



DEPARTMENT OF MECHANICAL ENGINEERING

FINAL YEAR PROJECT

JUNE 2020

THE ADJUSTABLE TROLLEY

SUPERVISOR 'S NAME : Ts.NOORAZLAN BIN MOHD SAMSUDDIN

GROUP MEMBERS	MATRIX NUMBER
MAHAYUSYAFIQ BIN MAHAYUTDIN	08DKM18F1121
NORZUL AZRIE BIN NOZLAN	08DKM18F1199
MUHAMMAD AKMAL BIN ABD.SALIM	08DKM18F1098

POLITEKNIK SULTAN SALAHUDDIN  
ABDUL AZIZ SHAH

THE ADJUSTABLE TROLLEY

GROUP MEMBERS	MATRIX NUMBER
MAHAYUSYAFIQ BIN MAHAYUTDIN	08DKM18F1121
NORZUL AZRIE BIN NOZLAN	08DKM18F1199
MUHAMMAD AKMAL BIN ABD.SALIM	08DKM18F1098

A final report submitted to the Mechanical Engineering Department in fulfilment of the requirement for the award of the Diploma in Mechanical Engineering

Mechanical Engineering Department

June 2020

## **ACKNOWLEDGEMENT**

Alhamdulillah , in the name of Allah the most gracious and the most precious, first and foremost, I would like extend our deepest praise to Allah SWT who given us the patient, strength, determination that helping us to think wisely in making decision and courage to completed this project.I wish to express my sincere appreciation to my supervisor, Encik Noorazlan Bin Mohd Samsuddin, who has the substance of a genius: he convincingly guided and encouraged us to be professional and do the right thing even when the road got tough. Without his persistent help, the goal of this project would not have been realized.I wish to thanks all the friends and senior whose assistance was a milestone in the completion of this project with their experience and knowledge.To our parents truly appreciated.Without their support and funding,this project could not have reached its goals.

## **ABSTRACT**

Trolley is a mechanical device used to carry or transport the load at various points. For different kind of applications, we have to select specific type of trolley. To overcome the problem of specific task trolley, a new trolley was designed so that it can be used for more than field application. This paper contains the design and development of trolley on the basis of creativity skills to perform multiple functions. The trolley designed is the integration of airport trolley and shopping mall trolley. The design focuses on aesthetic, ergonomics, functions and costs. Most of the consumers uses trolleys by bending their bodies to put or lift the load from bottom. The objective of the study is to create a light and highly durable trolley that can ease workers, especially those who often lift heavy objects. Methodology that we use are literature, Design and Concept, Material purchased, Cost, Proposal lastly Presentation. We hope that this project will make consumer's life easier and get recognized by its functions and qualities. As for the improvement section, we plan to add weights measurement to the trolley so that it does not exceed the level that can be accommodated for our trolley project. Based on the result of the creation and completion of this project it was found that designed project will benefits for everyone as its help to use the technology more creatively. We hope by inventing this project would help more people to have an easy lifestyle in future.

TABLE OF CONTENTS

<b>CHAPTER</b>	<b>TITLE</b>	<b>PAGE</b>
CHAPTER 1	<b>INTRODUCTION OF PRODUCT</b> <ul style="list-style-type: none"><li>● 1.1 Introduction</li><li>● 1.2 Problem Statement</li><li>● 1.3 Objectives</li><li>● 1.4 Scope Of Project</li><li>● 1.5 Significant</li><li>● 1.6 Chapter Summary</li></ul>	
CHAPTER 2	<b>LITERATURE REVIEW</b> <ul style="list-style-type: none"><li>● 2.1 Introduction</li><li>● 2.2 History Of Trolley</li><li>● 2.3 Trolley By Using Hydraulic Jack</li><li>● 2.4 Comparison</li><li>● 2.5 Summary</li></ul>	
CHAPTER 3	<b>METHODOLOGY</b> <ul style="list-style-type: none"><li>● 3.1 Introduction</li><li>● 3.2 Project Design And Overview</li><li>● 3.3 Mechanical Advantages</li><li>● 3.4 Components And Materials Selections</li><li>● 3.5 Equipment Needed</li><li>● 3.6 Process Of Making It</li><li>● 3.7 Flow chart</li><li>● 3.8 Design Of Project</li><li>● 3.9 Summary</li></ul>	
CHAPTER 4	<b>RESULT AND PRODUCT ANALYSIS</b> <ul style="list-style-type: none"><li>● 4.1 Introduction</li><li>● 4.2 Analysis of survey</li><li>● 4.3 Advantages And Disadvantages</li><li>● 4.4 Fabrication And Installation Process</li><li>● 4.5 Testing And Demo</li></ul>	
CHAPTER 5	<b>CONCLUSION</b> <ul style="list-style-type: none"><li>● 5.1 Introduction</li></ul>	

	<ul style="list-style-type: none"> <li>● 5.2 Discussion</li> <li>● 5.3 Conclusion</li> <li>● 5.4 References</li> </ul>	
	<ul style="list-style-type: none"> <li>● Gantt chart</li> <li>● Costing</li> </ul>	

## Chapter 1

### Introduction Of Product

#### 1.1 Introduction

This section gives an overview about the project such as idea the project and the background of the project. The project title is Adjustable Trolley. This built of this project is to help people lift the loads more easier. We use the method of screw jack to lift the platform of the trolley so it can be adjusted.

Trolley are common form of transport in distribution environment for moving bulk loads. A very simple design offer basic flat platform with four casters and fixed handle which used to either push or pull the with the load on the platform. Without flat surface it becomes an open frame trolley and without a handle it is a bogie or dolly.

In our project Adjustable Trolley, it is will be more facilities for user to lift the loads on the platform. We come out with the idea of making the flat surface which can be got up by turn the screw jack. Our adjustable trolley also can be used as the table so it is multi features. So our trolley can turn into the table which is it can be used to put something weight. The examples are television, furniture and etc. It is also can be used for student to study. The advantages of our trolley it can give the comfort for student to study or revision anywhere.

#### 1.2 Problem Statement

The problems that exist in the current products have been identified as such most consumers of the trolley bend their bodies to put or lift the load from the bottom. With an Adjustable Trolley, the consumer can lift the load without bending their bodies. It is because this trolley can be adjusted in height by a screw jack. We put a screw jack in this trolley because we can help the consumer to ease their burden to carry furniture or heavy goods anywhere. The size is one of the problems we researched so our trolley size is not too big and easy to bring anywhere. The material is a common problem. We are looking for the material which can be used for a long term.

### **1.3 Objectives**

As objectives must be fully known and understood. After reviewing the objectives of the current trolley, we can be utilized to develop the trolley which can fulfill the requirement. The main objectives of the proposed trolley are as follows :

- I. We create a suitable size of the trolley
- II. Adjustable height
- III. The material durable
- IV. The adjustable trolley can be more facilities for user to lift the loads.
- V. The trolley can be used as a table.

### **1.4 Scope Of Project**

The scope of this project are about the improvement of function for this trolley. Which is the trolley we designed can be adjustable height. Next we made a lighter trolley but the trolley can afford the heavy goods on it. The improvement of materials also part of this scope which the material are strong, durable and could last for a long term with a good care. For example stainless steel can be resisted the fire and heat. PVC durable and more steadier and safe to work under the high load bearing condition. Then the adjustable trolley comfort the consumers to push and pull it. The adjustable trolley

can be used by all ages regardless of young or old. It is also can be used as the table for any good.

### **1.5 Significant**

The adjustable trolley will ensure a lot more secure trolley to the user. This project is very important for consumers easier to lift up the heavier load. Usually the consumer start lift up the load with bending their bodies. With this product, the consumer doesn't have to bending their bodies anymore. The innovation of this trolley is easier like bringing the trolley everywhere because its smaller than market trolley outside there. It also can assembly and easily to install or separated whenever to keep it . Furthermore, the materials of this trolley is very durable and can bring infinite loads. Finally, to comfort the consumer to pull or push the trolley, we add the sponge at the holder. Its soft and thick so the consumer will comfortable to use it.

### **1.6 Chapter Summary**

In this chapter, the studies was explained about its origin ideas and inspirations. All the objectives were made out of all the problem statements. The objectives of this project along with the importance for consumer and conformity in this project. The scope for this project only focusing at the adjustable, materials and comfort. Thus, this Adjustable Trolley very durable and long lasting.



## **Chapter 2**

### **Literature Review**

#### **2.1 Introduction**

A literature review means the survey of books, scholarly, articles and any other sources relevant to a particular issue. Area of research or theory and by so doing provides a description, summary, and critical evaluation of these works in relation to the search problem being investigated.

A trolley is a transport cart used to bring the loads, generally by push or pull the trolley. The platform used on some trolley are a plastic platform, because they allow the wheels and saddle to be easily removed. Unless such easily removable components are secured while the trolley is unattended, they are hard to moved..

To generate a better trolley, the adjustable trolley are becoming a good point of idea for the new era generation. It gives the user a more facilities to used and put any weight without worrying. Moreover, adjustable trolley is multi features can be used as a table for children to play or student for study.

## **2.2 History Of The Trolley**

Humans are beginning to realize that heavy objects can be easily moved or moved with round objects such as trees placed beneath them and moved by rolling them. The realization of this idea has given rise to snowboarding. The rudder is cut using a roller that only requires less energy to make a spin. On the trunk where the wheels rotate, the timber is used for repairing the wheel snowmobile where it is mounted on a roller to keep it moving and look like a wheelbarrow. Humans have become aware of the importance of the environment. The exchange or development is made by replacing the main wood material with metal such as mild steel to withstand heat as well as the durability of the product. Usually in terms of management and business of materials used to produce a trolley it has to be cheap and has a lot of durability to handle the load. To produce a lightweight, easy-to-use trolley, the easiest example to use is plastic.

However plastic is the main material of the cart with many disadvantages and is not suitable to be used as the main material of the cart because the plastic does not have high durability at high temperatures. So the main ingredient used today is iron. Certainly the trolley has various requirements for a tool to move heavy items and initially it only uses manpower, animals and water to lift the load. The idea of lifting the burden was dependent on the energy base in agriculture until the revolution in the 18th century where mechanical power was associated with an increase in lifting. In 1835, freight transport was introduced for the first time by a factory in England. The hydraulic lifting power used the water pressure which appeared in 1846. While the lifting power used the electric power in 1889, it was able to accelerate

Movement with the application of button presses and lever controls was discovered in 1894. The power of freight was known as its engine of mechanical advancement. Practically, the wheel is a method that has long been considered in terms of its own historical achievement. The first wheel ever produced was in the time of Mesopotamia. In its simplest form the wheel is a hardwood that is mounted and shaped in a circle where it is fastened with safety pin. The invention of the wheel was the turning point in the civilization of the day. It leads to more efficient use than the use of manpower in agriculture and other occupations by making mechanical inventions the most valuable tool in controlling the flow and direction of power and work. The use of wheels in modern and technological life is endless.

### 2.3 Trolley By Using Hydraulic Jack

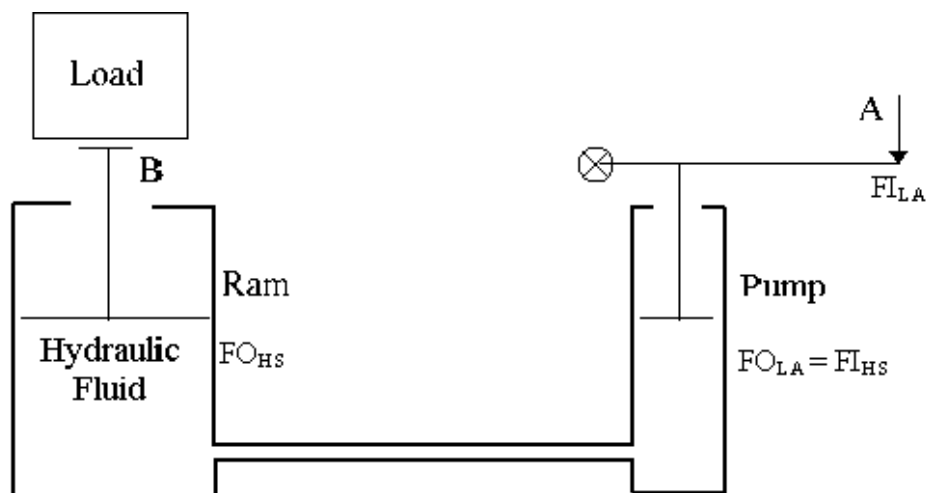


Figure 2.3

A hydraulic jack is a device that is used to lift heavy loads by applying a force via a hydraulic cylinder. A hydraulic jack creates pressure by moving oil through two cylinders via a pump plunger. The pump plunger is drawn back, which opens the suction valve and draws oil into the pump chamber. As the plunger is pushed down, the oil is transported through an external discharge valve and into the cylinder chamber. The

suction valve then closes, resulting in pressure being built up within the chamber; causing the piston in the chamber to rise and lift your heavy object

## **2.4 Comparison**

As a comparison the adjustable trolley are not using the hydraulic system. Our project is using the screw jack as a method for the lifting the platform. This give a futuristic design to our project and this is one of the differences between our project and other trolley out there. On the other hand, our adjustable trolley has a multi features so it can used as the table and even our trolley lighter it can afford the heavy mass. Compare to our adjustable trolley is the cheapest than the hydraulic. Adjustable trolley can be maintained by yourself without to worry about leaking or something else. Another advantage of our adjustable trolley is jack screws over some other types of jack is that they are self-locking, which means when the rotational force on the screw is removed, it will remain motionless where it was left and will not rotate backwards, regardless of how much load it is supporting. This makes them inherently safer than hydraulic jacks, for example, which will move backwards under load if the force on the hydraulic actuator is accidentally released.

## **2.5 Summary**

The different between the previous project and the new project are the method they are using to lifting the platform and the previous project. The new project that our group are going to make are using the bearing. This difference gives some advantage to our project. Bearings provide either a sliding or a rolling contact whenever relative

motion exists between parts of a machine. Sliding contact bearings are referred to as plain bearings and rolling contact bearings are often called anti friction bearings. Other than that, the previous project does not have the bearing. This will also be an advantage to our new project. The bearing will be easy to lift the platform. This is a very good thing to be added to the project. Other than that, the adjustable trolley will be a lot easy to carry.

## **Chapter 3**

### **Methodology**

#### **3.1 Introduction**

Methodology is a method that provides a systematic description of the flow of activities used to solve problems. The selection of methodologies in project development is an important aspect of ensuring that projects developed are implemented in a neat and systematic manner.

Research methodology is a very neat planning system. In order to facilitate this project, the methodology must be as well-structured as possible. As such, every step of the project will not be left out of the way. The end result of the study should be on the project issues to be resolved. Therefore, a high understanding of each process found in the methodological structure is very important.

Methodology also describes how a problem is studied and why a particular method and technique is used. The purpose of the methodology is to help better understand the application of the method by providing a description of the research process.

We will introduce the screw jack based on lifting the platform that we will use in this project. What is a screw jack? A jack screw or screw jack, is a type of jack that is operated by turning a leadscrew. It is commonly used to lift moderately heavy weights, such as vehicles; to raise and lower the horizontal stabilizers of aircraft; and as adjustable supports for heavy loads, such as the foundations of houses.

How does it work? A screw jack consists of a heavy-duty vertical screw with a load table mounted on its top, which screws into a threaded hole in a stationary support frame with a wide base resting on the ground. A rotating collar on the head of the screw has holes into which the handle, a metal bar, fits. When the handle is turned clockwise, the screw moves further out of the base, lifting the load resting on the load table. In order to support large load forces, the screw is usually formed with acme threads.

In our adjustable trolley to support lifting the platform, we need bearing to assist the screw jack. Bearing is useful because bearings are "parts that assist objects' rotation". They support the rotating shafts of the wheels, gears, turbines, rotors, etc. in those machines, allowing them to rotate more smoothly. This item will reduce friction and make rotation more smooth. This cuts down on the amount of energy consumption. Other than that, it will protect the part that supports the rotation, and maintain the correct position for the rotating shaft. This function of bearings is what allows us to use our machines over and over again for an extended period of time. It is vital to the development of machine technology that we continue going forward to develop bearings that can work under ever harsher and more specialized conditions.

### 3.2 Project Design And Overview

This project main function is to develop the facilities and easily method and having a jack system that are using the man power as the method to lifting the platform as shown in Figure 3.2.



Figure 3.2

### 3.3 Mechanical Advantages

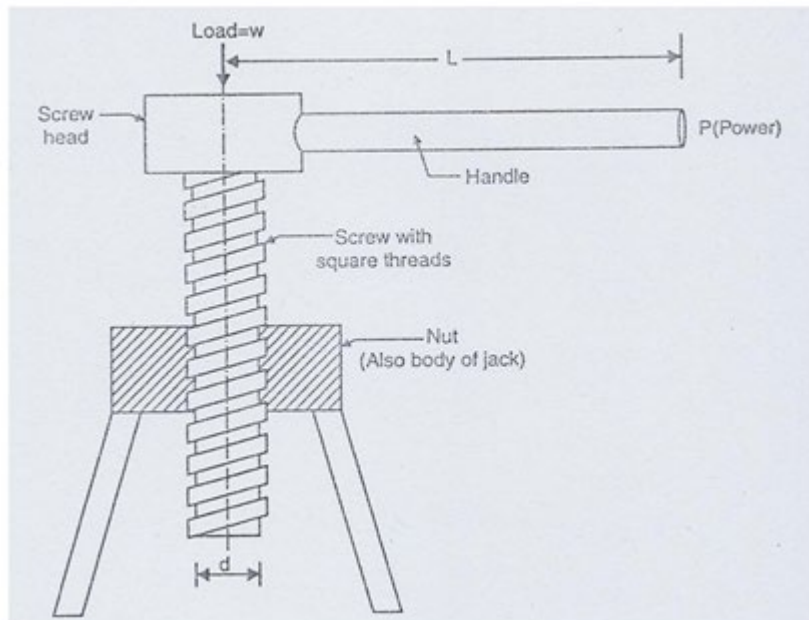


Figure 3.2

The ideal mechanical advantage of a screw jack, the ratio of the force the jack exerts on the load to the input force on the lever ignoring friction is

Where:

**Fload** is the force the jack exerts on the load.

**Fin** is the rotational force exerted on the handle of the jack

**r** is the length of the jack handle, from the screw axis to where the force is applied

**l** is the lead of the screw.

The screw jack consists of two simple machines in series; the long operating handle serves as a lever whose output force turns the screw. So the mechanical advantage is increased by a longer handle as well as a finer screw thread. However, most screw jacks have large amounts of friction which increase the input force necessary, so the actual mechanical advantage is often only 30% to 50% of this figure



### 3.4 Components And Materials Selections

#### Bearing



Figure 3.4.1

Bearings are "parts that assist objects' rotation". They support the rotating shafts of the wheels, gears, turbines, rotors, etc. in those machines, allowing them to rotate more smoothly. This item will reduce friction and make rotation more smooth. This cuts down on the amount of energy consumption. Other than that, it will protect the part that supports the rotation, and maintain the correct position for the rotating shaft. This function of bearings is what allows us to use our machines over and over again for an extended period of time. It is vital to the development of machine technology that we continue going forward to develop bearings that can work under ever harsher and more specialized conditions.

#### Threaded Rod



Figure 3.4.2

Threaded Rod Stud are used in all types of applications. They can be welded to a flat surface, or to the inside or outside of an angle. The materials used are mild steel, stainless steel, alloy steel and copper. The threaded rods are used for general purpose fastening for anything from an anchor bolt to a through bolt

## **Wheel**



Figure 3.4.3

Heavy-duty casters can handle loads from 2,000 to 44,000 pounds. Heavy-duty casters are often used in manufacturing plants, warehouses, and on other large objects that require mobility. These casters are essential for the successful operation of many kinds of material handling equipment, and have many additional uses in manufacturing and industrial settings.

## **Platform**



Figure 3.4.4

Wood is of course a long-lasting and robust material and is the perfect choice for anyone looking for longevity

## Hollow Steel



Figure 3.4.5

A hollow structural section (HSS) is a type of metal profile with a hollow cross section. HSS can also be used as beams, although wide flange or I-beam shapes are in many cases a more efficient structural shape for this application. However, the HSS has superior resistance to lateral torsional buckling.

The flat square surfaces of rectangular HSS can ease construction, and they are sometimes preferred for architectural aesthetics in exposed structures, although elliptical HSS are becoming more popular in exposed structures for the same aesthetic reasons.

## Screw And Nuts






Figure 3.4.6

Nut is a type of fastener with a threaded hole. Nuts are almost always used in conjunction with a mating bolt to fasten multiple parts together. The two partners are kept together by a combination of their threads' friction (with slight elastic deformation), a slight stretching of the bolt, and compression of the parts to be held together.

### 3.5 Equipment Needed

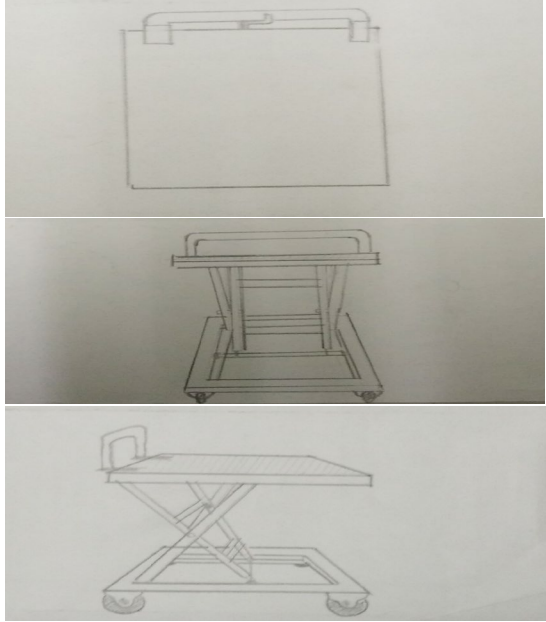


Table 1: Equipment item we use for making project

	<p>Chop Saw</p>
	<p>Measuring tape</p>
	<p>TIG Welding</p>

 A blue and black Makita angle grinder with a black grinding disc attached to the front. The Makita logo is visible on the side of the tool.	<p>Grinder</p>
 A blue Bosch hand drill with a silver drill bit inserted into the chuck. The Bosch logo is visible on the side of the handle.	<p>Hand Driller</p>
 A hand saw with a yellow and black handle and a silver blade with a serrated edge. The blade has some text on it, including "18cm" and "180mm".	<p>Hand Saw</p>

### 3.6 Process Of Making It

Table 2: Process for making it.

	<p>First of all, make a rough drawing of the cart. Then measure &amp; mark all the ingredients and cut them to the size you want. Then roll up the sharp edges after cutting all the material to remove any burr and make a chamfer so that the welding material is quickly filled at the joint and it will be very good for welding.</p>
	<p>Step-by-step welding angle When welding, the angle channel should be 90 degrees. Then weld 2 irons to make it a T. Link to the other segment in order to form a rectangle</p>
	<p>This approach is illustrated after the material has been welded. We made a device with a thread along the nuts at the end of the iron end so that the trolley could be flexible. We also add some small bearing and big bearing at the end of steel</p>

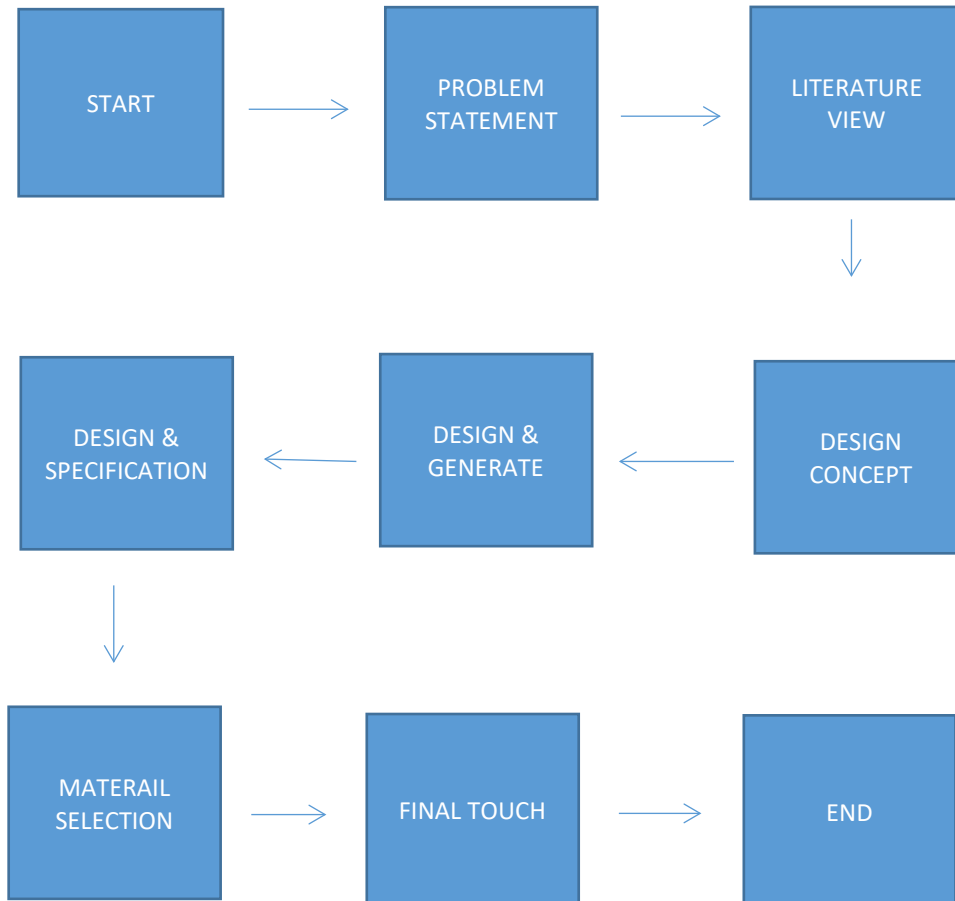


Next, weld the wheel to the bottom of the trolley so that it is possible to shift this trolley. Do the same process on various sides



Finally, on top of the trolley, we put a wooden table so it could be a surface where things could be placed. The bottom of the table is also welded so that it can be securely connected to the trolley. Adding wide bearings to allow the trolley's movement

### 3.7 Flow Chart





### 3.9 Design Of Project



Figure 3.9.1



Figure 3.9.2



Figure 1.9.3



Figure 3.9.4



Figure 3.9.5

### 3.10 Summary

Adjustable trolley will be using the screw jack module as the based to lifting the platform. This ensure the jack system of the adjustable trolley. Other than that, the bearing as the assist to lift up the platform.

## Chapter 4

### Result And Product Analysis

#### 4.1 Introduction

"Ergonomics is the scientific discipline concerned with understanding human interactions and other elements of a system, and the profession that applies theory, principles, data and methods to design in order to optimize human well-being and overall performance of the system." International Ergonomics Association.

Ergonomics is a discipline focused on research that puts together expertise from the field of ergonomics. Ergonomists and human factors experts strive to consider how a product, workplace or structure can be built to accommodate the individuals who need to use it rather than requiring people to conform to a design that requires them to work in an inconvenient, stressful or unsafe way.

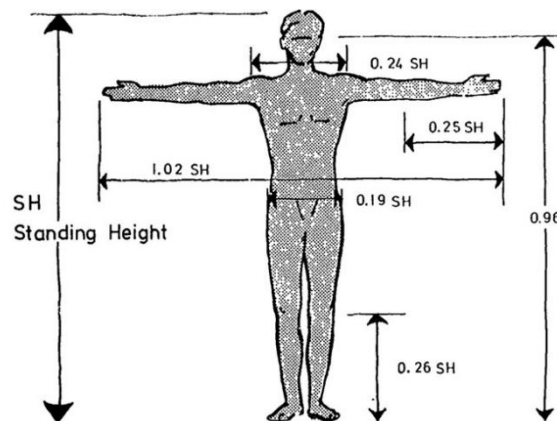


Figure 4.1.1

Ergonomics is that the process of designing or arranging workplaces, products and systems in order that they fit the people that use them.

Most people have heard of ergonomics and think it's something to try to do with seating or with the planning of car controls and instruments – and it is... but it is so much more. Ergonomics applies to the planning of anything that involves people – work spaces, sports and leisure, health and safety.

Ergonomics (or ‘human factors’ because it is mentioned in North America) may be a branch of science that aims to find out about human abilities and limitations, then apply this learning to enhance people’s interaction with products, systems and environments.

To minimize the risk of injury or damage, Ergonomics seeks to enhance workspaces and environments. So as technologies are evolving, so too is the need to ensure that the instruments we access for work, rest and play are built to meet the requirements of our body.

Why is Ergonomics important?in the workplace: The overall economic cost of job-related accidents and illnesses is projected to be \$60 billion dollars, according to Healthy Work Australia. Latest research has shown that lower back pain is the most prevalent work-related impairment in the world, affecting office workers, construction sites and agriculture in the highest risk group.

Ergonomics seeks to build secure, comfortable and efficient workspaces through the design of a workplace by taking human skills and limitations, The body size, weight, ability, speed, sensory abilities (vision, hearing), and even attitudes of the person are included.

In the wider population: The number of people aged 75 and over in Australia is estimated to double over the next 50 years. This will include equipment, services and structures designed to meet the rising needs of the elderly population, including public transit, building facilities and living spaces.

### **How does Ergonomics work?**

Ergonomists use the data and methods of many disciplines to achieve best practice design:

Anthropometry: body types, forms, populations and differences

Biomechanics: gears, muscles, powers, strength

Environmental physics: sound, light, heat, cold, radiation, body systems for vibration: hearing, vision, sensation.

Applied psychology: ability, learning, mistakes, distinctions

Social psychology: culture, engagement, learning, actions.

### **Lower back pain**

Low back pain (LBP) and accidents due to manual lifting practices appear to be one of preventive medicine's leading occupational health and safety concerns. Despite control measures, including interventions targeted at both employees and employment, back injuries associated with work still account for a significant proportion of human suffering and economic costs to this country.. The scope of the problem was summarized in a report entitled Back Injuries, prepared by the Department of Labor's Bureau of Labor Statistics {DOL(BLS)}, Bulletin 2144, published in 1982.

The DOL's conclusions are consistent with current workers' compensation data indicating that "injuries to the back are one of the more common and costly types of work-related injuries" (National Safety Council, 1990). According to the DOL report, back injuries accounted for nearly 20% of all injuries and illnesses in the workplace, and nearly 25% of the annual workers' compensation payments. A more recent study by the National Safety Council (1990) found that the most common cause of workplace injury was over-exertion, accounting for 31 percent of all injuries. The back, moreover, was the body part most frequently injured (22% of 1.7 million injuries) and the most costly to workers' compensation systems.

More than ten years ago, the National Institute for Occupational Safety and Health (NIOSH) recognized the growing problem of work-related back injuries and published the Work Practices Guide for Manual Lifting (NIOSH WPG, 1981).

A review of the lifting-related literature prior to 1981 was included in the NIOSH WPG (1981); analytical procedures and a lifting equation for determining a prescribed weight for specified two-handed symmetrical lifting tasks; and an approach to manual lifting to manage the hazards of low back injury. The hazard management method was coupled with the Action Limit (AL), a consequent term denoting the recommended weight derived from the lifting equation.

In 1985, the National Institute for Occupational Safety and Health (NIOSH) convened an ad hoc committee of experts who reviewed the current literature on lifting, including the NIOSH WPG (1981). (1) The analysis of the literature was summarized in a paper entitled Documentation on Scientific Support for the Updated 1991 NIOSH Lifting Equation: Technical Contract Reports, 8 May 1991, accessible from the National Technical Information Service {NTIS No. PB-91-274-226}. Updated details on the physiological, biomechanical, psychophysical, and epidemiological dimensions of manual lifting is included in the literature review. The ad hoc committee recommendations, based on the conclusions of the literature review, were publicly presented in 1991 by NIOSH staff at a national conference in Ann Arbor, Michigan entitled A National Strategy for Occupational Musculoskeletal Injury Prevention -- Implementation Issues and Research Needs. (2) The documentation for the equation was subsequently developed by NIOSH workers and played a prominent role in proposing methods for interpreting the lifting equation results.

The revised lifting equation reflects recent results and offers methods for determining asymmetrical lifting activities and lifting items with less than ideal relations between the object and the hands of the worker. The revised lifting equation also presents recommendations for a variety of lifting activities that are more diverse than the previous equation (NIOSH WPG, 1981).

According to the Bureau of Labor Statistics, in 2010 there were over 500,000 workplace injuries involving back injuries and other sprains, strains and tears?

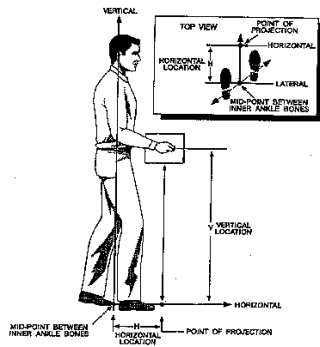


Figure 1 Graphic Representation of Hand Location

OSHA defines ergonomics as the science of fitting workplace conditions and job demands to the capabilities of the working population. Common examples of ergonomic risk factors are found in jobs requiring repetitive, forceful, or prolonged

Figure 4.1.2

exertions of the hands; frequent or heavy lifting, pushing, pulling, or carrying of heavy objects; and prolonged awkward postures

Finally, it should be emphasized that in a systematic attempt to avoid work-related low back pain and impairment, the NIOSH lifting equation is just one instrument. {Other preventive methods are outlined elsewhere (ASPH/NIOSH, 1986)}. Lifting, however, is only one of the causes of low back pain and impairment associated with work. Other causes which have been hypothesized or established as risk factors include whole body vibration, static postures, prolonged sitting, and direct trauma to the back. Psychosocial factors, appropriate medical treatment, and job demands (past and present) also may be particularly important in influencing the transition of acute low back pain to chronic disabling pain.

### **Lifting Task Limitations**

The lifting equation is a tool for assessing the physical stress of two-handed manual lifting tasks. As with any tool, its application is limited to those conditions for which it was designed. Specifically, the lifting equation was designed to meet specific lifting-related criteria that encompass bio-mechanical, work physiology, and psycho physical assumptions and data, identified above. To the extent that a given lifting task accurately reflects these underlying conditions and criteria, this lifting equation may be appropriately applied.

The following list identifies a set of work conditions in which the application of the lifting equation could either under- or over- estimate the extent of physical stress associated with a particular work-related activity. Each of the following task limitations also highlight research topics in need of further research to extend the application of the lifting equation to a greater range of real world lifting tasks.

1. The revised NIOSH lifting equation is based on the assumption that manual handling activities other than lifting are minimal and do not require significant energy expenditure, especially when repetitive lifting tasks are performed. Examples of non-lifting tasks include holding, pushing, pulling, carrying, walking, and climbing. If such non-lifting activities account for more than about 10% of the total worker activity, then measures of workers' energy expenditures and/or heart rate may be required to assess the metabolic demands of the different tasks. The equation will still apply if there is a small amount of holding and carrying, but carrying should be limited to one or two steps and holding should not exceed a few seconds

### **Definition and Measurement**

Horizontal Location (H) is measured from the mid-point of the line joining the inner ankle bones to a point projected on the floor directly below the mid-point of the hand grasps (i.e., load center), as defined by the large middle knuckle of the hand (Figure 1).

Typically, the worker's feet are not aligned with the mid-sagittal plane, as shown in Figure 1, but may be rotated inward or outward. If this is the case, then the mid-sagittal plane is defined by the worker's neutral body posture as defined above.

If significant control is required at the destination (i.e., precision placement), then H should be measured at both the origin and destination of the lift.

Horizontal Location (H) should be measured. In those situations where the H value can not be measured, then H may be approximated from the following equations:

Metric	US Customary
{All distances in cm}	{All distances in inches}



-----  
 $H = 20 + W/2$

for  $V \Rightarrow 25$  cm

-----  
 $H = 8 + W/2$

for  $V \Rightarrow 10$  inches

$H = 25 + W/2$

for  $V < 25$  cm

$H = 10 + W/2$

for  $V < 10$  inches

## 4.2 Analysis of survey

Construction sites are known to be one of the most dangerous areas for human health and safety. In developing countries, enforcement of safety rules are often negligible to minimize occupational injuries and illnesses. As the result, work related injuries are very rampant. Ethiopia is currently one of the developing countries where rapid growth is observed in the construction industry. However, in these industries, the incidence of injuries can vary from place to place and even by business. The present study assessed the prevalence of injury and associated factors among building construction workers in southwestern Ethiopia. Institutional based cross-sectional study was conducted among workers of construction industries located in Jimma town. A stratified multi-stage sampling followed by simple random sampling was used to select the study participants. A pre-tested and structured questionnaire was used to collect data. Physical examination of the study subjects was done to complement self-reported information of occupational injury. Bivariate logistic regression analyses followed by multivariate analyses were employed to identify main causes of injury. The overall prevalence of work-related injuries in the preceding one year was 41.4% [95% CI: (37.8, 49.4)]. The top five injuries were injured by object (36.9%), followed by lower back pain (35.6%), falling injury (23.5%), skin disorder (20.1%), and eye problem (18.2%). Working without personal protective equipment (PPE), absence of vocational training, khat chewing, and working overtime were significantly raised the odds of having work-related injuries among construction workers. The finding revealed that provision of safety equipment and promoting its

utilization, avoiding work overload, and controlling khat use in workplace could help to minimize work-related injuries and occupational diseases to ensure construction site safety.

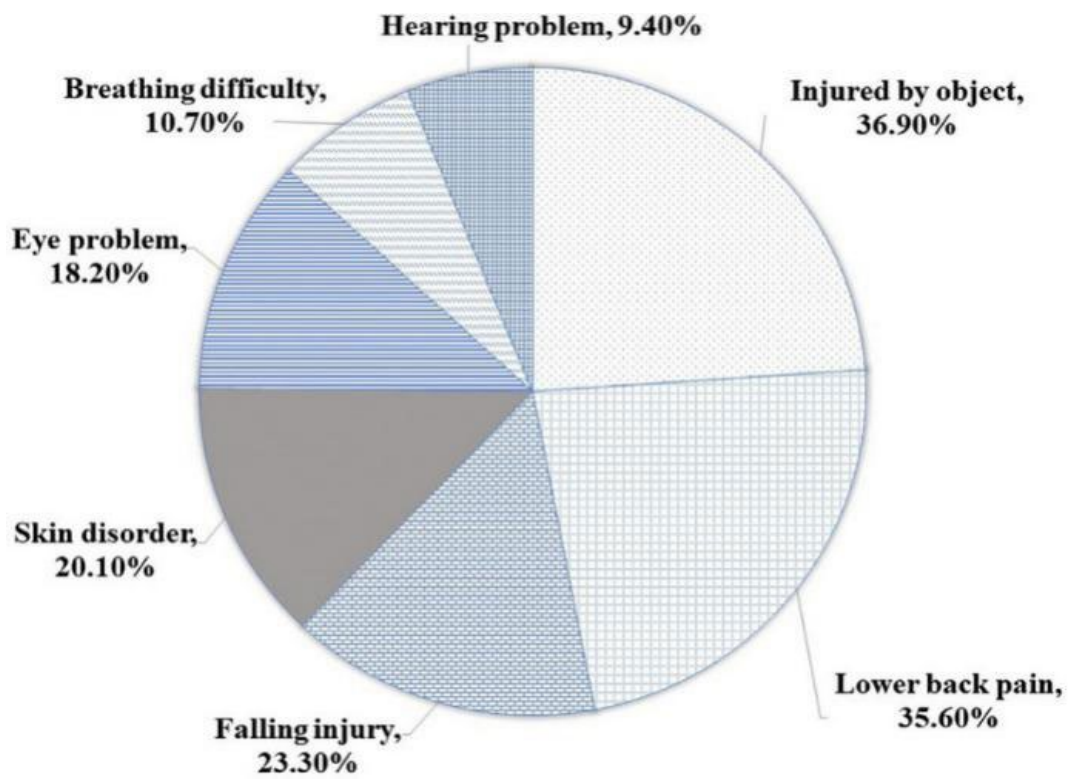


Figure 4.2

### **4.3 Advantages And Disadvantages**

After we survey, there are advantages and disadvantages from this project. We consider our project is balance from benefits and weakness.

#### Advantages

- Easier to lift the loads from one place to another place.
- Material of the trolley are durable.
- Low cost.
- Can be maintained by yourself.
- Safer than Hydraulic

#### Disadvantages

- The mechanical part is risky to be jammed.
- The flip able might to be rusty if not service properly.
- Need to use manpower.
- Need to pay more attention to the sliding iron section.

### **4.4 Fabrication And Installation Process**

As shown in below, fabrication process start with cutting a plywood and acrylic sheet according to design measurements. Then level each surface of the piece of wood and the acrylic sheet so that it is flat to ensure that each angle is the same and

to avoid the taping process damaged or defective. Upper and lower parts of the frame is joined by using wood glue and then nail it so that it attached. During installation of acrylic sheet , a cutting process are made to make sure the size are similar with the frame. Hinges are also installed so that books can be stored.

Table 3



#### 4.5 Testing And Demo

Table shows a test result at the height part of the adjustable trolley. This part only works when we rotate to the right the pulley up to the maximum level and the height of surface flat trolley will be increased. Then when we rotate the pulley to left the height of surface flat trolley will be decreased.



Figure 4.5.1

Table below shows a test results at the part that can afford the loads on the our surface flat trolley. The loads have weight around 25kg and the trolley still can afford 10kg more .

--	--



Figure 4.5.2

#### **4.6 Summary**

The final test shows that the trolley is working properly and the design is suitable. The final test also shown that the product durable and not easy to be broke.

## **Chapter 5**

### **Conclusion**

#### **5.1 Introduction**

Each project has its own advantages and objectives. Although there are many weaknesses but many objectives have been achieved. The findings of this study are supported by opinions that can strengthen the results of the study and thus reach its conclusion.

The findings from the study are used to discuss whether the proposed hypotheses are supported. All research questions will be answered subsequently and finally the achievement of research objectives are determined. Conclusions are made based on discussions of the findings of the study and some suggestions are also available for use in future studies.

Lastly, based on the results of the creation and completion of this project, it was found that this designed project will benefit everyone as it helps to use the lighting technology more creatively.

## **5.2 Discussion**

Discussions were held every week to discuss the project development. All the problems are discussed so that it can be solved quickly. Problem that can't be handled were addressed quickly to the lecturers. To make the project difficult everything that is going to be done must be planned properly (proper planning). This can ensure the project move smoothly without any interruptions.

There are some major research questions raised in this study. The first question is, how can an individual use this project we created as a useful and innovative product. There are few steps need to be done to completing this project. One of them is designing process. This process may use auto-cad or inventor to make it done. Our group had choose to use inventor to make it easier to design. Inventor can create 3D and actual design.

In term of material selection, we had chosen suitable material for our project. We choose light and solid material to produce the project. It is because, we want to ease all the consumers that use it. It can bring it everywhere they want without problem. Plus, they will not having problem to put it in tight place whenever they don't want to use it.

## **5.3 Conclusion**

Each project has its own advantages and objectives. Although there are many weakness but many objectives have been achieved. The findings of this study are supported by opinions that can strengthen the results of the study and thus reach its conclusion. The findings from the study are used to discuss whether the proposed hypotheses are supported. All research question will be answered subsequently and finally the achievements of research objectives are determined. Conclusion are made based on discussion of the findings of the study and some suggestion are also available for use in future studies. Lastly, based on the result of the creation and completion of this project it was found that designed project will benefits for everyone as its help to use the technology more creatively.

## 5.4 References

[1] Anthony J Sambuca Jr, CASE SEALER MAST AND TROLLEY ASSEMBLY, Illinois Tool Works

Inc', 09/414,489, Nov. 20, 2001

[2] Jonathan M. Rathbun, Belmont, MI (US); Charles C. Frost, Ada, MI (US); Eric J. Ahiquist,

Portage, MI (US); Eric W. Pierman, Cedar Springs, MI (US), ADJUSTABLE HEIGHT TROLLEY

ASSEMBLY, FROST INCORPORATED, PCT/US2009/066370, Jun. 28, 2012

[3] Richard Miller, Gaisbach (DE); Johann Lung, Kinzelsau (DE); Manfred Finzel, Kinzelsau

(DE), CONTINUOUSLY WIDTH-ADJUSTABLE TROLLEY TRAVELLING WINCH, R. Stahl

Fordertechnik GmbH, PCT/DE97/01510, Feb. 11, 2003

[4] Bjorn Refsum, Alesund (NO); Hilde Angelfoss Oxseth, Alesund (NO), TROLLEY, Stokke

Gruppen AS, pp. 29/197,028, May 24, 2005

[5] Chuan-Kai Lin, New Taipei (TW); Sheng-Kai Lai, New Taipei (TW), VARIABLE HEIGHT



TROLLEY AND HEIGHT DISPLAYING ASSEMBLY THEREOF, KINPO  
 ELECTRONICS, INC.,; CAL-  
 COMP ELECTRONICS & COMMUNICATIONS COMPANY LIMITED, pp.  
 14/154,274, Sep. 15,  
 2015

**Gantt Chart**

<b>MINGGU</b>	<b>M1</b>	<b>M2</b>	<b>M3</b>	<b>M4</b>	<b>M5</b>	<b>M6</b>	<b>M7</b>	<b>M8</b>	<b>M9</b>	<b>M10</b>	<b>M11</b>	<b>M12</b>	<b>M13</b>	<b>M14</b>	<b>M15</b>
<b>Tarikh</b>	13/08 - 19/08	20/08 - 26/08	27/08 - 2/09	3/09 - 9/09	10/09 - 16/09	17/09 - 23/09	24/09 - 30/09	1/10 - 6/10	7/10 - 13/10	14/10 - 20/10	21/10 - 27/10	28/10 - 3/11	4/11 - 10/11	11/11 - 17/11	18/11 - 24/11
<b>Project 2 PLANNING</b>															
<b>Project 2 INPLEMENTATION</b>															
<b>Project 2 TESTING AND VERIFICATION</b>															
<b>Project 2 DATA GATHERING</b>															
<b>Project 2 DEMO</b>															
<b>Project 2 FINAL DEMO</b>															

<b>Project 2</b>  SUBMISSION OF FINAL PROJECT																

## Costing

Materials	Quantity	Price
Hallow Steel	12 x 700mm	RM 240
Screw/Nuts	20	Rm 25
Wheel	4	RM 50
Wood	1	RM 40
Threaded Rod	1	RM 30
Bearing	3	RM 16 and RM20