IAgrE Student Awards

NOMINATION SUMMARY

Student Project Award*
Safety Award*
***please delete as appropriate:**

PROPOSER: (usually Course Director/Head of Department)

Name: Rhys James

Position: Level 3 Course Director

University/College: ColegSirGar, Gelli Aur Camps, Home Farm, Golden Grove, Camarthen SA32 8NJ

Contact details:	**Tel:01554748583**	**Email: rhys.james@colegsirgar.ac.uk**

DETAILS OF NOMINATION:

Name of Student/Group of Students: Ifan Davies

Personal contact details (i.e not college) to enable us to contact the student(s) once their course has ended:

Penrhiw Farm,
Trecastle, Brecon,
Powys LD3 8UH

07594272786

Email:
ifandavies2@gmail.com

Name of course studied: Level 3 City and Guilds Extended Diploma in Land based Technology

Period studied	**From: September 2024**	**To: July 2026**

Qualification to be gained:
180 Credit extended diploma

Project Title: Multi-purpose trailer that can carry ewes and lambs that can either be pulled with a UTV or pallet fork mounted.

Details of material submitted with nomination: (Project/Exec Summary/videos etc)

Powerpoint presentation

SIGNED BY PROPOSER: DR James	**DATE SUBMITTED:** 18/09/26

If you wish to provide any additional information to support this nomination, please do so in a covering letter. When complete, return this form, together with the supporting documents, to

The Secretariat, IAgrE, The Bullock Building (Bldg 53), University Way, Cranfield, Bedford MK43 0GH
secretary@iagre.org

NB All work submitted is treated with complete Confidentiality; no part of the paper will be published by IAgrE except for the Title and Name of the winner in each category.

Final project presentation

Ifan Davies
Level 3 agricultural engineering

Background

- 5th generation farmer with a passion for farming and livestock
- Beef and sheep farm - provides me with a great variety of work
- Finishing level agricultural engineering course this year
- Worked within the industry at Beacon Plant Hire
- Active yfc member - competing stockjudging tug of war



Aims

- Develop a new idea within the agricultural engineering industry
- Objective of making a task safer or more efficient for the farmer
- Can be completely new or a adaptation of a already existing product
- Personal aim was to design and fabricate a project that we would get good use out of at home



Research

Researched the industry focusing on recent developments that had been made and identifying what they had achieved.

I attended the Agritechnica show last november and LLAMA in january this provides me with an insight into top level innovation with in the industry.

Identified the area that I wanted to focus on - Chose livestock farming

Carried out further research online in order to see what tasks could be made easier / more efficient











Previous concepts

Shed feeding shute on snacker

- Used to distribute cake in front of feed barriers for livestock
- Would be an addition to a snacker which is commonly found on livestock farms
- Reduce in labour, no carrying buckets improving efficiency can complete the task quicker
- Would have a complicated design in order to make it functional

Bale shear / elephant nose bale handler

- Multipurpose tool that features a changeable top bracket either being equipped with a shear blade or a double elephant nose bale handler.
- Useful as both are needed at different times of year - therefore would not need regular changing
- Multipurpose tool reduced amount of implements on farms - easier to maintain one implement than two
- Expensive design due to costly components required such as hydraulic rams

Proposed concepts

Quick hitch for Atv / Utv

- Similar function to tractor hitches with a hitch that drops down and locks when in place
- Electrically operated off the vehicles battery
- Reducing physical effort required to hitch on trailers onto vehicles





Weighting

	Concept 1 - Bale shear / Bale handler	Concept 2 - Tandem axle trailer for Utv / pallet tines	Concept 3 - Shed feeding chute on snacker	Concept 4 - Quick hitch for Atv / Utv
Ease of build (1, complicated, 10 easy)	2	6	7	6
Cost (1,high cost, 10 low cost)	1	4	7	6
Profit (1, low profit, 10, high profit)	5	9	6	2
Commercial value (1,poor value, 10, great value)	7	9	5	4
Maintenance (1, high, 10, low)	6	10	8	8
Overall mean	4	7.5	6.5	5

Chosen concept

After assessing my weighting I decided to design and fabricate the UTV tandem axle trailer that can also go onto pallet tines.

This trailer will be highly versatile and will be primarily used for moving livestock being pulled behind a UTV or farm trucks.

Trailer will be split into separate compartments - Keeps ewes and lambs in their pairs prevents any mismothering occurring.

Will keep calves separate allowing them to be moved between sheds easily

Smaller compartments will make it more difficult for sheep and calves to jump out of the trailer.





Chosen concept



The pivoting tandem axle on the trailer will allow the trailer to travel along rough and uneven ground at ease.

With the frame being able to be lifted with pallet tines this means that it can be used by all types of loader machines without the issues of having lots of compatible brackets.

The frame on pallet tines makes the trailer highly maneuverable around the yard in and out of sheds.



Additionally the frame can be used to put a small quad bike in while on the front loader with a stockbox behind allowing for a one man operation when moving livestock between different blocks of land.

Wooden boards as the trailer floor will allow water to drain out of the trailer , with checker plate used on the tailgate for livestock to get into the trailer.

Deliberately chose to not add a storage box on front, due to majority of farmers carrying their supplies into a built in compartment on their vehicles.

Justification of the idea

This is a multipurpose product that will be used all year round on farms for moving stock, carrying fencing and maintenance supplies and moving quad bikes.

WIll be used everyday at lambing and calving time, outside lambing and calving , sending pairs out to fields and moving calves between sheds.

This will greatly improve efficiency carrying out these tasks as it will be specifically designed for these jobs allowing the farmer to be more efficient.

This trailer will be capable of sendong four pairs of ewes and lambs out which is more than regular trailers as without separate compartments mismothering is a major risk which can result in lamb fatalities.

Due to this farmers typically only send out two pairs at time therefore this trailer will be capable of halving the amount of time to complete this daily task.

The average livestock farmer over lambing time spends two hours a day sending ewes and lambs out fourteen hours a week. Most of the time is spent travelling between the farm and fields therefore sending more out at once can nearly half the time taken resulting in a save of nearly a hour each day.





Justification of the idea

The pallet tines will allow access to wet ground that may be inaccessible with a towed trailer, essential for outdoor lambing and calving when stock may need to be brought back in.



Additionally when the trailer is on the pallet tines it will effectively be a crate that can carry supplies such as fencing materials and tools while the post knocker is on the back of the tractor.

Having a quad bike in the crate on the front loader also allows a stockbox to be pulled behind the tractor allowing for one man operation. This is important as 75% of farmers in the UK carry out day to day work by themselves with no help.

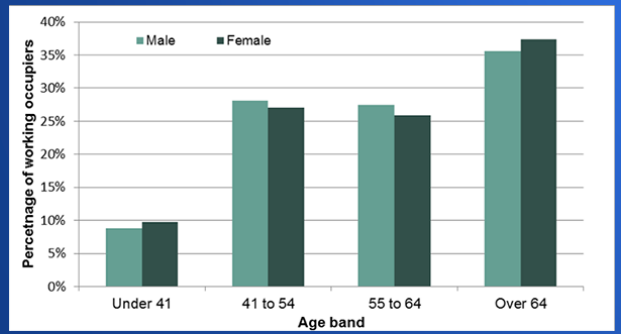
Justification of the idea



The loading process for the trailer is designed to be simple with a four separate gates to split the compartments. This allows for ease of loading and unloading as you can load them one at a time and secure them which prevents them from escaping when trying to load the others.

The gates are hinged on opposite sides in order to allow them to open freely without stacking on top of each other.

The purpose of the gate in front of the tailgate is so that the stock can be secured in the trailer before raising the tailgate.



This reduces the physical effort required as there is no rush to lift the tailgate to prevent the stock from escaping, this is safer for the stock as it prevents the risk of there legs becoming trapped and injuries occurring.

The need for simple loading and unloading with a minimal physical strain is important as the average age of the farmer being 59, with over 40% of farmers in the industry being aged 65 and older.

Issues to overcome

The main issue I had to overcome was the width on the trailer when on the pallet tines mainly caused by the drawbar sticking out in order for the trailer to be towed.

In order to overcome this I needed to come up with a hitch design that would be adjustable so it would not stick out as much when on the pallet tines.

Additionally I will also have to design a pivoting tandem that is strong enough to pivot and support the weight of the frame.

I will also need to ensure that the tandem axles can be easily removed so that the trailer can be used as a crate on the pallet tines.



What's on the market

There is currently no implements on the market that combine a trailer and being able to put it on pallet tines.

The closest product on the market is a tandem axle atv trailer which retails for £2,500 without having any individual compartments.

Therefore I believe this is a gap in a market that has great potential as a UK wide survey identified that over 200,000 holdings have small trailers.

I believe that I will be able to fabricate and sell my product at a reasonable price while still allowing me to obtain a reasonable profit margin.

Target market

The target market for this product will be all livestock farmers across the UK.

In order to establish the interest of the trailer I carried out a survey and sent it to farmers in the local area asking them to complete it and provide me with some feedback.

The purpose of these forms was to provide me with information on the systems of different farms allowing me to gain a better understanding on how to best design my trailer in order to ensure that it suits the needs of farmers

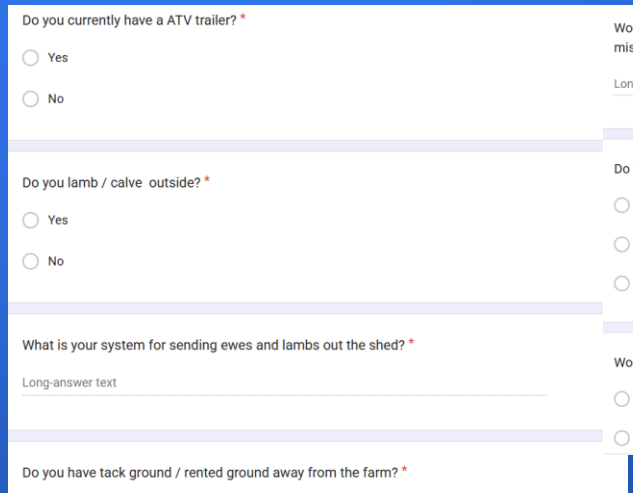

Market research - Tandem axle lambing trailer

Market research form in order to identify how much of a market there is for the tandem axle lambing trailer

What type of farm are you from? *

- Arable
- Beef
- Sheep
- Dairy
- Other:

What age group are you in? *


Do you currently have a ATV trailer? *

- Yes
- No

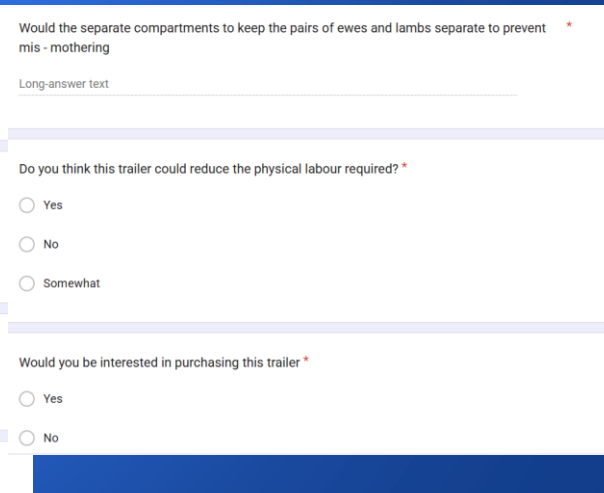
Do you lamb / calve outside? *

- Yes
- No

What is your system for sending ewes and lambs out the shed? *

Long-answer text

Do you have tack ground / rented ground away from the farm? *


Would the separate compartments to keep the pairs of ewes and lambs separate to prevent mis - mothering *

Long-answer text

Do you think this trailer could reduce the physical labour required? *

- Yes
- No
- Somewhat

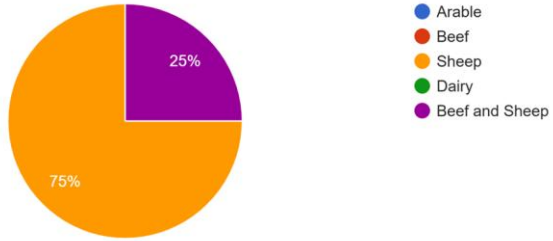
Would you be interested in purchasing this trailer *

- Yes
- No

Market survey feedback

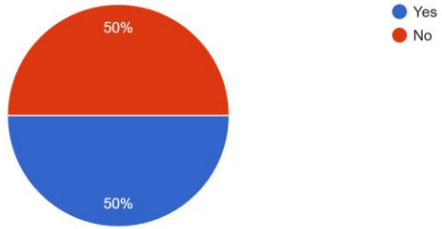
What type of farm are you from?

4 responses



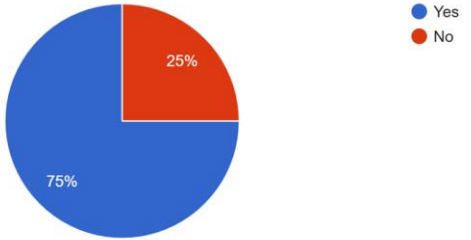
Do you lamb / calve outside?

4 responses



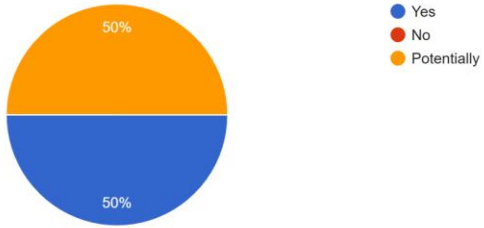
Do you have tack ground / rented ground away from the farm?

4 responses



Would you be interested in purchasing this trailer

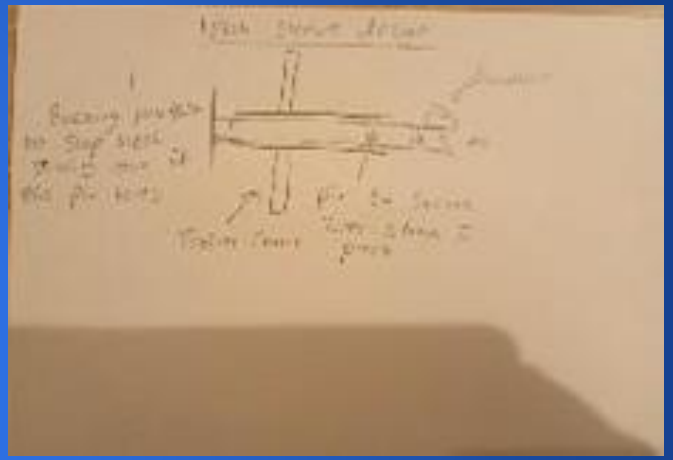
4 responses



Different designs

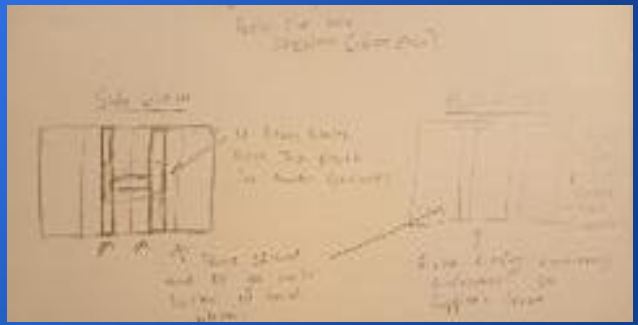
Original hitch design - The original design was a sleeved design

- Inner sleeve of 50x50 box section - Hitch bolted onto this
- Outer sleeve 60x60 thick walled box section
- Snug fit allowing the inner sleeve to pull in and out
- Secured in place with pin
- Backing plate to prevent the sleeve from sliding out in case of pin failure
- Lack of space behind due to pallet tine box - Would be to low if blocked down



Original loader mount design

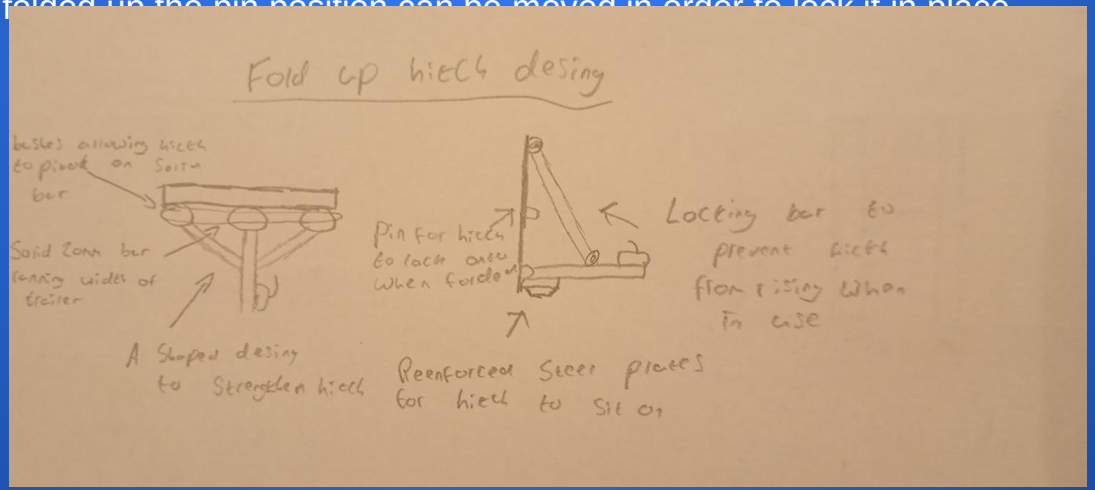
- Heavy duty frame running underneath and up both sides of trailer
- H brace support with rectangle 3mm sheet mounted to it
- Loader brackets o choice welded onto the 3mm sheet
- Would have a lot of stress on the corners
- Complicated design which would of added unnecessary weight



Chosen design

Chosen hitch design - Fold up hitch design

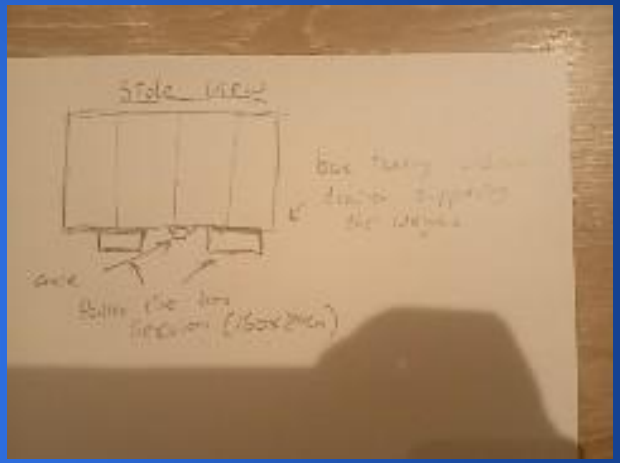
- 20mm solid round bar running across the width of the trailer running in 20 mm inner diameter bushes which are welded to the frame.
- A frame drawbar design with the hitch bolted on is mounted onto the solid bar on bushings which allows it to pivot
- 3 sections of 6mm flat plate reinforced with 20mm solid square bar placed stop hitch from dropping to low
- Box section bushed at both ends locks the hitch down with a pin and clip to prevent it from moving
- When hitch is folded up the pin position can be moved in order to lock it in place



Chosen design

Chosen loader mount - Pallet tine box 160 x 80 running underneath the trailer

- Box section supports the whole weight of the trailer and carries it from underneath
- Much simpler design
- Allows to be used for all loaders no issues with bracket compatibility
- Pallet tines locked in place with a pin situated behind the tines



Calculations

Trailer loading calculation

Trailer length = 2000 mm

Pivot = 1120 mm from front

Hitch = 2760 mm from rear reference

CG = centre of gravity

Payload

Ewe weight= 100 kg

Lamb weight=10Kg

Total weight=

(4x100)+(8x10)=480 Kg

$$CG = \frac{\sum(W_i X_i)}{\sum W_i}$$

W_i= Weight of each item

X_i=Distance from the front

$$CG = \frac{(400X1000)+(400X1000)+(80X1000)}{400+400+80}$$

$$CG = \frac{880000}{880}$$

Center of Gravity from the front = 1000mm

Locate the Tandem Pivot

Pivot = 837 mm from rear

Trailer length: 2000mm

Therefore:

Pivot=2000−837

Pivot = 1163 from the front

Locate the Hitch

Drawbar length = 760mm

Therefore hitch location = 760+2000=2760mm from rear

Calculate Distance Between CG and Axle Pivot

A=Pivot−CG
A=1163-1000=163mm
A=163mm

Calculate Distance Between Pivot and Hitch

$B = Hitch - Pivot$

$B = 2760 - 1163$

$B = 1597mm$

Apply Moment Equilibrium

The trailer is in balance, so the moments about the pivot must be equal.

For the trailer:

Trailer weight X Distance $_A$ = Tongue weight X Distance $_B$

880 X 1163 = TW X 1597

143440X = TW X 1597

Tongue Weight = $\frac{143440}{1597}$ =89.8Kg

Final Result

Trailer weight	400 kg
Livestock weight	480 kg
Gross trailer weight	880 kg
Combined CG	1000 mm
Pivot from front	1180 mm
Hitch from front	2760 mm
CG ahead of pivot	180 mm
Hitch behind pivot	1580 mm
Tongue weight	**89.8 kg**
Tongue weight %	**10.2%**

Agricultural gators are rated to have a tongue weight of 90kg and are safe to tow 900 kg of gross weight.

The trailer drawbar is rated to pull 1200kg

The tandem axles are rated to support 1500kg

32mm pivot

- **Total Force on Pivot System (F):** Under static conditions, the axles carry the GTW minus the tongue weight: $750\ \text{kg} - 75\ \text{kg} = 675\ \text{kg}$. Under dynamic driving conditions (bumps), you must apply a **3× shock factor**:

$$F_{\text{dynamic}} = 675\ \text{kg} \times 9.81\ \text{m/s}^2 \times 3 \approx 19,865\ \text{N}$$

- **Per Side Load:** Divided across two pivot points (left and right sides), each shaft experiences $9,933\ \text{N}$ of force.
- **Shear Area (A) of a 32 mm Shaft:**

$$A = \pi \times \left(\frac{d}{2}\right)^2 = \pi \times 16^2 \approx 804.25\ \text{mm}^2$$

- **Shear Stress (τ):**

$$\tau = \frac{F}{A} = \frac{9,933\ \text{N}}{804.25\ \text{mm}^2} \approx 12.35\ \text{N/mm}^2\ (\text{MPa})$$

Standard mild steel (like mild steel grade EN8 or structural structural steel) has an allowable shear yield strength exceeding $150\ \text{MPa}$. A $32\ \text{mm}$ solid steel shaft is structurally highly adequate, provided it is securely welded/supported to prevent bending leverage (bending moments).

Risk assessment

Ifan Davies - Project L3 Risk Assessment

Hazard	Person(s) at Risk	Existing Controls	Risk Rating (see matrix)			HighMed Low	Any additional control measures required.
Explosions	Myself and others	Gas bottles must be chained / strapped to the welding plant. Empty bottles / bottles not in use must be stored in a caged area outside. Before using the welder ensure that the gas system does not have any leaks, raise to working pressure before equipping yourself with PPE, in order to check to see if the pressure drops. Be aware when welding near / explosive or flammable objects such as fuel tanks.	2	5	10	MED	If welding outside make sure appropriate signage is in place or corden off the area.
Dust & Fumes	Myself and others	Make sure that the Local exhaust ventilation (LEV) is switched on and working correctly (check that it is drawing air in). If welding away from the LEV system ensure that there is sufficient ventilation in the workshop such as opening the workshop doors. Make sure the correct PPE is worn when cleaning off any components with the airline such as dust mask and safety goggles.	2	2	4	LOW	If welding in a confined area ensure that a air fed mask is worn.
Slips, Trips & Falls	Myself and others	Maintain good housekeeping and make sure that any objects are moved out of the way before beginning work. Be aware of any welding cables and place signage if there are any potential trip hazards.	2	2	4	LOW	If working outside place cones or signs so others are aware of the work taking place.
Crushes & Knocks	Myself and others	Make sure the correct PPE is worn, (steel toe cap boots). Be aware of moving parts on work securing devices such as vices and jigs.	2	3	6	MED	
Cuts & Splinters	Myself and others	Make sure the correct PPE is worn while handling metals and materials (welding gloves). Be aware of sharp edges on any metals. Use files / grinders in order to remove any sharp edges. (Must have received the correct training to use various power tools) ensure the correct guards are fitted. First aid boxes are supposed to be installed in the workshop.	3	1	3	LOW	
Lifting & Straining	Myself and others	If lifting manually ensure that you follow MHOR (max lift male 26kg,	2	3	6	MED	
Chemicals & Poisons	Myself and others	appropriate fitting aids / equipment. Make sure that any of the gas fittings do not have leaks by turning them on and seeing if the pressure drops, if it does then there is a leak, also inspect the condition of all of the	2	3	6	MED	Control of Substances Hazardous to Health (COSHH) - HSE
Vehicle Parts, Machinery & Vehicles	Myself and others	equipment and listen to any issues. Take care to wear the appropriate PPE and use a grinder in order to grind back any paint before starting any work. If machinery is brought into the workshop ensure that the safe stop procedure is follower handbrake on, in neutral and chock the wheels. Be aware of any moving parts on tools and equipment such as laives, band saws and grinders and ensure that the appropriate safety guards are fitted to these machines.	2	4	8	MED	Training courses / safety certificates should be completed for the appropriate machinery.
Noise Exposure	Myself and others	Any task that has a noise level that exceeds 85 d.b requires mandatory ear protection such as ear defenders or ear plugs, if exposed to noise for a long period of time it is recommended that ear protection is worn.	2	2	4	LOW	HSE - Noise: Regulations
Eye Damage	Myself and others	When carrying out tasks using a pressure washer, airline or grinder safety goggles or a full face shield should be worn. A welding mask should be worn when welding and a plasma cutting mask should be worn to use the plasma cutter. Before beginning to strike the welder say "eyes" in order to warn colleagues that you are about to strike or start welding.	2	3	6	MED	
High Pressure	Myself and others	Make sure to follow the correct procedures when changing gas bottles. Ensure to reduce pressure in pneumatic or hydraulic systems before starting any welding tasks.	2	4	8	MED	
Waste Disposal & Environmental Control	Myself and others	Make sure to dispose of waste materials and other waste products in the correct bins such as metal in the scrap bin and they are then collected by a licensed courier.	1	1	1	LOW	

Timeline

Month	Work being carried out
September	Initial researching of different project ideas
October	Further research into ideas
November	Selection of 4 project proposals
December	Completed and presented the initial ideas presentation
January	Researched me chosen design
February	Used CAD in order to start designing my idea
March	Finished using CAD and stress tested the design
April	Started fabricating my design
May	Finished making my design and painted it
June	Presented my final presentation

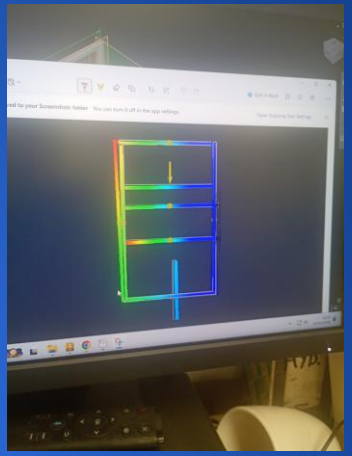
Computed aided designing (CAD)

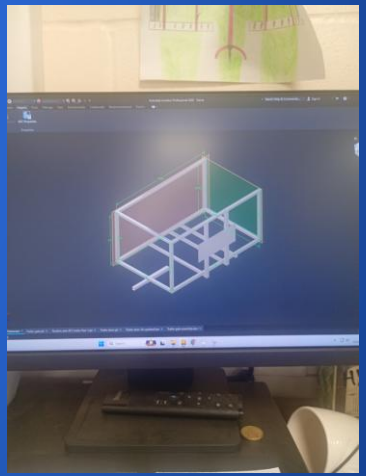
First step after selecting my concept was to design it on CAD which is a specialist software used for designing ideas.

This was a new experience for me teaching me new skills and definitely provided me with a better understanding of this software which is extremely beneficial.

The main purpose to designing it on CAD is to carry out stress testing to test key areas such as the hitch, axles and the pallet tine box section.

This is done by applying load onto the correct areas of the trailer once it has been fully designed and carrying out a test this then indicates whether the design is strong enough or if changes need to be made.





Fabrication and Manufacturing - Frame

Began by making the frame of the trailer which is made up of 50x50x3 box section.

Firstly measured them to the correct lengths and marked the 45 degrees and angles as I was mitering the corners.

I then used the bandsaw in order to cut the 45 degrees angles as it provides a clean finish.

Then I placed the outline of the frame on the floor and measured corner to corner in order to ensure it was square before then welding the frame together.

Once I had the top and bottom parts of the frame done I welded the corner uprights onto the bottom part of the frame using a set square to ensure they were square before then placing the other frame on top and welding them together.

I then fitted the 25x25x2 intermediate uprights into place at 50cm spacings in order to have the correct sized compartments.

I then added diamond shaped steel plates in order to brace the four corners of the frame in order to provide extra stability.









Fabrication and Manufacturing - Compartment gates



To begin with I made the frame for the gates mitering the corners together using the bandsaw before using a tape measure to ensure that they were square before joining them together.

I then marked around the gate onto the workbench as I would be repeating the process.

Next I welded in a bar across the middle in order to weld the sheet onto as well as the spring latch.



After I had the gates made I welded the gate hinges onto the trailer at 20cm spacings from the top and bottom before then matching the eyes on the gates in order to fit onto the hinges.

Once all the gates were hanging I then welded the spring latches onto them, before then marking where the latches were latching into and using a drill and correct size drill bit to drill the hole.

Finally I then stitch welded 2mm sheets which were already cut to size onto the frame.

Fabrication and Manufacturing - Tailgate





To begin with I made the outer frame for the tailgate mitering the corners in order to provide a strong finish that does not allow any water to get into the frame.

I then used angle iron in order to make a + design between the frame in order to spread the surface area when weight is going up the tailgate and welding the angle iron into place.

I then used pin and latch hinges with the pins being welded to the trailer frame and the latches being welded onto the tailgate allowing it to pivot and open and close. I welded the pins on the same way so the tailgate could be removed if required.

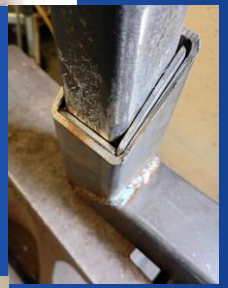
I then stitched welded the tread plate sheet onto the tailgate frame.

Next I drilled out a 12mm hole in order to fit the antiluce latches welding them in ensuring they were straight before then using 6mm plate in order to make a catch and drilling a 25mm hole in order for it to fit over the latch securing the tailgate in place.

Fabrication and Manufacturing - Pivoting tandem



Firstly I made the tandem frame before then fitting the stub axles into the frame and using 2, 5mm shims in order to keep them square and using a drill to drill a hole behind the axles and below in order to provide me with more surface to weld to.



I then used chalk and a metal rule in order to mark out the centre and draw a 32mm circle before using the plasma cutter to cut a hole out ready for the bushes.

Once I had done that I used a die grinder in order to clean up the edges.



I then welded the 40x40x2.5 box section axle into place running across the bottom of the trailer before then using the plasma cutten in order to cut gusse out, 8 in total in order to reinforce the axle.

Fabrication and Manufacturing - Pivoting tandem

With the assistance of the lecturer I used the lathe in order to machine the end of the 32mm solid circular bar using a vernier caliper in order to get measure the solid bar until it was 23.8mm.

Once it had reached that size I was able to use a M24 die in order to create a thread on the end of the solid bar, I then repeated this process for the other piece of solid bar.

I then drilled 3 holes in the axle using a mag drill in order to increase the surface area before then welding the bar into place ensuring that it was running straight by fitting small shims and removing them once it was tacked.

Next I used the plasma cutter in order to cut dut out 4 washers with a internal diameter of 32mm in order to place behind each of the bushes. I then fitted the bushes into the tandem and placed the tandem onto the solid bar fitting the washers either side before then fitting a m24 nylock nut and tightening it up.







Fabrication and Manufacturing - Fold up hitch





Firstly I welded the outer bushes in the correct place on the trailer frame tacking them on with the solid round bar running through them in order to ensure that they were straight.

I then cut out the end of the 50 x 50 x 3 drawbar in order to bush it and tacking the bush in and checking it was straight before then fully welding it in. I then cut 2 lengths of angle iron and did the same bushing them on the end and sliding them onto the solid bar before then welding them to the main drawbar.

Next I drilled through the end of the box lining it up with the holes on the hitch before then making bushes to stop the box collapsing and bolting the hitch on.

After I made the locking bar in order to prevent the hitch from moving and locking it in the correct position for towing.

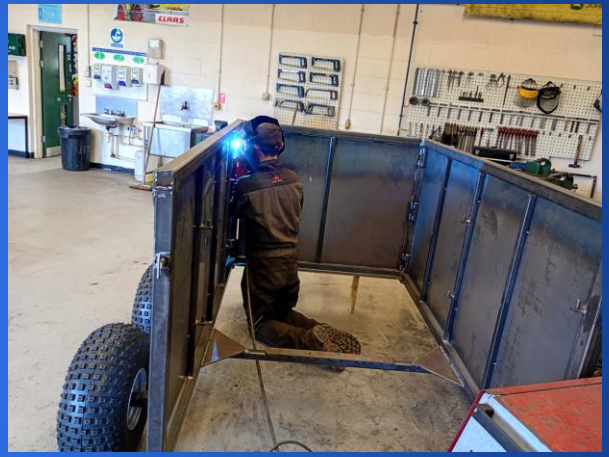
Fabrication and Manufacturing - Sheeting

Next I had to cut the sheets down by measuring the correct gap and marking it out on the sheets before clamping a length of flat plate and cutting along it to ensure it was straight.

Then I fitted the sheets onto the trailer by stitch welding them along the corners and welding them to the top and bottom of the upright sections.

I was then able to spray paint the trailer in order to provide it with a protective layer and a finished appearance.

In order to test the trailer I drove it around the yard and through the fields in order to ensure that it was following correctly and the tandem was working. I then lifted it on the pallet tines which functioned correctly.



Costs

Item	Cost per item (£)	Total cost (£)
Stub axles	60 (x4)	240
Flotation tyres	55 (x4)	220
Wooden floor boards	12 (x5)	60
Cost per gate	35 (x4)	140
Axle bushes	13 (x4)	52
Trailer sheets + treadplate	150	150
Total steel cost	350	350

Total trailer cost	**£1,212**
Labour cost (20 hours x 15 hourly rate)	**£300**
Total cost + Labour	**£1,512**

Possible improvements

Main improvement - Galvanise the trailer



Lighter overall weight - Aluminium trailer sheets



Piece of rubber on the tailgate in order to prevent legs being caught when stock running into the trailer.

Diolch / Thank You

All the lecturers and my fellow classmates who have assisted me by giving me advice as well as assisting me with part of the fabrication process.

