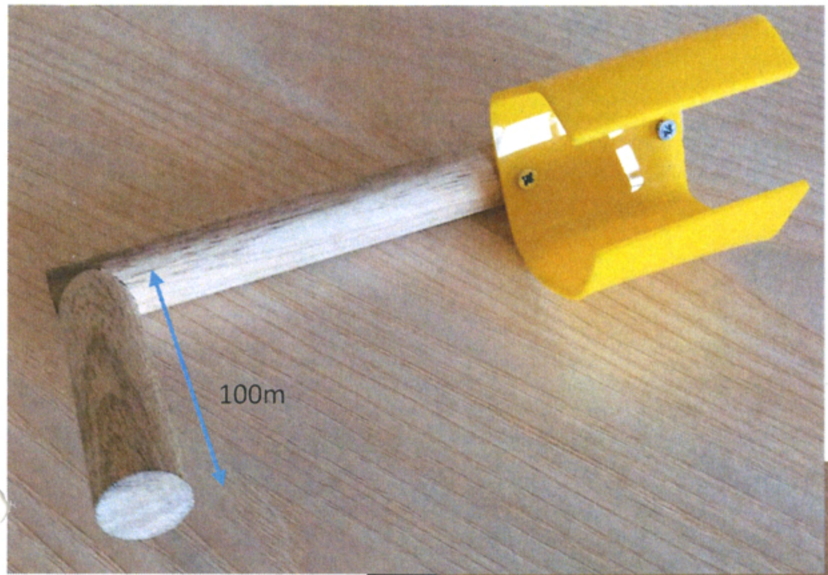
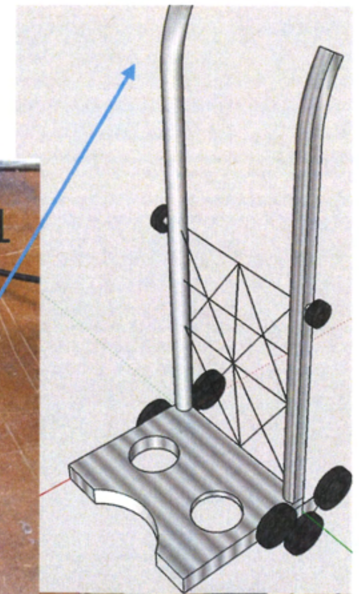
Development

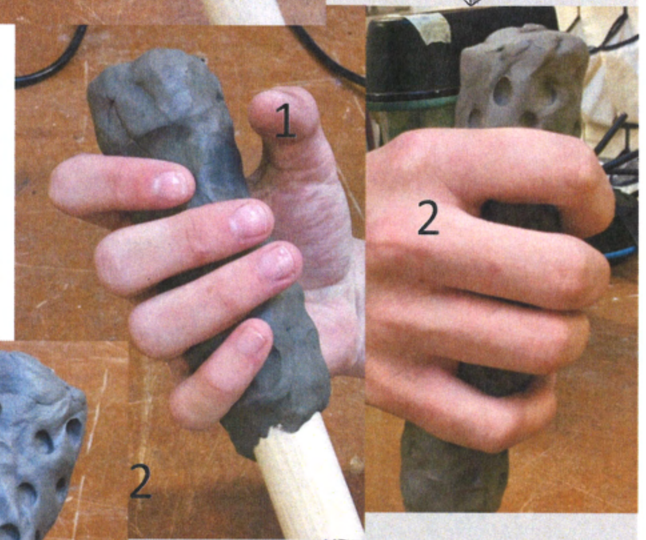


My original handle was quite basic and I think some less abled people would have struggled to use it. As a result, I made an almost crutch like handle. This is going to replace the original handle and therefore hopefully should be easier for less abled people to use. As a result of the mode I realised some of the weight of trolley could be distributed alongside the wrist which will reduce the pressure on the hand. The wrist catch also means you are less likely to accidently let go of the trolley, hopefully this will improve safety.

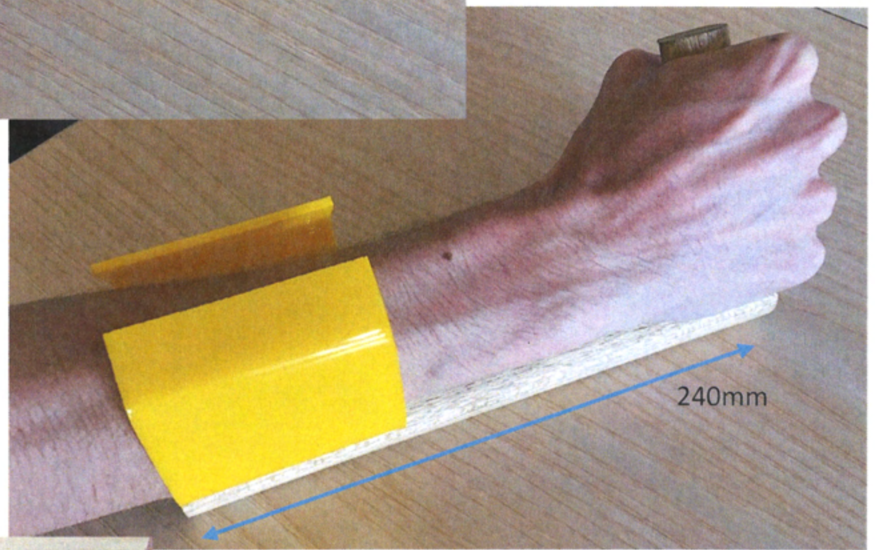
Choosing the correct handle for this product is very important. The handle must be comfortable for all users of all ages. As a result of this I decided model a few handles to try and find the right one for my product. The first handle I modelled was very comfortable to hold but when another user used it they said the handle didn't quite fit their hand. If I was to use this handle I would have to use a more generic hand hold so that it can be used by more people. Handle number two was surprisingly good. The circular holes provide a suction like grip for your fingertips and so I found this handle very easy to grip. I was less impressed by my third design. Although the lines provided some grip for the handles, the end result was that there was little grip for the handle.

As a result of my modelling I have concluded that a combination of model one and two would provide a suitable grip for all ages and abilities.

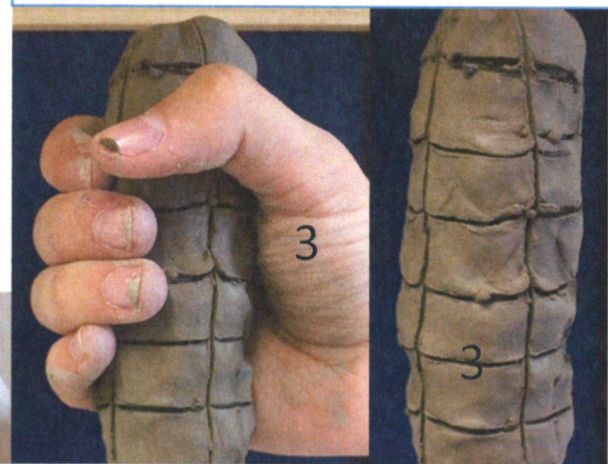


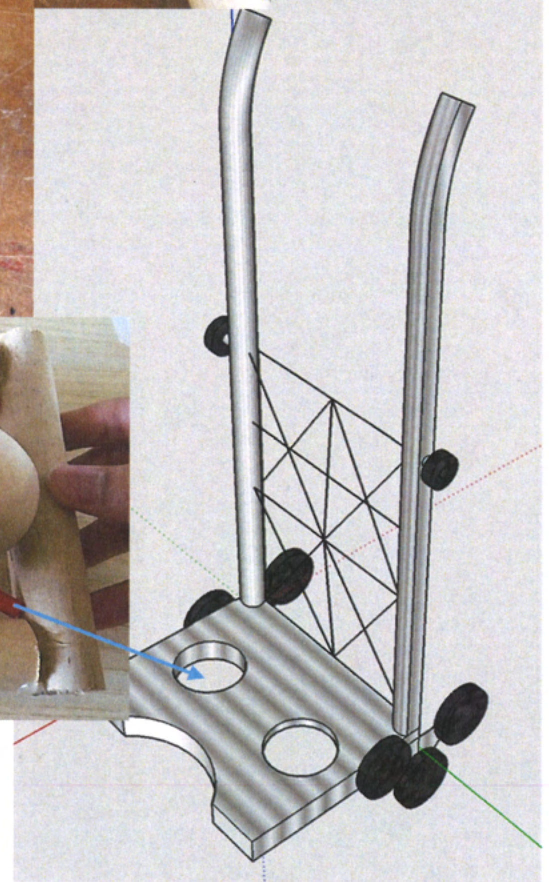


The handle will have an ergonomic grip which I will experiment with before deciding on the grip I want to use. Once I have decided a grip it will wrap round the current handle frame.

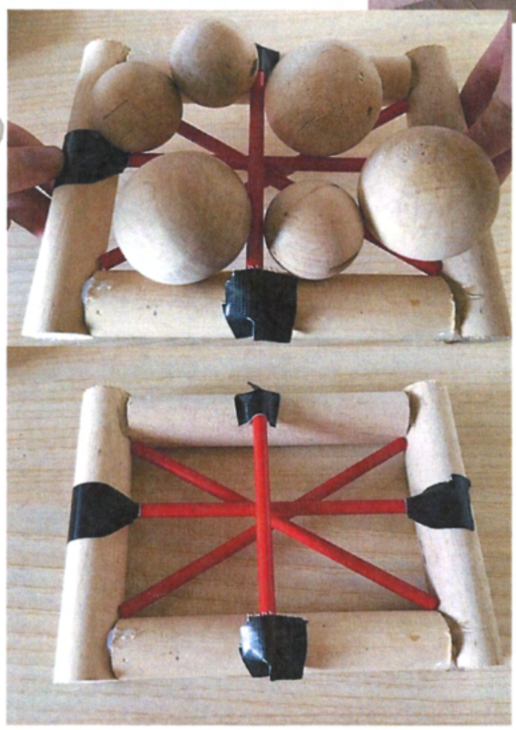


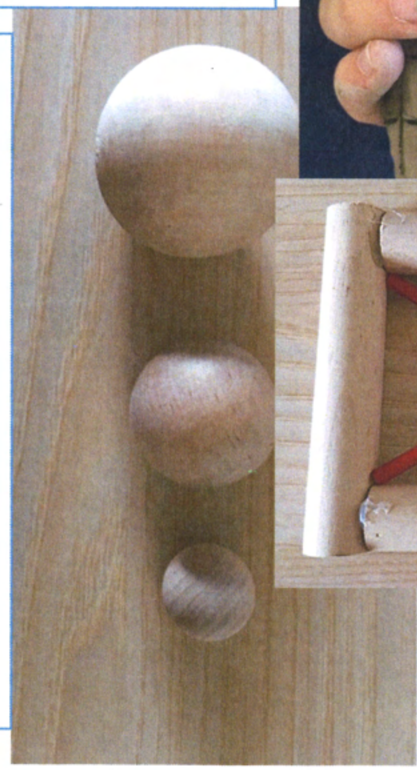
The main frame of the handle will be made from steel tubing which has been welded together. The arm cuffs will be made from High impact polystyrene. This combination of materials should result in a very strong yet durable handle.

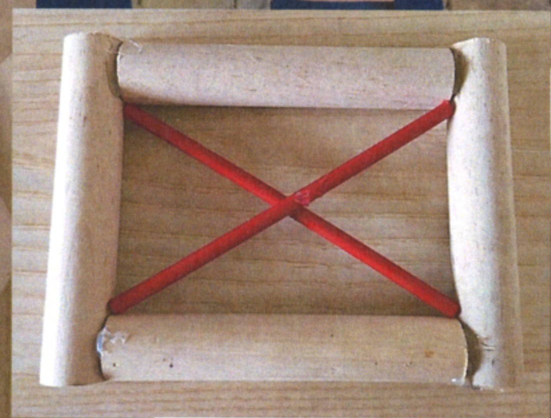




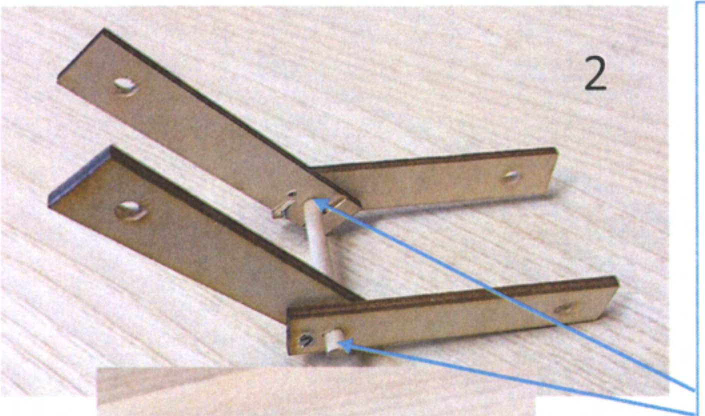
Due to the base frame of my idea being very heavy I decided to develop the idea to see if I could find a solution which reduced the weight. Using a quick model, I found that the best way to reduce the weight would to create a thin metal wire frame. The first frame I made consisted of a cross pattern. Although this would be the lightest model, I found it only held the largest logs and therefore would be ineffective. My second model added on a plus shape to the already existing cross. I found this model to be a lot more effective as it caught most of the balls. However, the smallest balls still managed to fall through the base. To counter this, I plan on butting a thin wire frame under the thin metal beams. This wire mesh will only need to be very thin as it will only support the smallest of logs and therefore will not need to support much weight.

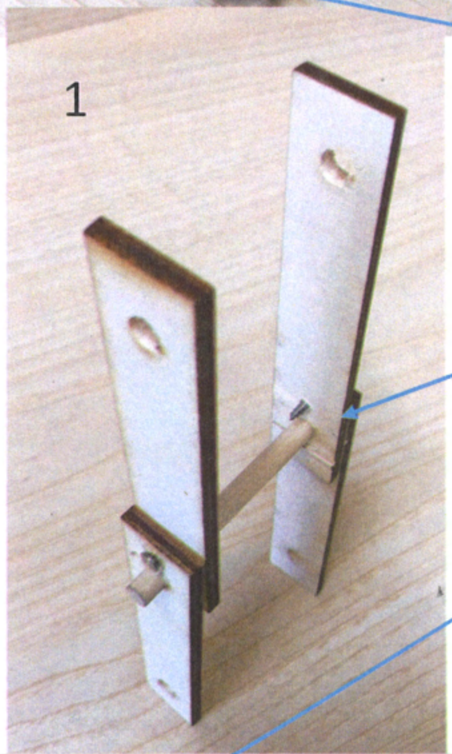


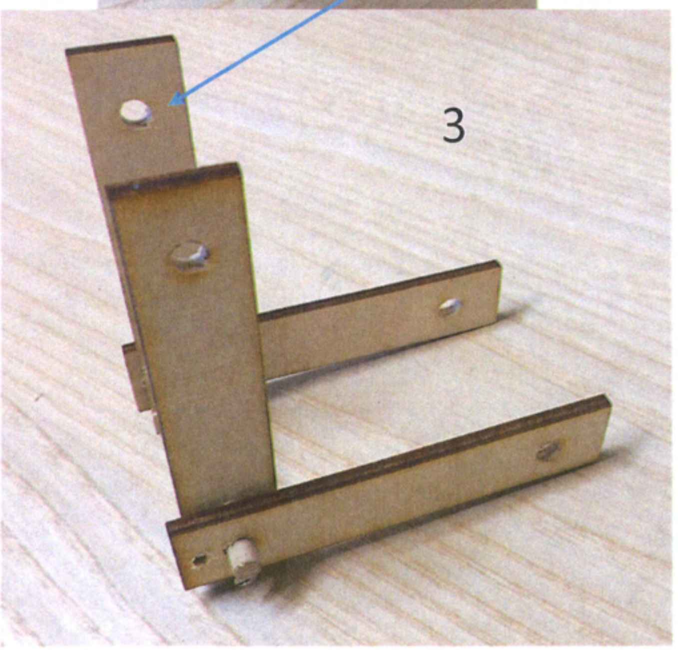




Development 2







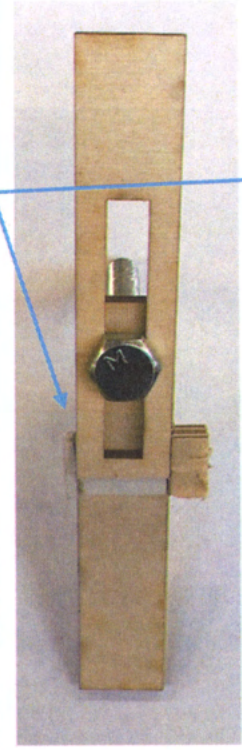
Transformation of trolley mechanism 1

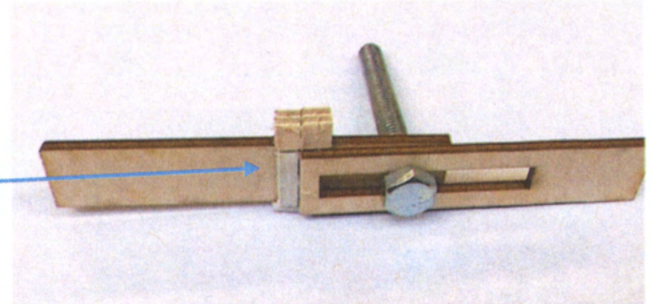
Whilst looking at my original design I wanted to look at how I could better interchange the two modes of the trolley. Upright and at a right angle. To look at this I created a variety of models and designs to try work out the best option.

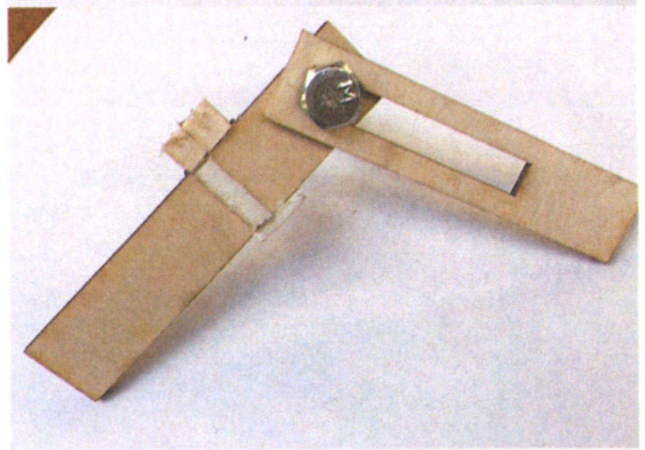
My first model was taken from how a gym machine changes the rest positions for different anthropometrics. It uses a pin to hold the rest at different angles. Using this concept, I applied it to the model as shown. I experimented using three different angles. As a result of my model I realised that there must be plenty of space between the centre beam/rod and the pin holes, without this space I realised that the trolley would be structurally weak in this area. However, I think if the dimensions where slightly better this model would be perfect. As the legs can rotate around each other using the main connecting beam there is great strength between the two separate pieces. The only issue I can see with this is that there would have to be a handlebar at the very top of the rods. This would be to stop the metal bending towards each other under the stress and strain whilst the product is being used. Overall, I think this could be a great way to intertwine the two different versions of my product.

Transformation of trolley mechanism 2

My second idea for transforming the trolley gave a great range of positions for the angle of the trolley handles. These angles include past to 90-degree mark which could lead to the product being able to fold up. The upright position is held by "sidebars" which hold the trolley handles in their upright position. To escape the straight up version, you simply lift up the handlebars and rotate the handles around the bolt. Although this design gives a great range of adjustability it needs a locking mechanism to hold the handlebars at the different angles chosen. This mechanism will need be very strong and durable so that it does not falter over time. Looking at existing solutions to this problem I came across something called internal tooth lock washers. I planned on fixing this on to my original idea however this "locking screw" gave me a completely new idea.

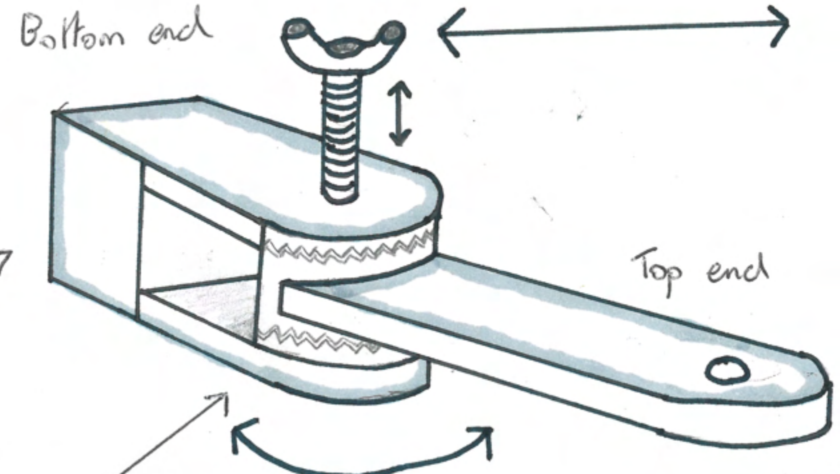






Mechanism 3

Bottom end

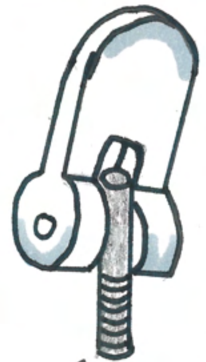


Top end

Using a square block at the end of the mechanism will allow the second wheels to easily be joined to the main frame of the product.

The teeth allow many different angles for the trolley to be positioned at.

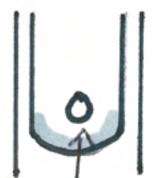
Math can be used to calculate the number of positions.



As a wing nut would be difficult for the elderly using a flap tightener will be easier for them.

Screw thread to hold lockings washers together.

Made from Aluminium to reduce weight.



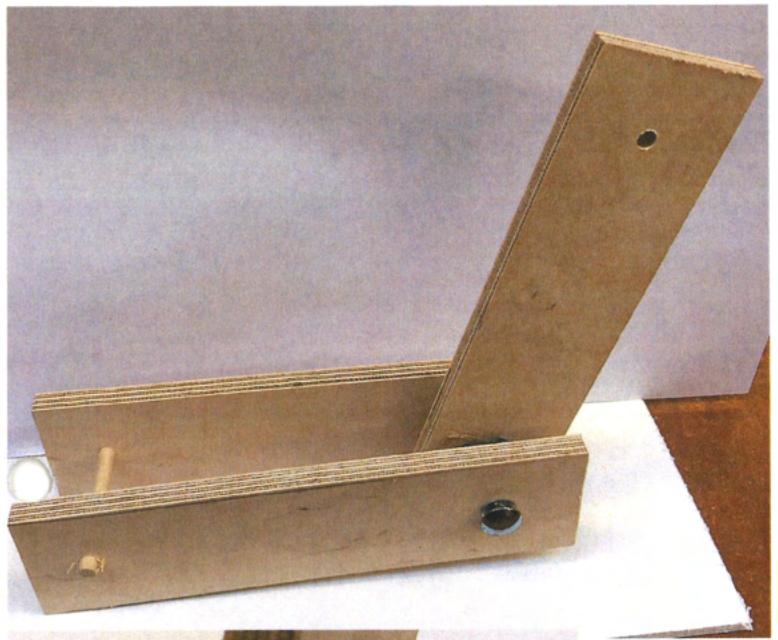
Exterior tubing

Using this method we can still use the crutches tubing.

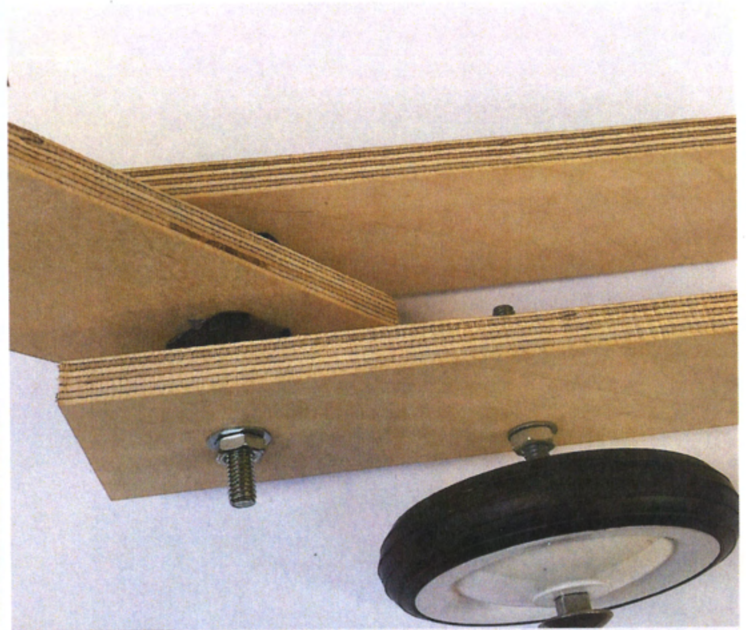
The pin hole, this is for the crutch adjustable system.

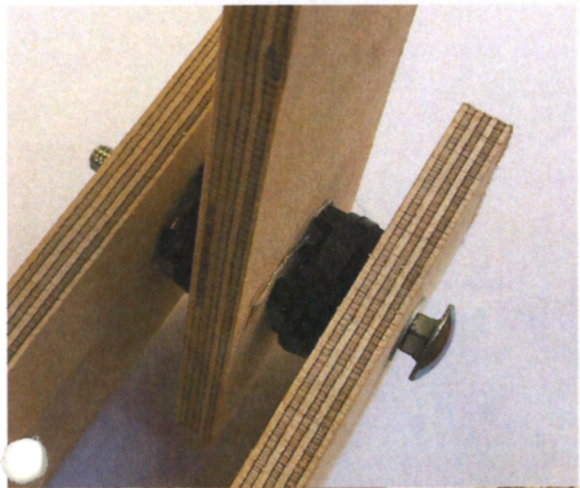
Due to the complexity of this third idea I decided to construct a model. This model is shown on the next development page.

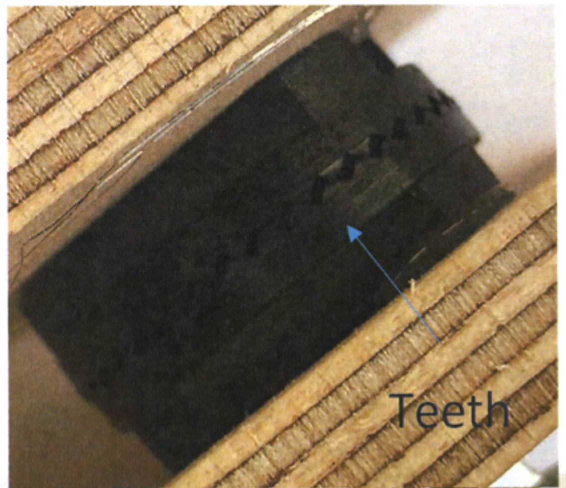
Development 3

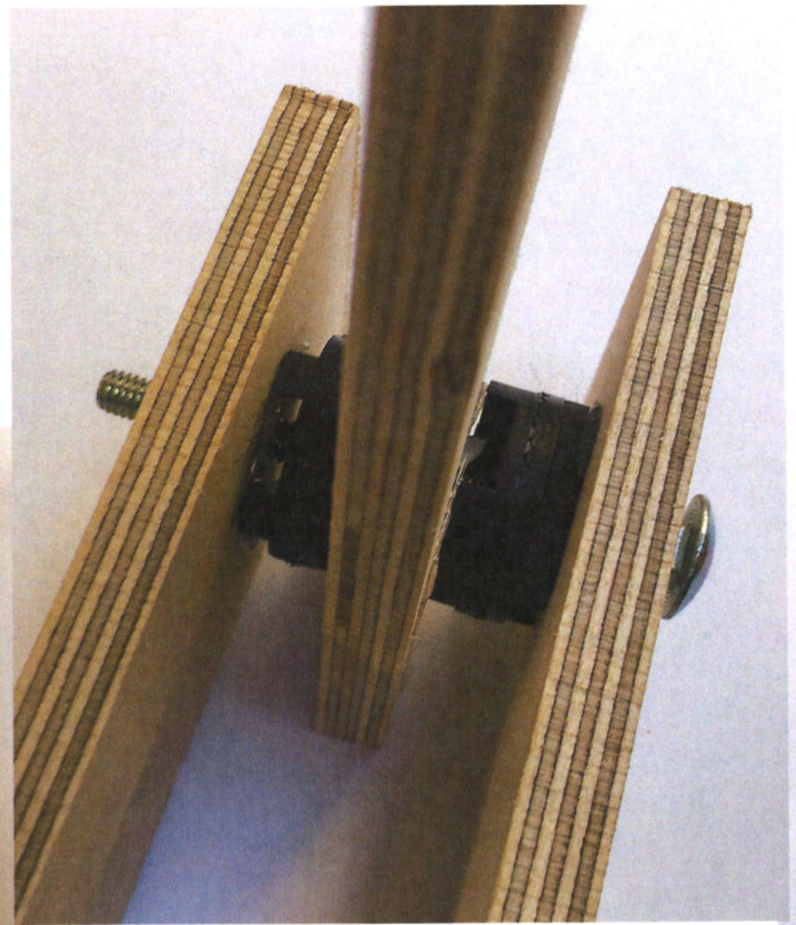


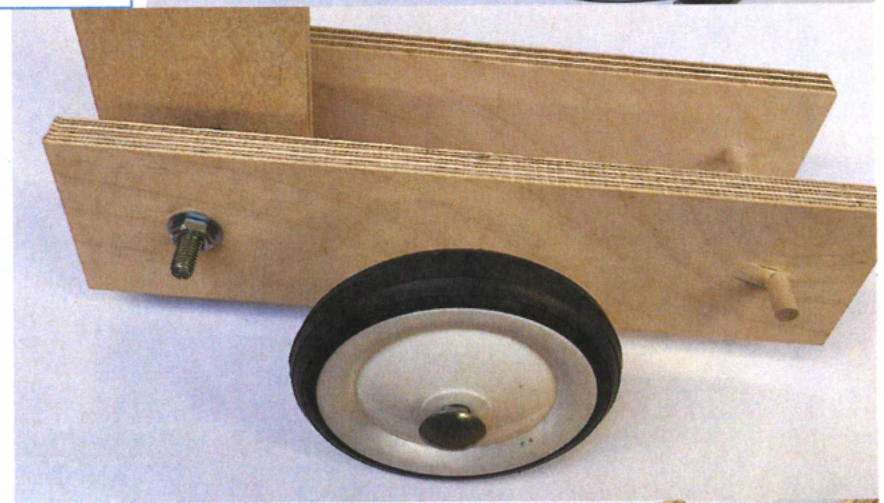
As a result of my last model I created this mechanism. It works by using four locking screws/washers and a central axis. I found from this model that the four locking screws/washers must be correctly aligned otherwise when the beams are at both positions they may be incorrectly aligned. I also learnt from the model that the secondary wheels must be placed slightly down the lower beam in order for it to avoid blocking the mechanism above it. Structurally my model was very strong. However, like my last model the further away from the central mechanism the more the beams bend towards each other. To help fix this I plan to add structural support beams along both the top and bottom beams. As a result of adding the wheel I also learnt that the axel for the wheel must pass through both beams, this will help the beams to stay strong as well as the wheel wont bend upwards with the weight. As a result of my model I also decided the crutch mechanism which uses metal hollow tubes would be easier to construct by using to separate beams which are joined together. This beam will have holes allowing for the adjustability of the heights of the beams. The two outside beams will be joined by thin panels either side. To help work out the dimensions of this idea I made a model as seen on the next page. In terms of this model I think it really helped me move forward my project. Although it had its flaws it helped me to work out these problems as well as how to improve my design.

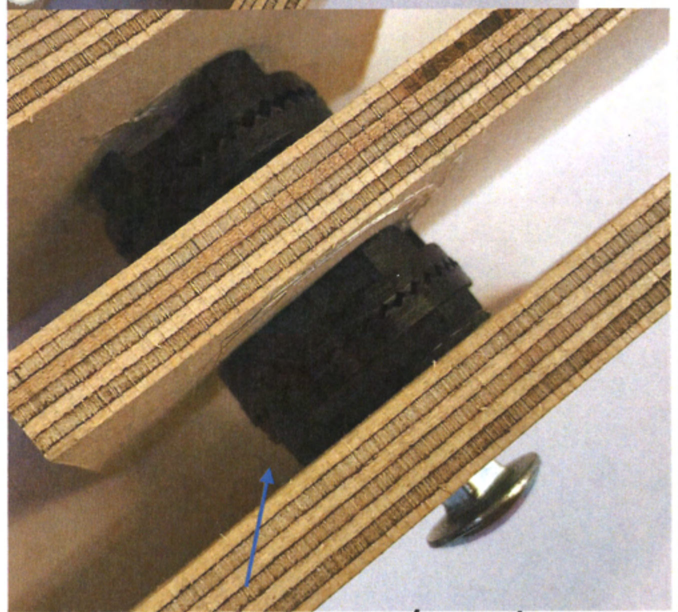




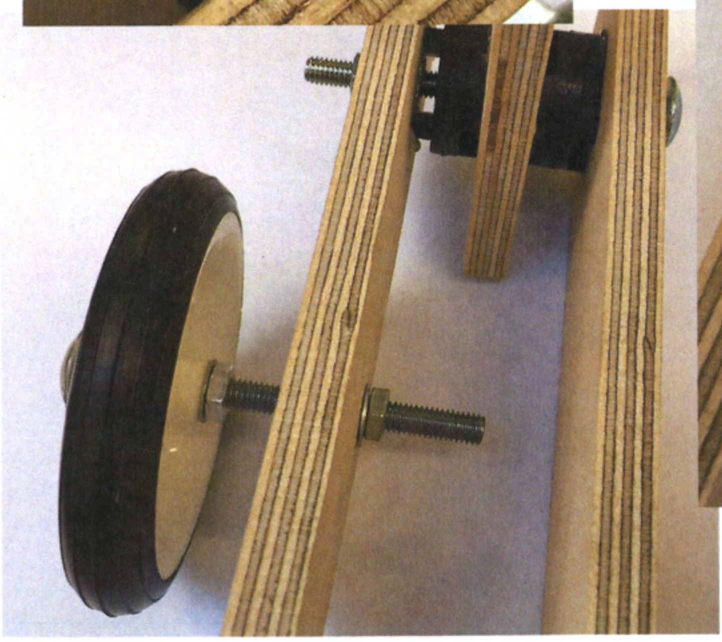


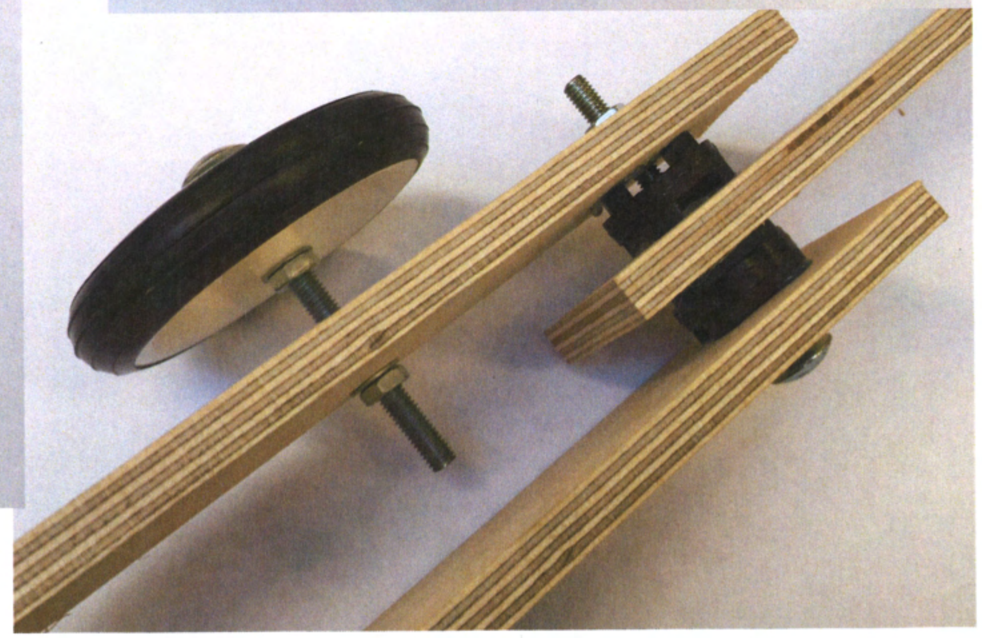




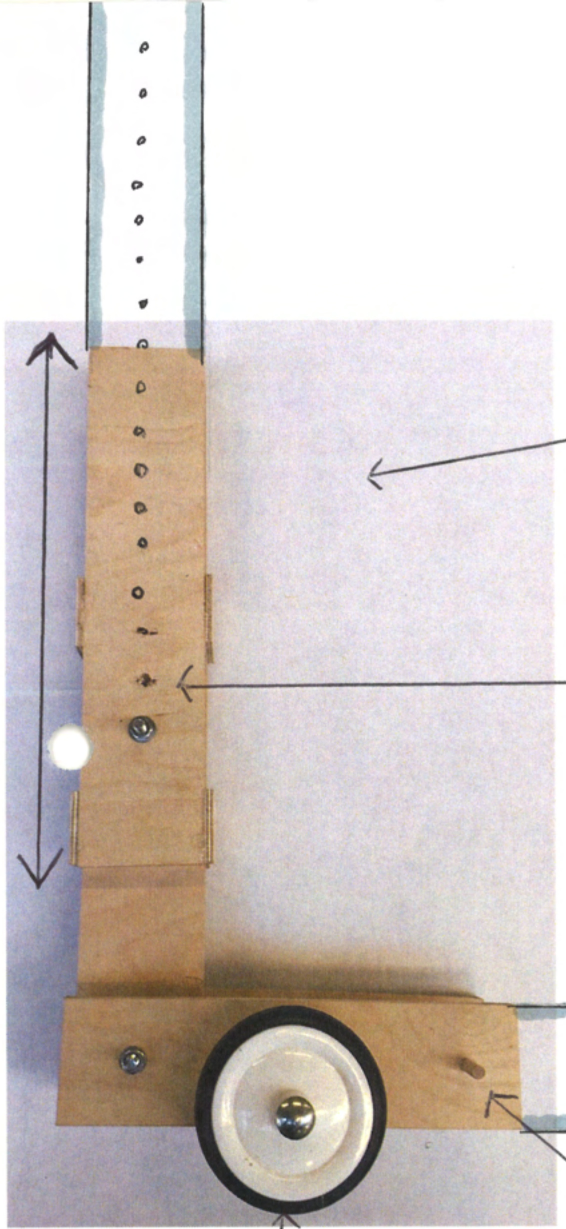


Locking screws/washers





Development 4

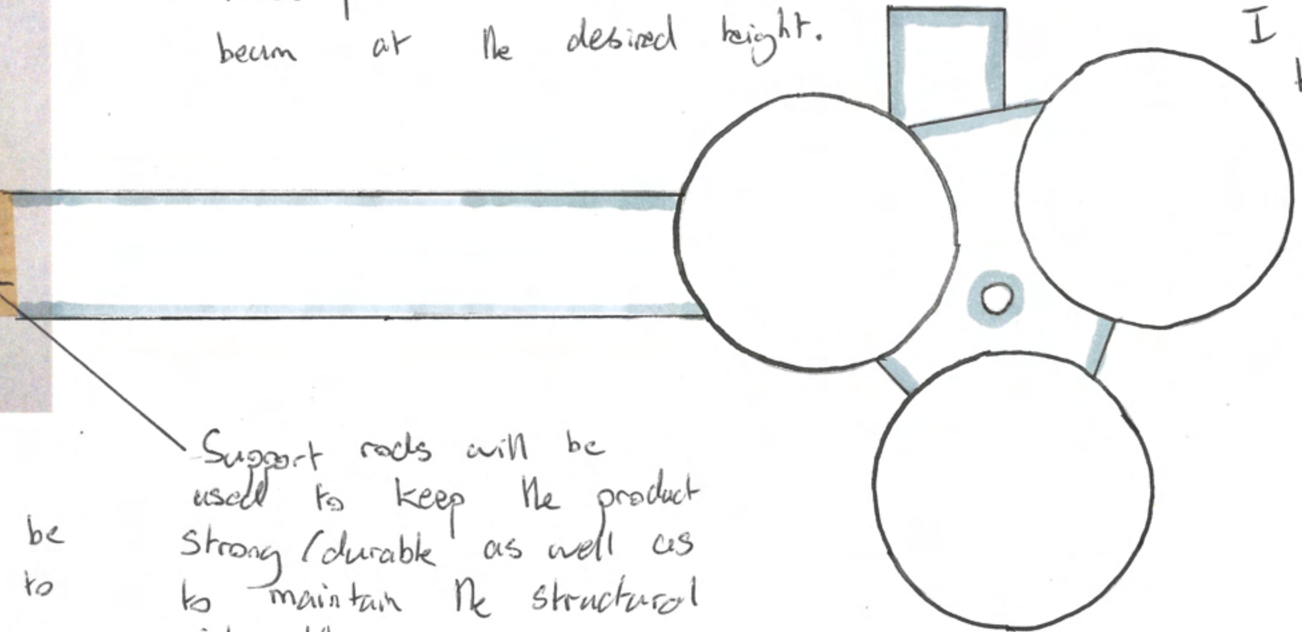


This is roughly what the second mode of the product will look like.

These holes allow for the adjustability of the height of the handles. A single loose pin with a nut can hold the beam at the desired height.

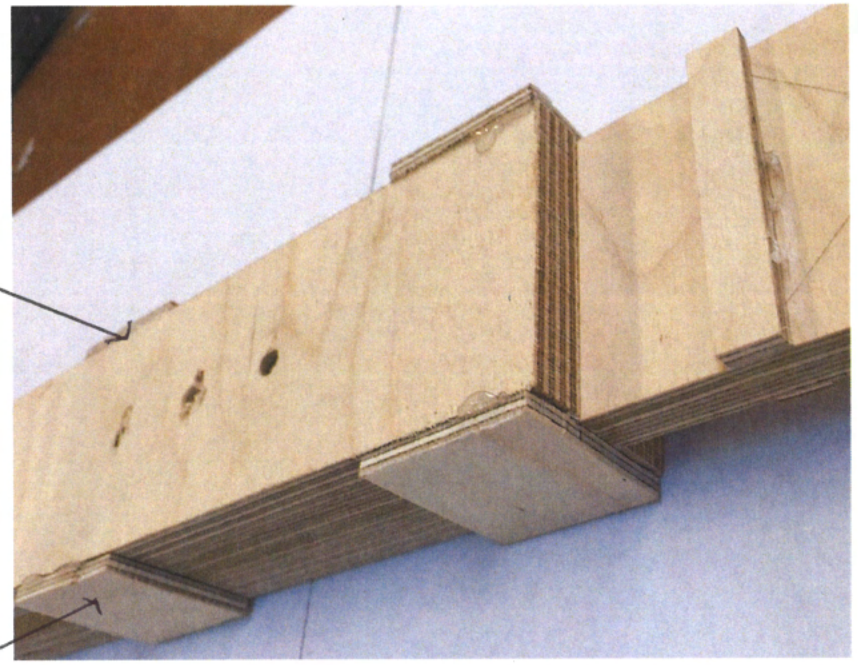
I found the wheel must be away from the mechanisms to the left to avoid interfering.

Support rods will be used to keep the product strong/durable as well as to maintain the structural integratity.



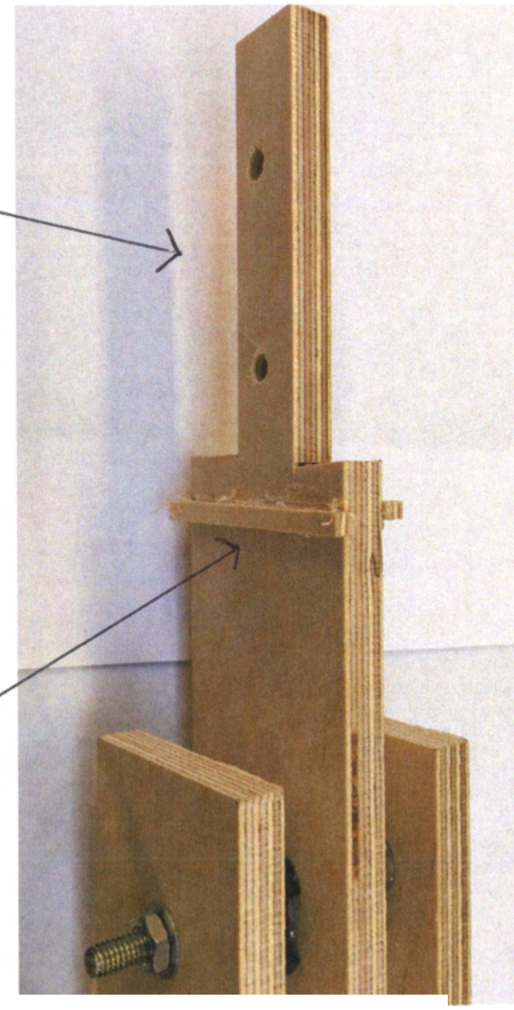
The strips will be on both sides and will be joined to the metal using brazing as there will be little stress on the product in this area.

I will use Aluminium to reduce weight



The strips that hold the inner beam must run the entire length of the beam. This way the inner beam will always be correctly aligned.

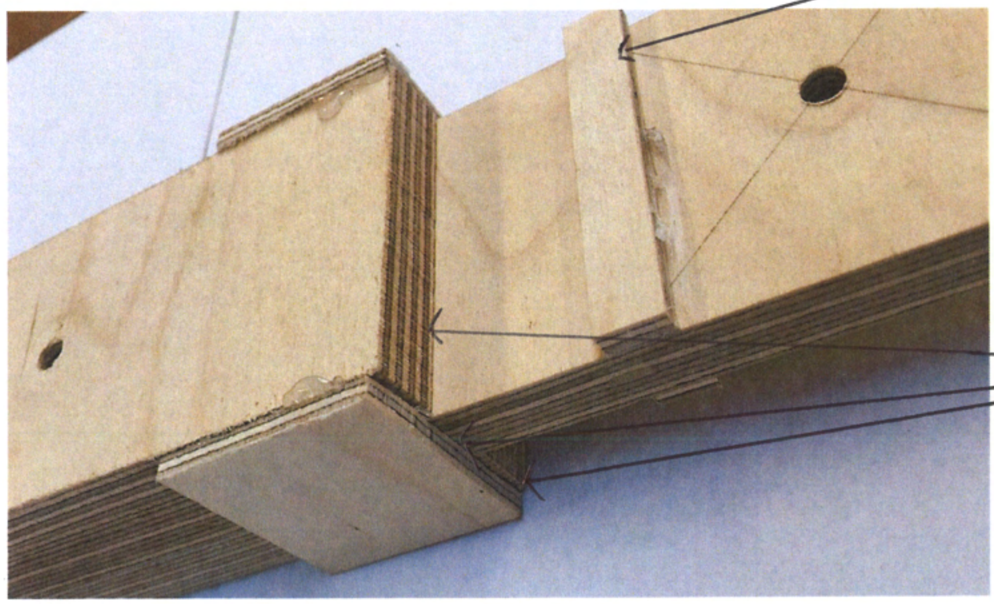
Whilst working out how the crutch mechanism worked I realised the central support axis must be a lot larger for greater structural support.



I also learnt there must be a 'stopper' so that if the user drops the beam it does not hit the wheels or mechanisms.

Blocker to protect the wheels if the user accidently drops the beam. Will be welded on to the main frame.

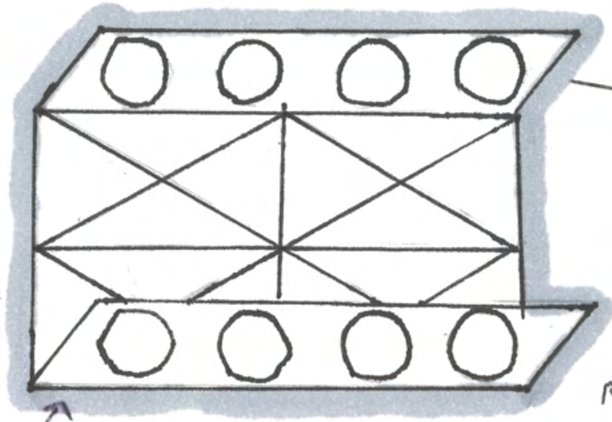
Welding provides an incredibly strong joint



The crutch mechanism is now made up of three rectangle beams. This will make construction easier as well as it should improve the products structural integrity

Development 5

Mid Section



I raised this bit up to help hold the log's in place better.

Aluminium due to its light weight

Metal sheets with holes cut out/punched out.

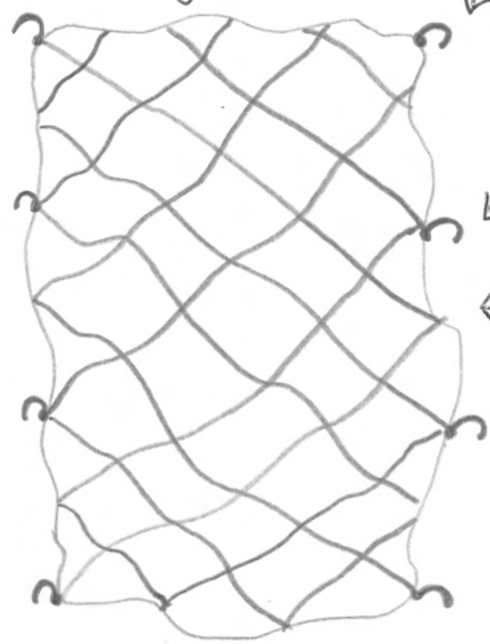
Metal frame will remain the same, just it will have a wire mesh intertwined with the frame.

New idea

Development

The rope will intertwin to stop logs falling through the net.

The hooks attach to the mid-section to help hold the logs down.

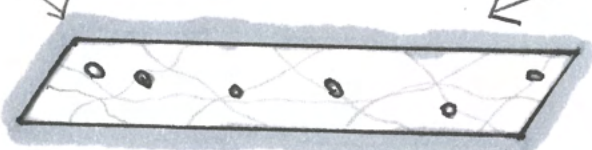


The hooks clip onto the raised sides.

The net is made from strong stretchable nylon rope.

Provides flexibility for the net

The frame will be bolted into the mid-section.



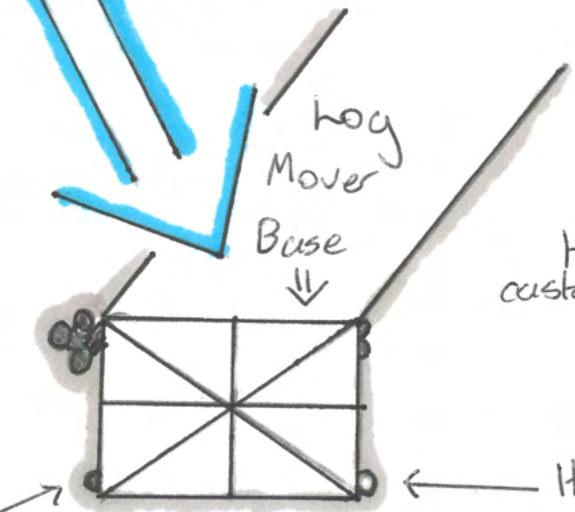
This is a development of my original idea. By removing the metal sheet and just using rope the weight of the product should be reduced.

This idea will still use a metal frame to keep the mid-section strong and durable.

This will make carrying logs in the products on first made safer and easier.

The hooks will slide to allow the logs to fit into different positions.

Log Mover Base

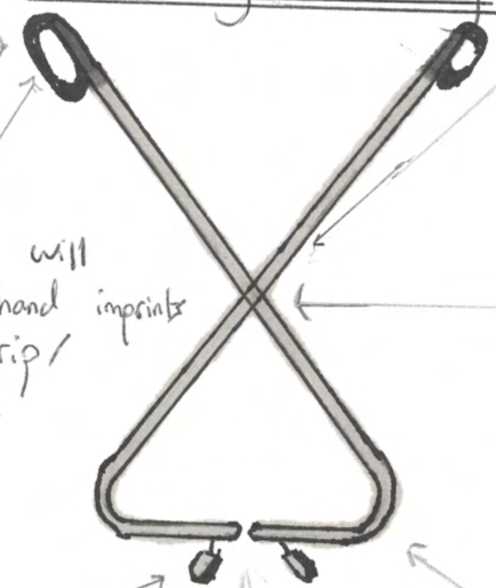


Hooks pewter casted to speed up production (same model)

Hooks at the end of the base on both sides

The hooks allow the cargo net to attach to the base

Unloading/Loading



Aluminium

A thin bolt will pass through both metal frames holding them together

The handles will have rubber hand imprints for better grip/ergonomics.

The mechanism will have brass washers to avoid abrasion/the mechanism wearing down.

The covers will protect the user and sharp edges when the grabber isn't being used.

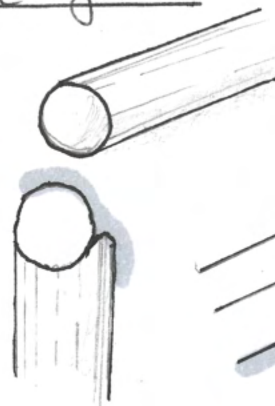
Sharp edges will pin the log in place whilst it is being picked up

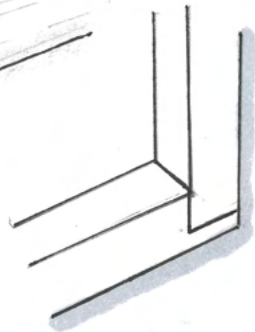
The bends will be made using a jig and heat until the metal is the correct shape

Materials, Dimensions and Construction techniques

Base frame

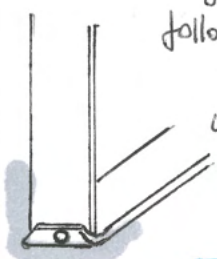
Brazing





Welding

I will use brazing as it provides a strong joint. It is a quick and easy process to learn so it will be the most effective for making my product.

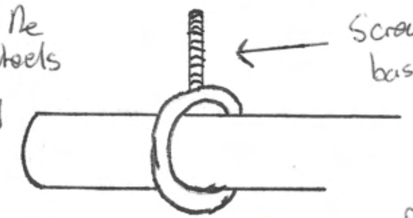


Pop riveted

After looking at the following joining techniques I decided that brazing would be the best joining technique.

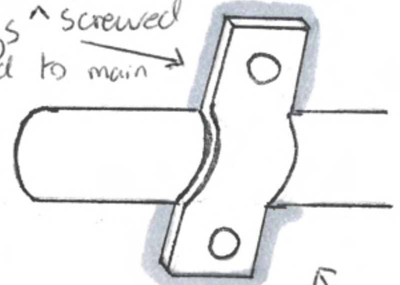
Wheels to base frame

Axel for the wheels



Screws into the base of the ~~main~~ base frame

Casings ^machine screwed or welded to main frame

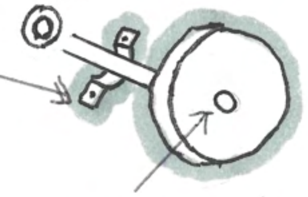


For my final product I will use both techniques. I will use the screw in the middle for main strength supported by four casing support that are screwed in.

Axel pinned in to main frame by multiple casings.

washers to reduce friction

Pop-riveting is possible



domed locking nut

Both ends of axel are thread using tap and die

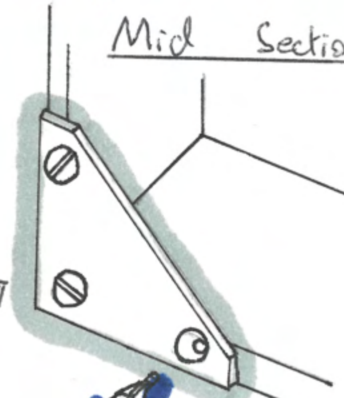
Same joining method for axel

Top area brazed to the main frame.

metal bent to 90° using jig

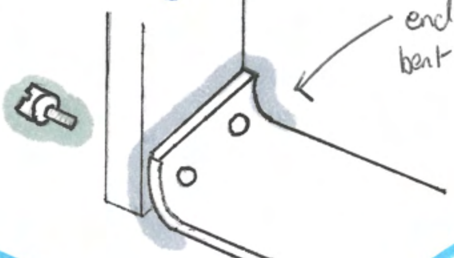
Bolts and washers used to hold axel in correct place.

Mid Section



Although this temporary joining method is more complicated it is stronger and requires less machinery. Therefore I will use this joining method.

joining the mid section ~~[illegible]~~ to the raised section

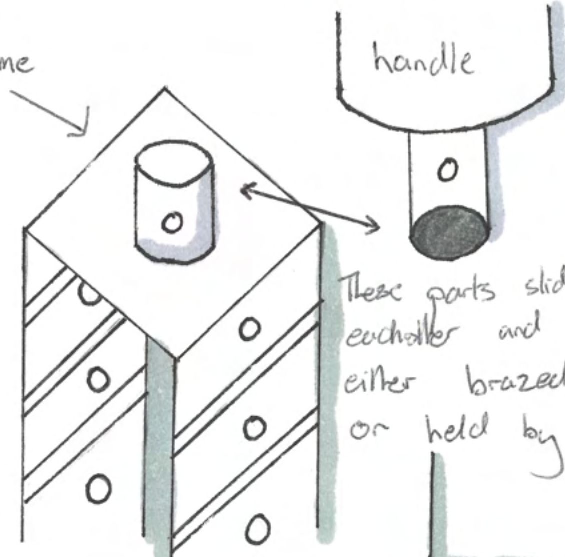


end of mid-section bent for screw holes

Handles to main frame

main frame

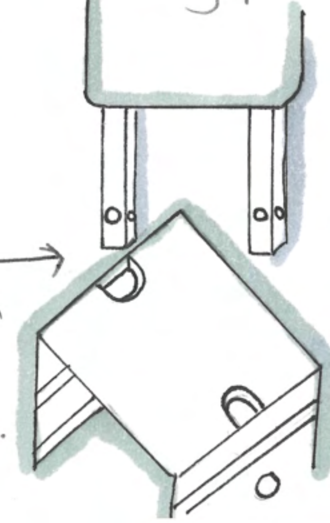
handle



If I use pins for this construction technique I will be able to change/replace the handles easily if there is a fault with the handles at some point.

These parts slide over eachother and are then either brazed together or held by pins

Pins slide in and are then bolted down using a big screw and a locking nut.

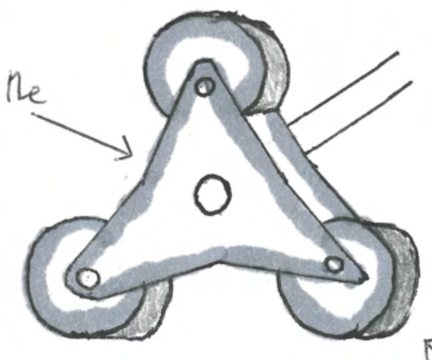


I think this method will be stronger and easier to construct so I have chosen it.

3 Wheel Construction

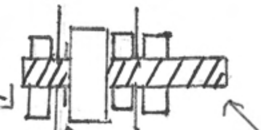
Steel sheet metal holds the three wheels in the correct place

Main Base



Large rubber wheels for better stability

Nuts ~~Bolts~~ will hold the wheels in place



Bolt passes threw each wheel

washers either side to reduce friction and corrosion.

Bolt passes through both sheets of metal and a little further to allow room for the nuts and washers.

Base frame to main frame

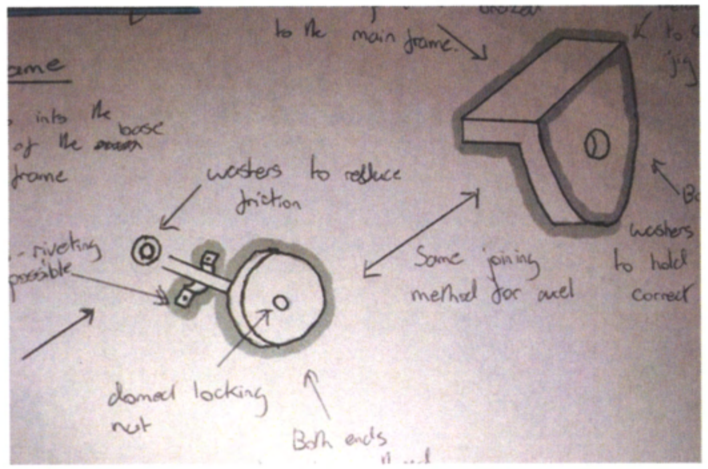
I think using the joining method on the left will work better as with the join and also weld a very strong joint is made

Little grip for joint therefore ~~[illegible]~~ less strength in the weld

Comments on development of design

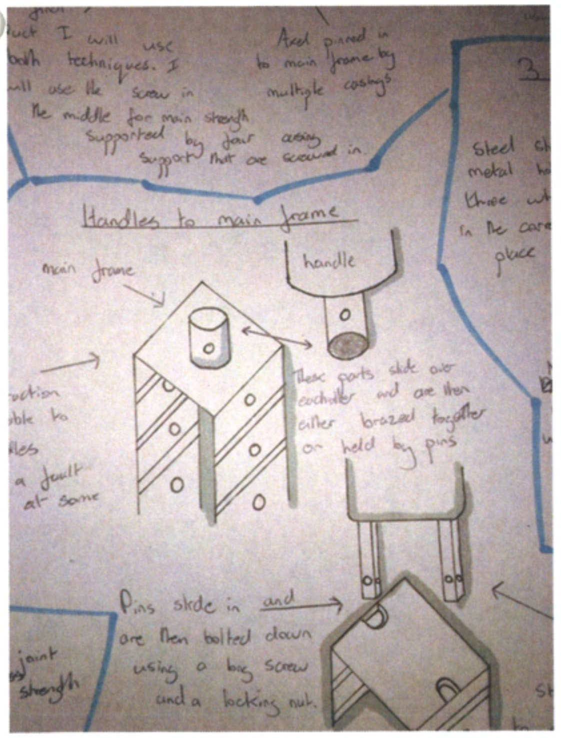
Handles- "I really like the way you've created the handles, I often struggle to grip items and products but by the looks of what you've developed here it looks suitable for someone like me."

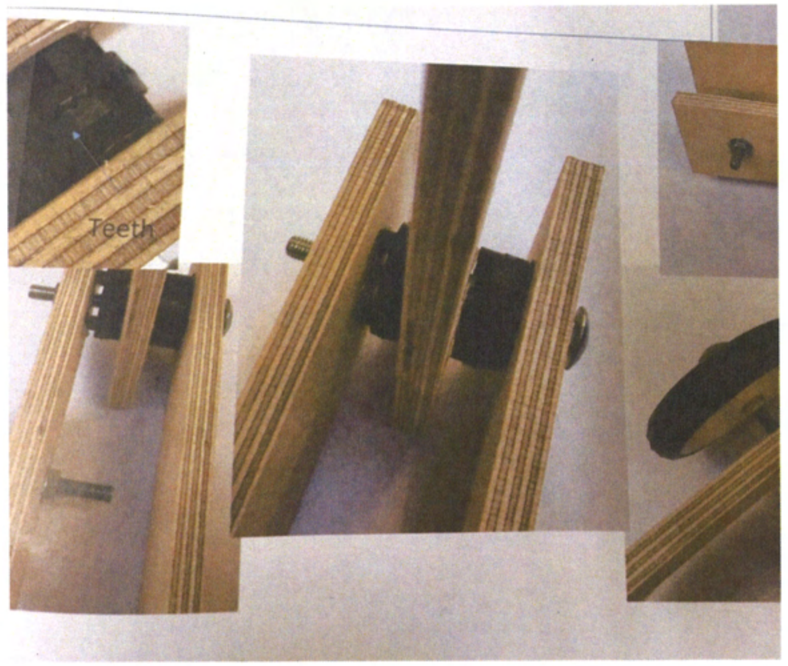
Unloading/loading- "The concept of using a grabber as a go between from the ground to the mover will be very useful."



Crutch Handles- "After breaking my wrist last summer I think having the extra support on the handles will greatly benefit someone like me. Spreading the force over more area should make the product easier to use."

Construction techniques- "Although I don't really understand many things with construction Will explained it all very well and as a result I can say that the construction looked very well thought out and clear."





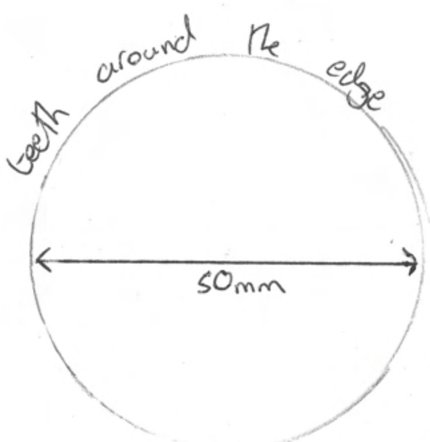
Crutch adjustment- "Another very thoughtful design. As many different heighted people will use this product, it must be adjustable and I think this is a very clever way to do just that."

Folding mechanism- "This mechanism is very clever and I like the way it works. As long as I am strong enough to move the mechanism I think it is a great idea."

Mathematical/Scientific principles and commercial production possibilities

* If they are to hard to produce in the workshop they will be bought in from elsewhere.

Locking washer

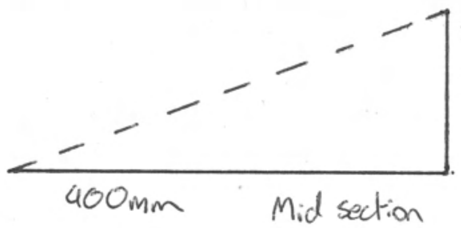


Circumference of circle is equal to $2\pi r$

The circumference is $2 \times \pi \times 25$ = 50πmm or 157mm (3sf)

Say we have 40 teeth for the locking washer they would need to be spaced just less than 4mm apart.

Cargo net length to reach the base

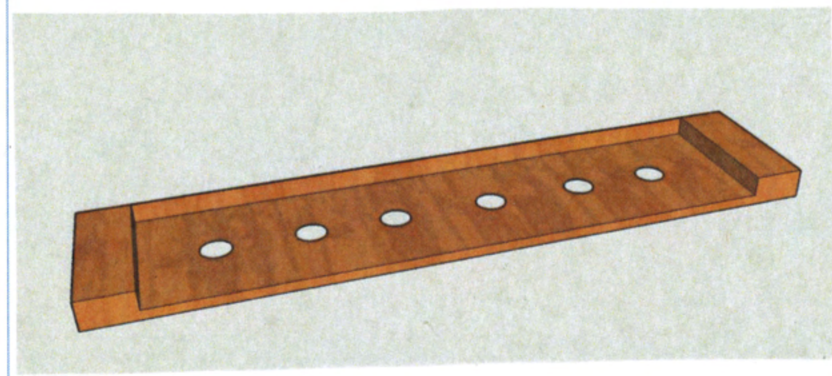


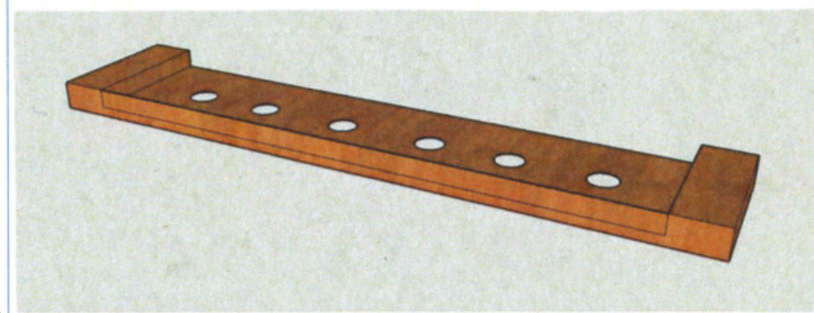
Using the triangle rule we know that $a^2 + b^2 = c^2$

Therefore we know that the length of cargo net needed is $\sqrt{400^2 + 250^2}$ = 472mm

To allow for a little slack I have decided the cargo net length should be 475mm.

Looking at how batch production could work for a problem like this I looked at jigs/templates for this product. Using jigs/templates helps speed up production





I designed this jig on CAD, it shows how I plan on cutting out the main frame above the mid-section.

How it works

The correct sized peice of metal is cut and fored. It is then slid into the jig and locked in place with two clamps. Once secure the jig is placed on the pillar drill where the correct holes. are drilled the correct distance apart.

If I do choose batch production as my scale of production I will also create jigs to help create the crutch grips. This could be done using handle bends as well as the handle a mould. I would also use bending jigs for various components throughout my design.

Scientific principles

Throughout my manufacturing/designing I will perform tests on materials/processes used.

Brinell test - I will use this test to evaluate the hardness of the materials I plan to use for my product.

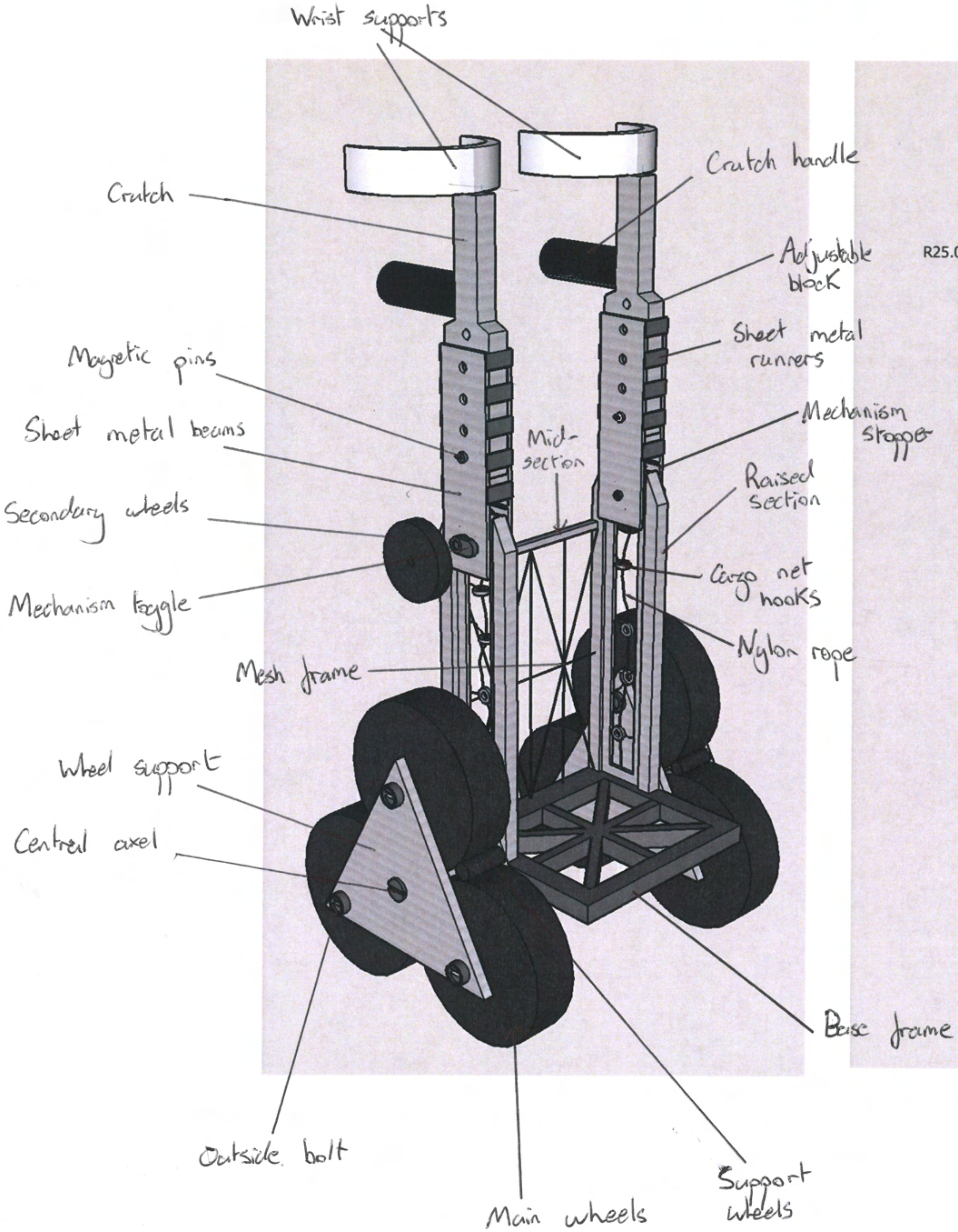
Izod impact test - I will use this test to see the toughness of the parts I plan on using. This is very important as logs will be dropped on my product at some point and the product must withstand these impacts.

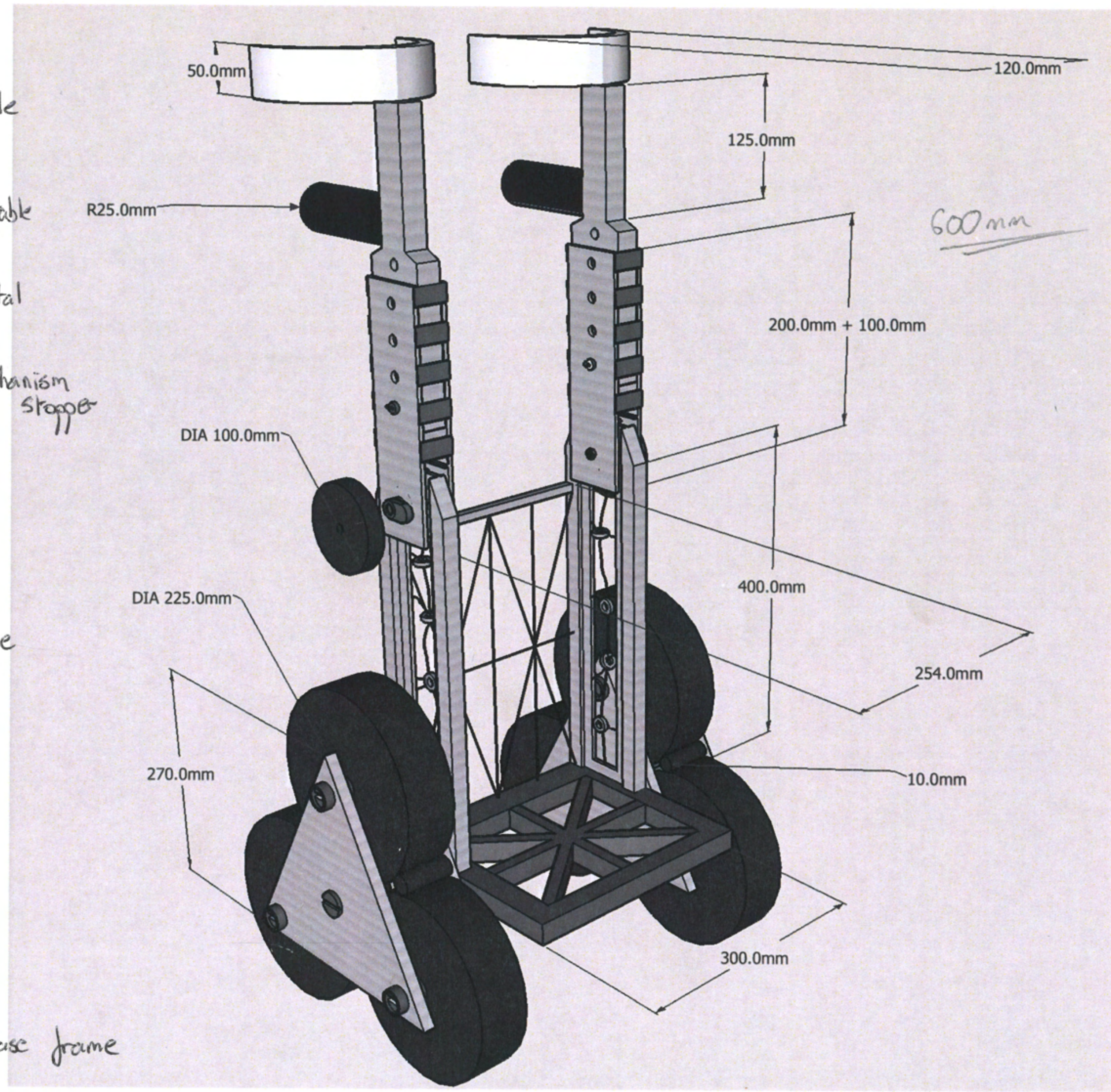
Tensile strength - Using nylon rope and other materials that could be pulled apart means I must choose materials that can handle high tensile stress.

Although this product will be a one-off production it would be time consuming and expensive to make each of this product the same way. Making products like this using one-off production is ineffective. For this reason I will try to employ batch production or continuous production techniques throughout the production and manufacturing stages.

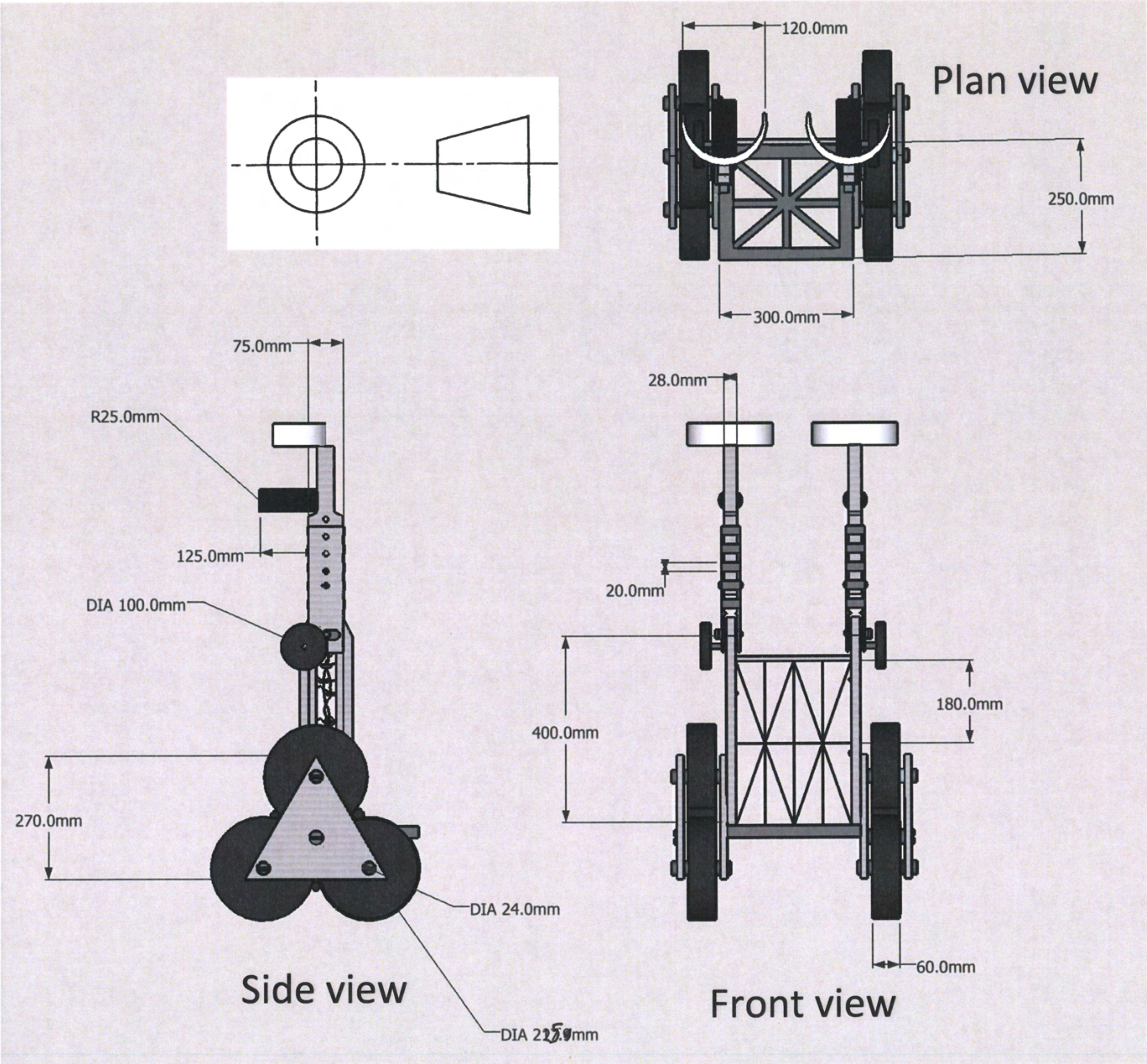
Some methods of continuous production could be employed throughout the making of a product like this. A production line method could be introduced is a real world environment. This would greatly increase the speed of production for the product. However using a production line leads to little flexibility of the product meaning if a fault was discovered after the testing stage it would be expensive to fix the problem by changing the machines.

Final design in isometric

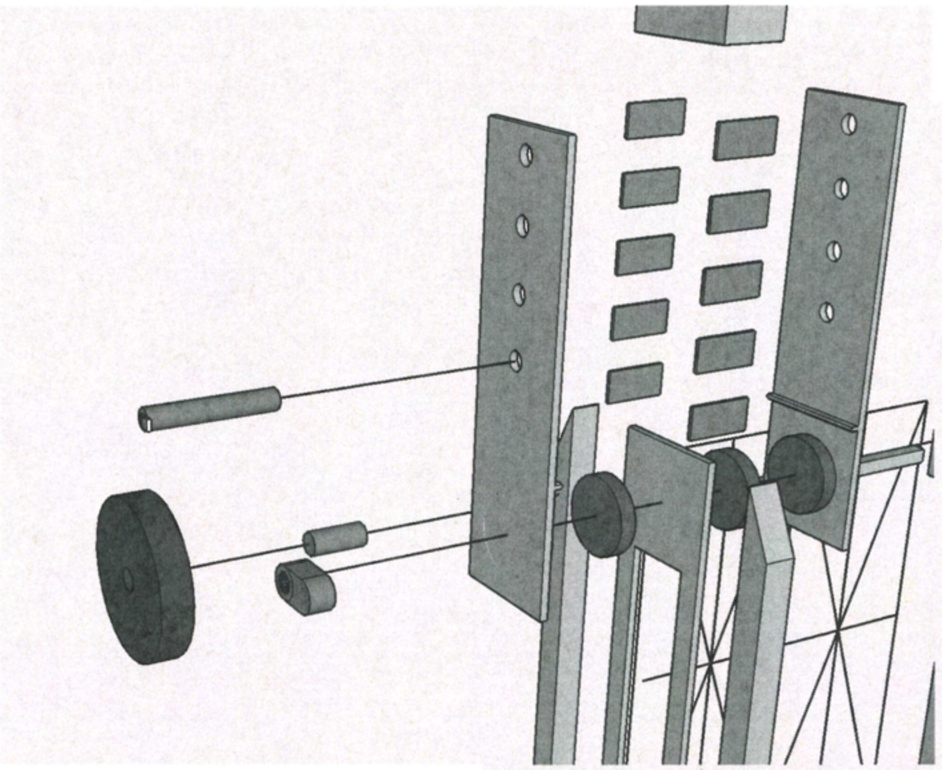


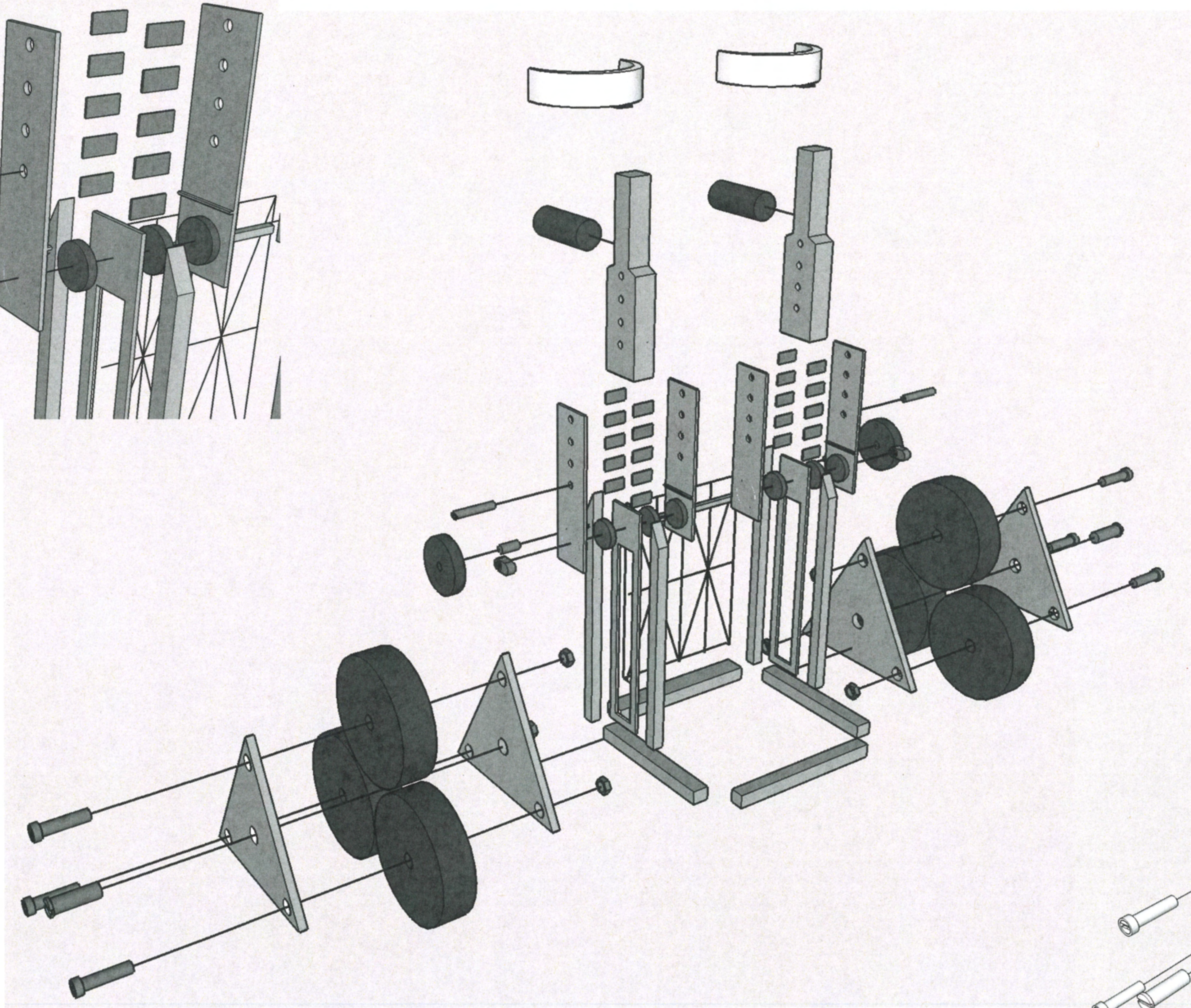


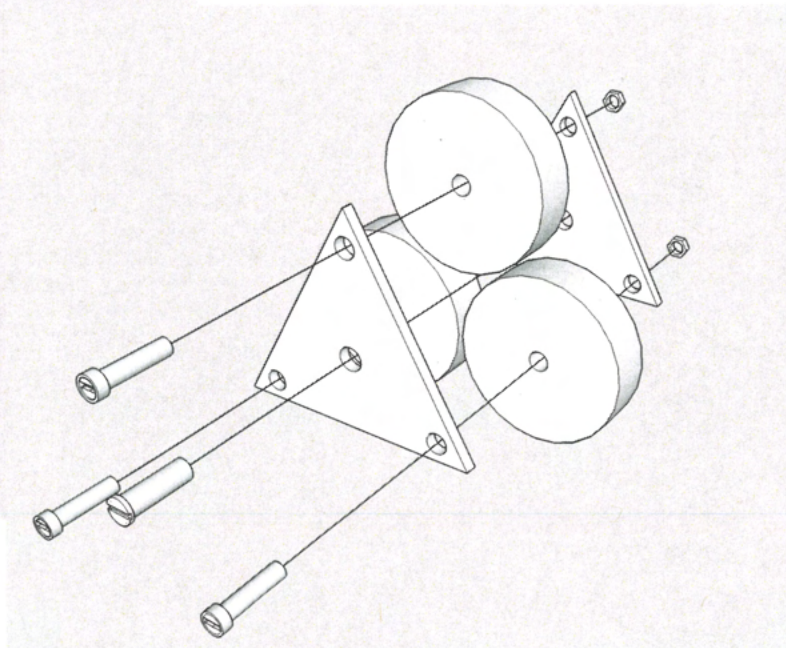
Third angle orthographic drawing to scale



Exploded drawing

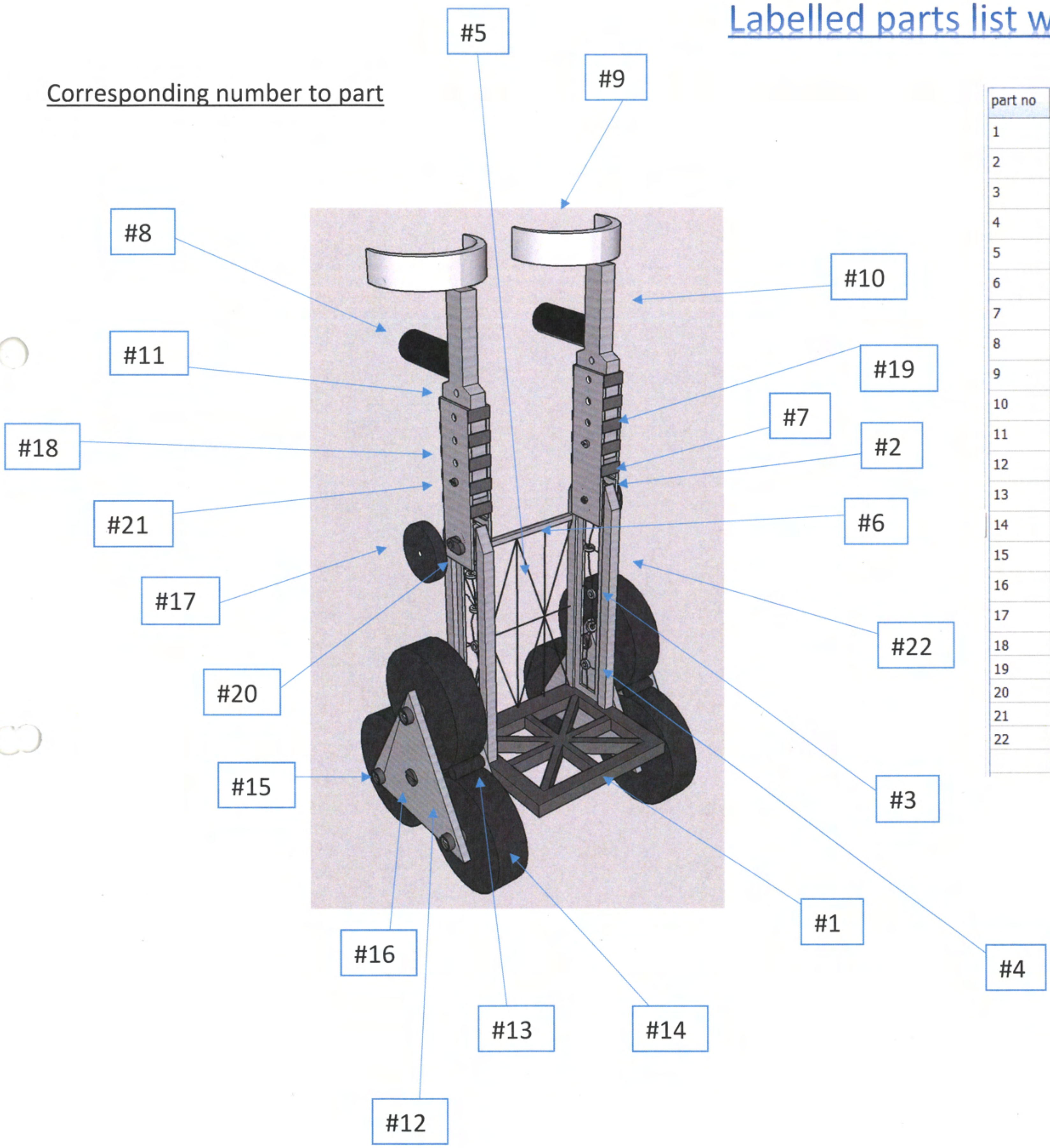






Labelled parts list with costing

Corresponding number to part



part no	description	material	no. off	size/item	length	width	thickness	unit cost	total cost
1	Base frame	Aluminium	1	20 [square tube]	1.800 m			£1.38 per m	£2.48
2	Locking washer	Nord locking washer	8	25mm				10p each	80p
3	Cargo net hooks	Circular hooks	10	20mm				4p each	40p
4	Nylon rope	Nylon rope	1	6mm	2.000 m			96p per m	£1.92
5	Mesh frame	Mild Steel	1	3 [round]	2.500 m			30p per m	75p
6	Mid-section	Aluminium	1	6 [square]	300 mm			£2.07 per m	62p
7	Mechanism stopper	Aluminium	1	12 x 3 [strip]	300 mm			£1.80 per m	54p
8	Crutch handle (-rubber)	Aluminium	1	25 [round]	250 mm			£14.37 per m	£3.59
9	Wrist support	PVC	1	75x75x10mm	400 mm			£1.20 per m	48p
10	Crutch beam	Aluminium	2	20 [round]	125 mm			£10.10 per m	£2.52
11	Adjustable block	Aluminium	2	25 [round]	350 mm			£14.37 per m	£10.06
12	Wheel support (second hand)	Wheel support	1	270x270x15mm	270 mm	270 mm		1p per sq m	0p
13	Support wheels (second hand)	Support wheels	6	100mm circular				1p each	6p
14	Main wheels (second hand)	Main wheels	6	225 circular				1p each	6p
15	Outside bolts	Bolt, coach	6	M10 x 130mm				20p each	£1.20
16	Central axel	Aluminium	1	12 [round]	400 mm			£4.35 per m	£1.74
17	Secondary wheels	Secondary wheels	2	100m diameter				1p each	2p
18	Sheet metal beams	Aluminium	4	1.6 mm [sheet]	250 mm	75 mm		£65.00 per sq	£4.88
19	Sheet metal runners	Mild Steel	20	0.9 mm [sheet]	40 mm	20 mm		£7.90 per sq n	20p
20	Mechanism toggle	Pewter	2	25x25x100mm				£1.64 each	£3.28
21	Magnetic pins	Magnetic pins	2	75x12x12mm				95p each	£1.90
22	Rasied section	Aluminium	4	12 [square tube]	400 mm			£1.00 per m	£1.60
								Total	£39.10

Total cost = £39.10

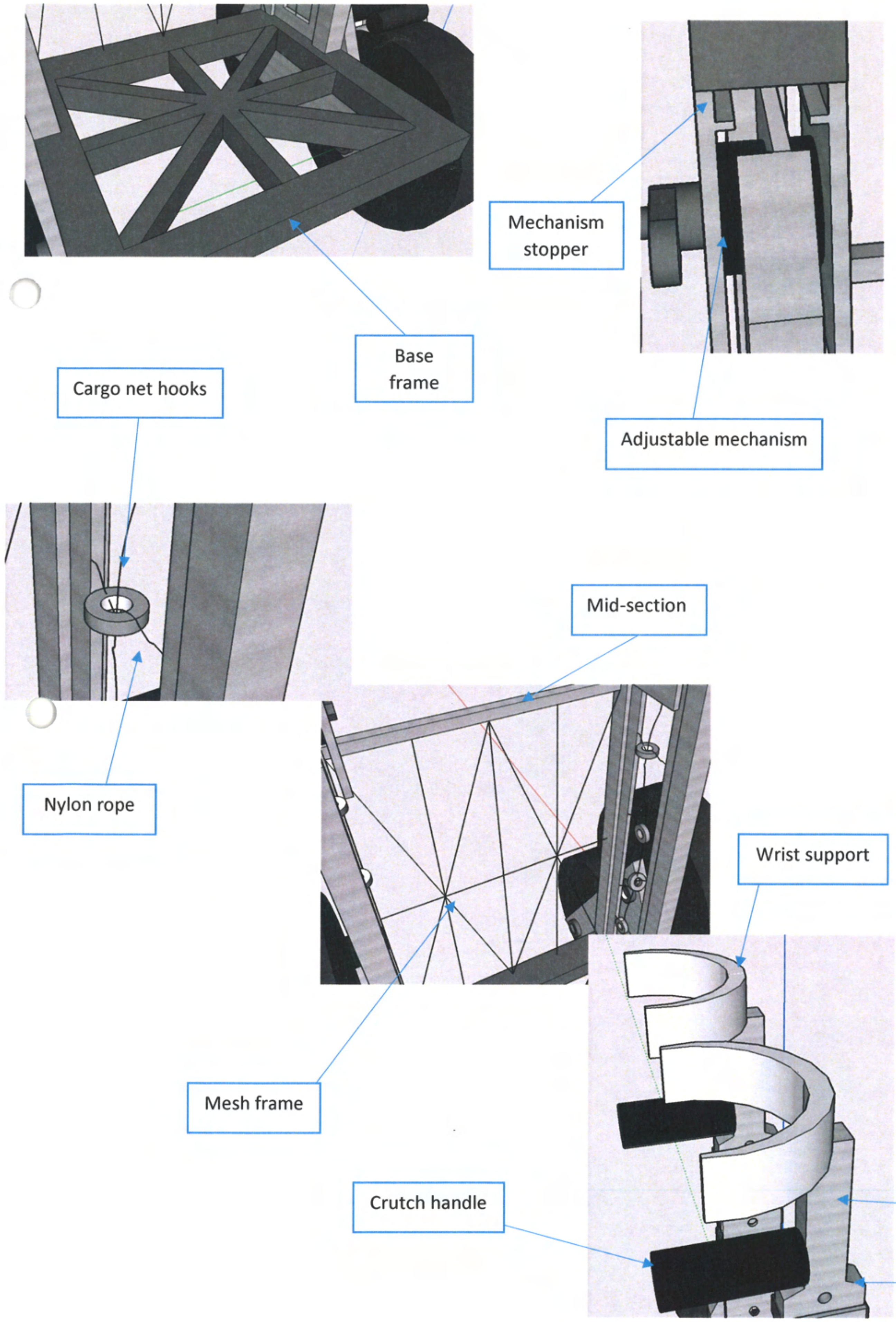
Plus £2.86 for cost of joining methods = £41.96

Add 20% text = £41.96 X 1.2 = £50.35

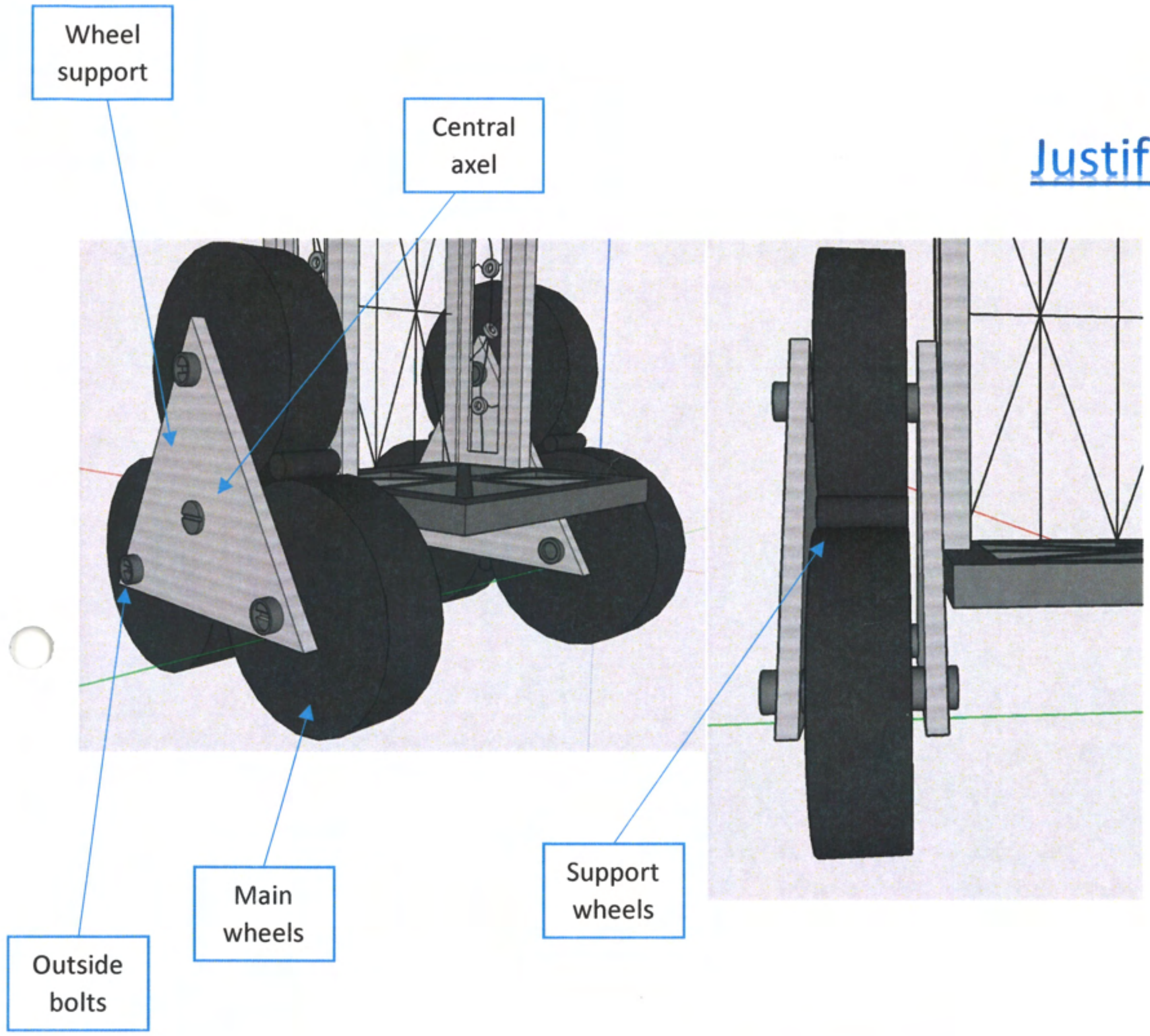
Final cost = £50.35

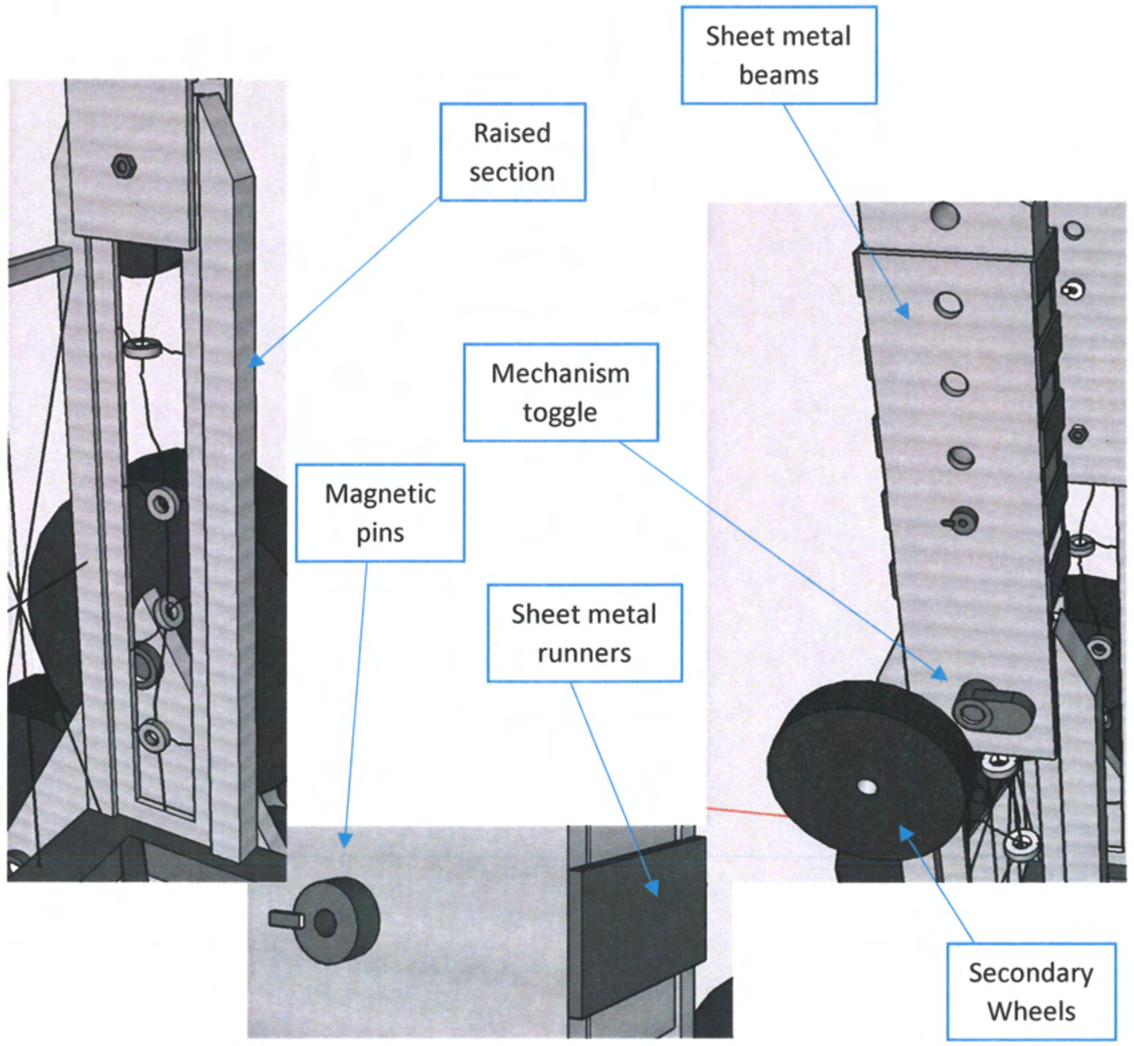
Justification of all materials and processes

*Numbers relate to parts list



Part	Material	Justification	Process	Justification
Base frame (1)	Mild steel	Steel is an incredibly strong metal; therefore, it will withstand the forces placed on it from the weight of the logs	Welding	Welding is a very strong joint that can withstand large impacts and forces therefore it is perfect for the base frame. Brazing is energy intensive so its use must be limited
Adjustable mechanism (2)	Mild steel	Steel is an incredibly strong metal; therefore, it will withstand the forces placed on it from the weight of the logs. Mild steel is very durable, extending the lifespan of the product	Nuts and bolts	Using a temporary method of joining allows the mechanism to be easily accessed and replaced if there is a fault. This stops the whole product needing to be replaced if there is a fault
Cargo net hooks (3)	Pewter	The cargo net hooks are complex shapes and therefore using pewter casting can mean we can achieve this complex part.	Pewter casting	Pewter casting will be a suitable process as it is easy to repeat multiple times which will be needed for these hooks
Nylon rope (4)	Nylon	Nylon rope is readily avbailable as well as it is very strong meaning it can hold the weight of the loges if nessary. It can also slightly eleastic tio allow room for more logs. Nylon is made from crude oil which can be harmful to the environment/it's a finite resource	Tied together	The nylon rope will be tied together using knots and they will be tied to the cargo net hooks
Mesh frame (5)	Mild steel	Steel is an incredibly strong metal; therefore, it will withstand the forces placed on it from the weight of the logs	Brazing	Brazing is a strong permanent joint as well as it is easy to learn. Brazing will allow for precise joins. Permanent joins can make the product harder to recycle.
Mid-section (6)	Aluminium	Aluminium is a lightweight material with great strength. It is corrosive resistant as well as it can be recycled. It does not require a finish. Aluminium can also be recycled	Brazing	Brazing is a strong permanent joint as well as it is easy to learn. Brazing will allow for precise and durable joints.
Mechanism stopper (7)	Mild steel	Steel is an incredibly strong metal; therefore, it will withstand the forces placed on it from the weight of the logs	Welding	Welding is a very strong joint that can withstand large impacts and forces therefore it is perfect for dealing with the mechanism stopper
Crutch handle (8)	Rubber	Rubber is a eleastic material and therefore can change sgape to fit the users hand making the product more ergonomic. Rubber can be recycled multiple times	Nuts and bolts	Using a temporary method of joining allows the part to be easily replaced if there is a fault. Nuts and bolts are a zero-energy joining method
Wrist support (9)	Polyvinyl chloride	PVC is a strong thermoplastic that can be moulded into shape. It is also a very hygenic material and is easy to upkeep	Brazing	Brazing is a strong permanent joint as well as it is easy to learn. Brazing will allow for precise joins. Permanent joins can make the product harder to recycle.
Crutch beam (10)	Aluminium	Aluminium is a lightweight material with great strength. It is corrosive resistant as well as it can be recycled. It does not require a finish	Brazing	Brazing is a strong permanent joint as well as it is easy to learn. Brazing will allow for precise joins. Permanent joins can make the product harder to recycle.
Ajustable block (11)	Aluminium	Aluminium is a lightweight material with great strength. It is corrosive resistant as well as it can be recycled. It does not require a finish	*Not physically attached	This part of the product slots into my design and it not physically attached





Justification of all materials and processes

*Numbers relate to parts list

Part	Material	Justification	Process	Justification
Wheel Support (12)	Aluminium (second hand)	Aluminium is a lightweight material with great strength. It is corrosive resistant as well as it can be recycled.	Nuts and bolts	Using a temporary method of joining allows the wheels to be easily replaced if there is a fault
Support wheels (13)	Rubber (second hand)	Rubber has great tensile strength and impact resistance therefore the pressure from the larger wheel will not cause a mechanical fault	Nuts and Bolts	The force of the two larger wheels will hold the support wheel in place. This way removing the wheel will be as easy as removing one large wheel
Main wheels (14)	Rubber (second hand)	Using rubber will allow for a stable product that will be able to traverse many terrains. It is also very durable/strong and so will last a long time	Nuts and bolts	Using a temporary method of joining allows the wheels to be easily replaced if there is a fault or they need replacing
Outside bolts (15)	Mild Steel	Steel is an incredibly strong metal; therefore, it will withstand the forces placed on it from the weight of the logs	Nuts and bolts	Using a temporary method of joining allows the wheels/outside bolts to be easily replaced if there is a fault
Central axel (16)	Mild Steel	Steel is an incredibly strong metal; therefore, it will withstand the forces placed on it from the weight of the logs	Nuts and bolts,	Using a temporary method of joining allows the wheels/axel to be easily replaced if there is a fault
Secondary Wheels (17)	Rubber (second hand)	Again, rubber is very strong/durable. Using second hand wheels will reduce the carbon footprint of my product	Nuts and bolts	Using a temporary method of joining allows the wheels to be easily replaced if there is a fault
Sheet metal Beams (18)	Aluminium	This is a large part of the product and so must be lightweight. Aluminium is also strong as well as it doesn't need a finish making it more environmentally friendly.	Brazing	Brazing is a strong permanent joint as well as it is easy to learn. Brazing will allow for precise joins.
Sheet metal runners (19)	Stainless steel	They must be very strong to hold the adjustable mechanism correctly in place. Steel is also resistant to corrosion.	Brazing	Brazing is a strong permanent joint as well as it is easy to learn. Brazing will allow for precise.
Mechanism toggle (20)	Pewter	The mechanism toggle is a complex shape and therefore using pewter casting can mean we can achieve this complex part.	Nuts and bolts	Using a temporary method of joining allows the wheels to be easily replaced if there is a fault
Magnetic pins (21)	Iron	Iron is a strong material whilst it is also magnetic therefore it will be able to hold the sheet metal beams without being structurally weak	Uses magnets to hold in place	Using magnets mean the part can be easily removed and replaced quickly without any faults occurring
Raised section (22)	Aluminium	Aluminium is lightweight and it is a good material to weld. These properties make it great for this part of the product	Pop riveting	Pop riveting is sufficiently strong for the raised section, it is a quick and easy process, as well the mid-section will support the pop rivets.

*Same sustainability issues as first page

Life cycle assessment

Life cycle assessments allow designers to consider the impact of a design on the environment. A way to measure the sustainability of a design is to calculate how much CO_2 the design releases from the extraction of raw materials to its end of life. Using LCA calculator I calculated how much CO_2 my design released. I calculated that my design would release about 54.6kg of CO_2. To put that into perspective it is the equivalent for driving a car for 2 hours or flying a plane for 6 seconds.

Raw materials: As my product is made mostly from metals such as aluminium and mild steel the extraction of these materials will be energy intensive. The extraction of bauxite ore and the electrolysis needed to get the aluminium can use a lot of energy. To reduce raw materials needed I am going to recycle metal were possible as well as to remove unnecessary parts of my design where I feel fit. Another major contributor to my CO_2 output is synthetic rubber used in the wheels. For this reason, I am going to try and use second hand wheels from an old go kart.

Manufacture: The two most used processes in my design are brazing and joining with nuts and bolts. Brazing is a process which requires heating and melting metals together. It is energy intensive and so I intend to limit its use where possible. Nuts and bolts however release zero CO_2 when being joined, they also allow parts to be replaced instead of the whole design which will further reduce CO_2 emissions throughout the products use and lifespan.

Transport: As this product is a one off the CO_2 emitted is relatively low as it only needs to be transported to one destination. If the design was to be batched produced, bulk buying of materials could help reduce transport emissions however the overall emissions would still increase. If batch production were to be introduced I would buy my raw materials locally in an attempt to reduce transport emissions as well as transport costs

Use: As the product does not use energy during its use the CO_2 emission for this part would be zero. However, if the product is not used correctly this could lead to parts needed to be replaced which would result in CO_2 being emitted.

After life: After the product has been used for its intended use and no longer works as intended the product will need to be dismantled and recycled where possible. As some of the product is made from nuts and bolts it can easily be dismantled and recycled. The rubber wheels can be shredded and used for other purposes. However, the parts that are welded will be harder to recycle. Separating the welded parts can be difficult and energy intensive. Therefore, I would limit permanent joining methods where applicable

'A level project' results

Download Excel data

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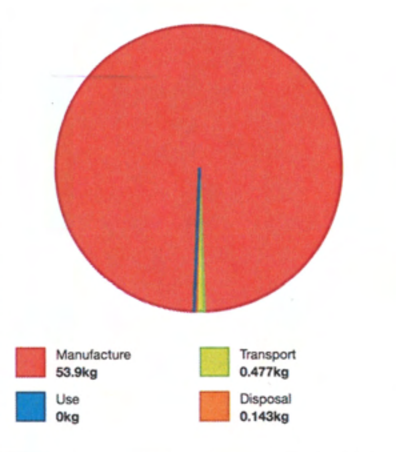


Total product impact during lifetime

54.6kg CO2

This product's CO2 emmissions are the equivalent of watching television for

88 days

Manufacture and disposal

Your disposal phase notes:

Wheels *Manufactured in: Europe (EU)*

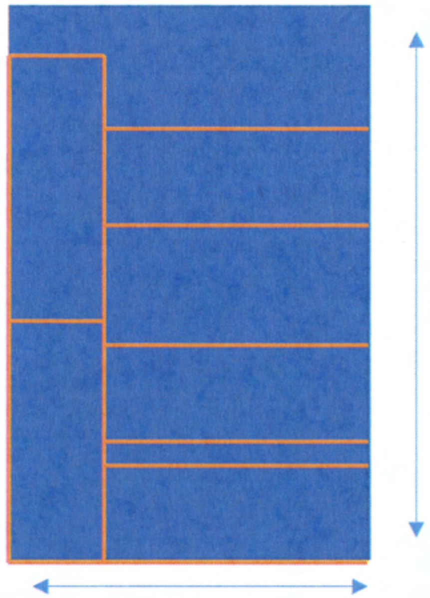
Part name	Material	Part mass	Qty	Notes	CO2
Raised section	Aluminium, Virgin	0.15kg	1	Notes	1.88kg
Magnetic pins	Cast iron	0.05kg	1	Notes	0.0816kg
Mechanism toggle	Aluminium, Cast Alloy	0.05kg	1	Notes	0.162kg
Sheet metal runners	Steel, Low alloyed grades	0.05kg	20	Notes	2.21kg
Sheets metal beams	Aluminium, Virgin	0.25kg	4	Notes	12.5kg
Secondary wheels	Synthetic Rubber	0.3kg	2	Notes	1.67kg
Central Axel	Steel, carbon steel	0.3kg	1	Notes	0.532kg
Outside bolt	Steel, carbon steel	0.1kg	6	Notes	1.06kg
Main wheels	Synthetic Rubber	1kg	6	Notes	16.7kg
Support wheels	Synthetic Rubber	0.2kg	2	Notes	1.11kg
Adjustable block	Aluminium, Virgin	0.2kg	2	Notes	5kg
Crutch beam	Aluminium, Virgin	0.2kg	2	Notes	5kg
Wrist support	PVC, flexible	0.15kg	2	Notes	0.64kg
Crutch handle	Synthetic Rubber	0.15kg	2	Notes	0.834kg
Mechanism stopper	Steel, Low alloyed grades	0.05kg	4	Notes	0.442kg
Mesh frame	Steel, Low alloyed grades	0.4kg	1	Notes	0.883kg
Nylon rope	Natural rubber cert.	0.1kg	2	Notes	0.416kg
Cargo net hooks	Aluminium, Cast Alloy	0kg	10	Notes	0kg
Adjustable mechanism	Steel, Low alloyed grades	0.05kg	4	Notes	0.442kg
Base frame	Aluminium, Recycled	0.1kg	4	Notes	0.601kg
Wheel support	Aluminium, Recycled	0.2kg	4	Notes	1.2kg
Totals:		13.8kg			53.9kg

Transport

Transport name	Assembly transported	Mode	Distance	Notes	CO2
Delivery to client	Final Assembly	Car	25km	Notes	0.477kg
Totals:					0.477kg

Use

Calculations to plan the most efficient use of materials and reduce waste



Total area of 1mm thick metal grid= 1000 X 500 = 500,000mm^2 (0.5m^2)

Total area being used = (350X10) + (350X110) + (350X140) + 2(450X110) + (350X210) + (350X240) = 347500mm^2 (0.3475m^2)

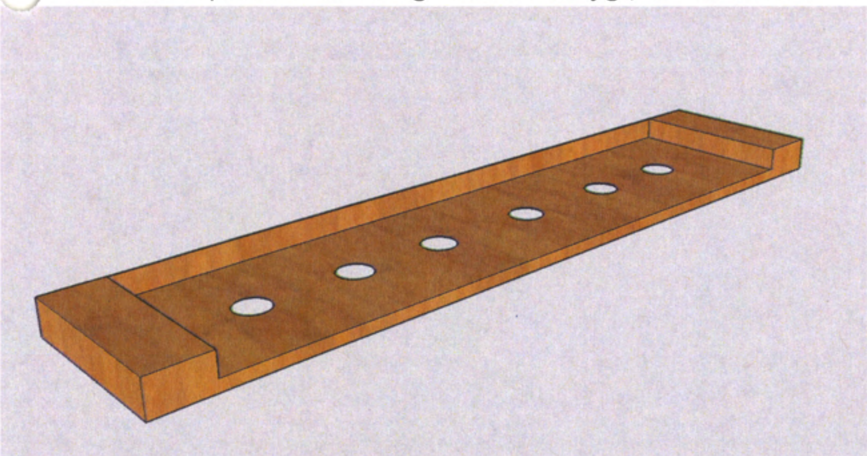
Percentage of area of metal sheeting being used = (347500 ÷ 500000) X 100 = 69.5%

Therefore, the metal being wasted is 30.5%

For my project, I plan to find a use for wasted materials. Whether this being recycling them or integrating them into my design depends on the situation. For this metal square frame, I plan on donating it to the DT workshop where if will be used and not thrown away.

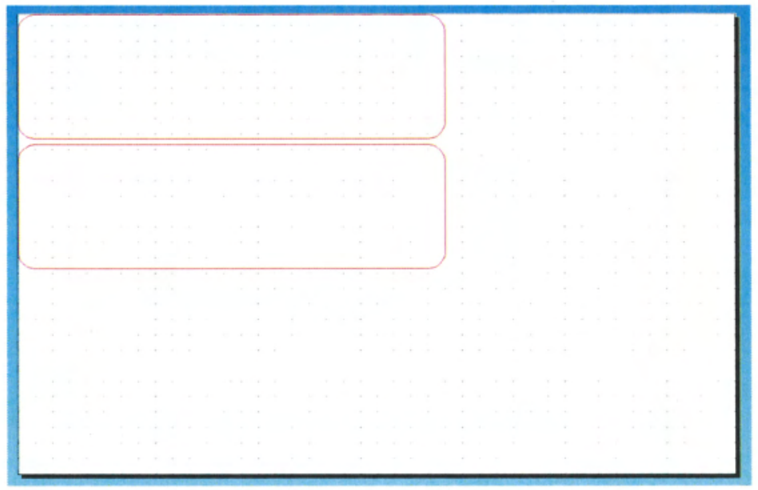
Whilst cutting out parts I plan to employ a few methods to reduce waste as much as possible. The first being at the first stage of manufacture. I plan to ben very accurate with my marking out so that I make no mistakes which could lead to wasted materials. For example, in the example above, when marking out the dimensions I was very accurate. If I had made a cutting mistake I would have needed a whole new sheet of metal grid which would have doubled my costs.

were to batch produce this design I would use jigs, this would reduce the number of dimensional errors in manufacture. This would reduce waste material which would in turn save money. Employing jigs to repetitive manufacture processes in my design would reduce material wastage and would make the most efficient use of materials.



Obviously, there will be some material that is wasted, for this material I plan to find another use for it. For example, the wasted metal Swarf and be either recycled or collected in large drums before being sold to a scrapyard. This way a little amount of money can be regenerated from the scraps which will help reduce the price of the product as well it will have less of an impact on the environment.

The most efficient use of materials



Using materials in the most efficient way can help reduce CO_2 and make the design eco-friendlier. For example, when laser printing my crutch handles from acrylic I will make sure the piece being cut is as close to the top left corner so there is little wasted material. The bulk of the leftover material can be used for other purposes and other designs.

If I was to make my design in bulk it could lead to a lot of waste material and wasted money

For bulk buying I would buy a 3mm thick 600mm by 400mm sheet at a price of £5.87 from Kitronik

Sheet Area = 600 X 400 = 240,000mm^2 (0.24m^2)

Area needed for one support = 250 X 80 = 20,000mm^2 (0.02m^2)

Waste from one waste support = π X (8.5)^2 = 227mm^2 (0.000227m^2

Pieces fitting on one sheet is (400÷80) = 5 width and (600÷250) = 2.4 = 2 length (5 X 2) = 10 wrist support per sheet

Waste per sheet so far = (100 X 400) = 40,000mm^2 (0.04m^2)

This leaves room for one wrist support length wise

So, 11 wrist supports fir per sheet which means the total wasted material is equal to (11 X 4) X (227) + (150 X 100) + (20 X 400) = 32,988mm^2

So, the area wasted is 32,988mm^2 (0.032988m^2)

As a percentage, the waste can be calculated by (32,988÷240,000) X 100 = 13.745 %

This means that per sheet 81 pence is wasted per sheet

This is a relatively low waste in industry, the layout of the wrist support use as much as the material as possible, which saves money and reduces emission

Review of improvements and development based on the specification

	Improvements and developments
Function	• By adding ringed loops and a cargo net I was able to increase the capacity of the log carrier to help meet the 50L volume of logs required • After experimenting with different bases, I developed a more effective base whilst managing to reduce the mass of the product. This will reduce the overall mass of the product so it should meet the 15kg mass limit • As a result of testing my main mechanisms, I developed its strength and rigidity which will lead to a stronger final product. Performing these tests during development should allow me to produce my real mechanism with the same strength • As well as this I made the mechanism easier to use by using more ergonomically designed locking nuts. The quick release mechanism should allow for easy adjustability of the product • I also created ergonomic handles using many models to try get the best grip for someone who is elderly • I created a crutch handle with wrist supports which I found took a lot of weight off the wrist • Using the cargo net development, it helped me meet my client's requirement for the volume of logs carried to be greater than her last solution
Form	• In terms of form I looked mainly chose to prioritise ergonomics as my product is focused on function over form • I stuck with my minimalistic design as I designed my product to the client's specification • I only used necessary features throughout to keep my design to a minimalistic design
Quality Control	• Although quality control can't really be developed properly at this stage in production I did look at ways the quality of my product could be improved through things such jigs. I developed a jig for the adjustable heights of the handles. By introducing jigs, I can recreate the adjustable mechanism with extreme accuracy • Through development I looked at how accurate things need to be made to gage an idea of what my tolerances should be • During the manufacture stage I plan to look at where else I can implement jigs
Dimensions	• Through the development of my idea the dimensions changed little • The adjustability that I developed effects the maximum displacement however it has no overall effect on the dimensions of the actual product • Little dimensions changed such as I added a raised section to the mid-section, however no huge dimension changed where added
Safety	• I developed my mechanism so that it fit on the inside of the product, as a result the user can't access the mechanism accidently risking an injury to themselves • I developed attachments such as the wrist support that reduced strain on fragile parts of the body to reduce the chance of injury whilst lifting heavy loads • I designed a cargo net and rings so that the logs are less at risk of falling out and possibly injuring someone • I developed the mechanisms to be strong and stable so that they didn't break and injure the user whilst being used
Materials	• Whilst developing my design I always looked at using the most effective and eco-friendly materials • I also looked at reducing materials where possible such as the base frame • However, where reducing the material effected the product such as with the strength of my mechanism I did not compromise the strength of my design • I looked at different materials for my mechanisms to see which material could provide the optimal strength and efficiency • I prioritised materials that would help me meet my performance materials for the hardness test
Ages	• Whilst developing this design I always looked at how to include as many ages as possible, whether this was through making the design more applicable for older people (wrist supports, easy handles etc) or creating dimensions suitable for the younger side of the spectrum
Cost	• Looking at my development I can see there was little thought with the cost. However, by reducing material usage throughout the development would have greatly reduced the cost of my product
Scale of production	• I looked at three commercial production options. In a real manufacturing process, I would use batch production to allow flexibilities in my design if a fault was discovered • I also developed a jig with a plan to look at how I can use more jigs in my manufacturing stage
Sustainability	• Whilst developing my product I look at creating temporary joins and mechanism where possible without effecting performance so that welding, a high energy process, is not needed • When designing/developing my design I only looked at using a maximum of two different materials so that recycling will be easier at the end of the products life • When looking at finishes for design I only looked at ones that would have little to no effect on the environment and its surroundings