boxed in section. The vertical and horizontal strips of wood shown in the CAD box in the medal ribbon.

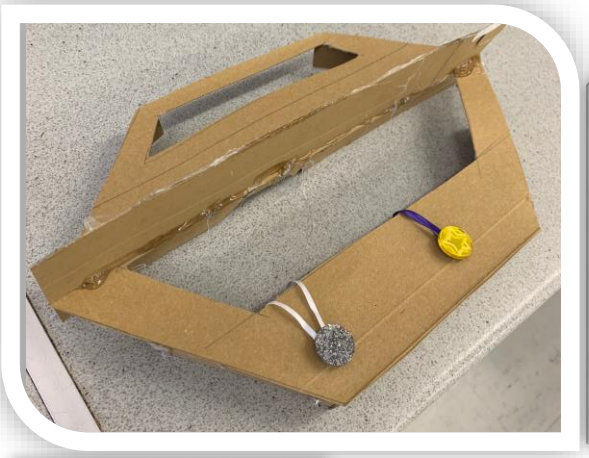


Next steps: create a model based off the design developments of the back of the product, the clips and also the shape

Design developments - model

The model

I made a model to show the boxed part on the back and also the hexagonal shape of the front. The boxed part on the back has been developed to keep the medal ribbon in the correct area and not visible from the front. The hexagonal shape has been developed to be aesthetic and to have lots of space for medals and also space for a long shelf across the width of the product.

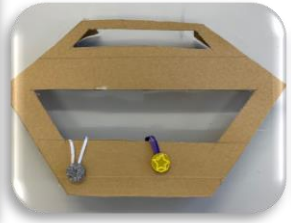


How it could look

This picture shows how the model looks against a wooden wall. The model sits off the wall by an inch as that is the distance that the boxing off pieces stick out of the back of the product. This does not look as aesthetic as it would if the product was flat against the wall but if it was flat against the wall then the medal ribbons would be visible in the wrong areas, so overall the design would look less aesthetic.

Making the model

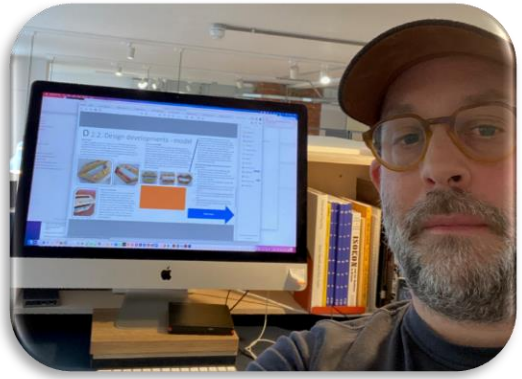
This model was created quickly and not accurately to save time and allow me to generate lots of ideas quickly. That is why the cuts are not to scale or even for the holes in the product. Recycled card was used for the model to reduce waste and cost for the development process. Also a glue gun was used for fixing parts together because it is easy and very quick to do. The clips used were clothes pegs and they were glued to the model to show how the clip mechanism could work and then removed so they were mot wasted.



Feedback from stakeholder Ed Carpenter:

Pros – “Good practical design while also clean and simple.”

Cons – “The shelf does not look supported enough.”



Response to feedback:

I will develop how the shelf is held so that it is stronger later in the development process so that it is able to far hold more weight. I will do this by using support pieces and far stronger materials.

This picture above shows the back of the product with the developments made on the previous page such as the clips and the boxed off sections. It is clear in this model that there is not much space in the boxed off areas, especially compared to the CAD models on the previous page. This is likely not a problem as this model is not to scale (it is smaller) and also was not made accurately and if it was made more accurately there would be more space below each clip.

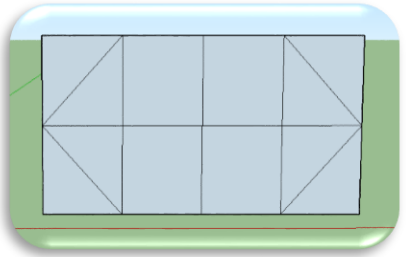
How well the design meets the non-technical specification

1. Specification point 1 is met relatively well because the design is relatively simple
2. The product was very easy to assemble as a model and could be made of simple shapes and easy to use materials
3. This design could be completed for under £40 so spec point 3 is met
4. The design shown would not be able to hold 10 medals in a neat way so it does not meet spec point 4
5. The shelf shown on the design would be able to hold 3 average sized trophies, so spec point 5 is met
6. Spec point 6 is completely met because the method of holding medals and the shape are both innovative.

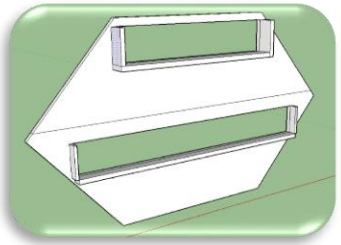
Next steps: explore how the product will be fixed to the wall and develop how exactly it will work best

Design developments – fixing to the wall

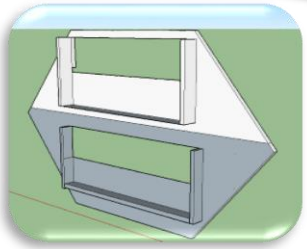
CAD design
I created a CAD model of my current developed design to experiment with how the product could fix to a wall. This design was created using Sketchup and different colours are used to show features.



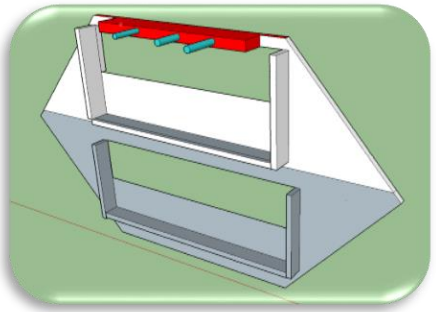
I made the hexagonal shape symmetrical and with appropriate angles by drawing lines using mid points within the rectangle.



This design had the bottom of the boxes on the back too high, so medal ribbons would have no space to hang.



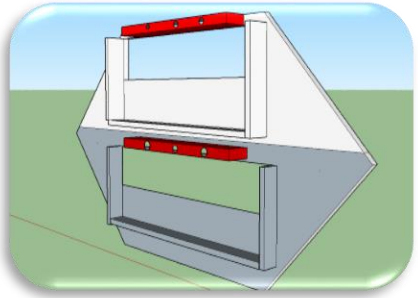
I noticed the problem and changed the design so this CAD model has the boxes going lower.

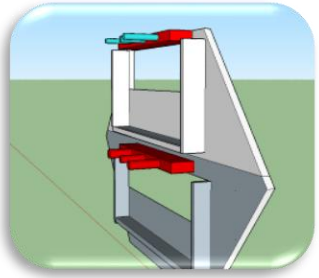


One way that the product could fix to a wall is by having a wooden piece attached to the top of the product that bolts or screws could go through. The materials for this method would be cheap because not much material is needed and also cheap manmade boards can be used much as MDF. For this design solution, long screws would have to go through the front surface of the product and all the way through the added wooden piece and then the wall.

The red highlighted parts is the wooden piece added to the design. The blue coloured pieces are a demonstration of how bolts or screws would stick out (and go into the wall behind the product). The blue screws/bolts are not to scale, they are shown as larger than they will be to show the stakeholder and end user the concept for the design and where these components are going to be. If this CAD model had the bolts/screws to scale than they would be difficult to see.

Feedback from primary user Ben Guilford: "This design is pretty good but it's a very serious looking design. It doesn't look as good for people my age."





Another way that the product could be fixed to a wall is by having multiple fixing points on the wall. In this model I have left the top part the same but also added another part to fix to the wall near the centre of the product. This makes the connection between the wall and the product stronger and decreases the stress on the wall where the top fixing is by spreading the weight. However this idea uses more materials and requires more labour to produce. Also the idea to double the fixings to the wall will mean that double the amount of holes need to be made in the wall that the product is fixed to.

Next steps: conduct more research on fixing mechanisms and decide on what method should be used for the product

Technical requirements

Design developments – wall fixings

I have researched screws to see different sizes and types of screws at my school and I also have years of experience using screws with projects at home and within school.

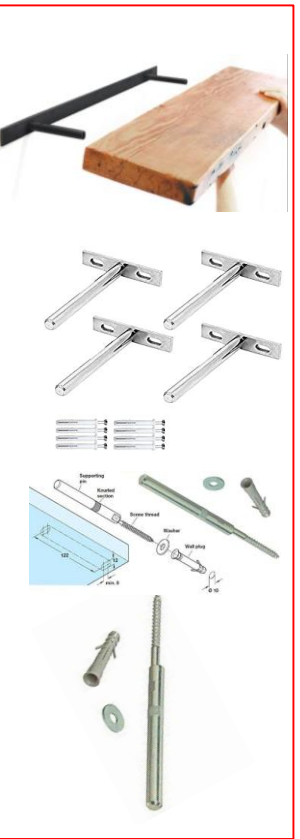
Screws

Screws are a good option as a fixing because they are cheap, easy to use and relatively strong. Screws would be the easiest option for all of the designs shown on the previous page because a long screw can be screwed through the front, all the way into a pre-drilled hole in the wall. The problem with this idea is that the screw head would be exposed and visible. This is a negative because it is not aesthetic to have a screw head visible and it can look unprofessionally made. However a positive of having an exposed screw head is that it can be unscrewed at any time to remove the product. This is very likely to be useful for consumers if they wish to remove the product to place different medals in the product. Removing and then screwing screws back in often will damage the product and the wall because each time the holes will be made bigger.

Bolts

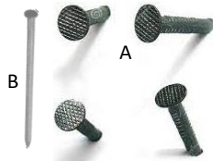
I have experience of using bolts for projects such as my GCSE desk and have researched different sizes and types in the school workshop, as shown in the image above. There are many different sizes of bolts, nuts and washers available

Bolts are a way of fixing that can be used for any product from shelves to boats because they come in many different shapes and sizes and are used to fix any type of material together. The way that bolts would be used for the design shown on the previous page is holes would be drilled into the back of the product and into the wall and then bolts could be put into the wall and then the product can be attached to the bolts sticking out of the wall. The main advantage of using bolts is that there are no screw heads visible, so the product looks aesthetic. This is not a good solution because the fixings would not be able to be tight in the wall or in the product because there is no way for them to be tightened, unlike screws, which tighten as they screw in and can also be helped by a wall plug to ensure a tight connection. Bolts would also be a bad solution because it would be hard to take the product off the wall, unless the connection was extremely loose. However if the connection was extremely loose then the product would be at risk of falling off the wall and the movement would damage the wall.



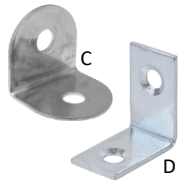
Floating shelf brackets

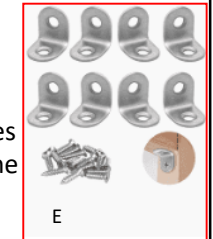
Floating shelf brackets use a screw that goes into the wall to hold a bracket permanently in the wall. The brackets fit into holes in the back of shelves. There are different type of floating shelf brackets that are used in different ways for shelves with different weights and shapes. Some larger floating shelf brackets are stronger and use more screws into the wall while some only use one screw per bracket. For my product I will need to use either many single screw brackets (like the top right image) or 1/2 large brackets (in the style of the top left image). Using floating shelf brackets would allow my product to be removed and then fixed back to the wall again at any time easily and with no damage done, which is perfect for users to change medals. Another positive of floating shelf brackets is that there is no screw head visible from the front of the product, which makes the design look more aesthetic and professional looking. Also floating screw brackets are a good option because if a consumer wanted to change where the product is held then it would be easy to remove it and screw in new shelf brackets at the new destination. Using a wall plug makes the connection into the wall tight and strong because there won't be any movement when the bracket is screwed in. Using a washer reduces the damage to the wall and stops the screw going too deep into the wall.



Nails and brackets/braces

Nails are small sharp pieces of metal that can be easily hit into materials by using a hammer or a mallet. Nails being easy to use means users can put into a wall at home by themselves, which saves cost for the manufacturer because they will not need to provide a worker to fit the product, the user can do it themselves. Images C and D show examples of braces that could be used with the product. One side of the brace can be glued/screwed to the product itself while the hole on the other side can hang on a screw or nail. Image E shows a place where brackets can be purchased, and it also shows that this type of small metal bracket is extremely cheap.





Conclusion

I have decided that nails and brackets/braces is the best option because it is by far the quickest, easiest and most cost effective method. If my product was taken to mass production choosing the cheapest and easiest method would increase profit margins. Nails are an appropriate method because the product can be removed from the wall without damaging the wall and then placed back on easily by the user

Feedback from primary user Luke Rayner:

"I had never seen floating brackets before but from what you have said It seems that the floating shelf brackets are the logical choice for the product. I like how they allow the joint to be kind of hidden. However I have concerns on whether the floating shelf brackets will be able to hold the product without slumping."

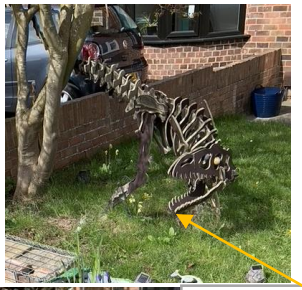
Next steps: research the possible materials that could be used for the product and decide which ones to use

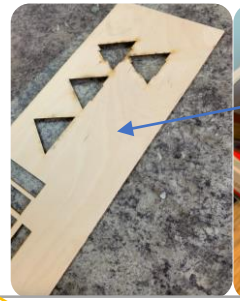
Design developments – materials

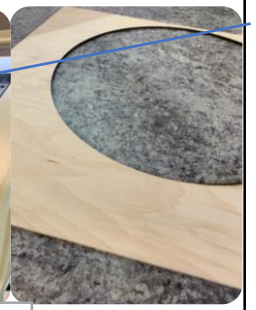
To help me with making my final decision on what materials to use I have completed more research on some specific materials that I could use on the final design. I have decided, using previous research, that mild steel is a material I will use for the structure of my product. The options for the rest of the product are either laser cut ply or acrylic because they are both relatively strong, lightweight materials that can be laser cut in school to produce an accurate prototype.

Laser plywood and mild steel

Laser cut ply is a material that can be cut in very intricate shapes very accurately by a laser cutter. The look of raw plywood is becoming more trendy and if the product is cut accurately and the shape is aesthetic, the plywood can look very professional and sleek. In school the only thickness available is 3mm, which could be too thin and fragile for my product idea. I could use 2 pieces stuck together or I could order in a thicker sheet of plywood if it is too weak.







I looked at some of the laser cut plywood scrap to test the thickness, weight and strength. I found that the plywood is very light and easy to cut. This could be an appropriate material for my product.

While on holiday with my family I saw this laser cut plywood style product in a front garden. It is an interesting product and proves that a plywood product cut out in pieces and slotted together could work.

Acrylic and mild steel

Acrylic is good because it is available in many different colours, patterns, transparencies and thicknesses. Colours such as grey, black and white can create a modern, serious feel from the product and colours such as red, yellow, orange and green create a more child friendly feel for products aimed at kids. Acrylic is easy to laser cut in school and lots of the colours are available to test using off-cuts. Acrylic is available in school in 3mm and 6mm sheets.

I found that acrylic scratches easily but is stronger than laser cut plywood. The acrylic often looks childish on products, like a child's toy because it is usually scratched and colourful.

Conclusion

Plywood is the best option for the product because it is good looking and meets the stakeholder requirements and feedback. Also using a laser cutter means that the product can be made extremely accurate.

Finishes for steel

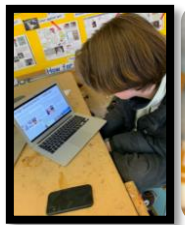
Powder coating is one way to finish steel that leaves a speckly finish and is available in different metallic colours such as a brass colour, plain grey or dark grey. Powder coating creates a protective layer that prevents erosion. Paints are also available for protecting metals from damage and erosion. They can be cheaper and easier to apply to the metal but offer less protection. An example of a paint for metal is Hammerite. I have experience working with both powder coating and Hammerite. I believe that powder coating is not a finish that I want as I do not like the appearance. Painting is an option that I could add after construction but I believe that leaving the metal unfinished will look best for this product. Raw steel will work well with plywood and give an industrial, modern look to the product.

Mild steel

Mild steel is the best metal to use for the structure because it is available in school, I have experience working with it and it is very strong. Mild steel is also well suited because it is a colour that I like in its raw form. If mild steel is left raw then it can rust when exposed to moisture, however if it is kept inside then it will take a long time to rust. Many people do not like the appearance of rust but some products are designed specifically to rust for the industrial, modern look. Though I am not making this product deliberately rusty, if it does rust then the product will not be ruined.

Feedback from Luke Rayner

"The plywood looked like an interesting idea."

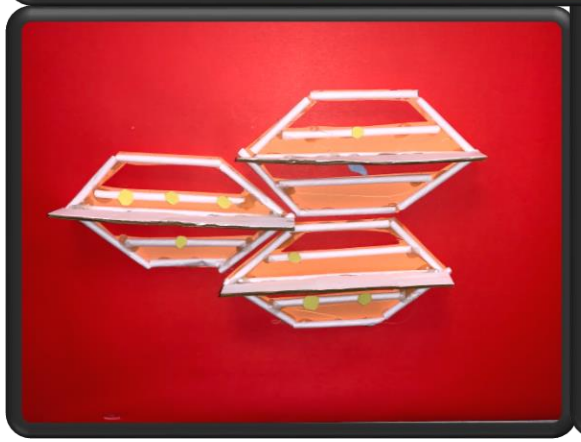


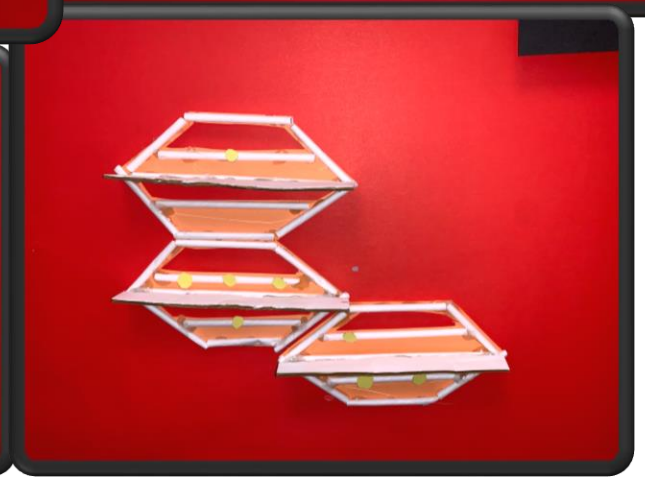
Next steps: make a model to show how this product could be made to fix with many of the same products

Development of design solutions

Model
I created this model to show the shape developments and also to show how multiple products could be fitted together. This model does not contain any clips or any box like structures on the back of the product. Therefore these models are flat against the wall and do not completely show an accurate representation of the design.

Multiple of the product
The models created are arranged in many different ways to show that there are many different options for how to display multiple products. They can be arranged in ways that take more vertical or horizontal space, depending on the environment that it is put into, for example how tall or wide a wall is and what other products or pieces of furniture are around.





Positives
I think that having multiple products joined together looks innovative because normally, shelving and products on walls are very simple designs and are not in unique shapes. I also think that this model makes the hexagonal shape look aesthetic.

Improvements
An issue that that could be a problem for the product is that the shelves in this model are not supported, they are only held in place by the glue I used to fix the model together. An improvement that could be made so that the shelves are better supported is to make them supported by mild steel that sticks out underneath the shelf part. This improvement will be done by fixing some short mild steel tube to the horizontal metal support piece running through the middle of the product. Another change that I am going to make is putting some engraving on the product, it could be the name of the user or even a quote.

The small yellow circles represent medals at the scale of the model. They are used to show where medals would be seen and so that me and my stakeholders can judge whether enough medals can be hung and how aesthetic the design looks. I believe that the number of medals seen in the model is an appropriate number and it looks aesthetic.

Feedback from primary user Luke Rayner:
"I very much like these designs. This is the type of shelf that would be good for me."
Response to feedback:
I will continue to develop this shape and design however I do plan on changing the colour for the final design.

Changes to the last model
The last card model was a slightly different shape because this model is more wide and less tall. I believe that the wider hexagon looks more aesthetic.

Materials and construction of this model
This model was a quick model made using card and card straws with hot glue from a glue gun. The materials were appropriate because they are quick and cheap to use.

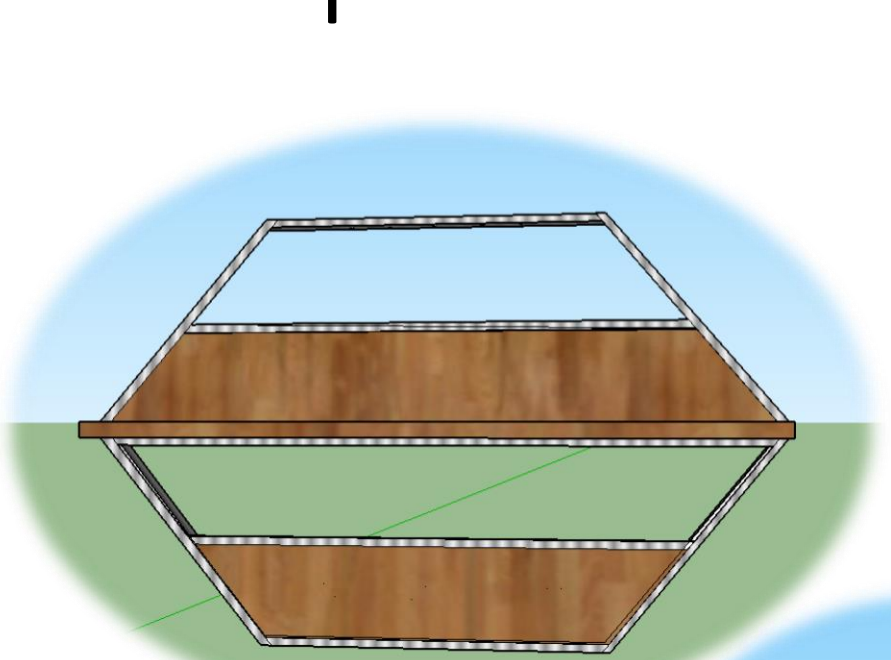
Next steps: use SketchUp to create a 3-D model of the final design

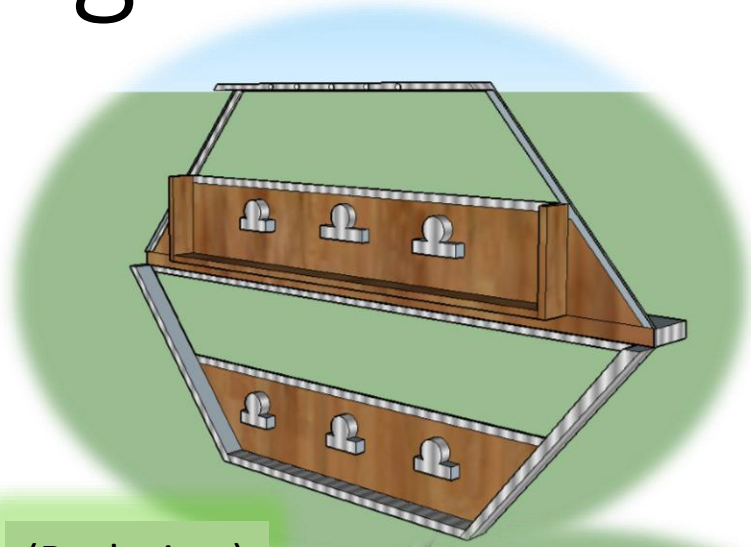
Design development - Design solution 1

The design
I created this CAD model as the design before starting construction of a prototype. This design uses the development shown in previous pages such as the shape developments, peg developments and material developments.

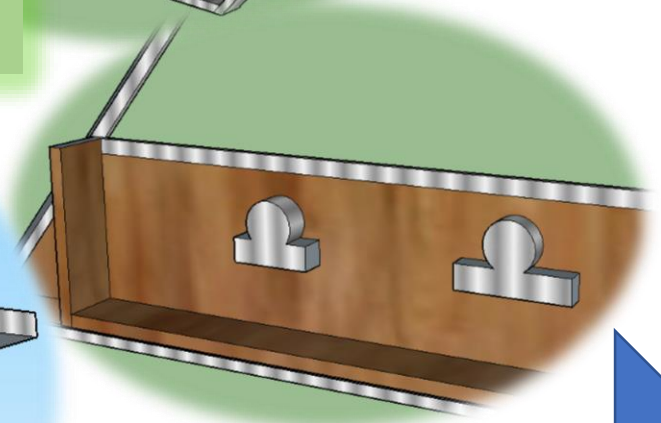
Negatives
This design uses a dark wood colour and a light coloured metal, which does not fit with the materials that I have chosen to use. The plywood I will use is a pale colour and the mild steel I will use will be a darker colour than the metal shown in this CAD. Another problem with this design is that the boxed off wood for the lower half is coloured in the metal colour rather than the wood colour that should be shown.

Wall fixings
For the method of attaching to the wall I chose to use the floating shelf brackets instead of the decided nails and braces because I believed that the floating shelf brackets could be built into the framework of this design, therefore improving the product.

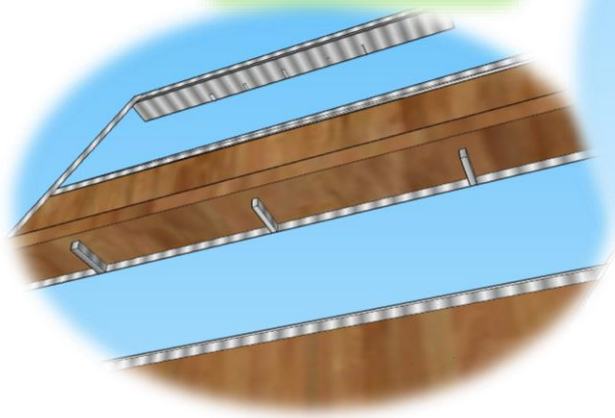


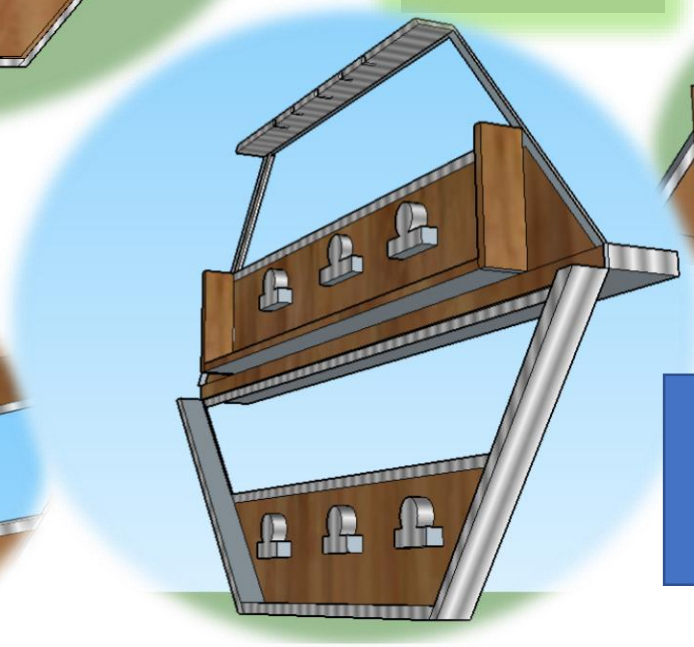


(Back view)



(Front view)

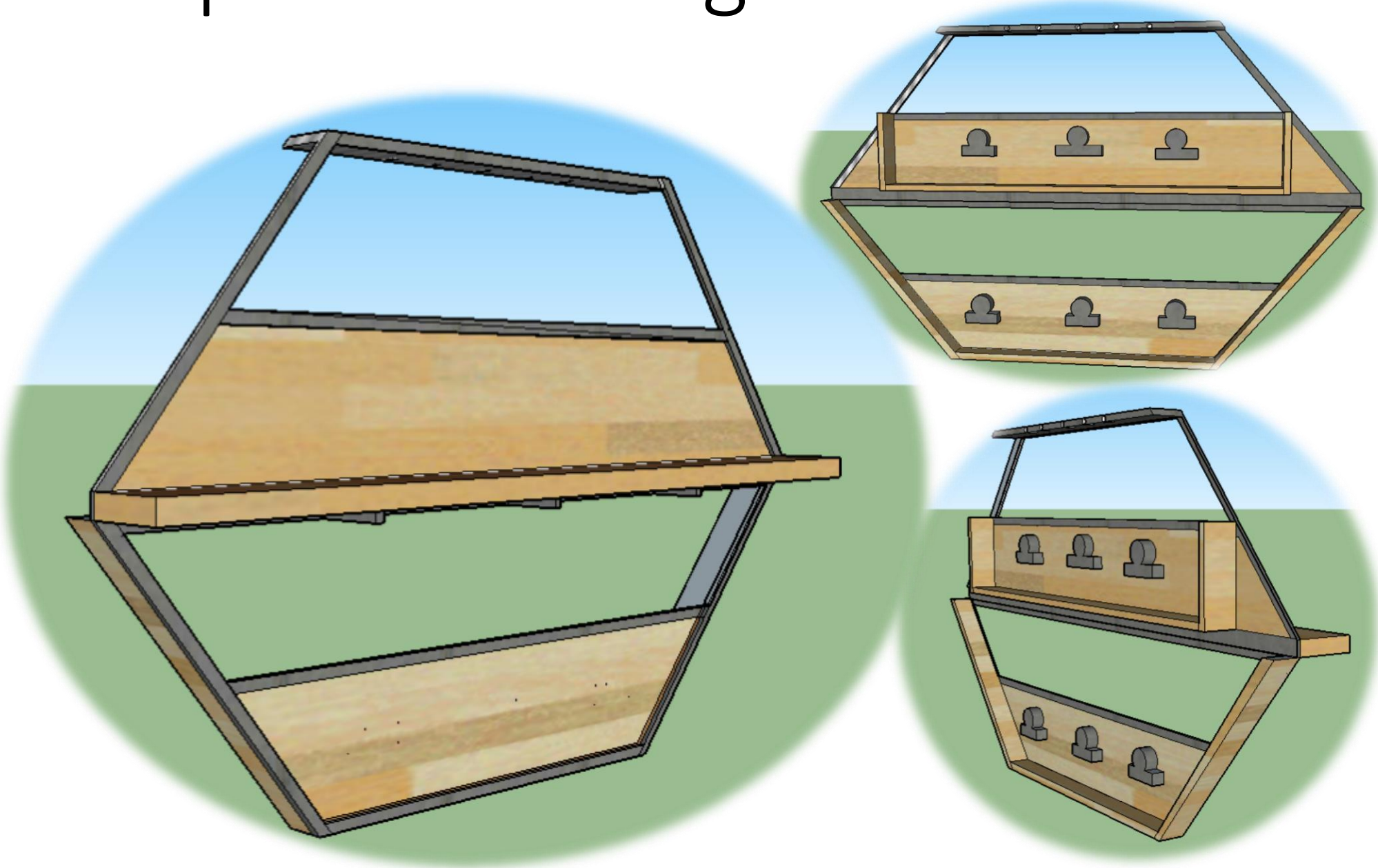




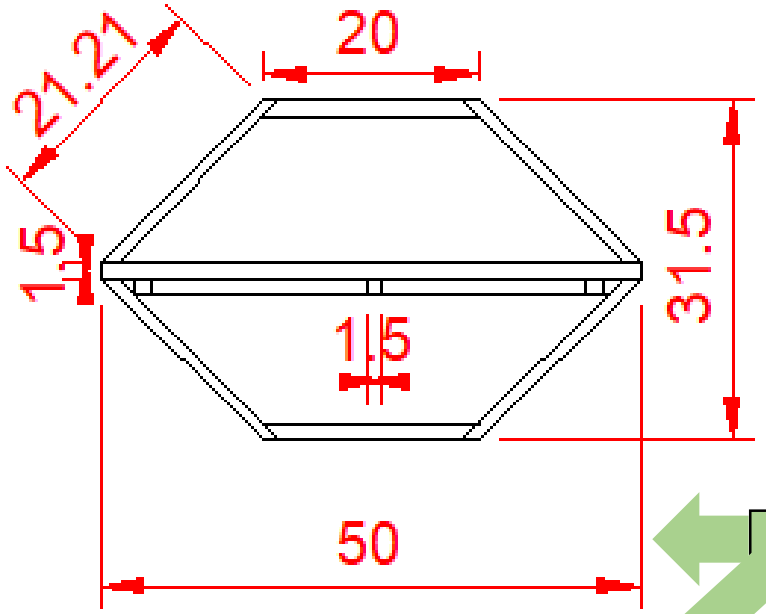
Next steps: create another CAD model that shows the wood and metal parts correctly and also uses more accurate colours

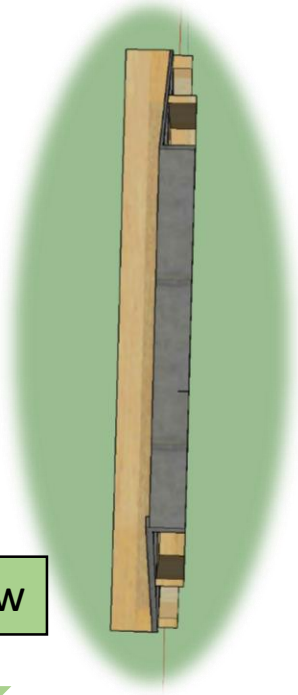
Design development - Design solution 1

The design
This CAD model was created as an improved version of the 1st final Sketchup design because the first design did not accurately show all of the materials used on the product. For this design I used a wood colour closer to the look of plywood and a darker, less shiny metal to more accurately represent mild steel.
This 3-D model is an accurate representation of my 1st design solution and will help with finding improvements and developing the design further.

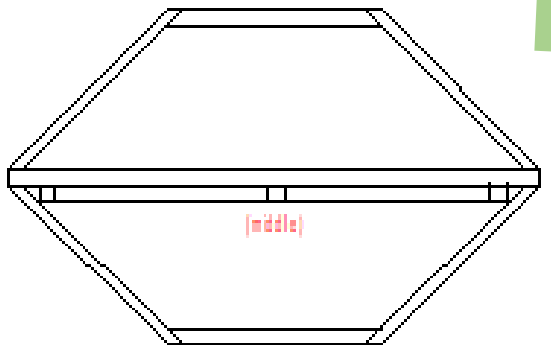


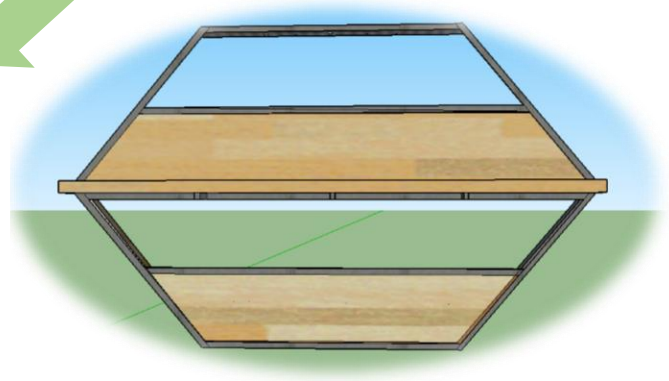
Design development -Design solution 1



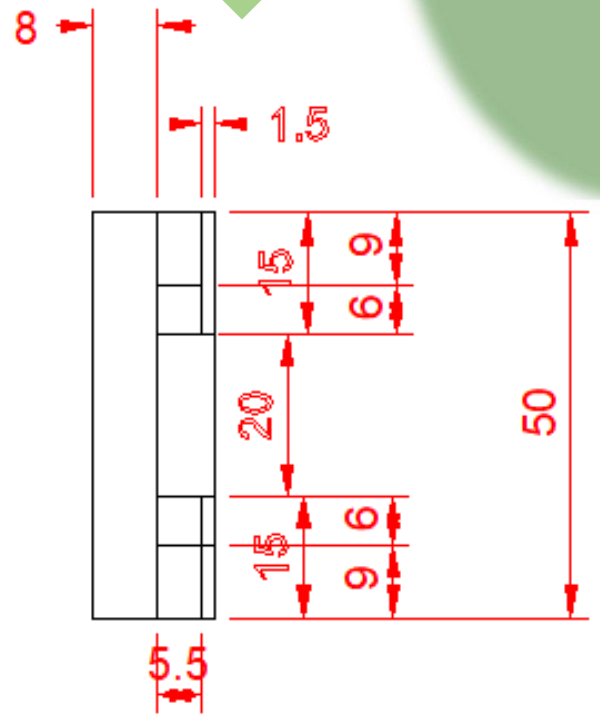


Front view

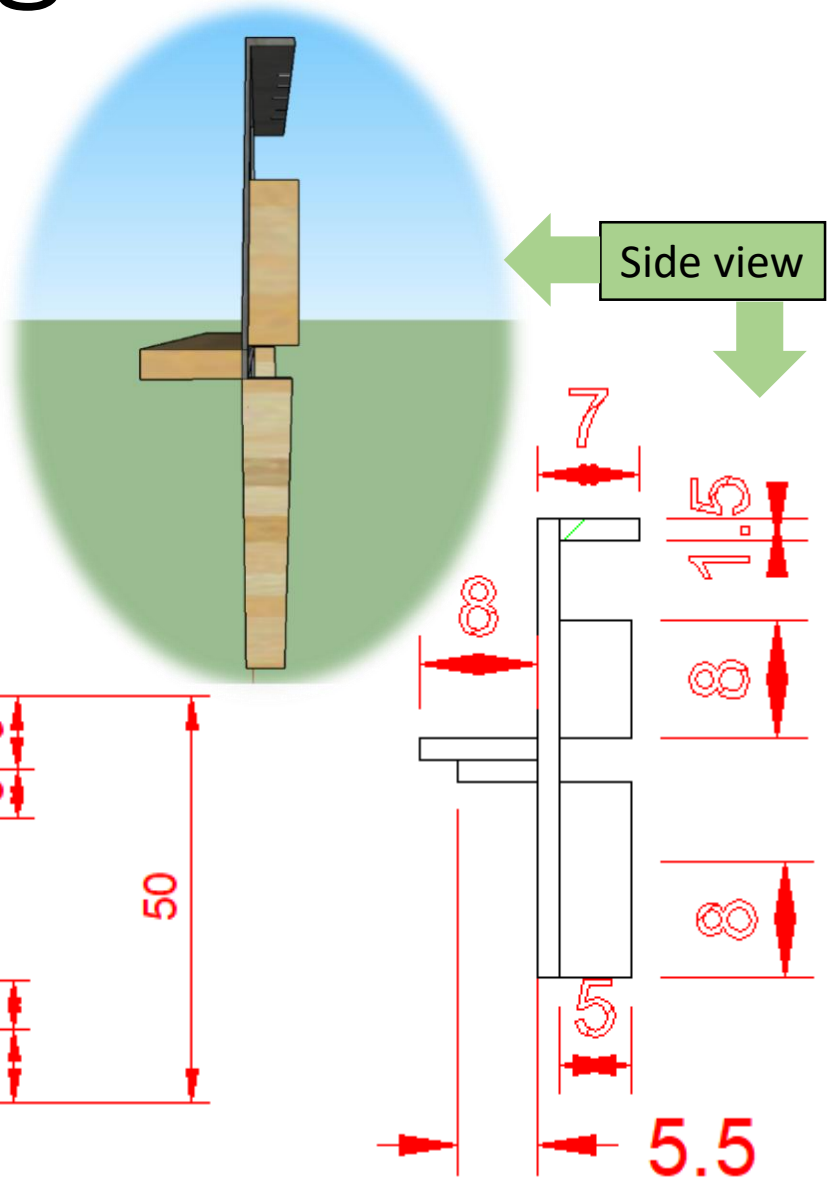




Top view



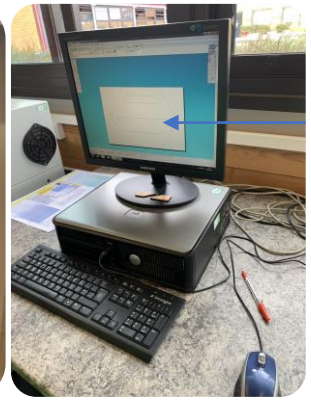
Side view



Design development – Prototyping

Prototype

The first prototypes made were hexagon shapes cut out of laser cut (3mm) plywood. I did this to test if the shape was appropriate for my product and also to find if the size (400mm) was a good size. The product has to be small enough so that it can be cut in a laser cutter and is light but it also has to be big enough to hold many medals and some trophies.

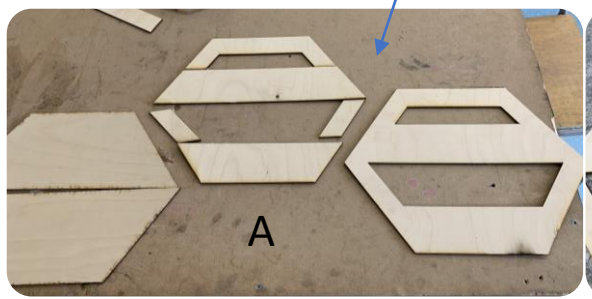


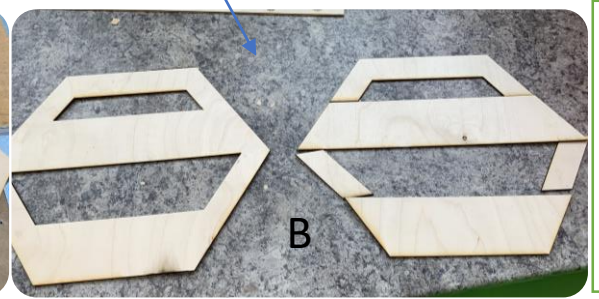
Process

The prototypes produced on this page were designed on the CAD software: 2D design. This CAD programme was used to draw the shape and print the design on the laser cutter. The cutting was successful as designs were cut out as expected and extremely accurately. Laser cutting will be used to produce all further prototypes and also the final product because of the far superior speed and accuracy compared to traditional methods of cutting wood.

Different designs

To find how the design could be put together I cut out 3 different designs. The design shown on the left of image A was the first shape cut out and it was done to test that the laser cutter was working accurately and also to allow me to test the size and shape to scale. All previous models and designs have not been to scale so seeing the real size was very helpful for me and my stakeholders. The right design in image A (the left design in B) was based off the shape of the gaps and overall shape from design solution 1. Specifically the technical specification page was used for this prototype. The middle design in image A (right design in B) was cut out last and the purpose of this exploded design was to allow me to move around parts to find what size the lower gap needs to be.





Feedback from primary user Ben Guilford:

"I still like the hexagon shape here and the size looks ok."

Conclusions from prototype

I found that 400mm was a good size for the product as is did fit comfortably in the school laser cutter and also the pieces produced were very light. If my product was made on a mass production scale then larger laser cutters would likely be used, so size would not be as much of an issue but the weight will always be an issue that will keep size low, even if mass produced. Another conclusion that I have drawn from the prototype is that 3mm plywood is strong enough and it does not need to be supported by another layer or even a metal frame. I have now decided that I will not use a metal frame for my product, I will just use plywood. This decision will keep the weight low, which makes production and transport easier. The decision will also hugely reduce costs of each product, which will allow me to meet my requirement of the product not costing over £40. Cutting and braising mild steel is a costly and very time consuming process, so cutting out the metal components allows this product to be cheap and easy to produce, benefitting the manufacturer and also users.

Changes made from design solution 1

The biggest change made from design solution 1 is not using a metal frame to support the plywood face. Another change that has been made is the front face being one solid connected piece, rather than several separate pieces connected by the metal frame.

Negatives and improvements

An improvement that could be made would be to make the gaps look more symmetrical as they look very different. The very bottom part of the product is bigger than the top section, so the hexagon shape no longer looks aesthetic. A different design of the gaps needs to be developed.

Next steps: design and print more pieces to complete this prototype into a usable product based off design solution 1

Design development - Prototype

To make a full working prototype I used the school laser cutter to cut out more parts to complete this version of design solution 1. This prototype is based off design solution 1 except from the fact that it was built without a metal frame.

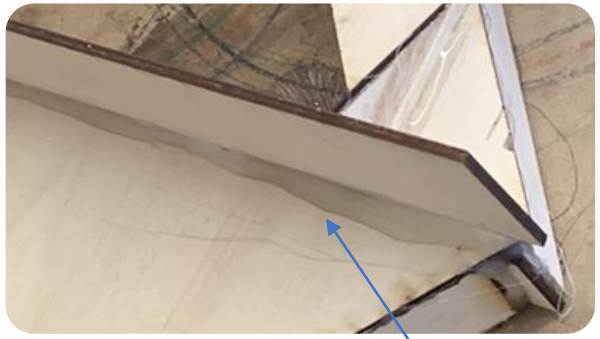
To complete the prototype I used the front piece already created (shown on previous page) and printed side pieces, a shelf and pieces to box in the medals on the back of the product (all shown above).

The material used for all parts was 3mm plywood because it is an easy to use and affordable material and is the material that I have chosen to use in my final design.

To fix the parts together I used a hot glue gun because it is the quickest method of joining wood that is strong enough to test the product (as seen below).

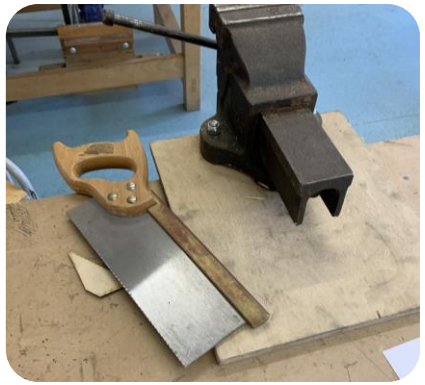
Material choice

Using 3mm plywood for this prototype was chosen for two reasons, one reason is because it is a material available in the school workshop that is good for making prototypes as it is light and easy to use. Another reason is that 3mm plywood is the material that I will be using for my final design so using it now gives me more experience. Therefore I will have more knowledge on the material and will be less likely to make a mistake that results in the product being of low build quality.

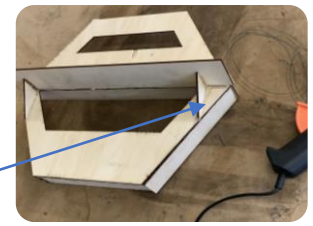


Problems and improvements

One problem with the prototype is that the hot glue left a messy look because lots of glue had to be used to hold the product together, so glue was visible on the joints. This looks messy so for future designs I will use a different joining method. Using slots in the plywood could be a solution because far less glue would be needed to hold parts together.



Next steps: develop how this design could be adapted to using slots as the main joining method



Shelf support development

The lack of support for the shelf part has been a concern of mine and the stakeholders throughout the development process of this idea so to solve the issue I cut out some support pieces. I used a wood saw to cut 3mm plywood into triangle shapes to be fitted under the shelf. I made these components by hand because it would have taken more time to use CAD and CAM to produce the parts. For a final design I would have used the laser cutter to produce these components because it is more accurate. The shelf supports were glued with a hot glue gun to the shelf and were successful because they made the shelf extremely well supported.

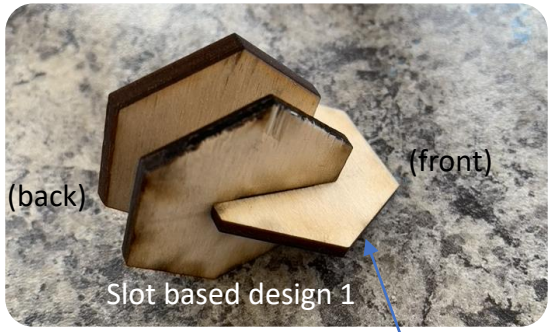
Fixing to the wall

The method of fixing to the the wall is similar to the design solution 1 idea but this prototype uses a large piece of wood fixed onto the product (with screws) that has holes in it for a smaller piece of wood with dowels sticking out to go in to. The smaller part is designed to fix to the wall (with screws). This method is good because the product can easily be taken on and off the wall. However the problems are that it is relatively complex and also screwing into a wall can cause damage to the wall.

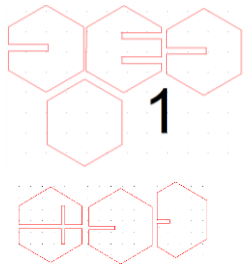
Design development - Prototype

Slot idea
To make my product stronger and easier to assemble I will attempt to make it fix together with slots that other parts fix into. This development should reduce the amount of glue needed considerably and therefore solve the issue of excess glue looking messy. Using slots could make the product more innovative because it is a unique idea not often seen on storage products.

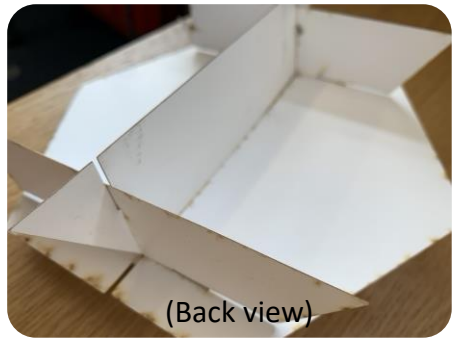
Inspiration
The product shown here is an example of the type of product that has inspired me to change my design towards using slots rather than just glue and screws. The product shown above is a pencil/pen holder that uses thin laser cut plywood which has been cut so that when together, the parts support each other. Glue has been used in the product to stop any parts ever moving but it is not messy because not much glue had to be used.

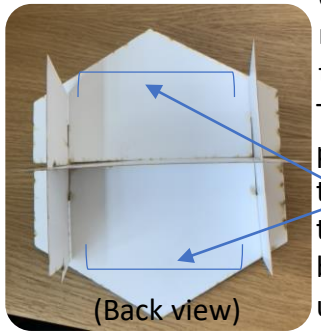


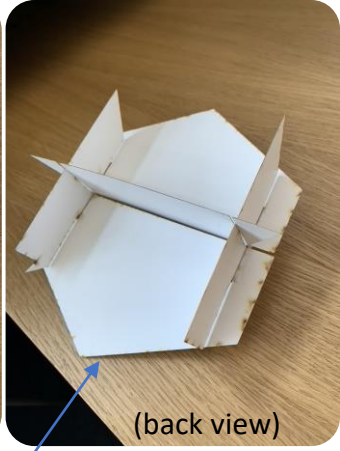
Slot bases design 1
The first design was completed to find how to make slots fix together and how this could be adapted for the hexagonal design. The prototype used 3 hexagons that were each the same size. Two of the hexagons had one gap in the middle of one side, these were the sides and also the back of the product. One piece had 2 slots (for the other parts to go into), this part is the shelf component. A problem with this design is that there is no obvious way to fix it to a wall. Another issue is that it is too deep, so it extendes too far off the wall.



Materials
For the slot based design 2 I used card because it is a cheap and easy to use material, which makes it good for creating quick models that will be changed.







Prototype created
The second slot design was designed to test out if the slots would work and also to judge size and shape. A change in the shape was made by rotating the hexagon 90^0 so that the horizontal sides are now the vertical sides and corners are now at the top and bottom of the product. This development to change the shape allows the support pieces to be larger. Another development that has been made on this prototype is that the support pieces now go through the front face and slot into the shelf part.

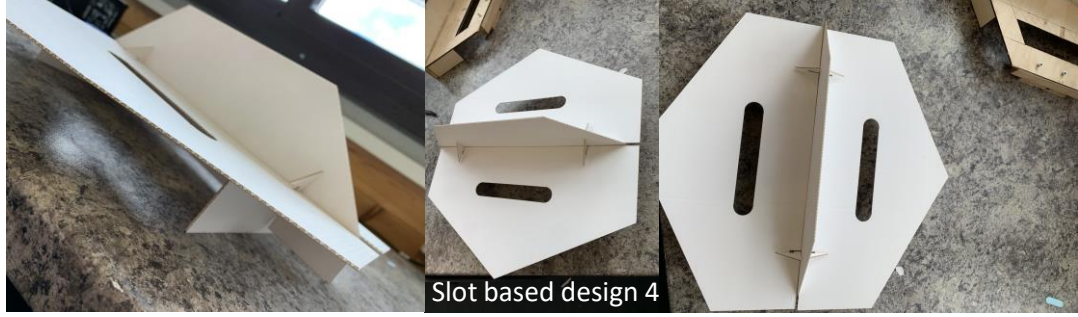
The back view shows that the medals are partly boxed in but not completely because there is no piece along the bottom face or top face. This means that medal ribbon will be able to fall bellow the product and look untidy.

Feedback from primary use
Ben Guilford – "Those kind of items with bits that go into each other look good.
The design in the bottom left does not look very useful."

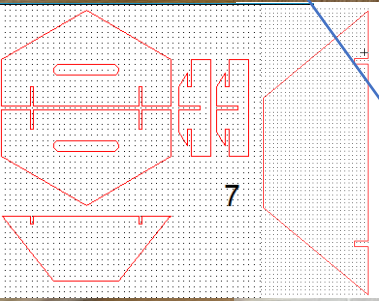
Next steps: develop a new prototype design that has gaps to hang medals through

Design development - Prototype

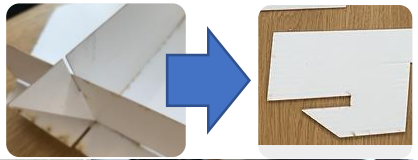
Materials and techniques
The prototypes shown on this page are laser cut card. Because it is much thinner than the 3mm plywood the slots do not fit together as tightly as they will with plywood

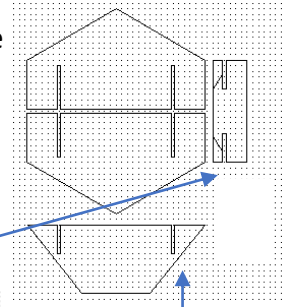


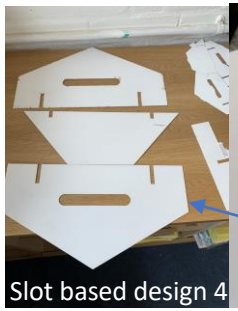
The next prototype I have made (slot based design 4) is a developed version of slot based design 3. The main change made is that the front of the vertical pieces is far smaller. I believe that this is an improvement because the design is simpler and more aesthetic now.

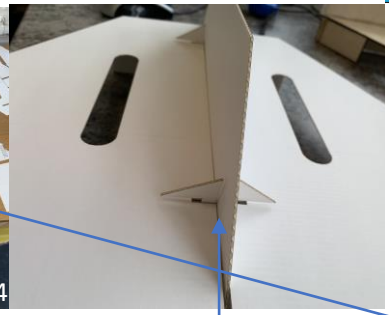


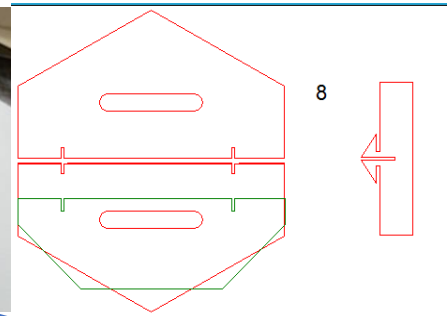
The change made on the 3rd slot based design from the 2nd is the gaps for medals to hang from. Also the vertical pieces shape has been changed as seen below. The change was made because triangular shaped pieces on the back of the product do not serve any practical benefit and are not visible.



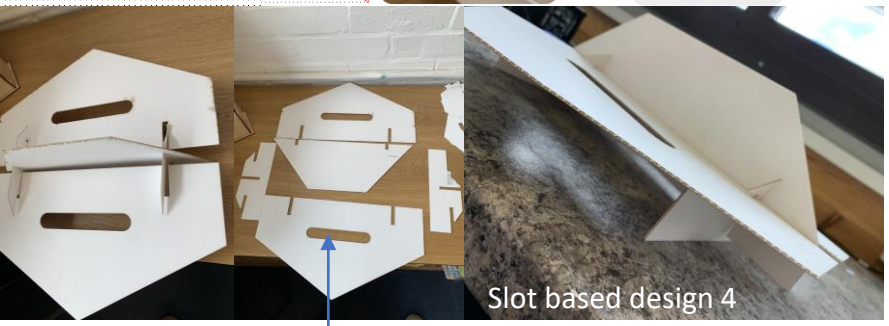


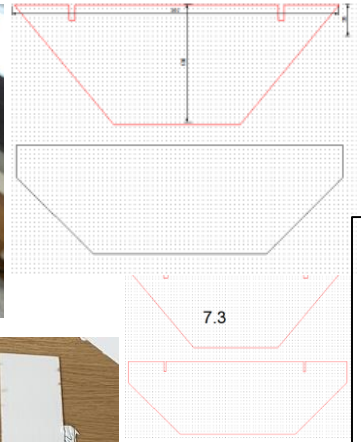






The CAD above shows how the parts were designed to create the prototype seen above and then how the parts slot together to create a working prototype. This CAD uses red for telling the laser cutter to cut here and the green was just to double check the length is correct and to check that the slots line up perfectly. It is very important that slots line up because they need to fit into each other and if they are even a small amount off then they may not fit in at all.





Slot based design 4 was a similar design to slot based design 3 but slots were made shorter. They were made shorter because the gaps were longer than they needed to be on previous designs. Shorter gaps makes the product fit better together with a tighter fit. Another change I made while making this model was to cut the front area of the vertical pieces because they are unnecessarily large and would look better if they were smaller. On the next prototype I will make these pieces smaller.

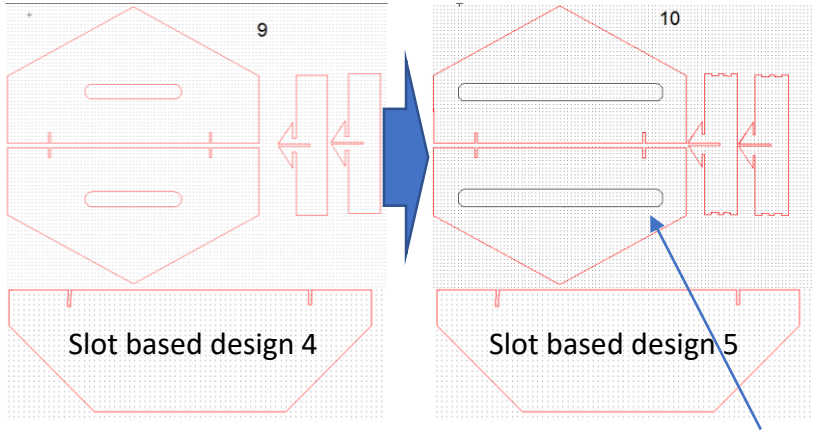
The shaded area is an area to be cut out in future prototypes.

Engraving
Engraving is a technique that I will use in my final product design to make the product more personalised. This could be done by engraving an individuals name or engraving a badge or image relating to a sport that awards came from. I practised engraving when I made models of medals.

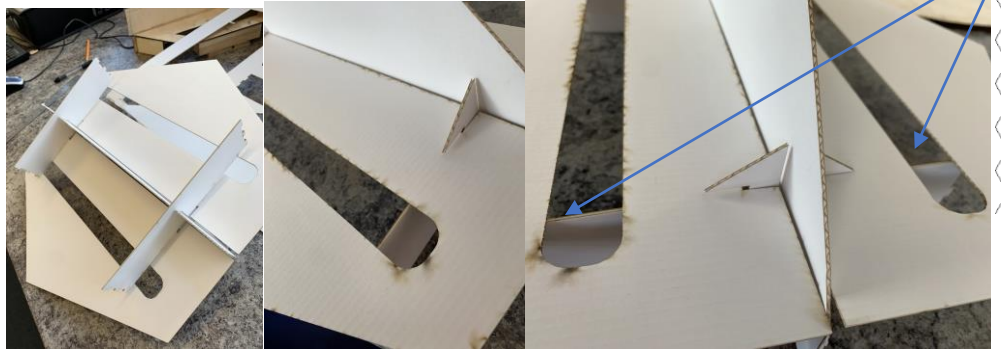
Feedback from primary user Luke Rayner –
"The slot designs look like they are getting better and better but I think if the gaps filled more of the product it would look better."

Next steps: experiment with using larger gaps for medals to hang through. Also use the prototypes to test if the product will fit together with more of the same product

Design development - Prototype



A change that I made was to increase the length of the gaps that medals hang from. I did this because I thought that it could give a more interesting modern look while also increasing the number of medals that can be hung in each gap. Increasing the size of the gap was an improvement because more of the space on the product is used effectively and a higher number of medals can be held, however a negative is that the gaps overlap with the vertical support pieces, which looks bad and like it is not deliberate.



Materials

For slot based design 5 I used a different material to make the prototype because as it is closer to the final design so I wanted to make the materials more similar to the 3mm plywood that I will use for the final prototype. I used White Correx Plastic Polypropylene Fluted Display Board for this prototype.

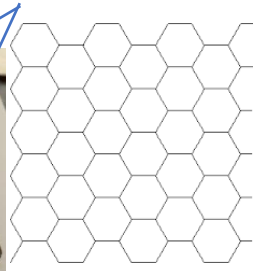
Processes

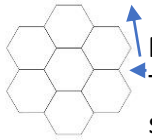
The processes used to create prototype 5 used a laser cutter the same way as previous designs, except from the fact that the thickness of the material was increased.

Next development

The next step for developing the design is to change the slot size back to the size seen in slot based design 4. The change made with design 5 was unsuccessful so the development will not be used.

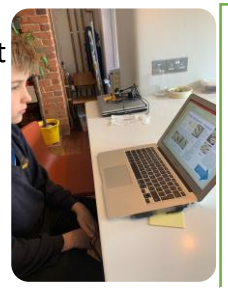
Slot based design 5 is only useful as an experiment and it shows me that design 4 is a successful design.





Many hexagons

These images from Google show how more than 3 of the product could fit together and cover a larger area of wall. For example at a sports club where different age groups have their own awards.



Feedback from primary user Ben Guilford-

The holes are not -

useful because you would not be be able to fit a medal in the bit that has another piece right behind it.

(The overlapping vertical support pieces)

How multiple products fit together

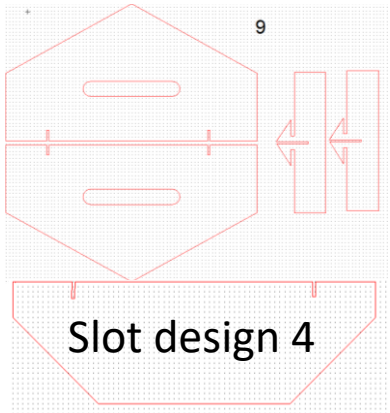
I put my prototypes 3,4 and 5 together to see how lots of the product fit together. I found that they fit together perfectly as seen in the images to the left.

One option for selling this product could be to sell the product in sets of three. As they would be sold in higher numbers they could be sold for a lower price per individual product. This sort of deal could lead to higher sales and therefore higher profits.

A problem with the prototypes is that they do not use as thick materials as they are designed to use (the gaps drawn on CAD are for 3mm plywood). This is a problem because some of the parts do not fit together well so they come apart. This is seen in the image to the left because prototype 3 is coming apart. This will not be an issue with the final prototype or real products because they will be made out thicker 3mm plywood that should fit perfectly.

Next steps: create a prototype using the final material (3mm plywood) to make sure the design will work with the material

Design development - Prototype



Idea

For this prototype I used the material that will be used for the final prototype (3mm plywood) and I used the method that will be used for the final prototype (laser cutting using 2D design CAD) The red lines are the lines that cut.

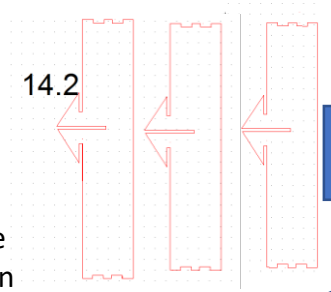
Positives

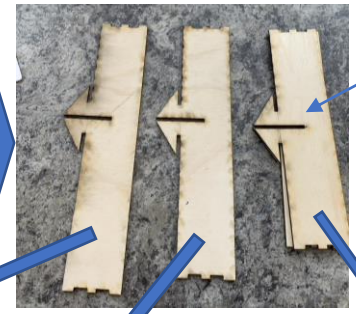
The prototype was successful in that the joints fitted perfectly together so the product felt secure and strong, even without any glue. With the final prototype I will use glue because it makes the product even more secure and less likely to break apart. Another positive is the fact that the laser cutter cut the design accurately, which gives me confidence that it will work for the plywood final prototype and would work for any more of the units produced for sale.

Negatives

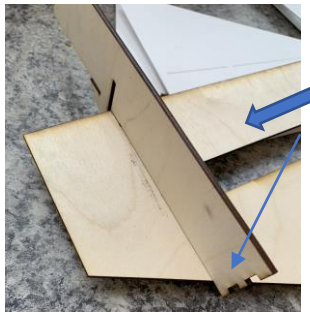
The main negative of the design is that this piece is too high, so there is no space for the medal ribbons to go. I will change the design to fit clips to hold the medal ribbons here. Another negative of the prototype is that the clips are not used on it. I did this because I believe that the clip system should work easily so I will make it for the first time on the final prototype.

To solve the issue of the lower set of medal ribbons not having space to be clipped I have designed new side parts that extend lower on the product. I used 2D design to cut 2 different sizes so that I could judge which size is the best and therefore what size should be used on the final prototype so there is clip space.

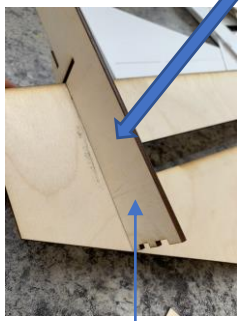




This is the original size of the piece in slot design 4. It is clearly smaller than the new parts that were cut out.



This size of the side piece is too long because it sticks out further than bottom of the the product when the pieces are pushed together as far as they go. It does fit perfectly when pieces are loosely fitted. However the pieces do need to be tight so this size is not usable.



The size shown above is perfect because it does not stick out under the product but it does make use of all of the available space.

The problem with the size is that there is no space for clips and also no space for medal ribbon to hang. At least 5cm is needed for the clips but for the medal ribbons, having lots of space will make it easier to keep them in the correct section. For this reason I will give the section as much space as possible

Development

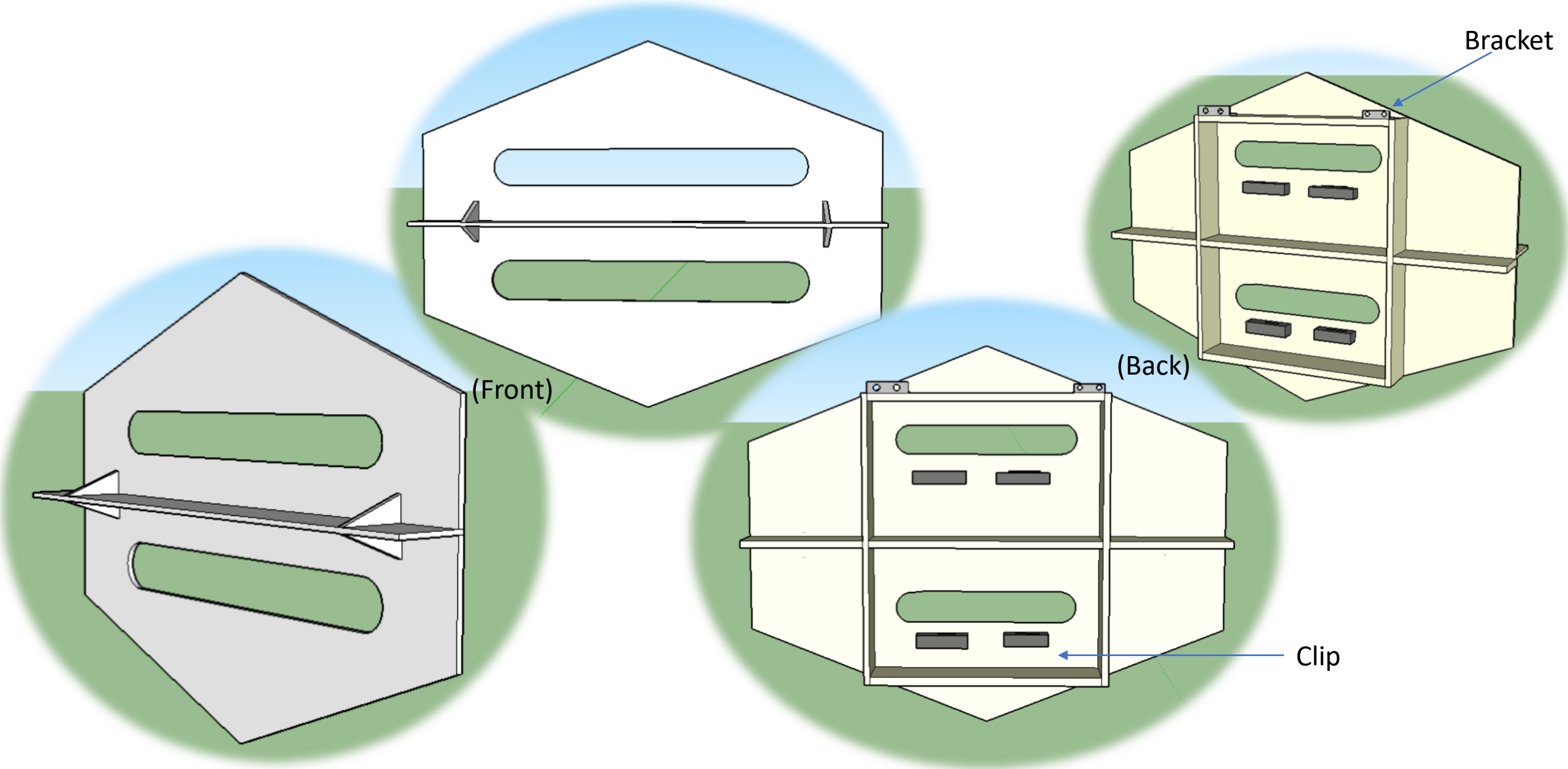
The middle size side piece will be used for the final prototype because it is the perfect fit for maximising the space available.

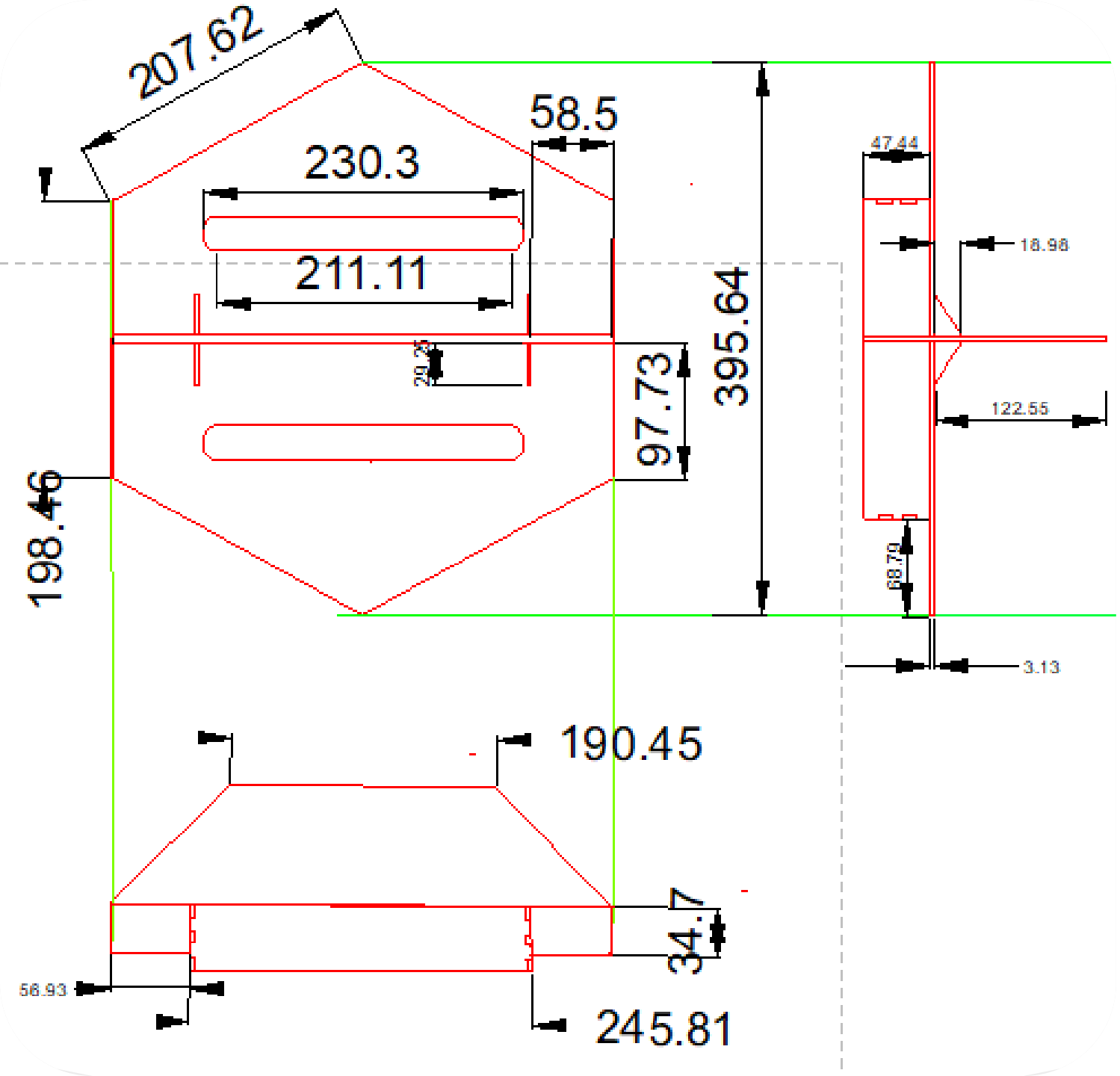
This development should make the final design successful.

Feedback from primary user Ben Guilford – ”These models look good to me. They look far better than the ideas in the pages before. Maybe put something on top of the wood to make it look smarter though.”

Next steps: create a design for the final prototype using slot based design 4 and the development completed on this page

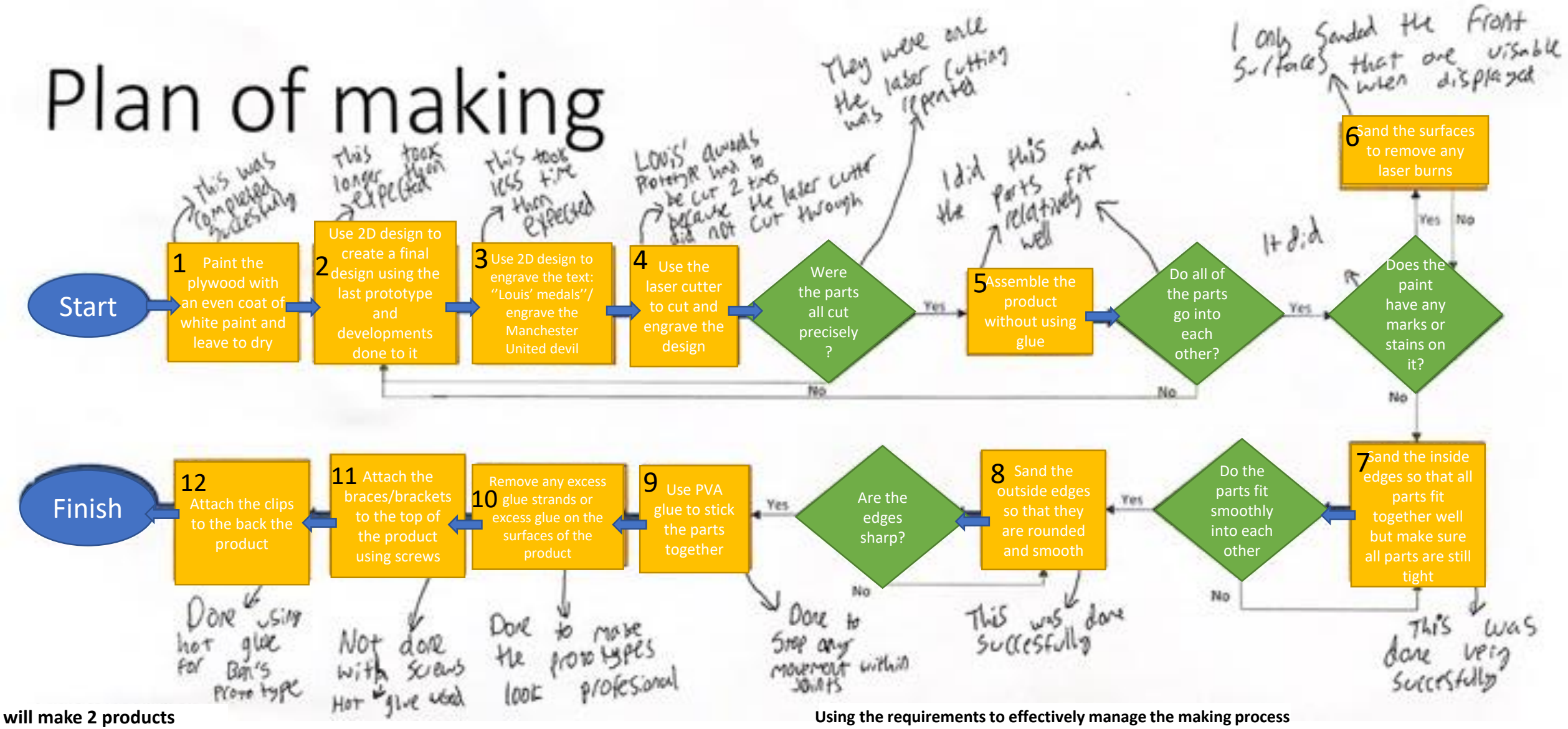
Design development – Final prototype design





Technical specification

Plan of making



I will make 2 products

To get feedback from a variety of people I will make 2 similar prototypes. One of them will be made specifically for an end user called Louis who is a 14 year child who plays football and has awards from the football and also some awards from running. The other final prototype will be made specifically for the end user, Ben Guilford. The design for Ben will be the devil from the Manchester United badge because he is a Manchester United fan. Making two products will give me more opportunities to find problems because making more of the product increases the chance that problems will be found in the manufacture and also in the use.

Using the requirements to effectively manage the making process

The requirement of the product needing to be easy to assemble (spec point 2) will be achieved by making the parts all fit together easily. This will be checked at 2 points ((Do all of the parts go into each other?) and (Do the parts fit smoothly into each other)). Work will be done to make the product easy to assemble by sanding inside edges.

The product will cost a consumer less than £40 because the manufacturing and materials will cost far less than £40. The material costs are low because 3mm plywood is cheap and only 1600mm x 600mm sheet is needed per product. The product will be able to hold other awards, such as trophies (spec point 5) because the shelf will be supported by other parts so that it can hold enough weight.

Plan of making - stages

Stage	Description	Equipment	Materials added	Time taken	Quality control
1	Use a paint roller to evenly spread paint over the front and back of the plywood. Do a few layers so that plywood cant be seen	Paint roller	1600mm x 600mm sheet of 3mm plywood White paint	30 mins + drying time	Keep painting until all areas are covered evenly
2	Design a final 2D design for the laser cutter, using red lines for cut lines. The design should be accurate.	A computer with 2D design	NA	1 hour	Zoom in on high detail areas to check all lines are as they are meant to be
3	Use 2D design to design the engraving. Lines to be engraved are black. The engraving of the devil for Ben will need to be extracted from an online image.	A computer with 2D design	NA	40 mins	Zoom in on high detail areas to check all lines are as they are meant to be
4	Turn on and set up the school laser cutter and then cut the design onto the painted plywood.	Laser cutter	NA	40 mins	A question check is done to check accuracy
5	Assemble the product so it can be checked for accuracy and ease of use.	NA	NA	10 mins	This stage is a quality check
6	If there are any marks left on the plywood from the processing then sand them off using a fine sandpaper	Sandpaper (medium coarse, fine and extra fine)	NA	30 mins	Make sure not to sand off all the paint in any areas
7	Use a variety of sand paper thicknesses to sand the inside edges of the parts so that they are not sharp and all parts fit smoothly	Sandpaper (medium coarse, fine and extra fine)	NA	3o mins	Touch the edges to test smoothness
8	Use a variety of sand paper thicknesses to sand the outside edges of the parts so that they are not rounded and not sharp.	Sandpaper (coarse, medium coarse, fine and extra fine)	NA	40 mins	Touch the edges to test smoothness
9	Pour some PVA glue into a cup and apply glue to all of the areas where slots go into each other and where parts touch.	A cup Fine paint brush	PVA glue	30 mins	Apply glue with a fine brush
10	Remove excess PVA glue so that the product is not messy.	NA	Paper towels	10 mins	This step is for ensuring quality
11	Drill pilot holes using a pillar drill to ensure the cuts are accurate. Then use a screwdriver to screw in small screws to connect the brackets to the top of the product.	Pillar drill Screwdriver Penicil (draw on hole positions)	Screws	50 mins	Make sure the material is held securely to prevent damage
12	Glue the clips to the back the product using a strong glue and then remove excess glue strands to make the prototype look tidy	Scissors	Glue	30 mins	Apply glue slowly and carefully so there is minimal mess

Making

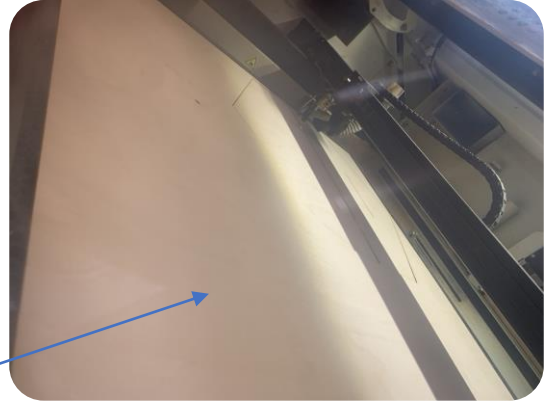
Stage 1 – painting plywood

In accordance with the plan of making I first painted the sheets of plywood needed. I used a roller and cream coloured furniture paint to paint the sheets.

Problems and successes (stage 1)

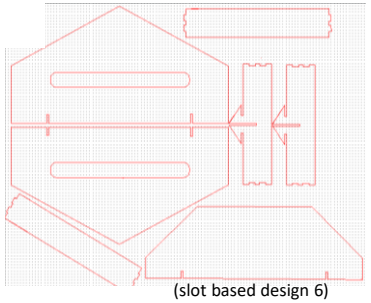
One problems with stage 1 weas that the paint finish was not completely even. The main reason that this happened was because the roller used was bad quality. Some parts of the roller had gone hard because paint had been left in it before and also bits of the foam were missing. This made it difficult to have a completely even coating of paint. However, overall the painting was relatively even and all of the plywood was fully covered.

The painted pieces were left on a radiator to dry while I completed stage 2 and 3. This is an efficient use of time because less time was spent waiting.

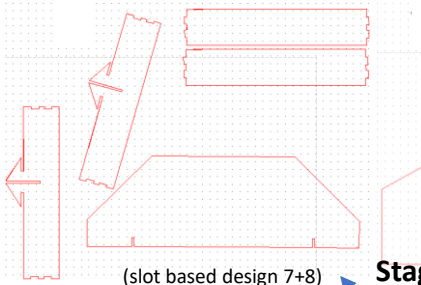


Stage 4 – Laser cutting

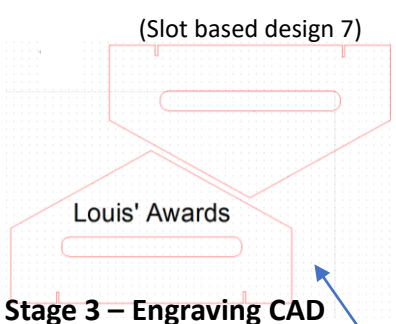
To complete this stage I first turned on the laser cutter and left it to prepare. Then I put the material (the painted plywood) in the cutter and made sure that it was as far into the top right as it could go so that the design would cut accurately and at the correct angle. To make that the laser cutter cut to the correct thickness I set the material to 3mm plywood. However the design did not cut all the way through because I did not take the paint into account when inputting the material thickness. Because of this issue I had to repeat the cutting process again so that the material was cut all of the way through.

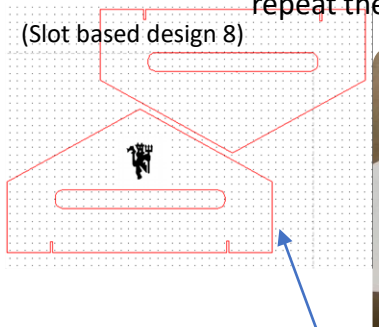


(slot based design 6)



(slot based design 7+8)





Stage 2 – Designing CAD

To produce the final CAD design I developed slot based design 4 further. The size of the slots was slightly expanded from design 4 but still a far smaller size than design 5 as that size was unsuccessful.

Stage 3 – Engraving CAD

To adapt the previous design to include engravings, I first moved the parts around onto a page the size of the materials (this took 2 pages per design). Next I designed the text on design 7 by using the add text feature of 2D design. To add the engraving of the devil I had to import the image from Google images and then make it black and white (image above shows the design at this stage),then contour the shape and finally I removed the background. This stage was completely successful because the designs created were accurate and space efficient.

Feedback from primary user Luke Rayner

"I'm not a big fan of Manchester United but I still think that this devil shape looks very cool. I'd like a Liverpool version."

Stage 5 – Dry assembly

The laser cut parts were all successfully cut so they did fit together when I assembled the product without using any glue. The finger joints worked well because I deliberately made them partially tight so that they hold themselves in place.

Problems and successes

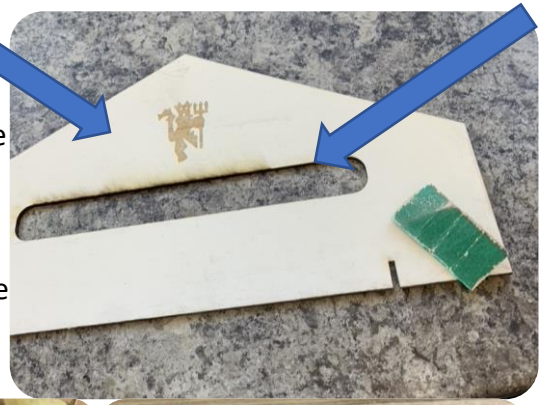
One problem I had with stage 4 was that the laser cutter left burn marks on the paint and also left other scratch marks of the front face of the material. This would not be an issue for commercial manufacture of the product because a higher quality laser cutter would be used.

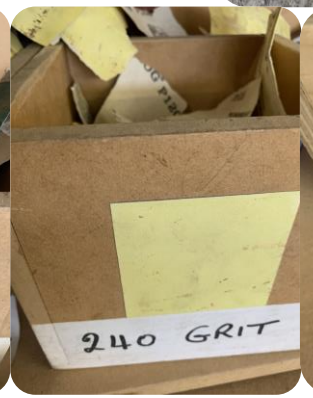
Next steps: continue with the next stages on the plan of making, so next sand and glue the final prototype.

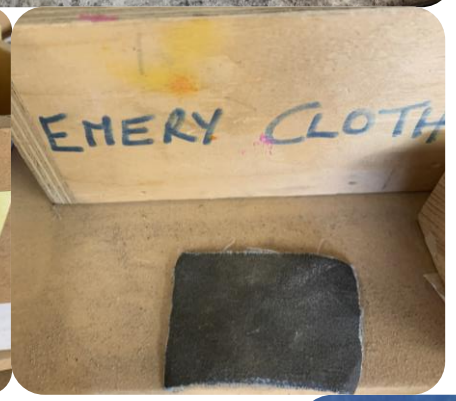
Making

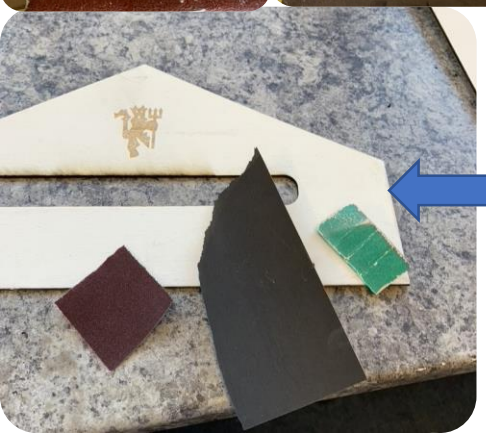
Stage 6

I sanded the front face to remove the burn marks and the other marks left by the laser cutter. The sanding makes the marks not visible and the surface smooth. Any bumps got removed during the sanding of the the surfaces so the paint became very smooth and flat after the sanding. At first I started with the coarse sandpaper and then moved onto the fine sandpaper. The coarse sandpaper is used to wear down the paint and get rid of any marks and the fine sandpaper is used to make the surface smooths and to remove and scratches from the coarser sandpapers.









Stage 8

Next I sanded the outside edges to make them not sharp so a user would not get cut by the edges. Also having smooth edges made the product look more professionally made. I made the edges rounded using a sanding block and different sandpapers from 100 grit to 240 grit and then emery cloth. The sanding block makes sanding the edges into a rounded shape easier than without the sanding block.

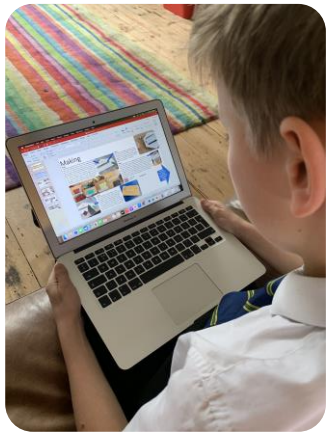
Stage 7

Sanding the inside edges was done to make the parts fit smoothly together. This was done successfully and made the parts easier to put together. Even though the parts did already fit together, the sanding has made the product easier to assemble for a consumer.

Stage 9

To complete stage 9 of the making process I used PVA glue to permanently fix the parts together. Glue was applied to the areas where the parts touched, for example on the finger joints on the back and also along where the shelf connects to the front pieces. The glue made areas it was used on slightly more shiny than other areas, which is a negative because a consistent finish would be more aesthetic. However it was still useful because the product is now less likely to ever fall apart. An issue is that PVA glue is not particularly strong so an improvement could be to use a stronger glue such as superglue.

(A paintbrush that was used to apply the glue)



Feedback from primary user Ben Guilford -

"The brown marks around where it was cut don't look good."

Does it matter to you how smooth the face of the product is?

"Yes, if it is rough then that is bad."

Next steps: continue with the next stages of making (cleaning up glue and also attaching brackets)

Making

Stage 10

To clean up excess glue I used paper towels to remove the wet PVA glue from the front surface where it had dripped down and also where the brush was too wide to accurately apply glue just to the area it was aimed.

The images of completing stage 11 show that I chose to attach the brackets on the edges of the back. I did this because it will make the product hang in a more stable way.

Stage 11

In the design plan I wrote that I would use screws to attach the brackets to the body of the product but the equipment was not available so I chose to use the simpler and quicker solution of using hot glue from a glue gun. This was an appropriate solution to fix the brackets because the glue is strong enough to hold a light weight and the product is light. A negative of using hot glue is it is messy and far weaker than using screws.

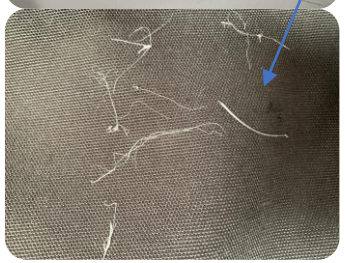
If the product was manufactured for sale screws would be a better option because screws will last longer than the glue used. Also screws could be removed by a user if the brackets were damaged or they wanted to remove the brackets completely and have the product resting on a surface rather than hanging on a wall. Glue cannot be removed and reused by a user because most consumers will not have a hot glue gun or any other appropriate glue to fix the product. The use of glue instead of screws decreases the chance of the product having a long lifespan because if the glue connecting the brackets fails the product will likely be thrown away.

Final prototypes

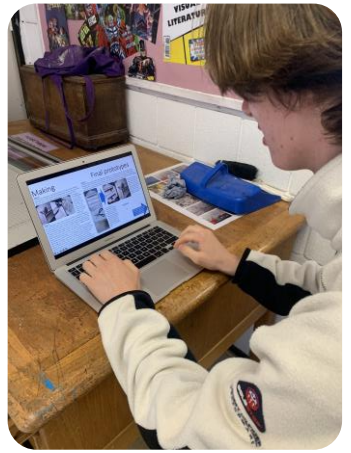
Stage 12

To fix the clips I used hot glue from a glue gun because it is a quick and easy solution that is appropriate for fixing the clips because the clips are not under much stress so stronger glue is not needed. The glue looked messy but this is not a major concern because when the product is on a wall it is not visible. If the design mas made for sale a different glue should be used that is less messy and also a stronger glue could increase longevity.

The clips used were simple wooden clothes pegs because they are extremely cheap and easy to use. A problem with using metal clips is that they are harder to open, which makes it difficult for users to put medals in the clips.



I used scissors to remove excess strands of glue. Even though the back is not visible when the product is displayed, consumers will look at the back of the product before purchasing and if it is more aesthetic and tidy it is more likely to sell.



Feedback from primary user Luke Rayner-

"I didn't realise the clips looked like that but they seem like they should work, I like it."

Next steps: show the final prototypes created so end users and stakeholders can see the final design

Final prototype

Theses images and video show the final prototype produced for Ben, with the Manchester United devil engraved.

This shows the back of the product

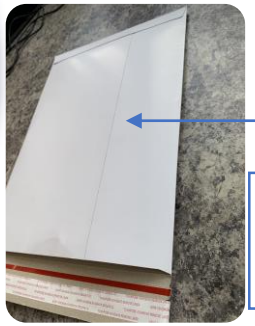
Click on this video to play it

Packaging

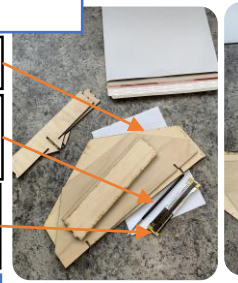
These images show how the product can be flat packed into a small area.

The pieces fit into a standard size large letter comfortably because of the thin materials. A small packet of glue and a paint brush also fit into the letter.

This version does not include the clips because they could be an extra part sold separately because the product should work relatively well without them, and they are not a useful feature for users with only trophies.



Brush and glue
A small brush and glue are included



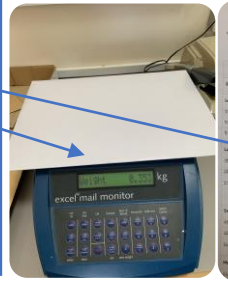
Instructions

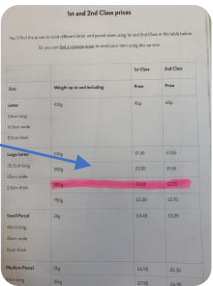
A small paint brush

A small packet of glue

Instructions
Instructions were included to help the users assemble the product in a safe and easy way. Good instructions will increases user satisfaction

The weight of all the parts to be delivered came to 0.353kg but this does not include paint because this prototype was not painted.
The total cost to send the product came to £2.15 for second class delivery.





Final prototypes

The prototype created for Louis (right) is not the same as the Ben's prototype because I wanted to see if the product needed clips or whether the design was successful without them. Because of this, Louis' product has not got any clips fitted on the back. For Ben's product I attached the clips. However even for the finished prototypes, the time for construction was less than what was initially planned so the clips and brackets were attached quickly with hot glue. This had to be done to get Ben and Louis the products quickly so they would have time to test it properly and give feedback.

Costs

Each plywood sheet costs £4 and it takes 2 sheets to create 1 product. The cost of equipment and machinery needed to be able to produce the product is expensive because laser cutters are expensive but the use of the machinery per product is low. Electricity costs are a factor but per product the maximum cost is 50p. Other costs are glue and paint but if mass produced these materials would cost under 50p per product. Overall each unit could be manufactured for £9. If the product was sold for £12 (plus delivery) then £3 could be made per unit for labour and profit.

The prototypes created

The final prototypes are fully built examples of the product but the format that the product would be sold as would be in a flat pack. This product could come in a pack with the (painted, cut and sanded) pieces of plywood, a small bottle of glue and a small paint brush to apply the glue. Also simple instructions would be needed to show a user how they can assemble the product. The fact that it could be flat packed reduces labour costs for the manufacturer and reduces transport costs. Also some users enjoy assembling products themselves. An example of a company that sells flat packed products is IKEA.

Next steps: Evaluate the prototypes created on how successful they are

Risk assessment

Health and safety risks

- Using the laser cutter (in school)
  - This is a risk to eyes if anyone looks at the laser while it is cutting (without the use of protective goggles).
  - To reduce the risk of damaging my eyes I did not look at the laser while it was cutting.
- Whether stakeholders are safe people to use
  - It would be unsafe for me to talk to and work with unsafe people
  - My stakeholder, Ed Carpenter is a trusted family friend so is a safe and reliable stakeholder.
  - My primary user, Luke Rayner is a safe person to use because he is a friend .
  - My other primary user, Ben Guilford is my brother so he is safe to use.
- Glue gun use
  - During the initial design and development phases I used glue guns and in my final prototype I used glue guns. Glue guns get hot and heat up glue to high temperatures, which is could burn skin and damage eyes.
  - To reduce the risk I was careful to avoid contact with the glue on my skin and I kept my skin away from hot metal parts of the glue guns.
- Use of scissors
  - Scissors were used during the initial idea and development phases for models and were also used during the making of the final prototype
  - Scissors are sharp so they should be handled carefully and kept away from eyes and the blades should not go near skin as they can cut skin.
  - I was careful not to cut myself or stab myself when using scissors.
- Knives
  - A crafting knife was used to cut models during the development process but they are a risk because they are very sharp and could cut skin or cause serious damage to eyes.
  - When using a knife I was careful to keep the blade facing away from me and the blade was kept away from skin and eyes to reduce the risk of cutting or stabbing myself.

(more) Health and safety risks

- Use of screws
  - I used screws in design solution 1 and planned on using screws for the final prototype.
  - Screws are sharp so I avoided contact between the sharp end of the screws and myself to avoid cutting myself.
- Use of nails
  - Nails are used for the final design to fix it to the wall.
  - Nails can be dangerous because they are sharp so I avoided contact between the sharp end of nails and my skin so that I could not get cut .
- Use of drills
  - I planned to used the school pillar drill for my final prototype but changed my plan of making so that it was not needed.
- Braising
  - Braising was an option I considered for making a frame however I decided it was unnecessary.
  - Braising uses high temperatures so heat proof gloves must be worn.
  - Braising is bright and can damage eyes so eye protection must be worn.
- Wood saw use
  - A handheld wood saw was used during the development process.
  - Saws are very sharp so must be handled carefully and blades/teeth of the saw must be kept away from skin.
- Electric screwdriver
  - Rotational movement can be dangerous so hair should be kept away from spinning parts and also spinning parts should not be touched.
- Card and paper
  - Paper and card can cause paper cuts it the edges are touched so I was careful to avoid touching or running my skin down the edges
- Wood
  - When working with any rough wood I wore gloves to avoid splinters and cuts
- Paint
  - Paint fumes can be toxic and harmful so I painted in an open room with open windows for good ventilation.
- Sanding
  - Small particles can be created during sanding that can damage eyes.
- Glue
  - Glues can be toxic so contact with skin and eyes was avoided and glues were only used in well ventilated spaces.

Feasibility of the design prototype

What?	Who?	Where?	Why?	How?
Luke Rayner interview and feedback	Primary user – student who has medals and trophies	School	To get feedback on the quality of the product and the feasibility of the product	Interview
Ben Guilford interview and feedback	Primary user – student who has medals and trophies	His home	To get feedback on the quality of the product and the feasibility of the product	Interview
Louis Holden -Feedback and pictures in use	A child with medals and trophies to display	His home	Testing and feedback feedback on the product	Video feedback and pictures of the product in use
Weight test	NA	Testing at home	To find how heavy the product is in grams	Weighing scales
Pictures of the prototype in use	NA	Home, school, other peoples' homes	To analyse how useful the product is to use and to judge how feasible the design is	Take pictures with medals in the places
Strength test	NA	Home	To judge how strong the product is and therefore how durable and long-lasting it is	Test the resistance of components
Functionality test – the clips	NA	Home	To judge if the clip system is successful and beneficial	Use the clips and record how well they work

Meeting requirements with the final prototype

1. The product must not be an overcomplicated design
    - This is met because the product could be assembled easily and with no equipment. Also it is made up of only 7 main parts.
2. The product must be easy to assemble, install and use
    - The product only requires glue to be assembled, which makes it very easy to assemble. The slot in joints help make this possible. Installing the product requires 2 nails in the wall, so installation is easy. Use is extremely easy as when the user wishes to change the medals being displayed, they just pull the product away from the wall and off the nails.
3. The product must not cost a consumer more than £40
    - The product will cost under £40 as the material use is low and manufacture can be mostly done by machines (laser cutter), so it is quick and low cost.
4. The product must be able to hold numerous medals (at least 10)
    - This spec point is partly met because 10 medals would technically fit in the gaps (as seen in the Louis feedback section) but it is cramped. Four medals fit into the product far better (as seen in the prototype in use pictures).
5. The product must be able to hold other awards, such as trophies (at least 3)
    - This spec point is fully met because the shelf on the product design has enough space for 3 average trophies. It also has the strength to hold the weight of over 3 average trophies.
6. The product needs to be innovative, which will be achieved with a unique design and the ability to hold medals and trophies in a better way than normal medal holders
    - This spec point is met because the shape and design of the product is completely unique and different to medal holders on the market now. The product design holds medals better than existing designs because it keeps the medal ribbon out of the way and makes the medals look more aesthetic.

Feasibility of the design prototype

Luke Rayner interview (primary user)

In my interview with Luke Rayner we discussed which medals and trophies that he owns could go on the product and we found that the best display would be to hang four of his football medals in the gaps, using the clips. Also we agreed that it would still look aesthetic if one of his smaller trophies was displayed on the shelf alongside the medals hanging from the gaps. Luke's football trophies are mostly too large to look good on the shelf but one of the small ones would work well. Luke likes the hexagonal shape of the product and thinks that the fact that many of the products can be grouped together is a huge selling point that I should push if I do marketing for the product. Overall Luke is a big fan of the design solution and would consider purchasing this sort of design.

Ben Guilford interview (primary user)

In my interview with Ben he said that overall he liked the shape and the engraving in particular but was not sure where he would put it in his room. This shows that the idea itself is not unpopular but this specific end user would possibly not purchase the product purely because he doesn't fit it fits the aesthetic of his room.

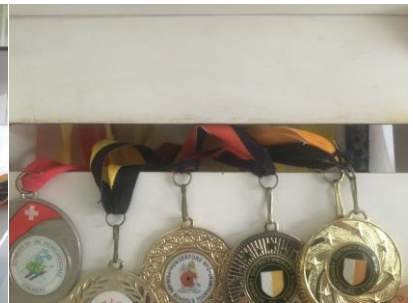
Louis feedback

Louis is positive about the shape and design which suggests that the idea is well suited to being sold to children. He also likes the slots, which suggests that they are a successful feature that could make the product better than other medal display products.

The prototype that Louis tested did not have clips fixed to the back of the product, this is one reason for the medal ribbons being messy and coming out of the bottom of the product. With the clips, the ribbons should have not been visible. This proves that the clips are an essential feature.

The location of the trophy shelf was another issue raised by Louis, this also could have been partly due to the fact that the ribbons were not held in place by clips on the protype he tested, so the medals dropped down onto the shelf.

Overall Louis' feedback shows that the type of product has a market and that the main design of the product is liked by this individual. The problem Louis raised about the medal ribbons being visible may not be an issue for the other prototype tested by Ben because it has the clips. Therefore the feasibility of the design will be good if the clips work successfully.



Select this to listen to Louis' feedback

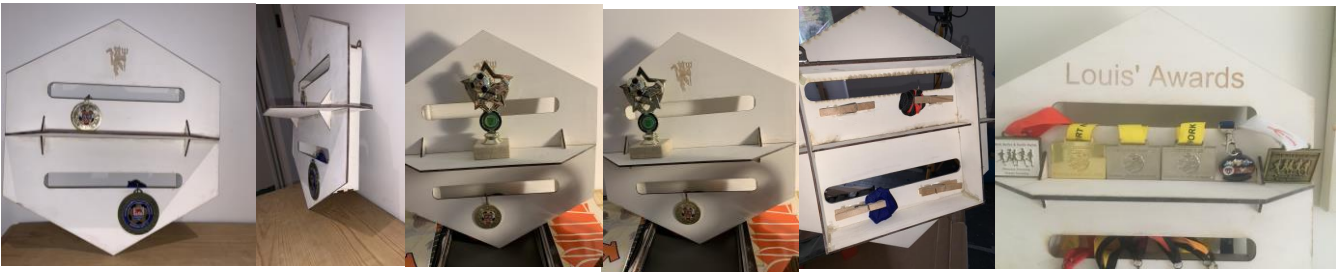
Weight test

The test found that the weight of the final prototype is 282 grams. This is an extremely lightweight for a display product. These frames are other types of display products but are far heavier than my product (1025g and 750g). The frames are a useful comparative product because even though they would normally display photos, they could display medals and they could be hung on a wall. These similarities between the picture frames and my final design make the frames useful to compare against. The light weight of the product increases the feasibility of the product because it gives it an advantage over current display products in terms of reducing transport costs and also the in use benefits.

The purpose of the weight test was to find if the product is light. Being light is a positive for many reason such as that light products are cheap and easy to transport and also deliver to customers. Another benefit is that light products are less likely to damage a wall they are hanging on. Heavy products put stress on plaster and can cause bits to chip off.

Feasibility of the design prototype

Prototype in use pics

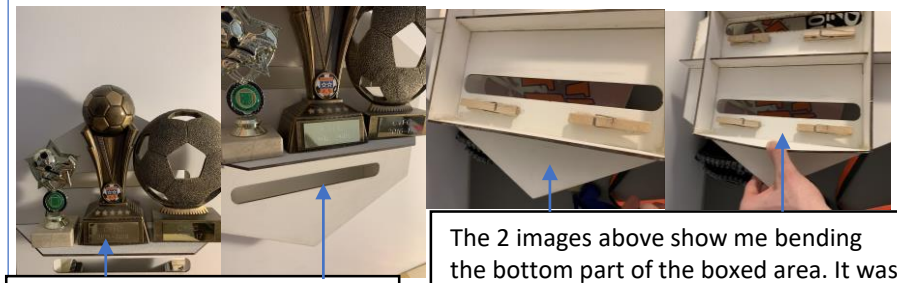


The images above show different views of the prototypes in use with medals hanging from the slots. The left pictures show the prototype made for Ben (with clips) and the image on the far right shows the prototype built for Louis. One of the photos shows the back of the product while it is holding two medals. These photos of the product in use show that the design works how it was meant to. I believe that the appearance of the product is very good, especially the engravings because they look very professional.

Functionality test - clips

As seen in the videos, the clip feature works well and is easy to use. Clip A shows how a medal ribbon is folded and put into a clip. Clip B shows how easy the clips are to use. Clip C shows that the medal is held tight by the clip. This is a successful innovative design feature that makes the prototype successful and making a profit using the design solution shown is very feasible.

Strength test



The images above show that the shelf part is strong enough to hold trophies that are relatively large. To prove that the part is very strong and well supported I bent the part as far as I could (shown in video D). The fact that it is very strong means that the part is likely to last a long time. Lasting a long time will improve reviews and therefore the reputation of the product, leading to further sales.

The 2 images above show me bending the bottom part of the boxed area. It was challenging to bend this part because it was supported by the other piece's joints and and also the glue. No damage was done to the shape from the bending. This suggests that the product is long lasting and strong.

This image shows a clip/peg being pulled apart. The part was undamaged by this test, therefore proving that the part is strong and robust.

The images above show the top corner joints of the boxed area being tested by attempting to pull them apart. The right side corner did break eventually due to the stress but the left side survived. The design of these corners could be stronger to last longer under stress.

Video E shows a prototype being dropped on the ground. No damage was taken.

Overall the product is relatively robust, which could help it make a profit on a mass scale.

The strength of each component determines whether it is fit to do its job (of holding medals) and also strength determines how long the parts will last. The longer parts last the better user satisfaction would be, which increases sales because people recommend the product to other people. Once a part breaks, the product will likely be unusable and will need to be disposed of by recycling.

Evaluation of the final prototype

Conclusions from analysis of feasibility assessment

One conclusion drawn from the feasibility assessment is that the design is successful in holding medals and trophies. This can be seen on the previous page in several places. Another conclusion drawn is that the prototype appears to be a feasible design that could be commercially viable specifically because of the innovative feature of the clips and the low weight. These aspects make the product better than much of the current market and also cheaper to distribute than some similar products. The strength of the product is the largest concern from the viability assessment because one of the corners eventually did break and it is clear that the design is not best suited for the horizontal stress that the component is put under.

Strengths and weaknesses of the design solution

Strengths

- The look of the product is aesthetic
- The technical specification points are met
- The weight of the product is low
- The clip idea works well and is useful
- 4 medals can be held neatly with the clips or 10 medals can be held nit as neatly if the user wishes
- The product can be flat packed to save delivery costs and labour costs
- The cost of materials is low
- Lots of the manufacturing can be done using CAM, which saves time and reduces labour costs
- The product can be displayed with multiple of the product

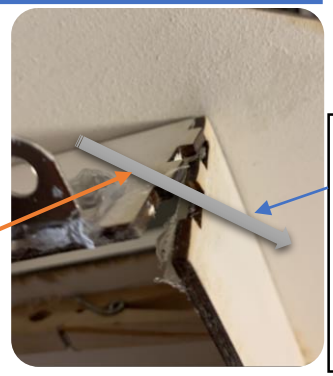
Weaknesses

- The strength of the top corners of the boxed area is lower than the other parts
- The prototype with a devil engraved has the brackets only fixed by hot glue rather than screws
- The prototype with a devil engraved has the clips fixed by only weak hot glue from a glue gun
- The clip mechanism makes the ribbons creased

Improvements/modifications

One modification that could be made to the final prototypes is to superglue the clips on because it is a stronger glue that will last longer and be less likely to fail/break. Another improvement that could have been made to the final prototypes is using screws to fix the brackets. Superglue and screws would be the strongest and longest lasting option.

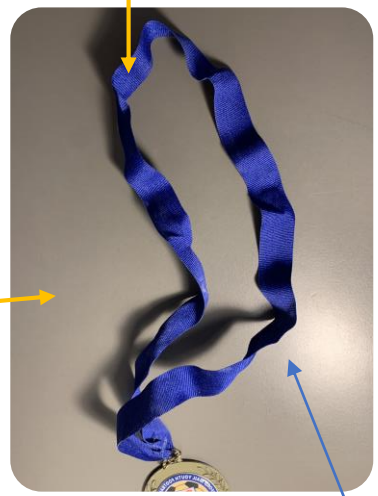
An improvement that could be made to the design is to change how the top corners of the boxed section fit together. A screw going through the pieces at an angle would make the joint far stronger, however it would look less aesthetic.



The grey arrow shows the direction that a screw could go at to hold the corner together. The arrow is shown on top of the product but in reality it would go through each piece around 3cms from the joint.

Creased ribbon

The ribbon being creased is an issue for users who wish to ever take medals out and display them in a different place such as on a bedframe on a shelf.



This medal was held in a clip for 3 days when Ben Guilford was testing the feasibility and this lead to the creases seen in the image above

Areas of value and excellence

One area of excellence is the hexagonal shape, which gives the product its aesthetic look. Evidence for this is the fact that Louis commented specifically on how he liked the look of the product.

The ability of the design to fit with other hexagonal products is a valuable feature that Luke Rayner particularly likes because in a group the products look very aesthetic and also selling the product 3 at a time could increase sales significantly and therefore increase profits.

Another area of excellence is the low weight of the product because it means that transport and delivery are cheaper and easier and also manufacture is easy and low risk for workers. If the product was heavy then the chance of causing injury would be higher but as the product is light, injuries such as strains and damage from it falling on people are very low. Another benefit of the low weight is that damage to the wall is low.

A key area of value on the design is the clip mechanism because it is an innovative idea that other current products could be modified with so that they hold their medals in a better way with less ribbon visible. This is proved by Louis' prototype not being successful (as medal ribbons were not held neatly) but Ben's prototype with the clips was far more successful and looked neater.

Evaluation of the final prototype

Commercial viability

The commercial viability of the design idea and final solutions are high because the prototype functions well and the feedback was mostly positive. All of the people who tested the design liked the shape and design, which suggests that the design would attract the attention of consumers if it was in a shop to be sold or online on a website for sale. Also some of the people who tested the product would consider purchasing the product as it is, even without the modifications that could be done to improve it such as strengthening some joints with screws. The product idea is commercially viable because it is relatively cheap to produce and cheap to deliver, so if needed the product price point could be as low as £12 (as I discussed on the final prototype page). This price point was specifically decided upon because of the cost of the prototype but if the design was mass produced, economies of scale would reduce the material, energy and labour costs. A reduction in manufacture costs could mean the product could be sold for even less than the low price of £12, for example £10 may even be still profitable. To increase sales at the products release special two for £15 or three for £20 deals could be done to get sales going. Even if this initial deal takes a slight loss the long term affect of high initial sales and hopefully high user satisfaction with result in overall higher full price sales in the long term.

Marketability

- Unique selling points
  - One unique selling point is the fact that multiple products can be displayed together to increase the storage capacity
- Price
  - The price is very low for the type of product, which is a key selling point for advertising such as TV advertising or posters, which could be done to raise product awareness and increase sales
- Product description
  - ‘A practical and easy to assemble medal and trophy display solution that will de-clutter your rooms and give you pride in your awards'
- Place to be sold
  - Online, on websites such as Amazon, similar products are successful so online would be the most profitable place to sell the product. In shops is also an option that could sell well however profit will have to be reduced per product because shops add their mark up on each product so they can make a profit. If the product is sold to other companies at a reduced price the marked up price will stay competitive .
- Promotion
  - If sold to other companies such as shops that sell awards then the promotion could happen in store with posters. If sold online, social media advertising could be used to expose potential buyers to the product and offer a link to where the product can be purchased.

Conclusion of wider design solution and the future product performance

The wide design solution of the product is a medal and trophy holder with built in clips to hold medals in place. I believe that this idea is a viable idea that could have commercial success. People will continue winning awards such as trophies and medals in the future so I predict that this type of product will continue being successful for the foreseeable future. However as the design is well suited to younger demographics, after a few years when users become adults, they many no longer want to display their awards. However it may be nostalgic to keep their medal display the same throughout adulthood, so the product may be very long lasting for some users.

Design optimisation

- **Balancing trade off between prototype cost, weight and manufacturability**
- The design optimisation is currently good because not too much money was spent on materials because the product uses cheap materials
- I believe that design optimisation would still be good if more money and time was spent on the modifications
- I believe the retail cost is very reasonable at £12 and this could be raised if sales are good to make more profit. The price point is very realistic and affordable for consumers, especially compared to similar products on the market.

How and where the product could be sold:

My product is not actually planned to be specifically sold at Ikea, this is just to show an example of how it could be sold.

Free click and collect – Know exactly what you want? Order online and collect in store, free.

IKEA

What are you looking for?

Hej! Log in or sign up

Products Rooms

Enter postcode Select store

Products › Furniture › Children's furniture › Toy storage › TROFAST Shelf

Medaljhållare £12

Award display product - plywood

0% APR Interest-free credit from £99, T&Cs apply

Add postcode for home delivery availability

Check in-store stock

Add to shopping bag

A practical and easy to assemble medal and trophy display solution that will de-clutter your rooms and give you pride in your awards