



DIPLOMA IN MECHANICAL  
ENGINEERING DJJ50193: PROJECT 2  
PORTABLE OIL PALM  
TROLLEY  
CLASS: DTP5A

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## **APPRECIATION**

In carrying out this project successfully, many parties have showered us with blessings and support, this time we would like to say a thousand thanks to all parties involved in this project.

First of all, I express my gratitude to God because with His abundant grace we were able to complete this project and report successfully. Then we would like to thank all the supervisors that participate in the Portable Oil Palm Trolley project. This is because they were helped and guided us a lot by teaching. Their suggestions and instructions have been a major contributor towards the completion of the project.

Then I would like to thank my parents and friends who have helped me with valuable suggestions and guidance which have helped a lot in various phases of project completion.

## **ABSTRACT**

This report introduces an innovative approach aimed at improving the safety and operational efficiency of workers in small-scale oil palm plantations. By focusing on design improvements and safety measures, this approach aims to significantly improve the working conditions of farmers. A careful integration of design improvements and robust security measures, this approach not only aims to reduce risk but also aims to optimize workflow efficiency. Through careful consideration of ergonomic principles and innovative technology, the proposed improvements aim to streamline tasks while minimizing physical stress on workers.

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## **CHAPTER 1: INTRODUCTION**

### **1.0 INTRODUCTION**

The mobile oil palm cart is built with small-scale farmers in mind, making it easier and safer for them to gather oil palm kernels in the tough, dense conditions of their farms. Designed to be both sturdy and portable, the cart's control system helps it move smoothly on narrow tracks and rough terrain—ideal for those who find large, expensive mechanized equipment out of reach.

With easy-to-hold handles and stable controls, farmers can handle loaded trolleys with confidence, even on uneven ground. Safety guards around the spikes add another layer of protection, reducing the risk of accidental injuries and doing away with the need for extra safety gear. As technology in material handling advances, these carts aim to bring efficiency levels closer to what large-scale operations achieve. For small-scale farmers, this means not only greater productivity but also a way to work more comfortably and reach areas of their farm that would otherwise be hard to access.

## 1.1 BACKGROUND

The first oil palm plantation in Malaysia was in Tennamaram Estate, Selangor. It came into existence in 1917. After that, the landscape of Malaysia changed in terms of economy, social and environment. This is because of the large impact of the palm industry and this industry has also contributed a lot to our country.

There were three major plantation companies that existed in the 50's. The company was owned by Asin, Guthrie, Golden Hope and Sime Darby. The Federal Land Development Board (FELDA), which was established in the 60s, was directed to managing the resettlement of rural residents to newly developed areas to regulate the agricultural activities of smallholders, especially palm oil plants. There are 44 plantation companies listed in Malaysia in 2019. Their market capitalization is RM113 billion, number five on Bursa Malaysia. The palm oil plantation sector also contributes to 5.6 million jobs including small farmers, manufacturers, entrepreneurs, marketers, traders, and others.

In addition, the maximum area of palm oil plantations is set at 6.5 million hectares by 2023. Land exploration to open new plantations has also not been a priority for the past few years. On the other hand, the Malaysian government encourages replanting activities and efforts to improve the yield and quality of palm oil through breed production research, fertilizers, and the use of modern machinery.



Figure 1.1: palm oil plantation area statistic by state in Malaysia

Based on Figure 1.1, in 2009 there were 4,691,160 hectares of palm oil plantations in Malaysia compared to 1975 when only 642,000 hectares were recorded. According to statistics in 2023, the state of Sabah has become the main palm oil plantation area in Malaysia with an area of 1.362 million hectares followed by Sarawak which has an area of 0.840 million hectares and Johor with 0.712 million hectares of palm oil plantation area. While Penang is a small oil palm area with an area of only 14,000 hectares. Of the total production, private estates have planted an area of 2,807 million hectares of palm oil while the government scheme has planted an area of 916,261 hectares promoted by FELDA, RISDA, FELCRA. In addition, an area of 321,947 hectares by the State Government Scheme and the remaining area of 540,194 hectares are owned by smallholders.



Figure 1.2: safety rules for hand tools

However, safety is everyone's responsibility, especially for farmers who do their work. In palm oil plantations. They must follow the rules in the safety of hand tools because they can prevent themselves from injury or death.

Based on Figure 1.2, we can realize that safety in the workplace must follow the rules that have been set. For farmers, especially oil palm farmers who always use oil palm spikes, that do not have safety protection. Therefore, farmers should follow certain guidelines such as always checking tools before using them and always wearing safety clothing such



as gloves and safety shoes. This is because most oil palm farmers do not have the right knowledge and can cause serious injuries. There are many dangerous accidents that can happen, for example, injuries from tools if you don't wear gloves. Slipping, tripping and falling can also happen if you don't wear the right clothes, it can cause serious accidents.

Therefore, after we conducted research, we wanted to design a Portable Oil Palm Trolley, which is a tool to carry oil palm fruits. The function of this trolley is to carry a small amount of oil palm fruits. The purpose of this portable oil palm trolley is to ensure the safety of farmers. This is because there are safety features on the trolley such as protection at palm oil spike. So, no more injuries involving sharp objects.

## 1.2 PROBLEM STATEMENT

- In the oil palm plantation, the workers need to bring the loading spike and trolley separately.
- Can cause hand injuries like cuts, pinches, or punctures.
- There is no trolley for a small quantity of oil palm that comes with the loading spike oil palm.
- No safety features such as sharp spikes are exposed to the surrounding conditions.



Figure 1.3 Hand injury

### **1.3 OBJECTIVES**

- To design a Portable Oil Palm Trolley for palm oil plantation purposes.
- To develop a combination of trolley and spike into one.
- To create safety features for farmers.

### **1.4 RESEARCH SCOPE**

- Use in the palm oil farming industry.
- A trolley equipped with a handle that can be modified to be used to lift oil palm.
- Trolley space for 1 to 2 bunches of palm oil only.

### **1.5 CONCLUSION**

What is important when we do this project is to make sure people are careful and check tools before starting and after work. Our target for this project is oil palm plantation workers. This Portable Oil Palm Trolley is a promising innovation for the agricultural sector, especially in palm oil harvesting. Anyone who uses this portable oil palm Trolley in doing work such as lifting palm fruit, moving palm fruit and so on will be safer because of the safety features that have been improved on the palm oil spike. These trolleys also offer significant advantages in terms of mobility, efficiency and ergonomics over other methods.

## CHAPTER 2: LITERATURE REVIEW

### 2.1 PREVIOUS DESIGNED / RESEARCH WORK

#### 2.1.1 ADVANTAGES OF PALM FRUIT COLLECTION TROLLEY



Figure 2.1: palm fruit collection trolley

1. **EFFICIENT AT MOVING PALM FRUIT:** There are many benefits of using an industrial palm oil collection cart. First, they are very efficient in moving larger quantities of palm fruit at once. This means they can move and lift the palm fruit quickly and improve worker comfort and productivity. This can also improve the quality of the employees' work. In addition, this can also reduce the time and effort required for manual harvesting.
2. **LABOR SAVING:** Industrial palm fruit collection carts also reduce the physical burden on workers compared to carrying fruit manually because palm fruit can be carried in large quantities by just using this cart. This makes them easy to transport within the plantation, enabling smooth movement of the harvested fruits to the processing areas.
3. **CAPACITY AND ORGANIZATION:** The main reason to use an industrial palm oil collection cart is to allow more fruits to be collected in one trip. This method has a larger capacity than traditional collection methods such as baskets or bags. This improves farm management and overall workflow, as carts can be organized and integrated into a systematic harvesting process.

### 2.1.2 DISADVANTAGES OF PALM FRUIT COLLECTION TROLLEY

1. **Cost:** One disadvantage of this industrial oil palm cart is that maintenance of the oil palm carts and the vehicles used can be expensive for small or less mechanized farmers.
2. **Terrain limitations:** Another drawback of this industrial palm trolley is that it is not suitable for all terrains which can limit its effectiveness in certain areas of the plantation. This is because the use of this trolley involves a vehicle. The use of these trolleys may be effective with only dedicated infrastructure such as well-maintained paths or roads within farms.
3. **Environmental Impact:** One disadvantage of industrial oil palm carts is that they have the potential to contribute to soil compaction or damage in sensitive areas of plantations.

### 2.1.3 INJURIES DUE TO LACK OF SAFETY FEATURES



Firemen sawing through the spike to allow hospital staff to treat the victim.

KOTA KINABALU: A plantation worker was rushed to hospital after getting impaled on an oil palm loading spike at an estate in Sabah's east coast Sandakan district.

Figure 2.2: body injuries

A risk that is often highlighted along with using palm oil spike loading involves bodily injury. As mentioned above, loading palm oil spikes are used to lift palm fruit. This may involve a safety risk as sharp objects on palm oil spike loads can accidentally hit the body. It may seem harmless, but most people who have

experienced this will feel that safety features are very important in the use of palm oil spike loading. Our bodies are very sensitive and even small sharp objects can create a lot of damage, which can penetrate the skin and cause bleeding, in the worst cases, injury or long-term disability.

In addition, injuries that often occur in oil palm plantations often involve puncture wounds, which can occur when workers meet each other or the sudden misuse of equipment. These injuries can also range from minor wounds to more severe puncture wounds, among is an injury to a muscle or ligament, depending on the condition and nature of the object causing the injury. It is important to follow the protocol that has been prepared to minimize the risk of injury and it is important for workers in palm oil plantations to use appropriate protective equipment.

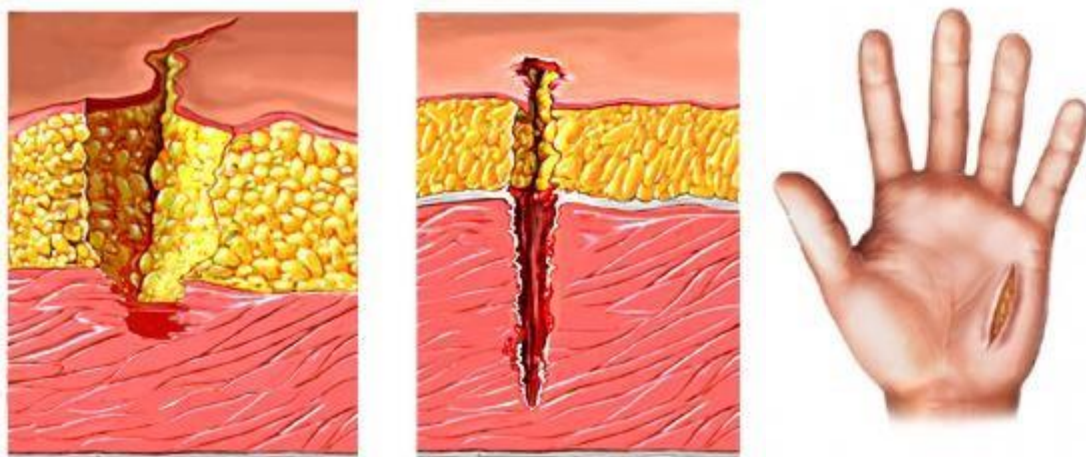


Figure 2.3 Muscle injury

## 2.2 MECHANISM EXISTING

### 2.2.1 DRUM TROLLEY

From the project we made, the drum trolley is our source of inspiration where the function used is almost the same, but we improved it in the palm oil plantation factor on our project. We also use more portable and cheap materials to make it easier to use on oil palm plantation.



Figure 2.4 Drum trolley

A drum trolley is a specialized piece of equipment in an industrial setting. It is designed to transport and move heavy drums easily. These trolleys are used to move drums containing chemicals or oil safely from one place to another. This way in the workplace is a very efficient and convenient way for workers. The design of this trolley is also strong and can support the weight of drums containing liquids. It is usually equipped with wheels that can turn to make it easy to move in different environments. In addition, this trolley also has a special feature which is to have a drum clamp to make it easy to load and unload the drum onto the trolley. This has increased efficiency in the workplace and reduced the risk of injury due to manual lifting.

But in our project, we produced the same functionality for portable oil palm trolley, and we improved our project to be a more user-friendly design in oil palm plantations. The material we used to make this project is also durable and the price is cheaper than other palm fruit trolleys.



### 2.2.2 TROLLEY WITH HEAVY DUTY TIRES



Figure 2.5: heavy duty wheel

This trolley with heavy duty wheels is a trolley that can carry heavy loads easily. In addition, this trolley has a special feature which is wheels made of durable material. It is designed to withstand heavy loads without damage. The large wheel feature of this trolley has the special feature of providing stability and being able to move on uneven surfaces easily.

From this cart we have made the use of wheels to improve in our project. This is because the wheels used are very useful in oil palm plantations because the environment and the surface are uneven. This can also make it easier for palm oil plantation workers to move the palm fruit easily and does not take a long time.

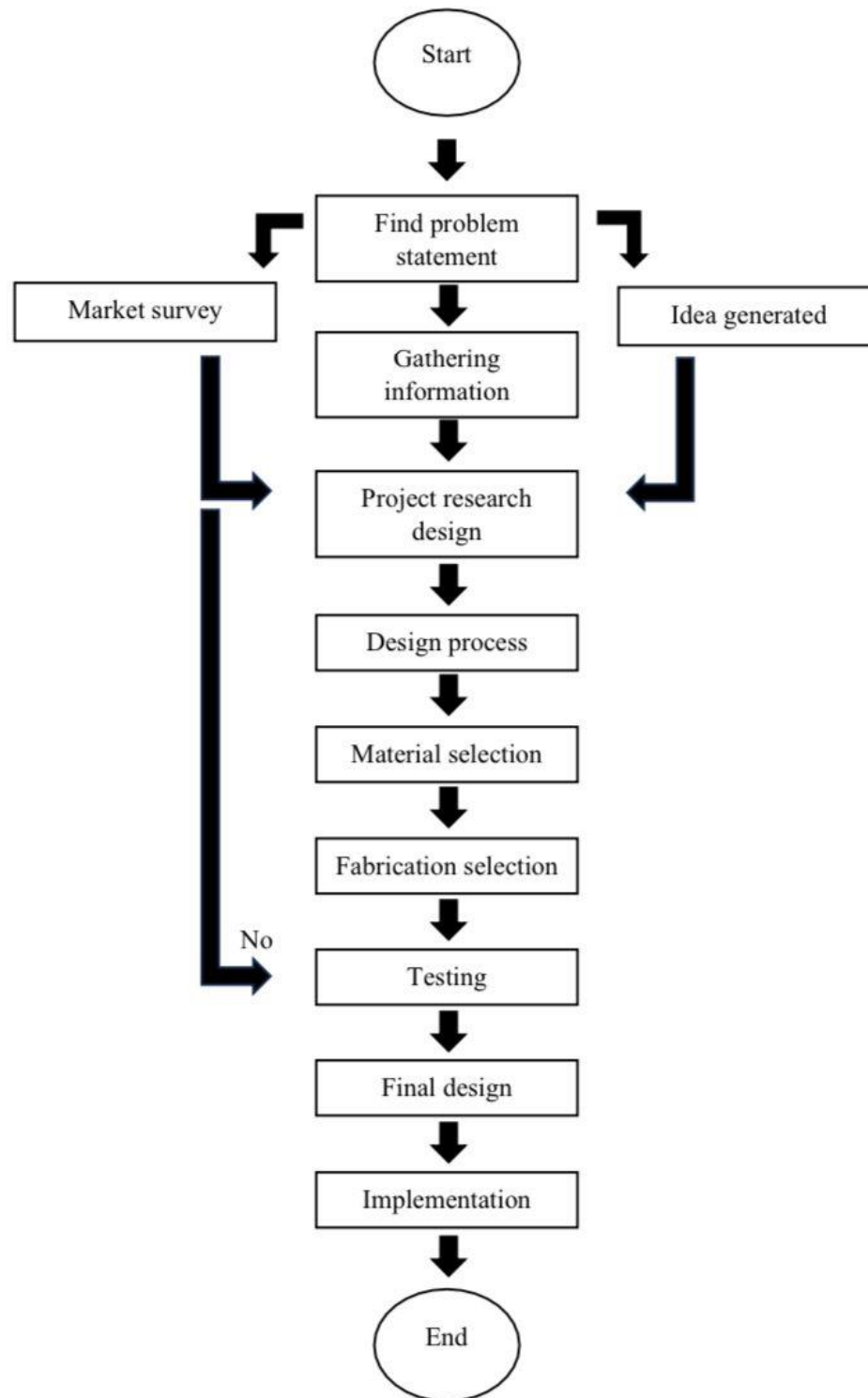


## **CHAPTER 3: METHODOLOGY**

### **3.1 INTRODUCTION**

In any research project, the methodology section is a crucial component that outlines the overall approach and specific procedures used to conduct the study. It serves to explain how data was collected, analyzed, and interpreted, ensuring that the research is transparent, replicable, and scientifically valid. Giving a precise and comprehensive explanation of the study strategy and techniques is the main goal of the methodology section. This adds to the corpus of knowledge in the subject by enabling other researchers to comprehend the procedure and maybe duplicate the study.

### 3.2 FLOW CHART



### 3.3 GATHERING INFORMATION

#### 3.3.1 MARKET SURVEY

A market survey was conducted, with 20 respondents responding to questions about the exposure and opinion of students on portable oil palm trolleys. The research was conducted among employees and those involved in oil palm plantation in Politeknik Banting Selangor. The survey found that most students are unaware of the trolley's function, allowing for further research on this topic.

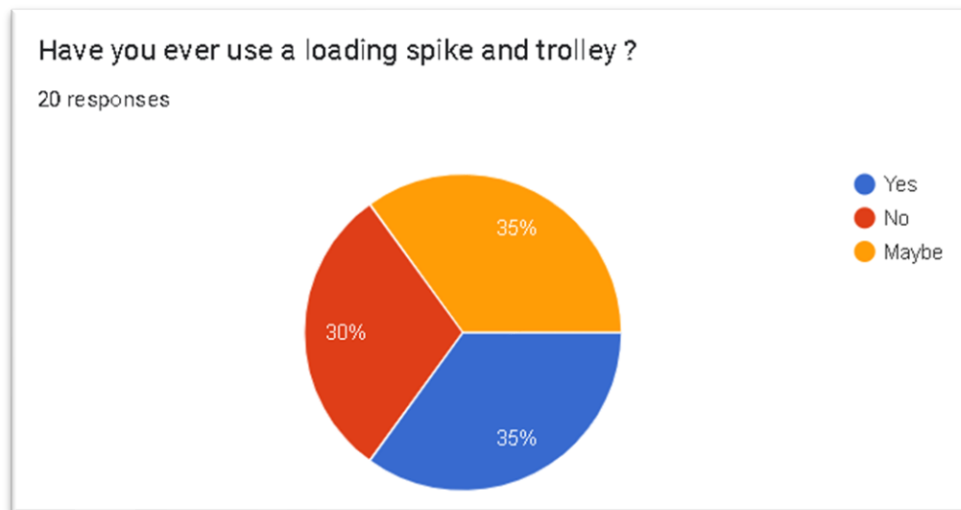


Figure 3.1: percentage of people have used the loading spike and trolley.

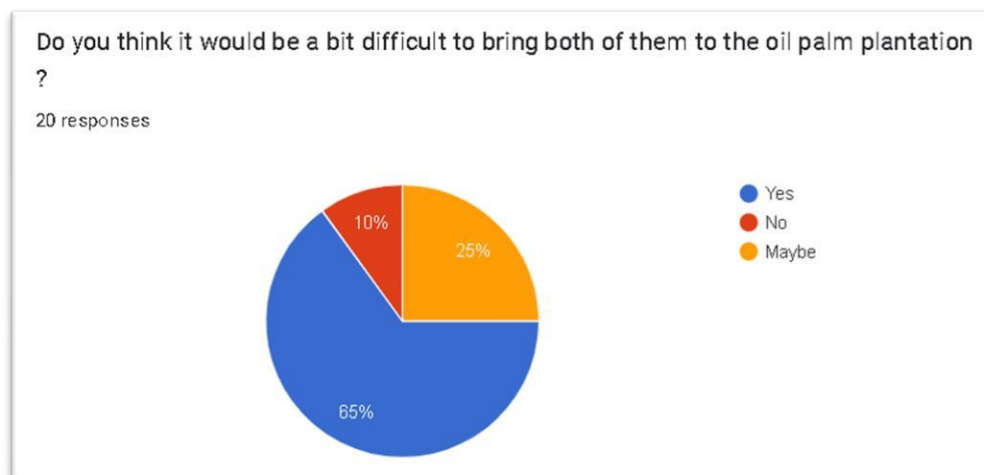


Figure 3.2: percentage of people think that the loading spike and trolley are difficult to bring separately.

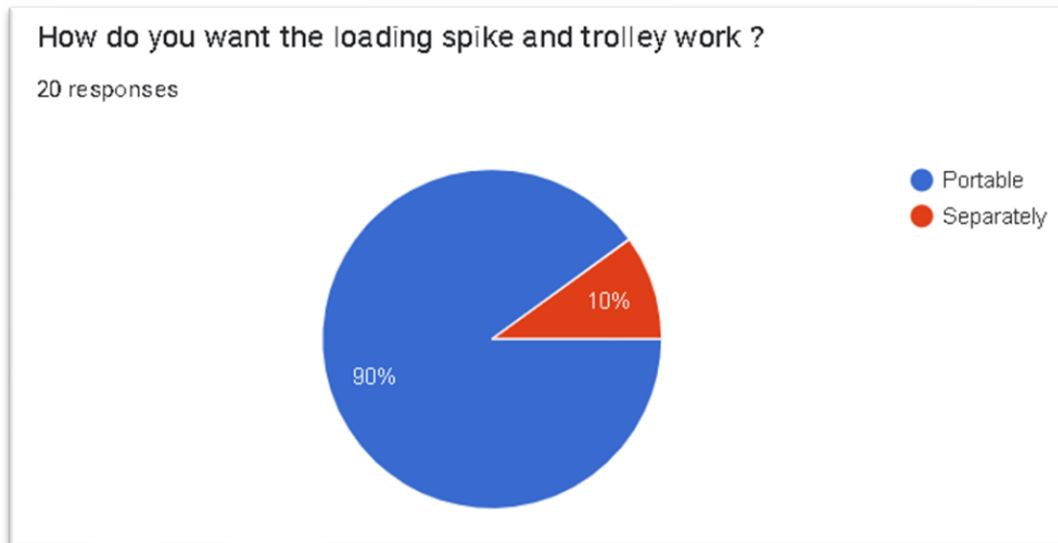


Figure 3.3: Portable Oil Palm Trolley work

Based on Figure 3.3 we can see that a lot of people want the loading spike and trolley work portable.

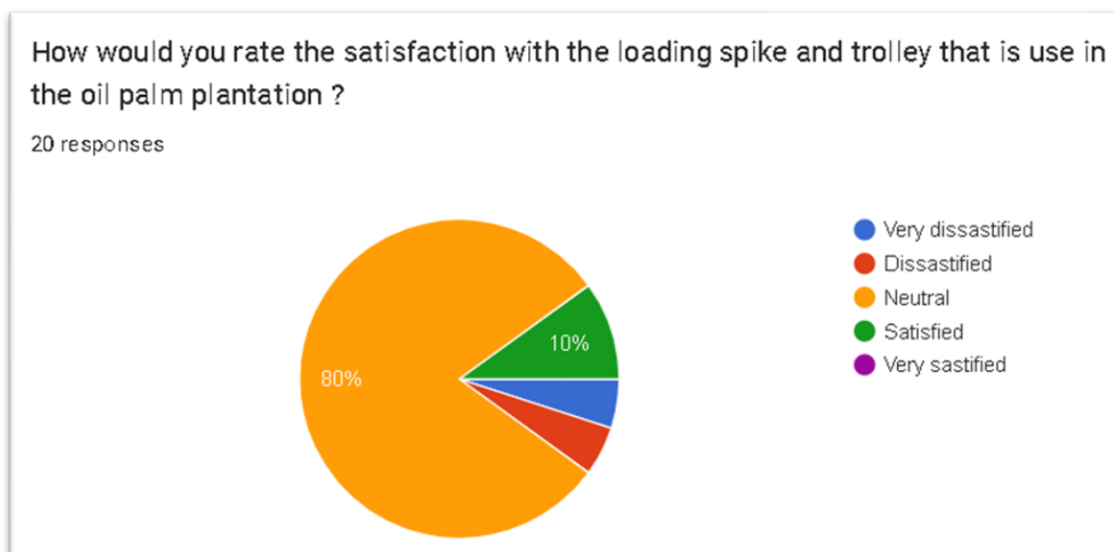


Figure 3.4

Figure 3.4 show that the rate of satisfaction with the loading spike and trolley that is use in the oil palm plantation.

What improvements would you like to make ?

9 responses

A bigger tyre that would accommodate the weight of palm oil and if can, put a suspension so that it would stabilize when it goes through hilly areas or potholed roads.

no

Buh turbo

make an automated adjustments

Portable it

put motor at the trolley for easy movement

None

Should make it more efficient

Upgrade to robot Technology portable

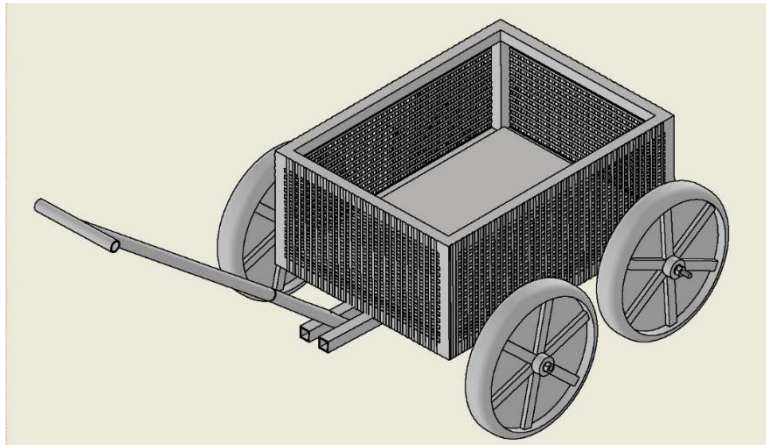
Figure 3.5: suggestion for improvement

Figure 3.5 shows the improvements that have been suggested. It can help us make improvements to our portable oil palm trolley before the final design is decided.

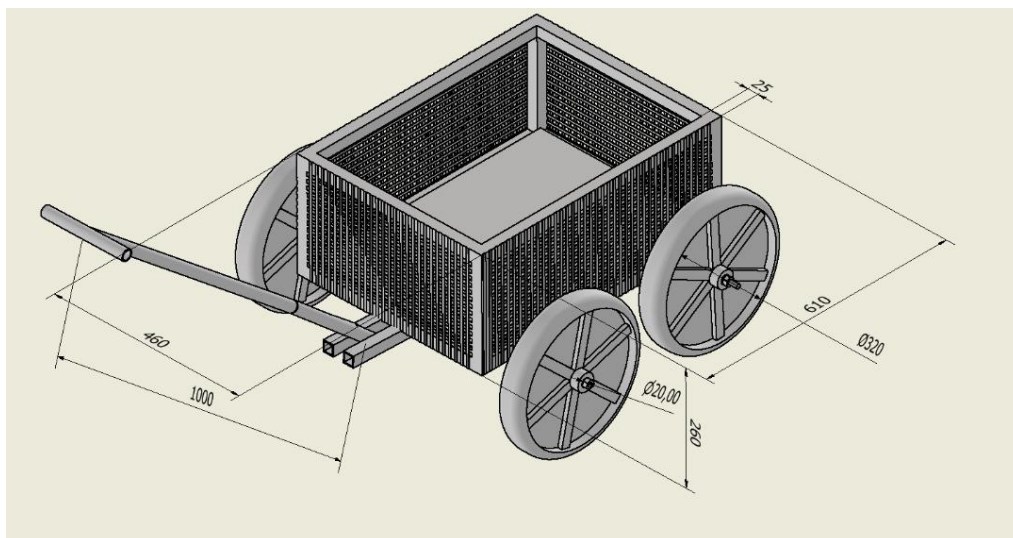
### 3.4 DESIGN PROCESS

To design the Portable Oil Palm Trolley, we use the Inventor application. We used millimeters to calculate the dimension based on Figure 3.7: Design Process (Assembly), where each part has been assembled one by one, starting with loading spike , trolley ,wheel , and holder . The dimension is all provided based on the design process shown in

#### 3.4.1 SPECIFICATION

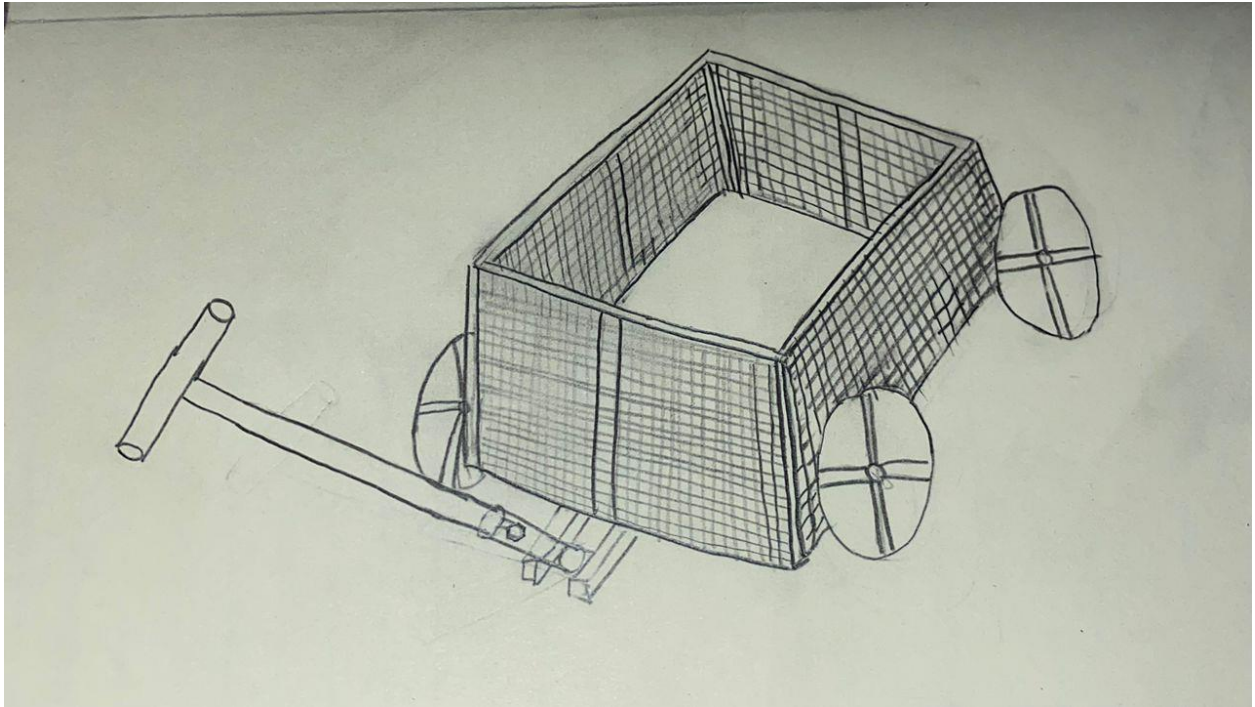


**Figure 3.6:** Design process (assembly)



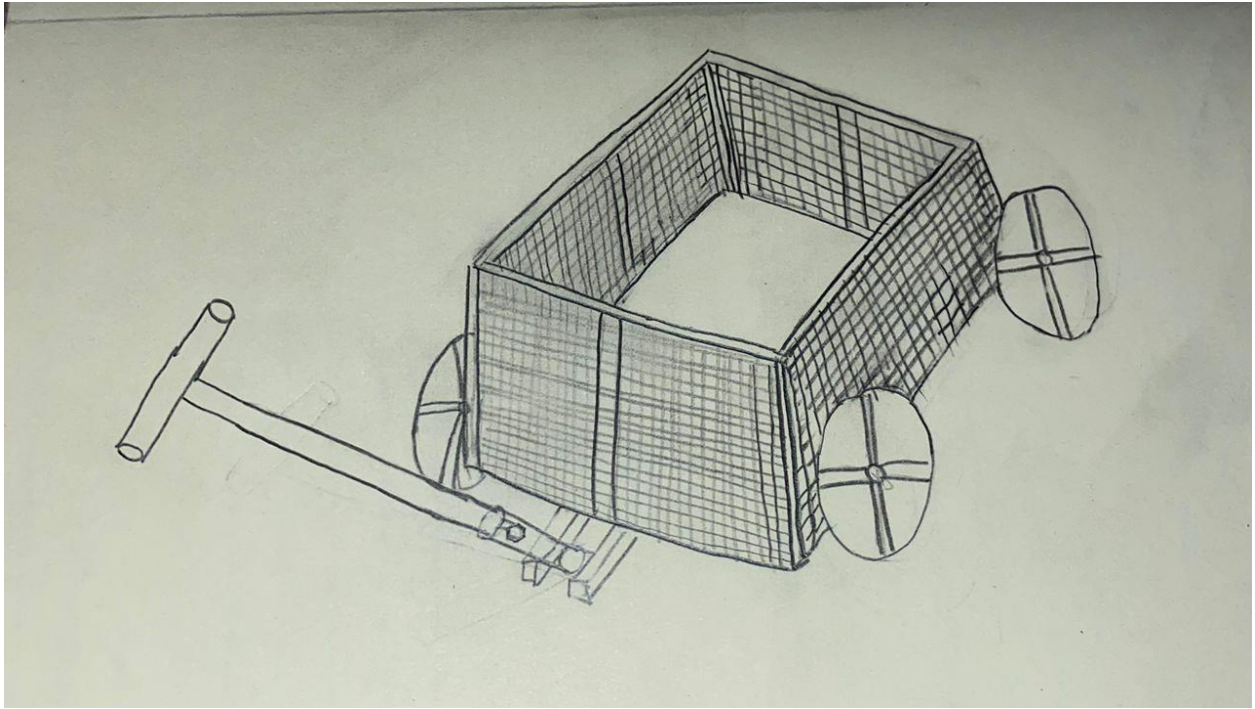
**Figure 3.7** The dimension of project

### 3.4.2 IDEA PROPOSED



**Figure 3.9** Design sketch

### 3.4.3 SELECTED CONCEPT



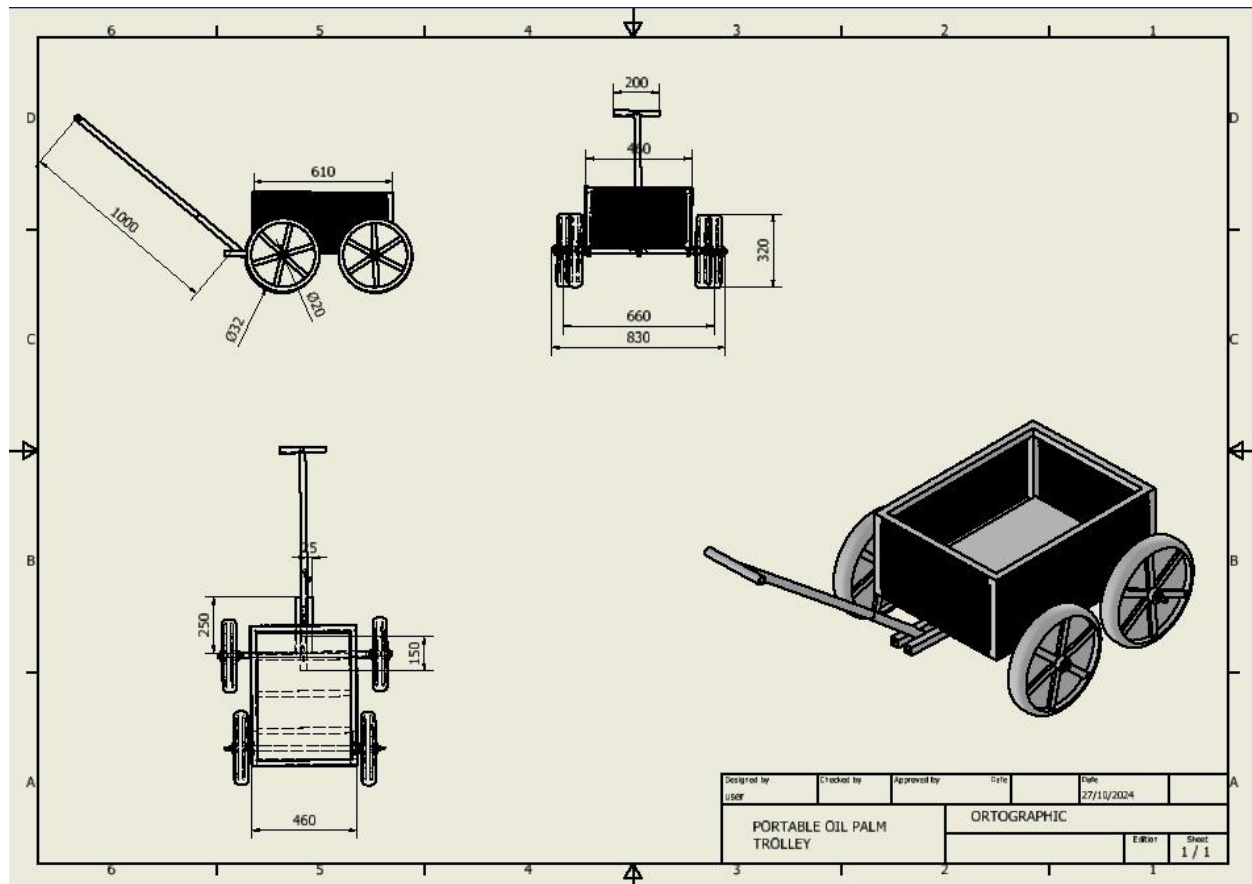
**Figure 3.10** Design pick

- Using a mild steel for a frame
- Use a mild steel chequered for a trolley base.
- Use a mild steel plate for a trolley barrier.
- Have a safety feature on the spike.
- The safety feature on spike uses a mild steel. • The trolley handle is made from mild steel.

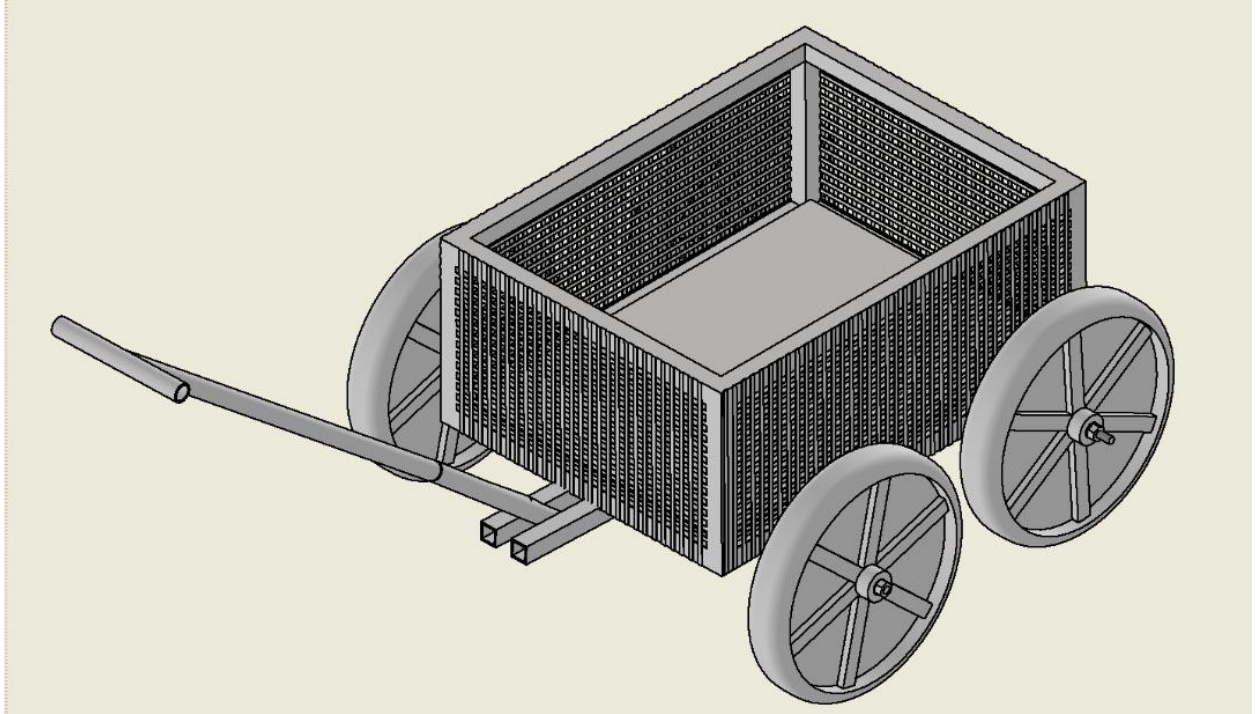


### 3.4.4 DETAILED DESIGN

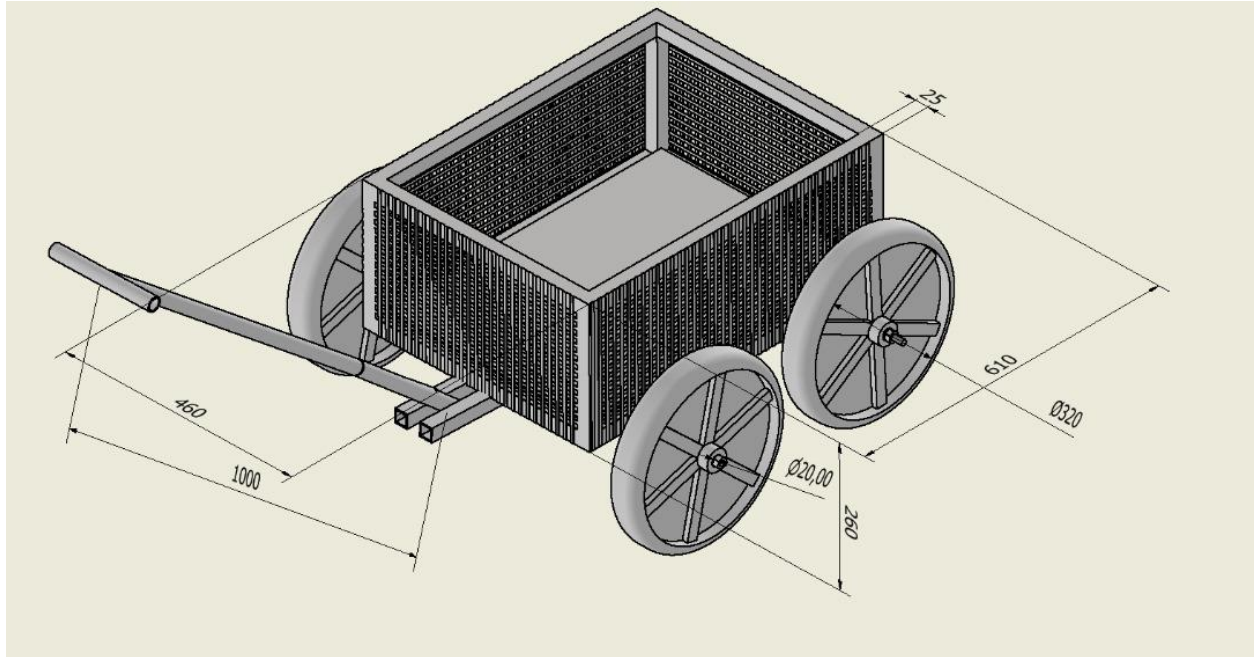
Based on **figure 3.12**, there is the isometric view of Portable Oil Palm Trolley which are the part has been separated while in **figure 3.11** is the view of the Portable Oil Palm Trolley.



**Figure 3.11** Drawing view



**Figure 3.12** Final design



**Figure 3.13** Detail design

### 3.5 MATERIAL

#### 3.5.1 MATERIAL SELECTION

Table 3.5.1

| No | Material                                                                                                | Description                                                                                                        |
|----|---------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------|
| 1  |  Mild steel            | Use to make project frame and handle.<br><br>Advantages: -<br>Lighter                                              |
| 2  |  Bolt and nut          | Use to connect wheels and spike to the trolley.<br><br>Advantages:<br>- Can lock object tightly                    |
| 3  |  Heavy duty tires    | Use to move the trolley easily.<br><br>Advantages: - Can hold a lot of weight.                                     |
| 4  |  Loading spike       | Use to pull the trolley and lift the palm fruit.<br><br>Advantages:<br>- Can use it easily                         |
| 5  |  Circular mild steel | Use to make a safety feature on loading spike.<br><br>Advantages:<br>- Can make a sharp part on loading spike safe |

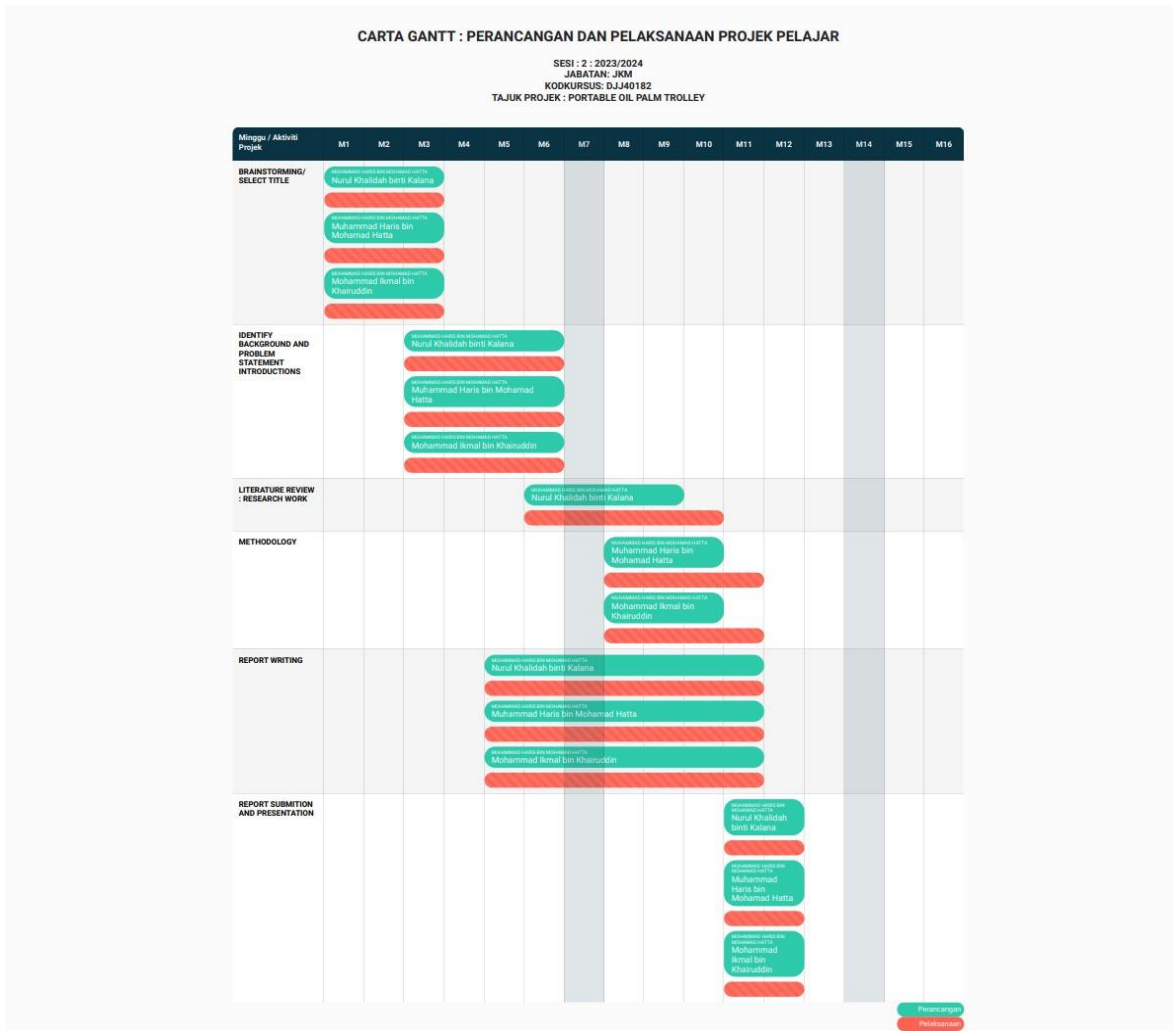
### 3.5.2 FABRICATION PROCESS

Table 3.5.2:

| Part                | Material                   | Description                                                                                                                                            | Fabrication                                                                                                                                                |
|---------------------|----------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Body frame          | Mild steel                 | Used to make project frame and handle<br><br>Advantages: <ul style="list-style-type: none"><li>- Lighter</li><li>- Efficiently malleable</li></ul>     | Arc welding<br><br>Arc welding is a process that creates an arc between an electrode and metal, melting them at the point where the metal is to be welded. |
| Trolley surface     | Mild steel chequered plate | Used to make a surface on the trolley<br><br>Advantages: <ul style="list-style-type: none"><li>- Heavy duty</li><li>- Can use in a long term</li></ul> | Arc welding                                                                                                                                                |
| Loading spike cover | Circular mild steel        | Use to cover the sharp part at the spike<br><br>Advantages: <ul style="list-style-type: none"><li>- lighter</li></ul>                                  |                                                                                                                                                            |
| Heavy duty wheel    | -                          | Use to make the trolley move easily<br><br>Advantages: <ul style="list-style-type: none"><li>- heavy duty</li><li>- can use in a long term</li></ul>   | The wheel will be connect to the trolley by a bolt and nut                                                                                                 |

### 3.6 GANTT CHART

Gantt chart below showed that the project has been handled since week 1 till week 14 on project one at Semester 4.



Gantt chart below showed that the project has been handled since week 1 till week 14 on project two at Semester 5.



## **CHAPTER 4: DATA AND ANALYSIS**

### **4.1 INTRODUCTION**

This chapter discusses the development and testing of our portable oil palm trolley, designed to make it easier for farmers to bring the oil palm in small quantities. This product combines two things into one and has safety features to prevent any injury. It also makes it easier for farmers to bring oil palm fruit to trucks if the trucks cannot pass through the oil palm area.

To evaluate the performance of portable oil palm trolley, we conducted a test that focused on ease of movement, capacity that can be carried and also durability, we measure the effectiveness of this portable oil palm trolley by carrying objects of different loads, ensuring that it is in the best performance in various situations.

The results of this test show that it is in the best condition and can be used to make it one of the important products that can increase the productivity and safety of users.



## 4.2 BUILDING THE PROTOTYPE AND PRODUCT

This chapter present how to build up the prototype and product. This involved section upper body, wheel support and handle.

### 4.2.1 UPPER BODY

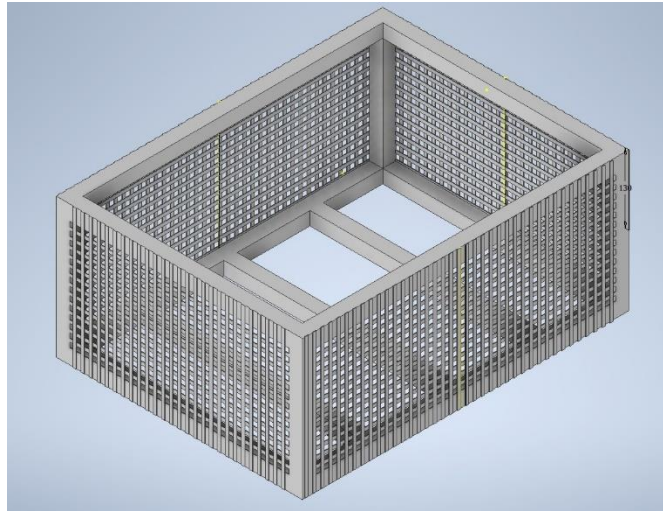
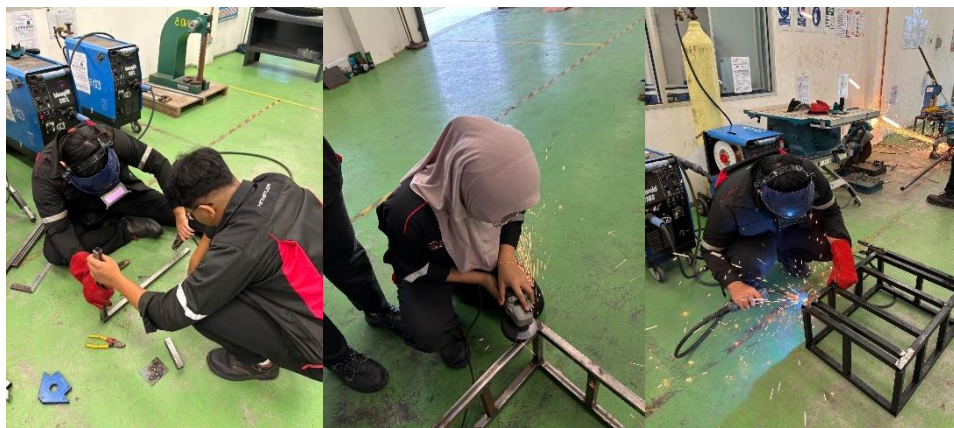


Figure 4.1 Drawing of the upper body



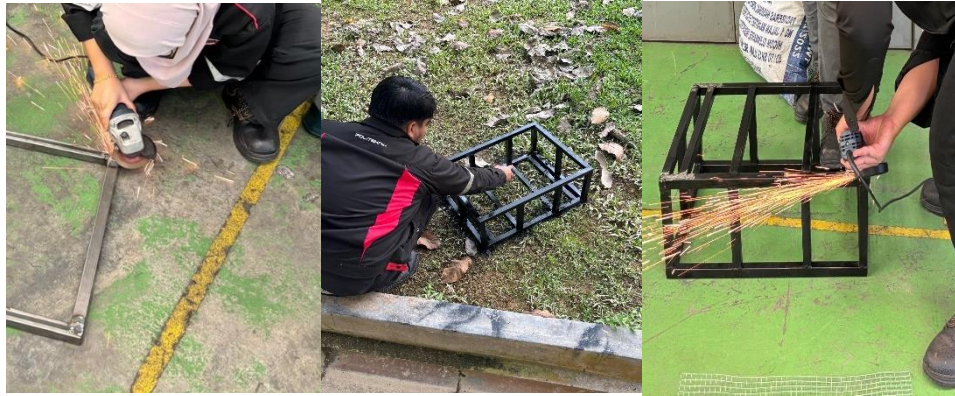


Figure 4.2 Show the progress to produce upper body by cutting, grinding and welding

#### 4.2.2 WHEEL SUPPORT

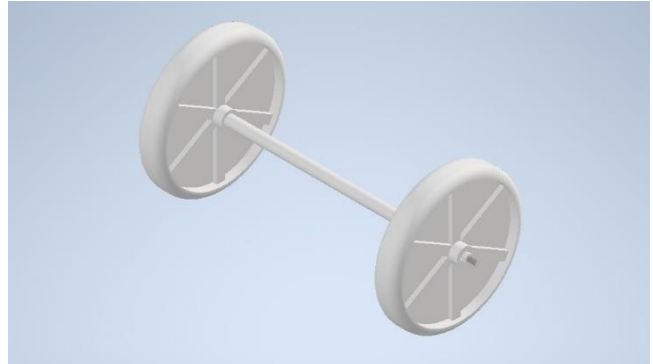


Figure 4.3 Drawing of wheel support

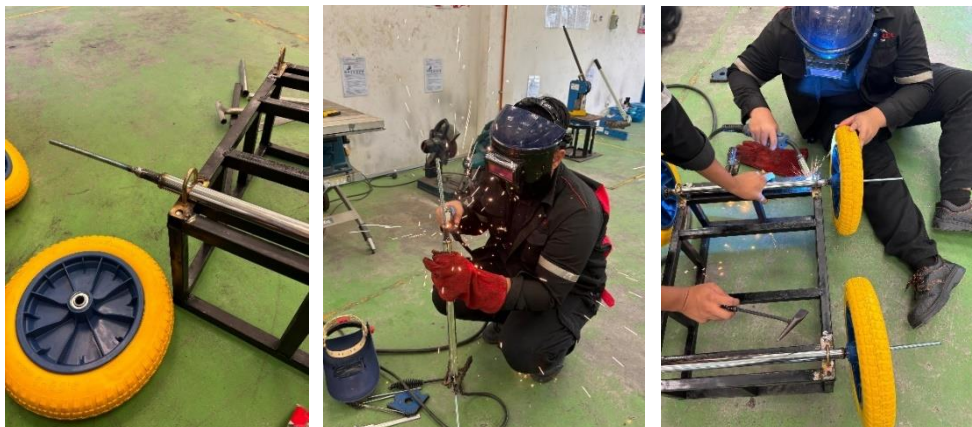


Figure 4.4 The progress to produce Wheel support. Welding wheel supports the upper body of the trolley for ensuring stability and balance.

### 4.2.3 HANDLE



Figure 4.5 Drawing of Handle



Figure 4.6 The progress of handle for trolley. Cutting the steel to be used as a spike protector

### 4.3 PROJECT FINDING

This chapter demonstrates the testing of samples in different aspects to determine the most effective Portable Oil Palm Trolley that has been produced. Table 4.2.1 shows the detailed experiment conducted on the Portable Oil Palm Trolley.

#### 4.3.1 EXPERIMENT DETAIL

| Test Aspect     | Measurement/Criteria                    | Result                                        | Analysis                                                                |
|-----------------|-----------------------------------------|-----------------------------------------------|-------------------------------------------------------------------------|
| Weight capacity | Maximum weight that can be accommodated | Maximum weight successfully carried<br>100 kg | Designs are built to specifications, suitable for heavy weight.         |
| Stability       | Load stability test (product stability) | Remained stable with no tipping or imbalance  | Safe to use when carrying loads                                         |
| Safety features | Number of safety incidents reported     | No safety incident reported during testing    | The safety features that are placed are very reassuring and safe to use |

Analysis of the portable oil palm trolley shows its effectiveness in terms of weight capacity that can be carried, its stability, and also safety features that can guarantee safety.

#### 4.3.2 PROJECT ANALYSIS DATA FOR PORTABLE OIL PALM TROLLEY

| Test Aspect /Repeation | Weight Capacity           | Stability                            | Safety Features                            |
|------------------------|---------------------------|--------------------------------------|--------------------------------------------|
| 20 kg                  | ✓                         | ✓                                    | ✓                                          |
| 50 kg                  | ✓                         | ✓                                    | ✓                                          |
| 80 kg                  | ✓                         | ✓                                    | ✓                                          |
| 100 kg                 | ✓                         | ✓                                    | ✓                                          |
| 130 kg                 | ✗                         | ✗                                    | ✗                                          |
| <b>Result</b>          | Supported up to 100 kg    | Stable at 100 kg, unstable at 130 kg | Functional up to 100 kg, failed at 130 kg  |
| <b>Analysis</b>        | Safe load limit is 100 kg | Overloading affects stability        | Safety features reliable only up to 100 kg |

#### 4.4 ANALYSIS COST

Cost analysis is namely the cost of purchasing materials

| NO | COMPONENT                | PRICE PER UNIT    | QUANTITY NEEDED | TOTAL PRICE (RM) | SOURCE   |
|----|--------------------------|-------------------|-----------------|------------------|----------|
| 1  | Mild Steel               | RM15 / 6m         | 1               | 15               | Hardware |
| 2  | Bold and Nuts            | RM3 / set         | 2               | 6                | Hardware |
| 3  | Heavy Duty Tires         | RM18.75 each      | 4               | 75               | Shopee   |
| 4  | Loading Spike            | RM30 / unit       | 1               | 30               | Shopee   |
| 5  | Circular Stainless Steel | RM35 / 25mm,800mm | 1               | 35               | Hardware |
| 6  | Hook eye plate           | RM2 each          | 3               | 6                | Mr.Diy   |
| 7  | Cable tie                | RM5 / set         | 1               | 5                | Mr.Diy   |
| 8  | Wire mesh                |                   |                 |                  | Hardware |
| 9  | Threaded rod screw bar   | RM12 / 2m         | 1               | 12               | Hardware |
| 10 | Washer                   | RM0.50 each       | 4               | 2                | Hardware |
| 11 | Bicycle wheel hub        | RM17.50 / unit    | 2               | 35               | Hardware |

#### 4.5 SAFETY RISK

Every product design must comply with safety specifications either during the development or operation process.

| RISK                    | HOW TO PREVENT                                                                                                                                  |
|-------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------|
| Sharp edges and spike   | <ul style="list-style-type: none"><li>• Avoid placing hands on sharp parts like spike</li><li>• Wear gloves when handling the trolley</li></ul> |
| Loose bolts and nuts    | <ul style="list-style-type: none"><li>• Inspect bolts and nuts regularly to ensure they are tight</li></ul>                                     |
| Tipping over when empty | <ul style="list-style-type: none"><li>• Avoid sudden movements when the trolley is empty</li><li>• Handle with care</li></ul>                   |

## **CHAPTER 5: CONCLUSION AND RECOMMENDATIONS**

### **5.1 CONCLUSION**

The Portable Oil Palm Trolley is an innovative tool designed to ease the transportation of harvested oil palm fruit bunches, addressing the challenges faced in palm oil plantations, particularly in rough terrains. The trolley enhances productivity by reducing the time, energy, and labor required for manual transportation, while also minimizing physical strain on workers.

Data analysis indicates that the Portable Oil Palm Trolley can lift heavy loads and have a good stability, enhancing productivity in small oil palm plantation. For instance, this product can move on uneven ground easily and has the strength to carry palm fruit on uneven ground.

Moreover, this Portable Oil Palm Trolley also has a safety features. This safety features intended for safety when carrying a Portable Oil Palm Trolley. For example, the sharp part of the loading spike has a cover on a trolley. If the loading spike is not used, it needs to be inserted into the cover on the trolley and it is also used as a handle to make it easier for the trolley to move.

Overall, this project confirms that the Portable Oil Palm Trolley not only streamlines operations but also contributes to a safer and more productive work environment.

## **5.2 RECOMMENDATION**

### **Recommendation for Portable Oil Palm Trolley**

#### **1. Increase weight capacity**

- Improved to increase load capacity beyond current specifications, allowing heavier loads to be carried

#### **2. Ease of use**

- The trolley should have an ergonomic handle design, ideally adjustable for different heights, to reduce strain on workers.

#### **3. Braking system**

- A simple but effective manual brake system can help control movement on sloped or uneven terrain, ensuring safety when transporting heavy loads.





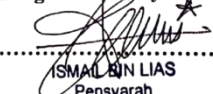
## JABATAN KEJURUTERAAN MEKANIKAL

### JADUAL AGIHAN TUGASAN INDIVIDU KUMPULAN PROJEK

#### TAJUK PROJEK : PORTABLE OIL PALM TROLLEY

| SUB-CHAPTERS                                              | DESCRIPTION                                                          |
|-----------------------------------------------------------|----------------------------------------------------------------------|
| <b>NAME OF STUDENT : MUHAMMAD HARIS BIN MOHAMAD HATTA</b> |                                                                      |
| 1.4,1.5                                                   | INTRODUCTION: RESEARCH SCOPE, CONCLUSION                             |
| 2.2                                                       | LITERATURE REVIEW: MECHANISM EXISTING                                |
| 3.2,3.6                                                   | METHODOLOGY: FLOW CHART, GANT CHART                                  |
| 5.1,5.2                                                   | CONCLUSION AND RECOMMENDATIONS: CONCLUSION, RECOMMENDATION           |
| <b>NAME OF STUDENT : MOHAMMAD IKMAL BIN KHAIRUDDIN</b>    |                                                                      |
| 1.3                                                       | INTRODUCTION: OBJECTIVES                                             |
| 2.2                                                       | LITERATURE REVIEW: MECHANISM EXISTING                                |
| 3.3,3.4,3.5                                               | METHODOLOGY: GATHERING INFORMATION, DESIGN PROCESS, MATERIAL         |
| 4.2,4.4                                                   | DATA AND ANALYSIS: BUILDING THE PROTOTYPE AND PRODUCT, ANALYSIS COST |
| <b>NAME OF STUDENT : NURUL KHALIDAH BINTI KALANA</b>      |                                                                      |
| 1.1,1.2                                                   | INTRODUCTION: BACKGROUND, PROBLEM STATEMENT                          |
| 2.1                                                       | LITERATURE REVIEW: PREVIOUS DESIGNED/RESEARCH WORK                   |
| 3.1                                                       | METHODOLOGY: INTRODUCTION                                            |
| 4.1, 4.3, 4.5                                             | DATA AND ANALYSIS: INTRODUCTION, PROJECT FINDING, SAFETY RISK        |

Pengesahan Penyelia Projek:

  
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## PORTABLE OIL PALM TROLLEY

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