UNIVERSITI TEKNIKAL MALAYSIA MELAKA

MOTORIZED SYSTEM TROLLEY WITH EXTENDABLE FRAME

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BACHELOR OF DEGREE MECHANICAL ENGINEERING (AUTOMOTIVE) WITH HONOURS

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A thesis submitted
in fulfillment of the requirements for the degree of
Bachelor Degree of Mechanical Engineering Technology (Automotive) with Honours

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DECLARATION

I declare that this project is entitled “Motorized System Trolley With Extendable Frame ” isthe result of my own research except as cited in the references. The project report has not been accepted for any degree and is not concurrently submitted in candidature of any other degree.

Signature : .....

Name : THASARATHAN A/L ARUMUGAM

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APPROVAL

I hereby declare that I have checked this thesis and in my opinion, this thesis is adequate in terms of scope and quality for the award of the Bachelor Degree of Mechanical EngineeringTechnology (Automotive) with Honours.

Signature : 

Supervisor Name : EN. HAMZAH BIN MOHD DOM

Date : 25/01/2022

DEDICATION

I would like dedicate my dissertation work to my family and many friends. A special feeling of gratitude to my loving parents who always giving words of encouragement and push for tenacity ring in my ears. Furthermore, i also would like to dedicate this work and give specialthank to my supervisor, En. Hamzah bin Mohd Dom for guiding me along the process withprecious idea suggestion. I also dedicate this dissertation to my many friends and course mates who have supported me throughout the process to complete this project.

ABSTRACT

This motorized system trolley with extendable frame will prioritize the convenience and satisfaction of users by giving something unique and never seen before. This project is primarily intended for usage on farms and in households. Nowadays, agriculture or farming sectors contribute significantly to our country's economy. At the same time, farmers have struggle to carry out their everyday farming activities, particularly while moving large loads and tools. All of these issues have a number of negative consequences for farmers, including health issues, time loss, and financial waste. As a result, this project was aimed at helping farmers in reducing their agricultural burden while also increasing their contribution to our country. Furthermore, this project is excellent for usage in the home. The major reason this project was designed for households is because individuals nowadays struggle a lot with moving large weights at home. Furthermore, by using this project, they will be able to lessen the health issues that they suffer when moving large weight.

ABSTRAK

Projek "Motorized System Trolley with extendable Frame" ini akan memberi tumpuan kepada keselesaan dan kepuasan pengguna dengan memberikan sesuatu yang unik dan tidak pernah dilihat sebelum ini . Projek ini bertumpu kepada kegunaan dalam kebun dan rumah.Tujuan pertama projek ini diwujudkan adalah untuk membantu petani yamg bertungkus lumus dalam meningkatkan ekonomi negara. Dalam hal ini, para petani telah berdepan depan dengan pelbagai cabaran dalam membawa benda berat kepada kebun mereka. Bukan itu sahaja, dengan masalah tersebut mereka telah berdepan dengan pelbagai isu seperti masalah kesihatan, pembaziran duit dan masa. Merujuk dengan hal tersebut, Projek ini membuat untuk membantu para petani dalam melaksanakan tugas mereka dengan senang. Bukan sahaja kepada para petani , projek ini juga boleh digunakan untuk kegunaan rumah. Ada beberapa golongan masyarakat dalam keadaan sukar untuk membawa beban berat dalam kawasan rumah. Dengan mengunakkan projek ini, ia akan mengelakkan masalah-masalah yang dihadapi oleh mereka dalam membawa berat.

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LIST OF SYMBOLS AND ABBREVIATIONS

Dc	-	Direct current	50
v	-	Voltages	52
%	-	Percentages	63
AH	-	Amp for an hour	52

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CHAPTER 1

INTRODUCTION

1.1 Background of Problem

There are many problems which face by the agricultural workers every day. These problem can be reduced and if this problem decrease it may help the farmers to carry out their work more easily, safely and thus the countries economy will be rise.

The major problems which face by the farmers are the heavy loads in the farm areas such as fertilizer sack, sand sacks, tools, loaded baskets and etc. They are suffering very hard to carry these loads. Carrying heavy loads can cause serious strain, back and neck problems. So by this, it may cause the farmers to spend their money for medical expenses.

Either than heavy loads, agricultural sides are full with sharp tools such as knifes, hoe, cutter and etc. Farmers had difficulties on brought the entire tools to work in a safe way because it can cause injury. Due to these problems farmers has to spend their more time on brought their tools. This problem directly leads to waste of the time for the farmers.That was some of the problems that the farmers face in the agricultural sides. Now lets had a look at the problems that are in the house. The main problem at the house was the heavy loads such as flower pots, gas cylinders which is state in (Penyelia & Diesmak, n.d.).Ifpeople continuously lifting and bringing the heavy things, it causes many side effects. Young girls who carries heavy loads have problems with their backbones, which can lead to dangerous in pregnancy and causes some women to suffer from miscarriages.

1.2 Problem Statement

Why was this motorized trolley developed? This is due to the fact that the farming sector now plays a significant role in the country's economic growth. As a result, farmers require this type of project to make their work easier and more efficient. Farmers, for example, are having difficulty carrying heavy loads such as heavy sacks, sand, baskets, tools,and so on. Farmers must bring all of their farming tools to work every day. They are havingdifficulty carrying all of the tools because they are heavy, sharp, and dangerous.

As a result, they'll need something to transport all of their tools. Despite the fact thatthey are using a wheelbarrow, it is still not comfortable. This is because the farmers are working very hard to move the wheelbarrow that is loaded. They must expend the greatest amount of effort in manoeuvring the wheelbarrow. So, by developing this project, the hopeis that it will make farmers' jobs easier while also reducing the amount of human energy usedin agricultural areas. Farmers will be able to do their work more easily and safely as a resultof this project.

Because time is of the essence in agricultural activities, most farmers spend a lot of time bringing loads into the farms using their hands and a wheelbarrow. To avoid this, a project was created that can transport the load faster than wheelbarrows.

As a result, this project will also enable in daily household activities. The main issues in the home, particularly for females, are the difficulties in moving heavy items such as flower pots, gas cylinders, and so on. With the help of this project, they will be able to transport heavy items without risking their health.

In summary, the list of the problems are :

i. Farmers are facing difficulties in carry the heavy loads.
ii. Farmers that use wheelbarrow to carry loads are not comfortable because hard

to moved the wheelbarrow with heavy loads.

iii. The farmers also spending more time on bringing their loads and equipment.

iv. At house females are suffer to move heavy things such as gas cylinders, flower pots.

1.3 Objective

The objective of motorized trolley is :

1. To design and fabricate a Motorized system trolley with extendable frame that canbe used by farmers and house hold.
2. To apply electric system motor to move the trolley easier.
3. To create an environment friendly project.

1.4 Scope of Project

II. Maximum capacity of the motorized trolley :

- The maximum amount of weight that can be brought by the motorized trolley was 100KG.

III. Dimension of the motorized trolley :

- The project has a dimensions of length 145CM, width 65CM, and a height of 85CM. This are the normal dimensions of the project without extend. If the trolley extend its dimensions can be increase with a length of 15CM and the widthcan be extending until 20CM.

IV. Motorized trolley are operated by an electric motor.

- To reduce the burdens of the farmers our project is feature with an electric motorwhich is attached at the bottom part of our project.

V. This motorized trolley only can use at small vegetable farms, flower farms, smallconstruction site, and also in car workshop.

- This motorized trolley not suitable to use at heavy industries.

CHAPTER 2

LITERATURE REVIEW

2.1 Introduction

A literature review is conducted during the early stage of the project, which is a previous study that involves research from sources such as the internet resources, newspaperclippings, periodicals, and materials linked to motorized system trolley. As a preliminary investigation, collecting information from literature research is highly important.

Various actions must be followed from the beginning to the end of a project when itis being implemented. Problems with the product are evaluated and repaired in order to provide superior items.

This chapter provides a review of the system and the parts that will be installed in the motorized trolley.The goal of a literature review is to identify gaps in existing knowledgeand to assist us avoid reinventing the project by uncovering previous study on a topic.

2.2 Studies On Design

There have various types of wheelbarrow design in Malaysia which was marketed widely in social media and on the market. But as we know each wheelbarrow designed have its advantages and disadvantages of each. Therefore, there are several examples of existing designs that I have examined, namely:

2.2.1 Easy load Galvanised Wheelbarrow

Figure 2.1 Easy load galvanised wheelbarrow
(The LeadingWheelbarrow Manufacturer in the UK, 1867).

The Easy load Galvanised Heavy Duty Builders wheelbarrow(The Leading Wheelbarrow Manufacturer in the UK, 1867) is a builders wheelbarrow equally at home when used for garden use, medium industrial use and for all the heavy duty jobs around the home. The Galvanised wheelbarrow has a capacity of 85 litres / 150 kg and a pneumatic wheel that may be used on hard or soft ground.

Table 2.1 Specification of Easy load galvanised wheelbarrow.

Specification		Advantages	Disadvantages
Tray Material	Metal	➢ Its compact design and easy to use. ➢ Suitable for light goods ➢ Cheaper because of its compact design and does not have many components ➢ has a thickness of container loads of hard and heavy	➢ **metal** is strong but will rust ➢ Does not have the extra edge and under the order. ➢ Cannot fill a lot of work. ➢ Life expectancy isnot long if used prudently.
Load Capacity	150Kg		
Net Weight	11 kg		
Tray Thickness	0.7mm		
Water Capacity	85 Litre		

OverallLength	1270mm	➢ More stable tire grip ➢ Ranking framework that can accommodate heavy loads	➢ Using a lot of manpower.
HandleHeight	555mm		
Width of Handle	550mm		
Length ofTray	810mm		
Width ofTray	620mm		
Height ofTray	285mm		
Wheel Dimension	3.5" x 8		
Type of Wheel	Pneumatic		

2.2.2 Walsall Contractor Twin wheelbarrow

Figure 2.2 Walsall Contractor Twin wheelbarrow (The Leading WheelbarrowManufacturer in the UK, 1867).

The Walsall Contractor Twin wheelbarrow features a strong strength, low slung chassis and is completely welded. It has a tubular front tipping bar that makes it simpler to manoeuvre heavier loads. To increase strength and stiffness, the pan is soldered to the frame.

This Twin Wheelbarrow is an excellent working companion, with a sturdy frame that wasmade to last.

Table 2.2 Specification Walsall Contractor Twin wheelbarrow.

Specification		Advantages	Disadvantages
Tray Material	Metal	➢ Its compact design and easy to use. ➢ Suitable for light goods ➢ Lighter and easier. ➢ Using two tires and facilitate the process of pouring more balanced work because ➢ Can fill a lot of material for a large tray. ➢ More stable tire grip ➢ Ranking framework that can accommodate heavyloads	➢ **Metal** is strong but will rust ➢ Does not have the extra edge and under the order. ➢ Life expectancy is not long if used prudently. ➢ Using a lot ofmanpower. ➢ Easily damaged if the workpiece of iron ➢ Frame is inefficient because there is no order under the tray. ➢ Use a pair of tires cause this to be a heavy wheelbarrow.
Load Capacity	220Kg		
Water Capacity	175 Litre		
Overall Length	1310mm		
Overall Height	720mm		
Handle Height	730mm		
Handle Width	440mm		
Tray Length	890mm		
Tray Width	700mm		
Tray Height	260mm		
Wheel Type	Pneumatic		

2.2.3 Dump Cart wheelbarrow

Figure 2.3 Dump Cart wheelbarrow(Ld, 2020).

With a high loading capacity of 300Kg this garden dumper will hold up to 75 liters in its heavy duty plastic tray. It's perfect for a variety of gardening tasks but ideally suited for moving garden waste. The tray tips for easy removal of gardening waste and large pneumatic wheels ensures ease of use over the roughest of terrains. The Dump Cart an excellent product particularly for older people who find pushing a normal wheelbarrow when loaded a bit difficult (Ld, 2020).Very versatile as the tipping mechanism is very useful and moves very easily.

Table 2.3 Specification Dump Cart wheelbarrow.

Specification			Advantages	Disadvantages
Tray Material	Plastic	➢	➢ Can bring more load, which is 300kg ➢ Very versatile as the tipping mechanism is very useful ➢ Have a capacity of	➢ .cannot bring in a narrow spaces ➢ Difficult tooperate ➢ Heavy weight ➢ Plastic tray can damage easily
Load Capacity	300Kg			
Water Capacity	75 Litres			
Tray Length	945mm			
Tray Width	500mm			
Tray Height	525mm			
WheelInfo	10" x 4" Pneumatic Tires			

WheelType	Pneumatic		bring 75 litre fluid	
Max Load Capacity	300Kg			
Material	Strong Steel Frame			

2.2.4 Folding Platform Trolley

Figure 2.4 Foldable Platform Trolley (Folding et al., n.d.).

The Foldable Platform Trolley is useful for any small scale things moving job (Folding et al., n.d.). It can be transported and stored anywhere due to its folding design andits also capable to carrying 150 KG of things. Its use stainless steel to make foldable handle.Its used four small wheel structure to move. Normally used in garage, warehouse, shop, home, or office. Easily transport household items, wood planks, gardening tools, luggage, and office supplies.

Table 2.4 Specification Foldable Platform trolley.

Specification		Advantages	Disadvantages
Tray Material	Plastic	➢ Can bring load up to 150kg. ➢ Very easy to bring everywhere becauseit can fold.	➢ Cannot bring in a narrow spaces. ➢ Small tires hard to operate and cannot bring in rough surface. ➢ Plastic platform will easily damaged. ➢ The things that brought can fall easily.
Load Capacity	150 Kg		
Tray Length	900mm		
Tray Width	600mm		
Tray Height	865mm		
Wheel Info	4 inch		
Wheel Type	Plastic wheel		
Max Load Capacity	150 Kg		
Material	Steel Frame		

2.2.5 Heavy Duty Hand Trolley

Figure 2.5 Heavy Duty Hand trolley (Trolleys & Hand Trucks, 1800).

Heavy duty hand trolley normally used for general warehouse (Trolleys & Hand Trucks, 1800). It has a fixed and also a folding toe plate area. For a smaller items they used

the fixed toe, while for the heavier items they used the folding toe. The frame is made froma strong tubular steel and has a load capacity of 400kg. In addition, this sack truck has 26cm solid rubber wheels and twin safety handles, making it ideal for warehouse environments.

Table 2.5 Specification Heavy Duty Hand trolley.

Specification		Advantages	Disadvantages
Tray Material	Metal	➢ Easy design and easy to handle. ➢ Can load up to 400kg ➢ Ranking framework that can accommodate heavy loads.	➢ Life expectancy is not long if used prudently. ➢ Metal frame easily rust. ➢ Cannot bring in a narrow spaces. ➢ The things that brought can fall easily and broke. ➢ Using a lot of manpower.
Load Capacity	400Kg		
Tray Length	800mm		
Tray Width	590mm		
Tray Height	1330mm		
Wheel Info	250 mm		
Wheel Type	Solid rubber		

2.3 Study On Material

Some research on materials which used for the making of wheel barrow was done. After doing the research about the materials used in the making of a wheel barrow, thematerials used on the making process are been known. The materials are listed below :

Table 2.6 Advantages and disadvantages of material.

Material	Advantages	Disadvantages
Aluminium	• Light • Have high resistance to erosion • Malleable • Easy to forge	• Too soft • Easy to absorb heat • Easy for electricity to flow through • Difficult to be welded

	• Easy to be machine	• Easily damaged
Stainless Steel	• Difficult to be erode • Easily welded • Have high strength • Does not rust • Resistance to heat	• Difficult to do any job because it is very hard • Very expensive • Easy for electricity to flow through.
Copper	• Malleable • Easy to forge • Light • Easy to work • Durable	• Expensive • Easy for electricity to flow through • Absorbs heat easily
Mild Steel	• Durable • Resistance to heat • Malleable and can beforged easily • No corrosion • Easy to weld	• Weight • Expensive • Erosion can occur onit • Absorb heat easily
Iron	• Easily forged • Malleable • Durable	• Easy oxidize to air • Corrosion can occur • Electricity can flow through easily
Chromium	• Can be forged easily • Have high resistance to erosion • Strong and hard	• Hard to work with • Electric current can flow through it easily • Absorbs heat quickly

2.3.1 Types of Materials

Different types of steel are created based on characteristics needed for their purpose, and different grading systems are used to differentiate steels based on these characteristics. Steel can be broadly classified into four groups based on their chemical compositions, according to the American Iron and Steel Institute (AISI), which is :

1. Carbon Steels
2. Stainless Steels
3. Alloy Steels
4. Tool Steels

2.3.1.1 Carbon Steel :

Carbon steels, which account for 90% of global steel production, contain trace levelsof alloying metals. Carbon steels can be divided into three categories based on their carbon content:

- Low carbon steels/mild steels have a carbon content of up to 0.3 percent.
- Carbon content ranges from 0.3 to 0.6 percent in medium carbon steels.
- Steels with a carbon content of more than 0.6 percent are known as highCarbon steel.

2.3.1.2 Stainless Steel :

Stainless steels are regarded for their strong corrosion resistance and typically include 10-20% chromium as the principal alloying element. Steel is nearly 200 times more corrosion resistant than mild steel because it contains more than 11 percent chromium. Based on their crystalline structure, these steels may be classified into three groups:

- Austenitic : Austenitic steels are non-magnetic and heat-treatable, and usually include 18% chromium, 8% nickel, and less than % carbon. Austenitic steels account for the lion's share of the worldwide stainless steel market, and they are commonly used in food processing equipment, culinary utensils, and pipelines.
- Ferritic : Ferritic steels include trace levels of nickel, 12-17 percent chromium, and less than 0.1 percent carbon, as well as additional alloying metals including molybdenum, aluminium, and titanium. These magnetic steels cannot be toughenedby heat treatment, but they can be reinforced by cold working.
- Martensitic : Martensitic steels include 11-17% chromium, less than 0.40% nickel, and up to 1.20% carbon. These magnetic and heat-treatable steels are utilised in blades, cutting tools, dentistry and surgical instruments, and so on.

2.3.1.3 Alloy Steel :

Alloy steels include alloying elements with variable qualities for example, manganese, silicon, nickel, titanium, copper, chromium, and aluminium in order to control the steel's qualities such as hardenability, corrosion resistance, strength, formability, weld ability, or ductility. Alloy steel is used in pipelines, vehicle components, transformers, powergenerators, and electric motors.

2.3.1.3 Tool Steel :

Tool steels include different amounts of tungsten, molybdenum, cobalt, and vanadium to boost heat resistance and durability, making them excellent for cutting and drilling equipment.Steel products may also be classified based on their forms and applications:

- Bars and rods, rails, wires, angles, pipelines, and forms and sections are examples of Long/Tubular Products. These items are often used in the automobile and construction industries.
- Plates, sheets, coils, and strips are examples of flat products. These materials are mostly utilised in automobiles, appliances, packaging, shipbuilding, and construction.
- Other products include valves, fittings, and flanges, which are mostly utilised in pipes.

2.4 Components

When making a motorized system trolley, there are several components that play important roles in assisting the trolley to perform properly. Here are some of the components,as well as the pros and disadvantages of the wheel barrow and trolley on the market, in thissection. By listing the components of the wheel barrow and trolley, all the components wasknown well and also understand how to select acceptable components for the project.

2.4.1 Tire

The presence of an useful tires are much important to help the loaded an unloaded wheelbarrow to move easily.

Classification Number of Wheel :

One Wheel

- The one-wheel wheelbarrow is old. It is the most manoeuvrable and simple to dump, but it demands more upper body power than a two-wheel or garden cart.

Two Wheels

Double wheels, more suggestive of a garden cart, give significantly greater stability than a single wheel, which aids in the handling of very large or imbalanced loads. Two wheels, on the other hand, are less manoeuvrable than one. They are also inconvenient to use if you will be pulling loads laterally on an inclined surface, whereas a single wheel is not.The Ace Two Wheel Contractor Steel Wheelbarrow ($85) is an excellent example of a low-cost twin wheelbarrow. Its metal frame and two wheels make it a useful workhorse.

Wheelbarrow Tires Type

I. Pneumatic

Figure 2.6 Pneumatic type.

Pneumatic wheelbarrow tires contain an internal air-filled tube that is inflated in thesame way as a bicycle tire (Biology et al., 2019) The advantage is that the air works as a shock absorber, resulting in a smoother ride in general, and is especially handy when wheeling up stairs or over pebbles. One downside is that the air pressure must be monitoredand maintained on a regular basis, and they are prone to become flat.

II. Semi-Pneumatic

Figure 2.7 Semi-pneumatic type.

Semi-pneumatic tires have built-in air pockets that give part of the shock absorptionof pneumatic tires without the need to pump air into them.

III. Non-Pneumatic

Figure 2.8 Non- pneumatic type.

There is no air tube within solid rubber tires, hence they cannot fall flat. This reduces maintenance and makes them ideal for tough terrain, which might cause a pneumatic tire toexplode, such as while operating in severe temps or in cactus-infested

areas. Sterling's wheelbarrows are built in the United States and have flat-free tires. They cannot go flat, but otherwise function similarly to pneumatic tires. Keep in mind that when your pneumatic wheelbarrow tire does go flat, you can probably replace it with one of these.

Table 2.7 Specification Non-Pneumatic type, Pneumatic and Semi-Pneumatic.

Specification	Advantages	Disadvantages
Non-Pneumatic		
Tires that are not supported by air pressure. They are used on some small vehicles such as riding lawn mowers and motorized golf carts. They are also used on heavy equipment such as backhoes, which are required to operate on sites such as building demolition, where risk of tire punctures is high	➢ tires is that they cannot goflat ➢ need to be replaced less often resulting in a savings ➢ Heavy equipment outfitted with airless tires will be able to carry more weight and engage in more rugged activities ➢ tires can be easy to install	➢ can have higher rolling resistance and provide somewhat less suspension ➢ Problems for airless heavy equipment tires include dissipating the heat buildup that occurs when they are driven ➢ heavier than the rubber tire it is meant to replace however many rubber pneumatic tires are also heavy.

Pneumatic		
Air-filled tires provide great performance and are a less-expensive replacement tire option. Though they require more maintenance, they are cost-effective and provide a great bounce and cushion. Air filled tires are lightweight and due to the price and performance are often a chosen by OEM's for new equipment	➢ It is low in cost ➢ Have long life resultingin longer system reliability ➢ Easy to handle	➢ Easily break if exposed to sharps. ➢ The tires must filled with air before it used
Semi-Pneumatic		
Semi-pneumatic tires are also Flat Free because they don't go flat, but they do not provide the bounce or cushion of flat free or air filled tires. These tires are made of solid rubber with a hollow air-pocket through the center of the tire. The air pocket is built into these molded tires, so unlike air filled tires, they have no tubes or valve stems and cannotbe inflated.	➢ tires lighter in weight than a completely solid tire ➢ Semi-pneumatic tiresare generally less expensive than polyurethane tires ➢ tires and are best usedon solid flat surfaces	➢ the wheel is damaged or torn tires it is necessaryto change the new. ➢ Can't not accommodate the load is too heavy.

2.4.2 Tray

I. Plastic tray

Figure 2.9 : Plastic tray(Masons Supply Company 149, n.d.)

A plastic tray wheelbarrow is a common choice for landscapers, gardeners and around the home. They are suited to shifting a variety of materials including: mulch, mud and sand.

II. Steel tray

Figure 2.10 Steel ray.

A steel tray wheelbarrow is most typically used by bricklayers when scooping loadsor mixing materials together inside the tray, since the steel tray is more durable to a shovel and more abrasive loads like cement. They are ideal for moving materials such as rocks, bricks, sand, tiles, pavers, and concrete. Richmond offers a stronger strength

builder's barrowin steel tray with a thicker tray wall, reinforced nose, and heavy gauge grips**.**

Table 2.8 Show Advantages and Disadvantages of Plastic Tray and Steel Tray.

Advantages	Disadvantages
Plastic tray	
➢ trays are lighter ➢ more weather proof ➢ not be corroded by horse waste ➢ Plastic is more resistant tosome toxics ➢ Cheaper than steel tray	➢ Not as strong as metal trays ➢ Not suitable to bring heavy weight
Steel tray	
➢ mixing materials togetherinside the tray ➢ is more resilient to a shovel	➢ Difficult to do any job becauseit is very hard ➢ Very expensive
➢ more abrasive loads such as cement ➢ strong	➢ Easy for electricity to flow through.

2.4.3 Handle Grip

Figure 2.11 Handle Grip.

A handle with an elongate grip intended to be held by a hand throughout its length and along a grip axis is included in a hand grip assembly for a wheelbarrow handle shaft. The handle is pivotally attached on the wheelbarrow's handle shaft for movement on a pivotaxis that is normally parallel to the support surface. Wheelbarrow handles are sold in pairs and can be constructed of wood or metal. Depending on the size of the wheelbarrow tray, they range in length from 36 to 60 inches(Nawi et al., 2015). For improved handling, the handle ends are frequently covered by fibreglass, vinyl, or plastic grips.

Table 2.9 Show Advantages and Disadvantage of Handle Grip.

Advantages	Disadvantages
➢ Easy to hold ➢ Cheap ➢ Light in weight ➢ Easy to install ➢ Hard	➢ Causes pain to the hand if hold itfor a long time ➢ The griping lines on the body of the handle not comfortable

2.4.4 Support Leg

Figure 2.12 Both picture show different type of support leg.

The support legs are typically constructed of steel. Steel is created in a blast furnaceby mixing iron ore and coke (a carbon-rich material created by burning coal in

the absence of air) and then heating them with extremely hot air. The resultant iron-carbon combinationis known as pig iron. To eliminate the majority of the carbon, molten pig iron is blasted with oxygen. The molten steel that results is cooled into a variety of forms. Steel strips are delivered to the wheelbarrow producer and examined. Sharp dies are used in big, powerful presses to punch different components out of steel strips. Holes are punched into these components so that they may be fastened together.

Steel components are typically painted to preserve them. The components are cleaned with a degreasing solution and then dried. An electrostatic method is used to apply paint. Electrical charges are applied to the steel and the paint in different directions. Becauseopposing charges attract, the paint covers the steel evenly and fully. In an oven, the paint isthen baked onto the steel.

Table 2.10 Show Advantages and Disadvantage of support leg.

Advantages	Disadvantages
➢ To support the wheel barrow ➢ The make the user become comfortable while bringing the load ➢ For balancing purpose	➢ Very expensive ➢ Bent easily if collide with anyheavy weights ➢ Both the sides must parallels

2.4.5 Frame of Body

Figure 2.13 Both picture show different type frame of body.

The frame is crucial since it is the major portion that holds the body of trolley or

wheel barrow (Kotowski et al., 2009). As a result, the frame must be highly sturdy to ensurethat it can be used for a long period without breaking down. To avoid the welded pieces becoming readily removed, proper welding must be utilized while welding the pieces on theframe. Two handles are fitted to the end of the frame to make it easier to manoeuvre. The axle for installing the tire is located at the front of the frame.

Table 2.11 Show Advantages and Disadvantage frame of body.

Advantages	Disadvantages
➢ Moderate weight ➢ Easy weld and drill with new parts ➢ Long lasting ➢ Cannot bent	➢ Costly ➢ Big dimensions ➢ Need to check for balancing ➢ Both the sides must parallel and same size

2.5 Theory Related

This project have many theory which can applied related to the courses in University.In this project there are motor used to move the trolley. The efficiency of the motors and its capacity which can calculated by using the theory and formula that was studied.

2.5.1 Design specification

A design specification is a formal document that provides information on the qualities of a project in order to establish requirements that developers must follow. Its application is required when a structure or product must be custom-made to satisfy a specificrequirement.

A design specification, for example, must include all essential drawings, measurements, environmental factors, ergonomic considerations, aesthetic elements, cost, necessary maintenance, quality, safety, documentation, and description. It also gives detailed examples of how the project's design should be carried out, assisting others in working appropriately.

2.5.2 Design strength

I. The load-bearing capacity of a member calculated using the allowed stressesanticipated in design.

II. The assumed parameters for concrete strength and steel yield stress from whichthe theoretical ultimate strength of a segment is determined.

2.5.3 Explicit factor of safety

According to Fattah Shaikh, professor of engineering and chair of the Department ofCivil Engineering and Mechanics in the College of Engineering and Applied Sciences at the University of Wisconsin-Milwaukee, and structural engineer Tom Whittow, gradual rather than rapid acceptance of one technology over another is comprehensible. They have been apart of that progress, both in terms of changing building materials and in the teaching of newengineers.

Both strength design and permissible stress design construct a safe structure by combining dead and live loads. Strength design also use different resistance factors for

particular structural parts to precisely compute the factor of safety, taking into considerationchanges in material qualities, design techniques, and construction quality.

Material values cannot be accurately replicated. Engineers, for example, estimate thateach steel beam has a little different resistance than the next. That's where strength design concepts come in, according to Tom Whittow, vice president and partner of Milwaukee engineering company Computerized Structural Design. Whittow focuses on industrial constructions and steel construction.

Strength design calculations enable the engineer to account for bending, axial compression, shear, and other load effects at a higher level than may be required. The engineer is designing for failure, resulting in a higher factor of safety.

The strength design technique necessitates more precise calculations with figures relevant to each design and construction aspect. These particular values provide the design engineer with more leeway when making adjustments or selecting materials. There is also the possibility of cost savings through more efficient material utilisation. Finally, strength design allows for a more accurate evaluation of structural behaviour, which may enhance

safety.

2.6 Conclusion

Wheel barrows and trolley perform important roles in transferring a cargo from one site to another in agriculture. On that note, this motorized trolley was designed to perform the function of a wheel barrow in an agricultural setting. Choosing right supplies is critical to ensuring that this job runs well. As a result, some study was conducted on the wheelbarrowand trolley fittings to better understand the project's components.

CHAPTER 3

METHODOLOGY

3.1 Introduction

In general, product design and specification are two important elements in the process of designing the motorized system trolley in order to meet the criteria and reach theobjectives. The main factor is the design element, which contains the major structure and functional mechanism of the project with a combination of requirements, results in a competitive product with features.

As a result, from the beginning to the finish of this project, several functional procedures are carried out and performed in an attempt to gather the information and requirements. All of the methods and measurements used are relatively important to ensure that all of the parameters and processes used are accurate throughout the process and that theproject is completed with quality assurance.

3.2 Methodology Process Flow (Flow Chart)

This section will explain towards all the method and procedure involved during theprocess. All the planning and process flow being executed according to the planned time frame.

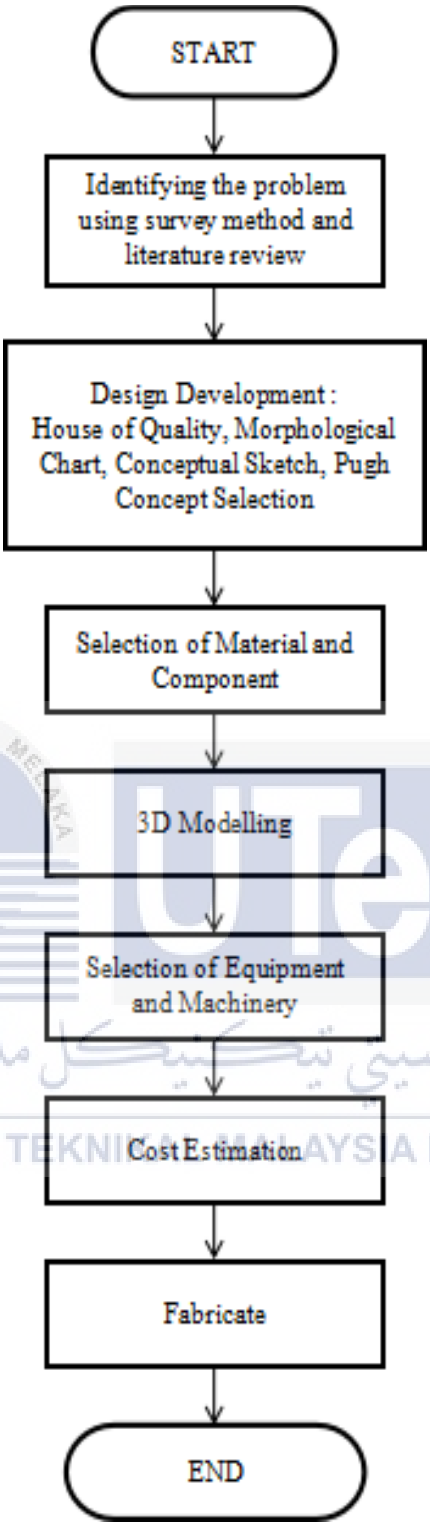


Figure 3.1 Methodology of flow chart.

3.3 Proposed Methodology

Several quality tools, planning tools, and design techniques are being applied in thisproject for this methodology process, such as data collecting and design development process. First and importantly, a questionnaire survey is being conducted to get the customer's opinions on the issue statement as well as their specifications requirements. The Quality Function Deployment (QFD) method is used to implement the design development process, which includes the House of Quality (HOQ) and Morphological Chart. The process then moves on to conceptual design sketching and design concept selection.

3.3.1 Questionnaire Survey

A questionnaire is one of the most commonly used methods, consisting of a set of questions meant to gather data statistically more efficiently and quickly. A questionnaire was distributed to 50 farmers and local neighbors as part of this experiment. This questionnaire is divided into three sections, with a total of 12 questions, as shown in the appendices.

Part 1 of the questionnaire was aimed to collect the customer's field and personal information from responses. There are 3 questions, the first question is to identify the gender of the respondents in order to identify the number of each gender among all the respondents. The question was followed by specifying the respondents' age range, which began at 18 years old and above. The third question intends to identify the respondents' educational level, ranging from SPM/STPM/Matriculation to PhD.

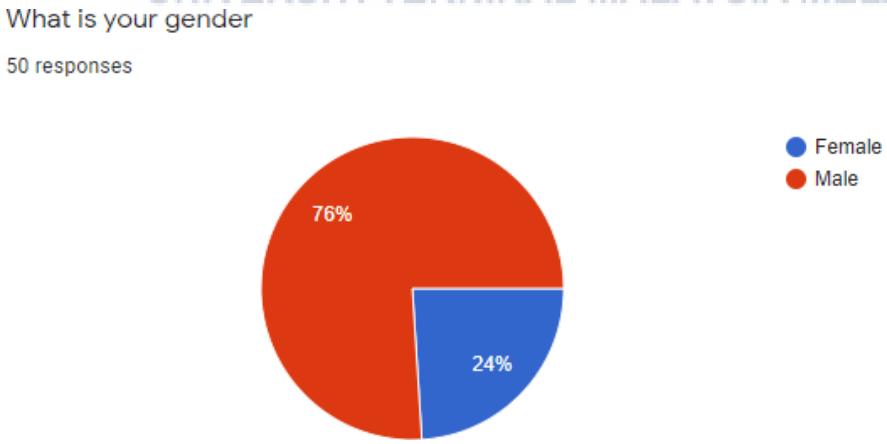
Part 2 of the questionnaire is designed to obtain the opinions of responses to the stated problem statement. The first question seeks the respondent's opinion on the describedproblem statement, which is related to moving weights using a wheelbarrow or

trolley. The second question is to determine the purpose of the trolley or wheelbarrow. The third and fourth question is to identify the difficulties encountered and the pain gets by respondents when utilizing the present trolley or wheelbarrow. The fifth question is to determine the level of satisfaction with the current trolley or wheelbarrow, and the sixth question is an agree or disagree question to get opinion on the main factors and causes of the problem. The final question in this part is to identify the level of agreement on the needs for product design or development.

Part 3 is aimed at collecting the requirements and specifications required to develop the project. This part has two questions. The first question is to collect specification data from respondents that will be used in the product design process. The second question is to know about the respondents' preferred alternative for the complexity of the product's mechanism.

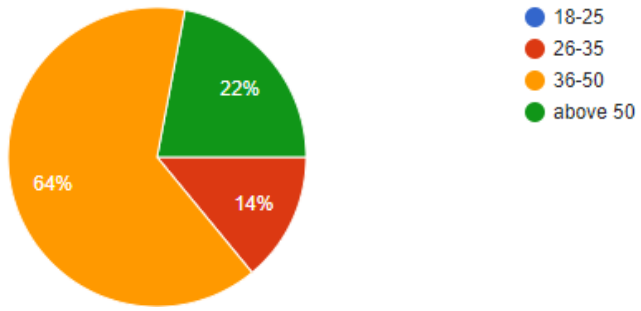
3.3.1.1 Overview of Survey

Part 1 : Personal Information



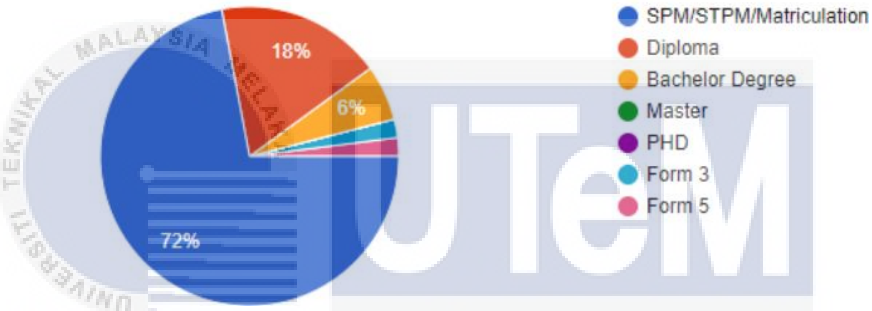
What age group are you in?

50 responses



...at is your educational level?

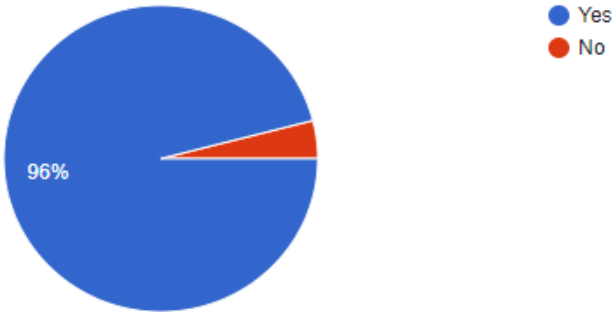
50 responses



Part 2 : Opinion By Customers

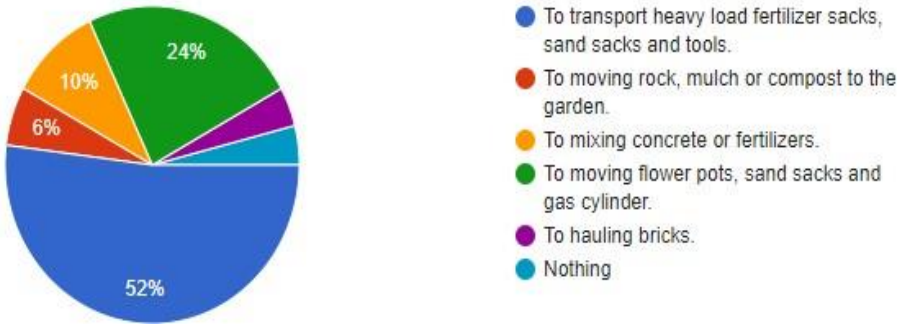
Do you ever use wheel barrow or trolley to carry load?

50 responses



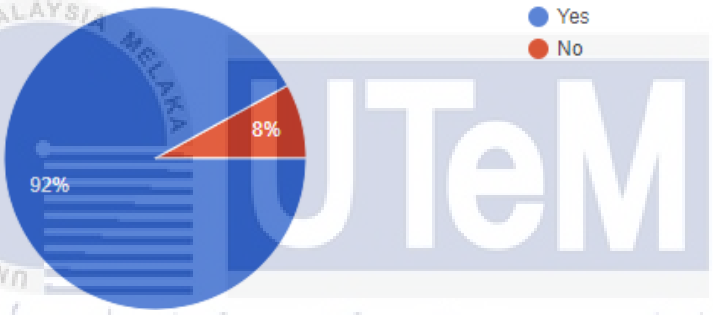
Why Do You Use A Wheelbarrow or Trolley?

50 responses



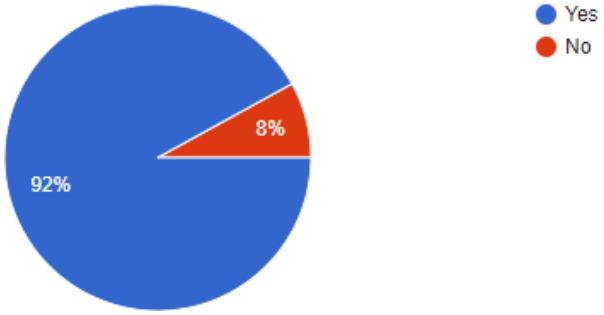
Do you face difficulties to lift or carry load on wheel barrow or trolley ?

50 responses



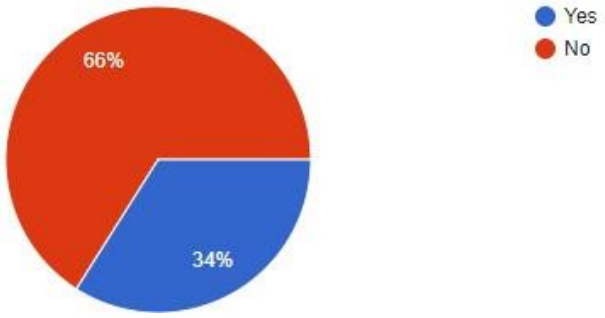
Do You Face Body Pain When Using The Wheelbarrow or Trolley?

50 responses

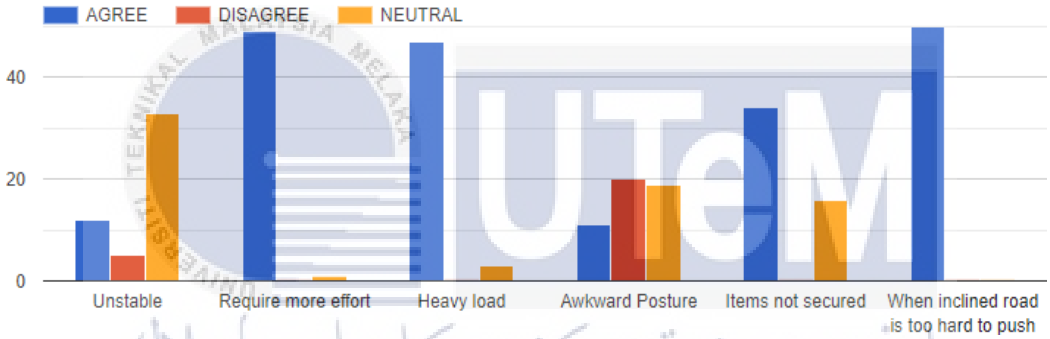


Do You Think the current Wheelbarrow or Trolley Used Today Is efficient enough to move many loads?

50 responses

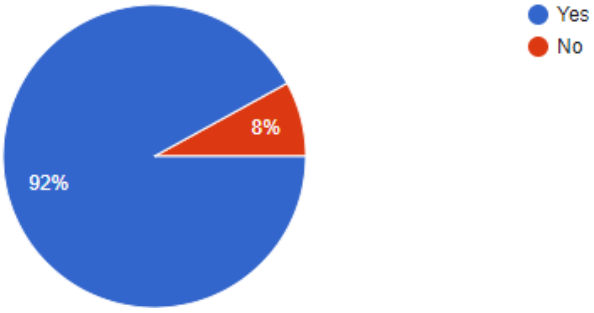


Why do you think current wheelbarrow or trolley is hard and difficult to move many loads?



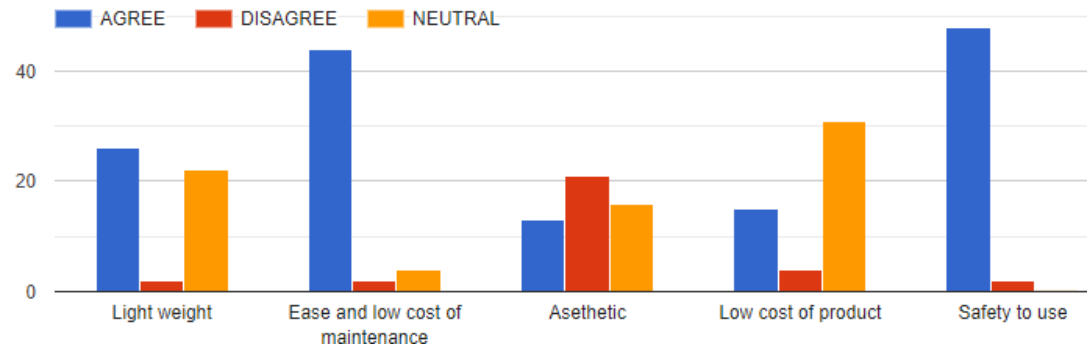
Do You Think the Conventional Wheelbarrow or trolley needs Innovation with more convenient and efficient?

50 responses



Part 3 : Mechanism of Product

From your opinion, what aspects and factors should be considered if there is an invention of a trolley ?



From the mechanism design aspect, What do you prefer for complexity of the trolley mechanism over the cost?

50 responses

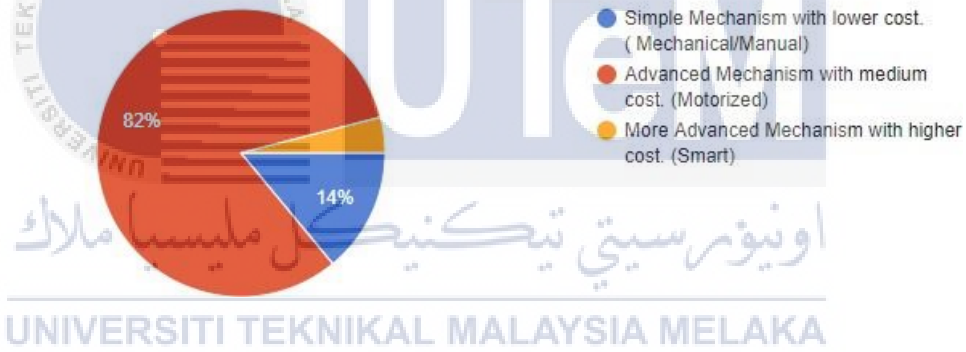


Figure 3.2 Survey questions and responses.

According to the questionnaire survey results, the majority of respondents are male (76%), with females accounting for 24%. The majority of respondents (64%) are between the ages of 36 and 50, with 22 percent being above 50 and 14 percent being between the ages of 26 and 35 years old. For the education level, 72 percent of respondents have completed SPM/STPM/Matriculation, 18 percent have completed a diploma, 6 percent have completeda bachelor's degree, and the remaining 4 percent have completed other education levels.

The second part of the survey revealed that 96 percent of respondents had ever

useda wheelbarrow or trolley to move their items, while 4 percent had never used one. 52 percentof respondents said they utilized the trolley or wheelbarrow to transfer large loads such as fertilizer bags, sand bags, and tools, while 24 percent said they moved flower pots, sand bags,and gas cylinder. Another 10 percent of respondents are used to mixing concrete or fertilizer, while 6 percent are used to transporting rock, mulch, or compost to the garden. 4 percent ofrespondents had hauled bricks before, while another 4 percent have never done so. Following that, 92 percent of respondents agreed that they are having difficulty carrying loads on wheelbarrows or trolleys, while just 8% said they are not having any problems. Similarly, 92 percent of respondents stated experiencing body pain when using a wheelbarrow or trolley to transport items, while the remaining 8 percent claimed no discomfort.

Aside from that, 66 percent of respondents think that the existing wheelbarrow or trolley is inefficient for moving big items, while 34 percent believe the opposite. Followingthat, 33 respondents believe that the unstable reason is neutral, 22 agree, and 5 disagree with this reason for moving heavy loads. 49 respondents agreed that the wheelbarrow and trolleyneed more effort to move heavy loads, while 1 respondent chose neutral. 47 respondents agreed that heavy loads make it harder to operate the wheelbarrow and trolley, while the remaining three chose neutral. There are 20 respondents who disagree, 19 who pick neutral,and 11 who agree that awkward posture is one of the reasons they have difficulty moving the trolley. 34 of the respondents agree that the item was not secured during the carry process, while 16 chose neutral as their option. All 50 respondents agreed that pushing a wheelbarrow or trolley on an inclined road or floor is hard. The majority of respondents (92%) think that the trolley or wheelbarrow requires invention to make it more convenient and efficient, while the remaining 8% said no to innovation.

According to their opinions, 26 of the respondents agree, 22 pick neutral, and 2 disagree with the light weight aspects to be considered in an innovation. Following that, 44 of the respondents agree with the ease and cheap cost of the maintenance factors, 2 disagree, and 4 chose neutral as their perspective. The majority of respondents disagree with the aesthetic factors to be considered, however 13 of them agree and 16 pick neutral. For the considerations of low product cost, 31 of the respondents chose the neutral option, 15 agreed, and 4 disagreed with the factors to be considered. Furthermore, 48 of the respondents agree that the safety of using the trolley must be considered, while 2 disagree. Finally, 82 percent of respondents selected advanced mechanism design in the product with a medium cost, 14 percent selected simple mechanism with a lower cost, and the remaining 4 percent wanted more advanced mechanism with a higher cost.

3.3.2 House of Quality (HOQ)

House of quality is a well-known product planning strategy that was developed to link and include target users or customers directly in product design or process developmentas a consideration to achieve and fulfil their wants and requirements.

In general, the house of quality provides a useful technique for identifying the customer's wants and requirements and establishing them as a factor during the product's manufacturing and design process. Finally, technical bench-marking refers to assessing howeffectively the designer meets target demands in terms of design criteria.

3.3.2.1 House of Quality Diagram

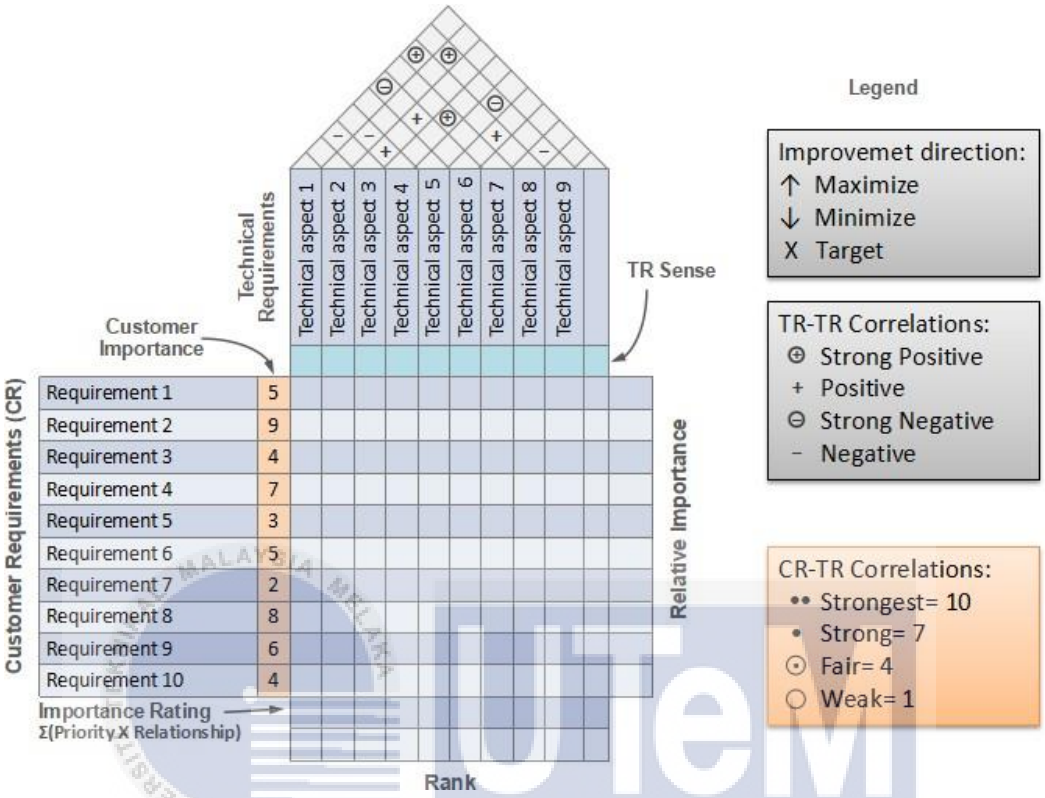


Figure 3.3 Example of HOQ Diagram.

The figure shows an example of the House of Quality diagram. First of all, the Customer Requirement (CR) column lists the basic priority features that the customer has preferred. The Customer Requirement Importance (CR-I) is represented by a number scale ranging from one to five. The Technical Requirements (TR) section shows the engineering scope and parameters required to carry out the project and it will detailed in the Technical Requirement Importance (TR-I) in specific measurements.

Therefore, the correlation between Customer Requirement and technical Requirement was indicate in symbols in legends. There are symbols indicates for weak relationship with weight scale of 1, fair with weight scale of 4, strong with weight of 7 and strongest with weight scale of 10. The (TR-TR correlation) column show the potential relationship between each technical requirement as Strong Positive, Positive,

Strong Negative and Negative.

Finally, the important rating represents the overall important findings after a complete assessment of the relationship between the customer's requirements and the technical requirements. The score is obtained by multiplying the relative weight of CustomerRequirement Importance by the scale value indicated by the symbol (1,4,7,10) of each technical requirement. The resulting value is then divided by the total value to get the percentage ratio, from which the importance weight is calculated. The larger the percentages,the higher the importance given to the conditions under consideration.

3.3.2.2 Overview House of Quality

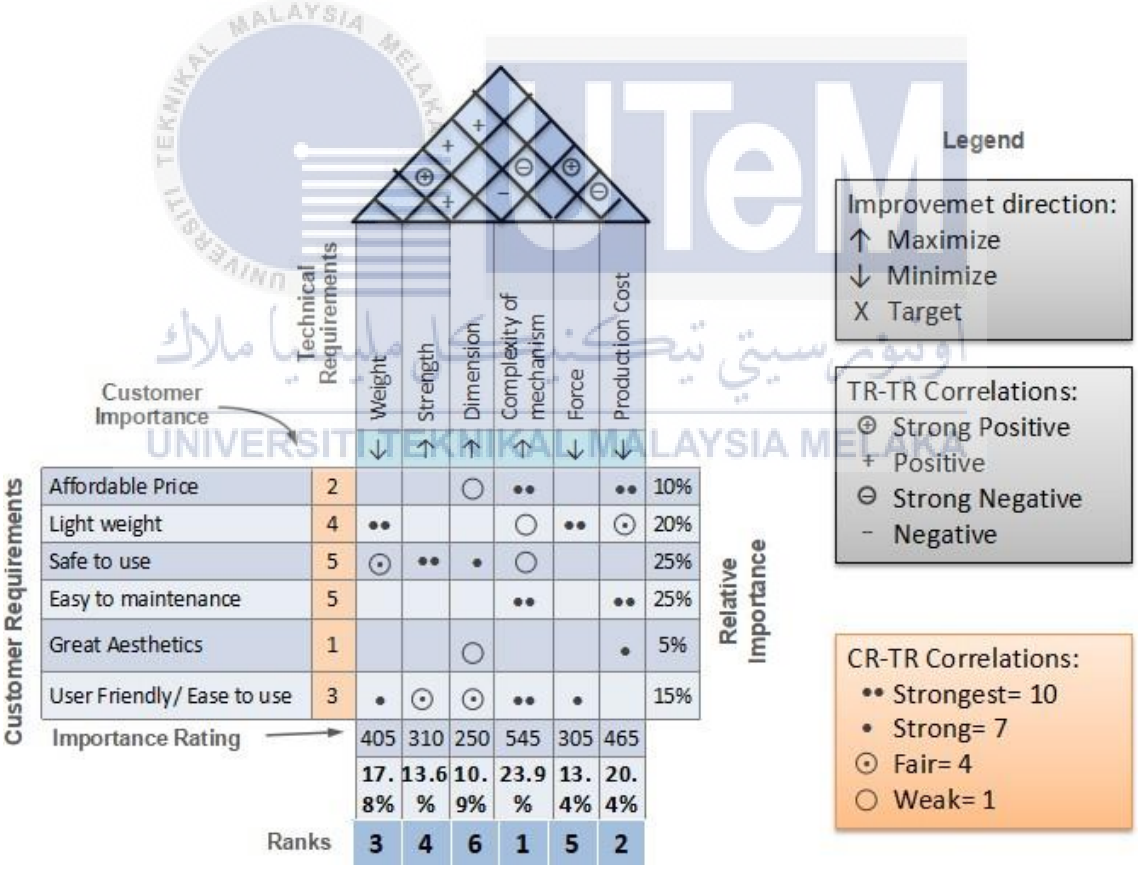


Figure 3.4 House of Quality.

Figure represents the entire House of Quality diagram in determining design specifications. Each requirement is included into the technical requirement, and a correlationanalysis is performed. The importance of each requirements is weighted using a specific scale and computed to determine the final ranking. The number in the HOQ's rank column represents the priority ranking of each specification as a reference during the product development and design process. As a result, the complexity of the mechanism ranks first in terms of technical requirements, followed by the product cost and the weight of the product.

3.3.3 Morphological Chart

A morphological chart is a visual tool and approach for capturing the product's basic functionalities and determining alternate techniques and combinations to identify the specific functionality. Every component of a product function may have a variety of possible combinations and solutions. As a result, the morphological chart allows these solutions to be stated and modified in order to evaluate alternate combinations. This enables early evaluation of the design and examination of various 'sub-solutions' that have not before beenfound.

The functions are arranged in columns, whereas the components that supply the function are arranged in rows. The criteria are determined and the main aspects of the solution are shown by focusing on the similarities of the components and describing them as the qualities that the result should have. These criteria are independent, conceptual, and categorized. The morphological chart divides the product's purpose into a set of 'sub- functions.' Each of the (sub)functions has its own set of ideas, which are then combined to provide an overall result. As a result, the main concept is formed by carefully selecting and combining a set of components. The creation of innovative technologies involves the identification of new components.

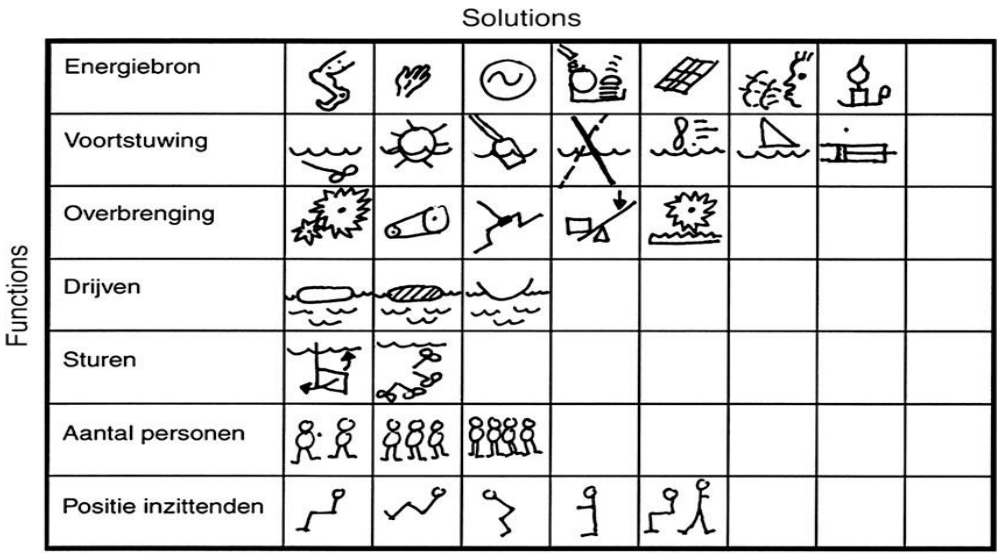
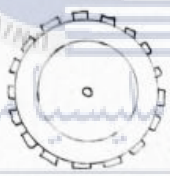
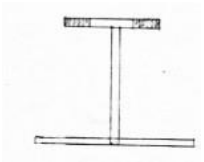
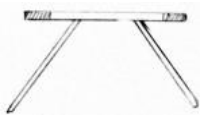
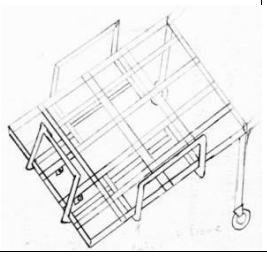
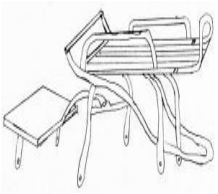
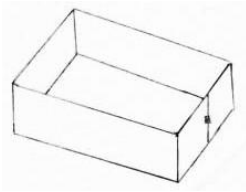
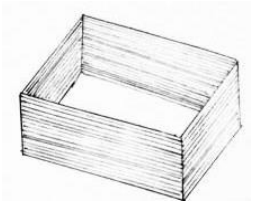
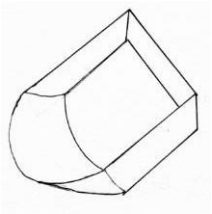
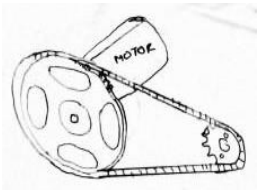
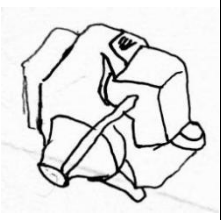


Figure 3.5 Example of Morphological Chart.

3.3.3.1 Overview of Morphological Chart

Table 3.1 Morphological chart.

Component	**Option 1**	**Option 2**	**Option 3**	**Option 4**
Wheel				
Handle				
Extendable Body frame				

Tray				
Mechanism	**Manual**	 Dc motor	 2 stroke motor	

3.3.4 Conceptual Sketch

Conceptual sketch is the combination of part option from the Morphological chart that been done before. Total 3 concepts are generated for this project.

3.3.4.1 Concept 1

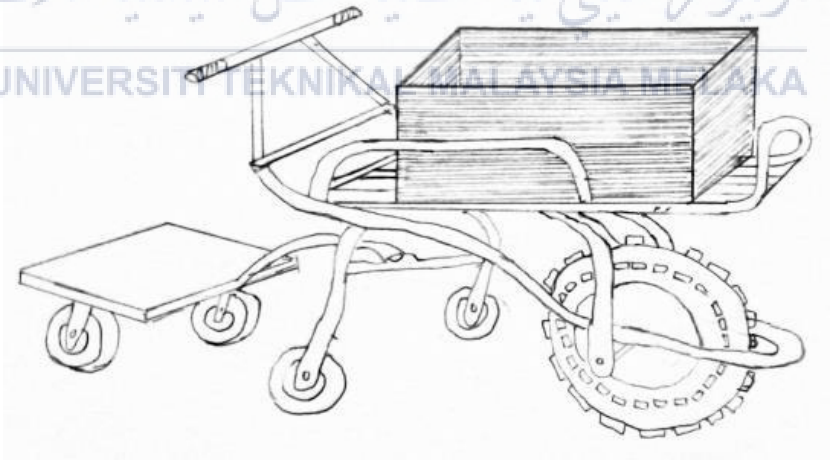


Figure 3.6 Concept 1

Concept 1 is combination of different options from each of the parts, the wheel selected is the wheel in option 1 which is pneumatic wheel and option 3 which is small plastic wheel. The handle chosen is option 3, which is an angled bar, and the 3rd option

of the body frame was chosen, which has five wheels. Option 2 (cage type) has been chosen asthe tray option. Finally, option 3 which is the 2 stroke engine has been chosen as the mechanism for this design.

In this concept, the cage tray of the trolley provide better capacity while carrying theload. Beside that, the body frame structure is more stable with five wheels and it is bigger insize. The mechanism use to move the trolley is 2 stroke engine. This makes the trolley become more heavier in weight. However, this trolley have 1 pneumatic wheel and 4 smallplastic wheel, this will give more stability to the trolley.

3.3.4.2 Concept 2

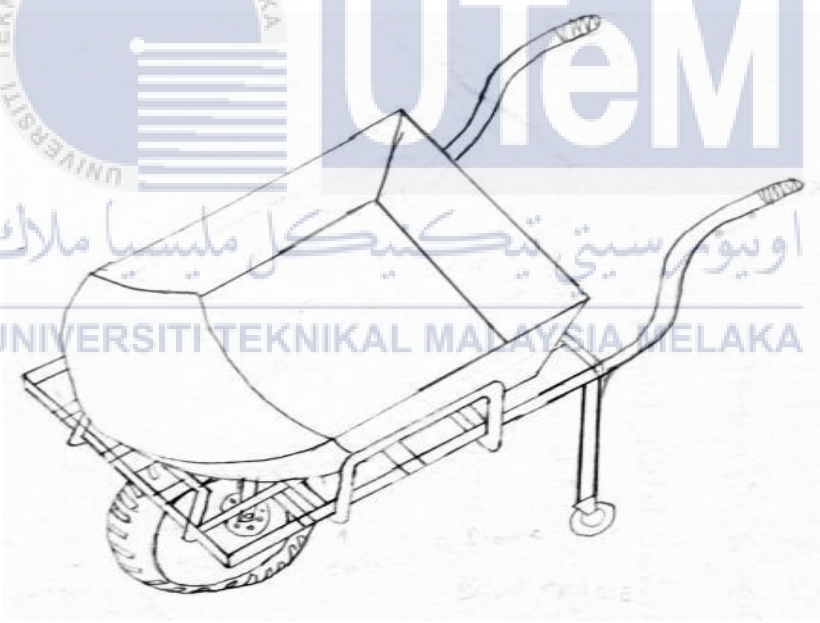


Figure 3.7 Concept 2

This concept 2 trolley is combination of wheel from option 4 which is non-pneumatic wheel and option 3 which is small plastic wheel. The handle chosen for this concept is option 1, which is s-curved and the 2nd option as the extendable body frame. Option 2 wheelbarrow tray has been chosen as the tray for this concept. Finally, the mechanism chosen for this design is an option 2, which is using electric dc motor.

For this concept, the wheelbarrow tray provide better capacity and less in weight. Moreover, the extendable body frame structure are provided to this concept and its help theuser to carry more load and this body frame are stable with 3 wheels and the frame are light in weight. The mechanism use to move this trolley is electric dc motor. This mechanism areuser friendly and less in weight. However, this trolley have 1 big non-pneumatic wheel and2 small plastic wheel, this wheels are give enough stability to the trolley.

3.3.4.3 Concept 3

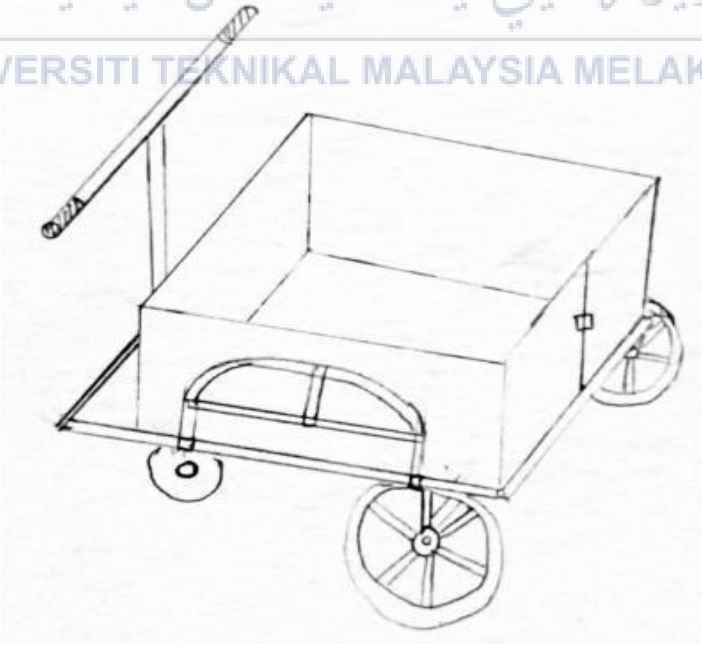


Figure 3.8 Concept 3.

Concept 3 is combination of different options from each of the parts, the wheel selected is the wheel in option 2 which is pneumatic wheel and option 3 which is small plastic wheel. The handle chosen is option 2, which is straight handle, and the option 1 of the body frame was chosen, which has 3 wheels. The tray is an option 1 that is a box type tray. Finally, option 2 which is using electric dc motor has been chosen as the mechanism for this design.

In this concept, the box tray of the trolley that enable to provide convenient in storage function and it is in small in size. Beside that, the body frame structure is stable with 3 wheels.The mechanism use to move the trolley is by using electric dc motor and it is user friendly and less in weight. However, this trolley have 2 pneumatic wheel with sport rim at front anda small plastic wheel at the rear of the trolley. This wheel will make the trolley heavier.

3.3.5 Pugh Concept Selection

Pugh concept selection is a quantitative technique for ranking a collection of optionsin terms of their multidimensional. It is also applied in the engineering profession to evaluateand decide on designs. A simple decision matrix consists of developing a set of criteria that may be used to analyse, score, and summarize probable possibilities in order to get a total score that can be ranked. The advantages of employing Pugh's technique for decision making are that subjective opinions may be replaced with more objective options. This allows the designer to make changes and improvements using their opinions in order to raise the lowerrated option over the competing option.

	Concepts					
Key Criteria	Baseline	Concept 1	Concept 2	Concept 3	Concept 4	Weight
Criterion 1	0					
Criterion 2	0					
Criterion 3	0					
Criterion 4	0					
Criterion 5	0					
Criterion 6	0					
Sum of Positives (+)	0					
Sum of Negatives (-)	0					
Overall Total	0	0	0	0	0	
Weighted Total	0	0	0	0	0	

Figure 3.9 Pugh Matrix Templates

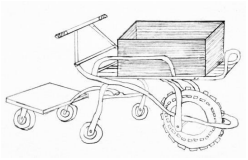
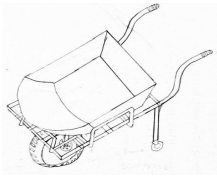
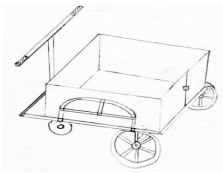
First and foremost, the Pugh Matrix are design by starting with the criteria selection chosen to make a comparison. Customer needs or engineering requirements from the House of Quality can be used to generate the criteria. After that, all of the different concepts shouldbe included in the comparison.

In the scoring process, where all concepts will be rated as better (+), equal (0), or worse (-). Following the evaluation, the total score of the idea will be calculated by adding the total number of positive scores, the total number of minus scores, the overall total, and the total weighted score. The overall total is calculated by subtracting the number of positivescores (+) from the number of negative scores (-). The weighted total is the sum of the scoresmultiplied by their corresponding weighting factor.

Finally, for a finer scoring system, the scoring might be interpreted on several scale levels. A score of more than 3 (+) indicates that the concept is much better, but while a scoreof less than 3 (-) indicates that the concept is much poorer, and the score of 0 indicates that the concept is in a neutral position. The concept with the greatest positive score (+) among the results will be chosen as the execution of design.

3.3.5.1 Pugh's Matrix Concept Evaluation

Table 3.2 Pugh's Matrix Evaluation.

Selection Criteria	 **Concept 1**	 **Concept 2**	 **Concept 3**	**Weight**
Product cost	+	+	+	2
Light weight	_	0	_	4
Safety	+	_	+	5
Maintenance	0	+	+	5
Aesthetics	_	+	0	1
Easy to use	+	+	+	3
Sum of Positives (+)	3	5	4	
Sum of Negatives (-)	2	1	1	
Overall Total	1	4	3	
Rank	3	1	2	
Develop Decision	No	Yes	No	

From the Pugh's matrix evaluation, the Concept 2 design is the top ranked among the 3 concepts. This concept will be selected as a final concept to develop and proceed to the nextphase of the project.

3.4 Component and Material Selection

In this section, research on materials to be used for the process of project was done.the selected materials are compared with others material before used for the project. The materials that were compared are :

3.4.1 Selection of Materials

Before beginning to process a project, materials that will be used should be considered. Because the end result must be of great quality. Several things must be taken into consideration:

a) Cost of the selected materials.
b) Resistance and durability of the materials to the environment.
c) How to obtain the materials.
d) The installment methods.
e) Low maintenance.
f) Resistance to vandalism.

3.4.2 Material and Component for the Motorized trolley

1) Screw, Nut, Washer

Figure 3.10 Screw, Nut, Washer.

When compared to nails, nuts, screws, and washers are more commonly used in the fitting process since they are easier and neater to deal with Screw, Nut, Washer (Imperial Grade 8 Bolts, n.d.)

2) Circular Hollow, Square Hollow and Plate Steel

Figure 3.11 Circular Hollow, Square Hollow and Plate Steel.

Steel was used as the main material for this project. Circular hollow steel are used tocreate the handle for the Motorized Trolley. Square hollow steel are used to build the body frame of the trolley and plate steel are used to joint the motor with the tire. The reason why steel are chosen for this Motorized Trolley is its have a high thickness, corrosion resistance,strong and have a long life span.

3) Non-Pneumatic Tire and Small Trolley tires

Figure 3.12 Non- Pneumatic tire and small trolley tires.

This polyurethane foam is made up of millions and millions of closed and open air cells, by utilizing both closed and open air cells in the foam, HI Spec's Flat-Free wheels have the bounce and rebound characteristics of air-filled tires, which solid rubber tires lack, as well as the advantage of solid rubber tires in never succumbing to punctures or cuts to the tire. This trolley tire is mounted to the motorized trolley's back stand. It makes it easier for users to transport their loads. It is made up of a dual raceway with

stronger legs for maximumstrength.

4) Handle Grip

Figure 3.13 Handle Grip.

Grip handles will be added to the motorized trolley's handle, providing as a grip whenmoving the loads. Furthermore, it has a good grip characteristic and is inexpensive.

5) Steel Tray

Figure 3.14 Steel tray.

A steel tray wheelbarrow is a common choice for landscapers, gardeners, and households. They can move a wide range of materials, including mulch, dirt, and sand. Thistray may be mounted to the top of the frame and easily disassembled.

6) 24 Volts, 450W DC Motor (Objectives, n.d.)

Figure 3.15 24 volts,450w DC Motor.

An electric motor is one of the project's main components, and it is used to move thetrolley with the appropriate weight. Following considerable research into the engine's characteristics and capability, it was concluded that this 24V electric dc motor is appropriate for the motorized trolley. The main reason for selecting this sort of motor is that it has a smooth performance, is easy to move and maintain, and environmentally friendly.

7) Sprocket and Chain

Figure 3.16 Sprocket and Chain.

The sprocket and chain have been used to transfer energy from the motor to the tire.

The big diameter sprocket is connected to the tire, while the smaller diameter sprocket is connected to the motor(Handy, 2021).

8) Mechanical Front Disc Brake Rotor

Figure 3.17 Mechanical Front Disc Brake Rotor.

The brakes play an important role in the operation of the motorized trolley. After extensive research, it was determined that these types of brakes are important for stopping or slowing down an engine power project(Manual, n.d.). Not only that, but in order to operatethese brakes, you must provide a force to the brake in accordance with the requirements. This disc is mounted to the trolley tire and is connected to a brake lever that is attached to the handle. The brake wire creates a connection between the disc and the brake.

9) Battery and wire

Figure 3.18 Battery and wire.

A battery with a 12V and 7.2AH capacity are chosen to supply power for the electric motor. These batteries can be recharged. When connecting the motor to the batteries and other electric elements, these wires serve an important role in moving current from one source to another.

10) Controller and ON - OFF Switch

Figure 3.19 Controller and ON - OFF Switch.

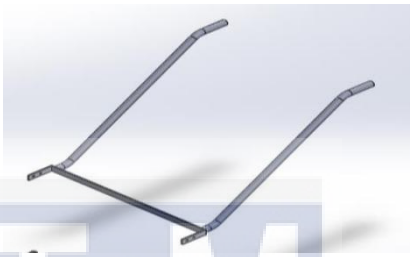
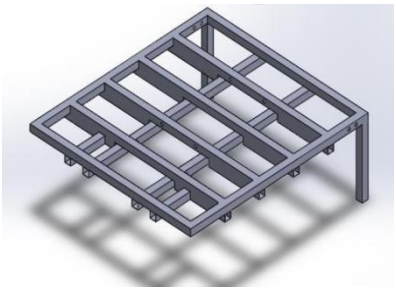
Controllers play an important role in adjusting the speed of the motor based on the needs of the user. The On-Off switch is used to start the trolley while it is in use and to stopit when it is not in use. This controller and On-Off switch is a safety features for this Motorized trolley.

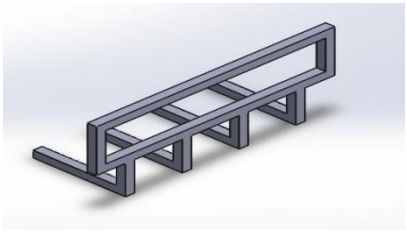
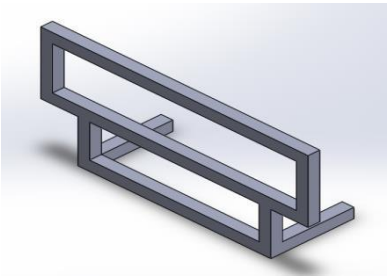
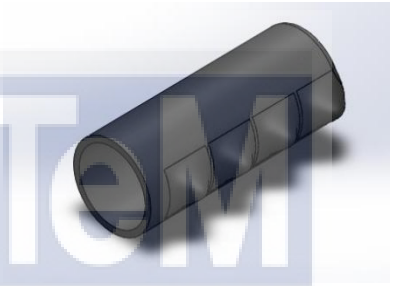
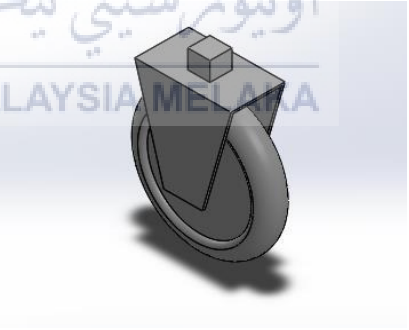
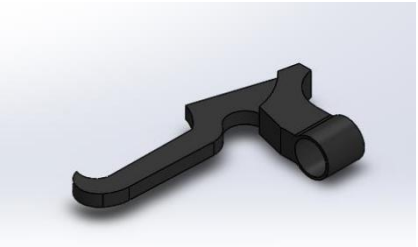
3.5 3D Modelling

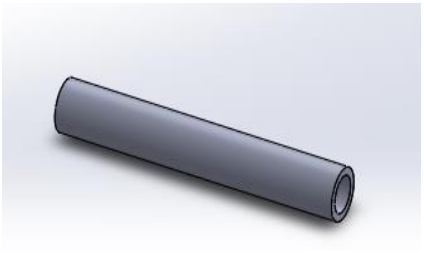
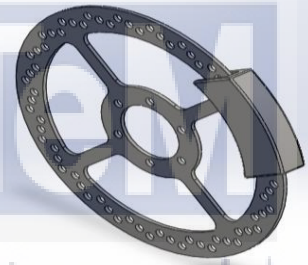
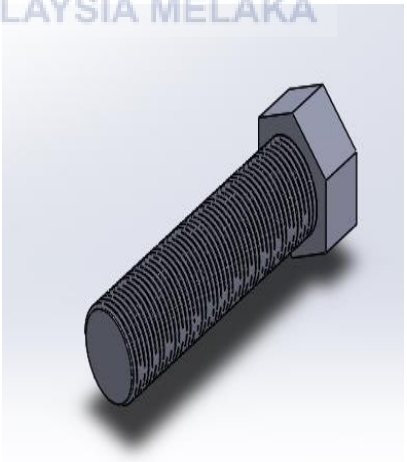
Concept 2 that was chosen as the final design for the Motorized System Trolley with Extendable Frame are proceed to develop for the 3D modelling. By using the Solidworks 2018 software's, the components and parts for the project was build and assemble accordingto the concept number 2.

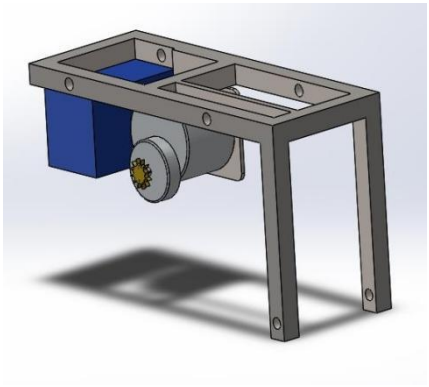
3.5.1 Parts & Components

Table 3.3 Parts & Components

No	Part / Component	3D model
1	Wheel	
2	Handle	
3	Tray	
4	Body Frame	

5	Left & Right Extendable Frame	
6	Front Extendable Frame	
7	Handle Grip	
8	Small Trolley Tires	
9	Brake Lever	

10	Shaft	
11	Big Sprocket	
12	Disc Rotor	
13	Bolt	

14	Electric Motor & Battery	
15	Chain	
16	Nut	

3.5.2 Final Assembly

The parts and components that completed in 3D model was assembled in Solidworksassembly.

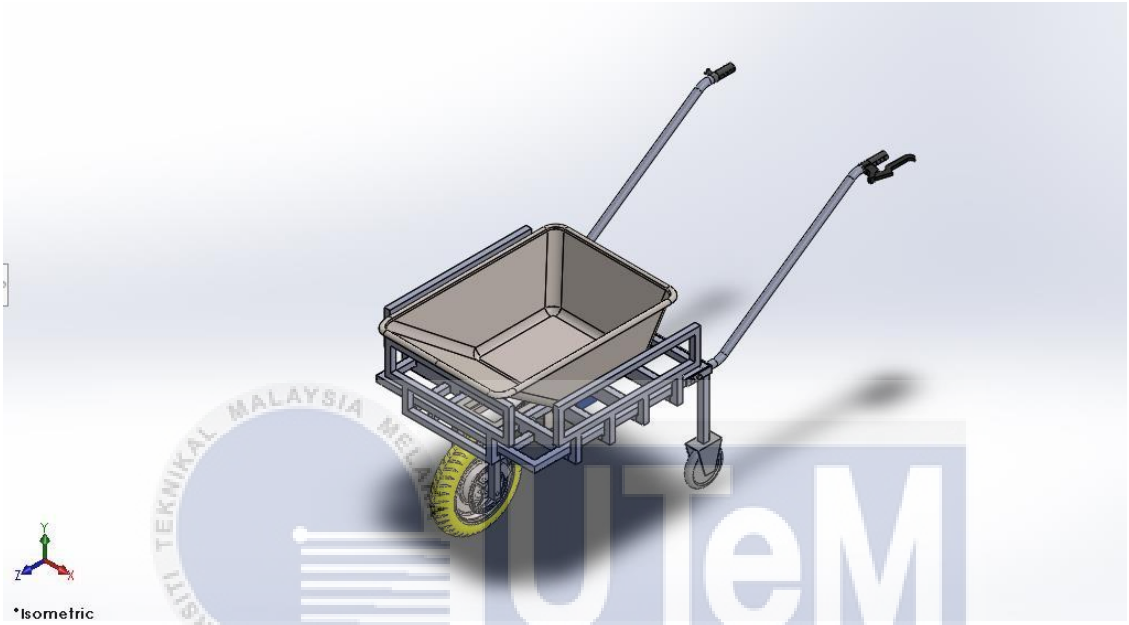


Figure 3.20 Isometric view

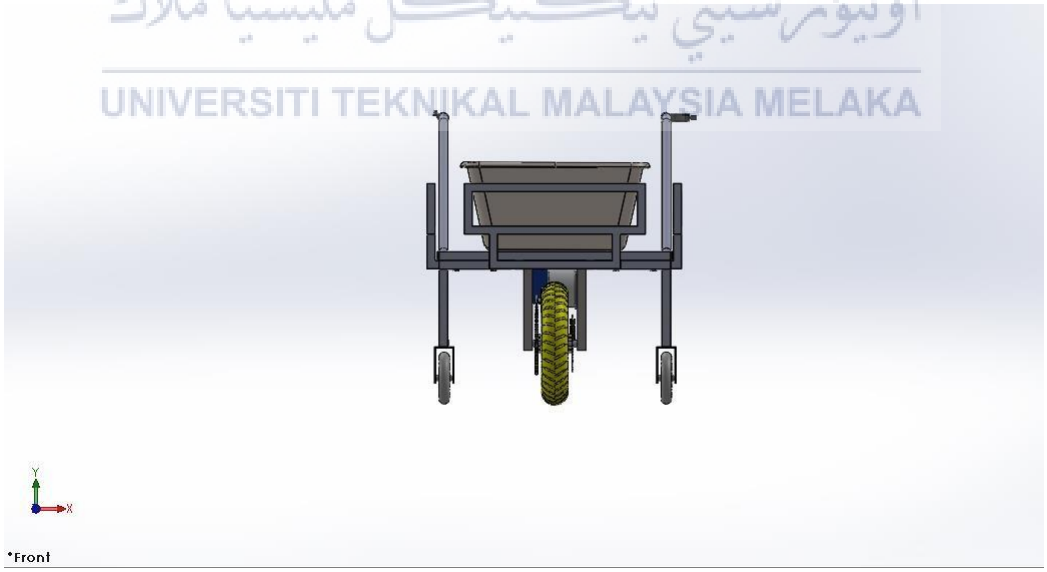


Figure 3.21 Front View

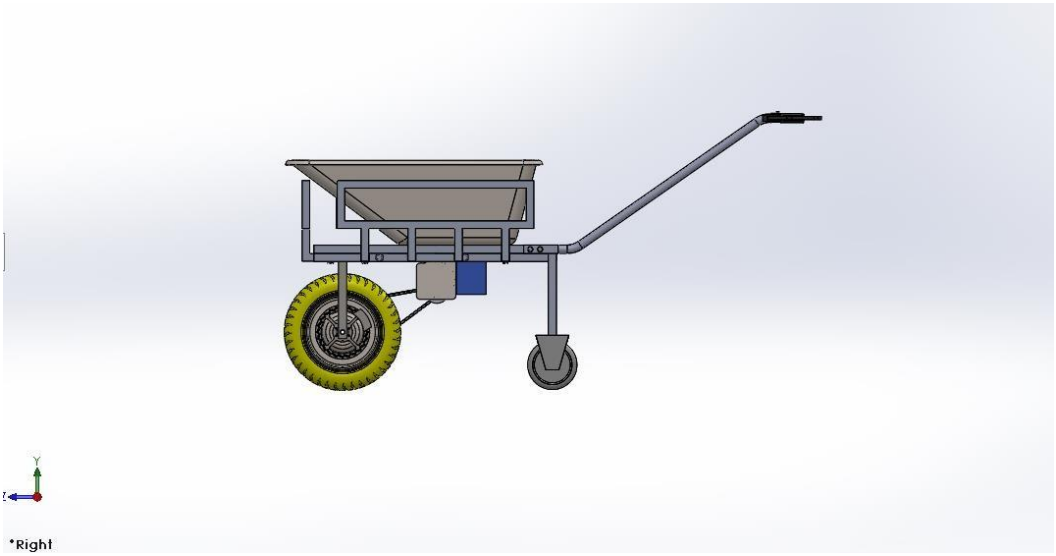


Figure 3.22 Side View

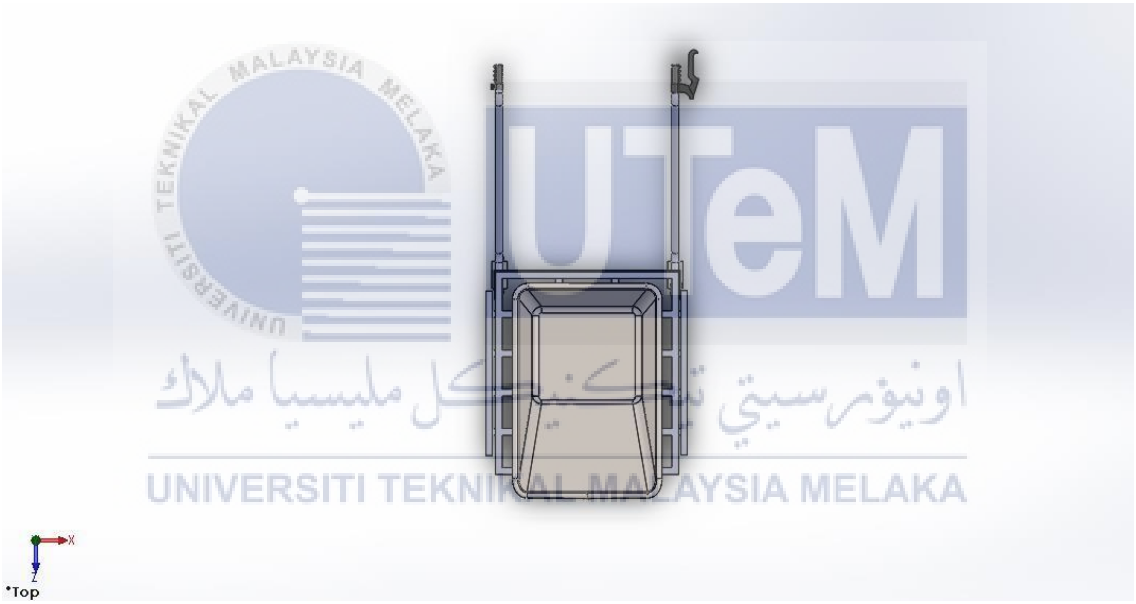


Figure 3.23 Top View

3.6 Equipment and Machinery

Equipment and Machinery is been used to prepare this project in order to make the preparation and installation of materials. The installation and preparation work required a suitable machine to produce a high quality product.

It also helps to ensure the safety of the workers and consumers. Here are the tools and machines used to complete the project on the other page:

3.6.1 Machines

There are few machines will used during the progress of the project:

a. Drilling Machine

Figure 3.24 Drilling Machine.

Table drilling machine is use to drill a flow hole with a drill bit according to the sizeof certain.

b. Electrical Cutting Machine

Figure 3.25 Electrical Cutting Machine.

This machine is use to cut the piece in the specified size. This machine was use quite often to cut out the correct size of plate that needed. To cut the aluminum rod according to the project requirement.

c. MIG Welding Machine

Figure 3.26 : MIG Welding Machine

MIG welding machine is use to weld the frame part of the Motorized trolley.

d. Grinding Tool

Figure 3.27 Grinding Machine

For smoothness the edges and surface of aluminium rod .

3.7 Estimation Cost of Project

In the process of manufacturing the project Motorized Trolley with Extendable Frame, the estimation total cost to complete the project is emphasized greatly to ensure thatthe group is able to afford to do the project within the budget. In general, the cost of the project can be categorized into 4 sections:

a) Cost of materials and components

b) Machining cost

c) Overhead cost

d) Total cost of the project

3.7.1 Cost of Materials and Components

Table 3.4: List of material prices.

Type Of Material	Quantity	Price(RM/Per Square Feet)
Metal rod / square	35	RM 2

Total Material Cost : RM 70

Table 3.5 : List Of Components Prices

Components	Quantity	Price per unit (RM)
Screw and nut	1	8
Electric motor	1	290
Disc brake (1 set)	1	25
Tires (1)	1	24
Roller tires (2)	1	16
Hand Lever	1	5
Grip handle	1	6
Metal tray	1	35
sprocket and chain	1	38
Battery	1	60
Speed controller	1	25
Wire	1	4

Total Component Cost : RM 536

3.7.2 Machining Cost

Cost of machining involves the cost of shaping of the material by using specific machines to produce the desired shape. Among the cost of manufacturing for a company worker to produce the pieces of the project that cannot be done by using:

MIG Welding Machine Worker's rate per hour = RM 25

= 4 hours x RM 25Total = RM100

Total Machining cost per hour = RM 20

= 4hour x RM20Total = RM 80

Total Machining Cost :

= RM 100 + RM80

= RM180

But in this project there are don't have to spend money on machining cost, because this project will fabricate at (UTeM), thus the welding cost and fabrication cost for this project can be reduced.

3.7.3 Overhead Cost

Overhead cost is the other costs that are related to the project during the manufacturing process of the project. Among the costs that are involved are like electricity cost, usage of tools, usage of machine and many more. For this project, estimates that the overhead cost is about 10% of the machining cost:

Machining cost x 10% = RM 32.50

3.7.4 Total Cost of project

The estimation total cost of the project is the counting in all the previous costs that are require to complete the project. The total cost of the project are the following:

Cost of material and components + Machining cost + Overhead costRM 606+ RM 0+ RM 32.50= RM 638.5

Total Cost = RM 638.5

3.8 Conclusion

By the end of this chapter, one may conclude that the study on user requirements, project components and parts, material types, and a fabrication idea has been completed. This chapter provides a better guidance for carrying out the project's following steps and ensuring that the project is completed without any difficulties.

CHAPTER 4

RESULTS AND DISCUSSION

4.1 Introduction

In this chapter, it can be said that the project has been completed following the specification that was stated previously. The project 'Motorized Trolley with Extendable Frame' will function as stated which is, it is able to move selected loads in agricultural side, and so on. Therefore, this chapter explains the obtained result of this project.

4.2 Results and Discussion

In this section, the result of the Motorized Trolley with extendable frame project will be discussed.

4.2.1 Body Frame of Motorized Trolley

Figure 4.1 Body Frame of the Motorized Trolley

The body frame of the motorized trolley was made of square hollow steel with the dimension of length 74CM and width 67CM. The square hollow steel was measured and marked to cut with the required dimensions. After cut the steel, the body frame was started to fabricated. The steel was attached together as the required design by using welding process. The machine used to welding the steel is MIG welding machine.

4.2.2 Extendable Frame of Motorized Trolley

Figure 4.2 Extendable Frame of the Motorized Trolley

The Figure 4.2 shows that the fully fabricated of the extendable frame of the trolley. This extendable frame was made from the square hollow steel and it was measured and marking out with the required dimension to cut. The extendable frame with four legs was fabricated for the left and right side of the trolley. The two legs of extendable frame was fabricated for the front side of the trolley. The frame was fabricated using the welding process by the MIG welding machine. This extendable frame was created with this design so that the loads that brought on this extendable frame does not fall to the ground.

4.2.3 Extendable Frame attached with the Body Frame of Trolley

Figure 4.3 Front Extendable Frame on the Motorized Trolley

The Figure 4.3 shows that the front extendable frame on the motorized trolley body frame. Its fabricated with two legs to support on the body frame and there are two holder was attached on the front of the body frame for this extendable frame to fix. This extendable frame was tighten using bolt and nut that attached with the holder.

Figure 4.4 Left and Right Extendable Frame on the Motorized Trolley

The Figure 4.4 shows that the left and right extendable frame on the motorized trolley body frame. This was the condition of the trolley when the extendable frame fully extend. Its fabricated with four legs to support on the body frame and there are four holder was attached on both left and right side of the body frame for this extendable frame to fix. This extendable frame was tighten using bolt and nut that attached with the holder. This extendable frame are used to increase the load on the trolley to make the work easier for the user.

Figure 4.5 The Extendable Frame holder on the Motorized Trolley

The Figure 4.5 shows that the holder for all extendable frame that was attached with the motorized trolley body frame. The holder is created from the 2x2 inch square hollow steel bigger than the extendable frame steel. Bolt and nut was attached to the holder by welding for tighten the extendable frame when its fully open. The tighten process needed after the extendable frame fully open because it can avoid the frame to came out of the holder when the load was applied to the frame.

4.2.4 Motor Part/Frame of Motorized Trolley

Figure 4.6 The Frame of the Motor Part

The Figure 4.6 shows that the frame of the motor part. It made from the square hollow steel and the angle bar steel. The square hollow steel was used to fabricate the frame that will hold the motor part on the body frame of the trolley. The angle bar steel was used for holds the non pneumatic tire. The whole motor part was made by the welding process used MIG welding machine.

Figure 4.7 The Frame of the Motor Part attached with the Motorized Trolley

The Figure 4.7 shows that the assemble of motor part by electric motor, non pneumatic tire, circuit and battery box. The electric motor and the non pneumatic tire was connected together by chain and sprocket. The motor part frame was attached to the body frame of the trolley used by bolt and nut. This method was used for attached them because the user can easily dismantle the motor frame from the body frame for service or repair works.

4.2.5 Electric Circuit of the Motor Part

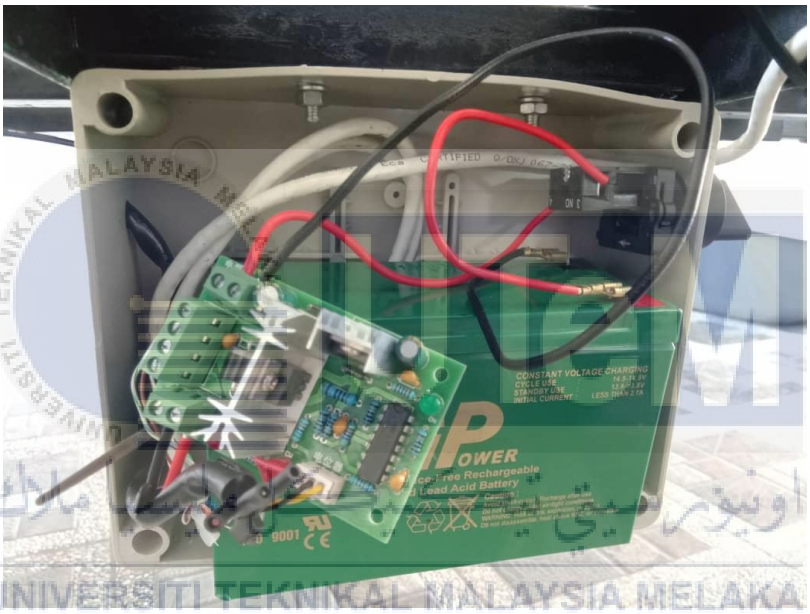


Figure 4.8 The Electric Circuit of the Motor Part

The Figure 4.8 shows that the electric circuit that was built for the motor system to run. The forward-stop-reverse DC motor speed controller was used to built the circuit. This device used as DC motor speed controller and drawing up to a few amps of current. This device was connected to the battery, current cut off switch, and with the DC electric motor by wires. The current cut off switch was used to this circuit because it can stop the current supply from battery so that there is no battery drained. The circuit was located into the closed box at the rear of the motor frame. Bolt and nut method was used to attached the box to the motor frame.

4.2.6 Brake System of Motorized Trolley

Figure 4.9 The Brake System of the Motorized Trolley

The Figure 4.9 shows that the motorized trolley was attached with the disc brake system to stop the trolley when its moved and prevent the trolley to roll or move in an incline surface. It used bicycle disc brake system that was a mechanical type of disc brake. This disc is mounted to the trolley tire and is connected to a brake lever that is attached to the handle. The brake wire creates a connection between the disc and the brake. This brake system was attached to the angle bar steel of the motor frame by bolt and nut. This method was used due to easy service or repair works for the users.

4.2.7 Handle Part of Motorized Trolley

Figure 4.10 The Handle Part of the Motorized Trolley

The Figure 4.10 shows that the handle part of the trolley and it was made from circular hollow steel. This circular hollow steel was bend to the perfect shape and the dimension that has been stated before. Swivel bench vise was used to bend the circular hollow steel for handle. The end of the handle was inserted with the handle grip so that the user had a grip when they hold or move the trolley. The brake lever was attached to the left side of the handle. It located at the place where user can easily reached when they need to stop the trolley.

Figure 4.11 Right side of the with Control System of the Motorized Trolley

The Figure 4.11 shows that the right side of the handle attached with the control system. The forward-stop-reverse switch was located at the side of the handle for easy switched. The switch was merged into the handle and fixed by using hot glue. The speed controller was attached upside of the handle so that the user easily can control the speed. The controller was also merged into the handle and tighten used bolt and nut.

4.2.8 Non Pneumatic Tyre Part of Motorized Trolley

Figure 4.12 Non Pneumatic Tire with Sprocket

The Figure 4.12 shows that the non pneumatic tire that attached with the sprocket. Nut and bolt was used to attached the sprocket with the non pneumatic tire. This sprocket was attached to the tire so that it can help the electric DC motor to move the trolley. The non pneumatic tire was drilled and get a hole to insert the nut. The sprocket was fixed at one place with the tire so that when the electric DC motor spin the sprocket the tire follow the sprocket together.

Figure 4.13 Non Pneumatic Tire with Disc Rotor

The Figure 4.13 shows that the non pneumatic tire that attached together with disc rotor. Nut and bolt was used to attached the disc rotor with the non pneumatic tire. This disc rotor was attached to the tire so that it can help the user to stop the trolley from moving. The non pneumatic tire was drilled and get a hole to insert the nut. The disc rotor was fixed at one place with the tire so that when the user apply the brake the tire will stop together with the disc rotor.

4.2.9 Motorized Trolley attached with Steel Tray and without Steel Tray

Figure 4.14 Motorized Trolley with the Steel Tray

The Figure 4.14 shows that the motorized trolley with the steel tray. The steel tray was attached to the body frame of the trolley. Bolt and nut was used to attached the steel tray on the body frame. This method was used to connect them because it is the easiest way to dismantle the steel tray when the user does not want to used it. The steel tray was used in this project because it can help users to moved loads such as sand, cement or any other loads.

Figure 4.15 Motorized Trolley without the Steel Tray

The Figure 4.15 shows that the motorized trolley without the steel tray. This trolley can be used for moved many loads from one place to another place. This trolley normally can be used at houses areas and small industries.

4.2.10 Motorized Trolley with an Extendable Frame

Figure 4.16 Motorized Trolley with an Extendable Frame

The Figure 4.16 shows that the final result as a fully assembled motorized trolley with an extendable frame. This motorized trolley can be used to moved many loads and also suitable to used at the small vegetable farms, flower farms, small construction site, and also in car workshop. This motorized trolley was attached with the extendable frame, motor frame with an electric DC motor, non pneumatic tire attached with sprocket and disc rotor, and the handle with brake lever, speed controller and forward-stop-reverse switch.

4.2.11 Motorized Trolley with the Maximum Loads of 100KG

Figure 4.17 Motorized Trolley with the Maximum Loads of 100KG

The Figure 4.17 shows that the motorized trolley loaded with three gas cylinders of 30 kilograms each and two water bottles with 10 kilograms of weight each. The total loads that loaded onto the motorized trolley was 100 kilograms. The bottles was placed at the extendable frame that was design and the frame can support the weight of the bottles. Moreover, the electric DC motor can moved the trolley with the maximum load of 100 kilograms from one place to another place with the maximum speed of the electric DC motor. This shows that this project was successfully fabricated and it is meets the objectives that stated before.

CHAPTER 5

CONCLUSION AND RECOMMENDATION

5.1 Conclusion

In a nutshell, This project, 'Motorized Trolley with Extendable Frame' has been successfully completed and meets the scope, objectives and goals to be achieved. This project takes about two months to fully fabricate. The Motorized Trolley with Extendable Frame can be used in placed like agricultural side, small warehouse, or at house.

Firstly, the materials to fabricate this project was bought by done some researching of the shop. Most of the materials bought from the shopkeeper and some of the components such as electric motor, ON&OFF switch and controller was bought at the online shopping. After done with the purchasing, started to fabricate the trolley by using some machines such as welding machines, electrical cutting machine, and drilling machine.

The Motorized Trolley with Extendable Frame was meets the objectives that was design and fabricate a Motorized system trolley with extendable frame that can be used by farmers and house hold. The extendable frame part was fabricated completely as design by using the Solidworks 2018 software. This extendable frame help user;s to carry more loads on the Motorized trolley as stated in project scope.

This project are also meets the second objectives that was to apply electric system motor to move the trolley easier. The trolley was assemble with the electric DC motor with

24 Volts, 450W which suitable to use at small vegetable farms, flower farms, small construction site, and also in car workshop. This Motorized trolley not suitable to used at heavy industries. It also meets the scope that the maximum capacity of weight that can be moved by the motorized trolley was 100KG.

In other hands, this motorized trolley also meets the third objective that was this project are an environment friendly project. There is no any pollution made by this projects cause it used an electric motor to moved the trolley.

As all the objectives was achieved by this project, it can conclude that this motorized trolley with an extendable frame can be the alternative source to moved a heavy loads from one place to another at small industries and house areas. Its also can reduce the burden of the user to moved heavier loads.

5.2 Recommendation

For future improvements, the motorized trolley with extendable frame could be enhanced as follows:

a) Increase the power of the electric motor will helps to bring heavier loads easily.
b) The steel can be replaced with some other steel which can withstand more qualities. Get a better material which is stronger and convenience. Make it easy to carry and movable.
c) To make the user more comfortable , a roller board like mechanism can be attached at the behind part of this project. Thus the users can stand on this while operating this project. The users will move with the weight mover.
d) Create a special tray which can used to bring water, and the water can be

automatically split out to water the plants.

e) The non-pneumatic tire can be replaced with scramble wheelbarrow tire to make the project easy to bring in rainy days.

f) The Motorized Trolley with Extendable Frame can be added with a small hydraulic jack system to lift the weights.

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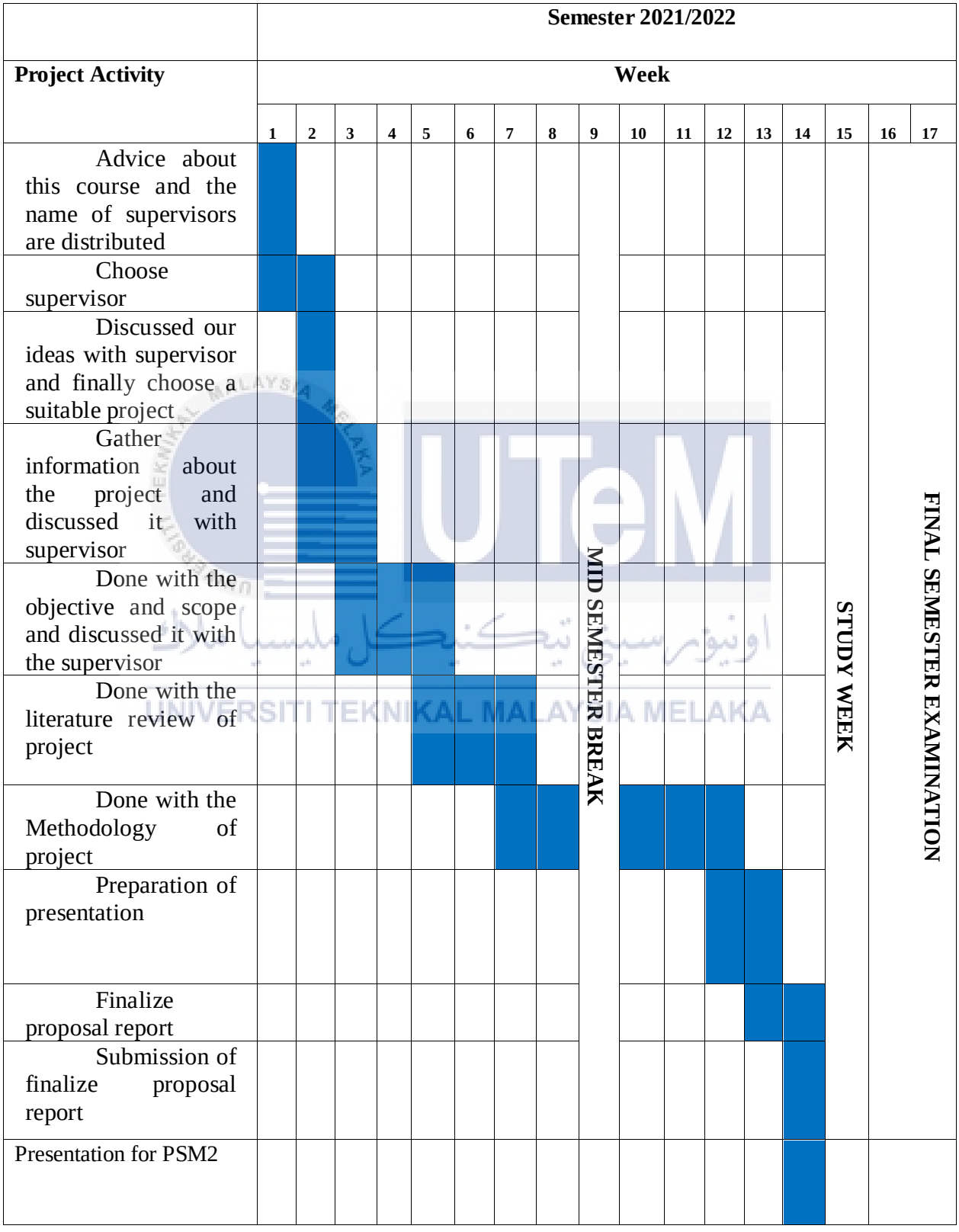
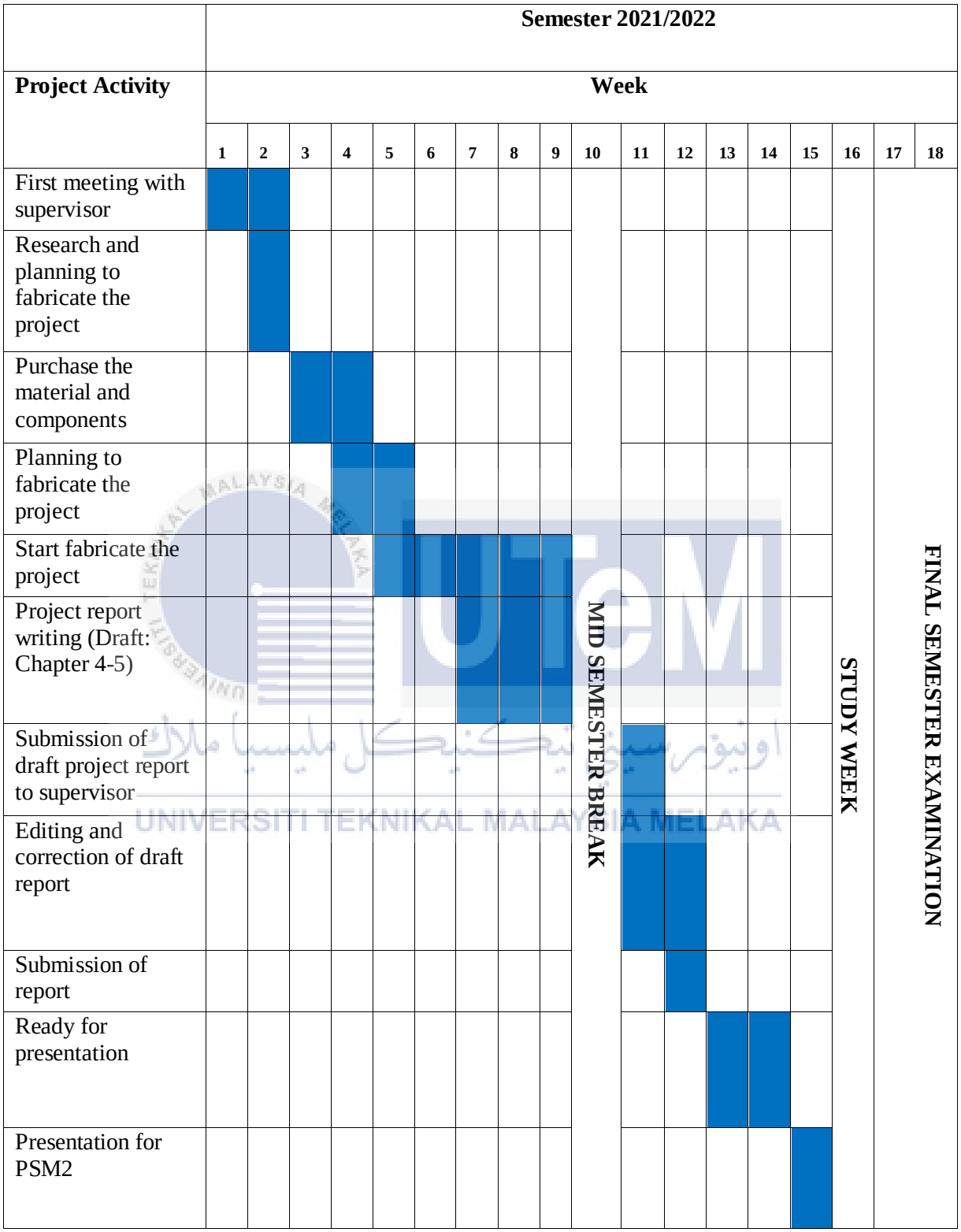
APPENDICES

APPENDIX A Gantt Chart for PSM 1



APPENDIX B Gantt Chart for PSM 2



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