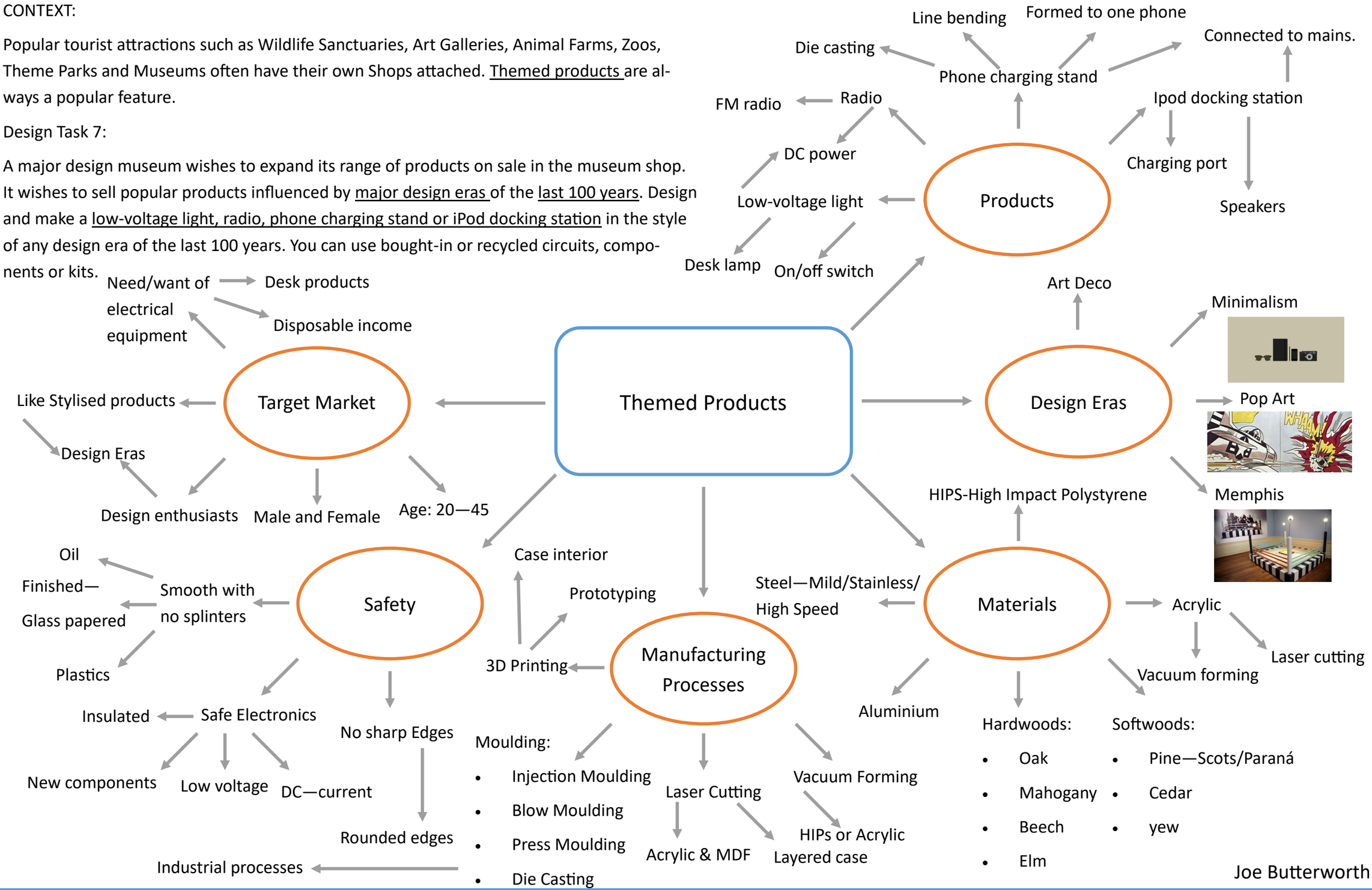
Task Analysis & Design Brief

CONTEXT:

Popular tourist attractions such as Wildlife Sanctuaries, Art Galleries, Animal Farms, Zoos, Theme Parks and Museums often have their own Shops attached. Themed products are always a popular feature.

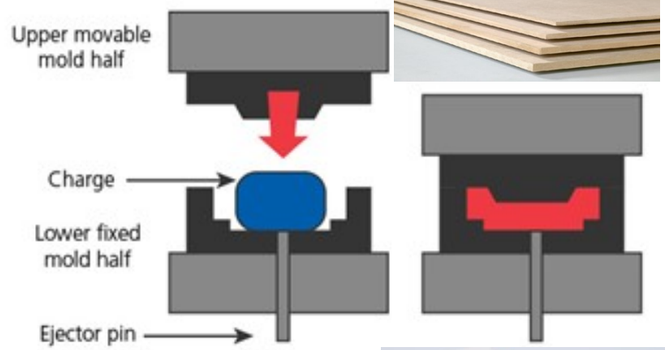
Design Task 7:

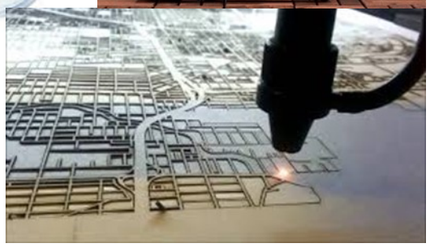
A major design museum wishes to expand its range of products on sale in the museum shop. It wishes to sell popular products influenced by major design eras of the last 100 years. Design and make a low-voltage light, radio, phone charging stand or iPod docking station in the style of any design era of the last 100 years. You can use bought-in or recycled circuits, components or kits.

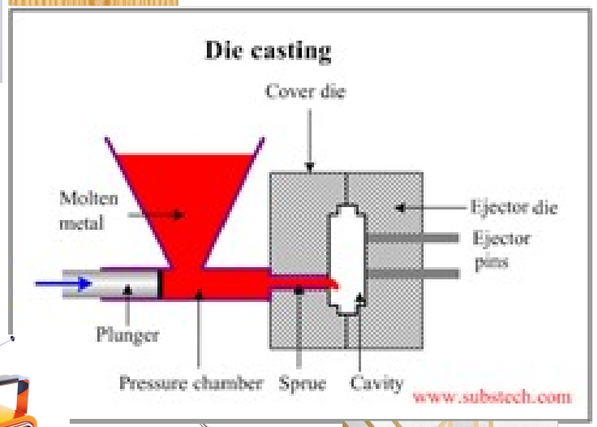


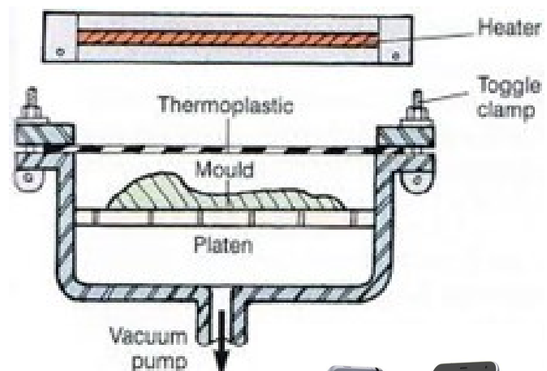
Joe Butterworth

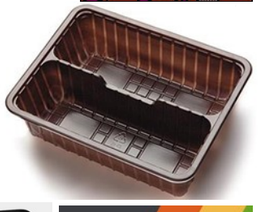
Mood Board

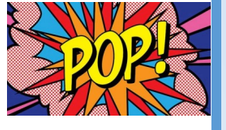


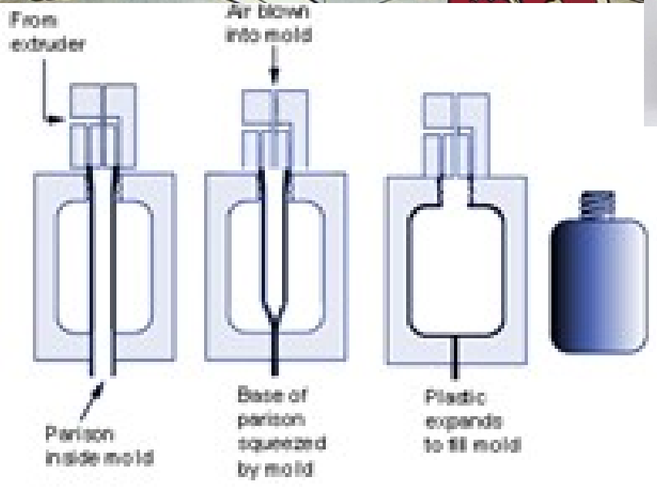


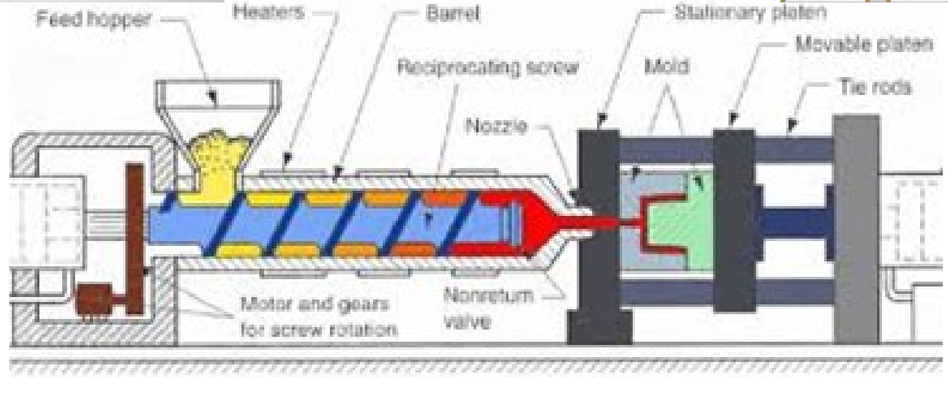


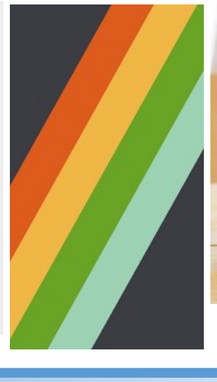












Joe Butterworth

Materials

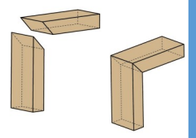
- Softwood: Softwoods come from coniferous trees, like Pine, Cedar and Yew. Softwoods grow in colder climates and are fast growing, as they are evergreen, this makes them fairly cheap. Pine may be used in my themed product as it is cheap compared to hardwoods and can bring some good results. If this was the case this would make the product more for low end consumers and cheap, this could reduce consumer price or increase profit.
  - Paraná Pine: There are several types of pine but they're all generally pale with brown streaks. Parana pine is more expensive and it's hard. This would have a nice finish but would defeat the point of being cheap. I may use this as I like the texture it has.

- Hardwood: Hardwoods come from deciduous trees. They usually grow in warm climates and are slow growing so they are generally more expensive than softwoods. These can make really nice products, this makes hardwoods a likely material to be used in my product.
  - Oak: Oak tends to be very grainy. It is very durable, this gives it a distinctive look. This is good for furnisher as it is visually pleasing and is strong.
  - Mahogany: Mahogany has a dark colour and stands out. It used to be used in a lot of furnishings. It has a very straight grain and works well with dark greens. I would use this in an Art Deco design with blacks golds and greens.
  - Beech: Beech has a pale cream colour and used for decorations. This works well with whites and granites, in my product this would compliment white acrylic.

- Acrylic: Acrylic is a thermoplastic meaning it can easily be melted and reshaped using heat. Acrylic usually comes in thin sheets, these can be cut using a laser cutter into any two dimensional shape. These shapes can then be bent and contorted using heat, for this we would usually use a line bender to heat a certain section of the material, it may also be used in a vacuum former to get more complex shapes. This material is more expensive than MDF but can have great visual appeal when matched well with other materials or colours

Construction

- Mitre Joint: Mitred joints are nice looking as they hide the end grain. You can use pins in a mitre joint, these make the connection stronger as it increases the surface area between the two points. This is not the strongest joint but it's form is the best for my project. I would use this for an art deco or minimalist design as it is a plane and simple style. In industry this may be used. However, there are other processes that can be more easily automated.



- Stacked case: A stacked case will provide a more functional case. It consists of many layers. Each layer can be unique allowing for the internals to be supported. The spine of the case will be striped and may use different colours. On the other hand it may be covered with a veneer or sheet of acrylic. I would use this for a pop art or Memphis design as it allows for large complexity in the design. This would be easier, than a mitre joint, to achieve in industry as it would be easy to automate with each layer being glued together by machine.

Processes

- Vacuum Forming: Vacuum forming heats a sheet of thermoplastic, like Acrylic until it goes soft. A mould is put onto the vacuum bed and is lifted up to the plastic. Then all the air is sucked out of the system, creating a vacuum the pressure difference moulds the plastic to shape, were it cools. This may be used in my product to make my acrylic into more complex shapes.

- Laser Cutting: Laser cutting uses a Laser cutter to cut out a 2d design made in CAD programs, like 2D design and Ethos. The CAM uses a precision laser to cut out the design. This can make simple shapes but is limited to 2D. This may be used to cut my acrylic into shape so that it can be used. This may be used in prototyping my design.

- Milling: Milling uses a microrouter to cut shapes and designs out off woods and metals. This can make cuts (interior and exterior) or make 3D shapes. This is a subtractive CAD process and requires a CAD design to route.

Relevance

I have looked at both softwood and hardwood, softwood would be a cheaper material to make it out of but as it is a novelty item it can be made from more expensive items, these would be more appropriate to the time periods I am looking at. Acrylic can be used in many ways and the different colours mean that can compliment most design eras well. To assemble my project I looked at a conventional method, the mitre joint, and a less conventional method, a stacked case, as this allows more flexibility in the holding of the components. The stacked case was not a common construction method for my design eras. However, the benefits it brings for the support of the internals of my product, I feel out ways the lack of authenticity. For the processes of my design I have looked at CAD/CAM processes. Although not available to the people making products during the design era, like with the stacked case I feel the benefits they could have for my project is more important than the authenticity of this approach.

Joe Butterworth

Product Analysis

								
Appearance	Black spike with a translucent slotted head	A grey lampshade with a black overhead fixture	Cuboid with an orange case and beige & black front	Cuboid with a wood veneer case and metal like front	A folded sheet of brushed metal bent like a headless S	Fillet rectangle with a phone extrusion and stand	Two circles looping, supported with a wooden triangle	A rectangle with a speaker unit on each side
Cost	£5 per unit Cheap for low end consumers	Approximately £25 Standard price for an overhead lamp	Approximately £25 A cheap radio for the style	£30—£40 A higher price for a well made product	£5—£10 Cheap, aimed at younger buyers	£5—£10 Cheap but with a high profit	Approximately £10 Cheap, as it's a more novelty item	£30+ Expensive due to high making cost
Customer	Adult looking to illuminate there garden	Someone who wants a reading lamp	Someone looking for a cheap retro style radio	Something looking for a high quality retro radio	Teen or young adult looking for a phone holder	Someone in there 20s-30s who want to store a phone	Teen or young adult looking for a formed speaker	An older person looking to play music
Environment	Outside so needs to be waterproof	Bulbs and plastic are non renewable	May use a recycled circuit board	Using new materials. This can be recycled	Made from recycled aluminium, this can be reused	Made from new wood and not easily recycled	Made of reused electronic components	This is sturdier as it may be taken outside for parties
Size	10cm Ø 25cm depth	Occupies 1.5x0.3x0.3 metres	20x10x8 cm s mall and transportable	40x20x15 cm size for a desktop radio	Occupies a small phone like volume	Slightly larger than a phone with a similar depth	About the size of an A5 piece of paper	Has a large volume and takes up the majority of a shelf
Shape	Cylinder with a thicker translucent head	A conical lamp supported by an overhead fixture	Cuboid with filleted edges	Cuboid with filleted edges	A sheet bent like a headless S with a backwoods bend	Rectangular with filleted corners held by an angle	A triangular Prism with loops coming off of it	This is a cuboid with filleted edges and rounded fronts
Function	To light the garden at night	To light up an area of room	To play the radio with a specific appearance style	To play the radio with a specific appearance style	To hold a phone and be able to use/ charge it	To hold an iPhone 4 and its charger	Plays music or audio from your phone	Plays music from the phone and can play the radio
Material	This will have been made with a cheap thermoplastic	This has a material overhead fitting and a plastic shade	Made from plastics and some metal furnishings	Nice finish with good Plastic and metal	A sheet Metal, probably made of aluminium	Wood, Probably softwood	Metal and plastic or metal and wood	Nice finish but cheap Plastic and possibly MDF

Joe Butterworth

Target Market & Customer Profile

Customer Profile

Name: Lucy Ackerell

Gender: Female

Age: 27

Location: London, UK

Interests: Design, Music, Netflix

Occupation : Accountant

Income: £46 000

Budget: £50

Family Status: Mother of one, has a boy-friend.

Joe Butterworth

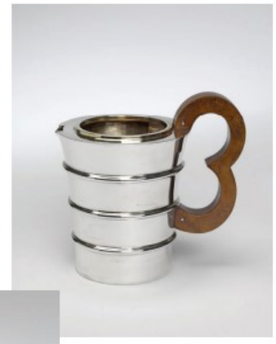
My Target Market:

- Mixed Gender
- Aged between 20-30
- Living in the south of England
- High paying Job
- Interested in design
- Lives with a partner or with a family of their own
- Has a need for either a low voltage light, Radio, Ipod docking station, or phone charging station

Research of Design Era

Art Deco (1920—1940)







Notes on Style:

- Simple clean lines with areas of faceted detail
- Usually combines natural wood grain and shiny surfaces
- Metal is painted
- Geometric shapes and lines

Minimalism (1967—1978)







Notes on Style:

- Inspired by Bauhaus movement
- Very simple clean lines
- Simple repeat patterns
- Sharp lines rounded edges

Pop Art (1958—1972)





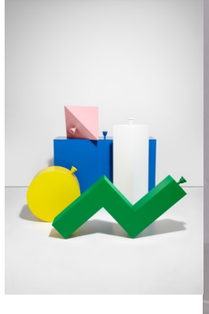

Notes on Style:

- Inspired by comic heroes and comic style drawings
- Loud unusual colours
- New forms which are playful
- Fun detailing and patterns

Memphis (1981—1987)








Notes on Style:

- Made as a reaction to minimalism
- Drew from Art Deco, Pop Art and 50s Kitsch
- Colourful, bright and often shocking
- Based on asymmetrical shapes

Joe Butterworth

Existing Product Disassembly

Construction Techniques—Stacked Case

A stacked case will provide a more functional case. It consists of many layers, stacked on top of each other. Each layer can be unique allowing for the internals to be supported by the case and allow a fluid shape to more easily be made. The spine of the case will be striped and may use different colours, or different materials. These could be contrasting or complimenting, they will be a key part to tie the product to whichever theme I choose. On the other hand it may be covered with a veneer or a sheet of acrylic. This will allow flexibility in what the case looks like aesthetically. However, a stacked case design can require a threading bolt or dowel which may look garish on the front panel. Especially for a minimalist or Memphis design.

Assembly Technique—PCB Mounting

PCB Mounts—If I were using a box like design I would use PCB mounts. These suspend the PCB from the edge of the casing, this protects the electronics as it removes contact points with the PCB which may damage the components. Unfortunately this does require screws on the side of the case that the mount is attached to. This means that the case will not be flush. If I do use this it will be attached to the back side of the case.

Custom Case— If I mould or cast the case I can design a case that has internal supports for the PCB, like the image opposite. This will allow a flush design and the most ideal support. If I was making a box–like case I could use the stacked case technique just for the internals not the externals. This will allow custom support for all the components.

Construction Techniques—Box /Frame Joints

Dovetail joint— These joints are often used to create draws as they are very strong in one direction. This is good for draws as they are only pulled out in one direction. This would not be the best joint for my box as it would come apart in one direction. However, I may use a dovetail joint and glue it together this will be sufficiently strong and will be more visually appealing than the comb and finger joint.

Comb & finger joint— These are very strong joints as they have an increased surface area for the glue. The strength comes from it's increased contact area. Although these are the strongest they are the least visually appealing.

Mitre joint— The mitre joint is the most visually appealing of the joints as it covers the end grains of the box. This is not the strongest joint as it does not have the increased surface area of a comb/finger joint.

Construction Techniques—Curved Cases

Laminating— This technique uses thin strips of wood—usually 2-6 mm thick—glued together and held in a jig, which keeps them in the right shape till the glue has dried. This is a timely process that can be very expensive to do. This gives a versatile case that can be made in most shapes.

Slotted Board— This utilises a laser cutter to cut slots into plywood. This creates a piece of board that can be flexed to any shape. This would be useful for creating more abstract shapes. This will, however, have a burned appearance on the slotted board from where the laser cutter was.

Casting/Moulding— Like commercial products I could mould or cast my design. This would be best if it was being made commercially. This type of construction is quite versatile and has the most versatility in shape of the case.

Finishes

Veneer— This is a thin shaving of wood. It can be glued to the front of any wood surfaces to change the type of wood this can be cheaper than using a full sheet of wood. This can also be laser cut to have more intricate patterns.

Oil—This seals the wood which stops it from warping and protects it from the environment. This also stops the wood from gathering dirt from the surroundings.

Paint—This applies a protective coating around the wood. Paints apply a colour to the surface. This allows the possibility for designs of many colours.

Wet & Dry—This can be used to finish the edges of plastic that has been cut. This rounds the edges and makes them not sharp, this is important for the consumers as it makes the product safe.

Joe Butterworth

Research Analysis & Specification

Research Analysis—

Products: I can make a low voltage light, a radio, a phone charging station or an Ipod docking station. These are all electrical device used around the house. As such these products should all be very durable so to withstand normal use. These are all desirable products and so with there themes can be charged more for.

Theme: My product is to be themed to a design era in the last hundred years. The design eras I looked at were Art Deco, Pop Art, Minimalism, and Memphis. If I were to do an Art Deco design I would use simple geometric shapes with dark coloured materials like Mahogany. For a Pop Art design I would use sharp edges and bright contrasting colours, for such a design I may use various acrylics. In a minimalist design I would have to use straight lines with clean curved edges, this would best use beech or a black or white acrylic. For Memphis I would need to use bright design consisting of many simple shapes this may be accomplished by painting or contrasting acrylics.

Materials: For my project it is likely I will use a hardwood like Oak, Mahogany, or Beech or I may use sheets of acrylic – most likely a combination of these. I am not likely to use pine as it is does not fit the designs as well. Hardwoods though expensive are desirable woods. These woods also fit with my chosen design eras well. Acrylic will be useful as it will provide a much brighter and shinier colour than the woods. This will be useful for the exaggerated style of Pop Art.

Construction: To make my case I may make it in many different ways. A stacked case will allow flexibility in the design as a whole. A stacked case may not be the most appropriate for all the design periods but this is made up for because a stacked case can be made to hold the internals up. I may also use different Joints like the comb & finger or mitre joints. The comb & finger joint is the strongest joint, but I do not feel that it is the most fitting for my chosen design eras. Alternatively, I could use a mitre joint, these aren't as strong but they are more aesthetically pleasing. This will hide the end grain of the wood. To increase the strength of the mitre joint I may pin the two pieces together.

Customer: The customer for my product has a fairly wide range. My customer may be from the age of twenty all the way up to their mid-forties as this is the wide range of people who may visit a design museum. This product is not for a specific gender and the customer will have disposable income so are most likely have a high income job.

Specification—

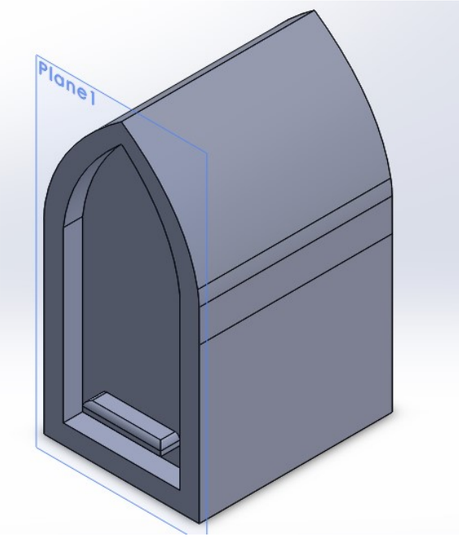
- It must be a radio or a phone charging station.
- It must be in the style of Art Deco.
- It must be durable to stand normal use.
- It must be stable so it doesn't fall of the table.
- It must be battery powered.
- It must have control inputs.
- It must have an on/off switch as to not drain the battery.
- It can't be gender specific.
- It can't be offensive as it is for in house use.
- You must be able to access the battery to change it.

Joe Butterworth

Developed ideas

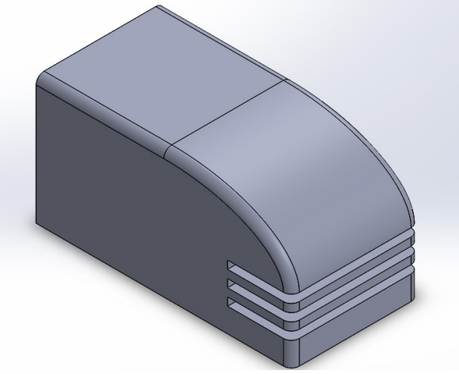
Joe Butterworth

CAD Development

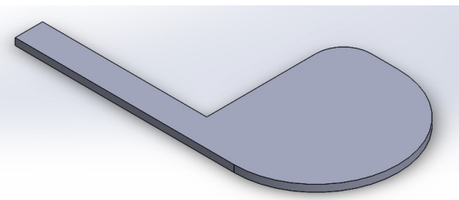


The first three components were made for the modelling of my design. Once assembled these components were 3D printed.

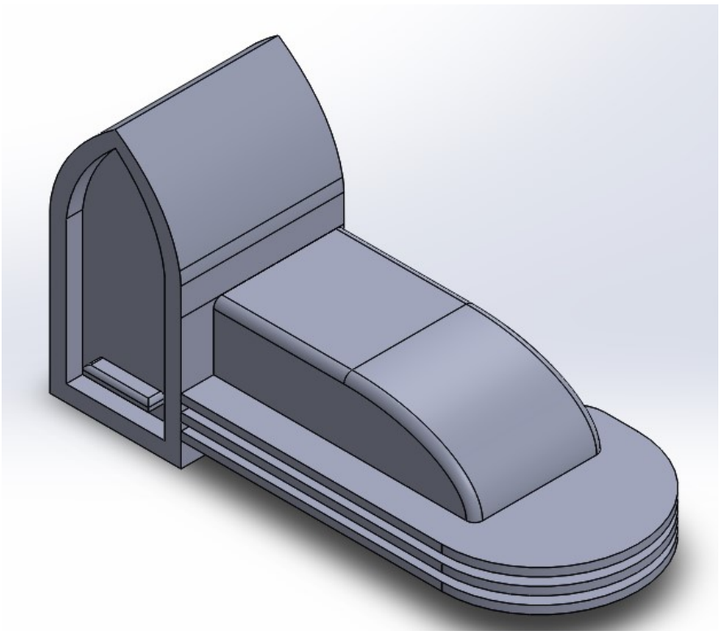
- The first component I made by making a rectangle with the dimensions 48x32.15mm on the front plane. I then split the vertical (80mm) sides into 1/8ths. I then used a spline tool and went from the centre of the top side to 5/8th from the bottom vertically and the bottom corner. This created a curve that intersected at 5/8ths. This joint was then filleted so that it has a smooth curve. I repeated this on the other side of the rectangle. Alternatively, this could have been achieved using the mirror tool. I then extrude boss/based this to 40mm
- Once it was extruded I inserted a reference plane (plane 1) through reference geometry. I then repeated the earlier steps on the plane, making sure they are inline by starting the sketch on the bottom left vertex. Once the shape had been made I used the offset entities tool to create a contour. Within this contour I made a rectangle and used smart dimensions to centre it in the design. I then used extrude cut to remove the area within the contour except the rectangle . This was cut to 10mms. I then filleted the top corners of the left behind rectangle this created a place to put your phone.



- The second component was also made from a 48x32.15mm rectangle. The corner was curved by making an ellipse. The ellipse was made in the rectangle and the radii were driven to the top and right sides. $R_{Vertical}$ was set to 16.075and $R_{Horizontal}$ was set to 24this made the ellipse the perfect size to the rectangle. I then used powertrim to remove all the unwanted sides to the oval. I then added rectangles coming from the right side and used smart dimensions to make them the same shape and uniformly spread out. I then extruded the design out and filleted the top/curve/side edges.
- The final Piece was made on the top plane. It was made with two rectangle. The first was 8x48mm, attached to the shorter side was a rectangle 48x16mm. On the full larger length side I then added a circle. It was centred to the middle of the line and the radius was set as driving to the top side of the rectangle. I then filleted the remaining 90° angle. I used powertrim to clear the inside of the shape and I extrude boss/based it to 2mm.

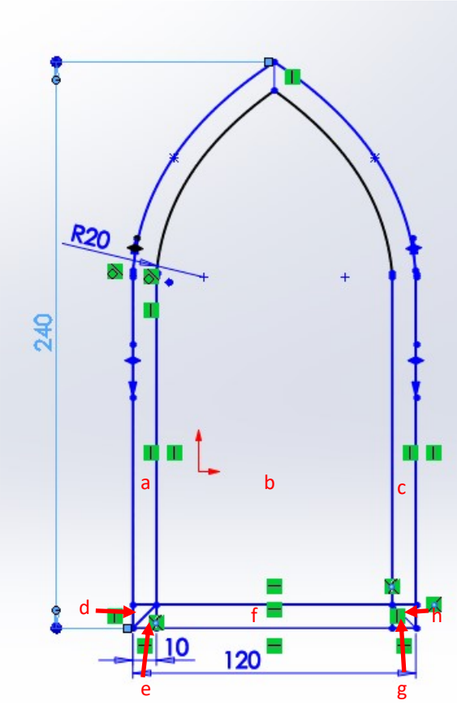


- These were then all then compiled into one assembly. Component 2 was mated to the right face of component 1, this created the main body of my docking station. I then mated component 3 into the gaps in component 2. This was done two more times creating the slatted part to my design.

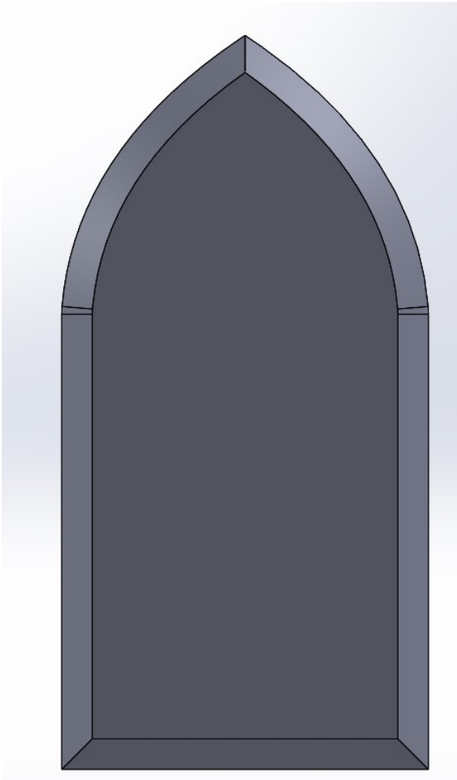


Joe Butterworth

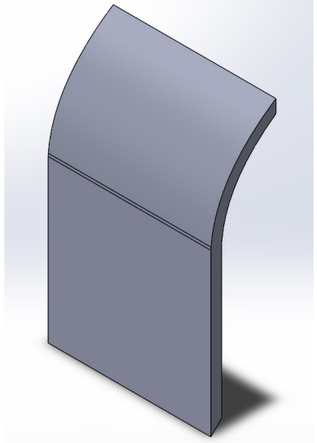
CAD Development

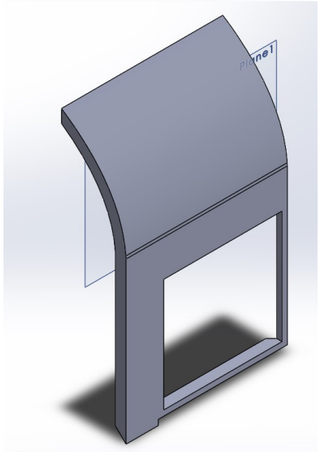


- This sketch was made using the same step process to component 1 in my prototyping design. However, the dimensions were 240x120mm. This created a much larger design to the size of my final product. When contouring this design I again used a 10mm offset. This gave a proportionally thinner side thickness to the prototype. This thickness was chosen as it gave the design a less clumsy look to it but also because it is easily achieved when laminating wood.
- This was made so to save me time whilst designing. This would be used as a template to allow me to make many components with the same shape. This is important to making sure that it would all fit together in the final assembly
- This sketch was saved as an appropriate name (Sketch of sub assembly 1-RM controlled assessment). Whenever a new part was started from it I would save as (new file name) and choose “save as copy and open” as this would keep the original sketch as a document whilst allowing me to easily use it in making a part.
- When making a part I would use power trim to remove any lines not needed to make the new component. This makes extrude boss/basing easier as it means I don’t have multiple areas I could or need to select to extrude.



- For this component I extruded all of my sketch to 10mm. I used power trim to remove all the interior lines. I did this so as to stop me making an error when extruding this piece.
- I then chamfered all the edges this creates a mitre joint with both arches and the baseplate.
- This however, creates a difficult section to make on my actual product. This does mean that I have to make a mitre joint on the curve of the arch. I intend on doing this by using a curved file.

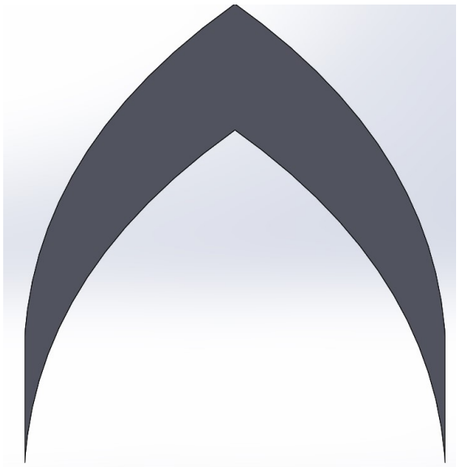




- These components are also made from the sketch. The left hand piece was made with sections a and d. These were power trimmed together, alternatively I could have used the ctrl key to click on both, and they were extruded to 150mm. This created the left hand piece to the arch.
- The inner rear edges were then filleted, this was done to create a mitre joint to the backplate.
- The second piece was created from section c, g and h. This was also extruded to 150mm. This gave me the arch with a 10mm extension to it.
- I then drew a 120x10mm rectangle to the rear of the bottom surface and extrude cutted it to 5mm this makes the piece fit to the housing joint in the baseplate. With the remaining 30mm of full depth I filleted it as to match with the mitre joint along the outside of the baseplate.

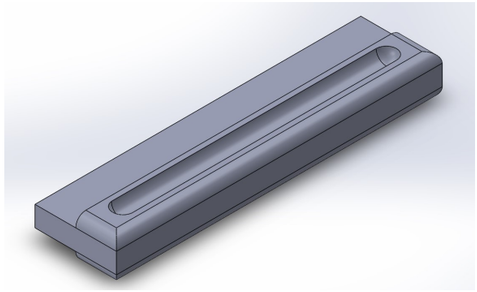
Joe Butterworth

CAD Development

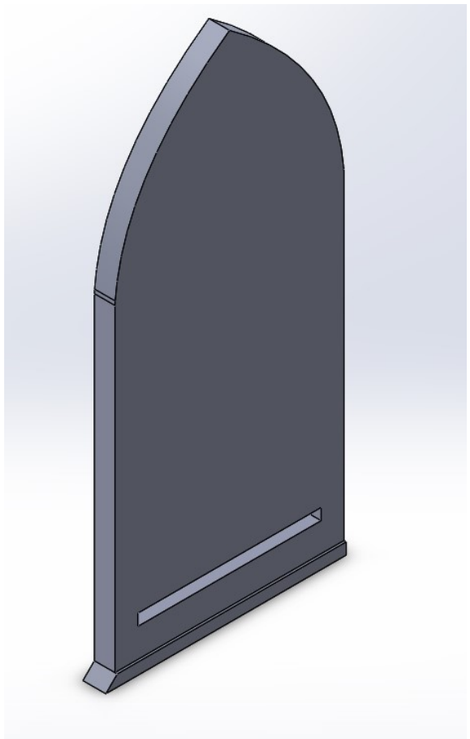


- To make these pieces I first removed the outside sections to my sketch. I also removed the sides and base to the inside. This left me with just the arches. I then created a linear sketch pattern 20mm below it. This translated a copy to were I wanted it.
- I then connected the sides of these arches with the line tool. This was extruded to 1mm and saved twice.
- This had to be saved twice so that when it is in a finished assembly I can assign the alternating pieces different materials.

- This second piece is almost the same as the previous but the bottom of the piece has been cut of. The height was found by making an assembly were the previous piece was added to the alcove plate until it intersected the housing joint.
- I then used the measure tool to find how much needed to be cut off and this was extrude cutted from the new piece.
- The final piece was done in a similar way. Cutting the height according to how much room was left. I used the sketch tools to fill in the missing section and used extrude cut to cut a 10x80mm hole into this design. This was centred and 12.5mm away from the bottom of the piece.

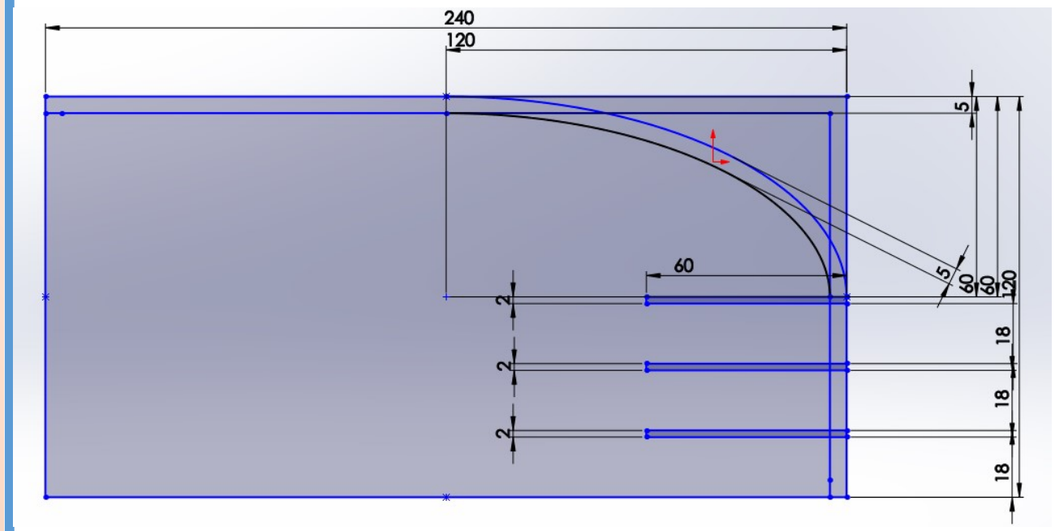


- To make this piece I first drew a rectangle on the right plane. This was 15mmx20mm. I then used the line tool to halve this rectangle to two 10mm rectangles. I then drew to line both 2.5mm away from either the top or bottom. This created two rebates within the piece.
- I then extruded all but the rebates to80mm. I then drew a rectangle on the topmost face and used smart dimensions to make it 5mm away from the side edges, 1.25mm from the rear edge, and 2.5mm thick. I then used sketch filet to round the corners closest to the rear by 2.5mm.
- I then used revolved cut to remove this this shape from the material, rotating it around the edge closest to the front. I then filleted to 2.5mm the front and side edges.
- For the second component I extruded the centre of my sketch to 9mm. This gives me 1mm for my marquetry design to be overlaid on this part.
- I then inserted a plane as reference geometry set at the bottom face of my design. This allows me to easily create sketches larger than the surface it will be connected to.
- From this I drew a 105x10mm rectangle, with a common point on the back right of the design. This was extrude boss/based downwards by 5mm. This will be part of a housing joint to the base of the design.
- The overhanging lip was then chamfered by 5mm at 45° this allows it to mesh with the mitre joint from the laminate curve.
- To finish this piece I cut a hole for the phone stand to slot into. To do this I created a sketch of a rectangle. I then used smart dimensions to make the hole uniform. It is 10mm from the edges and 12.5mm from the baseplate.

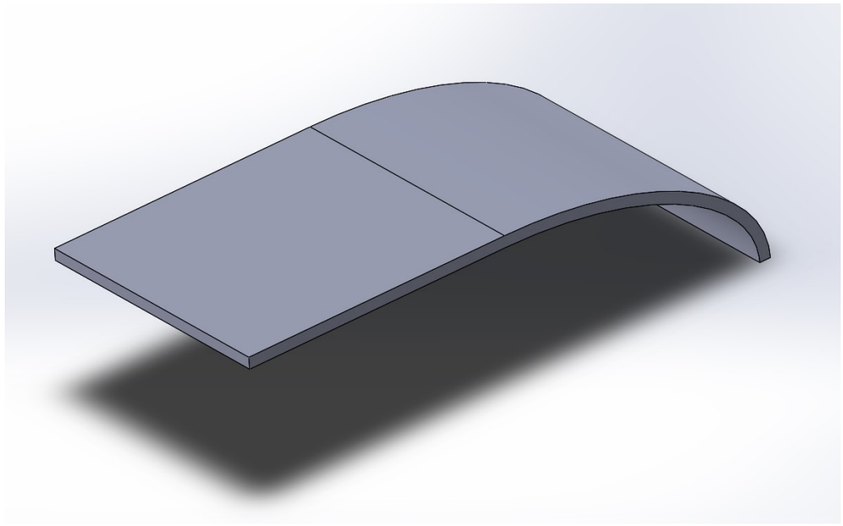


Joe Butterworth

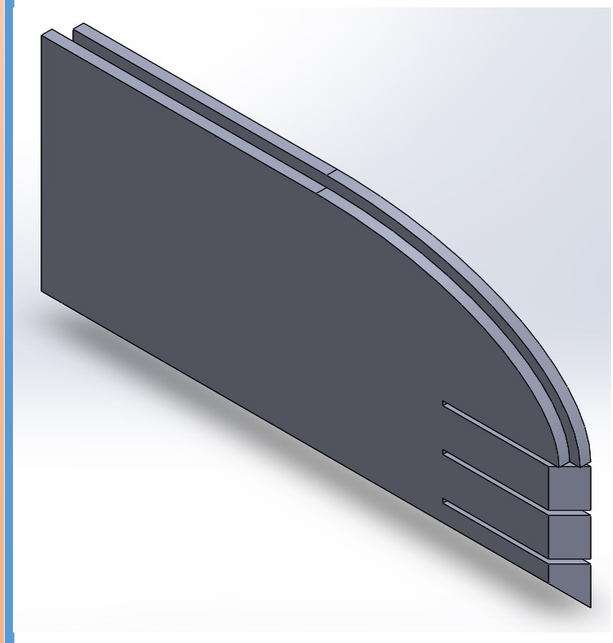
CAD Development



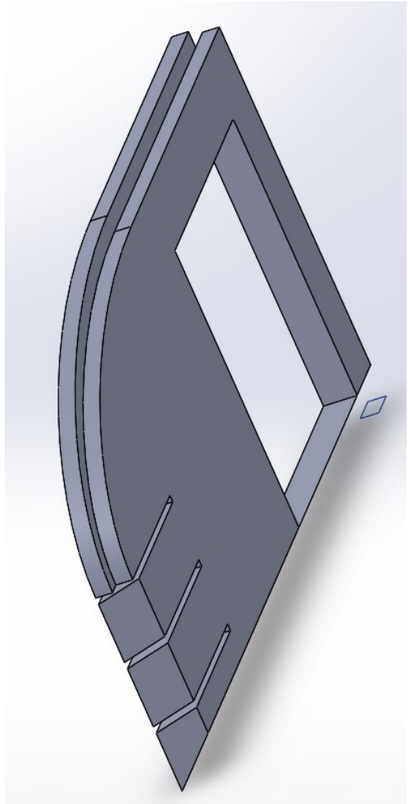
- Like with the Arches I created a template for the side of my docking station. This template was then used to create the pieces that make the side of docking station.
- To make this I first drew a rectangle of 240x120mm, inside this piece I made an oval and set its radii to 60mm and 120mm so that the oval was contained in the rectangle. I then used the power trim function to remove all but the top right quarter to my circle.
- Using the offset entities function I contoured the shape to 5mm, this allows me to make a lap joint on the curve. Finally, I used the rectangle tool to create gaps for my slatted pieces to be put in.



- This piece will be the roof to my phone docking station. It shall be made by scoring plywood by adding lasercuts into it. This will allow it to bend.
- To make this piece I clicked on the sections I made for the lap joint. To click on multiple sections I held the shift key. This was extruded to 110mm.



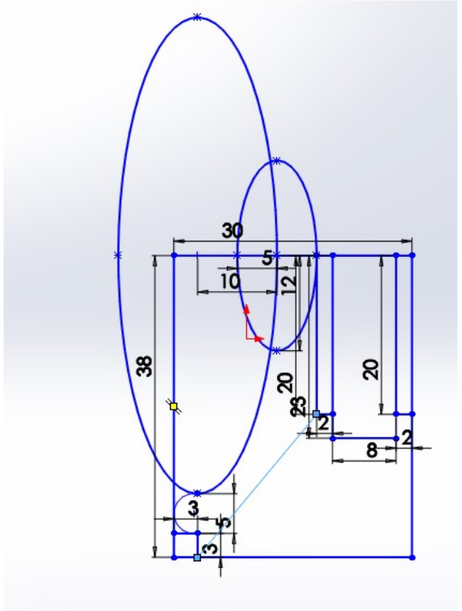
- This piece was made by extrude boss basing all but the rectangles drawn for the slats to slide into. Onto this shape I redrew the template.
- I extrude cutted the lap joint sections, this created a rebate for the roof to be put. The bottom and the side with the slots were then chamfered to create mitre joints.
- Finally, I drew another rectangle on the opposite end. I used smart dimensions to make it match the inner 5mm. This was extruded to 10mm to creates another rebate.

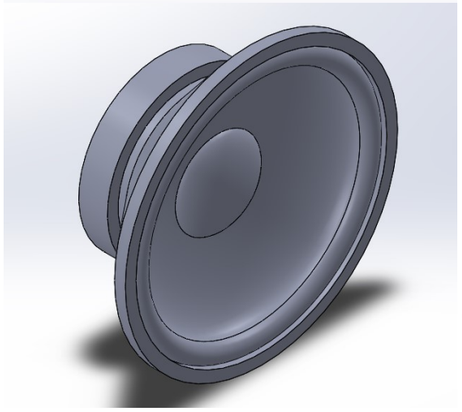


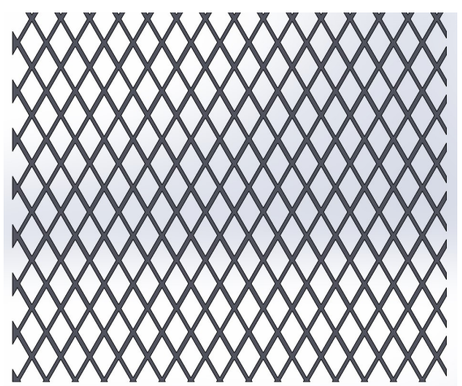
- The front piece is similar to the previous piece. It can be made by following the steps for the previous but making all the cuts for joints on the alternate side.
- From here I added a hole that was big enough to fit the speaker I was planning to use. A hole or fabric in front of a speaker allows its sound waves to travel properly.
- Again , I drew the rectangle on the far end to create a rebate that attaches it to the arches. This adds strength to the design and, besides the hole, makes it symmetrical.

Joe Butterworth

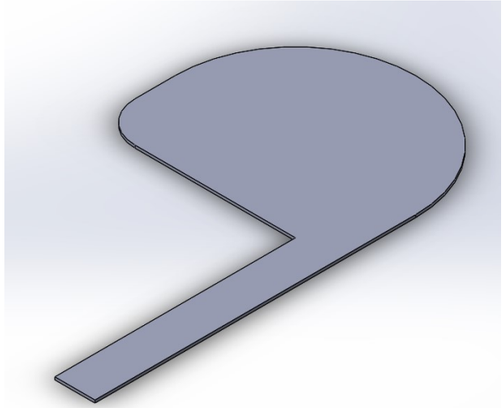
CAD Development

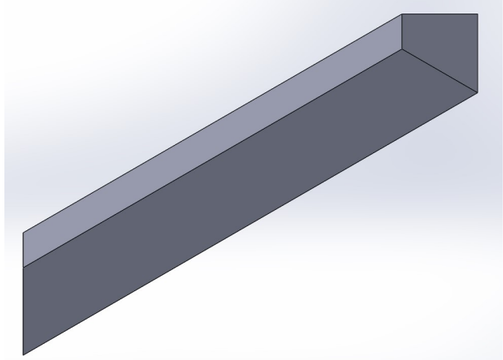






- Designing the speaker I used an a actual speaker to make an accurate design. First I measured the depth of the speaker and its radius. These were the dimensions of my first rectangle. Then I measured the radius and the depth of each of the different sections of the back of the speaker. These became the back magnet To create the rim I used the rectangle tool to make 3x3mm from the bottom left corner. Next to this I created a semi oval. I did this by drawing an oval, 3mm and 2.5mm radii, I halved it with the line tool and then used power trim to get rid of the undesired half and the splitting line. I connected the rim to the magnet using a line. I then created the diaphragm using two ovals. They both centred on the edge of the rectangle. The lowest turning point on the larger oval was driven to the oval of the rim. The smaller oval was centred on the right turning point of the larger and had the distance between the magnet and its centre as a radius.
- Not many extra lines were cut from this sketch as by removing them it can easily mess up the relationships between shapes. To make it 3D I revolve boss/based the desired shapes around the edge of the original rectangle.
- To create the meshed piece I made a square of 80mmx80mm with the rectangle tool. This is the size of the extrude cut in the frontplate and will cover the speaker. To turn it into a mesh I made a parallelogram on the front surface and translated it south east. I then used the linear sketch function to duplicate these two diamonds across the shape vertically and horizontally. I then extrude cutted these to simulated holes of a mesh.

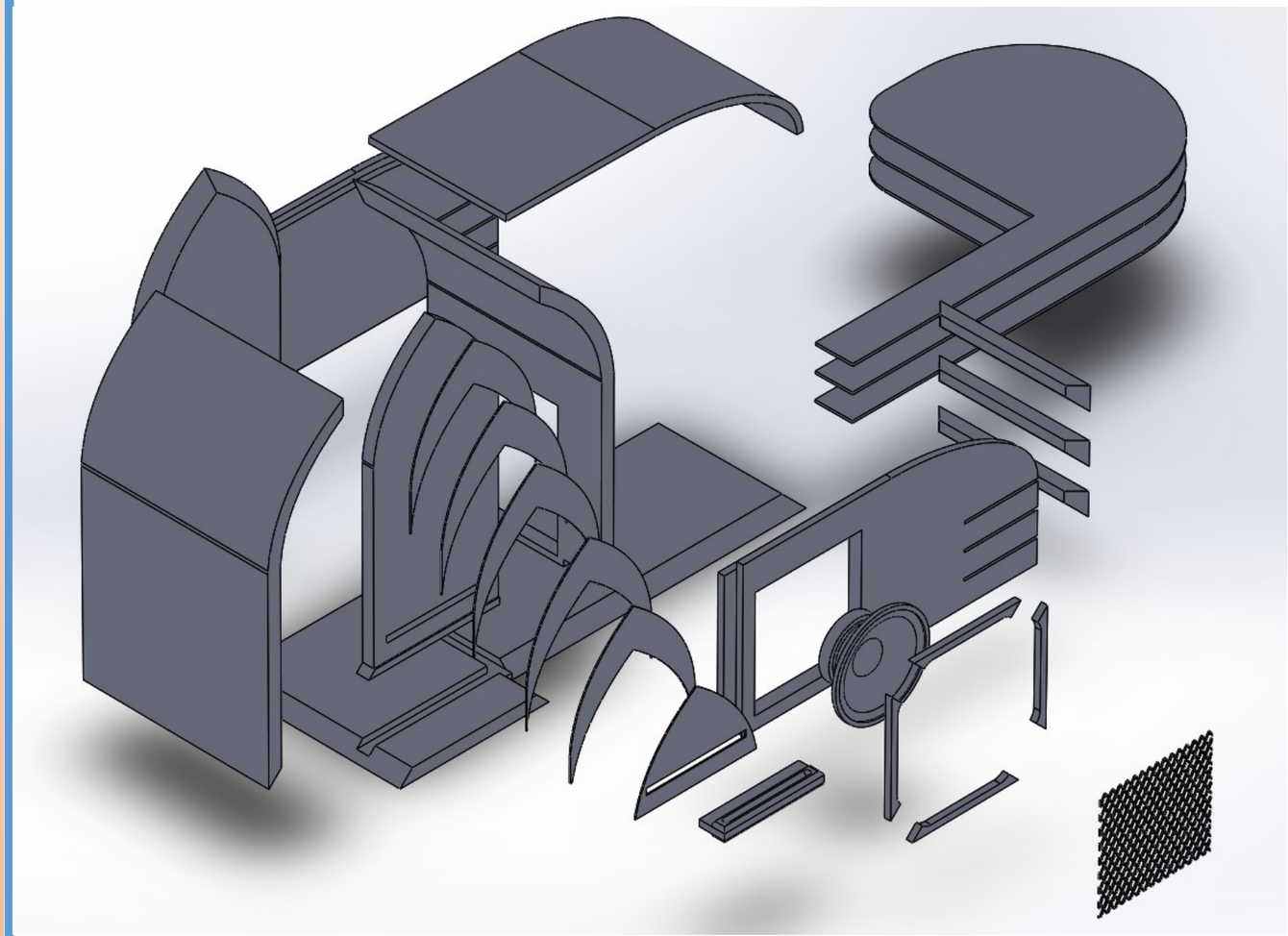




- This piece is still very similar to it's corresponding modelling piece. The only difference are the sizes used. To make it I made two rectangles. The first was x mm, attached to the shorter side was a rectangle x mm. On the full larger length side I then added a circle. It was centred to the middle of the line and the radius was set as driving to the top side of the rectangle. I then filleted the remaining 90° angle. I used power trim to clear the inside of the shape and I extrude boss/based it to 2mm.
- This piece was made to go in-between the slats to cove the holes on the end that would be created. To make this I drew a rectangle of 18x120mm on the right plane. This was extrude boss/based to 10mm. To make it fit the mitre joints on the end of my docking station I used the chamfer tool, 10mm at 45°, to create the corresponding joint.
- The third of these pieces is slightly different, as it has to match a joint on the base as well as the sides. To make this piece I saved a copy of the previous piece with a new name, this make a new part identical to the original. I then used the chamfer tool on the bottom side and saved to create the new component.
- The final piece was made by drawing a 60mm square within an 80mm square. I then drew the diagonals in with the line tool. Finally I filleted the inner square, this gave it its round edges. I then extruded one of the sections produced by this, This would be used four times.

Joe Butterworth

Exploded Drawing



To make my exploded drawing I first had to make an assembly of all my components. To do this I created a new document, but instead of creating a new part I created an assembly.

I started this assembly with the base, this allows me to add components onto something instead of attaching them randomly.

When adding and mating the components I added the parts to create the arch first. The front plate to this subassembly was added before the laminate pieces. This is because these components enclose the front plate. This would make it harder to mate into place. This also allows me to test a potential order for assembling the actual docking station.

Onto the front plate I mated the veneer pieces and the phone stand. This was then enclosed to the two laminate pieces that were mated into place from the baseplate. This was then closed by mating the backplate to the base and the arch pieces.

I then added the front plate for the second sub assembly. To this I mated four of the catch attachment pieces and the wire mesh to the hole. I then mated the speaker to the rear of the mesh so that it was facing into the shell.

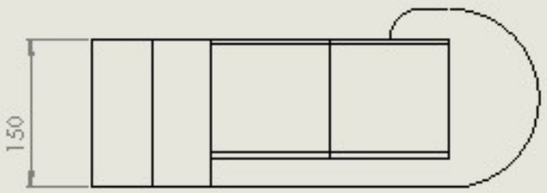
This was then mated to the base and right arch. Similarly, the backplate was also attached to these. The curve piece was then mated to the rebates in the top of the front and back plates.

To finish the design the slats were mated into there holes on the right of the front and rear plates. In between the slats ending pieces were mated in as to stop there being gaps.

With the final assembly I clicked exploded view in assembly. I then clicked on each piece and dragged them apart on the three axis. This allowed me to separate each of the twenty seven components. Exploded drawings are useful as they allow people to see were each piece of a design goes relative to each other. If the product was being assembled by the user this could be done to highlight options in an assembly like different handles or different shelve heights.

Joe Butterworth

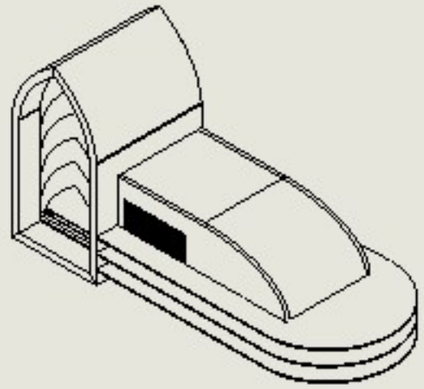
Orthographic Drawing

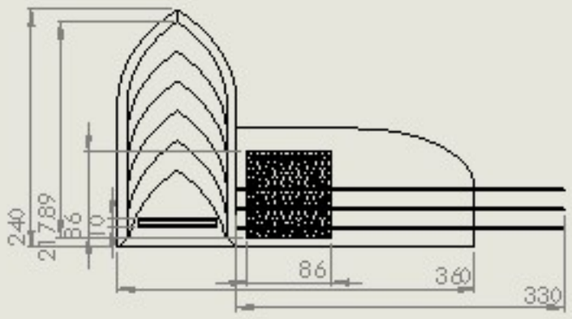


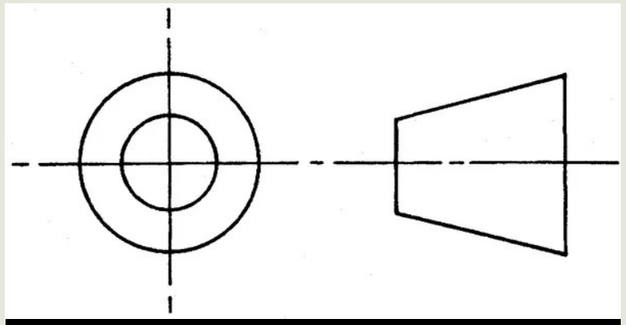
This is an orthographic drawing of my dicking station. This is also a 3rd angle orthographic projection. I made this on solidworks instead of drawing it by hand.

This is useful because it is a 2D drawing which shows all sides of the docking station. An orthographic drawing is also useful because you can show someone how to make it.

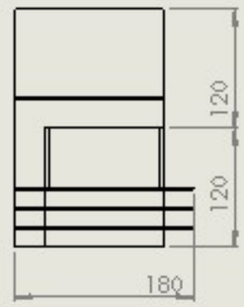
To make it on solidworks I opened my finished assembly and clicked file>make drawing from assembly. I then added the Front, Plan and Side elevations. I then also added an Isometric design to the top right of the page







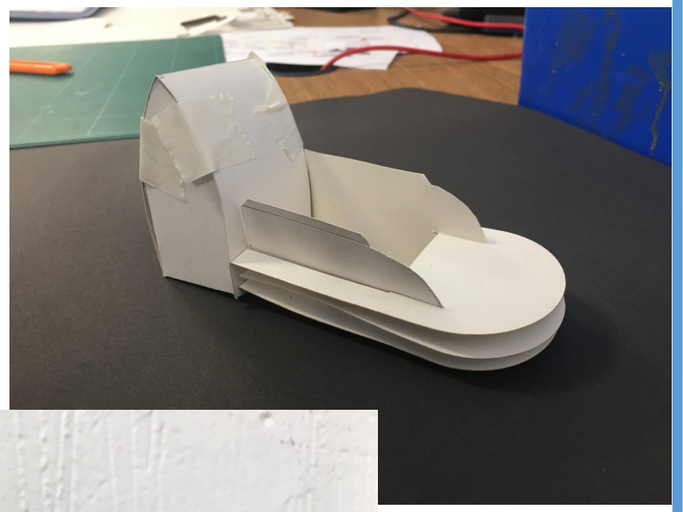
3rd Angle Projection



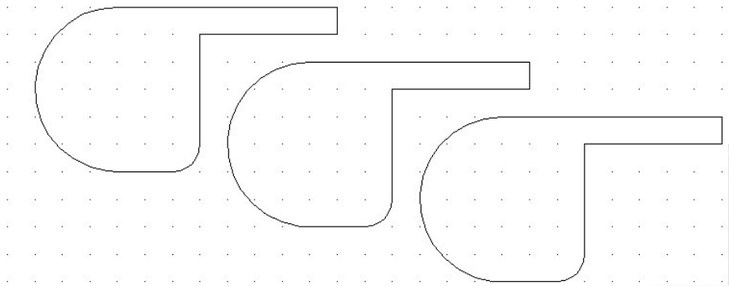
RM Docking Station

Joe Butterworth

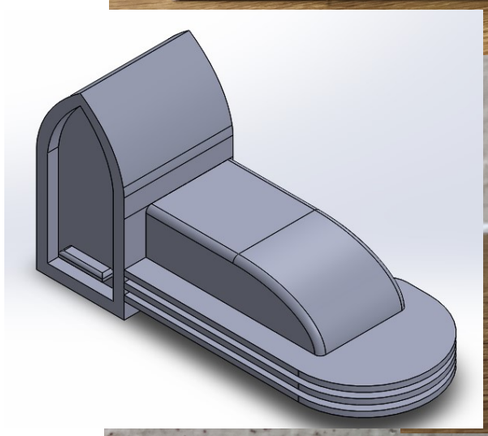
Picture of Modelling



- To make our models we initially used card. Card is used in modelling as it is a cheap material, this reduces the costs of prototyping in industry. Card is a quick and relatively easy material to use when making, we used it for these reasons. To make my model I first used a ruler and pencil to draw the net of my design on-to an A3 piece of card . This was then scored (on the fold lines) and cut out with a pair of scissors. I then folded the design to shape and stuck it together with masking tape.
- Due to the complexity of my design this did not mean that I was finished. I then had to make the horizontal slats. To do this I first tried to cut these from the card. However, due to them not being the same (and a lack of compasses) I used 2D Design and a laser cutter to make them. This produced 3 identical slats, these were then put into horizontal cuts in my main model.



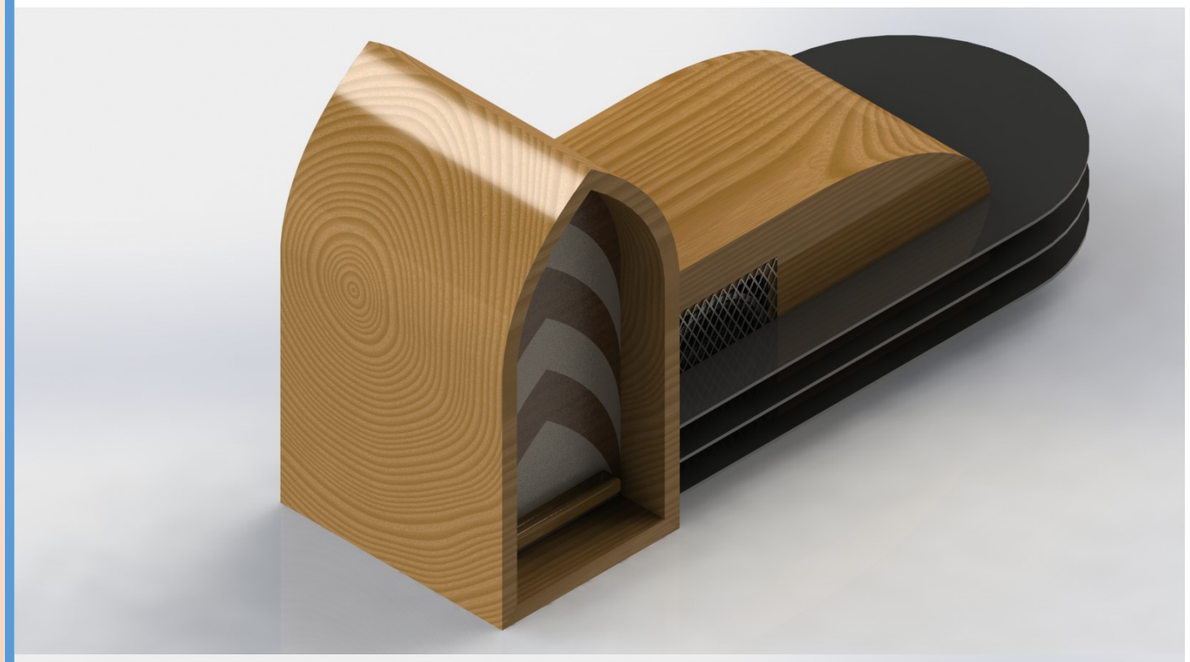
- To complete my card model I had to make a roof for the lower part of my design. To do this I used string and a ruler to measure the length I needed to cover. I then cut this out of card and stuck it to my main assembly with masking tape.
- After making my design from card I made it again in Solidworks. I did this by assembling three (one of which was used three times) components together. This was then exported this as a STL file. This was 3D printed on one of the schools UP minis.

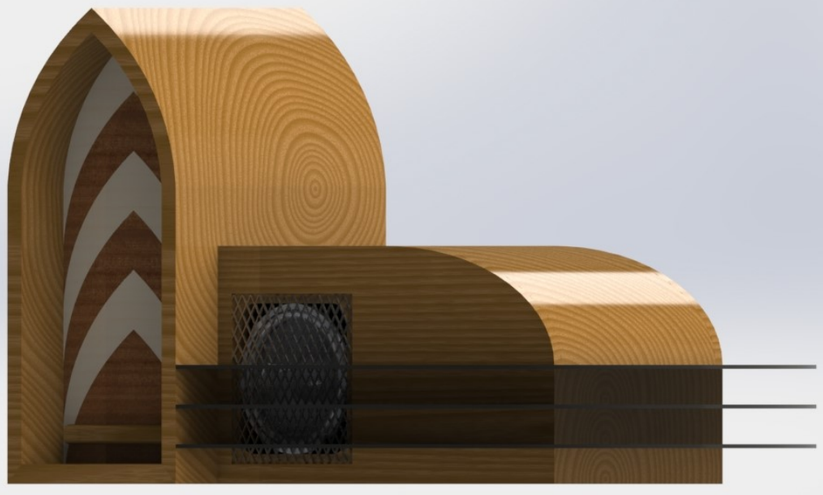


- 3D printing is an additive method of CAM. This means that it will start with nothing (in this case an empty bed) and then add material to it. A 3D printer does this by adding heated ABS (or another chosen filament) to a blank surface (or bed). It will then add layers on top of each other. This is slow as it requires precision and each layer must have solidified adequately before adding another. It is-n't used in industry to mass produce as it is expensive when making large quantities of items, opposed to injection moulding.
- To add strength to a the printed design the slicing software will add scaffolding. These are supporting beams added under any overhanging object in the design. In my case it added this to the horizontal slats. Once the design has finished printing and you have taken it out the scaffolding can then be cleared with clippers or a craft knife. Due to the small gap between the lateral slats it was very hard for me to clear out the scaffolding. If I were to print it again I would print the slats separately and have it as a sub-assembly.

Joe Butterworth

Final Design





To make the two point perspective of my final design I created two vanishing points. All lines either went to these vanishing points or vertically. This gave the illusion of depth in my drawing., creating a way of drawing in 3D. These lines are left faintly as construction lines with the actual shapes of the design being done with heavier lines. I then coloured the finished perspective design, to make it a final render of my work.

I also created a final render in Solidworks of my design, this is more accurate as it is done though CAD. To make the design I took my finished assembly and I added materials from the materials manager to each face. I added finished oak to most faces, the marquetry is made from Birch and Mahogany veneer. To make the marquetry in Solidworks I created each shape as thin pieces, these were already in the final assembly. Each Piece is then set to a material. For this reason when a piece is reused it needs to be saved as a new part so that there can be many of the same piece with different materials.

To export the final render of the shape I had to install a plugin on Solidworks, Photoview 360. Once installed the I used the final render function to turn the solid colours of materials in the Solidworks editor into actual finishes.

Joe Butterworth

Processes and Finishing Used

Current Process

- Cutting with the Bandsaw—In school we are not allowed to use the bandsaw as it is to dangerous for us to use. So we have to have either our teacher or the school technician cut the material on the bandsaw for us.
- Using the Hand Router—To make rebates or chamfers in my project I will use the school's hand router. This is time consuming as It will have to be used on multiple pieces, in some cases both sides of the piece. On top of this the bit must be changed for each different type of cut made.
- Laminating—When making the laminate arches I will make a single jig. This Jig will be reused to make two arches. This will make the curves of these arches identical and saves on making many jigs. This will be slow, as I must leave the pieces of wood in the jig for a while, but it would be impractical and possibly inaccurate to make multiple jigs.
- Marquetry—At school we use the Laser Cutter to cut out veneer to create marquetry. This marquetry is then glue onto whatever surface it will be attached to. By cutting the veneer with the Laser Cutter it allows complex and detailed shapes to be cut out.
- Laser Cutting—To cut specific shapes from more brittle materials I will use a laser cutter. To do this I will first design the shapes on 2D Design. This can then be sent to the Laser cutter to cut out the shapes accurately.

Industrial Process

- Cutting in Industry—When cutting materials in industry often a template is made. This will make each piece the same and speed up the process of making them. A template may be made to mark the shape of a part and then many of these could be cut from one piece of wood on a bandsaw.
- CNC Routing—In industry when a piece needs to be cut in an intricate 3D way it will often be routed using a CNC. This can make careful cuts of 3D shapes. This would ensure that the joints line up and work together perfectly.
- Laminating—In industry to make many laminated pieces they would use a jig. Multiple jigs would be made so that many laminated piece could be made at once. This helps each arch to be a consistent shape and would prevent bottlenecking caused by the use of more than one jig.
- Marquetry—Marquetry in industry would be quite similar to the process we used in school. Due to the intricate nature of the process it can't very easily be automated. This means skilled workers must carry out this process, unfortunately this can cause it to be a bottleneck in manufacture.
- Laser Cutting—To make more of a particular part I would find the most efficient way to fit that shape on a sheet. I would then put as many of that shape as I can on the sheet so that as little material is wasted as possible. This could then be sent to the same cutter many times or many different cutters to make more of that one part.

Current Finishes

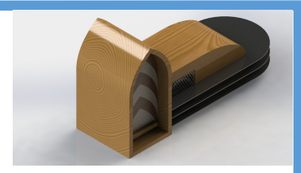
- Acrylic— Acrylic as a plastic already comes finished, it is shiny and smooth. This means it does not require much finishing up, It may require you to peel off a protective film from one or both sides of the acrylic.
- Oil— In School I will be using Danish Oil to finish my product. This requires time sanding and coating. The product should be sanded and then oil applied three times for a good smooth finish on the final product.

Industrial Finishes

- Acrylic—Acrylic in industry is the same as acrylic at school. This means it still requires very little effort in use. In industry much larger quantities are used. This means there almost certainly will be film, but this is not much of a problem.
- Oil—Like with marquetry this is not an easily automatable process. This means it has to be done by a skilled worker. The need of skilled workers does however limit the scale of production that this product can be made at, for my product it is limited to batch production.

Joe Butterworth

Manufacturing Specification



Materials

Part	Material	Size	Quantity
Arch Pieces	Plywood	280x150x3	6
Arch Veneer	Oak veneer	280x210x1	2
Baseplate	Oak	360x150x10	1
Arch Frontplate & Backplate	Oak	240x120x10	2
Frontplate Veneer	Birch Veneer	140x100x1	1
Frontplate Veneer	Mahogony Veneer	160x100x1	1
Phone Holder	Oak	80x20x10	1
Curve Frontplate & Backplate	Oak	250x120x10	2
Curve end Pieces	Oak	120x18x10	3
Curve	Oak MDF	270x110x6	1
Mesh Holder	Oak	86x10x8	4
Mesh/Cloth	Wire Mesh or Fabric	106x106	1
Acrylic Slats	Black Acrylic	330x150x2	1

Tools and equipment used

Pencil	Rule	Set square	Band saw
Laser cutter	Wood Vice	Chisel	Pillar Drill
Hand Router	- 45° bit	- 3mm slot bit	

Adhesives & Finishes Needed

PVA Glue	Danish Oil

Joe Butterworth

Step By Step Guide of How You Are Going to Make It

Making the baseplate: First I will mark out the shape of the baseplate and it's joints, with a pencil, rule, and set square, on a piece of oak. This will be cut to shape on the bandsaw, by my teacher. Then I will use the hand router to cut the rebates and mitre joints of the baseplate, that have been marked out.	Make mould for the arches: First design a mould in 2d design and print it out. Stick it to a thick piece of wood and have it cut out on the band-saw.	Laminate arches: Mark, with a rule and pencil, six 280x150mm rectangles on 3mm ply. These are cut out using the bandsaw. Glue three together with PVA glue and leave in the clamped mould, do this twice to make two arches.	Cut arches to shape: Once set, using pencil and rule, I will mark the area of the laminate arch I wish to use. The excess waste shall be cut of using the bandsaw. Similarly I will mark the mitre for the left arch on the side and this shall be cut off using the band-saw.	Cut hole in centre arch: On the centre arch I will mark out, with a pencil, rule, and set square, the window for the internal joins. I will then drilled the corners of the marked out section, with a 5mm bit. I then cut along the marked out lines with the reciprocating saw, using the holes to put the saw in	Marking the inside and rear panels: To make the Inside panel I will mark out the shape of the arches onto a piece of paper. To do this I will get someone to hold the arches in place on the paper and stencil around the inside with a pencil. This will be cut out and used as a template for the inside and rear panels, which it will be marked onto.
Making the inside panel: From the markings I will get sir to cut the inside panel out. I will cut the small hole in the centre for attaching the phone stand in a similar way to the hole in the arches. I will then laser cut the marquetry pieces, these will have been designed on 2D, and then glue these marquetry pieces to the inside panel.	Making the rear panel. From the markings I will have the rear plate cut from a piece of wood. I will then use the router's chamfer to cut the bottom edge so that it a lines with the baseplate	Template for the front and back plates: I will use 2D Design to make a template for the front and back pieces of the design. This template will have the same shape as the front and back while the slats and speaker window will be contoured by 1.5mm to fit the router.	Routing the back plate: I will clamp my template to the top of my piece of wood. I will use a router with a 3mm bit to cut the slats out of the side of the piece of wood. Once done I will mark around the outside of the template where it will be cut.	Routing the front plate: I will repeat this for the other piece and will route the speaker window out on this piece of wood.	Applying the chamfers: I will switch the routers bit out for a 45° chamfer tool. I will then use this on along the base and slatted side of both the front and back pieces. This means it will form a mitre joint with the base plate.

Joe Butterworth

Step By Step Guide of How You Are Going to Make It

Cutting the front and back plates: I will then get sir to cut the wood on the band-saw, using the lines marked when using the template.	Cutting the rebates: Then I will cut the rebate on the curved edge. I will use a rebate tool on the hand router to cut this out. It will be 6mm in and 5mm deep and shall be cut on both the front and back plates.	Cut curved piece: I will mark out the length and width of the curved piece, on 2D Design. This will have slots cut into the sides so that it can be curved. I will export this and use the laser cutter and cut it from 6mm oak MDF.	Cut slats: Like the curved piece, I will design the slats on 2D Design, and then cut them using the laser cutter. These will be the black acrylic slats that go horizontally across my design.	End pieces: To make the pieces that goes between the acrylic slats I will cut three lots of 17x10x120mm pieces of wood out. These shall then have there chamfers cut by hand using a bench saw.	Making the phone holder: The phone will be held onto the project by a piece of solid wood. This will be shaped so that it hold a normal smart phone. This piece will be shaped using the linishing machine and through the use of hand files. The filing will create a depression that a mobile phone can be held in.
Speaker Bracket: To make the bracket for the speaker I will laser cut two pieces of MDF. One of these pieces will fit into the window on the front plate, the other will screw onto the back of the front plate. The one inside the window will be sanded down with the linisher as so to give clearance for the cloth to cover the speaker.	Assembly: The separate parts will be assembled together to create the final product. I will start by gluing, with wood glue, the rear and inside panels to the baseplate along with the arches. Theses will be held together, with band clamps. In the meantime I will attach the speaker bracket and speaker to the front panel, the cloth will hold the front of the bracket in place while the back bracket will be screwed to the back of the front plate. Once dry I shall glue the front and rear plates to the arches, lining them up by using the baseplates chamfer, this will create a mitre joint. Onto these plates I shall also glue the curved piece and the end pieces. To finish the design I shall glue the phone holder on and put the acrylic slats into the gaps made for them, they should hold in place as it is a tight fit.			Finishing: I shall use a small plane to trim any joints that do not perfectly align this will make it connect together well. As it is all constructed from wood to finish it I shall sand it all with course glass paper. Once sanded I will move to a finer grit of sand paper to create a nicer finish. To make it really nice I will repeat the last process again before sealing it.	Sealing: I shall seal the design using Danish Oil. I will rub the oil into my design. I will then sand the product before adding another layer of oil. I will repeat this one last time to make sure I have a smooth finish that is completely sealed. This stops moisture in the air from deforming the wood in my project.

Joe Butterworth

Flow Chart

Start

Mark my piece of wood for the baseplate.

Cut to shape with the bandsaw.

Cut rebates into the design with a hand router.

Chamfer the edges with the hand router.

Design the shape of the arches on 2D Design.

Print shape and stick to a solid piece of wood

Cut the wood for the jig with the bandsaw.

Cut six pieces of plywood slightly larger than your arch.

Glue two lots of three sheets together.

Clamp each set of three with the jig.

Remove from jig and check they are the right shape.

Is it the right shape?

No

Yes

Mark excess on the arches with a pencil.

Cut the excess off with the bandsaw.

Are the edges smooth?

Yes

No

Smooth with a finishing plane.

Mark the shape of the arches onto card as a template.

Mark onto two pieces of wood with template.

Cut the two pieces of wood on the bandsaw.

Use the template to design the marquetry on 2D Design.

Cut the marquetry with the laser cutter.

Glue the marquetry to the inside piece.

Chamfer the rear piece with the hand router.

Make a template in 2D Design for the front and rear plates.

Laser Cut the template in acrylic.

Use hand router and template to cut the slots and the front window.

Mark the shape of the plates on the wood using the template.

Mark a contour of 4mm for the rebated section.

Cut to shape with the bandsaw.

Use the hand router to chamfer the bottom and side of each plate.

Check to see if all parts line up properly.

Do the chamfers line up to the baseplate?

Yes

No

Use a chisel to make chamfers flush with each other.

Cut the rebates using the hand router.

Turn over the panels and cut the rebates on the inner side of the plates.

Continues on next page.

Joe Butterworth

Flow Chart

Continues from previous page.

Using the linisher sand from the rebate's contour to the line stencilled from the template.

On 2D Design design the curved piece, using a slotted design on the right to create a curve.

Laser cut design in 6mm Oak MDF.

Design the shape of the slats in 2D Design.

Laser cut three of this design in 3mm black acrylic.

Mark the shape of the end pieces on a piece of wood.

Cut the chamfers using a bench saw.

Cut the slots using the bandsaw.

Laser cut speaker mount.

Sand Marquetry down till smooth.

Glue arches and front & rear panel together.

Nock pieces separate with a hammer.

Is it lined up correctly?

No

Yes

Super glue fabric to speaker mount.

Glue speaker and speaker mount to the front plate.

Glue front and rear plates into the arches.

Mount the electronics.

Glue the end pieces and curved piece onto the plates

Sand/Plane surfaces so they are flush with each other.

Sand all surfaces with a fine grit paper.

Apply a layer of Danish oil to all surfaces.

x3

Push acrylic slats in.

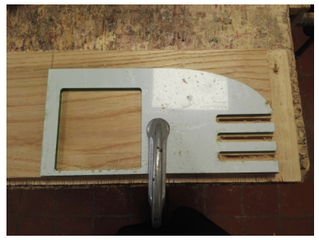
Finish

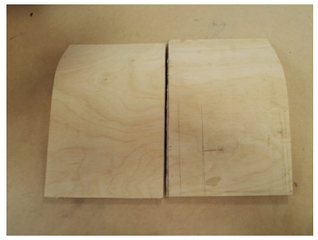
Joe Butterworth

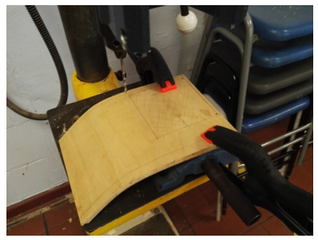
Photographic Record

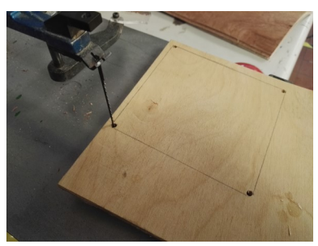









Marquetry—

To make my marquetry I grouped the Solidworks parts together and saved it as a single part. This then allowed me to save the shape as a DXF, this saved me from having to design it in 2D Design.

The DXF was then exported to the Laser cutter twice, once on oak veneer and once on birch veneer.

I then created a surface of masking tape by connecting together strips, I laid my the veneer pieces in the shape on the masking tape.

To the alternative surface I applied a layer of glue. I then put the marquetry on to the glued surface, clamping it and leaving it to dry.

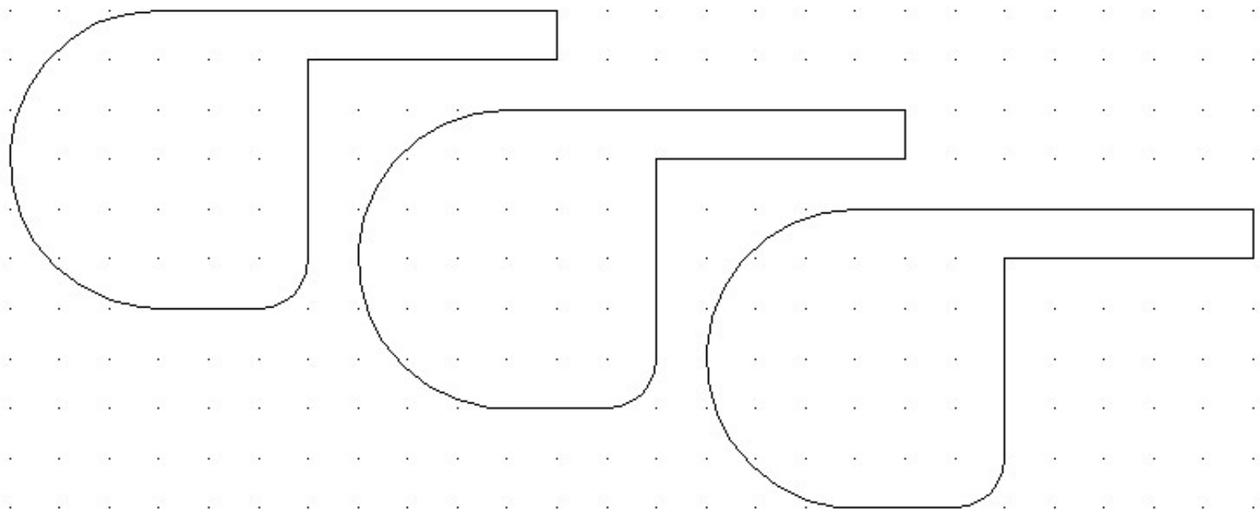
Opposite is the invert of my marquetry design. This was made from spare pieces left from cutting two sets of arches out.

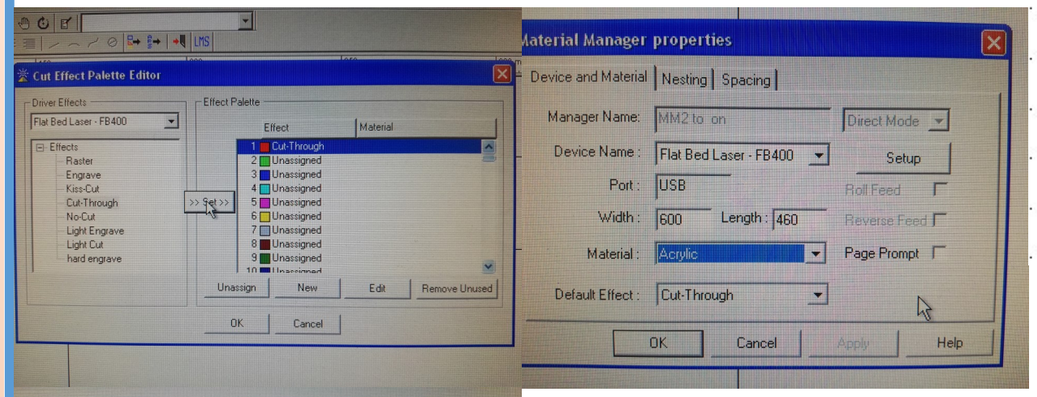
Joe Butterworth

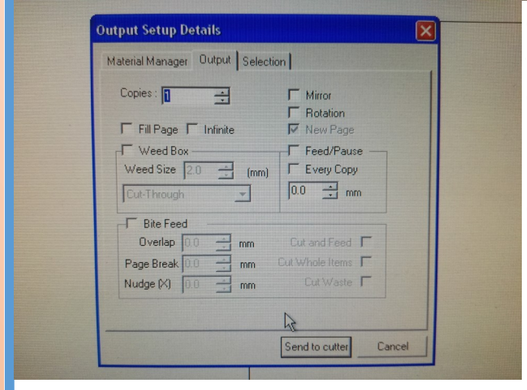
CAM Explanation

•To Laser cut the slats, I first designed them in Techsoft's 2D Design suite. This allowed be to make the unique shape needed for my phone docking station. This was then exported from 2D Design as a DXF file.

•The DXF was then loaded in another program called Ethos, the PC this was on is connected to the laser cutter. I then changed the outline of my shapes to red, this is so the laser cutter can distinguish between functions.





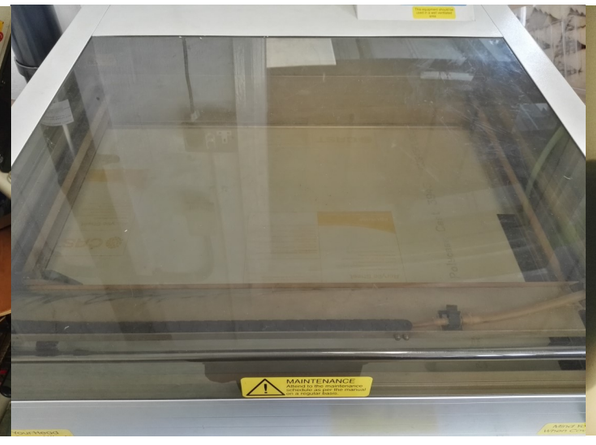


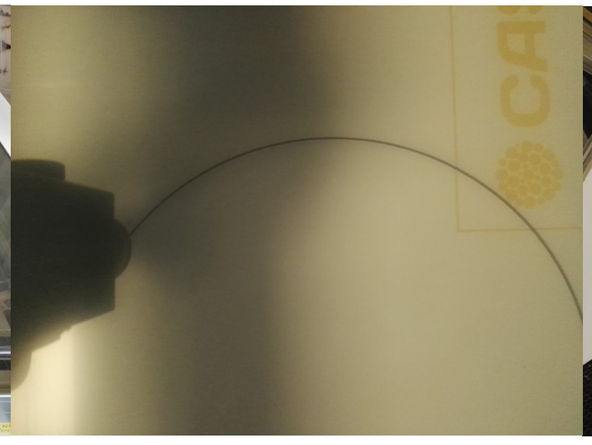
•I then had to set my output settings. First I changed red to cut through material. Then I changed the material to 3mm acrylic, so that it cuts with the right intensity as to not damage the material, while making sure it does go the whole way through.

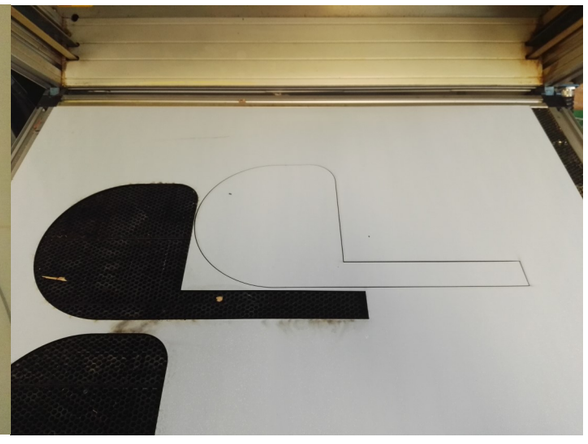
•Before cutting I had to set the media on the cutter. To do this I had to load a new sheet and set the origin and the media, these are two coordinates that tell the program where they can laser cut. I set these using the manual controls on the laser cutter, changing the x and y values of the coordinate

•Finally I exported the design to the laser cutter by using the "send to cutter" function. This had to be done a few times as it must be repeated for a change in material and was repeated for broken or incorrectly cut parts.

The same was done when making the marquetry and when making the template for routing the wooden pieces.







Joe Butterworth

Evaluation Against Specification

Specification—

- It must be a radio or a phone charging station.
- It must be in the style of Art Deco.
- It must be durable to stand normal use.
- It must be stable so it doesn't fall of the table.
- It must be battery powered.
- It must have control inputs.
- It must have an on/off switch as to not drain the battery.
- It can't be gender specific.
- It can't be offensive as it is for in house use.
- You must be able to access the battery to change it.

It must be a radio or a phone charging station—

My product is not a radio or phone charging station, so I have failed in this part of my specification. This is because as my design developed it moved from being a radio into becoming a Ipod docking station. However, this does still fit within the original design task, just not my specification.

It must be in the style of Art Deco—

I feel that my product does suite the style of Art Deco. The curves and straight lines used in the piece are common in Art Deco design. It has clear geometric shape, while still being stylised, another convention of Art Deco design. Art Deco products often combine natural and synthetic materials in there design, this too has been achieved through the use of acrylic and fabric on a wooden body.

It must be durable to stand normal use—

The product that I have made is quite strong, and I feel is durable enough to withstand normal use by the project. All the joints of glue have lots of contact with one and another making them strong enough to be frequently handled. However, the joins aren't strong enough to withstand high amounts of force, like being dropped or hit with an object.

It must be stable so it doesn't fall of a table—

The base of my project has a large area, which should make it stable as to not fall over. On top of this the weight distribution is relatively even, meaning that it isn't more likely to fall in one direction than the other, if it is over the edge of a table.

It must be battery powered, have control inputs and an on/off switch—

Unfortunately these features weren't added to my final product due to time limitations. As I was running out of time, and I am not awarded any marks for the electronics, I decided not to implement them in my final product. If had included the electronics for in my product, I would have most likely included all of these features in my project.

It can't be gender specific—

I have been successful in making my product non-gender specific. I have done this by not including any symbols that may have connotations to one gender over another. So it doesn't have the symbols of Mars or Venus. On top of this I have not used any clear gender labelling, for instance I have not made it clearly blue, for boys, or clearly pink for girls.

It can't be offensive as it is for in house use—

Similarly my product has been successful in not being offensive to people. I have achieved this by not including any offensive imagery or vulgar language. However, this doesn't stop the product from being used in an offensive manner, as I would have no control over how the speaker would be used by the customer. Ultimately, it does meet the specification as it is inoffensive in all ways that can be controlled by the designer.

You must be able to access the battery to change it—

I have not succeeded in accomplishing this. As I design on Solidworks my pieces, and throughout making it, I neglected this part of the product. This has resulted in the batteries not being able to be changed, this would have to be changed if it was made commercially.

Joe Butterworth

Client Testing

Aesthetics— My product is an Art Deco speaker. The aesthetics are in keeping with this design movement. It includes straight and curved lines, to make a visually striking shape. I also used both natural and synthetic (oak and acrylic) materials, something common to product of the Art Deco style.

Client— My product's potential customer is someone who goes to a design museum, as laid down by the design task. I think it is successful in this as it is clearly set in the Art Deco design style. This is one of the design movements I looked at and would most likely be a good product for my customers interests.

Cost— To make my product was fairly cheap as it was made from recycled materials, an old oak plant and a reclaimed speaker from an old radio. However, if more than one were to be made the materials would have to be bought. This would make the project quite expensive as oak is a highly sought after wood.

Environment— My product was made from wood which is strong and renewable. It could easily be disposed of because the wood naturally decomposes. However, the electronics within (a commercial version) would make my product e-waste, this is harder to dispose of because of the toxic materials and must be recycled properly.

Size— The docking station's maximum dimensions are 150x240x450mm. This isn't small enough to be handled often and should definitely be left on a desk. However, it is not obtrusively large, it still doesn't occupy much space and could comfortably be left on a table without taking up to much space.

Safety— The product is generally quite safe posing minimal risks to anyone using it. My product 90° edges, these could pose a danger but aren't particularly sharp. On top of this as my product is all one part, it has no choking hazard for young people who may find it.

Function— My product acts as an Ipod docking station. The Ipod will connect to it via Bluetooth. This makes the product easy to use and relevant to modern technology. It also means that other devices could connect to it and play music, this I feel makes it a more versatile product overall.

Materials— The product is made from both wood and plastic. The wood used, although expensive, is renewable and could be sustained. The acrylic used on the other hand is a type and plastic and so isn't renewable. This is made from crude oil, which has a limited amount left on earth.

Mateen Keshan

Aesthetics—	Function—
Curves add modern look. Different coloured wood makes product stand out.	Speaker made to amplify sound using Bluetooth connection.
Materials and Construction—	**Quality of Finish—**
Oak wood glued together, looks durable.	Smooth finish, sturdy structure, oak wood contrasts nicely throughout product.

Oscar Law-Jones

Aesthetics—	Function—
Looks very professional and could probably be sold right now.	Very well made and there is no echo or muffling of the sound.
Materials and Construction—	**Quality of Finish—**
Good choices of wood – not too expensive and great use of acrylic.	Very well done looks professional and has a nice finish.

Chloe Sutcliffe

Aesthetics—	Function—
Curved Piece is visually appealing. Marquetry makes it stand out.	Speaker.
Materials and Construction—	**Quality of Finish—**
The use of wood looks good.	The product looks well finished.

Natalija Woloncewicz

Aesthetics—	Function—
It looks like a lovely Art Deco church inspired speaker.	Made to amplify sound.
Materials and Construction—	**Quality of Finish—**
Oak wood looks durable, and veneer marquetry.	*No Comment.*

Joe Butterworth

Future Modifications & Commercial Manufacture

Future Modifications—

I am mostly happy with the final outcome of my project, but there are a few small modifications I would make to improve my product.

Foremost, I would include the electronics for the speaker, this had to be left out due to time restraints. To be included a solution for mounting it inside my project would have to be found. I would probably do this by mounting it to PCB pillars. The screws for these pillars could be countersunk into the back of the design, alternatively a modification t the design of the acrylic slats could be made to allow the PCB pillars to be mounted to the bottom of the slats.

On top of this I would add control buttons to my design, this would allow the user to operate the speaker manually. This I feel would be an important modification to make if I were to include the electronics to it in the future. I would do this by adding the buttons to the curved piece. The function of each button could be engraved on to the curved piece, with low profile buttons next to them. This is an elegant way of adding controls while not sacrificing the style of the design.

A battery compartment would also be needed, this should be small and accessible from the back. This would be important so that batteries could easily be changed, so the speaker works. This was in my initial design specification but was never actually made.

In terms of the case itself, it turned out very well. However, the pieces in the arch assembly do not line up perfectly, They line up well enough that it still looks good, but if it could be refined so that all the parts sit completely flush it would make my product even better.

I would also change the marquetry I used. My marquetry was made from oak and mahogany veneer, due to what the school had in stock. The oak did end up blending in; if I were to make my project again I would change the oak to a lighter coloured wood, like birch. This would add greater contrast in the marquetry and make it even more prominent.

The arches are made out of plywood, this is because it was what the school had and it was versatile. However, if I were to make the project again I would like to make these out of oak rather than plywood. This may not be strong enough to create the arches, unfortunately.

Commercial Manufacture—

If my docking station were made commercially, it would be batch produced. This would require skilled individuals to make my product. This can be more expensive as skilled labourers cost larger amounts of money. However, this would be the most efficient way to make the limited quantity of the product needed.

In batch production more moulds, jigs and templates would be used to create a quality finish to the product that is consistent between all of the docking stations produced. This would also involve rigorous quality assurance and quality control measures throughout.

In school my case, was made from many different pieces of recycled wood, some oak, some plywood and some oak veneer. If it were made commercially one material would have to be decided on and that would have to be used throughout the product, for consistency. In addition it would bring a significant increase in cost as the materials are no longer recycled but will have to intentionally be bought.

A commercially produced product would have a much tighter control on the tolerance for certain parts, this means that they will be made so that they fit together, this will also eliminate any gaps that may occur from the lower tolerance on parts in my school project.

When made commercially industrial methods will be used to make parts, this will make production easier, and faster as it will require less processes to make each of the individual components, although gluing, and finishing will still need to be done by hand.

In a commercial product it would have an accessible compartment for the batteries to go in, this would be an easy way to change the batteries if they were to run out in use, this would be an important feature as it is a common feature in consumer products that the customer would have come to expect from a product.

The Bluetooth speaker will have to be packaged before it is sold to an end customer. As it is a commercial product it will have to meet EU and UK regulations on the safety and environment impact of the product. This is an important consideration as It may require changes to the design to meet the regulations, or to make it easier to package.

Joe Butterworth