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**SMART WHEELBARROW**

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With this, the end of our year-end project came with the final report on the many challenges and challenges we had to face, but all of this made it a valuable lesson and sweet experience while gaining knowledge in Polytechnic Sultan Salahuddin Abdul Aziz Shah.

**Disediakan oleh:**

**MOHAMMAD NABIL BIN TARMIZI**

## **ABSTRACT**

Wheelchairs are very useful means of transport for the community to carry out transportation activities of gardeners, farmers, or building goods and so on. When viewed from the definition of a wheelbarrow, it is a hand-driven, one-wheel-drive vehicle, driven by an operator through a handle. The Smart Wheel Barrow is an innovated wheelbarrow than a regular wheelbarrow. It is a combination of hydraulic and innovative wheelbarrows that can facilitate the lifting and moving of objects from place to place over a distance of 10-50 meters. first invented this product, which is to save labor. Freight transportation is an activity that requires a significant amount of energy. The average energy consumption required by a wheelchair operator is  $\pm 4080$  kcal / day during work hours. This value is close to the upper limit of energy allowed for heavy work, which is  $\pm 4800$  kcal / day. NIOSH explains that 40% of energy is spent on lifting loads and 20% on pushing and pulling loads. This study makes it easy for employees and users of the cart to enable them to use this product safely and comfortably. The second objective achieved is the addition of a brake system that enables users to stop the cart quickly, especially on sloping roads. It is intended to ensure the safety of users when carrying heavy loads

**Disediakan oleh:**

**MOHAMMAD NABIL BIN TARMIZI**

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# CHAPTER 1

## INTRODUCTION

**Disediakan oleh:**

MOHAMMAD NABIL BIN TARMIZI

### 1.1 Introduction

Wheelbarrow have existed since ancient times again. These tools are friendly to farmers, gardeners and laborers in the field of construction or agriculture to facilitate the workload of freight transport [1]. Where heavy loads can be reduced by using a wheelbarrow that is rejected or pulled by human power. The carts lighten the weight of the goods or materials lifted due to the load it is transferred to the wheel and handle system.

The cart has a one-wheel component, a pair of handles, a pair of legs and the former filling. Wheelchairs are usually 2-2.5 feet consisting of iron rims and black rubber tires either having a wind tube or the tire is off. If using a wheelbarrow tires are relatively lightweight but easy leak. So if using a dead tire is a bit heavy and the advantage is not easily leaked and durable.

The main structural component of the cartridge is made up of strong hollow iron with a pair of holders at the end of the iron. At the bottom of the cart there is a pair of legs made of stainless steel that work to stabilize wheelbarrow. An important part of the cart is the filling container it is placed in between the tire and a pair of holders loaded with loads. This former container is also divided into two: plastic filling containers and iron filling containers. Used The plastic filling is lighter and less rusty then the former holds the iron rusty and heavy.

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iron filling containers. Used The plastic filling is lighter and less rusty then the former holds the iron rusty and heavy.

Therefore, improvements need to be introduced to give comfort and convenience to the user. In addition to know the uses, strengths, advantages and disadvantages of this project and to help resolve this project. So, with the innovation of cars shoulders can facilitate user work.

## **1.2 Research Background**

Wheelchairs are a very useful means of transport for the community to carry out transportation activities of gardeners, farmers, or building goods and so on. When viewed from the definition of a wheelbarrow, it is a hand-driven, one-wheel-drive vehicle, driven by an operator through a handle. The Smart Wheelbarrow is an innovated wheelbarrow than a regular wheelbarrow. It is a combination of trolley and innovative wheelbarrows that can facilitate the lifting and moving of objects from place to place over 10-50 meters. First invented this product, which is to save labor. Freight transportation is an activity that requires a significant amount of energy. The average energy consumption required by a wheelchair operator is  $\pm 4080$  kcal / day during work hours. This value is close to the upper limit of energy allowed for heavy work, which is  $\pm 4800$  kcal / day. NIOSH explains that 40% of energy is spent on lifting loads and 20% on pushing and pulling loads. This study makes it easy for employees and users of the cart to enable them to use this product safely and comfortably. The second objective achieved is the addition of a brake system that enables users to stop the cart quickly, especially on sloping roads. It is intended to ensure the safety of users when carrying heavy loads

### **1.3 Problem Statement**

After doing some research, there are several statements about the car problem existing hoops on the market. The first is the energy consumption when the process is heavy. This is because, the kind of cart that is existing in the market is a manual in which the full use of manpower to reduce the heavy load of the filling container. Second, the carts available in the market are less ergonomic because of the consumer experience difficulties when the load transfer process takes place where the user needs to lift heavy loads by bending down and getting back up together burden. Lastly, the wheelbarrow from a design aspect is very simple concept that facilitates the transportation of large amounts of difficult to move materials. It is most commonly used in the construction and gardening industries to move such materials as dirt, gravel, stones, plants, concrete, etc. The current design of the wheelbarrow can be physically difficult on the user when performing tasks where they must bend forward or pull a load backwards up a set of stairs; this can cause strain to the users back.

### **1.4 Research Gap**

Manual Wheelbarrow have disadvantage of fully utilizing manpower for lower and lift the load. The user is forced to use the push strong enough for the load to fall from the filling container and lift each load individually in the filling container for the lifting process.

The type of motorcycle wheelbarrow among the disadvantages or problems encountered is that it is located overseas. As with most wheelbarrow available in Malaysia too, consumers need to uses a lot of energy to lift the load to put it in. The former charges. Next, it's also expensive for those who want to own it in addition to the additional cost of importing goods from abroad. In addition, in the event of damage to the cart this type of thing can be difficult to fix without someone specializing in it and the cost repairs are also a lot more expensive.

## **1.5 Research Objectives**

- a. To design and develop a wheelbarrow to better facilitate user.
- b. To make a comparison with the standard wheelbarrow and the innovation wheelbarrow.
- c. To identify maximum loading the wheelbarrow can withstand.

## **1.6 Significance of study**

While conducting a survey on existing carts from construction workers, most of them made the same complaint. Among them is a hard handle that can cause injury to the arm. Consumers also need to use more energy because they need to lift the cart first to remove the goods, and to bend down to lift the cart. Based on the information on existing wheelbarrows obtained from short interviews with users and workers, the researchers have agreed to produce a better-quality innovative wheelbarrow and make it easier to work on the site and help student for doing their lab.

## **1.7 Scope and limitations**

The smart wheelbarrow will be limited:

- a. For use in SME agriculture production.
- b. For use in construction work.
- c. Individual(gardening).
- d. Not for big industries usage.

## **1.8 Conclusion**

Nowadays, the issue of spinal pain and burdening consumers is increasing among wheelbarrow users. In conclusion, this chapter such as the background of the study, statement of problems, objectives of the study, scope of the study and the importance of the study has been discussed issue among wheelbarrow users, especially the elderly in order to facilitate and prevent injuries while using wheelbarrows.

## CHAPTER 2

### LITERATURE REVIEW

Disediakan oleh:

MOHAMMAD NABIL BIN AHMAD TARMIZI

#### 2.1 Introduction

At the beginning of the project, a literature review was carried out, which included studies from sources such as internet sources, newspaper, magazines and sources related to wheelbarrows/trolley. The collection of information from the literature review is particularly important as a preliminary step.

In the implementation of a project, various steps must be taken from the beginning until the completion of the project. Problems encountered on products are reviewed and refined to obtain better products.

#### 2.2 Theory/Concept

The study began by studying the history of the existence of a Wheelbarrows. Early studies show that wheelbarrows have existed since ancient times in the form of single-wheeled wheelbarrows. They used this wheelbarrow as a medium to lift the load just as much as the wheelbarrows of today. In the past, traditional Chinese people have used a wheelchair assisted by a windshield mounted on a wheelbarrow and have a large wheel in the middle that holds the entire load lifted. Figure 2.1 below shows ancient wheelbarrows used by the ancient Chinese civilization.[1]

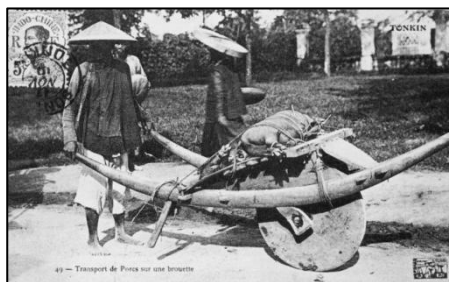


Figure 2.1 The wheelbarrows of the ancient Chinese civilization

Finally, wheelbarrows came to Europe around 1170 and 1250 with a single wheel.

Figure 2.2 shows European wheelbarrows.



Figure 2.2 European wheelbarrows

## 2.3 Type Of Wheelbarrows

Wheelbarrow have long been invented and used from time to time and even updated to meet current needs. Currently available in the market are as follows:

### 2.3.1 Manual Wheelbarrows

Figure 2.3 below shows the manual wheelbarrow. The user has to lift the load into the filling container and push it manually. Most of these carts are used by laborers, gardeners and farmers to carry out their daily work [2].

There is a downside to using fully manpower to lower and lift the load. The user has to use a strong push to allow the load to fall from the filling container and lift the load one by one into the filling container for the load lifting process.



Figure 2.3 Manual Wheelbarrow

### 2.3.2 Motor Type of Wheelbarrows

These wheelbarrows make it easy for users in process to lowering product goods or materials with minimal human consumption. One of the shortcomings or problems they face is that they are located overseas. As with most Wheelbarrows available in Malaysia too, use a lot of energy to lift loads to put in a container.

Motor type wheelbarrow as shows in figure 2.4 below it can be expensive for those who want to own it as well as the extra cost of importing goods from abroad. It's also not a kind of eco-friendly [3]. In addition, damage to this type of cart will make it difficult to repair without someone specializing in it and the cost of repairs should also be considerably more expensive.



**Figure 2.4** Motor Type Wheelbarrow



### 2.3.3 Hand Trucks

Hand trucks as shown in figure 2.5 below (also known as a two-wheeler, star truck, dolly, trolley truck, sack barrow, sack truck, or bag barrow) is essentially an L-shaped handcart that has handles at one end, wheels at the base, with a small ledge to set objects on and sits flat against the floor when it's upright. Objects that require moving are tilted forward while the ledge is inserted underneath, and then back to rest on the ledge. The truck and objects are then pushed backward until the weight is balanced over the large wheels, facilitating the movement of heavy or bulky objects. A motor mechanism is attached to this hand truck to lift it up the stairs.



**Figure 2.5** Hand Trolley

## **2.4 Wheelbarrow System**

A wheelbarrow consists of a tray or bed composed of steel, wood, or plastic. A steel brace attaches this bed to steel support legs and to a steel or plastic wheel, with a rubber tire around it. In two- or four-wheeled models, the wheels may be like bicycle tires, complete with inner tubes. Some handles are metal with foam or hard plastic grips, while some wheelbarrows intended for the home gardener have solid wooden handles with no grips.

### **2.4.1 Process**

Because wheelbarrows come in a variety of shapes, made from many different materials, the manufacturing procedures vary greatly depending on the type of cart being made. Some heavy-duty wheelbarrows, intended for industrial use, are manufactured with heavy machinery forming thick steel sheets. To discuss some of the different techniques used to make wheelbarrows. High density polyethylene can be formed into various shapes using various techniques. For wheelbarrow trays, they are usually made in the form of thick pieces. This can be done by extrusion. This process involves diluting the polyethylene grains into the liquid and forcing it through the nozzle. The polyethylene sheets are sent to the wheelbarrow manufacturer and inspected. They are then formed into tray using a technique known as vacuum forming or thermo formation. This process involves heating the sheet until soft. Soft plastic is then placed over an open box containing a mould in the form of a wheelbarrow tray. The plastic is cooled into the trolley tray and removed.

## 2.5 Motorised Wheelbarrow

A motorised wheelbarrow in Figure 2.6 below of the so-called four-wheel kind comprising an electric motor to drive the wheelbarrow; adapted for battery means, to be carried by the wheelbarrow to power the motor, to be in the region of the front axle means, with all four wheels driven by the single electric motor, that drives the rear two wheels directly and these wheels in turn drive the other two wheels; the wheelbarrow having, when empty, a weight distribution with more than half its weight on its front axle means, and a hopper such that its load will be substantially on the front axle means, with handle means for tilting the wheelbarrow so as to lift the rear wheels off the ground, with a brake that operates automatically upon interruption of power supply to the motor, and with a pivotal mount for the hopper such that if the wheelbarrow is suddenly braked the hopper will tend pivotally to tilt or overturn to eject its load forwards.



**Figure 2.6** Motorised Wheelbarrow

## **2.6 Conclusions**

Overall obtained from this chapter is the production that will be made referring to the sources of previous studies to complete the work done. In addition, some information from previous wheelbarrow with modern ones has been identified such as the technology and design used by the creators. Therefore, by studying past designs and in accordance with current needs and demands will improve design or innovation. This implementation can help create projects that can help users in more comfortable use, easy to use and prevent injuries.

# **CHAPTER 3**

## **METHODOLOGY**

**Disediakan oleh:**  
**PATTERSON ENJAT ANAK DEMPI**

### **3.1 Introduction**

The design, fabrication, installation and testing processes of product are conducted at welding workshop involving process of cutting, welding and drilling. The process started with finding the problem statement of the existing product. After that the best design will be chosen only can proceeds to the selection of materials. The fabrication process comprises of cutting parts for the wheelbarrow and welding all the parts needed. After cutting and welding all the parts, the wheelbarrow is assembled according to the specification. Finishing is added accordingly. The finished prototype is then tested and adjustments are administered as needed. Only then the end product is deemed suitable to use. Figure 3.1 shows the flow chart for the methodology.

### 3.2 Flowchart

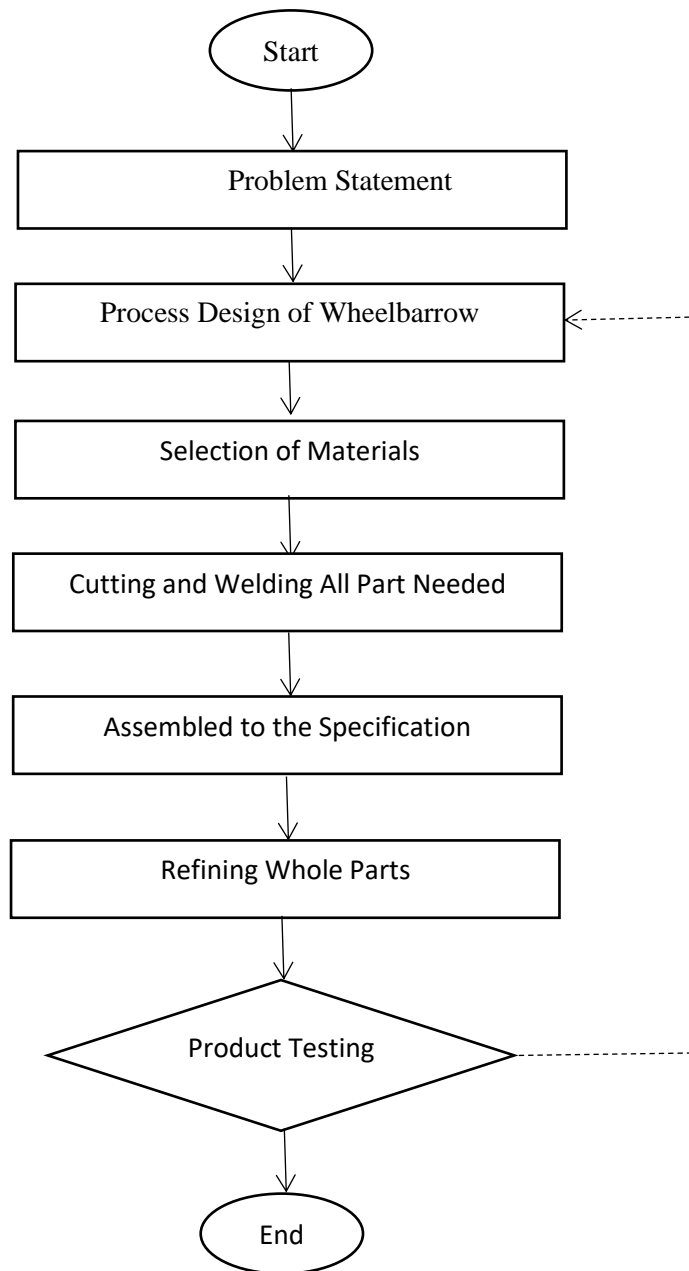


Figure 3.1: Project Flow Chart

### **3.3 Identifying Problem**

Smart Wheelbarrow is a vast improvement of the traditional wheelbarrow and other types of wheelbarrow. The wheelbarrow electric has lots of additional features which are efficient and improve the quality of the movements. The back of the wheelbarrow have one wheel and the wheel can rotate completely 360°. The reason behind the rotation is to ensure it easy to make a turn or change direction to other direction. Hence, this will save more times to make a turn.

As a matter of fact, there is a grip at the back of the tray/bed of the wheelbarrow to pull up the tray/bed by hand to dump the loads. This is more efficient as it don't have to pull the wheelbarrow all the way. The person just have to unlock the lock and then pull up the tray/bed.

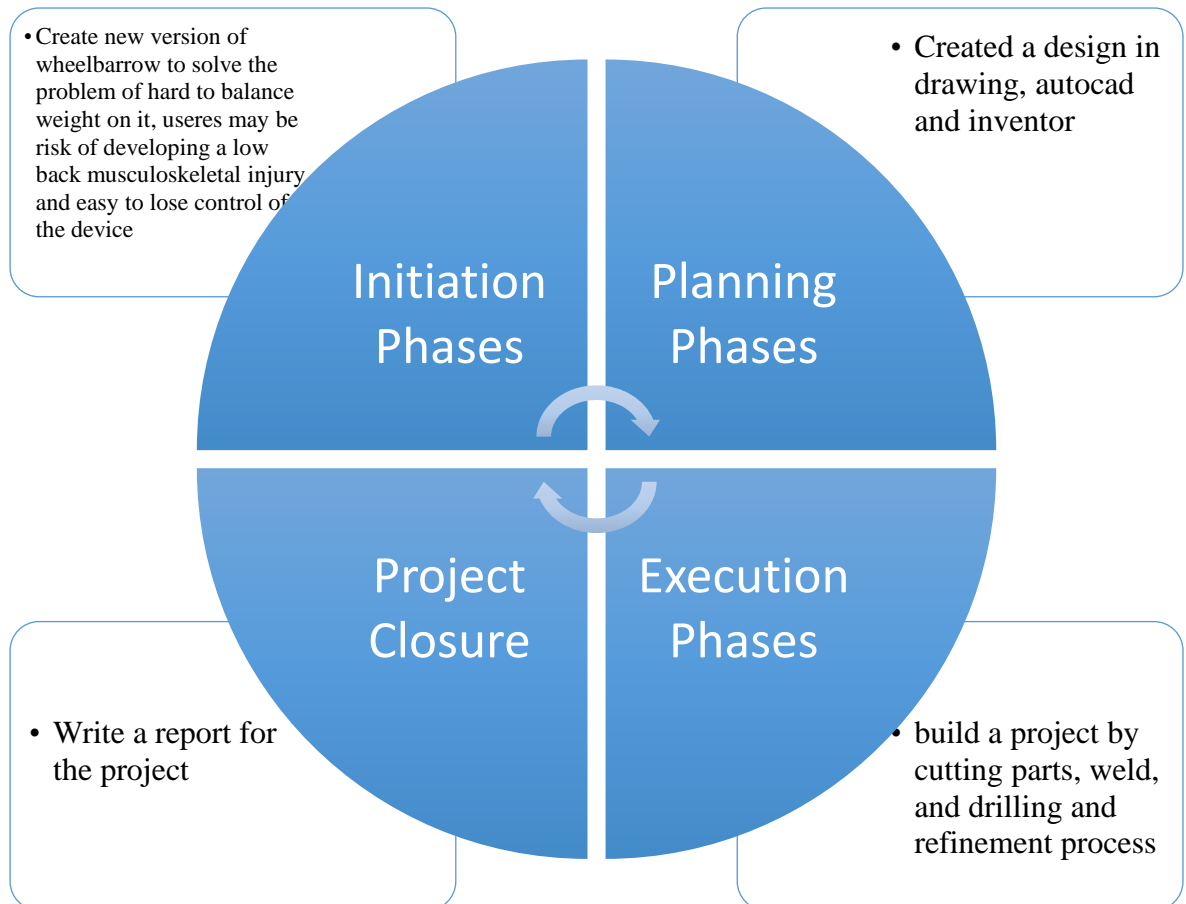
To make it easier when pulling up the tray/bed, the technique called scissoring apply to the wheelbarrow. Frame mounted at the back of the frame with a pivot to facilitate the removal of material in the cart.

In addition there's a design called toe plate or iron platform. Basically, toe plate is kind a platform. The function of the platform is to work as a trolley. The whole trolley can stand straight and use the platform to carry a load without even put the loads into the tray/bed.

The size of the wheelbarrow is same as the current one. The only thing that makes a different is the height of the handle is higher than the previous one. It would be easy for us to handle it without hunch your back.

### 3.4 Methodology Phases

Table 3.2: Methodology Phases Chart





### **3.5 Analysis**

Smart wheelbarrow has been through the trial according to the test result comparison between time and distance. The test imposed on the smart wheelbarrow has followed the specified specifications that users need. That is to say, it is safe to use by any user. The existing smart wheelbarrow only could stand for 6-10 months according to how hardcore the usage is. With the new design user can do maintenance to specific part of the wheelbarrow. This will make the wheelbarrow could stand in a long amount of time. The new design of wheelbarrow is mounted with 3 tyre. Hence, the load separate to the 3 tyre and it helps to increase the load from 1200lbs (concrete) to 1700lbs (concrete). As shown in Table 1, the comparison between standard wheelbarrow and smart wheelbarrow.

In this data analysis process, the data will be collect and the results will be analyzed and displayed in the form of tables.

### 3.6 Design 1

This is the first design for wheelbarrow. After do some analysis for the current design of wheelbarrow, there's so much weakness in it. The improvement that need to make is the way user dump the load and wheel. This two factor are make a lot of improvement to the wheelbarrow itself.

It is not easy to dump a heavy load, because user need to pull up the whole wheelbarrow. The new method which is only need to pull the tray/bed only. Unlock the tray/bed to dump the loads and lock it back to lock the tray/bed.

Wheelbarrow use to have one wheel, so there is no stability and hard to control. So, make it stable by added two front wheels.

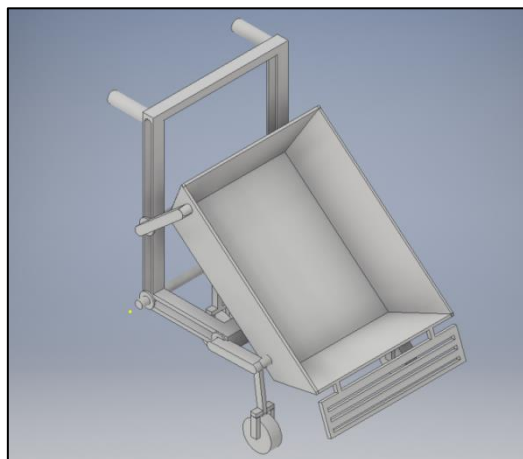


Figure 3.3: Sketch/Design

### 3.6.1 Design 2

This is the second design of wheelbarrow. The new design still with 3 wheels but one of the wheel is able to make a 360 degree rotation and put batteries onto the wheelbarrow so it has throttle to push.

One 360 degree wheel rotation is merged at the back of the wheelbarrow. It is able to make a turn easily even in a small space and save time.

The reason why make it as electric wheelbarrow because it will help human to move a heavy loads easily when climb the hills. Hence, you don't have to waste energy by pushing the whole loads alone.

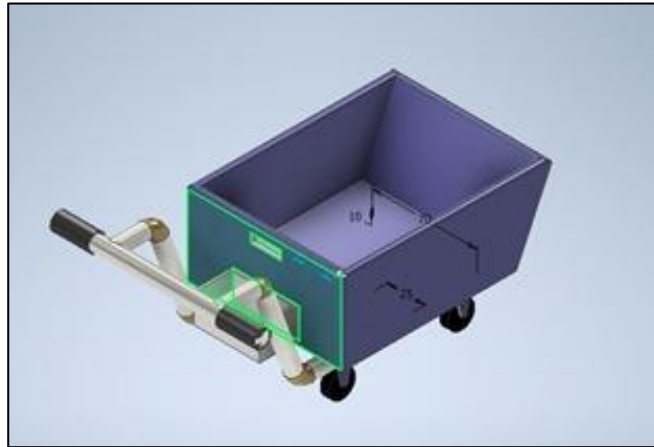


Figure 3.4: Sketch/Design 2

### **3.6.2 Final Design**

The Smart Wheelbarrow have a different functional and the way to use it is different than the existing wheelbarrow. The Smart Wheelbarrow have a high handle. Which mean, users do not have to pull up the wheelbarrow in order to change direction. To change direction of movement is very easy as users can easily do a rotation because the Smart Wheelbarrow have a 360 degree wheel rotation [5]. To dump a load or any weight on it, users have to press the break handle which work as a lock, this unlocks the tray of the wheelbarrow [4]. Then, push the handle down and the tray will lift by itself. The Smart Wheelbarrow also can be used as a trolley. A toe plate or platform that is mounted at front of the tray will carry the object toward it. It is same concept as a hand trolley.

### **3.7 Material selection**

Most wheelbarrows are made of durable metals, with the most common choice being steel. These wheelbarrows can easily handle light to heavy tasks without being destroyed. Their frame, handles and load tub are usually made of steel or other durable metals. This facts ensures durability as well as resistance to destruction from weather conditions, which may otherwise result to cracking, rusting and corrosion when exposed to moisture, the sun or cold temperatures.

These wheelbarrows can easily handle light to heavy tasks without being destroyed. Their frame, handles and load tub are usually made of steel or other durable metals. These material are largely used in industries, the facts this material perfectly fit for wheelbarrow, since steel are easily can be find everywhere and long lasting.

If stainless steel is a material for a wheelbarrow, The wheelbarrow will not have problems with the rust. However, if it use other metals like iron, then it may need to repaint it frequently and avoid exposing it to moisture and water to prevent rusting. As much as steel and metallic wheelbarrows are massive, their strength and ability to cater for a wide range of jobs is an advantage that cannot be offered by most types of wheelbarrows.

Steel wheelbarrows are typical in multiple niches ranging from when user want to move heavy loads around your home or within your garden, to the industrial environment

when transporting supplies and products from one area to the other. Since they are durable, sturdy and resistant to damage, steel and metal wheelbarrows can perform unlimited transportation tasks.

### **3.8 PROJECT OPERATIONAL**

The Smart Wheelbarrow have a different functional and the way to use it is different than the existing wheelbarrow. The Smart Wheelbarrow have a high handle. Which mean, users does not have to pull up the wheelbarrow in order to change direction. To change direction of movement is very easy as users can easily do a rotation because the Smart Wheelbarrow have a 360 degree wheel rotation. To dump a load or any weight on it, users have to press the break handle which work as a lock, this unlocks the tray of the wheelbarrow. Then, push the handle down and the tray will lift by it self. The Smart Wheelbarrow also can be used as a trolley. A toe plate or platform that is mounted at front of the tray will carry the object toward it. It is same concept as a hand trolley.

### 3.9 Project Refinement Process

As shown in Figure 3.4, the fabrication process comprises of cutting parts for the wheelbarrow and welding all the parts needed. All the parts of the wheelbarrow is joined by using MIG welding. After cutting and welding all the parts, the wheelbarrow is assembled according to the specification. Some of the parts have been drilled and joined together by screw, washer and nut.

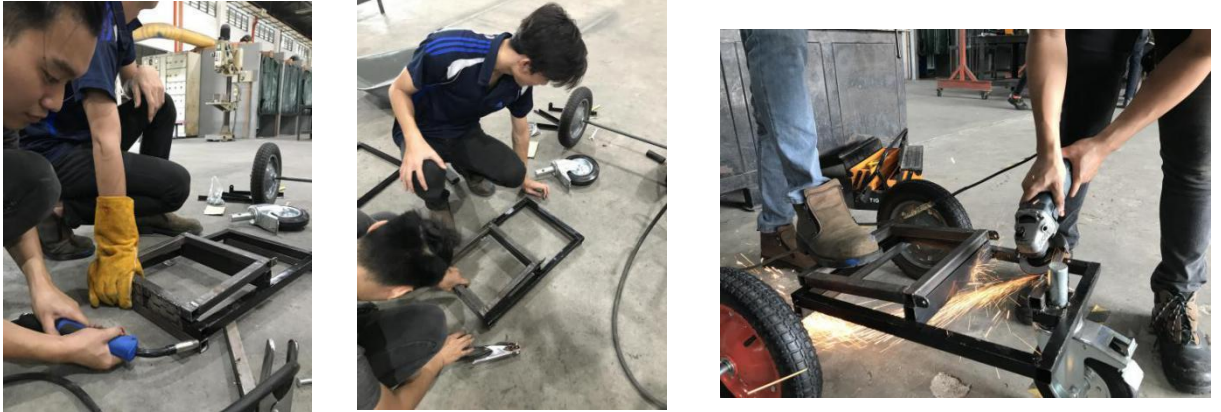


Figure 3.12: Fabrication and installation

### **3.10 Summary of The Chapter**

In conclusion, the methodology flow chart is very important that involved design, fabrication, installation and testing process of product. The best design will be chosen to proceeds with selection materials. Data analysis is done systematically in the methodological study to know the facts and information to support the research instrument and describe more clearly in this study.

## **CHAPTER 4 RESULTS AND DISCUSSION**

**Disediakan oleh:**

AHMAD HADI HAKIMI BIN JAAFFAR

### **4.1 Introduction**

Wheelbarrow is a small hand-propelled vehicle, which is a device used for carrying loads. Previous research has provided evidence that existing wheelbarrow on the market is hard to balance the weight on it. Also, users at any age may be at risk of developing a low back musculoskeletal injury. It is noted that a lot of energy is used to push the wheelbarrow. The existing wheelbarrow only have one wheel, making it easy to lose control of the device. The objective of the current study is to design and develop a smart wheelbarrow. The initial process in this research involved design and selection of materials used for a smart wheelbarrow. Subsequently, the fabrication process comprises of cutting parts for the wheelbarrow and welding all the parts needed. After cutting and welding all the parts, the wheelbarrow is assembled according to the specification. Finishing is added accordingly. The finished prototype is then tested and adjustments are administered as needed. Only then the end product is deemed suitable to use. The analysis conducted demonstrate that the Smart Wheelbarrow is more suitable for agriculture, construction and gardening work and not for large industries uses. Future suggestions are to upgrade the wheelbarrow by adding a motor, powder coated steel and battery.

#### **4.1.1 Component Cost**

Table 4.1 shows the cost of materials that have been used to make this smart wheelbarrow. 1- standard wheelbarrow, 2- static tyre, 1- 360 rotating tyre, 1-pair of handle, 21ft of wrought stainless steel, 2- can of spray and, 10 pairs of nut and bolt. (Refer Appendix B)



## 4.2 Verification

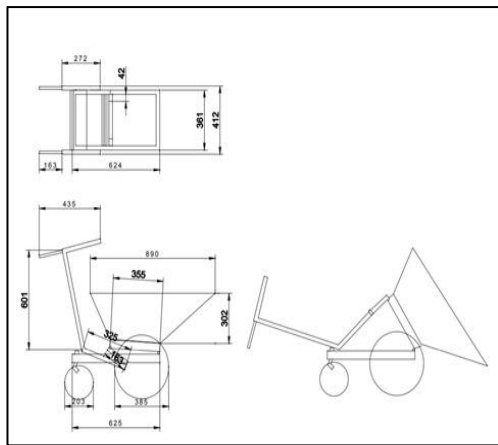
Smart wheelbarrow has been through trial according to the specific test. The test imposed on the smart wheelbarrow has followed the specified specifications. That is to say, it is safe to use by any user. The existing smart wheelbarrow only could stand for 6-10 months according to how hardcore the usage is. With the new design user can do maintenance to specific part of the wheelbarrow. This will make the wheelbarrow could stand in a long amount of time. The new design of wheelbarrow is mounted with 3 tyre. Hence, the load separate to the 3 tyre and it helps to increase the load from 1200lbs (concrete) to 1700lbs (concrete).



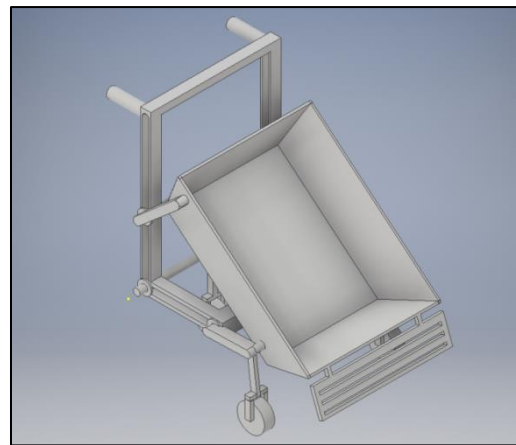
Figure 4.1 Final product (a) front view and (b) side view

### 4.2.1 Product Testing

The project of smart wheelbarrow was designed to carry any weight on it and to work as a hand trolley. From this device, users can use it in different way because the smart wheelbarrow is a multi-purpose device. The smart wheelbarrow can rotate easily even in a tight space with a 360 degree wheel. In generally, the innovation of smart wheelbarrow is to meet users requirement. Project Design was successfully proposed and fabricated according to designed material and fabrication method as exhibit in Figure 3.



(a) Product design



(b) Product fabrication

Figure 4.2 (a) product design and (b) product fabrication

What's more, the smart wheelbarrow can work as a hand trolley because it mounted with a platform in front of the tray to scoop an object in front of the device. Moreover, this device is can be maintenance by users itself, it won't cost any fee. This device is a eco-friendly with no harm to ecosystem.



Figure 4.3 Finish product development

### 4.3 Data Analysis

After extensive testing, the data has been compiled and tabulated as shown in Table 4.2 below.

Table 4.2: Comparison between time and distance Standard Wheelbarrow

| <b>Standard wheelbarrow</b>   |      |      |      |      |
|---|------|------|------|------|
| <b>Load (kg)</b>  | 20   | 30   | 40   | 50   |
| <b>Distance travelled before taking a break from lifting the load (m)</b> | 69.9 | 57.1 | 44.3 | 29.6 |

From Table 4.2, it has been determined that a standard wheelbarrow is not very ergonomic for a long period of time because the distance travelled by standard wheelbarrow is only 69.9 m with 20kg load. The more load in the wheelbarrow, the less distance travelled by the wheelbarrow . Figure 4.5 shows the time versus distance for a standard wheelbarrow.

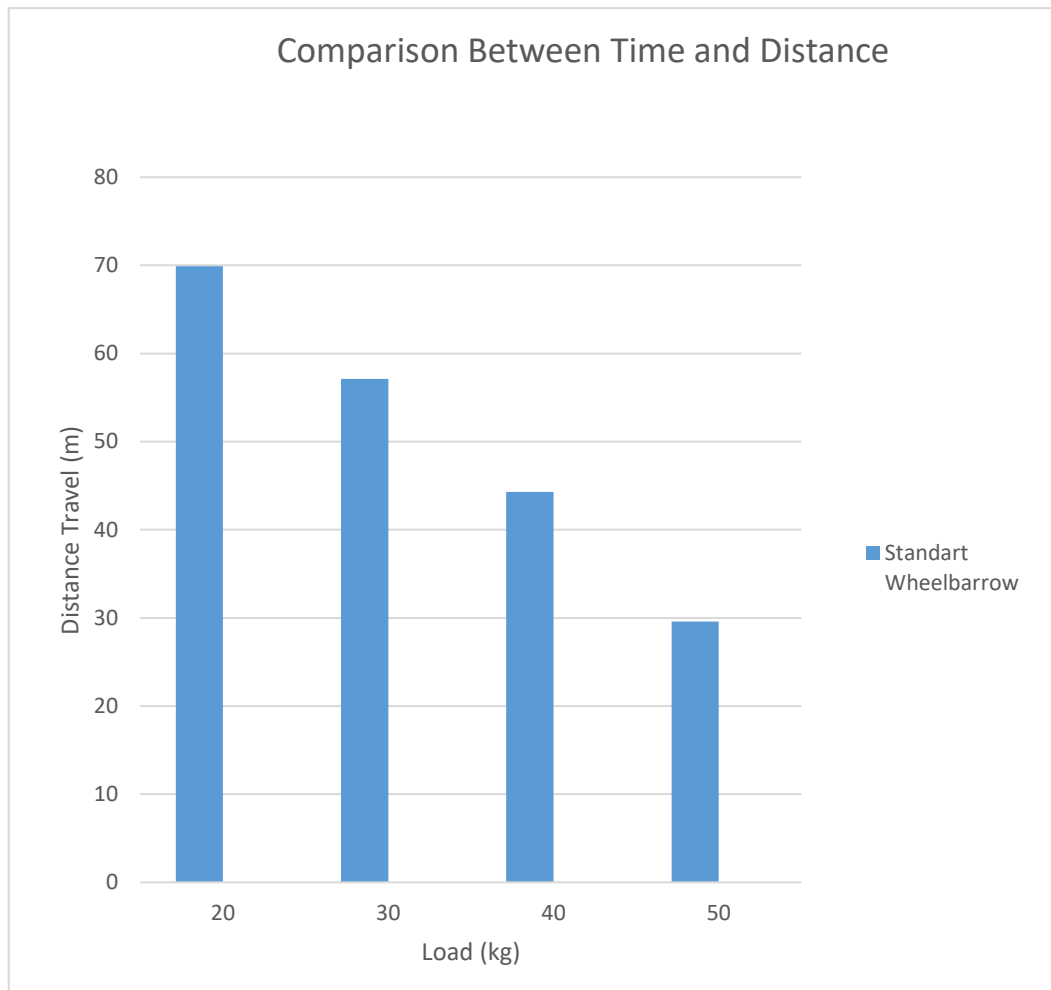


Figure 4.4: Comparison between time and distance travelled by Standard wheelbarrows.

Meanwhile, the smart wheelbarrow is found to be more ergonomic and more efficient for a long period of time. The distance travelled by smart wheelbarrow is much more further than standard wheelbarrow. With a weight of 20kg smart wheelbarrow could travelled atleast 200 meter far.

Table 4.3: Comparison between time and the distance travelled by smart wheelbarrow

| <b>Smart wheelbarrow</b>  |     |     |     |     |
|---|-----|-----|-----|-----|
| <b>Load (kg)</b>  | 20  | 30  | 40  | 50  |
| <b>Distance travelled before taking a break from pushing the load (m)</b> | 200 | 180 | 150 | 100 |

From Table 4.3, it has been determine that the smart wheelbarrow travelled futher. there is a huge different in the distance travelled by the smart wheelbarrows. base on the data in both Table 4.2 and 4.3 by using smart wheelbarrow it is clear that the distance travelled by the smart wheelbarrow increase as much as 65.05% compare to standard wheelbarrow. Figure 4.6 shows the time versus distance for a standard wheelbarrow.

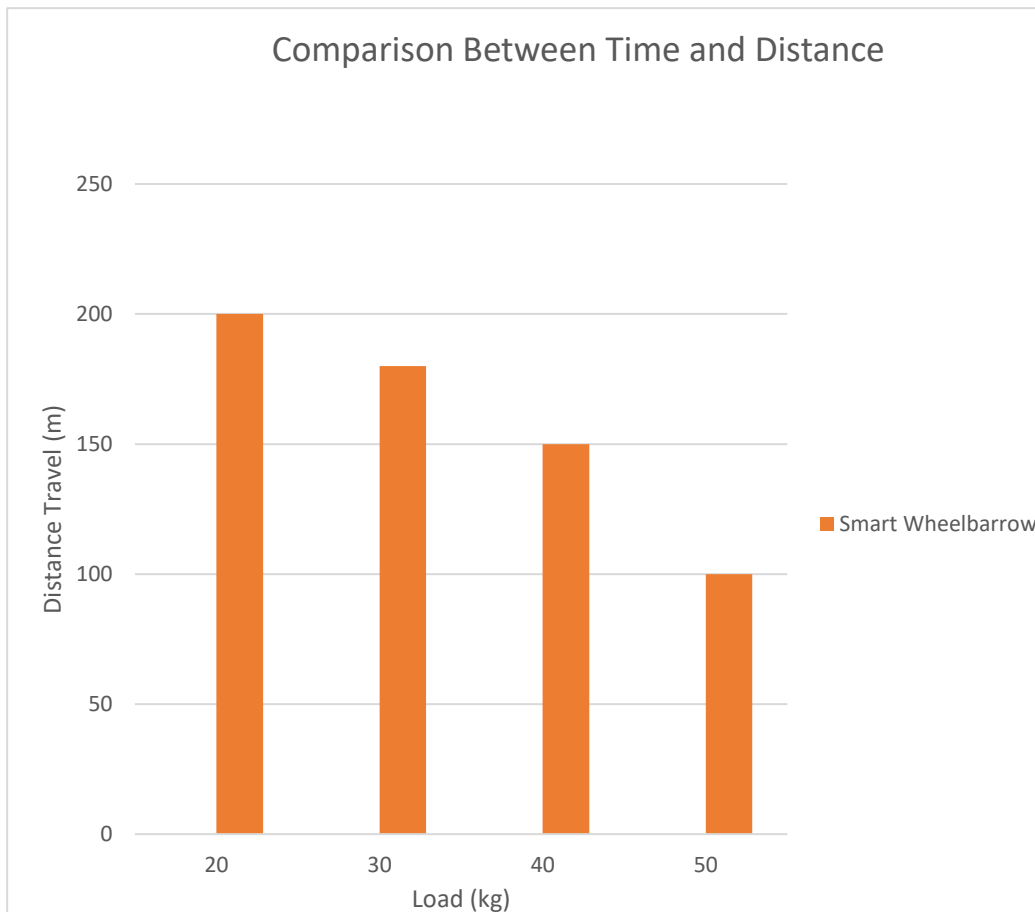


Figure 4.5: Comparison between time and the distance travelled by smart wheelbarrow

Standard wheelbarrow is less efficient for a long period of time usage such as construction and farming industries. Meanwhile smart wheelbarrow is much more ergonomic and can be use for a long time. This is because the structure of the design in smart wheelbarrow made to help with man posture. In addition, less man power used to lift and push the load. Figure 4.7 shows the comparison between standard wheelbarrow and smart whellbarrow. (Refer Table 4.4)

Table 4.4: Comparison between time and distance

| <b>Standard wheelbarrow</b>   |      |      |      |      |
|---|------|------|------|------|
| <b>Load (kg)</b>  | 20   | 30   | 40   | 50   |
| <b>Distance travelled before taking a break from lifting the load (m)</b> | 69.9 | 57.1 | 44.3 | 29.6 |
| <b>Smart wheelbarrow</b>  |      |      |      |      |
| <b>Load (kg)</b>  | 20   | 30   | 40   | 50   |
| <b>Distance travelled before taking a break from lifting the load (m)</b> | 200  | 180  | 150  | 100  |

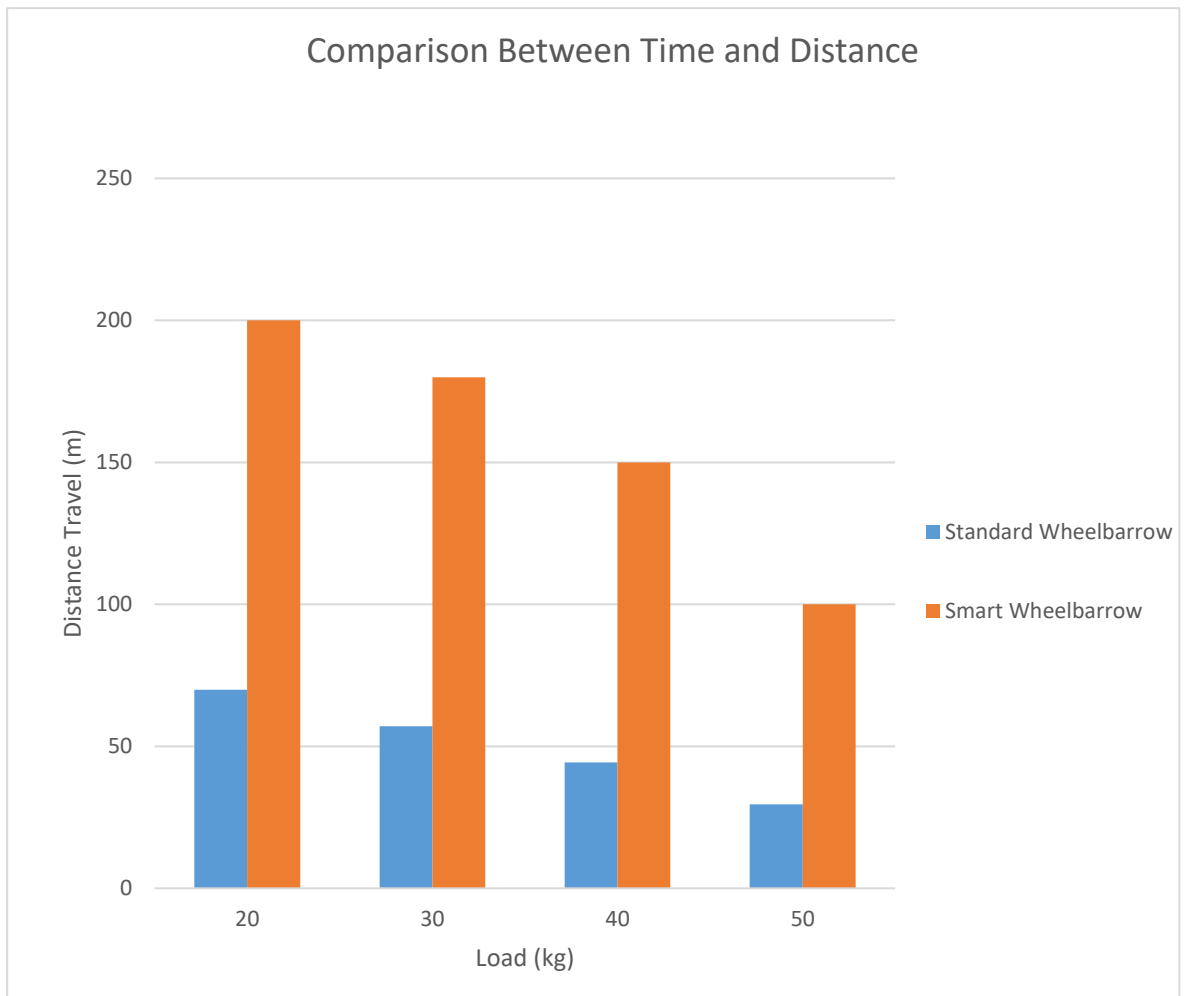


Figure 4.6 Comparison between time and distance travelled by standard and smart wheelbarrow



**CHAPTER 5**  
**BUSINESS PLAN OUTLINE**

**Disediakan oleh:**

AHMAD HADI HAKIMI BIN JAAFFAR

Smart Technology Cooperation is selling a type of wheelbarrow which is Smart Wheelbarrow. It is situated at Seksyen 13, Shah Alam. The company is involved in fabricate, sale and rent the Smart Wheelbarrow. The Smart Wheelbarrow is easy to use and affordable. It is also ergonomic for all walks of life.

**5.1 Introduction**

Name of the company : Smart Technology Cooperation

Nature of business : Smart Invasion Trading is a shop to buy mechanical product. But the main product that we strongly focus is our own product, called Smart Wheelbarrow. Other than that we can see a huge potential to grow a business to run a mechanical tools at industrial place.

Location of business : Lot 50, No.12, Jalan Ragum 15/17, Seksyen 15, 40200 Shah Alam

Date of commencement : 5<sup>th</sup> February 2020

**5.1.1 Factor in selecting the propose venture**

1. Convenience

It is easily use for the elderly and all walks of life

2. Promote innovative product

This business is one way that can introduce the world the innovative product that can help people especially education institution and middle wage income.

3. Ergonomic

This Smart Wheelbarrow is well structured and design for all ages especially for the construction and farming industries.

### **5.1.2 Future prospect of the business**

The idea for future business will be proposed after the business is well established. To keep the business at the maximum market share, we will established a Franchise Business and it is a great way to expand a business.

### **5.2 Purpose of Preparing The Business Plan**

The purpose of a Business Plan is to identify, describe and analyze a business opportunity and/or a business already under way, examining its technical, economic and financial feasibility. Thats mean, to create a succesful business, we have to analyze the business first whether its feasible or not. it will help to manage the business when we have a strategy in our hands from the start.

### **5.3 Business Background**

Name of business :Named as Smart Tech Cooperation because it is an improved invention technology company.

Address of business : Lot 50, No.12, Jalan Ragum 15/17, Seksyen 15, 40200 Shah Alam

Telephone number : 012-879 7895

E-mail address : hadihakimi13@gmail.com

Date of commencement: 5<sup>th</sup> February 2020

## **5.4 Background of Partners**

### **5.4.1 Partner 1**

Name : Ahmad Hadi Hakimi Bin Jaaffar  
Identity card number : 000713-13-0463  
Address : No 28, Lot 601, Lrg Gunung Jat 1, Kpg Demak Baru Fasa  
1,93050 Kuching, Sarawak  
Phone number : 012- 879 7895  
Email address : hadihakimi13@gmail.com  
Date of birth : 13 / 07 / 2000  
Age : 21 years old  
Marital statues : Single  
Academic qualification : Diploma in Mechanical Engineering  
Course attended : Project 2  
Present occupation : Student in Politeknik Sultan Salahuddin Abdul Aziz Shah

### **5.4.2 Partner 2**

Name : Muhammad Nabil Bin Ahmad Tarmizi  
Identity card number : 000427-08-0047  
Address : 1, Jalan Kiara, Mont Kiara, 50480 Kuala Lumpur, Wilayah  
Persekutuan Kuala Lumpur013-8764465  
Telephone number : 016-922 9441  
\*Email address : Nabil76@gmail.com  
Date of birth : 27 / 04 / 2000  
Age : 21 years old  
Marital statues : Single  
Academic qualification : Diploma in Mechanical Engineering  
Course attended : Project 2  
Present occupation : Student at Politeknik Sultan Salahuddin Abdul Aziz Shah


### 5.4.3 Partner 3

Name : Patterson Enjat Anak Dempri  
Identity card number : 001118-13-0789  
Address : Prima U1 Condominium, Jalan Kerjaya, Seksyen U1, 40150  
Shah Alam Selangor  
Telephone number : 014- 2127550  
Email address : pattersonenjat00@gmail.com  
Date of birth : 18 / 11 / 2000  
Age : 21 years old  
Marital status : Single  
Academic qualification : Diploma in Mechanical Engineering  
Course attended : Project 2  
Present occupation : Student at Politeknik Sultan Salahuddin Abdul Aziz Shah.

## 5.5 Organization / Management / Administration Plan

### 5.5.1 Logo, Mission, Vision & Objective

Table 5.1 Logo, Mission, Vision & Objective

|           |   |
|-----------|---|
| Logo      |    |
| Mission   | Creating and inovating the best technology for all sort of work.  |
| Vision    | Being the only brand people need.   |
| Objective | <ol style="list-style-type: none"><li>1. To design and develop wheelbarrows for the convenience of users.</li><li>2. To make comparisons with standard wheelbarrows and innovation wheelbarrows.</li><li>3. To identify the maximum load the wheelbarrow can withstand.</li></ol> |

### 5.5.2 Manpower Planning

Currently, company only have 3 workers as shown in Table 5.5.2:

Table 5.2 Manpower in company

| Position              | Number of Personnel |
|-----------------------|---------------------|
| Manager               | 1                   |
| Technician            | 1                   |
| Marketing and Account | 1                   |

### 5.5.3 Organization Chart

The organization chart of the company is shown in Figure 5.5.3 and this organization chart are still contains only one level of management.

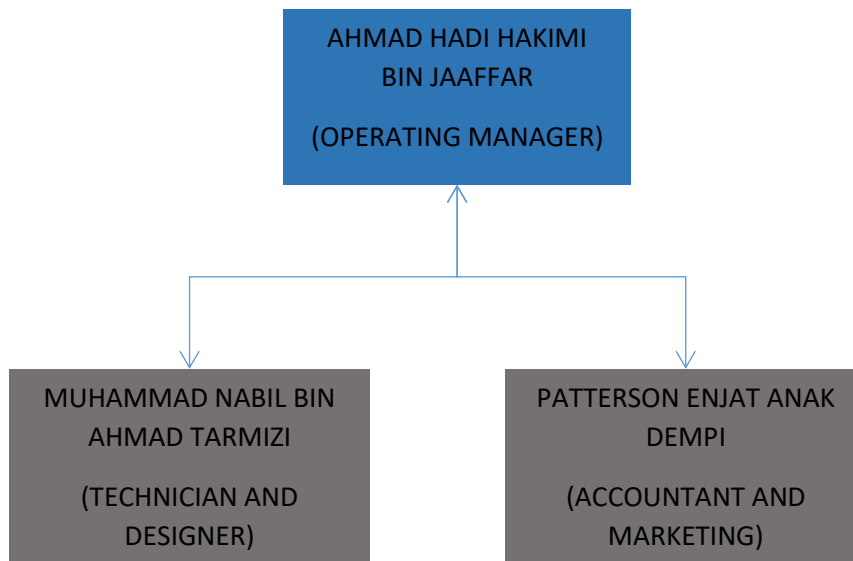


Figure 5.1 Organization Chart

### 5.5.4 Schedule of task and responsibilities

Table 5.3 Schedule of task and responsibilities

| Task       | Responsibilities description  |
|------------|---|
| Manager    | <ul style="list-style-type: none"> <li>● Responsible to carrying out and attaining the mission and manage business unit.</li> <li>● Manage the overall operational , budget and activities of the department.</li> <li>● Make business decision in accordance with organization policies and procedures.</li> </ul> |
| Technician | <ul style="list-style-type: none"> <li>● Responsible to diagnose the problems, replace or repair parts, test and make adjustments.</li> <li>● Comply with safety regulations and maintain clean and orderly work areas</li> </ul>   |
| Accountant | <ul style="list-style-type: none"> <li>● Preparing balancing sheet, profit and loss statement</li> <li>● Monitor the incoming data</li> <li>● Process the invoices</li> </ul>   |

### 5.6 Summary of Chapter

Smart Technology Cooperation is a shop to buy mechanical product. But the main product that we strongly focus is our own product, called Smart Wheelbarrow. Other than that we can see a huge potential to grow a business to run a mechanical tools at industrial place.

## **CHAPTER 6**

### **DISCUSSION, CONCLUSION, AND UPGRADE PLAN**

**Disediakan oleh:**

**AHMAD HADI HAKIMI BIN JAAFFAR**

#### **6.1 Introduction**

The conclusions drawn in this chapter include a comprehensive conclusion on the overall design that has been made. this conclusion involves the construction of a more user-friendly and more effective design in this study.

#### **6.2 Conclusion**

While starting this project, the researchers set three objectives, namely to produce a "Smart" innovation trolley, make a comparison of load limits with standard wheelbarrows and innovation wheelbarrows and design and develop wheelbarrows to facilitate users. In conclusion, all overall objectives are achieved. The researchers achieved three objectives by using interviews and wheelbarrow tests. The researchers are confident that there is a future in smart wheelbarrow as well as commercializing products and further improvements can be made to accommodate the needs for the everyday working man.

#### **6.3 Suggestion**

From the data analysis, the discussion will be made based on several parts namely:-

1. Motor
2. Brake
3. Size of tray
4. Material

### **6.3.1 Motor**

This project involves the extensive use of manpower to move and lift materials. to facilitate heavy work intends to add motor features to this project. Adding motor features to this project will make the project easier to use. Instead of pushing the wheelbarrow users only need to use the motor. This feature reduce the amount of energy usage so that they can do the work in a longer period of time.

### **6.3.2 Break**

Addition of motor to the project will need the addition of brake for safety precaution. Hence, it will be helpful for user who using it at hilly areas as the tyre rolls it will be easier to control the wheelbarrow.

### **6.3.3 Size Of The Tray**

Wheelbarrow is also widely used in the field of construction. In this field the materials that need to be carry are larger and havier than farming usage. In this case the size of the tray is really important to carry the load. With that being done construction company could complete the transfer of material easier and quicker.

### **6.3.4 Material**

To increase the amount of load that the wheelbarrow could carry. The quality of the material that is used in making of the wheelbarrow the from base to the top need to be improve. Steel durability is very important to produce a durable product



## **6.4 Discussion**

The wheelbarrow has always been used for hauling items. Be it a construction worker or even a farmer. The wheelbarrow is such a ubiquitous item in the arsenal of construction worker, it is hard to imagine a construction without one. The purpose of this study was to gauge the differences of a normal wheelbarrow and Smart wheelbarrow. Differences such as the structure of a wheelbarrow, the ergonomics and the overall comfortability were compared. The other objective was to make a comparison with the standard wheelbarrow and the innovation wheelbarrow. Results tests yielded that Smart wheelbarrow outperforms the normal wheelbarrow. While through the results of the questionnaire, the researchers prepared a set of 5 questions to gauge the overall public about smart wheelbarrow. The consensus of the questionnaire yields overwhelmingly positive results throughout the samples. From this, the researchers can surmise that Smart wheelbarrow is convenient.

## **6.5 Chapter Conclusion**

The results of the experiments conducted on smart wheelbarrow can be concluded that Smart Wheelbarrow has achieved the objective of the study which is to determine the total weight, and the durability of the wheelbarrow to accommodate the force applied to the wheelbarrow. in addition, after giving experiments to farmers it is proven to facilitate and expedite to complete the planting work.

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## **APPENDICES**

|            |                   |
|------------|-------------------|
| APPENDIX A | Gantt Chart       |
| APPENDIX B | Cost and expenses |
| APPENDIX C | PITEX Poster      |

## APPENDIX A

### Project Planning Gantt Chart

Table below shown a planning schedule and implementation of project production Activities.

Table 1: Planning Schedule and Implementation of Project Production Activities.

| Project Activities          | Weeks |     |        |        |        |        |        |        |        |        |        |        |        |        |        |
|-----------------------------|-------|-----|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|
|                             | 1     | 2   | 3      | 4      | 5      | 6      | 7      | 8      | 9      | 10     | 11     | 12     | 13     | 14     | 15     |
| PROJECT PLANNING            | Red   | Red | Red    | Red    |        |        |        |        |        |        |        |        |        |        |        |
|                             |       |     | Yellow | Yellow | Yellow | Yellow |        |        |        |        |        |        |        |        |        |
| PROJECT DESIGNING           |       |     |        | Red    | Red    | Red    |        |        |        |        |        |        |        |        |        |
|                             |       |     |        |        |        | Yellow | Yellow | Yellow |        |        |        |        |        |        |        |
| PROJECT MATERIAL COLLECTION |       |     |        |        |        | Red    | Red    | Red    |        |        |        |        |        |        |        |
|                             |       |     |        |        |        |        | Yellow | Yellow | Yellow |        |        |        |        |        |        |
| FRAMEWORK COACHING          |       |     |        |        |        |        |        | Red    | Red    | Red    |        |        |        |        |        |
|                             |       |     |        |        |        |        |        |        | Yellow | Yellow | Yellow |        |        |        |        |
| IMPLEMEN PROJECT            |       |     |        |        |        |        |        |        |        | Red    | Red    | Red    | Red    |        |        |
|                             |       |     |        |        |        |        |        |        |        |        | Yellow | Yellow |        |        |        |
| PROJECT NEADNESS            |       |     |        |        |        |        |        |        |        |        |        | Red    | Red    |        |        |
|                             |       |     |        |        |        |        |        |        |        |        |        |        | Yellow | Yellow |        |
| TESTING                     |       |     |        |        |        |        |        |        |        |        |        |        | Red    | Red    |        |
|                             |       |     |        |        |        |        |        |        |        |        |        |        |        |        | Yellow |
| END                         |       |     |        |        |        |        |        |        |        |        |        |        |        |        | Red    |

|  |          |
|--|----------|
|  | Planning |
|  | Actual   |

**APPENDIX B**

Table 2 List of Component

| <b>No</b>    | <b>Component</b>        | <b>Quantity</b> | <b>Price per unit (RM)</b> | <b>Price(RM)</b> |
|--------------|-------------------------|-----------------|----------------------------|------------------|
| 1.           | wheelbarrow             | 1               | 85.00                      | 85.00            |
| 2.           | Static tyre             | 1               | 15.40                      | 15.40            |
| 3.           | 360 rotating tyre       | 1               | 59.80                      | 59.80            |
| 4.           | handle                  | 1 pair          | 10                         | 20               |
| 5.           | Wrought stailless steel | 21ft            | 0.95                       | 20.00            |
| 6.           | Spray                   | 2               | 4.99                       | 9.98             |
| 7.           | Nut and bolt            | 10 pair         | 0.34                       | 3.40             |
| 8            | Door hinges             | 2               |                            |                  |
| <b>Total</b> |                         |                 |                            | <b>RM151.30</b>  |

## APPENDIX C

### PITEX Poster



# SMART WHEELBARROW

**Patterson Enjat Anak Dempi**  
**Ahmad Hadi Hakimi Bin Jaaffar**  
**Mohammad Nabil Bin Ahmad Tarmizi**  
**Politeknik Sultan Salahuddin Abdul Aziz Shah**



## PENERANGAN INOVASI

Wheelbarrow is a small hand-propelled vehicle, which was a device used for carrying loads. Previous research has provided evidence that existing wheelbarrow on the market is hard to balance the weight on it. Also, users at any age may be at risk of developing a low back musculoskeletal injury. It is noted that a lot of energy is used to push the wheelbarrow. The existing wheelbarrow only have one wheel, making it easy to lose control of the device. The objective of the current study is to design and develop a smart wheelbarrow. The initial process in this research involved design and selection of materials used for a smart wheelbarrow. Subsequently, the fabrication process comprises of cutting parts for the wheelbarrow and welding all the parts needed. After cutting and welding all the parts, the wheelbarrow is assembled according to the specification. Finishing is added accordingly. The finished prototype is then tested and adjustments are administered as needed. Only then the end product is deemed suitable to use. The analysis conducted demonstrate that the Smart Wheelbarrow is more suitable for agriculture, construction and gardening work and not for large industries uses. Future suggestions are to upgrade the wheelbarrow by adding a motor, powder coated steel and battery.

## IMPAK INOVASI

- Easy to make a turn or change direction to other direction.
- Able to reduce risk from a low back musculoskeletal injury.
- Capable of carrying different types of loads
- With the low centre of gravity designed, the product is more stable

## OBJEKTIF

- To design and develop a wheelbarrow to facilitate user.
- To identifying max loading the wheelbarrow will be.
- To fabricate design and develop a wheelbarrow.

## BLOK DIAGRAM / CARTA ALIR OPERASI

