



## **PROJECT REPORT**

**MR. CARRY**

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**POLITEKNIK SULTAN SALAHUDDIN ABDUL AZIZ SHAH**

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Laporan ini dikemukakan kepada Jabatan Kejuruteraan Mekanikal sebagai memenuhi sebahagian syarat penganugerahan Diploma Kejuruteraan Mekanikal (Pembungkusan)

**JABATAN KEJURUTERAAN MEKANIKAL**

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## **ABSTRACT**

Material handling equipment is any tool used to aid in the movement, protection, storage, and control of materials and products. The different types of handling equipment are classified into four major categories which are transport equipment, positioning equipment, unit load formation equipment, and storage equipment. manual handling equipment commonly used to assist in moving smaller such pallet trucks, trolleys, and sack trucks. Transporting load from ground to upstairs can give a big problem. The current design of the stair climber 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. This project is focused on developing a mechanism for easy transportation of heavy load over stairs. It will offer solution to overcome problems faced by human's in carrying loads from the ground to upstairs. The solution where prefers to this problem by providing a machine called Mr. Carry to transport loads to upstairs. The Tri-Star wheel is connected to the hand trolley and moves with the help of a motor to lift the load up the stairs. Further development can be considered to reduce the amount of twisting, stooping, and reaching on the trolley.

Keyword: Material handling, trolley, stair climber

## **ABSTRAK**

Peralatan pengendalian bahan adalah peralatan yang digunakan untuk membantu dalam pemindahan, perlindungan, penyimpanan, kawalan bahan dan produk. Peralatan pengendalian bahan dikelaskan kepada empat kategori utama iaitu peralatan pengangkutan, peralatan pengesanan, kelengkapan pembentukan unit, dan peralatan penyimpanan. Peralatan pengendalian manual yang biasa digunakan untuk membantu pemindahan bahan kecil seperti trak palet, troli dan trak guni. Mengangkat beban dari tanah ke atas boleh memberikan masalah besar. Reka bentuk semasa tangga pendaki secara fizikalnya sukar untuk mengangkut barang di mana mereka mesti membengkokkan badan ke hadapan atau menarik beban naik ke atas tangga; ini boleh menyebabkan ketegangan kepada pinggang pengguna. Projek ini memberi tumpuan dalam membangunkan mekanisma untuk mengangkat beban berat naik ke atas tangga dengan mudah. Ia akan memberi penyelesaian kepada masalah yang dihadapi oleh manusia untuk mengangkat beban dari tanah ke tingkat atas. Masalah ini boleh diselesaikan dengan menyediakan troli yang dipanggil Mr. Carry untuk mengangkat beban berat ke tingkat atas. Roda Tri-Star disambungkan pada troli tangan dan bergerak dengan bantuan motor untuk mengangkat beban menaiki tangga. Pengembangan selanjutnya boleh dipertimbangkan untuk mengurangkan jumlah memusing, membongkok dan mencapai troli.

Kata kunci: pengendalian bahan, troli, tangga pendaki

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# CHAPTER 1

## INTRODUCTION

### 1.1 RESEARCH BACKGROUND

It is often that man is born free but are always in chain, in one way or the other; human beings are faced with a lot of problems. There was a time when it is difficult to carry a load from ground to upstairs, solution where prefer to this problem by providing a machine called load lift wheel to transport loads to upstairs. Designed to be pushed and guided by a single person using motor, handle, and wheels. The fulcrum takes change of its movement and so many other features. This machine is fabricated to relieve the difficulties and probably eliminate loss of man-power time, money and especially the need for technological break though self-reliance. Manual material handling is the process of moving or supporting an object by physical force. Pushing, pulling, lifting, and carrying are all examples of manual handling tasks. These tasks can be found in every workplace, on a construction project and a ranch. Manual material handling poses several risks to employees. Strains and spinal cords are commonly reported by employees who perform manual handling tasks. Backs, knees, hips, shoulders, elbows, neck; they are all body parts threatened by manual handling tasks. The contributing factors for these risks vary but include the weight, size, shape and stability of the object, frequency and distance of move, the body mechanics. The considered problem is the lift and transport section of the wheel loader that operates in the short loading cycle, with the considered criteria are minimum time and minimum manpower.

## **1.2 PROBLEM STATEMENT**

The load lift wheel from a design aspect is simple concept that facilitates the transportation of large amounts of difficult to move materials. It is most used in the construction and industries to move such materials as heavy loads like cupboard, concrete n etc. The current design of the stair climber 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. Ideas for a redesigned load lift machine should give the user the ability to move heavy loads upstairs, as well as stair climbing capabilities through simple and easy to implement concepts. Redesign a heavy-duty load lift machine that could perform on upstairs climbing applications. With the completion of the brainstorming of new ideas that could be used to improve the design of the stair climber to meet with the design objective, the following is a list of the concepts:

- Higher handlebar on the front of the bucket.
- Sliding handles that latch into the front wheel extension.
- Front wheels with a radius greater than the height of the stair.
- Motor for easy to move ability.

## **1.3 OBJECTIVE**

- To eradicate the problems faced by human's in carrying loads from one place to another place (upstairs)
- To lessen the difficulties and probably eliminate loss of manpower
- To develop a mechanism for easy transportation of heavy load over stairs.



## 1.4 RESEARCH QUESTION

### i) Are there hazards associated with using hand truck?

The use of hand truck to transport loads instead of carrying them saves workers a lot of effort. It decreases the risk of overexertion injury in jobs that include manual materials handling. However, pushing, pulling, and maneuvering hand truck still involve some common hazards (overexertion). The most common injuries that result from hand cart operations are:

- fingers and hands being caught between the cart and other objects
- toes, feet, and lower legs being bumped or crushed by the cart
- slips, trips, and falls
- strain injuries predominantly for the lower back, shoulder, arm muscles and joints

### ii) To Push or To Pull?

One of the questions we are frequently asked as injury prevention experts is whether it is better to push or pull carts, hand trucks, racks. The answer is it depends. For most of the processes, pushing is preferred. A meta-analysis of the research on pushing or pulling shows that 9 works are capable of safely generating more force when pushing, rather than pulling. This is due to the postures experienced while pushing and muscle recruitment. This is situation-dependent though, pushing allows a man to see where they are going, but if the load “gets away” from them, especially while pushing the load up a steep incline, there is the possibility of the person being struck by the load. Pulling a load while twisted and with the shoulder extended allows the person to see where they are going and will reduce the possibility of the person being struck if the load “gets away” from them, especially while pulling the load up a steep incline, but increases the potential, severity of injury to the shoulder and lumbar spine by generating excessive forces while in a biomechanically disadvantageous position.

iii) Which is easier either Push or Pull?

Curb or up a few stairs. Pulling the hand cart is easier. This is due to the pulling requiring a lift of the hand truck while simultaneously applying a horizontal and vertical (diagonal) force. The lifting of the hand truck while simultaneously applying the diagonal force decreased the amount of friction of the item on the surface, thereby making the pulling task more energy-efficient and appropriate for the stair climbing especially. In conclusion, pushing a load is usually preferable, but there are instances (may fall the loads) in which pulling is the better option. The choice depends on the surface angle, coefficient of friction, the load distribution, type of manual material handling equipment, and obstacles. There may be instances where it is best to begin pushing the load and then alternate.

## 1.5 SCOPE

i) Wheels

A wheel is a circular part that is meant to rotate on a shaft bearing. In conjunction with axles, permit heavy objects to be removed simply facilitating movement or transportation whereas supporting a load or performing labour in machines. Wheels are also used for different purposes.

ii) Wheels Frame

It is function as a standard wheel on flat ground, however, could climb automatically once an impediment to rolling is encountered. This wheel design consists of each mounted to a separate shaft. These shafts are placed at the vertices of a trilateral. It will conjointly allow a vehicle to climb over little obstructions like stairs, rocks, and holes. The obstruction prevents the lower front wheel from moving forward however does not influence the motion of the live axle. This causes the top wheel to roll forward into position.

iii) Axle

An axle is a central shaft for a rotating wheel or gear. On wheeled vehicles, the axle is also fastened to the wheels, rotating with them or fixed to the vehicle, with the wheels rotating around the axle in the several cases, bearings or bushings are provided at the mounting points wherever the axle is supported.

iv) Trolley Frame

Frame is main assembly of trolley mounted on axle. Aim to kept material that must be moved. A frame is usually a structural system that supports different parts of a physical construction and steel frame that limits the construction's extent. Framing in construction is the fitting together of items to give a structure support and shape. Framing materials are usually wood or steel.

v) Handle

Handle is to hold by mover and easy movement of trolley from one place to different to hold heavy loads.

vi) Motor

To make work easier and more lesser the manpower.

vii) Switch Box

Reduce manpower by just pressing push button to run the project.

## **1.5 SIGNIFICANCE OF RESEARCH**

As a simple solution to alleviate problems associated with manual material handling, manual vehicles, such as carts, trucks, wheelbarrows, etc., are often provided to operators. This review was initiated by concern for the effects of design, task, environment, and operator factors on the usability of manual vehicles. The previous studies are summarized, and then ergonomic recommendations are made for each factor. Most studies have been performed on four-wheeled carts and focused on wheel design, handle height, load weight, moving direction, motion phase, and floor type. Biomechanics, psychophysics, and work physiology have been used to help understand usability. For future research, the systematic classification of manual vehicles is necessary to make specific ergonomic recommendations for special-purpose manual vehicles. Relevance to industry workers are use manual vehicles to reduce physical stresses during manual material handling without the awareness of their factor effects on usability. This review paper would be useful for a manufacturer and ergonomist to design and select general manual vehicles.

## **1.6 DEFINITION OF OPERATIONAL TERM**

A hand truck, also known as a two wheeler, stack truck, trundle, box cart, sack barrow, cart, dolly, sack truck, or bag barrow, is an L-shaped box-moving handcart with handles at one end, wheels at the base, with a small ledge to set objects on, flat against the floor when the hand-truck is upright. The objects to be moved are tilted forward, the ledge is inserted underneath them, and the objects allowed to tilt back and rest on the ledge. The truck and objects are then tilted backward until the weight is balanced over the wheels, making otherwise bulky and heavy objects easier to move. It is a first-class lever. A two-wheeled cart for moving heavy objects by hand, consisting of a vertical framework with handles at the top and a metal blade at the bottom that is inserted beneath a load, the entire assembly being tilted backward until balanced for easy pushing or pulling.

## 1.7 CHAPTER SUMMARY

Hand trucks were originally used in the 18<sup>th</sup> century to move large sacks of spices on docks by young boy from the age of 11, who were unable to lift the large sacks by hand. By using this method, they were able to work as well as grown men in moving items around. Later, such trucks were amended for use in many different industries, such as brewing, where hops were moved in sacks.

Some hand trucks are equipped with stair climber wheels which as the name implies are designed to go up and down stairs. This stair climbing hand trucks have two wheels on each side that are always in contact with stairs for added stability. Stair climber with two wheels can sometimes be problematic when trying to turn on flat ground as four wheels as Mr. Carry in a fixed position will be in contact with the ground. Hand trucks are fabricated from many different types of materials, including steel tube, aluminum tube, aluminum extrusion and high impact plastics.

Most commercial hand trucks used for beverage and food service deliveries are rugged and light. They are usually constructed from two extruded aluminum channel side rails and cast aluminum or magnesium parts. Some of the options that may be considered are the types of wheels, stair climber, handle type and size of wheels. Other things to be considered should be the load shape compared with the backrest shape, example of cylindrical loads should sit on curved backrests, and the environmental conditions in which the hand truck will operate. For example, on loose or uneven ground oversize wheels are a great advantage; solid or puncture-proof foam filled tires may be used where punctures could deflate pneumatic tires.

A rule of thumb is that the toe or nose of the truck should be at least one-third of the length of the load. Hand trucks are sometimes used as baggage carts by porters in train stations and skycaps stations. A piano tilter is a type of hand truck for moving an upright piano without damaging it. Unlike a traditional dolly, which pivots around a smaller wheel or point, the piano tilter has large, curved sections to gently tilt an upright piano until it is lying flat on its back. Moment of a force is defined as the product of the force and its perpendicular distance from the axis of rotation. When the man pull the truck various forces will act on the truck, these forces are the reaction force at the step in the  $x$ -direction, the pulling force in  $x$  and  $y$  direction and the weight of the truck. The moment of all these forces about the point  $A$  at the step will be zero.



Figure 1.7.1- Normal Hand Truck

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## **CHAPTER 2**

### **LITERATURE REVIEW**

#### **2.1 INTRODUCTION**

To make a new design engineer must understand the customer requirement that is important to expand in market today. It can be relating this information with ergonomic and apply in Quality Function Deployment (QFD). There are many types of material handling and various devices they used to carry the material and manage their work.

Wickens C.D. stated the situation when things go wrong that triggers to call for diagnosis and solution, understanding these situations represent the key contribution of human factors to system design. They may define the goal of human factors as making the human interactions with systems one that by enhance performance, increase safety, and increase user satisfaction.

#### **2.2 DEFINITION OF ERGONOMICS**

There are many definitions what the meaning of ergonomic. According to Kromer K, et, al, 2001). Ergonomic is the application of scientific principles method and data drawn from a variety of discipline to the development of engineering system in which people play a significant role. Among the basic discipline is psychology, cognitive science, biomechanics applied physical anthropometry and industrial systems engineering. The engineering system to be developed range from the use of a simple tool by a consumer to a miliaperson in a sociotechnical system.

Ergonomic is the study of the interaction between people and machines with the factors that affect the interaction. Its purpose is to improve the performance of system by improving human machine interaction. This can be done by designing in a better interface or by designing – out factors in the work environment or in the organization of work that degrade human machine performance (R.S. Bridger, 2003).

There are three major reasons for applying ergonomics (Kroemer. K, et, al, 2001).

a) Moral Imperative

- i) To improve the human condition and quality of life, especially at work and is regard to health, safety, comfort, and enjoyment.
- ii) Certainly, work and through work that we value personally.

b) Progress in Knowledge and Technology

- i) To join the human quest to learn more about people and their desires, capabilities, and limitations and to develop, apply new theories

c) Economic Advantages

- i) To reduce the effort and cost expended in work systems that include humans as doers, users, and beneficiaries.
- ii) In many new designs of things and systems, the human factor already has been incorporated during the concept stages.

## **2.3 HUMAN FACTORS**

Areas of interest for human factors practitioners include by workload, fatigue, situational awareness, usability, user interface, learn ability, attention, reliability, safety, shift work, work in extreme environments including virtual environments, human error and decision making.



The term of human factors engineering is used to designate equally a body of knowledge, process, and profession. As a body of knowledge, human factors engineering is a collection of data, principles about human characteristics, capabilities, limitations in relation to machine and environments.

## **2.4 RISK AND PERSONAL FACTORS**

There are several risk factors associated with pushing and pulling of loads.

Large amount of effort required to start or stop the load moving or to keep it moving. The risk increases over longer distances or at high speed. The worker needs to move suddenly or twist to manoeuvre the load. Obstacles can create risks as workers try to avoid colliding with them. The position of the hands should be comfortable for the worker they are best positioned between hip and shoulder height. Repetitive pushing and pulling without sufficient recovery time.

Workers have different characteristics and capabilities. For example, a tall worker may have to adopt an awkward posture to push a hand truck wheel with low handles, while a shorter worker may have difficulty seeing over the load. Specialized trainer or instruction is needed.

Consider the weight of the load and the weight of the equipment being used by the worker. Good handholds will help apply force and control the load. Ensure the load is sufficiently stable for negotiating any slopes, corners, or rough surface. Wheeled equipment needs suitable and well-maintained wheels or castors. Any breaks need to be effective. Plan the route and ensure the worker can safely see over the load.

Environmental factors such as temperature, lighting and air currents can increase the risk of pushing or pulling. Floor surfaces that are clean and dry can help reduce the force needed to move a load. Lack of space can force the worker to adopt awkward postures there should be a maintenance programme and a well-promoted fault-reporting system. Ensure that the wheels suit the flooring and environment, example is the wheels on the device suited to a hot environment or carpets. Poor communication between manager and workers can lead to unhappy workforce which could influence production.

The hazards associated with the use of lifting equipment in construction are hazards related to the loads by the crushing due to impact of moving objects or loads falling from hand truck because they are not slanged properly or the wrong type of slings were used. Hazards from moving hand truck or collapsing structures of cranes falling over because of improper fixation or strong wind, unsafe loads, loads exceeding the safe weight limits, trapping, or crushing risk while working at height or falling from height.

## **2.5 MANUAL MATERIAL HANDLING**

A process of moving or supporting an object by physical force. Pushing, pulling, lifting, and carrying are all examples of manual handling tasks. It causes several risks to employees. Backs, knees, hip, and shoulder are all body parts threatened hardly. Evaluate the risk factors associated with material handling and implement control measures to eliminate or reduce the potential for injuries and damage to equipment and facilities. Providing mechanical handling devices or aids can often eliminate the task itself or ease the demands on the worker.

## 2.6 CHAPTER SUMMARY

The literature review also investigated how the effects of hand trucks on the other modes. Hand truck weight enforcement agencies generally measure their accomplishments in terms of actual enforcement activity. In this project, the final design was an outcome of a sequential analysis and modification of stages which had been started with available local marketing products.

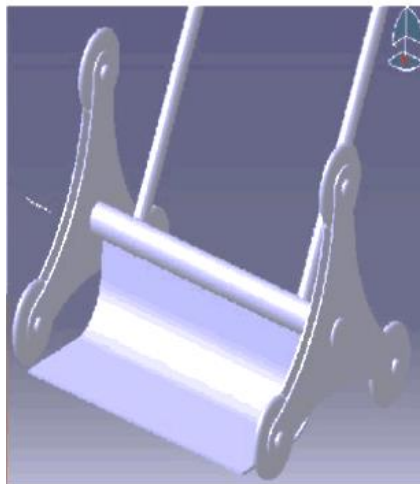


Figure 2.6.1- Initial Design of Wheel Arrangement and Wheel Frame

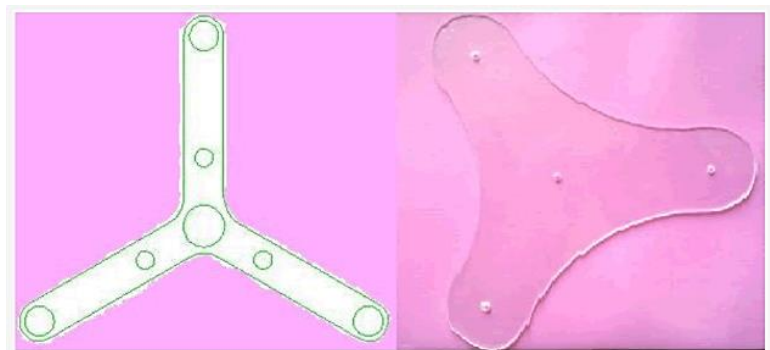


Figure 2.6.2- Modified Wheel Frame

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# CHAPTER 3

## METHODOLOGY

### 3.1 INTRODUCTION

What is methodology? A methodology is a plan-of-attack, especially when that plan-of-attack is used repeatedly. This might be obvious, but the word methodology is related to the word method. In fact, a methodology is a system of methods followed consistently. Scientists, for example, use various methodologies as they perform experiments. It might seem like the world is nothing but chaos and disorder. But sometimes there is a method to this madness. And sometimes there is a methodology.

In this chapter, there will be a lot of information about the process and journey throughout the making of our final project. There will be flow chart showing the process of us making the whole project. This flow chart will explain the processes we took. Next, is the Gantt Chart, which will show the actual and planning throughout all the 13 weeks of our final year project journey. However, in this chapter, we also will show 3 methods we researched to carry our final year project. Although, these 3 methods have its own pros and cons and it will be explained individually by the teammates.

In our project, we are using this Tri-Star wheel (Mr. Carry) arrangement in a hand trolley in the place of normal wheels setup to enable the trolley to climb up. Down the staircases and to up come small obstacles like holes and bumps on its path. Among those 3 methods are gas cutting, pipe bending and welding. Most common way of making Mr. Carry is by using the method of welding. This method has a lot of advantages and disadvantages. Hence, in this chapter we will discuss about these 3 methods and which one we chosen

### 3.2 FLOW CHART

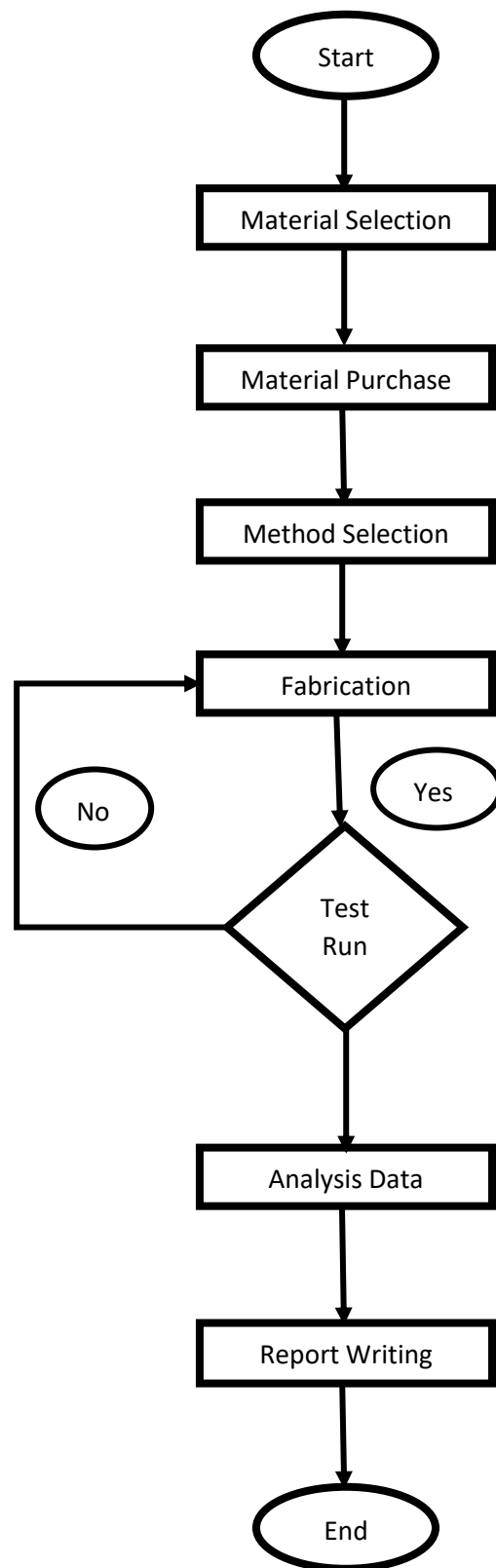


Figure 3.2.1 – Flow Chart

### 3.3 FLOW CHART EXPLANATION

- **Material Selection**

The process of material selection is one of the most important process in this final year project. The main factor of material selection is to discuss and finalized which materials that will be use in the project to avoid wasting of money and time. The material selection needs to be done precisely so that the risks could be avoided.

#### **TROLLEY BODY**

- Material Used- **Mild Steel**



Figure 3.3.1- Mild Steel

Mild Steel Mild steel, also called as plain-carbon steel, is the most common form of steel because its price is relatively low while it provides material properties that are acceptable for many applications, more so than iron. Low-carbon steel contains approximately 0.05–0.3% carbon making it malleable and ductile. Mild steel has a relatively low tensile strength, but it is cheap and malleable; surface hardness can be increased through carburizing. It is often used when large quantities of steel are needed, for example as structural steel. The density of mild steel is approximately 7850 kg/cm<sup>3</sup> and the Young's modulus is 210 GPa (30,000,000 psi).

## **TRI-STAR WHEEL WEB**

- Material Used- **Stainless Steel Grade 304**

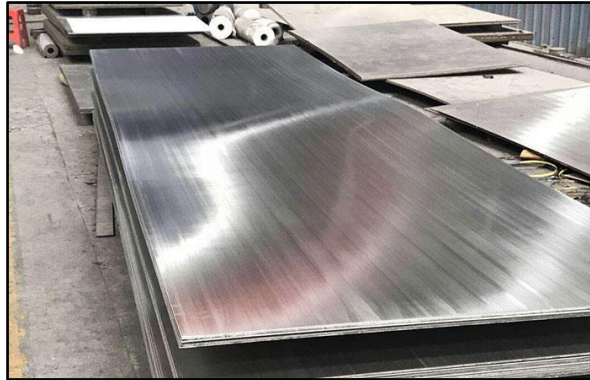


Figure 3.3.2- Stainless Steel Grade 304

Steel Type 304 is a variation of the basic 18-8 grade, Type 302, with a higher chromium and lower carbon content. Lower carbon minimizes chromium carbide precipitation due to welding and its susceptibility to intergranular corrosion. In many instances, it can be used in the “as-welded” condition, while Type 302 must be annealed to retain adequate corrosion resistance. Type 304L is an extra low-carbon variation of Type 304 with a 0.03% maximum carbon content that eliminates carbide precipitation due to welding. As a result, this alloy can be used in the “as-welded” condition, even in severe corrosive conditions. It often eliminates the necessity of annealing elements except for applications specifying stress relief. It has slightly lower mechanical properties than Type 304.

## **BEARING SELECTION**

- **Ball bearing**



Figure 3.3.3- Ball Bearing

A ball bearing is a type of rolling-element bearing that uses balls to maintain the separation between the bearing races. The purpose of a ball bearing is to reduce rotational friction and support radial and axial loads. It achieves this by using at least two races to contain the balls and transmit the loads through the balls. In most applications, one race is stationary and the other is attached to the rotating assembly. As one of the bearing races rotates it causes the balls to rotate as well. Because the balls are rolling, they have a much lower coefficient of friction than if two flat surfaces were sliding against each other. Selecting a ball bearing with minimum inner diameter of 30mm, minimum load carrying capacity of 50kg radially and speed greater than 100rpm.

### **Bearing Selected - SKF 6006 Open Deep Groove Ball Bearing**

30x55x13mm

Inside Diameter: 30mm

Outside Diameter: 55mm

Width: 13mm



This 6006-2RS 30x55x13-millimeter sealed ball bearing has deep groove geometry for high speeds and supporting both radial and axial loads. This bearing has rubber seals on both sides of the bearing to keep lubricant in and contaminants out and comes pre-lubricated from the manufacturer so that no additional lubrication is required. This deep groove sealed ball bearing is for use in applications that involve combined radial and axial loads, and a need for high running accuracy at high rotational speeds. Such applications include clutches, drives, gearboxes, compressors, pumps, turbines, and printing and textile machines, among others.

### **WHEEL SELECTION**



Figure 3.3.4- Trolley Wheel

#### **Filled rubber**

- In tires rubbers are usually filled with particles like carbon black or silica. They consist of a tread and a body.
- The tread is the part of the tire that meets the road surface. The portion that is in contact with the road at a given instant in time is the contact.
- Treads are often designed to meet specific product marketing positions.

## **Polyurethane**

- Polyurethane (PUR and PU) is a polymer composed of a chain of organic units joined by carbonate (urethane) links.
- While most polyurethanes are thermosetting polymers that do not melt when heated, thermoplastic polyurethanes are also available.
- The main ingredients to make polyurethane are isocyanides and polyols.
- Other materials are added to help processing the polymer or to change the properties of the polymer.

## **Steel**

- Steel is an alloy of iron, with carbon being the primary alloying element, up to 2.1% by weight. Carbon, other elements, and inclusions within iron act as hardening agents that prevent the movement of dislocations that naturally exist in the iron atom crystal lattices.

- **Material Purchase**

The process of materials purchasing is crucial to collect and obtain all the materials needed. In this process a lot of research on the places and suppliers that the materials are going to be purchased is done. This step is important so that the risk of material wasting, or money-loss will not happen. However, to carry out material purchasing, a well-made purchasing plan needed to be made. First, the suppliers will be contacted to make sure the availability of the materials. Then, the calculation of the amount of materials needed and the price of the materials. After that, surveys of price must be carried out to determine the better selling prices. Then finally, the purchases could be made.

- **Method Selection**

- **Gas cutting (Oxy-Fuel cutting)**



Figure 3.3.5- Oxy Cutting

Oxy-fuel cutting is a cost-effective method of plate edge preparation for bevel and groove welding. It can be used to easily cut rusty and scaled plates and only requires moderate skill to produce successful results. The oxy-fuel gas cutting process creates a chemical reaction of oxygen with the base metal at elevated temperatures to sever the metal. We have used this cutting to cut the measured lengths of hollow mild steel pipes and flat bottom plate as per our design.

- **Pipe bending**



Figure 3.3.6- Rectangular Pipe Bending

Tube bending as a process starts with loading a tube into a pipe bender and clamping it into place between two dies, the clamping block, and the forming die. The tube is also loosely held by two other dies, the wiper dies, and the pressure die. The process of tube bending involves using mechanical force to push stock material pipe or tubing against a die, forcing the pipe or tube to conform to the shape of the die. Often, stock tubing is held firmly in place while the end is rotated and rolled around the die. For some tube bending processing, a mandrel is placed inside the tube to prevent collapsing. Much of the tooling is made of hardened steel or tool steel to maintain and prolong the tools life. However, wherever there is a concern of scratching or gouging the work piece, a softer material such as aluminium or bronze is utilized. Pipe bending machines are typically human powered, pneumatic powered, hydraulic assisted, hydraulic driven or electric servomotor. We have employed human powered tube bending process to bend two mild steel hollow pipes to make 60° bent handles.

- **Welding**



Figure 3.3.7- MIG Welding

Welding is a fabrication process that joins materials, usually metals or thermoplastics, by causing coalescence. This is often done by melting the work pieces and adding a filler material to form a pool of molten material (the weld pool) that cools to become a strong joint, with pressure sometimes used in conjunction with heat, or by itself, to produce the weld.

This is in contrast with soldering and brazing, which involve melting a lower melting-point material between the work pieces to form a bond between them, without melting the work pieces. Many different energy sources can be used for welding, including a gas flame, an electric arc, a laser, an electron beam, friction, and ultrasound.

While often an industrial process, welding may be performed in many different environments, including open air, under water and in outer space. Welding is a potentially hazardous undertaking and precautions are required to avoid burns, electric shock, vision damage, inhalation of poisonous gases and fumes, and exposure to radiation. The main Types of welding used in industry and by home engineers are commonly referred to as MIG welding, Arc welding, Gas welding and TIG welding. We have use MIG welding in welding all the rectangular hollow section as the body of our project.

- **Fabrication**

- Cutting

- I. First, we cut the rectangular hollow section (1\*1 inch) according the measurement that we sketched to create the trolley body parts.
- II. Then, we start to cut the rectangular hollow section ( $1\frac{1}{4}\times 1\frac{1}{4}$  inch) according to the length and create a base and with the use of (1\*1 inch) rectangular hollow section, we created an adjustable base.
- III. We also did 2 holes at back and front of the base as to fix the centre column lock knob where the user can adjust the base and make the base did not move again with tight the lock knob that we fix inside the holes at the base.
- IV. We used the cutting process again to cut the S.S Grade 304 plate to create 4 tri-shaped wheel web and make 3 holes to install the trolley wheels and 1 hole at middle of it for sharp installation.

### Bending

- I. We also used the process of bending where we create a 135 ° degree between the handle and base part of trolley body.

### Welding

- I. We started to do welding process where we weld all the trolley body together. We use the MIG welding as we can get high quality welds much faster. We also did polish process on the welded place to make it clean.
- II. We also did weld for the tri-wheel web as to attach it with sharf and then weld the main gear at middle of the sharf.
- III. We also weld the place where we will keep the motor and battery (back of trolley).
- IV. We used weld to join a small sharf with the motor and then weld the small gear at the end of small sharf.

### Installation

- I. We use a viper motor which is 12V and 30Nm torque to be install in our trolley as to reduce human effort.
- II. With the use of wire connection, we connect the battery with switch and then to motor.
- III. We arrange the excess wire correctly as to make our project neat and fix chain within the main gear and small gear.

### Finishing and Cleaning

- I. We did the polishing process as we polish all the weld parts and some other parts as it will look neat and smooth.
- II. We also fix the rubber shoe for rectangular hollow section as the sharp end of it will not be danger to user.
- III. We also got use sandpapers to make the adjustable parts smooth as it will make the sides go in and out easily.

- **Test Run**

Test run is carried out to determine the strength and result of the product. In this test run, we test whether the motor is function or not and could carry the empty trolley up the stairs. After that, we try to put some load which is 5kg as it could carry it up the stairs and then we increased the weight until 40kg. At the end, we found that the increase in load will make the movement of trolley slow to claim up the stairs.

- **Analysis Data**

The process of evaluating data using analytical and logical reasoning to examine each component of data provided. This form of analysis is just one of the many steps that must be completed when conducting a research experiment. Data from the test run is gathered, reviewed and the analysed to form findings, discussions, and conclusion. In this project the data collection is collected from the tensile strength of the material we created.

- **Report Writing**

Report writing is one of the most crucial steps in every project invented. It is important to make a report based on the project, test run and analysis so that future improvements nor expansion of knowledge could be done. Our report writing is based on the analysis and findings that we collected throughout this whole process of completing this project.

### 3.4 Interview and research

We did a questionnaire using the help of google form to see what the 40 respondents say about the machine Mr. Carry. From the responses we gain, most of the respondents want a machine to carry things up and down the stairs. The age group that supports the survey is between 19 to 21 years old. For additional, the male group which 65% votes 'yes' for supporting the Mr. Carry compare to female which are 35%. Through the survey, we get to know that 62.5% of 40 respondents voted yes for those having problems to carry things such as cupboard up or down the stairs. Lastly, we got to know 67.5% of 40 respondents think the use of a machine that carries things in stairs can reduce the case of damage impact to the load or themselves instantly.

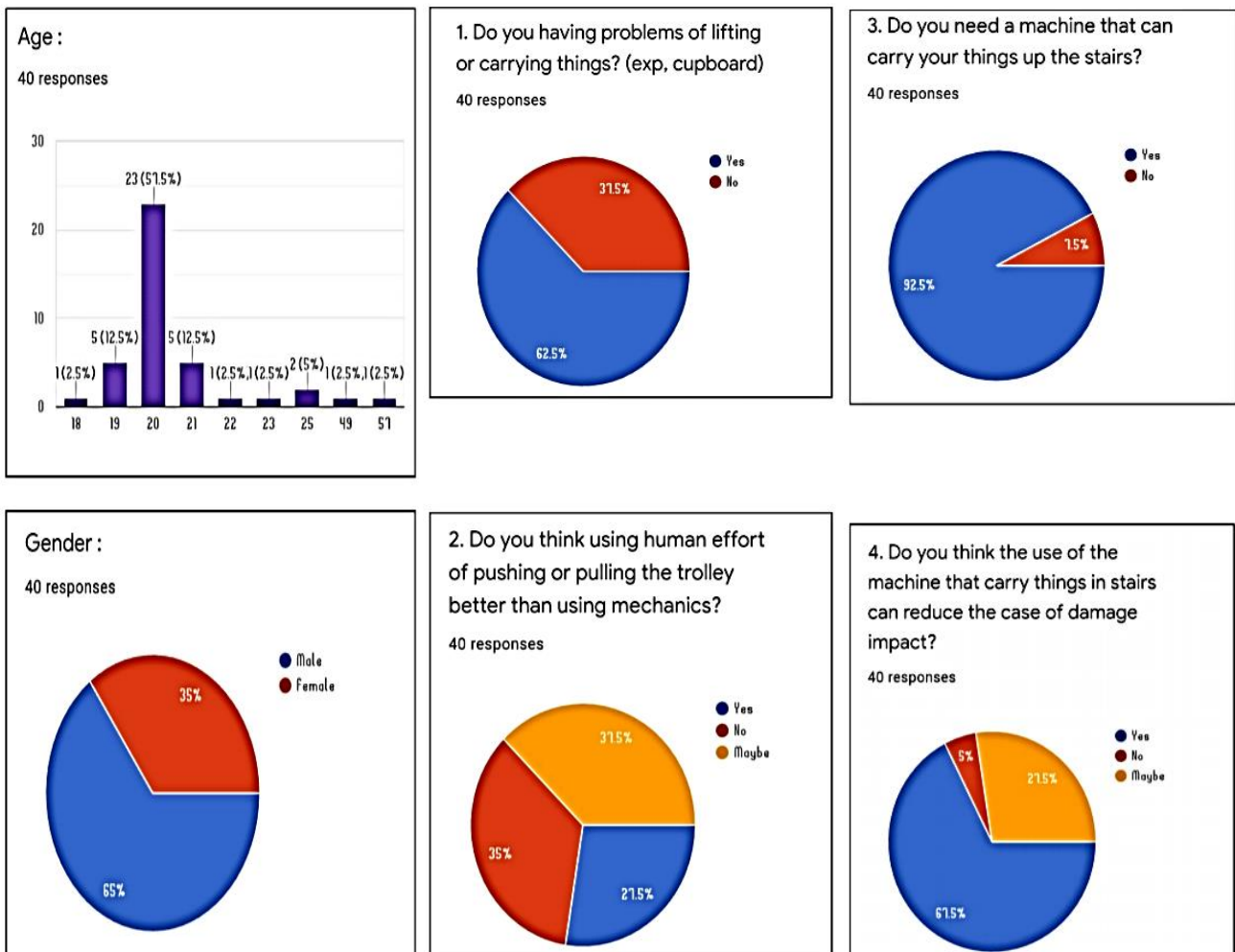


Figure 3.4.1- Questionnaire charts



### 3.5 PRODUCT DESIGN

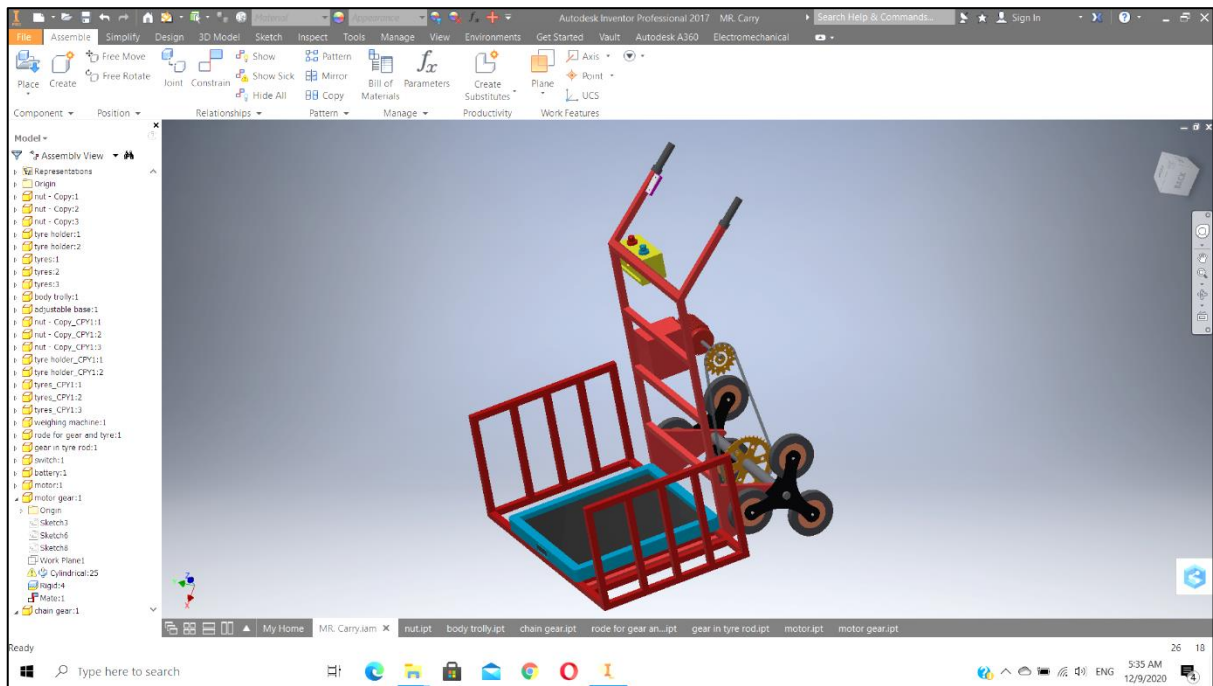


Figure 3.5.1 – Inventor 2017 Design

Alphabet	Name
A	ON/OFF BUTTON SWITCH
B	BATTERY (POWER SUPPLY)
C	GEAR FOR MOTOR
D	ADJUSTABLE SIDES
E	MID NORMAL BASE
F	BOLT AND NUTS
G	TRI-SHAPE RIM HOLDER
H	RIM AND TYRES
I	MID ROD FOR TRI-SHAPE TYRES
J	GEAR FOR TRI-SHAPE TYRES
K	MOTOR

Figure 3.5.2 – Explanation of Components

### 3.6 OPERATIONAL METHODOLOGY

Prepared by Dinesh Kumar A/L Velayutham

- **Cutting**

Cutting is the division or opening of a physical entity, into two or more parts, by the application of an intensely directed force. We use this process to cut the rectangular hollow section to create the trolley body according to our measurement and used the same process to cut the Stainless-Steel Grade 304 plate to create the tri-shaped wheel web.

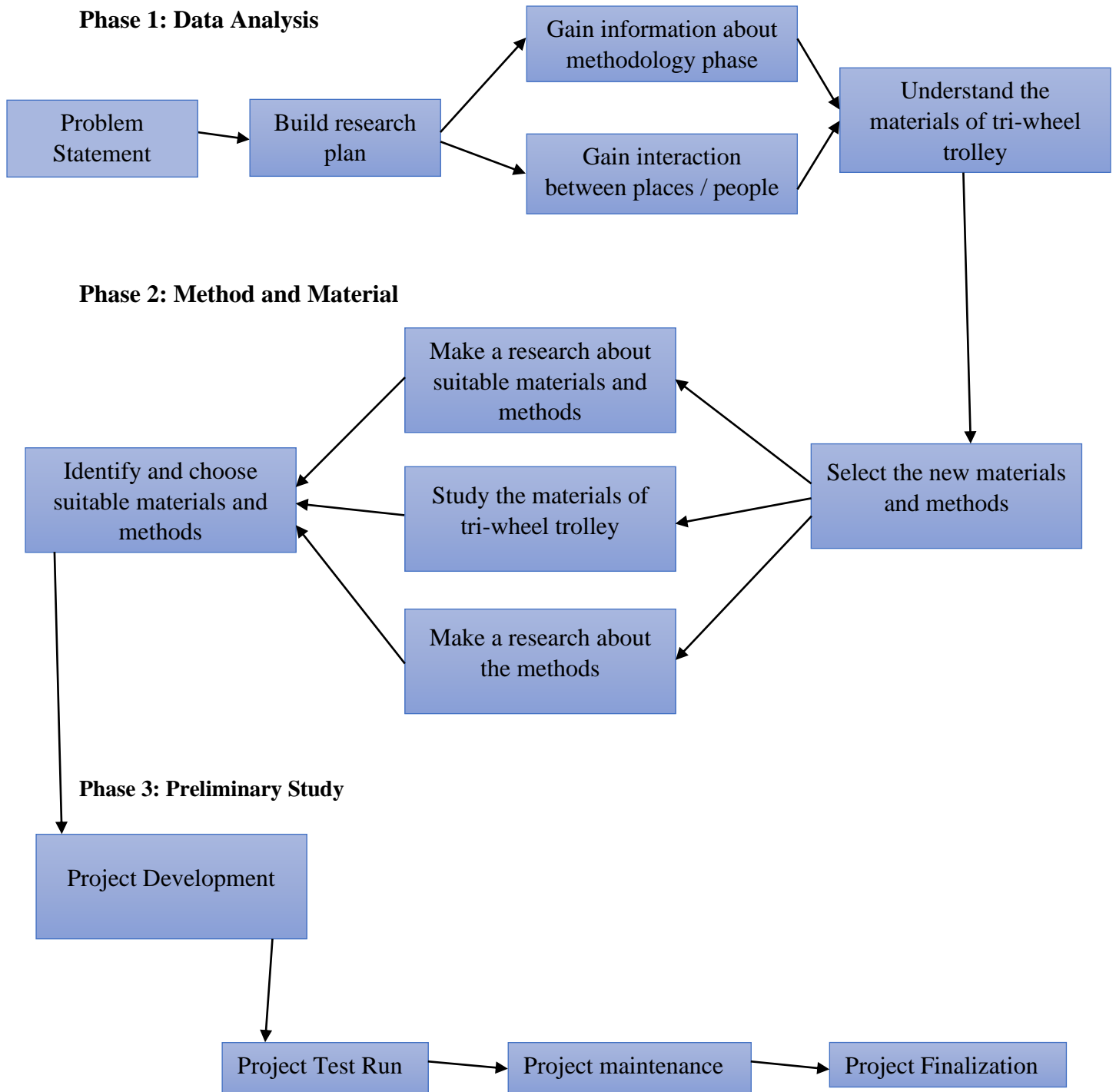
- **Welding**

Welding is a manufacturing process in which two or more components are fused together by means of heat, pressure, or both of which form a joint as cool part. We have used this process to we weld the rectangular hollow section to create the trolley body, weld the tri-shaped wheel web with sharf and weld the place where we keep the motor and battery. We also used the process of bending where we create a 135 ° degree between the handle and base part of trolley body.

- **Installation**

Strong working understanding of installation methods is essential for successful activity. Modern motors today involve analysis of all aspects of selection, application, and maintenance, as well as specifics of assembly, hardware and the interrelationship of components and materials. We have used the motor installation to our trolley as for reduce human efforts. The selection of motor type was difficult as we make a lot of research and found a viper motor which is 12V and 30Nm torque. Therefore, installation of these motor in an application is more significant than the time before.

### 3.7 METHODOLOGY PHASE



### 3.7 BUDGET CALCULATION

Prepared by, Dinesh Kumar A/I Velayutham

No	Materials / Equipment	Amount	Price
1.	Rubber Trolley Wheels	6 pieces	RM60
2.	Ball Bearing	4 pieces	RM50
3.	S.S Grade 304 (2*2 ft)	1 piece	RM52
4.	M.S Rectangular Hollow Section (1*1 inch)	12 meters	RM44
5.	Pipe Bending Cost	2 units	RM20
6.	M.S Rectangular Hollow Section (1 <sup>1</sup> / <sub>4</sub> *1 <sup>1</sup> / <sub>4</sub> inch)	6 meters	RM31
7.	Pipe and Plate Cutting Cost	34 unit	RM40
8.	Gear and Chain	3 units	RM40
9.	Sharf	2 unit	RM20
10.	Centre Column Lock Knob	4 pieces	RM24
11.	Rubber Shoe for Rectangular Hollow Section	10 pieces	RM5
12.	Bold and Nut	6 pieces	RM6
13.	Welding and Finishing Cost	-	RM60
14.	Motor, Wires, Switch and Battery	-	RM100
Total			RM552

Table 3.7.1

### 3.9 PROJECT ACTIVITY

project Activity	weeks													
	1	2	3	4	5	6	7	8	9	10	11	12	13	14
Briefing and Project Planning	Planning													
	Actual													
Project Design		Planning												
		Actual												
Material Selection			Planning											
			Actual											
Materials Purchase				Planning										
				Actual										
Method Selection					Planning									
					Actual									
Fabrication						Planning	Planning	Planning						
						Actual	Actual	Actual						
Test Run									Planning					
									Actual					
Analysis Data										Planning				
										Actual				
Report Writing											Planning			
											Actual			
Video and Slide making												Planning		
												Actual		
PITEX preparations													Planning	
													Actual	
PITEX presentation														Planning
														Actual

 Planning  
 Actual

### **3.9 SUMMARY**

As a conclusion, the methods implemented in this project are very crucial and important to complete the project. Thus, this project is agreed and accepted by Madam Isnuraini Binti Kassim @ Ismail, our team supervisor. The materials used in the project will create a benefit for the worker who having problems to carry things up or down the stairs. Though the initial cost of the project seemed to be higher but more accurate manufacturing would shorten this. As far the commercial aspects of this product are concerned, if this product can be fully automated and produced at a lower cost the acceptance will be unimaginable. However, this method will affect the result totally if one of the methods is change.

**CHAPTER 3 DONE BY,**

**DINESH KUMAR A/L VELAYUTHAM (08DMP18F1132)**

## **CHAPTER 4**

### **FINDING AND ANALYSIS**

#### **4.1 INTRODUCTION**

This chapter combines data and analysis of the 3-wheel hand truck (Mr. Carry). This data and analysis are especially important for this project because it is containing the discussion to achieve the objectives and scope of this project. This chapter analyse the advantages, disadvantages and comparisons between normal hand truck and the Mr. Carry. We used this data to, analyse every single possible to make it perfect and we did it.

#### **4.2 ADVANTAGES AND DISADVANTAGES**

Every project has its own pros and cons, the pros will help the people and the environment. However, the cons or the disadvantages must be improved or change for the future so that we could enhance the good and very efficient product that hardly to find disadvantage of the project. Besides of the advantages, this project also disadvantages that we must overcome it in the future for the better good.

##### **4.2.1 ADVANTAGES OF MR. CARRY**

Mr. Carry hand truck has more advantages compare to normal hand truck. Mr. Carry hand truck use less human effort compare to industrial hand truck which have in nowadays world market. Because of the motor installation to the wheels it reduced the human effort to lift the load. Also, because of motor installation this hand truck climbed the stairs faster with load. Other than that, can bring heavy loads on stairs such as heavy cartons, plastic cupboards with ease; this task become easier with the installation of 3(tri) wheel and motor.

Moreover, this Mr. Carry hand truck is perfectly balanced meanwhile the load is not slip or drop when climbing stairs or to lay the hand truck down horizontally. In addition, the vertical design allows us to easily lift and move tall option loads also can stacked up small items and carry multiple items at a time. Also, there is a capacity enlargement option by manually add up steels to bring and move loads which has long width loads or to bring multiple small items.

#### **4.2.2 DISADVANTAGE OF MR. CARRY**

Motor installation to the 3 wheels make a onetime movement for the whole set of wheels so this can make the steels become dent. To solve this problem, stronger and more stiffness of steel have been used in this project.

#### **4.2.3 DISADVANTAGES OF NORMAL 2 WHEEL HAND TRUCK**

Normal hand truck which is nowadays industrial market use more human effort to move the load using this hand truck and even more complicated to climb stairs with load. Other than that, it may cause serious injury due to unsafety situations and complication of bring load climbing up stairs. Also, lack of balance when climb stairs with load because do not have more than 2 wheels. Moreover, using this hand truck people in this industry are facing many difficult and hard consequences which is difficulties to move load or bring load climb up stairs. It will end up with serious back pain to this people in this industry where they will not be able to walk to a certain distance which will give pain to the lower spinal cord. These medical issues will be faced by the people when they hit above 40 or 50 years old.



### 4.3 COMPARISON TABLE

<b>MR. CARRY</b>		<b>NORMAL 2 WHEEL HAND TRUCK</b>
Less	<b>Human Effort</b>	More
3	<b>Number of Wheels</b>	2
Capacity enlargement	<b>Capacity of Load</b>	No capacity enlargement
Ease	<b>Stair Climber</b>	Difficult
More	<b>Load</b>	Less
Can	<b>Stack Small Items</b>	Can
More balance	<b>Balance</b>	Less balance in stairs
Yes	<b>Motor</b>	No

### 4.4 CHAPTER SUMMARY

As a conclusion for this chapter, the analysis and findings have been made. This Mr. Carry project have a lot of advantages however there are every cons to pros. Hence, the challenge is taken by us to bring more improvements and more developments based on the stiffness, power in which absolutely can help in the industrial field. Test run also carried out to determine the fullest potential and capability of Mr. Carry.

**CHAPTER 4 DONE BY,**

**JJIEVANES A/L JAYARETNAM (08DMP18F1170)**

## **CHAPTER 5**

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

#### **5.1 INTRODUCTION**

In this chapter it explains about discussion, conclusion, and upgrade plan all together for the project. From the data we collected from the test run of the project, the analysis has been done. Hence, the discussion from all the results of test run and analysis will be explained in this chapter. Then, the conclusion will be made based on the discussion, and upgrade plan that have been made.

#### **5.2 DISCUSSION**

Based on the data we collected, we admit that the fact we need to increase the motor capacity where it explains clearly need high volt of motor. This is because motor with high capacity can bring more load due to its power but most of the time a motor with high volt usually in big size. Whereas a big size of motor is usually more difficult to attach to the body of Mr. Carry which can make it unstable according to physics concept of stability.

It was found that the hand truck was moving well over the stair. It can move on flat surface without any fluctuation and there was no variation of speed oversteps. It was observed that there was extremely low noise and vibration over flat surface or stair. It was observed that the vehicle was disturbed when it faced the stair of different step sizes. This was because of the shape and size of the wheel frame. Therefore, for a range of stairs size can be considered for this hand truck. Although, different sizes step is not regularly available in building design. It showed good performance when the step size was uniform. From the test run of the Mr. Carry trolley it was seen that the maximum height the vehicle could climb the stair whose inclined angle was  $44^\circ$  maximum. If the inclination is more than  $44^\circ$  it would fail to climb the stair. In building construction, very few stairs are generally available having inclination more than that i.e.  $44^\circ$ .

The smooth ramp angle ( $\theta_s$ ) was not listed for the Mr. Carry. But it can be easily predicted that stair inclined angle ( $\theta$ ) is less than that of ramp ( $\theta_s$ ). Sometimes it cannot climb up stairs with more height. So, using a flat movement trolley which use as stair climber is better for all sized and range of stairs.

Example of flat movements stair climber:



Figure 5.2.1- Flat Movements Stairs Climber

Moreover, can state that the body of Mr. Carry trolley is too big which makes it heavier. To make it easier it can be folding body trolley which can save up space and can bring it to anywhere more easily. The velocity of the hand trolley during climbing the stair was higher than that on the flat surface as the wheel frame (higher radius) was used to climb stair. The velocity of the vehicle on the stair was 55 in/hr. However, the speed of the it is running on a ramp was not measured. This speed should not be higher or equal to the speed on the horizontal surface.

From the above discussion, it could be summarized that considering some of the limitations, the Mr. Carry trolley was an effective alternative to transport loads using stairs. Some limitations could not be avoided because of the lacking in technological availability. This pioneer project, with a little further improvement, was hoped to be succeeded to meet up the demand of carrying loads over the stair.

### **5.3 UPGRADE PLAN / RECOMMENDATION**

A sensor and steering wheel can be implemented to move around the stairs. Sensor and motor would be a replace of a manual power, which runs the frame wheel. A suspension system could be incorporated to minimize shock and vibration. Using a timer circuit, the movement would be more precise, accurate and easy to operate. With the help of timer circuits, the vehicle could run over a predetermined step size smoothly without using any switch. Single motor could be used to move over both the flat and tread of the stairs. It might be done by introducing an elongated shaft aligned with the wheel frame by using a spring, the shaft was resisted by an obstacle, and it forced the key to enter inside the notches of the frame. As a result, the whole frame was bound to rotate along the axis of the axle.

### **5.4 CONCLUSION**

Based on this project, it is confident to say that during the test run of this project, we were realized that it would be capable of carrying heavy load without suffering any deformation or local fractures. With applying our knowledge and hard work we have innovated a tri wheel hand truck in purpose to help workers in industrial side and we are also strongly believing it could achieve its purpose. Upgradation plan is highly recommended for future research to add up some new technologies. We discuss the upgradation plan after test run by theoretically. All the upgrades and improvements will be made so it could give more advantages and benefits. We tried to get rid of all the problems we stated in discussion and giving some upgradation idea. Last but not at least, we have faith that we successfully did Mr. Carry project. Hence, hope that this project could expand even more throughout all the upcoming generation to give its benefits in industrial are and to help many people in doing work.

**CHAPTER 4 DONE BY,**

**JJIEVANES A/L JAYARETNAM (08DMP18F1170)**

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