

Candidate Name: **Kai Baisley**

Candidate Number: **[REDACTED]**

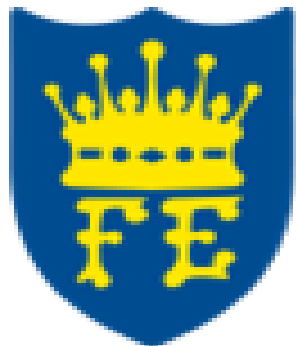
Centre Name: **Framingham Earl High School**

Centre Number: **[REDACTED]**

Course Code: **8552/C**

Course Name: **GCSE - AQA Design & Technology NEA 2025**

Contextual Challenge: **Eating Away From Home**



Framingham Earl High School

Design & Technology

Analysis of the project, ideas and client profiles

My contextual challenge:

Eating away from home

A definition of the challenge:

Eating away from home can be defined as food and meals that are created away from your house. Eating out can cover: Restaurants, camping or eating at a friend's house for just a few examples.

Picnic

Picnics require you to be able to carry the food and any other equipment like mats and plates. All of this can be rather heavy and a device that enables you to carry everything at once would be extremely useful.

Societies and clubs

when at a society or club, eating can be difficult as there may not be somewhere that you are able to eat so having somewhere to eat like a table makes this easier

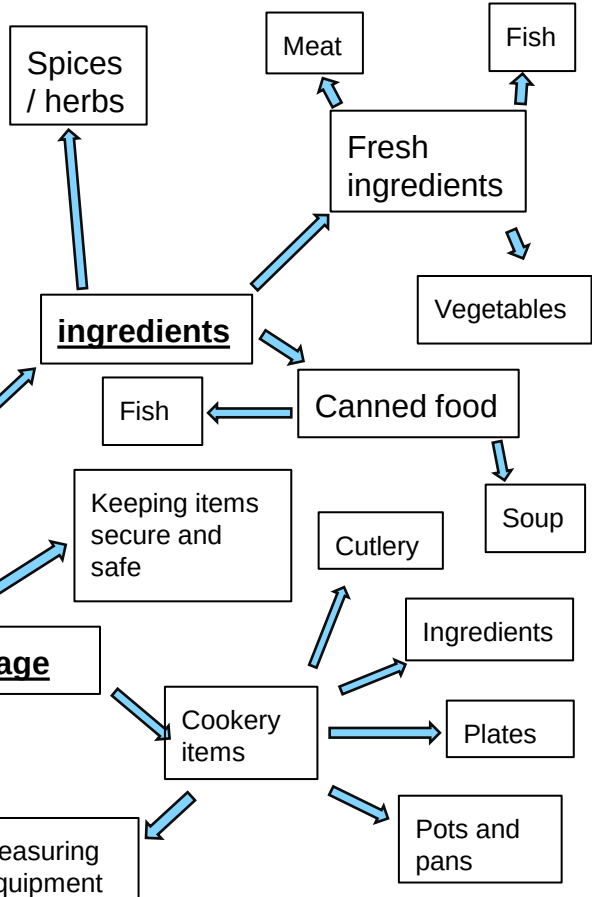
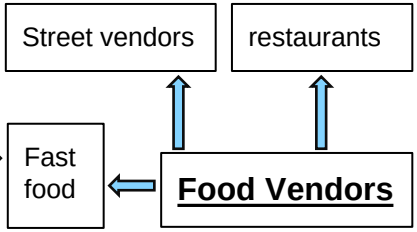
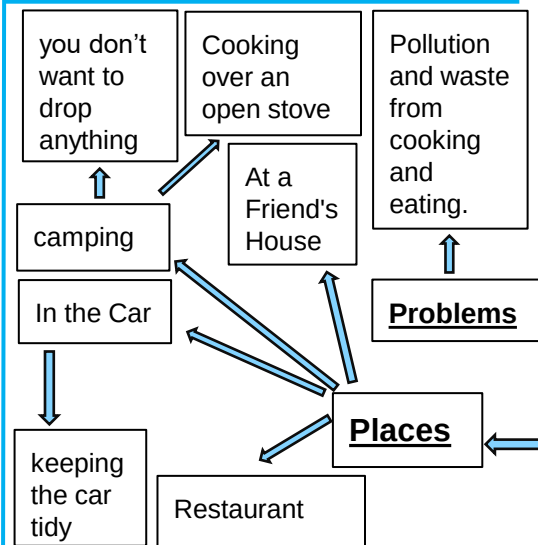
Eating in the car

Eating in the car can be messy and the cleaning afterwards may be difficult so something that keeps the car tidy or prevents you from spilling anything is essential.

Storage - the action or method of storing something for future use
Security - the state of being free from danger or threat

Reasons why people eat out frequently include:

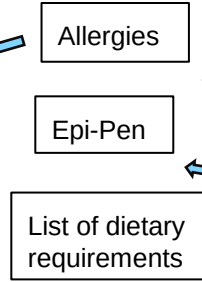
- Convenience: People find it easier and less time-consuming than cooking at home.
- Socialization: Dining out provides an opportunity to socialize with friends and family.
- Food variety: Restaurants offer a wider range of food choices.
- Less mess and clean up: Eating out means less cooking and cleaning at home.
- Cost: Despite higher prices, some people prefer the convenience of dining out.



Eating at a restaurant

For eating at a restaurant, staff need to know allergen information of people with allergies. This means that Staff are aware, and that the person won't have an allergic reaction.

If someone with an allergy eats something they shouldn't, they could have an allergic reaction which for some people can be life threatening.



Client Profile

My client is called Paul, he is a family member, he enjoys the outdoors and being in nature. He is a nature enthusiast who spends his weekend at nature reserves and working in the garden. He previously went on an expedition to Svalbard and has gone round many countries all over the world for nature. In his day job, he works as a full-time dentist but occasionally volunteers his time at nature reserves during the weekend. He often camps and sometimes takes his family along.



Six Potential Project Ideas

Camping

When camping, you live off what food you take with you. This includes long lasting food, food with short dates, equipment used like stoves and cutlery. This needs to be stored efficiently.

Client Project Idea Evaluation

After speaking to my client, they have chosen project 5 and a couple of key design specifications to accompany this:

- The product must be able to fit everything that he requires for a camping trip.
- The product should be able to be big enough to cook for his family and have a space for storage while cooking over an open fire like a BBQ.

Eating at a friend's house

While out at a friend's house, you may want to take certain things with you. For this, you will need storage which has to be small in order to be carried.

Client Questions And Things To Improve

- | Question | Answer |
|--|---|
| - What are the main problems with carrying equipment when camping? | It is hard to take large objects because they weigh lots. |
| - How much room do you reserve for food and cookery equipment when preparing for camping? | I reserve enough to get me through the time I will be camping. |
| - How do you camp, is it wild camping with a backpack or camping in a camper van? | Generally a camper van with my family. |
| - What are some essential cookery items that you take to every camping trip? | Food, plates, cookery utensils. |
| - Do you take fresh food or items that can last a long time? | Fresh if I am with my family but long lasting if I am on my own. |
| - Are there any problems with spilling food in your equipment bag, e.g. crumbs going everywhere or liquids spilling? | Yes, if it spills it is hard to clean up, so a better stronger storage would be better. |

What things would need to be stored?

What is the essential camping equipment / food that needs to be taken?

Sizes of objects used in camping (cutlery, plates, cups, E.T.C)

Possible size of the finished product so that the client knows whether it fits.

Existing products which would link to the project I am doing.



Design & Technology

Summary

Next, I will complete research on the things I have identified that should be researched. I will also take into consideration what my client has stated and take the project they have chosen. I will research existing products and make notes about how they work well, giving an evaluation about them. I will use my client's questions and take them into consideration for designing the product. I will use my project idea and client feedback to produce a rough idea for the product and ask my client what their views on it are.

Dimensions of items stored inside

The items stored inside would be:

- Camp Stove
- Fuel
- Cooking Utensils / cutlery
- Food
- plates
- Water Container
- Cleaning equipment

Fuel

- Trangia fuel bottle
- capacity: 1000ml
- weight: 160g
- height: 285mm
- diameter: 78mm



Camp stove

- Name: Coleman performance C500
- Diameter: 110mm
- Height: 215mm
- Weight (with some fuel): 665g
- Fuel: butane / propane mixture



Cooking pots

- Name: Lifeventure cook set 14
- Set can be stored in a small bag.
- Formed of 2 pots, 2 lids, 1 handle
- Diameter: 180mm
- Weight: 715g



Plates/ bowls/ cups

- Plates / bowls:
 - 4 of each
 - weight: 600g
 - Dimensions (stacked): 260mm x 120mm
- cups:
 - dimensions: 120mm x 90mm
 - weight: 148g



cutlery/ utensils

- cutlery:
 - one family set in a container
 - weight: 760g
 - dimensions: 170mm x 190mm x 230mm
- Utensils:
 - Weight: 170g
 - length: both around 370mm



Water container

- large water container for multiple people with tap
- length: 240mm
- width: 280mm (incl. Tap)
- height: 240mm
- Weight: 250g



Cleaning equipment

- Formed of soap & a sponge
- Soap:
 - liquid: 200ml
 - bottle: 140mm tall
- Sponge:
 - length: 140mm
 - weight: 45g



Product Analysis – Gas Camping Stove

Form - The product is rectangular in shape. It is compact so can be carried easily and stored efficiently. It has a handle so that it can be carried about easily.

Function - The product is made so that you can cook while camping and so that you don't have to take any large cooking product with you.

User requirements – The product must be small and lightweight so that it can be carried easily and stored in a small space, so that it is easy to take for camping.

Performance requirements – The product must burn at a high enough temperature to cook (e.g. 200c) for a period of time.

Production processes – plastic / injection molding for the case
- Metal parts made from folding and welding

of a single metal sheet

Materials – metal – possibly steel or iron

- plastic – possibly ABS or Polypropylene

Sizes – case open: 620mm x 360mm x 50mm

- case closed: 300mm x 360mm x 100mm

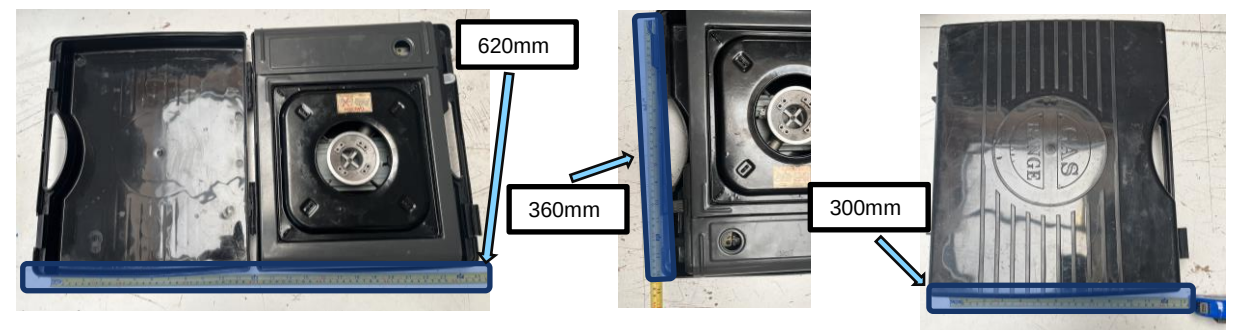
Cost – around £20

Finishes – metal – painted or powder coated

- plastic – black gloss

Social, Economic & Sustainability – the product burns fossil fuel, creating CO₂, which enhances the greenhouse effect, adding to climate change. The product is relatively inexpensive so shouldn't affect people too much. The plastic the case is made from may not be recyclable.

Evaluation – The product is great for its size and capability to be transported; however the product creates CO₂, which is negative for the environment, it could also be improved if the product was created from recycled materials, creating a new use for unused products. The case could also be improved if it was created from a sustainable material.



Yoke Outdoors

Company overview –

yoke outdoors is a company which specializes in camping kit, specifically making camp kitchens. They have been running for over 15 years and they are an American company, making sure they are all manufactured locally.

Their values/ promises –

The company makes all products within their family-owned manufacturing facility.

All of their products come with a lifetime guarantee so if any part gets damaged, they will make sure to replace the broken piece free of charge.

Durability -

Yoke Outdoors like many companies wants their products to last so they make their products from a polymer powder, this gets heated up and rotated until the polymer has melted, this is called rotational-molding. This creates a seamless product, making it exceptionally durable as objects like handles are created at the same time, giving it a stronger bod with the rest of the product.

The company are so confident with their product that they give a lifetime guarantee so that if your product does break, you get it fixed free of charge

Styling -

The company create products which appear military like, in green and black. This makes it feel high tech and makes you feel as though you are on a mission.

Example -

This is the Chuck Box Camp Kitchen; this product is their most well-known product and comes in black or green and is designed to make camping cookery easier.



Conclusion -

The styling and manufacturing of Yoke Outdoors' products makes these pieces lightweight and compact, creating space for you to pack. This means that you can have all of your cookery items withing one place, making cookery easier. Their price is quite high; however, their products are manufactured in a family-owned facility, and therefor I will be taking some of their ideas to implement into the product for my client.

Designers

BioLite

Company overview –

BioLite is a company which creates renewable energy products that can be used for multiple purposes, they are delivering products to people in places that go without energy so they can keep people safe, productive and connected.

Their vision –

The company's vision is to provide 20 million people with access to clean energy and avoid 3 million tons of CO2 by the year 2025. So far, they have reached over 8 million people in Africa and Asia, changing these people's lives so that they can stay connected and have an all-round better life.

sustainability -

All of BioLite's products are designed with sustainability in mind. Many of BioLite's products produce zero to almost no CO2. Many of their products are solar powered so produce no CO2. Some of their products use fire, which produces CO2, but the fire is generally used for more than just cooking, for example on the CampStove 2+, it uses the thermal energy for power, and you can also use it for heat and to cook on top.

Styling -

Each product is designed to have a metal finish with some bright plastic additions so that each product is recognizable. In addition, each product looks high end and is likely to be made with high quality parts.

Example -

This is the CampStove 2+ and this is possibly their most well-known product. This product is designed to be multipurpose and can be used as a campfire, stove and a charger. It uses the thermal energy and turns It into electricity for multiple uses. It is made from a high-quality metal, possibly aluminum or steel, with rivets holding it together.



Conclusion -

The company produces products intended to help people when camping or living with no power, they help people all over the world in getting electricity. They have so far reached over 8 million people in Asia and Africa. The products incorporate many things into a small space so that you can get the maximum use out of one source, for example using fire for heat, electricity and cooking.

Product Ideas

After speaking with my client, we have come up with some ideas for the product, this makes the design stage easier so that I can incorporate his ideas into the design he has requested.

First, my client has requested that the BBQ is in the theme of a train, with the BBQ being a boiler of a locomotive.

Secondly, my client has said that the product must be large enough to cook a family meal on it while he is out with his family.

Next, my client has requested that the BBQ uses charcoal as a fuel, as it is easy to take with you and isn't as flammable as gas.

My client has also requested that the product is lightweight, this enables him to be able to carry it on his own.

In addition, my client wants a way that is easy to remove ash from the bottom of the BBQ as this can often be hard to do.

Finally, the product must be safe, so the client has requested a thermometer is fitted and a safety instruction sheet is provided for incidents.



SMSC Issues

Accessible for everyone –

The product must be able to be able to be transported by anyone, this means that people with disabilities must be considered. For this, the product must be lightweight and able to be placed at any height. The product could either have stands that extend so that anyone can access the product, or the product could be made small enough to go on a counter that the user can reach.

Using environmentally friendly materials –

The material used must be taken into consideration as the environment is becoming a more pressing issue every day. Having sustainable materials such as wood harvested from a sustainable forest or recycled plastic means that in producing it, you are not contributing to pollution and climate change. Using recycled materials means that I can play my part, and I am in turn not contributing to waste.

Ethically produced materials –

Using ethically produced materials means that all workers used in the making of the materials have their rights followed and get a fair pay for what they produce. This means that I know the workers are getting fair pay and it is morally correct so that everyone who was involved in the making of materials is equal and they can make a living from what they manufacture.

Awareness of culture –

In some cultures, some colours, numbers and words can be seen as offensive. I will take this into consideration so that it is inclusive for all. This means that the product can be more widely used, and anyone can use it. For instance, orange can have many different meanings in many countries. In many western cultures, orange is associated with fun. In the Netherlands, it is seen as wealth and represents the Dutch Royal family. In many middle eastern countries such as Egypt, orange is associated with mourning. In Japanese and Chinese cultures, orange signifies courage, happiness, love and good health. Orange is also seen as a sign of strength and bravery in Ukraine.

Disposal of the product –

The product must be reuseable as it means that the product should be sturdy and strong. This makes it high quality and an overall strong product. The product shouldn't be designed to be thrown away as this makes it negative for the environment. This means that it isn't contributing to world pollution as it won't be thrown away. If it is made of wood, it could have a protective varnish so that if it is put in the rain, it doesn't rot. If the product does need to be disposed of, it should be recyclable so that the materials can be used again, and the disposal doesn't contribute to climate change or world pollution.

Other research

What material would be best for the product?

The product could be made of a wood as they are much easier to work with than plastics. I could use a manufactured board such as MDF and cover it with a veneer so that it has a nice-looking finish or use solid wood as it has a natural look. The BBQ itself could be made of a weather resistant metal that doesn't rust, this means that it can't be made of a ferrous metal such as steel, if it was, it would have to be painted or have a coating to prevent rusting.

How could the product be supported?

The main shelves could extend all the way to the floor and have some feet on the bottom to keep it off the floor and away from mud or water. This means that the wood of the product won't get damaged or rust. The BBQ could be held up by either shelves or be stand-alone so you can have it on its own without using the shelves on the side.

How can the product be sustainable?

The product could be made of materials that have been sourced from places such as a forest that make sure to replant trees after others have been cut down. This means that we can be sure no habitat is destroyed for wildlife, and we aren't contributing to the world loss of forest. The metal parts can be sourced from recycled metal so that we can reuse a product that was once loved, this stops it from going to landfill and contributing to pollution.

What finishes will the product have?

The BBQ part of the product will be finished with a rustic metal look or paint, this means that it looks nice while being weather resistant. This means that if left out and it rains, the product isn't damaged. The wooden parts of the product can be finished with a protective clear coat or varnish that protects it from the elements while also giving it a pleasant aesthetic. Overall, this provides the product with great weather protection while also keeping its nice appearance.

What products will inspire this?

Products such as outdoor and camping BBQs and cook tops will inspire this, this means it can be carried while being taken with you.



My Client's Car Boot Finding the size my product can be.

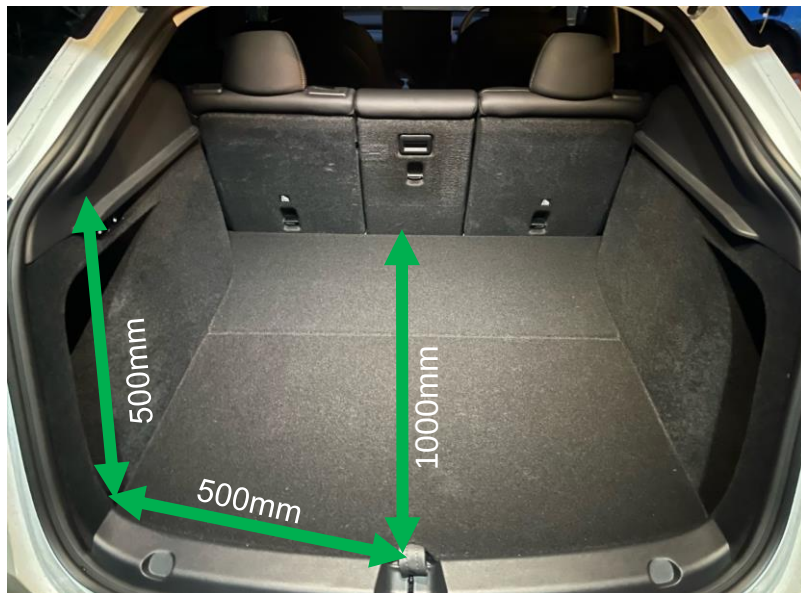
My client requires the product to be of a certain size so that he can easily take it away on holiday or on a camping trip.

This means that he wants half of the boot or less to be taken up by the product. He is therefore limited to a space of:

- Length: 1000mm
- Width: 500mm
- Height: 500mm

Below, you can see his car boot. The maximum area he wants to use is outlined and this gives me an indication of the maximum size of the product.

I will then take these sizes into consideration to make a product that will fit into the boot with ease.

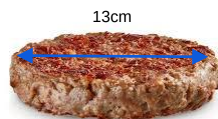


Average Sizes Of Objects Cooked On A BBQ.

To find a suitable size of grill for my client's BBQ, I need to find the average sizes of some foods, for example a burger, hotdog and chicken breast. This lets me work out how big my grill should be for 4 people.

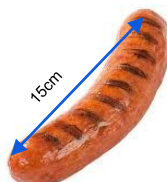
Burger

Average size
13cm (diameter)



Sausage

Average size
15cm (length)



Chicken Breast

Average size
15cm (length),
7.5cm (width)



Plasma Cutting, Templates & Mig Welding

Plasma Cutting

The best way to cut the sheet metal will be plasma cutting. This can be used to follow a line and easily cut through the metal.

Plasma cutting is a thermal cutting method that uses compressed air or other gases, such as nitrogen. Ionization of these gases takes place to create plasma.

the compressed gases come into contact with the electrode and then ionise to create more pressure. When the pressure builds up, a stream of plasma is pushed towards the cutting head.

The cutting tip constricts the flow to create a stream of plasma. This is then subjected to the workpiece. As plasma is electrically conductive, the workpiece is connected to the ground through the cutting table.

As the plasma arc contacts the metal, its high temperature melts it. At the same time, the high-speed gases blow away the molten metal.



Templates

I will use templates to outline the shapes. These templates will be made of cardboard, which is laser cut so that it is a precise shape. These templates will be designed on CAD and then created.

The templates can be lined out onto the metal, where they can be drawn around to mark out where cutting needs to take place.

Mig Welding

Mig welding stands for: Metal Inert Gas welding. This welding is an arc welding process that uses a continuous solid wire electrode heated and fed into the weld pool from a welding gun. The two base materials are melted together forming a join. The gun feeds a shielding gas alongside the electrode helping protect the weld pool from airborne contaminants.



Key	Specification point	Justification	Measurability / Tested
	Function – - The product is intended to provide a place that a family can cook while out of the house, e.g. a camp site. - The product is also intended to store all of the products needed for eating away.	After speaking to my client, they have said that they find it hard to cook meals for people when out and about because they have nowhere big enough to cook more than one meal. Keeping all the equipment and ingredients is hard as you often have to take lots with you, so you need enough storage to hold everything you need.	I will test how well my product functions during the evaluation and testing stage. This will ensure that the product works as intended. I will test the BBQ to see how much it can cook.
	User Requirements – - The product must be able to cook more than one meal at a time. - The product must be lightweight so that it can be carried with you when out of the house. - The product must have a nice finish.	Cooking more than one meal is essential for a family and this need to be able to be done so that they can all eat at one time. This means it must be around 400mm x 200mm Carrying everything with you while out and about can be difficult alone, so it needs to be lightweight so that it can be carried.	I will measure the approximate sizes of many BBQs to find out what the suitable sizes are. I will find out what an appropriate weight is and make sure that my product can easily be carried.
	Performance Requirements – - The product must hold a high enough temperature to properly cook. - The product must be able to hold all the items needed to cook while out and about. - The client must be able to carry it.	Holding a high enough temperature is essential because when you cook something, it must be done at a correct temperature so that it cooks properly and so that no one gets food poisoning or ill from the food. The product must weigh no more than 15kg otherwise my client would be unable to carry it.	I will test the BBQ and use a thermometer to make sure that it reaches a high enough temperature to cook a meal.
	Form & Size – - The product will be formed of a BBQ and legs to support it. - The BBQ part will have a train design as requested by my client.	The BBQ part is essential so that you can cook food while out and about. This means that you have a place to cook wherever you are, e.g. the campsite. The train design gives it a nice aesthetic that my client will like, and it will look appealing and interesting to all people.	I will find out whether I can cook a meal on the BBQ during the testing stage so that I can be sure it is suitable for a family.
	Manufacturing Processes – - The BBQ will be made using welding of metal sheets. - The shelves can be made using a hand saw with intricate parts being designed on CAD and manufactured with a laser cutter.	The use of welding has to be done so that all the metal pieces stay together, and this provides a strong joint so that no smoke will escape out of the wrong place. Smaller parts are easier to make with CAD as this makes sure all the parts are made at the right size and made with no mistakes.	I will test all the welding joints with something like a liquid to check that they are all secure and don't leak, this means that the product is safe to use.
	Materials – - The BBQ part of the product can be made of metal sheets, perhaps steel but with a weather coating. - The shelves can be made of wood, perhaps oak with a varnish to protect it from the weather. Intricate parts could be made of MDF.	The BBQ must be made of metal so that it doesn't melt at the high temperatures. It also gives it a rustic aesthetic, which my client will like. Using wood for the shelves will keep the weight lower, this means it can be carried easily.	I will find out what temperature different foods are cooked at on a BBQ, I will then choose a metal that melts at a higher temperature so that it doesn't melt when heated. I will look at the cost of wood to determine what would be most sensible.
	Sustainability – - the materials could be sourced from recycled parts, e.g. recycled metal or manufactured boards made from offcuts. - We can use energy efficient manufacturing methods.	Using recycled parts makes sure we are doing our part for the environment and reducing the amount of CO2 released into the atmosphere from the deforestation. Using efficient energy methods makes sure we are saving power that could be used for other processes and reducing our CO2 output.	I will see what manufacturing methods use the least energy so that I can make sure I am not harming the environment by making the product. I will then use these methods to make sure that I am using the most efficient methods.
	Social / Moral / Economic – - Consideration of price to make sure that it doesn't cost too much for some people. - We can also have a colour scheme which is appropriate for all cultures.	The product must be available for all people, I need to ensure that the product is a sensible price so that the product is available for a wider audience. Using an appropriate colour scheme is essential because it widens our consumer audience so that more people can buy it.	I will add up all the prices of all the materials and working hours to see what a sensible price would be for the final product. Colour schemes such as orange can signify good health in some cultures but other things in other cultures.

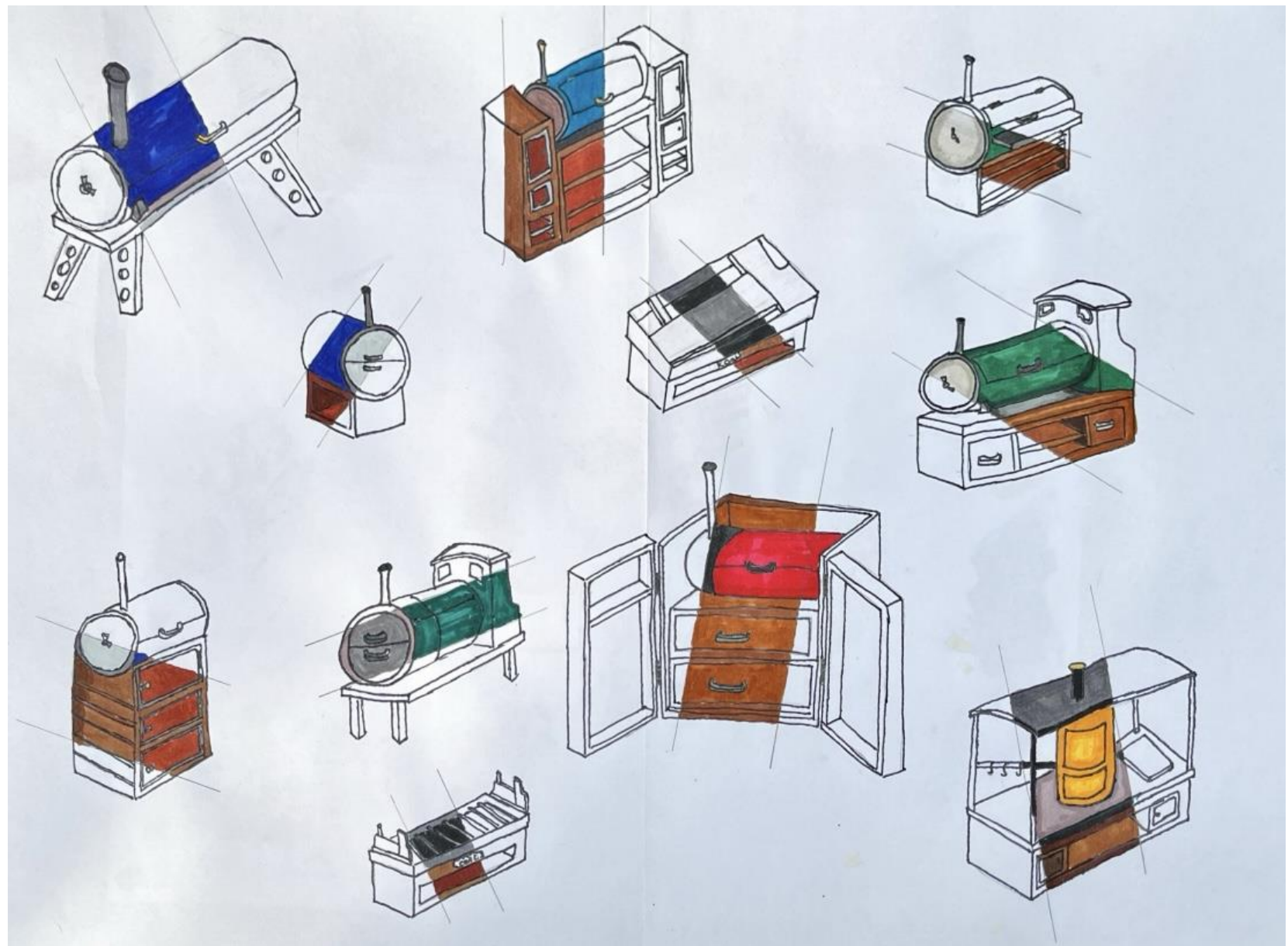
Design Brief

- I am going to design a solution to the problem for eating way from home while on a trip, e.g. while camping.
- The product will be designed for families and individuals who enjoy camping and want an easy way to cook a meal that can be made over an open fire as making meals while camping can be difficult so this BBQ would make it much easier.
- - What are the issues?
- At the moment, my client finds it hard to make meals while camping as other product are too small or too big to take along.
- - What must the product have?
- The product must be lightweight in order for the client to be able to carry it around with him. This means it needs to be made of light materials and be small in size, so that he can carry it on his own.
- The product must be weather resistant as it will be often kept outside. This means it must not rust or oxidise.
- The product should be made of recycled materials so that we can reduce the amount of waste created from manufacturing. Using recycled materials reduces the carbon footprint.
- The product must be made durable and of good quality so that it lasts longer for my client.
- The product's cooking surface must be around 400mm x 200mm so that a family's meal can be cooked easily.
- The product must be around 40kg maximum so that my client can easily lift the product and move it around.

Summary

Over this and the last slide, I have completed section B of my project. This has been writing a specification, in which I considered function, user requirements, performance requirements, form, manufacturing processes, finishes, components, materials, sustainability and finally social, moral and economic impacts of the project.

On this slide, I have written a design brief which developed points from the specification into more ideas. This has helped me prepare to start the design section of the project, as I know what is required in my product and what my client wants and requires from the product.



Summary (This Page)

Above this text, is my plan for my initial ideas of my project that I have been brainstorming. I have used isometric and 3D drawings, which have been fine lined and rendered.

I considered various designs and options for each of my ideas. My client has requested a train theme for the product so I have made each design in the shape of a train.

Creating this design sheet has given me a greater understanding of what the final product should aim to look like and this sheet will give me ideas and a base for what the next designs should be.

After speaking to my client he has picked 3 designs that he would like to bring on that fitted his wants and needs.

Summary (Next Pages)

On the next 3 slides, I will continue section 3 of my project, creating in-depth design sheets for the 3 designs that my client requested to bring forward.

On these design sheets I will create more detailed versions of the initial ideas which show how the final product will look, what size it will be and how parts will be manufactured and joined together.

I will also use 2D CAD software to create some online models along with some made out of card.

Annotations will be added to each design and these will be colour coded to match my specification. This helps me gauge how well each design meets the specification and design brief and confirms for the client that it has what they require. I will present these designs to my client and include his feedback on each slide.



This design is made so that it is in a box, meaning it can be put away easily. It is designed like this because it is easy to carry and transport.

This design follows all the SMSC issues I have identified, meaning it is available to everyone and doesn't do much harm.

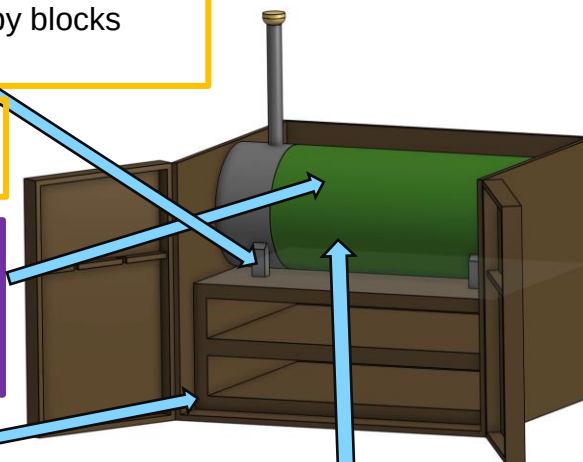
This design will be 600mm long and 400mm wide. It will be 500mm tall. This means my client can easily carry it and it fits into the boot of his car easily.

Design 1

The boiler will be supported by blocks either side to hold it in place

The boiler will not touch the wooden ends. This means they cannot get burnt.

the cooking surface will be made of steel. This means that it is able to conduct heat so it can be used as a BBQ.



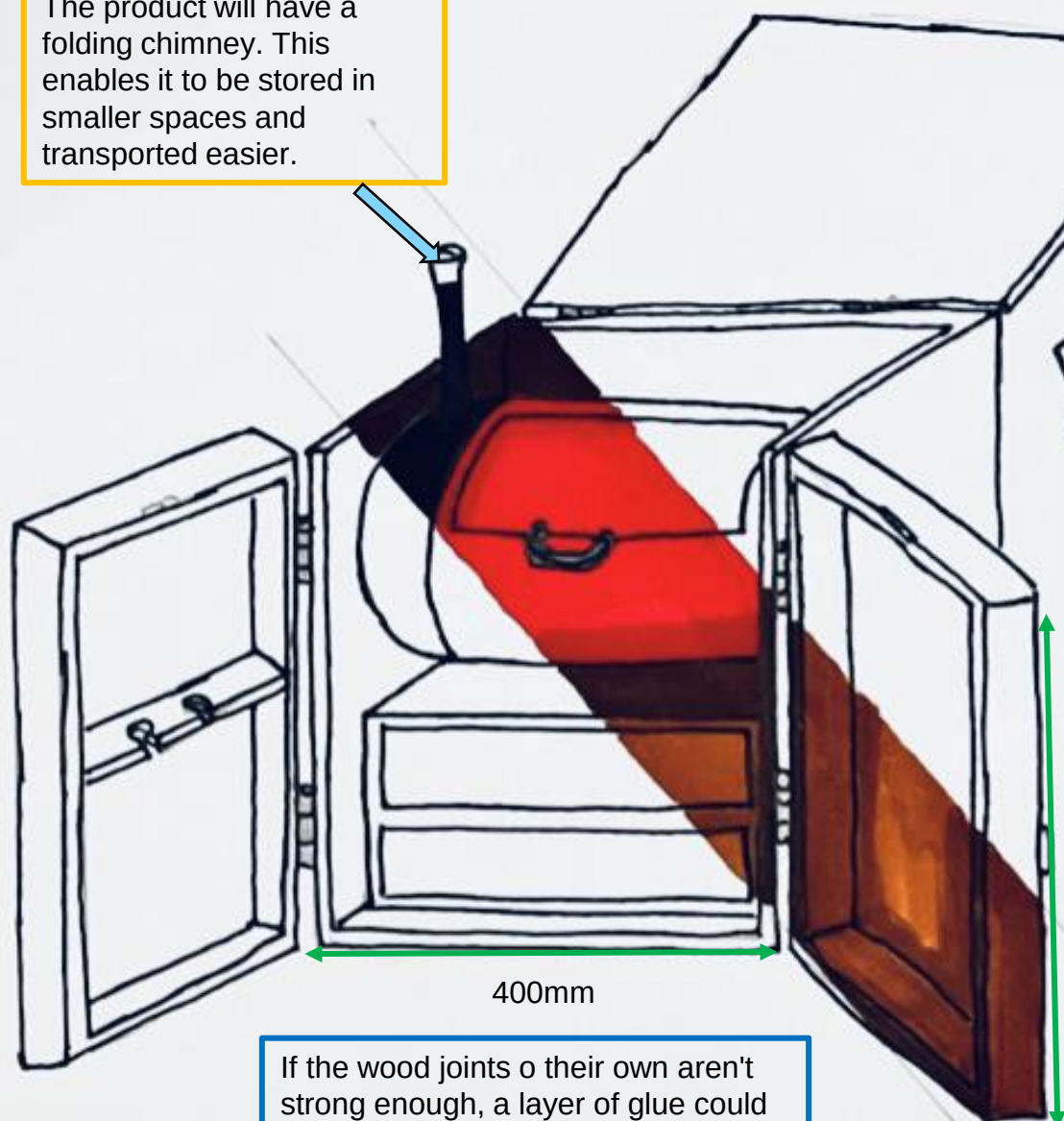
the panels will be made of wood, mostly ply and then varnished to make them weather resistant.

The product will have shelves so that the client has somewhere to store utensils and cooking supplies. This means that he doesn't have to store them somewhere else.

the metal parts will be painted. This gives it a nice aesthetic as the client asked. It will also make sure it is protected from any weather.

the metal components of the product will be joined using welding. This provides an extremely strong bond between parts.

The product will have a folding chimney. This enables it to be stored in smaller spaces and transported easier.



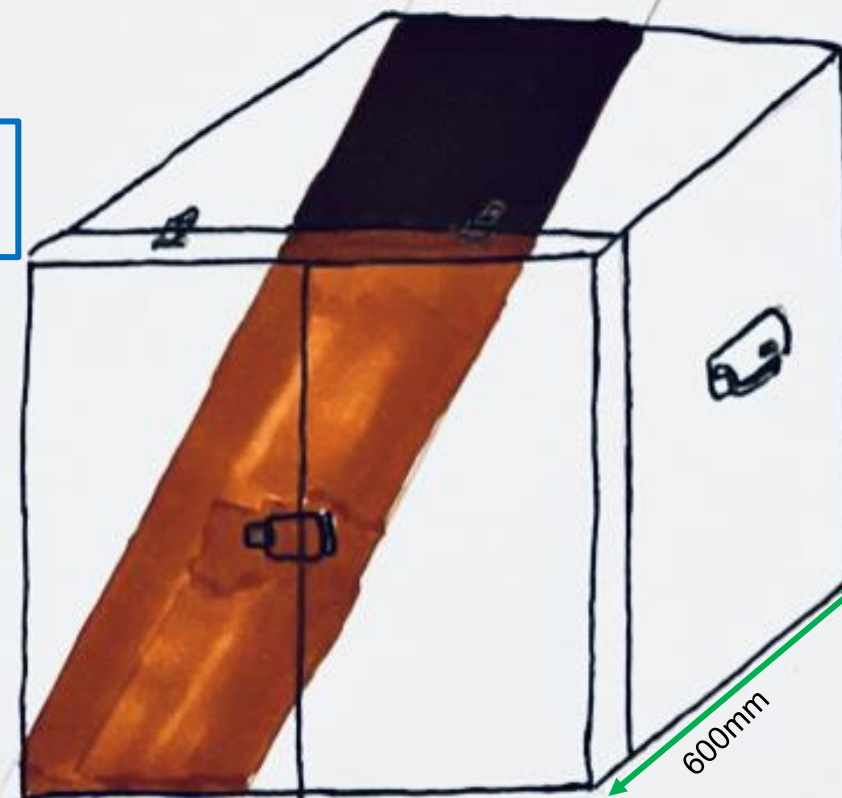
the wood will be joined together using dowel joints. This makes it strongly bonded and it will hold well.

The product will be made of large pieces of square and rectangular pieces of wood. This means they can be made easily without the production of much waste.

Client feedback:

My client says he likes this idea as it creates a fold away design, which is easy to carry. He says he doesn't need the amount of storage as he already has places to keep other parts like food and plates.

If the wood joints of their own aren't strong enough, a layer of glue could be put on, strengthening the join.

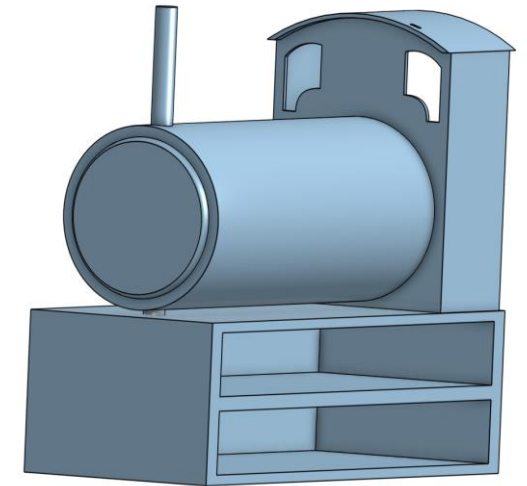


This design is made to look exactly like a train. It has a boiler to cook the food in and a cab where you can store your utensils. It also has shelves and cupboards so that you can store items inside.

Design 2

these will be varnished to provide waterproofing and weather protection.

the cab will be used as a store for utensils. This means they can be easily accessed. The cab will have hooks for these to be held on.



This design follows all the SMSC issues that have been identified and these will be recognized in the design so that they are followed.

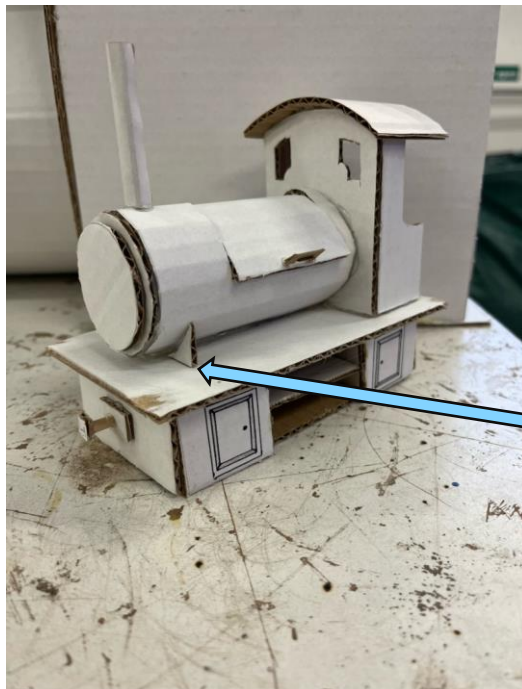
the shelves and cupboards will be made of wood. This is lighter than metal so brings down the weight compared to metal shelves

the metal components of the product will be joined using welding. This provides an extremely strong bond between parts.

The product's chimney will be used as an exhaust, this gives it the appearance that it is a train and it also gives the BBQ a place for smoke to come out.

the wood will be joined together using miter joints. This creates a strong plane to join together and this will be glued with wood glue to keep the parts together.

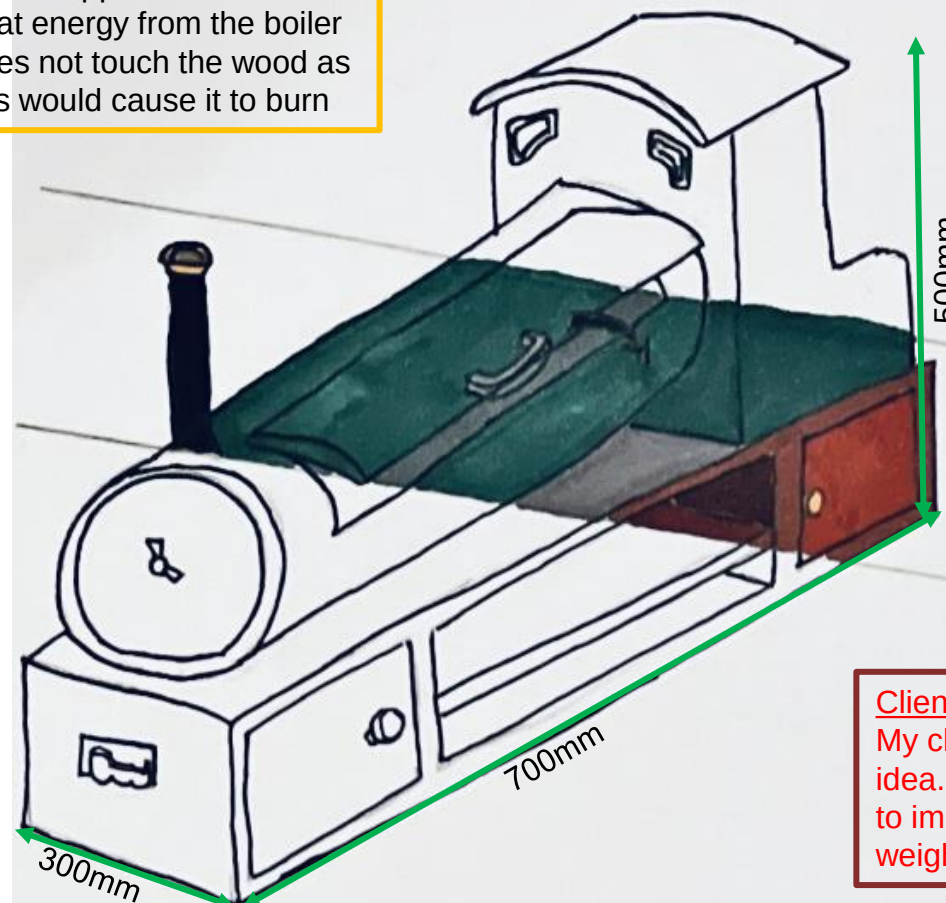
The metal parts can be cut with tessellation, meaning that we create minimal amounts of waste.



The boiler will be held off of the wooden base by some metal supports so that the heat energy from the boiler does not touch the wood as this would cause it to burn

The product will have shelves and cupboards. This provides a space to keep food, fuel, cutlery and plates/ bowls.

This design will be 700mm long and 300mm deep. It will be 500mm tall. This means my client can easily carry it and it fits into the boot of his car easily.



The metal parts of the BBQ will be protected with paint. This means it is protected from the weather and it also gives it a nice aesthetic.

Client feedback:
My client says he really likes this idea. He has some ideas of how to improve as he believes it may weigh too much.



This design is made to be simplistic and very portable. This design will be smaller and weigh less. It has an outline of a train in the background.

Design 3

This design follows all the SMSC issues that have been identified and these will be recognized in the design so that they are followed.

All parts of this design are going to be made with mild steel. This means that we don't have to worry about the transfer of heat to metal on the product. The sheets will be 1mm thick

The grate will be held up by a bar welded underneath. This supports all the grate pieces to hold them up.

The product's use of a grill means that the product can use charcoal as a fuel, as stated by my client.

the components of the product will be joined using welding. This provides an extremely strong bond between parts.

The back metal component, which is in the shape of a train will be painted in the color scheme that my client will choose, this protects it from the elements and prevents corrosion.

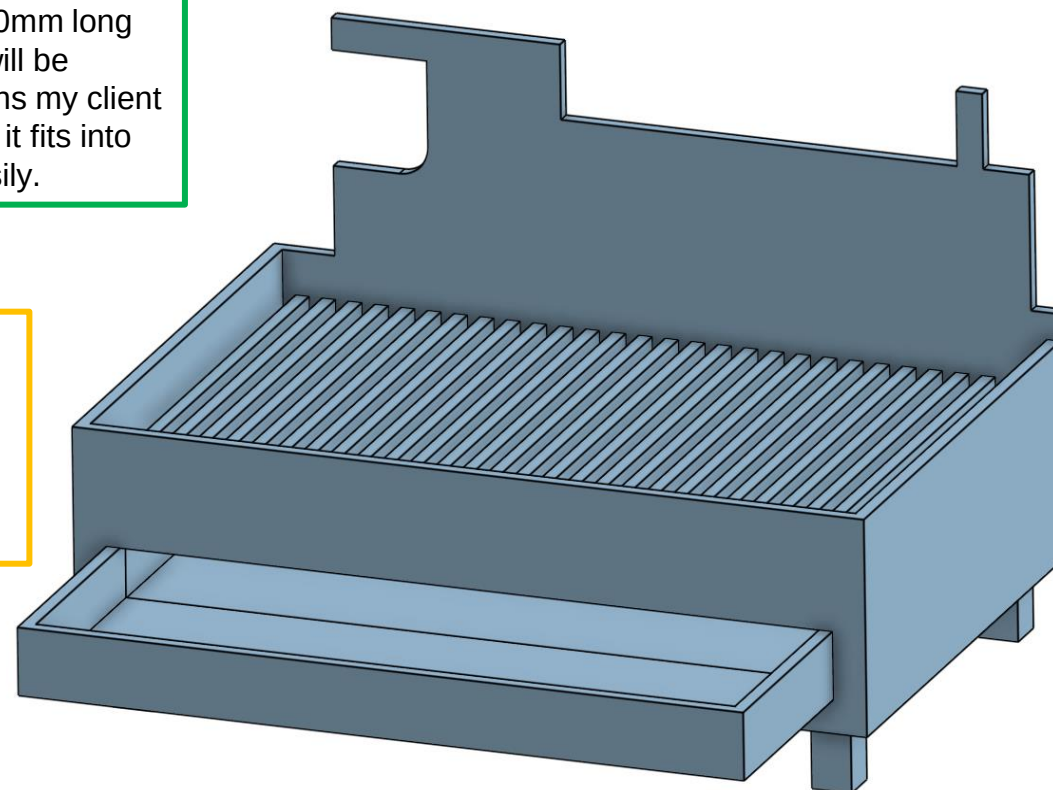
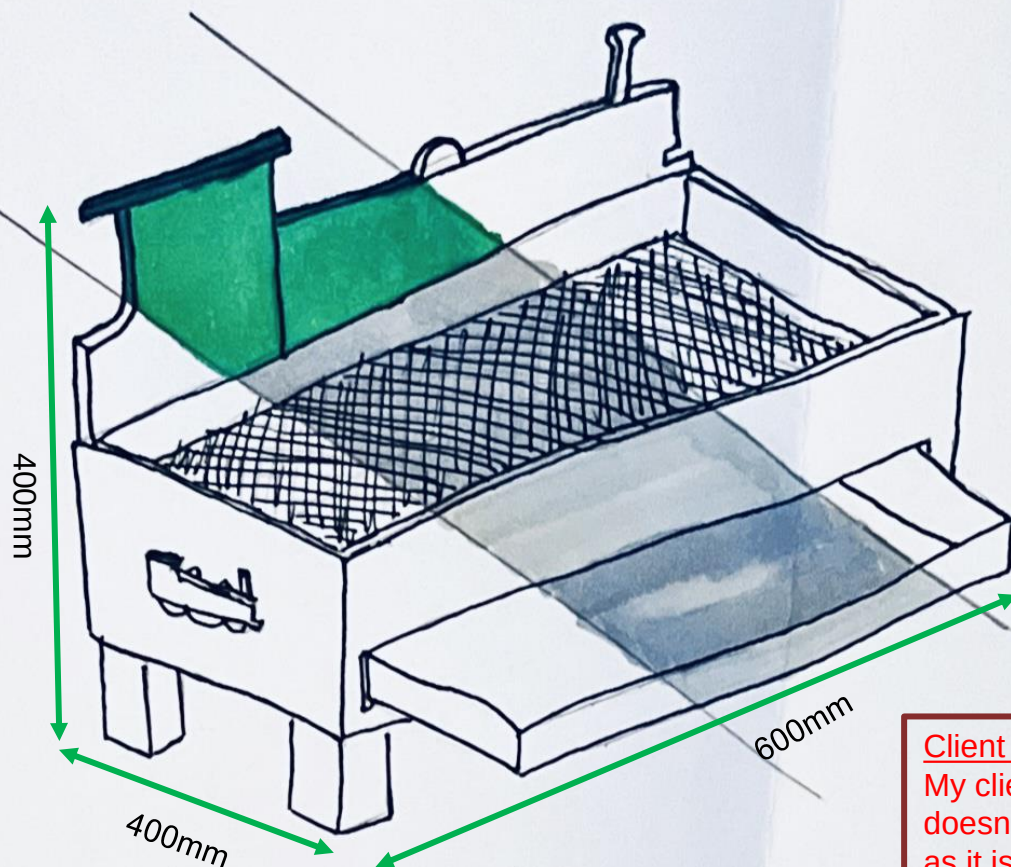
The steel parts can be cut with tessellation in mind, meaning that we create minimal amounts of waste. most parts are a regular rectangle shape, meaning they are easy to cut without creating too much waste.

The grill has a compartment where used charcoal will fall into. This collects the ash created and then the draw is opened so that the ash can be discarded easily.

This design will be 600mm long and 400mm deep. It will be 400mm tall. This means my client can easily carry it and it fits into the boot of his car easily.

the product will be mounted on legs. This protects it from any water on the ground.

Client feedback:
My client says that he doesn't really like this idea as it is only an outline. He would rather have a BBQ that looks like a train boiler.



Development plan

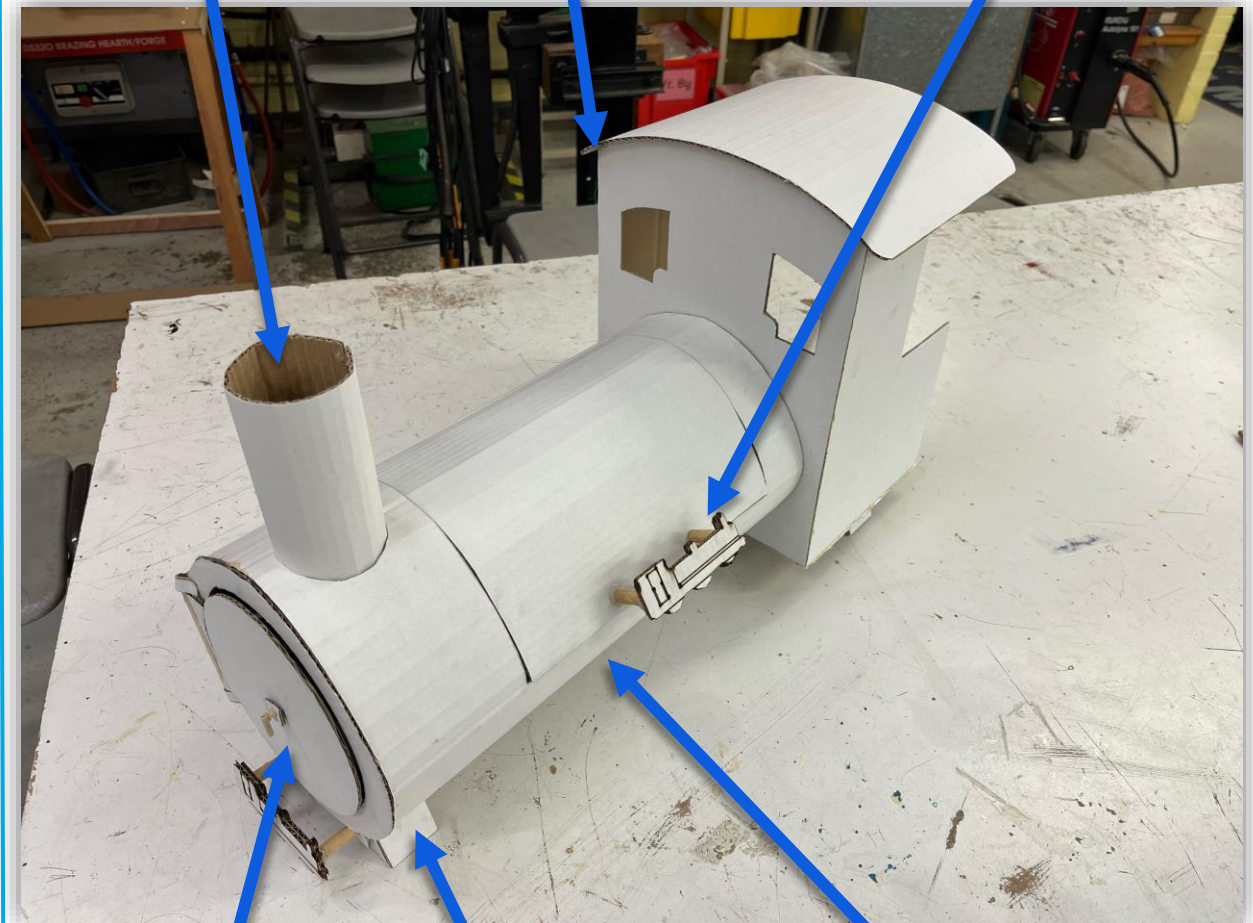
Component	Why does it need improving?	Client feedback	Suggestions
Draws / cupboards	The storage In the product is not necessarily needed. It makes the product extremely heavy and makes it less portable.	I agree - this design allows for a lot of storage; however, it increases the weight of the product, meaning that I won't be able to carry it.	Look at removing these shelves and cupboards as they add lots of weight that must be taken off as my client requires a product with a lighter mass.
Handle	The handle is in the shape of a train. This fits with the design but is currently not very ergonomic and will hurt someone who tries to pick it up.	I slightly agree - I really like the design of the handle. I like the look and aesthetics; however, I don't think it will be very ergonomic.	improve the handle so that it is ergonomic for a human hand. This makes it safe to handle without the risk of cutting your hand.
Airflow in the BBQ	In its design, the BBQ will be hard to keep alight. This is because the airflow is very limited to the fire, giving it a bad flame and the possibility of going out.	I agree - the design of this BBQ means that the product won't be able to stay alight easily so making better airflow is essential.	Look at cutting holes and gaps into the bottom of the BBQ. This increases the airflow and means that it will stay alight easier.
BBQ cleaning	The BBQ in its current design is extremely hard to clean. Removing ash and cleaning the area where the fire is currently is very difficult.	I agree – cleaning the ash out of the BBQ would be very hard. A better way to clean is essential.	I could look at using the mechanism real trains use to open the front of the loco. This opens the front so I can then remove the ash easily from inside.
Legs / stands	Currently, the design does not have any legs to keep it off the ground. This makes it more susceptible to getting damaged by water and moisture, meaning the product won't last very long without getting damaged.	I agree – I want the product to last as long as possible. For this, legs are essential on the bottom. This makes sure it's kept away from the elements, and it also means that the product can be raised higher so cooking on it is made easier.	I could take inspiration from the BioLite CampStove 2+, which Uses legs that fold out from underneath to rise it up from the ground. This raises it from the ground so that it is taller, which makes it easier for my client to cook from.

Development Ideas - Overview

Airflow – This needs to be changed so that air can flow all the way through. This makes sure that the charcoal in the bottom of the BBQ will stay alight.

Sharp corners – This is a particular concern. Many of the corners are currently very sharp and could injure someone, these need to be taken away to make the product safe.

Handle – This part of the product needs to be made more ergonomic so that it is more comfortable to hold. The material this is made of should also be considered.



legs / stands – This is a new part of the product which needs to be considered. It makes the BBQ raised up off the floor so it can keep away from any moisture on the ground.

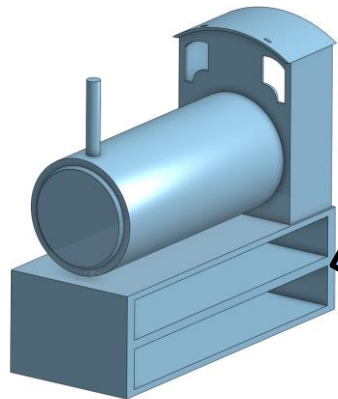
Draws / cupboards – Although these look nice, these add massive amounts of weight to the product. My client will not be able to carry the product so this must be removed and a new solution thought about.

Cleaning the BBQ – This needs to be considered because my client must be able to clean the product so he can use it efficiently. He needs to be able to remove any burnt charcoal and clean the grate to keep the cooking surface clean and sanitary.

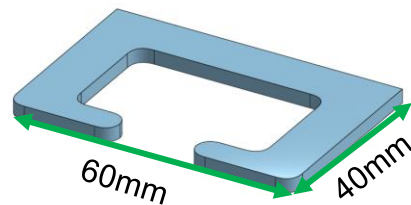


Development – Drawers / Storage

In its current design, the BBQ will be extremely heavy and could require two people to lift. I need to make it so that I can have enough storage, while making it so my client can lift the BBQ by himself.



This area of my design would make the product be too heavy to lift. It would also make it too large to fit inside the car.



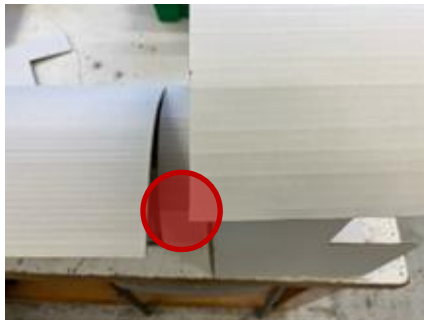
My first idea was to completely remove the draws. This would make it so that the product was lightweight and easy to carry. This worked well, however there was nowhere to store any items now.



After doing this, i knew that there now wasn't enough storage in the product. My client still needed some storage. I have decided to add space inside the cab area for utensils, so that they can be stored. In the cab, you can also fit plates. The metal parts of the cab will heat up, meaning that the plates will be heated.

Development – removing sharp edges

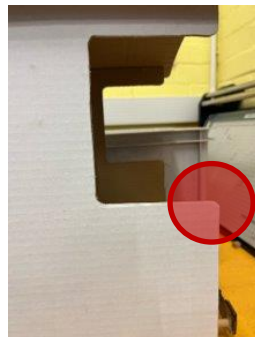
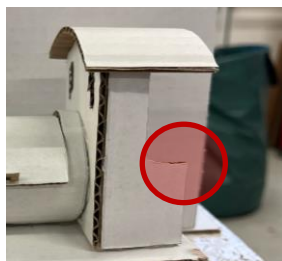
At the moment, the design had some sharp edges, which my client risks hurting himself on while using the product. My first spot that I noticed was the cab roof:



As you can see from the photos, I have identified this area as being particularly bad. The corner is on top of the cab roof and it is a place that you are likely to catch your hand. I have improved this by rounding off the corner. I can do this on the product by using a file. This makes the corner less sharp, meaning you won't cut your hand on it while cooking.

Client feedback:

I am glad you have thought about this, it was a concern as I know 90-degree corners on metal can be extremely sharp, I would prefer anything sharp to be filed so it cannot hurt anyone.

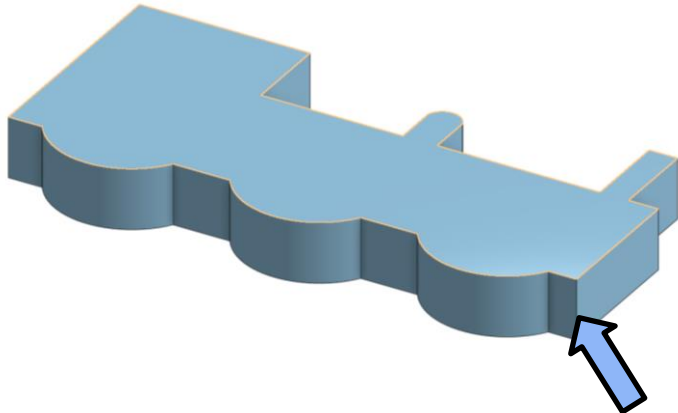


From this second part on my initial design, you can see that the cab side is sharp. This could injure someone while they are taking something out of the cab or when carrying the product. I have improved it by using a rounded corner, which can be smoothed down by a file and sanded.



Development – Handle

The current handle on the design is not very ergonomic. This means it has the possibility of injuring someone when they pick it up. This needs to be changed to make it safer for everyone to handle.



As seen by the CAD design, the handle is currently very sharp with rough edges, which have a possibility of cutting someone's hand.



Back handle



BBQ lid handle

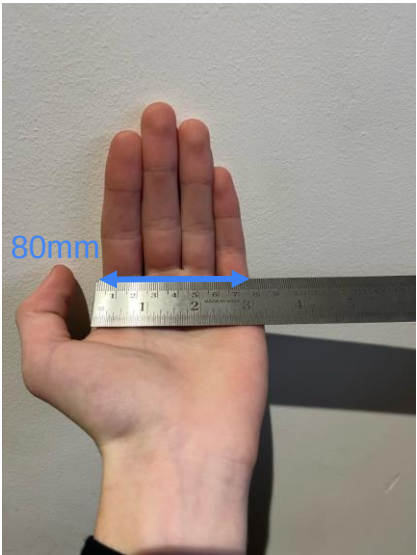
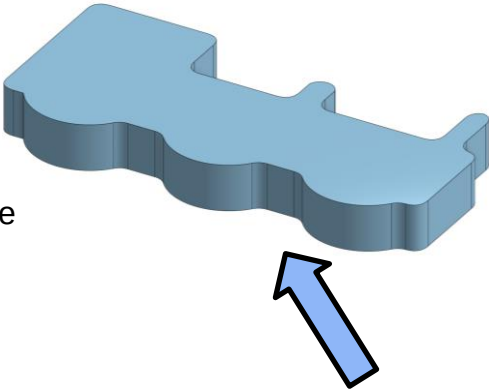


Back panel

front panel

For an initial plan, I decided to make the sharp edges round. This made the handle much better to hold. Unfortunately, this wouldn't be enough, and I decided to take measurements of my client's hand.

As you can see, I have changed the edges of the handle to be more ergonomic. I have done this to my client would not hurt his hand, however this can be improved with biometrics, I will measure his hand and create a handle that fits better around his hand.

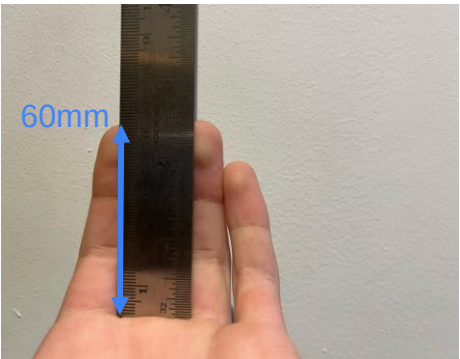


80mm

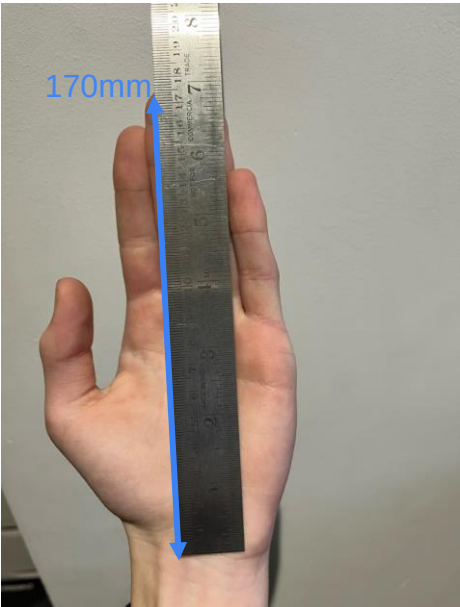
From this data, I have found out the length of my client's hand and the length of his fingers. I can now work out how the handle should be formed.

I have decided that a suitable handle would be made from 2 thin pieces of different sizes. This means that the handle will be smoothed out more round the back. This means that it will be more comfortable to hold.

Using this, I have decided the handle should be 100mm long, 30mm tall and around 4mm thick. This will be made of a Laser cut MDF sheet as this is more comfortable to hold than metal and is less slippery. The front panel will have engraving to look like a train and the back panel will be a smaller version of the front one to make it fit around my client's hand correctly.



60mm



170mm

In rain, MDF expands and starts to fall apart. I will have to varnish this part to stop it from taking in the moisture.

Client feedback:
the handle was a pretty big concern for me. When I first saw the design, I wondered how it would work without hurting someone, changing it to be like this is much more safe.



Development – Airflow Within The BBQ

with the first design, it would be very hard to keep the fire alight. This is because there is nowhere for the air to get in to keep the fire going.



In this design, there is no places for air to get in to keep the fire alight. This means that the fire would go out very easily.



First, I made changes to the cooking plate. I have decided this will be a mesh / grate material that the air can pass through, making the air move around easily within the BBQ.

To make the grate, I will use 3mm diameter steel wire. This means I can weld these together to form a grate which I will use as the cooking plate.

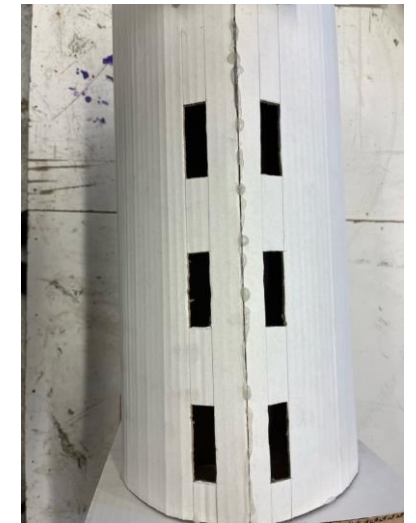
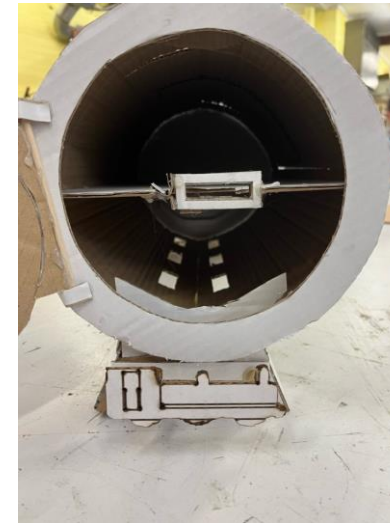
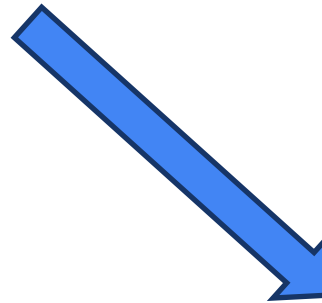


This part will be a grate or mesh in the final product.



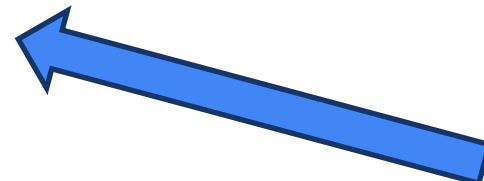
I created this tray design, which will be made out of a mesh material. This will hold the charcoal so it can get enough air to keep alight but also prevent it from falling out of the bottom and onto the floor. This in turn prevents any other fires from starting if burning charcoal touches the floor.

The tray has been designed so that it can be easily removed to refill the charcoal or so it can be cleaned.



I then had to find a way for the air to get into the bottom of the BBQ. For this, I worked out that I could create holes in the bottom, which will act as air vents to keep the fire going.

Unfortunately, I then encountered a new problem. With these holes in the bottom, there was a risk of boiling hot charcoal falling out the bottom, onto the ground.



Client feedback:
i like how this improved design makes it easier to refill the charcoal and it also means that I can cook more easily at a higher temperature without the risk of the fire going out.

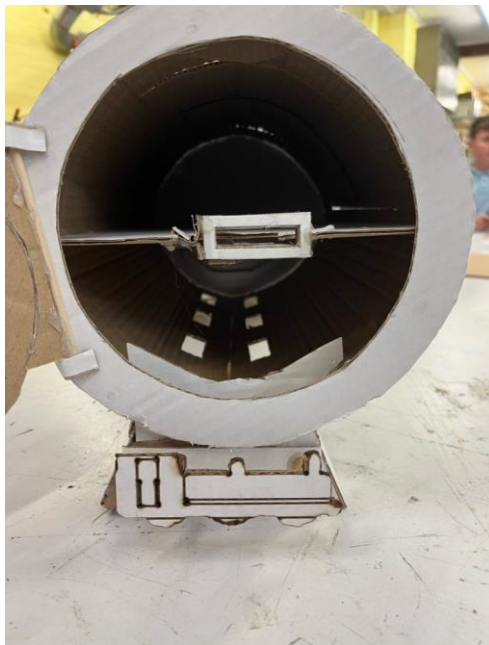


Development – BBQ Cleaning

with this design, the BBQ will be incredibly hard to clean. To solve this, I have decided that I need to make improvements for getting into the BBQ and also cleaning out the inside.



In this design, there is no way to get inside the BBQ (to the fire), meaning I cannot clean it easily.



(left) Inside the product, you can see the lock. This is where the center lock goes into, closing the door and keeping it in place.

Having this means that my client can get into the BBQ to clean out burnt ash that has been left in the BBQ. This also enables my client to close the front, giving it a realistic appearance, which is functional.

Client feedback:

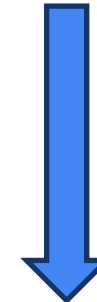
This improvement makes cleaning the BBQ much easier for me. I really like the look of the addition of the door as it looks like a real locomotive and I like how it is actually functional.



First, I decided I would change the front. Taking inspiration from a real locomotive. This uses a door on the front, which can be opened to get to the inside.



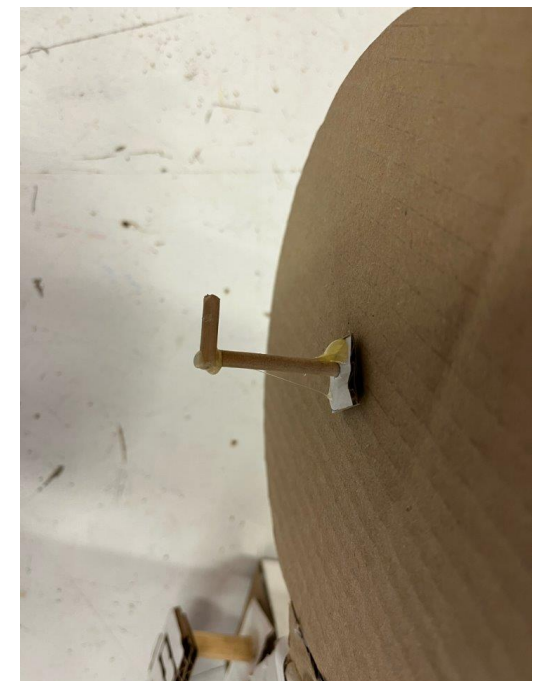
The door on my design works by using a simple hinge mechanism on the left. The center piece moves 45 degrees to open. It is locked with the handle pointing downwards.



(right) This is a picture of the other side of the handle. It follows the same pattern as the other side; however, it is much loner so that it fits over the lock.

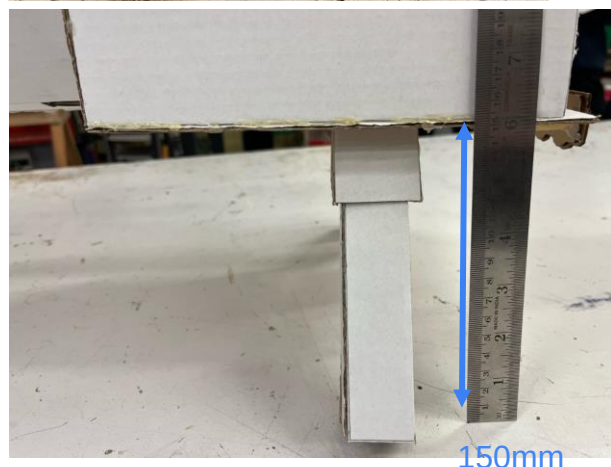
The piece will be held in by small pieces of steel, which are welded to the bar going through. This keeps it in place so that it cannot be taken out or damaged.

This means that the inside can easily be accessed for cleaning.

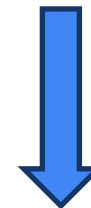


Development – Legs & Stands

With my current design, there is nothing preventing it from touching the ground. I need to change this to keep it away from the elements, like wet floors while also providing it with better airflow.



First, I added these small legs to the design. These raise the BBQ off the floor 30mm and mean that the BBQ can be kept off the floor a bit, while also being small enough to fit in the car.



I then decided that I needed to make the BBQ higher up off the ground. This is to make it easier to cook as the product isn't so close to the ground.

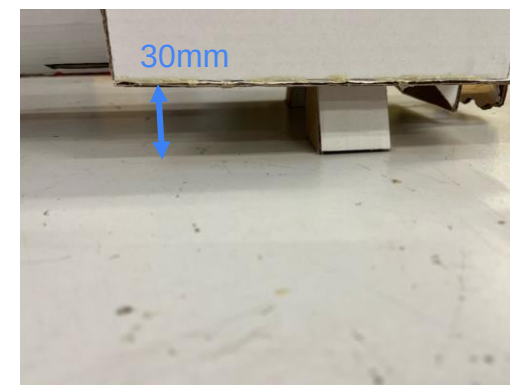
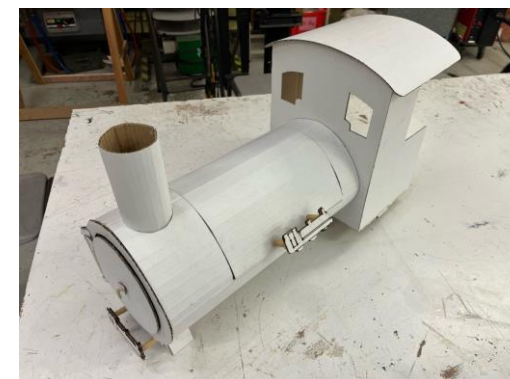
To make these legs, they will be formed of 4 pieces. 2 parts: 30mm x 150mm. The other 2 parts: 33mm x 150mm. These will then be welded together and they will slot into each of the smaller pieces



Overall, these new legs raise the BBQ 150mm off of the ground.

Client feedback:

Although I decided to remove the storage, I thought that the BBQ would then be too low to the ground. Adding this makes it easier for me to use the BBQ as it isn't closer to the ground, however it will easily fit into my car as it will be the right height to comfortably fit.



Development – BBQ uses:

The BBQ, having a lid and a chimney can be used for many different types of grilling. For example, smoking, grilling, etc. Direct and indirect grilling are two methods of cooking food over a grill.

Direct grilling involves placing food directly over the heat, this is ideal for quick-cooking items like steaks, burgers, chicken and vegetables.

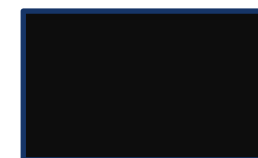
Indirect grilling, on the other hand, cooks food next to, not directly over, the heat source, using the grill like an oven. This method is best for larger or tougher cuts that need slower, more even cooking. e.g. a whole chicken.

Smoking is a slow cooking method that uses low, indirect heat and wood smoke to flavor and cook food over several hours. smoking happens at lower temperatures (usually between 107–135°C). It's perfect for tougher cuts of meat like brisket, ribs, or pork shoulder because the long cooking time breaks down connective tissues, making the meat tender and flavorful.

Development – The BBQ's Finish:

Traditionally, steam locomotives came in a selection of colors, and most of which having a black smoke box and chimney.

The color of the bodywork varied between companies and areas of the UK. Some were more common than others, a list below shows the common colors, and my client chose one of these for the BBQ to be in.

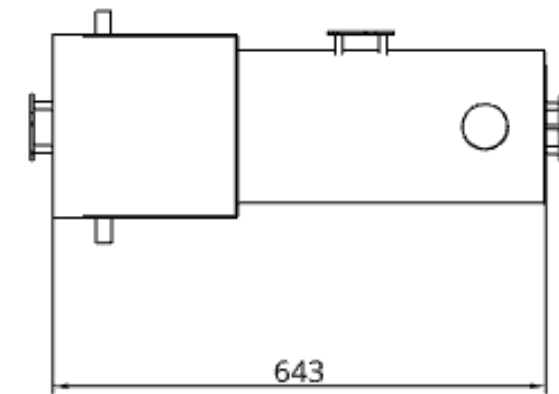
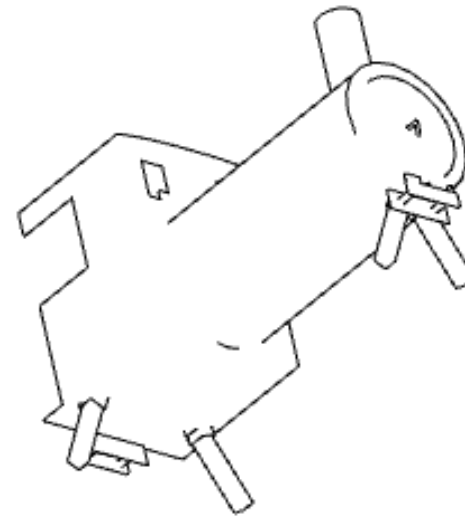
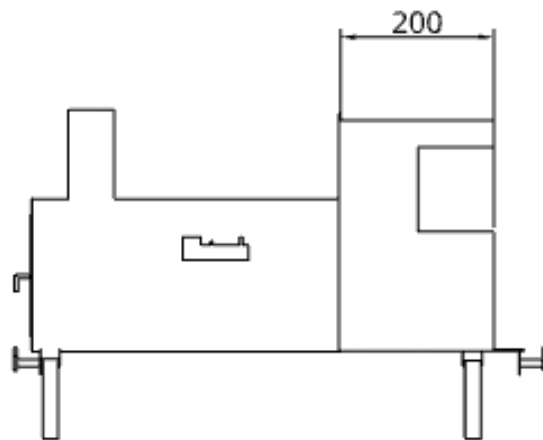
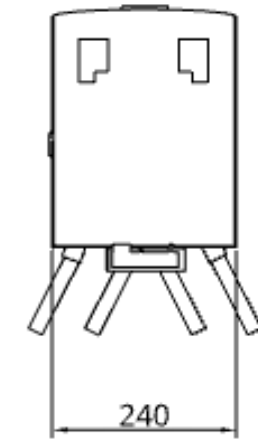
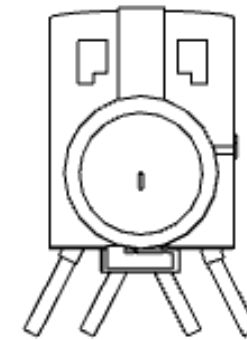
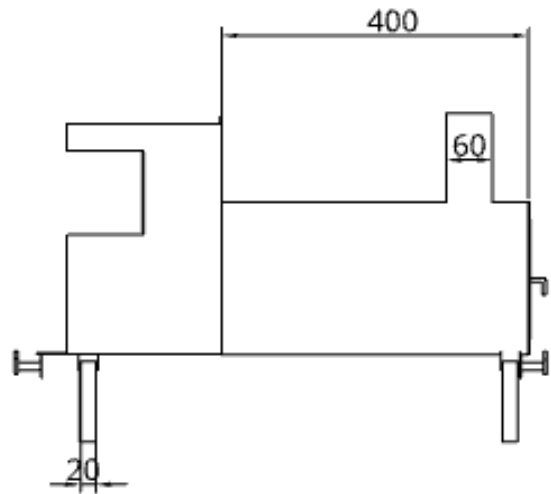


Client feedback:

I really like the black and dark green design. I think this will suite the BBQ best and it is a traditional colour scheme that everyone recognises.



Working drawings
(MESURED IN MM)



Cutting List – Measurements of components

<u>Component</u>	<u>Material</u>	<u>Quantity</u>	<u>Length (mm)</u>	<u>Width (mm)</u>	<u>Thickness (mm)</u>	<u>Diameter (mm)</u>
Cab Front	Mild Steel	X1	350	250	1	N / A
Cab Side	Mild Steel	X2	300	200	1	N / A
Cab Roof	Mild Steel	X1	290	230	1	N / A
Cab Floor	Mild Steel	X1	250	250	1	N / A
Boiler	Mild Steel	X1	400	N/A	1	200
Chimney	Mild Steel	X1	130	N/A	1	60
Leg	Mild Steel	X4	150	20	1	20
Leg support	Mild Steel	X4	25	25	1	25
Boiler Front Plate (Door)	Mild Steel	X1	200	200	1	N/A
Boiler Front Plate (Surround)	Mild Steel	X1	160	160	1	N/A
Handle Support Plate	Mild Steel	X2	100	30	1	N/A
Handle Shaft	Mild Steel	X6	30	30	10	10
Handle	MDF	X3	100	35	6.7	N/A
Grate	Mild Steel	X1	350	110	1.4	N/A



Production plan

component	Process	Equipment	Time Of Process (Hrs)	Quality Control	Safety	Safety Of Others
Handle	Laser cut handle from MDF sheet. (use CAD files). use scribe, ruler and engineer's Square to mark out cutting line on metal support. Cut using Hacksaw and face off on lathe. Add hole on one end and tap hole to create thread to hold handle.	Ruler Engineer's Square Scribe Hacksaw Lathe Cutting / Drill Bits Tap Laser cutter Sand Paper Beeswax	3 Hrs	Use Engineer's square to check parts are at 90°. Check parts from laser cutter (measure). Check all Metal parts are the same length (measure). Make sure laser cutter is set up correctly (use cutting sheet).	Don't look at laser to protect eyes. Wear goggles while using the lathe. Make sure all swarth is removed. Keep hands away from hacksaw blade.	Make sure people stand back from machinery such as the lathe. Make sure you work in designated places and bags are away. Make sure extractor is on for laser cutter.
Cab	Mark cutting locations on steel sheet using ruler / tape measure and marker. Use angle grinder to cut metal sheet into smaller pieces. Use guillotine and tin snips to cut the individual pieces out. File off rough edges. Mig weld all pieces together.	Ruler / Tape Measure Mig Welder Plasma Cutter Tin Snips Angle Grinder File Guillotine Engineer's Square Marker	4 Hrs	Check all parts are flat (unless specified) (visual inspection). Check all parts have no sharp edges (visual inspection). Check welded edges are at 90° (use welding magnets).	Wear gloves while handling sheet metal to stop injury. Wear welding gear to protect yourself (welding helmet, leather apron) Keep hands out of guillotine. Wear safety equipment for other machines (plasma cutting, angle grinding).	Keep people away from machinery. Communicate with people when machinery is going to be used. Anyone watching welding must wear welding helmet. Check extractor is on.
Boiler	Mark cutting locations with ruler and marker. Cut around all parts with an angle grinder. Use guillotine and tin snips to neaten up parts and cut them into a final shape. File rough edges. Roll the boiler so it is round Use Mig welder to secure all the parts.	Ruler / Tape Measure Mig Welder Plasma Cutter Tin Snips Angle Grinder File Guillotine Engineer's Square Marker Sheet roller	5 Hrs	Check all parts are flat (unless specified) (visual inspection). Check all parts have no sharp edges (visual inspection). Check welded edges are at 90° (use welding magnets). Check door works properly	Wear gloves while handling sharp metal. Wear safety equipment such as: masks, gloves, eye protection, ear protection while using machinery. Keep hands off anything sharp.	Keep people away from machinery. Anyone watching welding must wear a welding helmet. Communicate with people when machinery is going to be used. Check extractor is on.
Final Assembly & painting	Manufacture legs. Collect all the parts and make sure it looks ok. File off any rough edges or sharp parts. Mig weld boiler and cab together. Weld the 3 handles onto their respective parts. Paint the product.	Mig Welder File Welding Magnets Green + Black spray paint	4 Hrs	Check welded edges are at 90° (use welding magnets). Make sure all sharp points are removed (visual inspection). Check all parts are covered and nothing is left bare	Wear full welding gear (helmet, leather apron, lab coat). Wear a mask and have good ventilation while painting	Make people aware when welder is going to be used. Make sure extractor is turned on.



Safety For Welding

Welding can be very dangerous so you must wear the correct equipment and have the correct safety measures in place.

Danger of injury:
Without PPE: 10/10
With PPE: 4/10



Welding Mask:
Protects your eyes from sparks and the dangerous intensity of the light.

Lab Coat:
Protects you from any sparks and covers your arms and parts of legs.



Plastic curtain:
Protects Other people around you from any sparks and the intensity of the light created.

Leather Apron:
Protects you from getting hit by sparks, reducing risk of burns.

Gloves:
Protects your hands from sparks and burns

Extractor Fan:
Takes away any dangerous fumes created so they don't stay in the room as this could be dangerous to people

Metal Case:
Stops any sparks from flying away and hitting other people.



Safety For Sand Casting

Sand Casting can be dangerous as the intense heat can cause serious burns and injury if the correct safety precautions are not in place.

Danger of injury:
Without PPE: 10/10
With PPE: 3/10

Lab Coat:
Protects your arms from burns

Visor:
Protects you from molten metal getting in your eyes.

Extractor Fan:
Takes away any dangerous fumes created so they don't stay in the room as this could be dangerous to people

Leather Apron:
Protects you from molten metal, reducing risk of burns.

Gloves:
Prevents you from touching any molten metal

Key (for danger of injury):

= safe

= Slight Danger

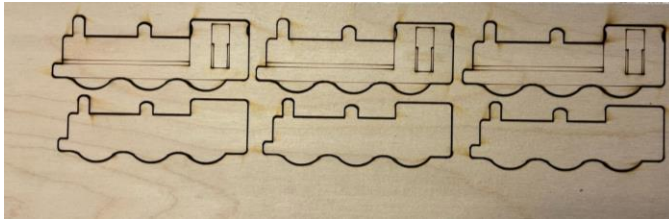
= Extreme Danger



Evidence of making:

Handles:

Laser Cutting MDF



I designed a file on CAD using measurements of my client's hand to create handle designs which fit my client perfectly. There were then laser cut onto plywood.

(H&S): I made sure not to look at the laser and make sure extraction is on so that it is not dangerous to work in.



Next, I used wood glue to secure the 2 parts of each handle together and secured it in the vice to make sure that it glued in the correct place.



(QC): I marked out on the back of the larger piece where the smaller one should fit and made sure it was in place before letting the glue set so that it didn't glue in the wrong position.



Finally, I marked out and drilled positions for holes to be drilled in order for the screws to pass through for the handle supports.

Key:

(H&S) = health & safety

(QC) = Quality control

(H&S): I made sure that I was safe while using the drill. I wore safety goggles and kept my hand away from the drill bit by putting the guard over the drill bit.

Adding A Finish



After making the handles, I wanted to add a finish. I did not know what would look best so I decided to make a tester to see what would look best on the plywood.

I tested 3 finishes:

- Linseed Oil
- Danish Oil
- Beeswax



I split a piece of spare plywood into 3, separating each section to see what would look best.

I asked my client what he liked the most and he said that he would like the beeswax the most,



Next, I applied the beeswax using a paper cloth to fully apply the finish.

(QC): I made sure to check after finishing applying the beeswax that it had a thorough coating across the whole handle so that there were no missing spots.



The next job to do would be to mark out and cut the handle supports. I used a steel rule and a scribe to mark cut where I needed to cut. I then used a hack saw saw to cut on my marked line.

(QC): I made sure to check after cutting that each piece was the correct and same length so that the handles sit correctly and all parts fit correctly.



Next, I used the metal lathe to face-off each piece of the handle supports.
This makes sure each end is flat so it will fit correctly.

(QC): I made sure to check that each piece was the same length so that they fit flush and flat to the product..

I needed to add a hole into one end of the support so I used a 6mm drill bit in the lathe's drill attachment.

(QC): I used a marking on the drill bit so that the distance was the same for each hole.

I used a tap to make a thread in the supports. This meant that I could make a hole and the handle top piece and attach it via a screw to the supports.

(QC): I used a full length M6 screw after using the tap to make sure that each screw would go into the supports and would not get stuck.

(H&S): The lathe can be a dangerous machine so I made sure that I wore goggles and kept hands away from the chuck while it was spinning. I also made sure that the hand guard was down so that I couldn't touch the lathe while the chuck was spinning.



The M6 screws were too long at their full length. This meant that I had to cut each one down so that it would fit through the top wooden piece and then stay in place in the support.



I then used a file to make the tops of the screw flush and not sharp. I also partly rounded the edge so that the thread would meet correctly and not get stuck when lining up.



Finally, I had to screw the wooden top of the handle to the supports. This completed the handles so that they are ready to be attached to the final product.



Key:

(H&S) = health & safety

(QC) = Quality control

A comparison of before and after the handles were varnished.



Cutting sheet metal parts & assembling the Cab:



I created templates on CAD for the sheet metal. This meant that when I marked out and cut the pieces they would be the correct sizes and all fit together correctly.



I then marked out each piece on the sheet metal using the templates that I have created. I used tessellation so that I could be efficient with the metal I have.

(H&S): While handling and cutting the metal sheets, I made sure to wear gloves. The sheets were sharp so could have the possibility of cutting my hands.

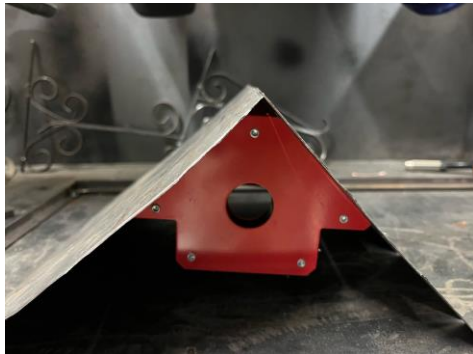


Next, I tried to use tin snips to cut each piece out of the metal. Unfortunately this was an extremely difficult process to use so I decided to use the guillotine instead, where I separated all the pieces and then cut them neatly.



So that the sheets could be handled safely, I used a file to make sure each edge was no longer sharp, this meant I could handle each sheet without gloves. I also used clamps to hold down the sheets so that they didn't move while I used the file.

(QC): I checked each piece after cutting and filing to make sure it was still the correct size and shape so that it would fit correctly.



I now needed to weld each piece of the cab together. I used the Mig welder on the lowest amp setting otherwise holes would form in the metal.

(QC): I used the welding magnets so that each piece would be welded at 90 degrees so they fit together correctly.



The roof piece had to be curved to fit correctly. I used the metal sheet roller to get the correct curve on the roof to fit.

(H&S): While using the roller, I made sure to keep my hands well away from the rolling wheels because they could crush my hand.



After welding the cab together, the front windows and side walls had to be plasma cut so that they could be removed.

(QC): I used a file to deburr and round any remaining sharp edges so that each piece was good quality and unable to hurt anyone.



To add detail to the cab, I decided to cut some angle pieces to line the edge. I used a steel rule to measure the distance and a scribe to mark where to cut. I used an engineers square to mark around the whole piece to make sure it would all cut in line. These were then cut using a hacksaw and welded onto the cab, adding better aesthetics and structural stability.



Finally, I needed to weld one handle to the underside of the cab. This acted as one of the end handles so that my client could pick it up.



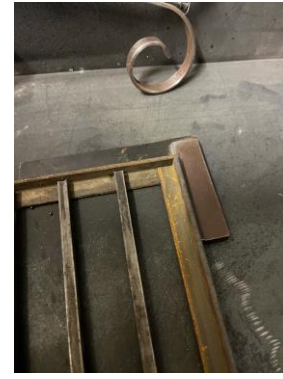
Key:

(H&S) = health & safety

(QC) = Quality control



Cutting sheet metal parts & assembling Boiler:



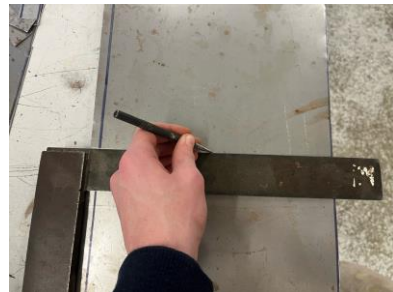
The first job was to create the grill to fit inside the BBQ. This was made with angle pieces on the outline. I cut these with a hacksaw after marking them using a scribe and engineers square.

The next, I had to cut the bars to go through the middle. These support the food while it is being cooked.

Before welding, I made sure to line each piece up and use an engineers square to make sure that each corner was at 90 degrees so that the grill sits correctly and flat inside the rest of the boiler.

(H&S): I made sure to turn the extractor on and pull the curtain across. This meant that no toxic fumes or small particles would stay in the room and the curtain would protect other people from the light created from the welding gun.

(QC): I made sure that each piece was cut at 90 degrees by using the engineers square to create a marking that is straight.



After previously cutting out the sheet metal parts, I had to make another cut in one part of the boiler. This enabled me to create a door that open upward. I used the guillotine to cut this sheet.

As the boiler was made of 3 parts, I rolled and welded each piece individually. The end pieces could be welded round, as shown above. The middle could not so I made these first.

The front section of the boiler needed to have a hole cut out for the chimney to fit and be functional. This was done with a plasma cutter.



Next, I welded the end pieces onto the middle section, ready to have the grill and door fitted.



(QC): I used welding magnets to hold the BBQ boiler together so that the pieces together while I welded each piece. This meant that I could make sure the boiler stayed in position while welding.



For the chimney, I had to use the roller to create a round shape. I used a clamp to hold the piece together while I welded it. I used a seam weld to hold the chimney together.

The chimney was then welded on later after the hole had been cut.

Key:

(H&S) = health & safety

(QC) = Quality control





The next job to do was to create small pegs that I could use to support the grill so it didn't fall onto the fire down below. I used a steel rule, engineers square and scribe to make a cut at 90 degrees with a hacksaw.

I welded the supports onto the boiler. I used welding magnets to make sure it stayed in place while I welded it.

I welded the grill I made previously to the supports.

(QC): to make sure that each piece I welded was in the correct place, I used welding magnets as these held each piece so I could support the welding gun with my hands.

(H&S): while cutting, I made sure to keep my hand away from the blade. This was so that I couldn't get hurt by the saw as this could cause serious injury.



To support the grate that would sit in the bottom of the BBQ, I created these supports that they tray would rest on. I spot welded these on using the Mig welder.

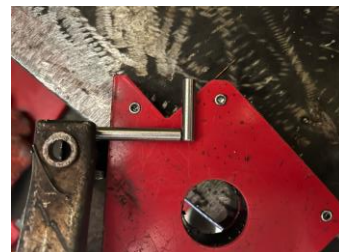
The next job was to make the door which sits on the front. I used the guillotine and a file to cut the shape and smooth it out. The middle was cut out using a plasma cutter.

Next, I marked out the spot where the hole would go for the handle and lock to go through using a centre punch. I then drilled this using the pillar drill.

(H&S): using the pillar drill, I wore goggles with the guard down so my hands would not touch the spinning drill bit.

I cut a piece of steel rod measuring 100mm, which would act as one part of the door's hinge.

(QC): Again, I used welding magnets to hold the piece together so that I could be sure everything is in the correct place.



Next, I had to make the handle / lock for the door. I used a metal rod, which I cut into 3 pieces. I then partly welded this together and put this into the hole in the door and then welded the other side. It is kept from moving by using some washers which are welded either side of the door plate to stop it moving.

Next, I had to weld the door on. I created my own hinge end pieces by bending two small sheet metal pieces. I then welded these on the end of the metal rod for the door's hinge so the door would actually move.

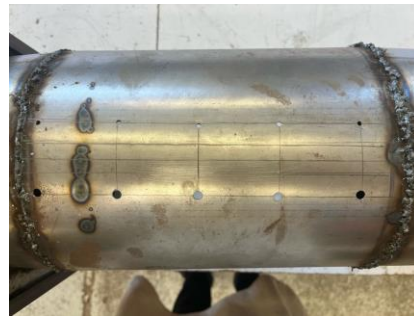
To get the lock working, I needed to add a bracket that would sit in between the gap I left on the BBQ grill. I used welding magnets to hold it in place while I welded it in.

Key:

(H&S) = health & safety

(QC) = Quality control





The next job to do was to create holes in the bottom of the BBQ to let air through to keep the charcoal alight. First, I marked out on the bottom where the holes would be placed. First with pencil and then I used a centre punch to mark where to drill.

When drilling, I first used a 2mm drill bit to go through the metal. After that, I used a 6mm drill bit to widen the holes to increase air flow.

(QC): Before drilling, I made sure to check my measurements once again so that everything was in line and in the correct position.

(H&S): while drilling, I wore goggles. This is so that I didn't get any swarf in my eyes.



To complete the boiler, I just had to add the lid to the top. First, I attached the handle to the bottom. Then, I attached some hinges that I had bought. For this, I used welding magnets to hold them in place while I completed the weld.

Finally, I attached the lid to the boiler via the hinges.



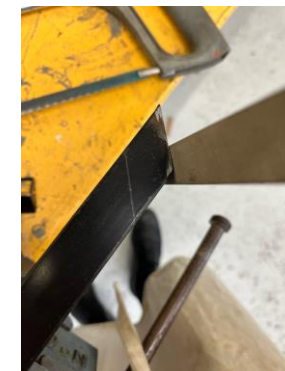
The final assembly:



I then removed any sharp parts by using a file. This stops the legs from hurting anyone.

First, I needed to make the legs and leg supports for the BBQ. First, I got a piece of box steel and cut it into lengths of 150mm.

(QC): I used an engineer's square to ensure 90 degree cuts on my product's legs. I also marked all the way around with a scribe to make sure I cut in the correct position.



Next, I made the leg supports. These were at 45 degrees to the product's base. In order to manufacture these I used a mitre square to get the exact marking position and ensure a correct cut.



(QC): to ensure a correct finish, where the legs would sit correctly, I measured the pieces again after cutting and used a mitre square to check the angle. If it was incorrect, I used a file to fix the angle.

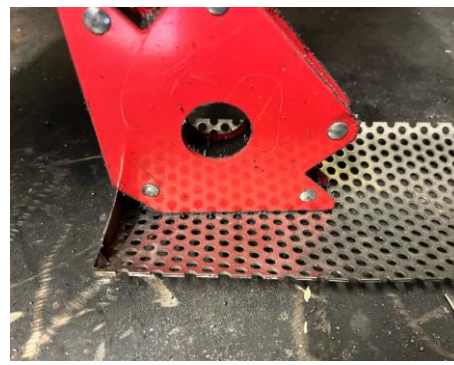


Key:

(H&S) = health & safety

(QC) = Quality control





The next job to do was to manufacture parts for the charcoal to sit in. This is made from a steel grate, which I cut using the guillotine. This piece was too long to fit in the roller so I used a vice to add a slight bend in it. This is so that it would fit the metal parts welded into the boiler earlier.

(QC): While bending this piece, I made sure to keep checking that it fits into the BBQ at the right angle.

The grate was the welded onto the end pieces to finish it.

Next, I needed to weld the cab and boiler together. I did this by using welding magnets to support the boiler to stop it from rolling over and tack welding around the join at certain spots. After this, I completed it by doing a longer weld which went all the way around the boiler. This created a neat weld while also providing more structure.

The front leg supports also had to be attached, which I welded on and then put the handle on the front.

Angle Grinding & Painting:



Firstly, I had to use the angle grinder to neaten any welds that stick up. I used a grinding disk and a battery powered angle grinder to remove these welds.

(H&S): The angle grinder can cause serious injury or burns if used incorrectly. For safety, I wore a lab coat to stop sparks hitting me, goggles to stop anything getting in my eyes, gloves to protect my hands and ear defenders since the angle grinder is extremely loud.



Before painting, I wanted to use a metal repair glue. This stiffens the joins on my product. Where the welds either were weak or didn't look very aesthetically pleasing, I applied the glue to neaten the welds. This makes sure each welding joint looks neat.

(QC): After letting it cure for 24 hours, I came back and used sandpaper to rub down the glue. This meant that the paint would easily stick to the BBQ and the repair glue.

(H&S): The repair glue can cause irritation to the skin; therefore, I wore gloves while applying the glue so that it did not get any on my skin.

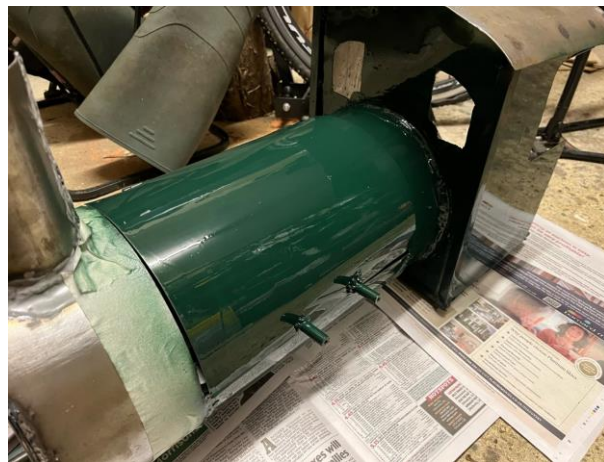


Key:

(H&S) = health & safety

(QC) = Quality control





The next job to do was to apply the green paint. Since my client chose a green and black colour scheme, I used this heat-resistant spray paint. I had to apply multiple layers to achieve a glossy finish. I marked out with masking tape where the change from black to green is, this is so do not lose the specific line.

(QC): After painting the green, I checked that every surface was covered in enough paint and that there were no missing patches

For the legs, I suspended these parts using a piece of wire. This meant I could easily paint all sides.



I completed all painting outside for good ventilation for removal of particles and over a mat so that the floor wouldn't end up becoming covered in paint.

(H&S): I completed all painting outside because I needed good ventilation since I was using spray paint. This can be dangerous to your body so I made sure I was in an area where I wouldn't be inhaling any paint particles.



The last job was to paint the final parts black. For this I used a black Hammerite paint rated for 600 degrees Celsius, so I could be sure it would work with my BBQ.



I made sure to mark out where I would be painting and protect the previously painted areas. I used masking tape and newspaper for this so that none of the green paint would get damaged.

I painted 3 coats of the black paint. This made sure there was a good coverage over all the parts.



Creating a plaque for the side:

I wanted to create a plaque using sand casting for the side as seen on many locomotives.

I used CAD (Onshape) to design the plaque

(QC): Using CAD meant that I could get very precise measurements and have a great accuracy.



Next, I exported the STL file into a slicer software where the G-code for the file is created. Next, this was 3D printed.



The next job was to sand cast the plaque. I used pewter, which is a metal alloy consisting of tin (85–99%), antimony (approximately 5–10%), copper (2%), bismuth, and sometimes silver.

I put my 3D print into the cast to create the design.

I then poured the molten metal in and waited for it to cool before taking it out.

Key:

(H&S) = health & safety

(QC) = Quality control



Final Photos of the product:



Section F: Testing & Evaluation

Photos Of Test	What Test was carried out	Outcomes	Client Feedback
	Form & Size – I needed to test that the product fitted inside my client's car boot, as stated in section A. It had to be smaller than 500 x 500 x 1000mm as my client must take other items with him when on a camping trip.	From the test, you can clearly see that the product fits into the specified area, giving my client plenty of space for other items for camping such as a tent and cookery items.	The size of the product is perfect, it gives me the much-needed space for other items to go in as well as the BBQ.
 	Performance – the BBQ needs to be able to hold a high enough temperature for a long enough amount of time to affectively cook and not cause health and hygiene concerns.	The BBQ was able to hold a sufficient temperature. In the test, I used a meat thermometer to check that the meat I used (chicken) was cooking at the correct temperatures to ensure that there is no possibility of my client or guests getting food poisoning. For the meat I used, the optimal temperature was 74 degrees Celsius, and the BBQ managed to cook the meat at this temperature and provided a hygienic cook that would not cause food poisoning.	I was very pleased with how the product cooked the meat. This ensures that anything cooked on my BBQ is safe to eat and will not harm anyone who eats from it. The test carried out produced great results with the meat being finished with a great consistency and taste.
	Materials - I needed to test that all the materials I used could cope with the temperature at which the BBQ would be operating at. This included all the metal and wooden parts along with the paint I have used to finish the BBQ.	After heating the BBQ up, I have concluded that all the materials can cope with the temperature that BBQ operates at. The only one I have a slight concern with is the green paint as this is rated for a lower temperature than the black paint so if heated to a very high temperature, it could burn off or melt, however in my tests, this did not happen.	I wanted to make sure that when I use the product there is no risk of me damaging it through just using the product as intended. This shows that it is all ok with the temperature and there is little risk of harm or damage through using the product.
 	Ability to carry the product – As specified earlier, the product must be able to be carried by my client. This is so that he doesn't need other people to help him move the product around as this would be a great inconvenience.	The product doesn't weigh too much and can easily be carried by one person. The BBQ weighs 7.3kg and this means that it can be carried by one person.	The weight of the product is a big consideration for me. It needs to be able to be carried by one person so that I can easily carry it and transport it around to different places.

Future Modifications

While testing, I found that the grate for holding the charcoal was far too high up. To solve this issue, I would move the position of the grate further down. This prevents the food from burning so easily if left for a minute.



Needs to be deeper so that the charcoal doesn't touch the grate.



Could do with having higher sides for more charcoal.

I also found that you couldn't get much charcoal into the grate because the sides were not very high up. To change this, I would either make a larger grate or a deeper one, so that you can get more charcoal into the grate for longer and easier cooking.

Client Suggested Modifications

My client has suggested an overall larger product. This is because he wants a larger cooking grill and area to cook.

This is because he can then make larger meals and have more food cooking at one time so that he can get his whole family fed quicker.



Currently approximately 160mm, would be better as approximately 250mm.



Add 1 or 2 more bars to decrease the gap between the grill.

In addition, my client has also suggested smaller gaps in between each grill. This is so that no smaller items of food fall through the gaps and into the fire.

This could be completed by adding more bars onto the grill piece.

Testing summary:

After testing, I have found that the product works as intended and all the important parts such as performance work as intended and work flawlessly. The product only has some minor issues as stated in the future modifications that can easily be sorted out and fixed.

Other parts that could be sorted is the presentation, the welding and joins are rather messy, and this could do with being sorted by redoing welds and the grinding them back to create a flatter surface.

User Requirements (specifically the finish):

The final finish of the product has come out very nicely. The green and black combination looks professional and just like a real steam locomotive.

Client:

I really like the finish to the BBQ, and it looks exactly how I envisioned it to be. The color scheme fits well, and the finish of the BBQ looks great.

Performance Requirements:

The final tests of the product show that the BBQ performs as it should, and it works correctly and keeps heating at a constant temperature where food can be cooked to a safe standard. The product can also be used for other applications such as smoking food, which makes it more versatile in case you want to cook other meats and fish.

Client:

I am impressed with how well the BBQ works and how it functions. It cooks well and at a safe temperature where the food will be a good standard and safe to eat.

Form & Size:

The tests of the product shows that it is a good size for cooking. The product does not take up too much space in my client's boot but cooking many meals may be hard with this size grill.

Client:

The size makes the product easy to carry about. The only improvement I would like to be made is to have a bigger grill and overall size. This means I can cook more at one time.

Final Client Feedback:

'The BBQ has exceeded my expectations. Both being aesthetically pleasing and highly practical through its mobility and low weight.'

'everything I wanted is on the BBQ and it works fantastically, I can't wait to get out and use it on my next camping trip! I will be the envy of the campsite!'

Design Life Cycle/ Sustainability:

Plywood – The plywood for the project was sourced from a sustainable forest where I only used scrap pieces from previous projects since I only needed a small section from the piece. When the product is going to be disposed of, the wood can be easily separated from the rest of the product as it can easily be unscrewed and recycled. This means that the wood has a new lease of life in another project or remanufactured into a new part.

Mild Steel Sheets – The sheets were sourced sustainably, and I used tessellation to make the product, so I used up the least amount of the metal as possible. This keeps much more spare for other uses and creates little waste. After being used, the metal can be melted down and reused again in another project, meaning it is reuseable, and this does not harm the environment.

Batch Production:

To have this product made in batches, we could use other processes such as laser cutting of the metal sheets to increase the production rates. This means that parts originally made by hand can be quickly manufactured and assembled without the slowness of humans and the possible errors they have made.

Better templates could also be made to make welding and cutting faster, meaning that many of the same product can be made quickly and efficiently.

Summary

Overall, I have produced a quality product that meets its design brief to the most part. My client is also very happy with the outcome and only has a few wanted modifications. Unfortunately, I was unable to manufacture the utensil holder as seen in the development section, however my client is not too concerned about this.

