POLITEKNIK MALAYSIA

SULTAN SALAHUDDIN ABDUL AZIZ SHAH

DIPLOMA IN CIVIL ENGINEERING

FINAL YEAR PROJECT

CLASS:DKA5B

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TITLE:

SCISARROW

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Abstrak- Kajian ini membincangkan tentang kereta sorong yang diubahsuai untuk memudahkan pekerjaan seharian. Kereta sorong ini diberi nama 'Scisarrow'. Sesuai dengan namanya kereta sorong ini menggunakan mekanisma yang terdapat pada gunting. Kereta sorong ini diubah suai daripada kereta sorong biasa yang terdapat di pasaran dengan memperkenalkan konsep 'self dumping' di mana pengguna kereta sorong ini tidak perlu menggunakan tenaga yang banyak untuk memunggah barang barang yang hendak dibawa. Penyelidik kajian ini menyasarkan tiga objektif utama hasil kajian ini di mana yang pertama, menghasilkan kereta sorong inovasi, seterusnya menghasilkan kereta sorong yang mampu mencapai had limit beban yang lebih daripada kereta sorong biasa dan yang terakhir menciptakan kereta sorong yang mampu memendekkan masa proses pemunggahan barang. Pengkaji kajian ini mendapat ilham daripada projek-projek pelajar semester lepas dan kajian tentang inovasi 'self dumping' yang terdapat pada jentera-jentera yang menggunapakai konsep ini. Data kajian ini dapat ditunjukkan dengan pengkaji mengedarkan borang soal selidik kepada responden-responden yang terlibat dalam pembangunan. Selain itu, pengkaji juga meminta responden untuk mencuba kereta sorong biasa dan 'Scisarrow' ini dalam proses pemunggahan beban yang melibatkan 20kg,40kg,60kg,80kg dan 100kg. Kesimpulannya kereta sorong inovasi ini dapat memenuhi objektif kajian ini dan produk inovasi ini mampu digunakan di pasaran sebagai alat bantu harian.

Kata Kunci - *gunting, self dumping, had limit beban, kereta sorong, pemunggahan, diubahsuai, inovasi*

SCISARROW

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Abstract- This research discusses about the innovation wheelbarrow to ease the daily worker. This wheelbarrow was dubbed 'Scisarrow'. It is named after the mechanism which resembles scissors. This wheelbarrow was modified from the ordinary wheelbarrow that is easily obtained from today's market with a twist that is 'self-dumping'. How this works is that this mechanism allows for unloading of the wheelbarrow without requiring too much energy. The researchers set three objectives, namely produce an innovation wheelbarrow, fabricate a wheelbarrow that can achieve load limit that is more than the normal wheelbarrow and lastly to create a wheelbarrow that can shorten the unloading time. The researchers took inspiration from past semesters and studies about other machinery that also uses the self-dumping mechanism. The way that data is obtain is by showcasing the product itself to the public, some people with background related to Civil Engineering. Another method to obtain data was to test it for itself by using 20kg,40kg,60kg,80kg,100kg and 120kg. In conclusion, this innovative wheelbarrow was able to fulfil the objectives of the study and the product might even pierce the market as the new norm for wheelbarrows.

Chapter 1

INTRODUCTION

1.1 Introduction

Wheelbarrows are one of the complex machines consisting of simple machines, wheels, levers and sloping planes.

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Figure 1.1 common wheelbarrow

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

1.2 Problem Statement

Operating a wheelbarrow expend quite a significant amount of energy. Aside from consuming a lot of energy, prolong use of wheelbarrow will cause compilation to the human body causing discomfort or pain to different parts of the body. During unloading for example, the average user will often lost balance while lifting and moving the wheelbarrow to the left or right. Also, to note, during loading the average person will feel that the heavy load will cause fatigue to the forearm. Having an extra wheel for balance can make all the difference when transporting heavy loads. Because the wheelbarrow won't be trying to lean one side or the other, energy can be directed towards lifting the wheelbarrow without fear of the wheelbarrow tipping over.

1.3 Objectives

i) To produce an innovation wheelbarrow "Scissarrow".
ii) To make a comparison of load limit with the standard wheelbarrow and the innovation wheelbarrow.
iii) To determine the time taken for wheelbarrow to unload

1.4 Scope of project

The inspiration the researchers obtained to create this wheelbarrow came from the difficulties of students of our prestigious institution, to complete tasks that are related to using the wheelbarrow. In some classes in which female student are the majority, they would often get fatigued after one use. Thus, the researchers think it is most appropriate that the scope of our project appeal to the general masses and not only focusing on the female students.

The comparison we make for the standard wheelbarrow and our innovation wheelbarrow is.

i) Time
ii) Maximum load that can be lifted
iii) Unloading process

Chapter 2

Literature Review

2.1 Introduction

A wheelbarrow is a carrier, usually having only one wheel, consisting of a tray bolted to two handles and two legs. While known mostly as a device for carrying small loads for the household gardener, a wheelbarrow is often also used in construction and industry for carrying larger loads.

The birthplace of the modern wheelbarrow was China, possibly as early as 100 B.C. One early version consisted of a large single wheel at or near the front of a platform. The load would be placed behind the wheel, and the operator would lift the heavy end and push the load. Sometimes a small basket would be used to carry the load, and if it was heavy, a second operator could pull from the front. Another type, probably invented by Chuko Liang in 300 A.D., had a carrying surface that was basically a large wheel housing that encased the top half of the wheel. A flat platform projected out from both sides at axle level could then carry large loads, people and goods in pannier fashion while the operator steered it. Loads were higher off the ground than those carried in modern wheelbarrows. Chinese wheelbarrows were hence like rickshaws in that the goal was to carry heavy loads long distances. Tseng Min-Hsung in 1200 A8.D. boasted that "ways which are as winding as the bowels of a sheep will not defeat it."

Figure 2.1 Chinese Wheelbarrow

Unlike Chinese wheelbarrows, European wheelbarrows were designed to carry small loads over short distances. It is difficult to trace the progression of the wheelbarrow from China to Europe. Possibly, Arab traders brought it to the Middle East and Europeans learned of it during the Crusades. Ancient Greeks might have used the wheelbarrow for construction, while the Romans might have adapted it for agriculture. After Rome fell, the wheelbarrow could have remained in use in Byzantium until the Crusaders learned of it during their journeys. However, it is most likely that it was an independent invention of the late middle ages, created by putting a wheel on the two-person hand barrow already in use for carrying such items as stones or sheaves of corn.

Figure 2.2 Old Western Wheelbarrow

The first use of the wheelbarrow in Europe was probably in agriculture; then, it spread to construction, transportation of goods, mining, and brick making. Some wheelbarrows had a wooden, box-like body with feet. Others had a flat slatted or wicker framework with

feet. French, Flemish, and Dutch wheelbarrows usually had a rack to rest the load or basket against. Swiss wheelbarrows had solid wheels, while English ones had four feet and spoked wheels. Bohemians of the time also used spoked wheels, but no feet were used to help lower the load. To assist when moving loads, European wheelbarrows of around 1200 A.D. had leather straps that wound around the handles. Operators would slip the straps around their necks.

The wheelbarrow's advantages were that loads could be lifted and carried close to the ground, as opposed to two-person hand barrows that required carrying to be done at waist level. A wheelbarrow carrying a basket of goods could be unloaded quickly and put back into action, although it was too unwieldy at this date to be emptied by simply tilting and twisting it. One person using a wheelbarrow cuts labour costs in half, and it's easier than two people coordinating their movements as they carry a load. Wheelbarrows quickly became items crafted by carpenters to be sold to construction workers. In 1222, records for the king of England's works show that eight wheelbarrows were purchased from the town of Canterbury for construction at Dover.

The modern wheelbarrow can have one, two, or four wheels. These wheels can be either in front or beneath the load. Other conveniences include storage space compartments or side clips to carry tools. Wheelbarrows are considered a necessity for the backyard gardener as well as industry, for they are considered simple, unmotorized, yet effective ways for one person to carry a heavy load. [1]

2.1.1 Raw Materials

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

2.1.2 Process

Because wheelbarrows exist in a variety of forms, made from many different materials, manufacturing procedures vary widely depending on the exact kind of wheelbarrow being made. Some wooden wheelbarrows are simple enough to be made with hand tools used by weekend hobbyists with modest carpentry skills. Some heavy-duty wheelbarrows, intended for industrial use, are manufactured with heavy machinery which shapes thick steel sheets. In order to discuss several different techniques used for making wheelbarrows, the following outline will describe the manufacturing of a typical garden wheelbarrow, with wooden handles, steel legs and braces, a rubber tire, and a plastic tray.

High density polyethylene can be formed into a wide variety of shapes using various techniques. For wheelbarrow trays, it is generally produced in the form of a thick sheet. This can be done by extrusion. This process involves melting granules of polyethylene into a liquid and forcing it through a nozzle. The opening of the nozzle has the width and thickness of the desired sheet. As the liquid polyethylene emerges from the nozzle it cools into a sheet that can be cut to the desired length.

Sheets of polyethylene are shipped to the wheelbarrow manufacturer and inspected. They are then shaped into trays using a technique known as vacuum forming or thermo forming. This process involves heating the sheet until it is soft. The soft plastic is then placed on top of an open box. The box contains a mould in the shape of the wheelbarrow tray. Air is removed from the box, and the resulting vacuum causes the air pressure outside the box to force the sheet against the mould. The plastic cools into the wheelbarrow tray and is removed.

2.1.3 Making the legs and braces

The support legs and braces are usually made of steel. Steel is made by combining iron ore and coke (a carbon-rich substance made by heating coal in the absence of air) and heating them with very hot air in a blast furnace. The resulting mixture of iron and carbon is known as pig iron. Oxygen is blasted into molten pig iron to remove most of the carbon. The resulting molten steel is cooled into a variety of shapes.

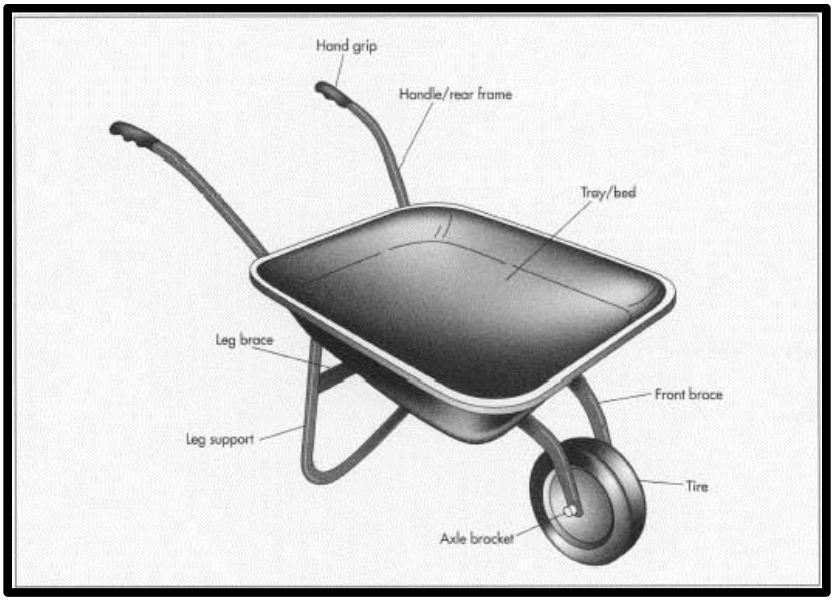

Figure 2.3 A Textbook Example of a Wheelbarrow

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Strips of steel arrive at the wheelbarrow manufacturer and are inspected. Sharp dies are used to punch various components out of the steel strips using large, powerful presses. Holes are punched into these components to allow them to be bolted into place.

The steel components are usually painted for protection. A degreasing solution is used to clean the components, which are then dried. Paint is applied using an electrostatic process. The steel and the paint are given opposite electrical charges. The opposite charges attract, causing the paint to cover the steel evenly and completely. The paint is then baked onto the steel in an oven.

2.1.4 Making the wheel and tire

The wheel may be made of steel or plastic. It is made using methods like those used to make other steel parts or the plastic tray.

The tire is usually made of natural or synthetic rubber. Natural rubber is made from latex, a substance secreted by rubber trees. The latex is filtered to remove foreign substances, and water is added to make the liquid latex thinner. A dilute acid is added to cause solid rubber to be deposited out of the liquid mixture. Synthetic rubber can be made from a wide variety of chemicals. The most common form of synthetic rubber is styrene-butadiene rubber. This substance is made by mixing styrene and butadiene, both derived from petroleum, in an emulsion of soap and water. The two chemicals combine to form synthetic rubber.

The natural or synthetic rubber is heated until it melts into a liquid. It is then poured into a mould in the shape of the tire. The rubber cools and the tire are removed from the mould. The tire is shipped to the wheelbarrow manufacturer and is placed around the wheel.

2.1.5 Making the handles

Lumber arrives at the wheelbarrow manufacturer and is inspected. The wood is stored and allowed to dry. It is then cut and shaped by woodworking equipment such as saws and lathes. Holes are drilled to allow the handles to be bolted into place. The wooden handles are then coated with varnish for protection.

2.2 Type of tyres

Tyres are important for the manoeuvrability of the product. Tyres are often overlooked when it comes to the creation of wheelbarrow.

				
Model TK207	Model TK205	Model TK223	Model TK215	Scaffold tyre

Figure 2.4 Tyre selection

Table 2.1 Characteristics of tyre

	TK 207	TK205	TK223	TK215	Scaffold tyre
Types	Semi-pneumatic	Semi-pneumatic	Pneumatic	Semi-pneumatic	Solid
Material	Rubber	Rubber	Rubber	Rubber	Nylon
Durability	Bad	Average	Good	Good	Best
Tread Pattern	Smooth	Treaded	Treaded	Treaded	Smooth
Size	Small	Small	Large	Medium	Small
Swivel	No	No	No	No	Yes

The purpose of the study is to create a type of wheelbarrow which is not prone to breaking down, it has been the main problem for the Brick Laboratory in our faculty. Most of the wheelbarrows are out of commission due to problems related to tyres. Although they are relatively cheap to repair, due to their rate of breaking down, their usefulness outweighs the cost. So, most of the time, the wheelbarrows are just being left in the storage room to collect dust. For the project, the researchers would try to create a product that can last longer than conventional wheelbarrow. So that is why the researchers will need to list out criteria that are needed.

2.2.1 Types

First are the types of tyres. There are three kinds of tyres in consideration, solid, pneumatic and semi-pneumatic. A pneumatic wheel is much like a standard car tire. An outer rubber wheel is attached to a rim and air is forced inside of the wheel to provide pressure, which provides shock absorption over uneven and bumpy surfaces.

A semi-pneumatic wheel can look very much like a pneumatic wheel on the outside, but it is what is inside that makes the difference. Semi-pneumatic wheels feature a dense, moulded rubber with a hollow core.

The hollow of the semi-pneumatic wheel is not under pressure, which is why the outer rubber is much thicker since no air pressure is in place to push out on the wheel. This causes the much heavier than the pneumatic wheel, but it is also immune to punctures since letting the air out will not cause the rubber wheel to become flat. The wheel can either include an inner tube or be tubeless, and the rims that the wheels are attached to come in many different materials and have options of various types of bearings. Then there is solid tyre, the amount of load it can withstand is highly dependent on the material.

2.2.2 Durability

Next, is the durability. Durability varies when it comes to the product but ultimately, it comes down to the materials and types. Since we are looking for a product that will last quite long than the average wheelbarrow, it must be up to our standards. We can find out the durability of a product by doing stress test.

2.2.3 Tread Pattern

Tread pattern are also an important factor to consider. It may not be as important as the ones used in cars, but in a worksite where the surface is varies, it may be to prevent a worker from tripping which will cause injuries. It is also known for provides traction. Although, tyres with no tread pattern also means that on even and flat surface it can glide more easily leading to less force being expended to push the cart.

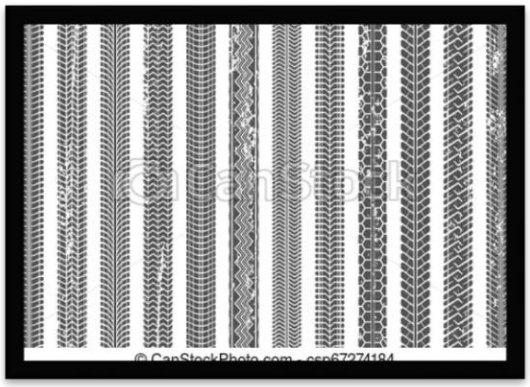

Figure 2.5 Different treads for tyres

2.2.4 Size

Then, the size of the tyre should be big. This is to allow pressure to be evenly distributed and does not put additional stress towards the tyres but sometimes the construction and build of the tyres are able to withstand high pressure even if it small. Another advantage is that at construction sites, big tyres can perform their task at a surface where it is muddy. Since we also aim to fit three tyres to our wheelbarrow, it is also able to distribute pressure evenly even if it is on a muddy surface.

2.2.5 Swivel

Finally, the ability to swivel could prove crucial. For a normal wheelbarrow, one wheel is great for manoeuvrability. Since the workspace is usually cramped nearing the end of the cycle of construction, this could make or break the usefulness of a wheelbarrow. So, the ability to swivel would make it able to turn without sacrificing the manoeuvrability of our product.

2.2.6 Selection

For this project, it is decided that two types of wheel will be used. Two for the front and one in the back. The wheels that is used for the front would be a 14-inch wheel that is also pneumatic. The back will utilize a 6-inch scaffold tyre with a lock. The two front wheels or primary wheels will be able to traverse even muddy grounds while the back tyres have a swivelling mechanic that is able to turn 360 without much space. This 3-wheel configuration also contributes in the ease of transport.

2.3 Type of Metal Used

There are 3 main types of metals used in building this wheelbarrow. Namely, carbon steel, steel alloy and cast iron. Steel is an alloy, the amalgamation of one or more metals with non-metallic elements. John W. Shuster (1997) Structural Steel Fabrication Practices.

2.3.1 Carbon Steel

Carbon steel a type of steel that contains iron, carbon, silicone, manganese, sulphur and phosphorus. The higher the carbon content, the lesser the workability. It can be divided into 3 sub types that is low carbon steel, mild carbon steel and high carbon steel with each respective getting increase in carbon content. Low carbon content is suitable for heavy loads while high carbon content steel is used for heavier loads. One of the many uses of carbon steel is structural steel, signs, cars, furniture and decorations, wire, fencing, nails.

Figure 2.6 Steelworks for carbon steel

2.3.2 Alloy Steel

All steel is an alloy but not all steel is “alloy steel”. Common alloyants are manganese, nickel, chromium, molybdenum, vanadium, silicon and boron. Alloy steels are also broken down into two groups, low allow steels and high alloy steels but there is a subtle difference between the two. Alloy Steel is used across a range of highly demanding applications within the aerospace and power (nuclear) industries. Alloy Steel is also found in applications where its response to magnetism is important, in transformers and electric motors for example.

It is the addition of other elements that makes Alloy Steel extra strong. The elements such as silicon and manganese through heat treatment makes Alloy Steel with improved characteristics and additional benefits, such as increased corrosion resistance or improved weldability. The mechanical properties achievable are dependent on the addition of elements such as nickel, chromium, molybdenum and vanadium.

Figure 2.7 Example of uses Alloy Steel

2.3.3 Cast Iron

Cast iron is a group of iron-carbon alloys with a carbon content greater than 2%. Its usefulness derives from its relatively low melting temperature. The alloy constituents affect its colour when fractured: white cast iron has carbide impurities which allow cracks to pass straight through, grey cast iron has graphite flakes which deflect a passing crack and initiate countless new cracks as the material breaks, and ductile cast iron has spherical graphite "nodules" which stop the crack from further progressing.

Cast iron tends to be brittle, except for malleable cast irons. With its relatively low melting point, good fluidity, cast ability, excellent machinability, resistance to deformation and wear resistance, cast irons have become an engineering material with a wide range of applications and are used in pipes, machines and automotive industry parts, such as cylinder heads, cylinder blocks and gearbox cases. It is resistant to damage by oxidation.

Figure 2.8 Iron being smelted

2.3.6 Circular Hollow Steel

Circular hollow steel is a common type of steel section that is used in a variety of formats over various industries in the whole world. These steel sections are rolled from steel sheet or slit coil. The slit strip of steel coil goes through a forming and sizing section in a normal cold forming steel mill. The mill consists of several passes through which the sheet is gradually formed, each pass bending the steel sheet more and changing the radii on each pass. This is done until the two ends of the steel are pressed together and then welded inline. Round steel sections can be rolled from a variety of materials. Most common is hot and cold rolled steel tubes. Hot rolled sections are predominantly used for structural purposes while tubes rolled from cold rolled steel has better bending ability and gives a better aesthetic appearance after being powder coated.

2.3.7 Selection

The best steel for the project would be circular hollow steel for the framework of the body. The steel used would be varying with 1’x1’ and 1’x2’ sizes which is used in various kinds. Hollow steel is ideal as it can hold more load before bending. For the handles until the lower parts of the wheelbarrow, it is imperative to use 1’x1’ because the weight that is put on the handles are not too heavy. While the lower parts of the wheelbarrow will be using 1’x2’ which is ideal because more stress will be put into the wheelbarrow.

2.4 Numbers of tyre

Figure 2.9 Two Wheel Wheelbarrow

In Figure 2.9, the main advantage of having one wheel is manoeuvrability. A single-wheeled wheelbarrow is a versatile tool that can be easily make tight turn and maneuver into small areas, making it ideal for tasks that require working in tight quarters.

On the other hand, with only one wheel to support the load, this type of wheelbarrow relies on you to provide balance during movement, making the wheelbarrow less steady and harder to use when weighed down with heavy loads. A single-wheeled wheelbarrow is best used for smaller loads.

In figure 2.4.1, having extra wheel for balance can make all the difference when transporting heavy loads. Because the wheelbarrow won't be trying to lean to one side for the other, you can focus your energy on lifting the back end and providing the pushing power without fear of the wheelbarrow tipping over.

"Having two wheels also means that these wheelbarrows can be moved in one-handed fashion. Even if you are only holding one handlebar, there will still be three points of contact with the ground. The trade-off is that two-wheeled wheelbarrows are less inclined to make

turns. This makes it a hassle to use in small areas, but this might be advantageous for transporting heavy loads." As quoted by J. Keeler Johnson, a writer for HobbyFarms.

The three disadvantages on a wheelbarrow with 2 wheels is that on an incline it will be harder to climb and if unloading is needed to do on an incline it will be more difficult compared to using the traditional wheelbarrow. Also, since it has 2 contact points, it will also be relatively more difficult to be used in a cramp site since the area in which occupies is bigger when it moves as compared to the traditional wheelbarrow.

While for three wheeled wheelbarrows, it has all the advantages and disadvantages of the one with two wheeled. But it also has some added advantages. For some inspiration, we can look at the British made car, the Reliant Robin.

Figure 2.10 Reliant Robin Crash

Well, for a car with 3 wheels is a bad design. For every turn, the car would most likely turn over from the centripetal force. But we can use this advantage for the design of our wheelbarrow. One of the shortcomings of having two wheels is that it occupies a lot of space especially during the end stages of a construction.

Referring to the figure in 2.10, the motion in which the car is side-lining. Occupies less space. Although it looks miniscule, in a cluttered space the motion is useful. So, having 3 wheels is a plus.

2.5 Mechanism

The name of our product is “Scisarrow”. It is inspired by the movement of scissors. After properly doing our research, we incorporated the “self-dumping” mechanism which was used in hoppers. When using these hoppers, forklift tines allow operators to transport them with ease. They are positioned carefully under the bin. For it to work, the forklift driver catches the bin on the edge of the hopper and reverses the forklift. When the tines clear the pivot point of the bin, raise the forks to completely discharge contents.

Figure 2.11 A hopper being lifted by a forklift

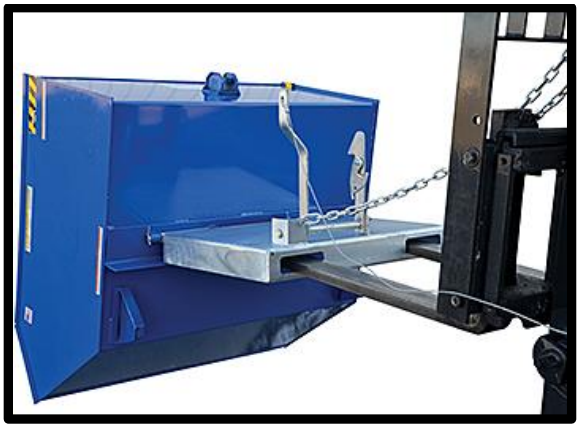

Figure 2.12 The hopper being lifted and tilting 90°

Of course, hoppers are designed for a heavier load and to be lifted. The construction is made with heavy steel withstand much heavier load. The absence of wheels also means that

it is stationary and must be dumped by using a forklift. With our Scissarow, we can achieve the mobility of a normal wheelbarrow while also being able to utilize the self-dumping mechanism of a hopper.

Also, Scisarrow is also fitted with an interlock that is incorporated in bonnet of cars. The use of this lock is to prevent the wheelbarrow from accidentally tipping when moving it.

Figure 2.13 Interlock used in cars

2.6 Dimension of the Wheelbarrow

We made a trip to the nearest hardware store located at Sg. Buloh. The purpose of our visit was to procure the accurate dimension so that we are able to accurately install the appropriate add-ons to our product. So, the first thing we measured was the height of the wheelbarrow. Then, we proceed to measure the length of the wheelbarrow.

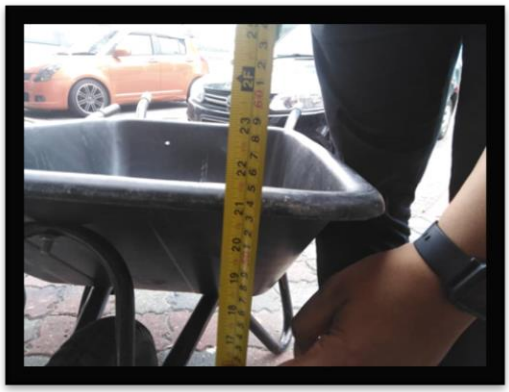

Figure 2.14 Height of the wheelbarrow

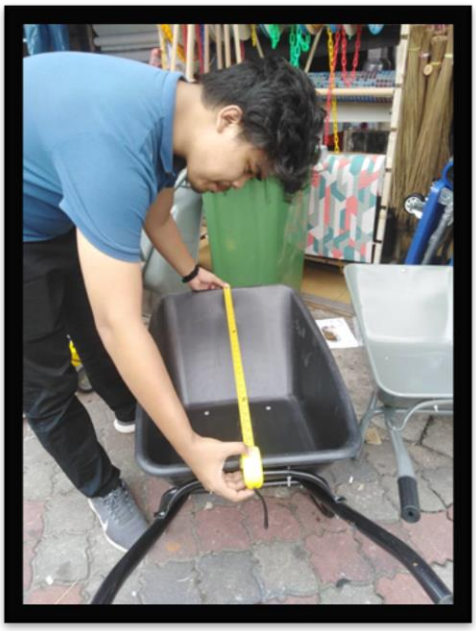

Figure 2.15 Length of the wheelbarrow's tray

Figure 2.16 Wheelbarrow tyres

Figure 2.17 Scaffold tyres

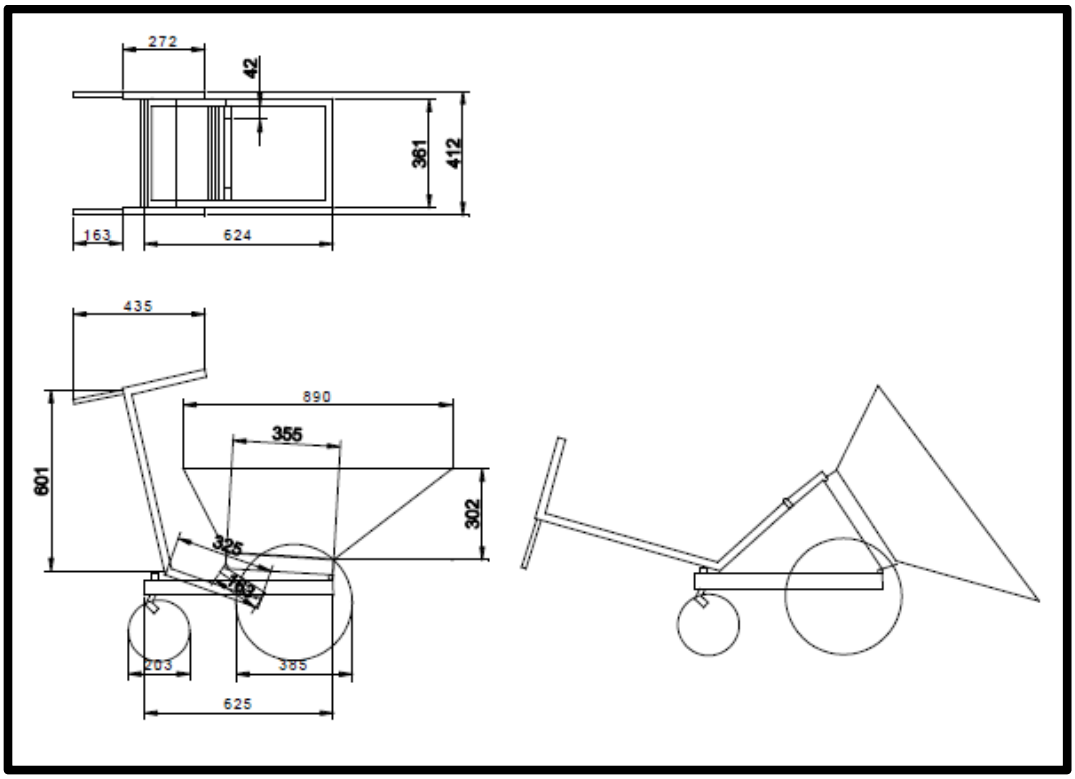

Figure 2.18 An approximate sketch of Scisarrow created in AutoCAD

Thus, with the reference diagram 2.18, the researchers were able to create a sketch of Scisarrow by using AutoCAD. The handle is designed as so to accommodate the average Malaysian height to push Scisarrow with ease.

2.7 Machinery

The machinery used in this project is potentially dangerous. Thus, most work done with machinery is under the supervision of the workers.

The first machinery we used is the circular saw. A circular saw is a power-saw using a toothed or abrasive disc or blade to cut different materials using a rotary motion spinning around an arbour.

When using the circular saw, make sure to not let it near any flammable liquid. The sparks generated from the cutting of metal is enough to ignite a fire.

Figure 2.19 Circular saw used in cutting metal

Next, is the machine that enables us to do gas welding or metal inert gases (MIG). Gas welding is done by which an electric arc forms between a consumable MIG wire electrode and the workpiece metal(s), which heats the workpiece metal, causing them to melt and join

Figure 2.20 Welding machine

This welding machine is used to regulate and supplied the voltage needed when used but the usage of welding machine is dangerous if unsupervised. Thus, some heavy lifting will be done by the experts.

2.8 Personal Protective Equipment (PPE)

When stepping inside a workshop that is filled with machinery, one must always take caution. Since the researchers are handling machinery that involves cutting, bright lights and strong smell. It is quite important to wear to avoid inflicting any harm in case of unexpected incidents.

Figure 2.21 Goggles

Goggles are a form of protective gear that usually enclose or protect the eyes. Goggles are great for those who are inexperienced with the circular saw, this piece of equipment is used to prevent thermal burns.

Figure 2.22 Workshop Jacket

A workshop jacket is a jacket that is a rugged piece of equipment and is made from a relatively tough material, able to prevent accidental slash from tools. The workshop jacket is used throughout the time inside the workshop.

Figure 2.23 Cotton Gloves

Cotton gloves are a form of hand protection. When welding, it gives assurance to the wearer so that the embers do not burn their hand. Also, it is useful when handling oily and sticky things that are in the workshop.

2.9 Ergonomics

Figure 2.24 Importance of ergonomics

The ergonomics of a wheelbarrow is horrid. The dated designs which was used mainly targeted the lower back when lifting. Scisarrow was able to mitigate the problem. The way it operates does not require the lower back but instead on using the weight of the user instead. By taking the lower principle, the body weight plus the added forces of pushing down will make the unloading process to be easier and more ergonomic. The position of the handle was also put into thought as scissarow was constructed to accommodate the average height of the average Malaysian.[2][7][8]

Chapter 3

Methodology

3.1 Introduction

The process of creating Scisarrow requires a few steps. This chapter documents how Scisarrow is made from start to finish

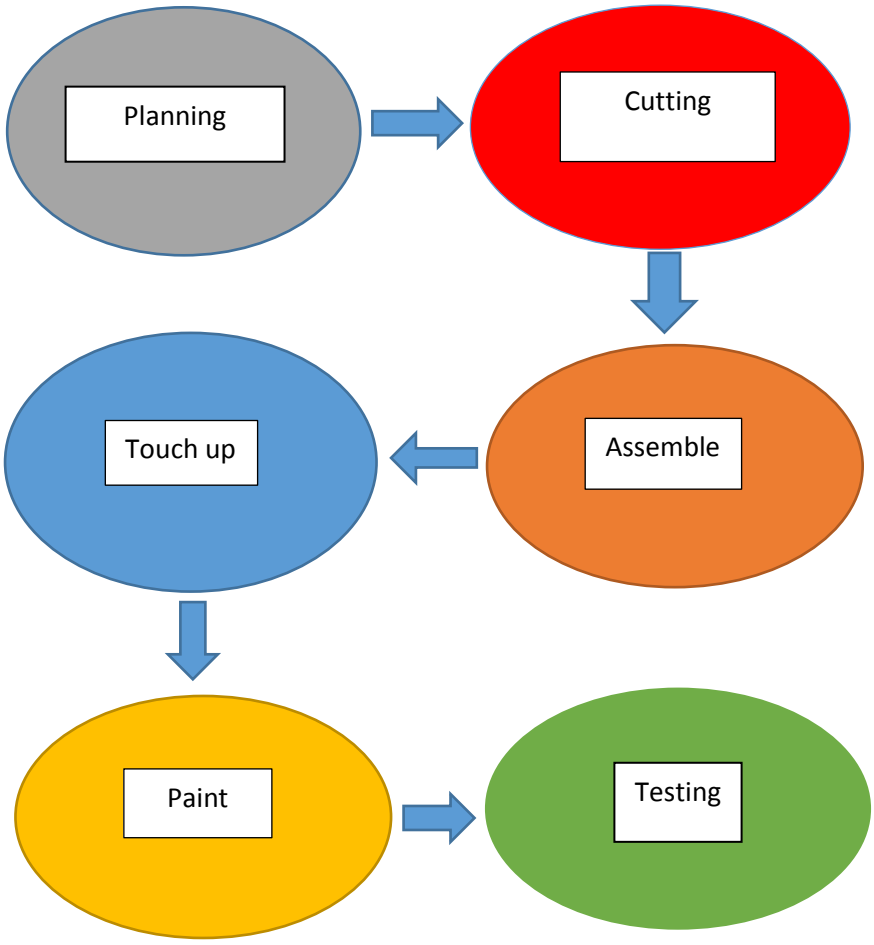

Figure 3.1 Scisarrow Road Map

3.2 Planning

The group is briefed on safety inside the workshop and the details of Scisarrow. The circular hollow tube is picked. The 1x1 is first measured with a measuring tape and marked with a pencil followed by the 1x2.

Figure 3.2 Briefing about the details and measurement

Figure 3.3 Handling the circular hollow tube

3.3 Cutting

This process involves the use of a circular saw. Before using the machinery, it is imperative to take caution as it is a dangerous machine if handled carelessly. The steel is rested on a plate as the circular is brought down to cut the steel by parts according to measurement that was marked by the pencil

Figure 3.4 Cutting process

3.3 Welding

The process of welding requires mechanical knowledge. The type of welding that was used is a gas welding. Without eye protection, it can cause discomfort or even irritation. The approach to this is to use a welding mask that was provided by the workshop. There was a few technique in welding and the one used in this was tapping. Welding was done under workshop supervision as it is quite dangerous and carelessness would cause damages to the machine.

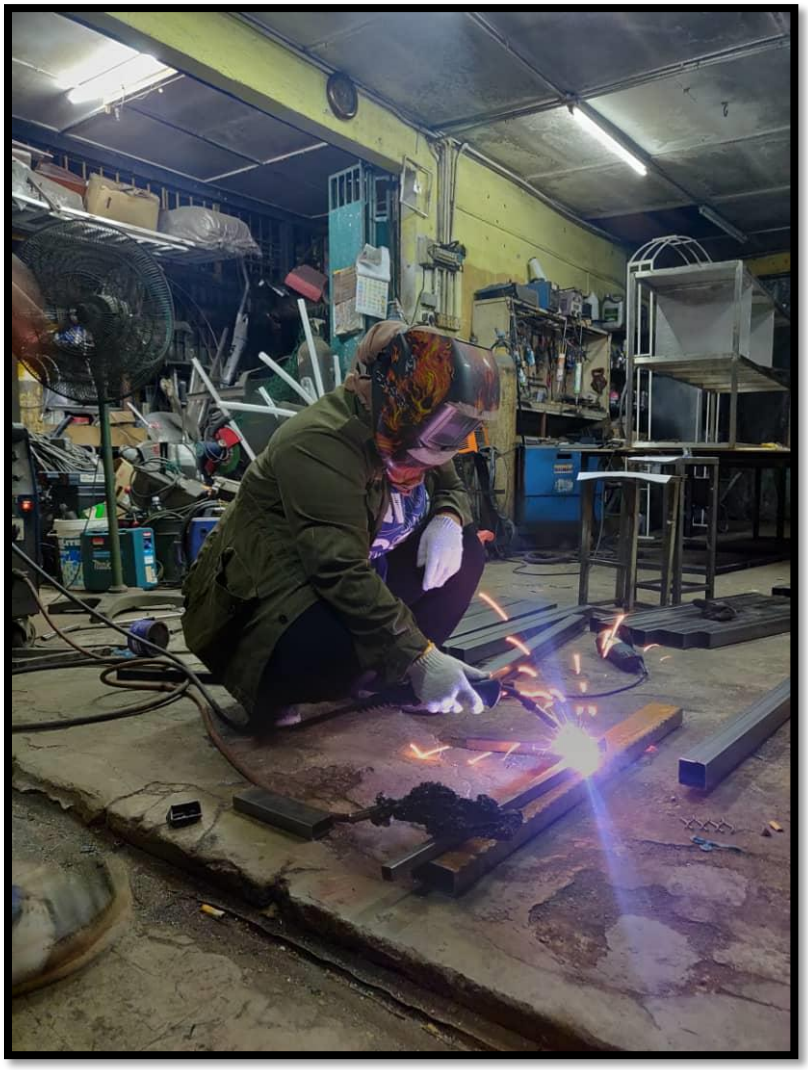

Figure 3.5 Welding process

3.4 Assembly

Figure 3.6 The start of the assembling process

After cutting and welding all the parts, it is time to assemble Scissarow. The process is fairly straightforward. The complicated part is making sure 2 parts of the Scisarrow which is involved in the mechanism to function as intended. Figure 3.5 shows the beginning of the process

3.5 Touch-up

Welding by using the tapping technique leaves a bit of mark that looks like bumps that will cause the aesthetic of Scisarrow to look unrefined. Thus, efforts of cleaning the bumps will take place

3.6 Paint

By using the paint Puff Dino 191, we painted the exterior of Scisarrow.

3.7 Testing

Scisarrow is finally sent out to be tested.

Table 4.1 Comparison between Wheelbarrow, Single tyre self-dumping wheelbarrow, Scisarrow

Item	**Normal Wheelbarrow**	**Single Tyre Self – Dumping Barrow**	**Scisarrow**
DIMENSION	31.8” x 8.5” x 24.5”	22.8” x 35.0” x 11.0”	31.8” x 8.5” x 24.5”
Load Capacity (kg/l)	80/100	75/80	100/115
Number Tyres	1	1	3
Size of Tyre	14”	14”	14” x 14” x 8”
Colour	Green	Grey	Green
Material	Steel	Steel	Steel
Length of Barrow (cm)	100	128	130
Length of Tipping (Kg)	100	126	130
Weight of barrow (kg)	10	22	20

Based in table 4.1, show the difference between a normal wheelbarrow, innovation wheelbarrow(Scisarrow) and our Scisarrow. There shows a huge gap in between these three products. For example, load limit, number of tyres and the weight of the product.

Table 3.2 Total cost of Scisarrow

ITEM	NUMBER	RM
WHEELBARROW	1	85.00
TYRES	3	86.30
HANDLE	1	20.00
STEEL	21FT	20.00
INTERLOCK	1	70.00

Based on the table 3.2 the researchers have done a the total amount of and research cost in the wheelbarrow. Based on table 3.2, the researchers took easy to obtain items and does not cost a lot of money to develop.

Table 3.2 Utility cost

ITEM	RM
TOLL FEES	20.00
FUEL	50.00
PRINTING	10.00

Based on the table 3.3 the researchers have done a the total amount of and research cost in the wheelbarrow. Based on table 3.3, the researchers took easy to obtain items and does not cost a lot of money to develop.

Table 3.4 Cost of everything

ITEM	TOTAL (RM)
PROJECT WHEELBARROW	281.30
TRANSPORTATION	70.00
OTHER	10.00

Based on the table 3.4 the researchers have done a the total amount of and research cost in the wheelbarrow. Based on table 3.4, the researchers took easy to obtain items and does not cost a lot of money to develop.

Chapter 4

RESULT AND DATA ANALYSIS

4.1 Introduction

For this section of this chapter, the researcher will attempt to gather data by using primary sources and secondary sources. Primary sources are sources obtained from testimony(interview), observation and the spread of questionnaire. While secondary sources are gathered from thesis, internet or journals.

4.2 Primary Data

Information gathered by means of primary sources are not obtained anywhere else except through the efforts of the researchers themselves.

Methods that are used to obtain primary sources such as testimonies gathered from testers. Questionnaires will also be issued to the people that tried Scisarrow.

4.2.1 Testimony

Researchers will conduct interview with 4 people with at least 3 in different fields and profession.

4.2.2 Questionnaire

The use of questionnaire is suitable to get a data that be quantified. Data gathered can be used to make a graph to visualize making it presentable and simpler to compare. About 30 people will be selected to test Scisarrow and give their opinion about it.

Figure 4.1 Interview with contractor

Figure 4.1 shows the interview with the contractor. His comments include that Scisarrow is suitable for small scale projects. He also notes that the construction of the wheelbarrow is solid and overall a good idea.

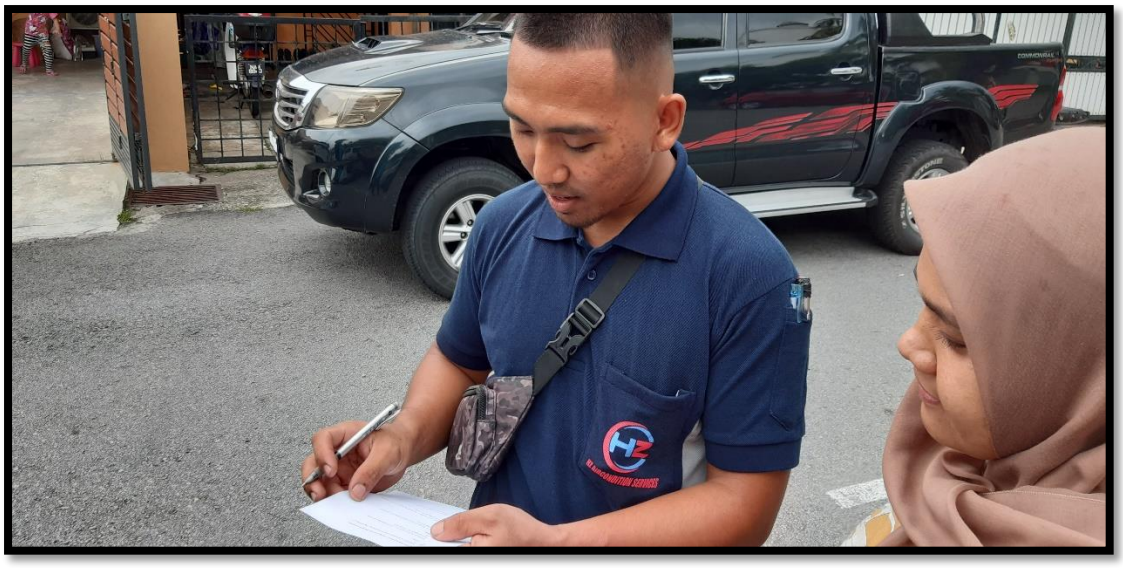

Figure 4.2 Interview with person with building services background

The interview did not comment too much but overall I quoted he said “It’s really good”

Figure 4.3 Interview with person with Mechanical (Automation) background

The researchers obtain information that Scisarrow was mechanically simple but functional. The functionality was limited.

Figure 4.4 Interview with person with background in Quantity Surveying

The person in interest was quite impressed with our project citing that the was willing to buy it. He also gives insight as to how we can improve the wheelbarrow by increasing dumping height and provide a few technical details that will improve the overall build of Scisarrow.

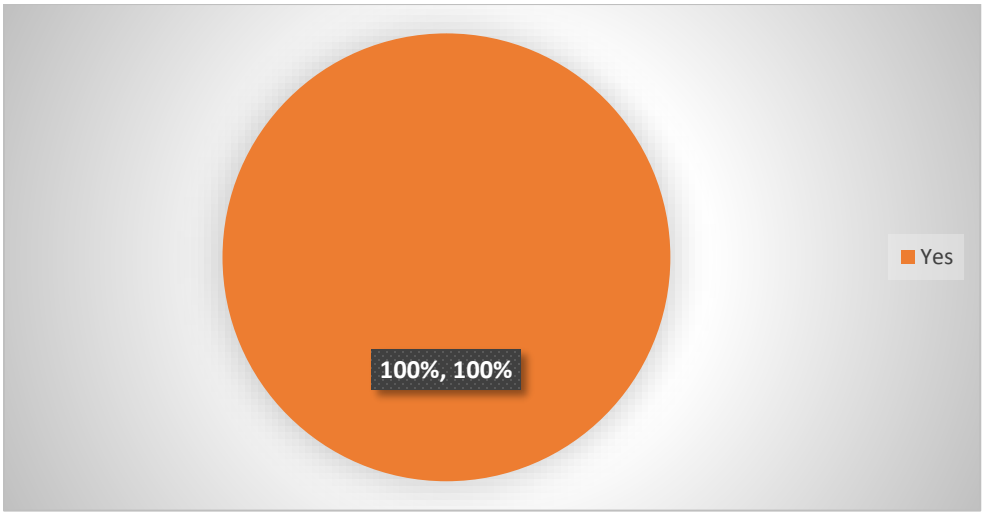

Chart 4.1 Is the wheelbarrow easy to operate

The chart above shows the users response towards the question is the wheelbarrow easy to operate. All the respondents answered yes. Thus, we can conclude that Scisarrow is easy to use.

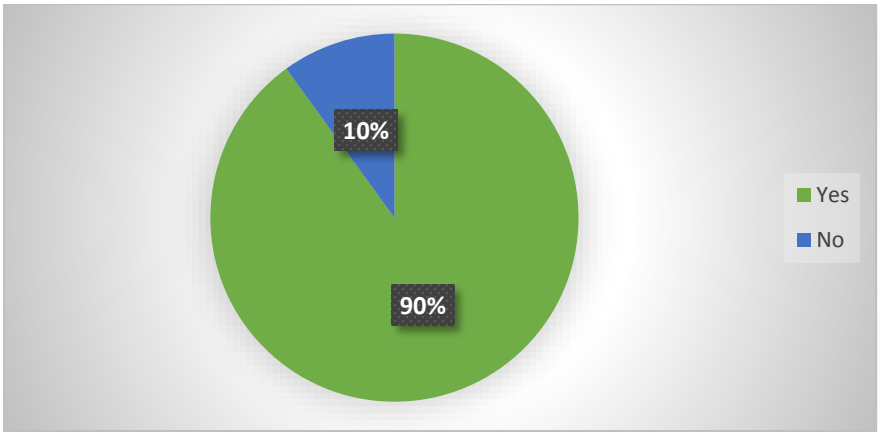

Chart 4.2 Scisarrow makes it easier to unload

The question above shows the reply for the difficulty in unloading. At most, only 3 people answered no while the rest answered yes. The results tell us that most people find that it us easy to unload by using Scisarrow.

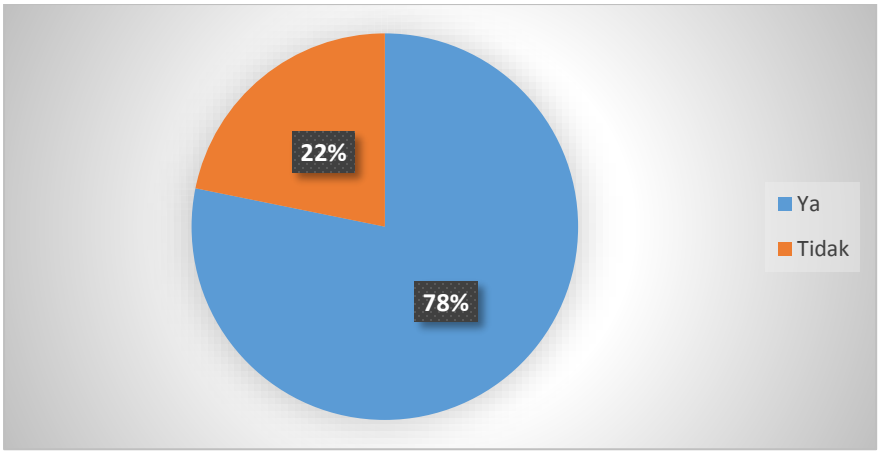

Chart 4.3 Scisarrow hastens the unloading process

The chart 4.3 yields the answers for the question “does Scisarrow hasten the unloading process”. The researchers have done an extensive research with this problem but, according to the survey obtained, the overwhelmingly positive 28 people agreed to this statement. Scisarrow main selling point is the unloading mechanism that is easy to use and fast to operate. Thus, we focused our part on fulfilling this question.

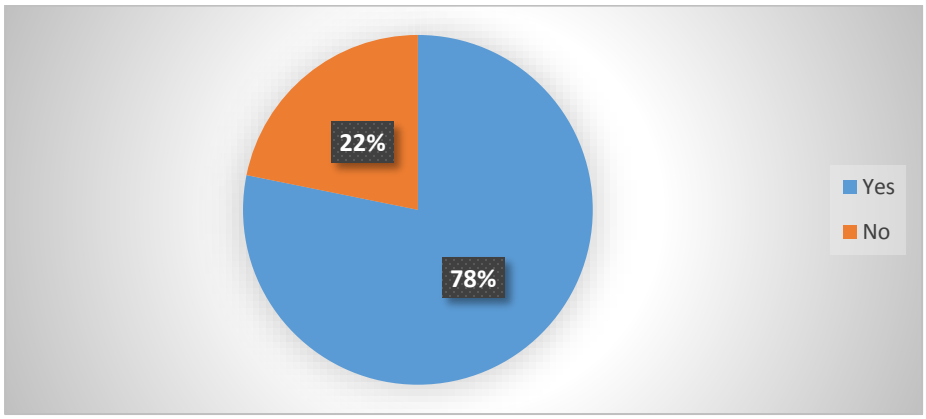

Chart 4.4 Even if load increases it is still easy to unload

The question asked is if load increases, is it still easy to unload? According to our general view, the majority answered with yes while only 1 person said no. Scisarrow was built to even work in the construction field, thus the build quality has to reflect that including the mechanism. Scisarrow is able to withstand even dumping 100kg which the standard wheelbarrow even had difficulty to do.

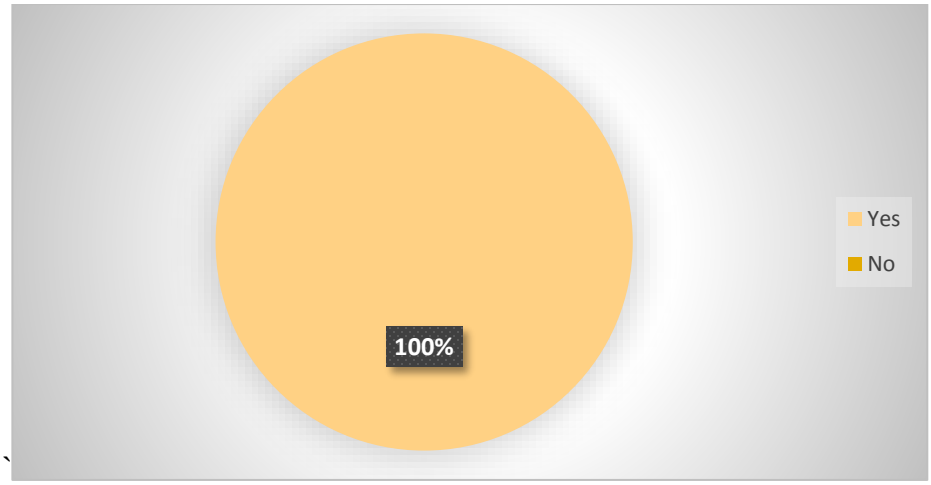

Chart 4.5 Does Scisarrow uses a lot of energy to use

For this part, does Scisarrow uses a lot of energy when used. Thus, we can see that most people

4.3 Secondary Data

Secondary data is obtained from past studies. These are in the form written sources such as thesis, journals and internet articles. Excerpts will be taken to support the researcher's study.

4.4 Data of Project

	Load (kg)	20	40	60	80	100
Time taken, seconds(s)	Wheelbarrow(s)	5	4.53	9.38	10.48	11.35
	Scisarrow(s)	2.36	1.97	3.79	3.69	5.24

Table 4.1 Load over time

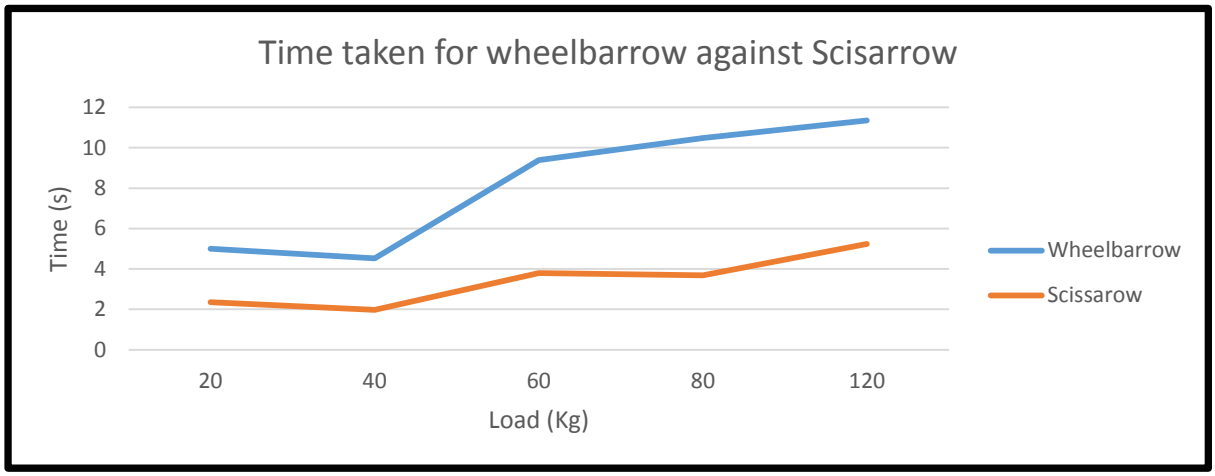

Chart 4.6 Time taken for wheelbarrow and Scisarrow to unload against load.

From chart 4.6, we can gather that Scisarrow perform well across the board. The researchers started with the initial load of 20kg and then 40kg, 60kg, 80kg and 100kg. The first test concluded with Scisarrow was able to dump 2 seconds faster than the normal wheelbarrow. The following test with 40kg was 1.97 seconds for Scisarrow while 4.53 seconds for the standard wheelbarrow. Next, the wheelbarrow had an increase of 1.5 seconds still performing better than the wheelbarrow which saw a spike in time taken which was 9.38 seconds. For 80kg, the wheelbarrow did 10.48s while Scisarrow was able to perform almost the same time with 3.69 seconds. Finally, with 100kg, the Scisarrow only took 5.24s to unload while the wheelbarrow took 11.35s, twice the time taken for Scisarrow to unload.

Chapter 5

Conclusion

5.1 Discussion

The wheelbarrow has always been used for hauling items. Be it a construction worker or even a farmer. The wheelbarrow is such a ubiquitous item in the arsenal of construction worker, it is hard to imagine a construction without one. The purpose of this study was to gauge the differences of a normal wheelbarrow and Scisarrow. Differences such as the structure of a wheelbarrow, the ergonomics and the overall comfortability were compared. The other objective was to measure the unloading time. Both wheelbarrows are loaded with 20kg, 40kg, 60kg, 80kg and 100kg to test the load limit. Results tests yielded that Scisarrow outperforms the normal wheelbarrow. While through the results of the questionnaire, the researchers prepared a set of 5 questions to gauge the overall public about our wheelbarrow. The consensus of our questionnaire yields overwhelmingly positive results throughout the samples. From this, the researchers can surmise that Scisarrow is convenient.

5.2 Suggestion

After going through extensive testing, the researchers were able to gain insight. There is always room for improvement. First, during an elevation shift from low to high, Scisarrow is unable to dump effectively. This method can be mitigated by raising the tray's position. Another point to add is the overall build of the Scisarrow. The build rattles when moving at paved road. This creates rattling noises. This problem can be amended by choosing a tighter joint and choosing a dead bolt or by introducing a rubber at pivotal points of the wheelbarrow.

5.3 Conclusion

When first starting the project, the researchers set out 3 objectives namely, to produce an innovation wheelbarrow “Scisarrow”, to make a comparison of load limit with the standard wheelbarrow and the innovation wheelbarrow (Scisarrow) and to fabricate a wheelbarrow that can shorten the unloading time. In conclusion, all the overall objective was achieved. The researchers achieved the three objectives by using interviews, questionnaire and extensive testing of the wheelbarrow. The researchers do firmly believe that there is a future in the Scisarrow in a way that it is worth pursuing commercialization of the product and further improvements can be made to accommodate the needs for the everyday working man.

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