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# FINAL YEAR PROJECT REPORT

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DEVELOPMENT OF MIXITINY MULTI-TOOL



**NAMA**

AMIRUL AKMAL BIN AZLAN ZAIDY

MUHAMMAD HAQIFF AMNI BIN HALIM

MUHAMMAD ADIB FARHAN BIN ZAMRI

**NO. PENDAFTARAN**

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**JABATAN KEJURUTERAAN MEKANIKAL**

**POLITEKNIK SULTAN SALAHUDDIN ABDUL AZIZ SHAH**

**MIXITINY MULTI-TOOL**

<b>NAMA</b>	<b>NO. PENDAFTARAN</b>
<b>AMIRUL AKMAL BIN AZLAN ZAIDY</b>	<b>08DKM18F1012</b>
<b>MUHAMMAD HAQIFF AMNI BIN HALIM</b>	<b>08DKM18F1045</b>
<b>MUHAMMAD ADIB FARHAN BIN ZAMRI</b>	<b>08DKM18F1075</b>

**Laporan ini dikemukakan kepada Jabatan Kejuruteraan Mekanikal  
sebagai memenuhi sebahagian syarat penganugerahan Diploma  
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**JUN 2020**

## AKUAN KEASLIAN DAN HAK MILIK

**TAJUK : MIXITINY MULTI-TOOL**

**SESI : JUNE 2020**

1. Kami,           **1. AMIRUL AKMAL BIN AZLAN ZAIDY           (08DKM18F1012)**  
                      **2. MUHAMMAD HAQIFF AMNI BIN HALIM   (08DKM18F1045)**  
                      **3. MUHAMMAD ADIB FARHAN BIN ZAMRI   (08DKM18F1075)**

Adalah pelajar tahun akhir **Diploma Kejuruteraan Mekanikal, Jabatan Kejuruteraan Mekanikal, Politeknik Sultan Salahuddin Abdul Aziz Shah**, yang beralamat di **Persiaran Usahawan, 40150, Shah Alam, Selangor**. (selepas ini dirujuk sebagai 'Politeknik tersebut').

2. Kami mengakui bahawa "Projek tersebut di atas" dan harta intelek yang ada di dalamnya adalah hasil karya/reka cipta asli kami tanpa mengambil atau meniru mana-mana harta intelek daripada pihak-pihak lain.

3. Kami bersetuju melepaskan pemilikan harta intelek 'projek tersebut' kepada 'Politeknik tersebut' bagi memenuhi keperluan untuk penganugerahan **Diploma Kejuruteraan Mekanikal** kepada kami.

Diperbuat dan dengan sebenar-benarnya diakui

Oleh yang tersebut;

- |                                     |   |                      |
|-------------------------------------|---|----------------------|
| a) AMIRUL AKMAL BIN AZLAN ZAIDY     | ) | .....                |
| (No. Kad Pengenalan:001221-03-0049) | ) | AMIRUL AKMAL         |
| b) MUHAMMAD HAQIFF AMNI BIN HALIM   | ) | .....                |
| (No. Kad Pengenalan:000914-10-2135) | ) | MUHAMMAD HAQIFF AMNI |
| c) MUHAMMAD ADIB FARHAN BIN ZAMRI   | ) | .....                |
| (No. Kad Pengenalan:000226-09-0011) | ) | MUHAMMAD ADIB FARHAN |

Di hadapan saya, ASNIZAH BT SAHEKHAINI	)	.....
(780410-10-5404)	)	
sebagai penyelia projek pada tarikh:6/8/2020	)	ASNIZAH BT SAHEKHAINI

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## ABSTRACT

A multi-tool includes any one of a wide range of versatile and portable hand tools that seamlessly combines many individual functions in one unit. Persons rarely carry heavy toolboxes, and emergencies occur all the time. Keeping a multi-tool for regular movements is a pretty good step, for instance, fix up bikes and cars. Multi-tool is a much more reachable and quick way to take care of the problem. Therefore, multi-tool is developed and brand as Mixitiny multi-tool as a solution to this problem. The objective is to build and create a convenient multi-tool suitable for daily use. Mixitiny multi-tool implements the design to be small, compact, and functional. This project will ease and aid everyday experience. The fabrication methods started with generating and brainstorming ideas followed by engineering design to exploit technical drawings before selecting parts. The fabrication continues by welding and joining all components. Functionality test performed to ensure the best performance. The results were analysed to solve the problem and the solution offered. Rising awareness regarding multi-tool is predicted to drive Mixitiny multi-tool demand and offer functionality at a reasonable price, bid 20% cheaper than its competitor. The compact design and it has just enough things you need on it without being unhandy. For further improvement, to put a rubber handgrip on the handle to provide a stable and comfortable ensuring safety.

**KEYWORD:** Multi-tool, Everyday carry tools

## ABSTRAK

Alat serbaguna termasuk salah satu daripada pelbagai alat tangan serbaboleh dan mudah alih yang menggabungkan pelbagai fungsi individu dalam satu unit. Seseorang jarang membawa kotak alatan yang berat, dan kecemasan berlaku sepanjang masa. Menyimpan alat serbaguna untuk keperluan harian adalah langkah yang cukup baik, contohnya, memperbaiki basikal dan kereta. Alat serbaguna kaedah yang lebih mudah diakses dan cepat untuk mengatasi masalah tersebut. Oleh itu, alat serbaguna dikembangkan dan dijenamakan sebagai Mixitiny multi-tool sebagai jalan keluar untuk masalah ini. Objektifnya adalah untuk membina dan membuat alat serbaguna yang sesuai untuk kegunaan harian. Mixitiny multi-tool mengaplikasikan reka bentuk yang kecil, padat, dan berfungsi. Projek ini akan memudahkan dan menolong pengalaman seharian. Kaedah fabrikasi dimulakan dengan menjana dan mencetuskan idea diikuti dengan reka bentuk kejuruteraan untuk memanfaatkan gambaran teknikal sebelum pemilihan bahagian. Pembuatan diteruskan dengan mengimpal dan menggabungkan semua komponen. Ujian dilakukan untuk memastikan prestasi yang terbaik. Hasilnya dianalisis untuk menyelesaikan masalah dan menawarkan solusi. Kesedaran mengenai alat serbaguna yang semakin meningkat diramalkan akan mempengaruhi permintaan Mixitiny multi-tools dan menawarkan fungsi dengan harga yang berpatutan, 20% lebih murah daripada pesaingnya. Reka bentuk yang padat dan mempunyai cukup barang yang diperlukan. Untuk penambahbaikan, meletakkan pegangan getah pada pemegang untuk stabil dan selesa memastikan keselamatan.

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# CHAPTER 1

## INTRODUCTION

Chapter one discusses the research background, problem statement, research objectives, research questions, research scope, the significance of the research, and the definition of operational terms.

### 1.1 RESEARCH BACKGROUND

Multi-tools are vastly useful devices that are purposed to replace a more traditional set of tools. Multi-tools are not intended to be a total replacement for your typical toolbox, but rather a handy substitute when a more extensive and massive set of tools is not reasonable to have.

A multi-tool consists of any one of a wide range of versatile and compact hand tools that seamlessly combines many single functions in one unit. In contrast, you can take others in a trouser pocket or belt-mounted pouch or. Multi-tool is a handy and efficient tool that has multiple features. Its main advantage is its stability.

Apart from that, each of the tools is designed to suit their purpose and are appropriately sized. Multi-tool is handy things, and we should all have one on our daily vehicles such as motorcycles and cars. Though carrying an average toolbox is not capable of motorcyclists, everyone can take a multi-tool that consists of common tools for everyday tasks—for instance, screwdriver, spanner, hex key, plier, and so on.

"Mixitiny Multi-tool" in this project title means the combination of a vastly useful tool, focuses on miniaturisation and portability with as few moving parts as possible to increase tool longevity. Therefore, "Mixitiny Multi-tool" is the tool that will be at your side when you need it to encounter those obstacles that any ordinary tools could not tackle.

## 1.2 PROBLEM STATEMENT

Single-use tools are useful but can take up a lot of space when there's a lot of it. Plus, you have to organise your single-use tools each time for them to be used properly. Paying for single-use tools are expensive and can cost hundreds of dollars if they are of high quality. Single-use tools become heavy after extended use. Every tool adds up in weight and eventually will become too heavy to carry around. Multi-tools are perfect and are great for the motorcyclist who travels on long trips. They need to provide tools in the event of an emergency. Multi-Tools are great because they have multiple tools in one small object. You only have to pay for one multi-tool and gain a various amount of tools for one price.

Although manufacturers nowadays did an excellent job developing many other everyday carry items, they typically set up folding multi-tool built around pliers or even knife and, unfortunately, the same design. The variety of styles, layouts, sizes, shapes, and toolsets could be widened far beyond the new versions of multi-tools.

## 1.3 RESEARCH OBJECTIVES

*The objectives of this study, as follows below:*

Design:

- I. To create a new product design and implement the multi-tool design to be small, compact, and functional.

Develop:

- II. To develop and create a convenience tool suitable for daily use.

Test:

- III. To test the functionality of a multi-tool product that features numerous attachments.

## 1.4 RESEARCH QUESTIONS

*This study will answer the following questions:*

- I. Is it possible to create a new design for multi-tool?
- II. What tool on a multi-tool does needed?
- III. What kind of situation that people faced?

## 1.5 SCOPE OF RESEARCH

*The scopes and limits of this research are:*

- I. This study will be focused on: "to create a new product design and to make a job easier for the motorcyclist.
- II. The project will be more of a travel accessory to solve user's problems and suitable for light mechanic work.
- III. Advantages of this project:
  - Create a tool for multiple purposes
  - Requires small spaces to store the tool
- IV. This product could not use two different tools at the same time very easily
- V. The handle or housing of the product adds a bit of extra weight

## **1.6 SIGNIFICANCE OF RESEARCH**

The project uses a variety of tools such as hex key, pliers, screwdrivers. This project will incorporate all of these tools and suitable for mechanics, motorcyclists, and home uses. The entirely new design for a multi-tool has four adjustable edges for the middle part of the product's desired work angle. The part that represents the bearing can be removed and reassembled, which makes it unique and versatile. The product is to work through a complex set of priorities, preferences, and limitations to create a product that met user demands. Besides, Mixitiny multi-tool will provide motorcyclists with some tools to make roadside or trailside repairs to their bikes. Moreover, it comes with six different bits and nut drivers to ensure that users always have the right bit for the task.

## **1.7 DEFINITION OF OPERATIONAL TERMS**

EDC - Everyday carry or EDC is a collection of useful items that are consistently carried on a person every day.

Hex key - Allen wrench or Allen key is a simple tool used to drive bolts and screws with hexagonal sockets in their heads.

Multi-tool - a device that contains various tools attached to a single object

## **CHAPTER 2**

### **LITERATURE REVIEW**

#### **2.1 INTRODUCTION**

In this chapter, will be shown three tools heavily used in the current markets. Each one has its advantages and disadvantages. Hence, all the characteristics of those single used tools will be compared to develop a product with its unique attraction and benefits. A multi-tool is any tool that has different utensils added to it. Multi-tools are known for their versatility, reliability and overall function. Most multi-tools are difficult to use and not very ergonomic. Larger and more robust than a pocket-knife-based tool, and incorporating a set of pliers. The multi-tools are too large for most pockets and may come with an inconvenient belt pouch. Our findings are based on a combination of ergonomics and portability of the product. In achieving this aim, we need to understand the importance of ergonomics and EDC principles, which is utility, versatility and portability.

Everyday Carry commonly initialised as EDC is the collection of items a person have within pockets or in a bag daily. The everyday carry philosophy is built upon the cornerstones of utility and preparedness. Each component of EDC should serve a purpose or have at least one specific, useful function. However, several items are relatively common among most of us these days and include phones, keys, and a watch. An increasing number of us are also choosing to carry items prepared for various unforeseen situations ranging from the somewhat dull to life-threatening. Such items include things like a flashlight, writing implements, first aid kits and of course the trusty multi-tool

Ergonomics is the process of designing or arranging workplaces, products and systems so that these things fit the people who use it. Ergonomics is a branch of science that aims to learn about human abilities and limitations, and then apply it to improve people's interaction with products, systems and environments. Ergonomics aims to improve workspaces and environments to minimise the risk of injury or harm, rather than expecting people to adapt to a design that forces them to work in an uncomfortable, stressful or dangerous way.

## 2.2 MULTI-TOOLS

Prepared by Amirul Akmal



Figure 2.2a – Multi-Tool

### 2.2.1 Introduction

The multi-tool embodies many core principles of EDC, for quick fixes, tinkering, and other handy work, having a toolbox's worth of functionality in a single pocketable tool is invaluable. Standard multi-tool functions include pliers, screwdrivers, bottle openers, scissors, and other cutting tools.

Multi-tools have been around since the Ancient Roman Era. During 200-300 CE, the first reported multi-tool was discovered around the Mediterranean region. The Roman version has many foldaway implements stowed inside: a knife, spike, pick, fork and a spatula. Unlike the modern-day equivalent, the Roman multi-tool has a useful spoon on end, found somewhere in the Mediterranean countries. While there were basic designs of multi-tools throughout history, there weren't any breakthrough developments until the 1800s.

By the mid-1800s, Karl Elsener developed the first model of a Swiss Army Knife. During this time, soldiers were given new rifles that needed to be unscrewed to be maintained. Instead of using a single-bladed knife tool, the Swiss Army contacted Elsener to create a multi-tool that aided the soldiers in and out of combat. The knife became so popular that by 1891, it became a standard piece of equipment for Swiss soldiers.

Today, the multi-tool market is filled with competition. Companies such as Victorinox, Wenger, and other smaller brands create high-quality multi-tools for EDC. There are dozens of small organisations and independent artisans that construct and design their multi-tools.



As is the case with many other everyday carry items, this is the era of multi-tools options. The variety of styles, layouts, sizes, shapes, and toolsets has widened far beyond the original Swiss Army Knife and continues to expand.

### **2.2.2 Types of Multi Tools**

#### Regular Multi-Tool

As its name suggests, a regular multi-tool is a small and efficient tool that has multiple features. Its main advantage is its stability. Each of the tools is designed to suit their purpose and are appropriately sized. While it can be hard to find the specific tool you need at times, a regular multi-tool is your best asset when outdoors.

#### Keychain Multi-Tool

These smaller, more compact multi-tools are efficient in portability. Keychain Multi-Tools are more comfortable to carry and conceal in public. But, the smaller size of the tools makes it harder to use at first. Practice using your keychain multi-tool a few times before taking it out with you. Consumers wanted smaller, more portable keychain multi-tools and manufacturers responded with options that provide incredible functionality in multi-tools tiny enough to attach to your keychain.

#### Credit Card Multi-Tool

Credit Card multi-tools turn your wallet into a fully functional device. But, we suggest that you don't use this type of tool for camping or outdoors. Instead, they are used as a last-ditch option that you'll rarely forget because it's stored in a place that you're seldom without your wallet. Mainly, these tools have a sharp edge that can pass for a ruler, bottle opener blade, and some small wrenches. The idea behind credit card multi-tools is for functionality that's on the go. Most credit card multi-tools have an odd-shaped design and take a long time getting familiar. While viewed as a novelty, some credit cards can be useful in EDC situations.

## 2.3 COMPONENTS RELATED

### 2.3.1 HEX KEY

Prepared by Amirul Akmal

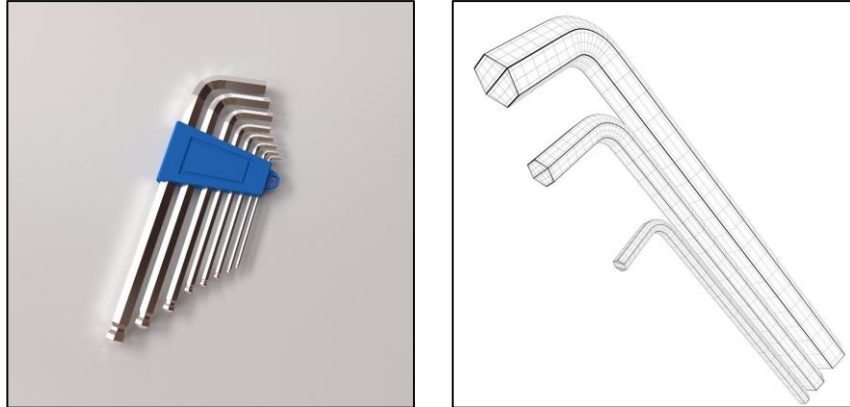


Figure 2.3.1 - Hex Key

A hex key is a simple tool used to drive bolts and screws with hexagonal sockets in their heads. Each key is meant to be used with screws of a specific socket size, with rather tight tolerances, so the tool is commonly sold in kits that include half a dozen or more keys of different sizes. Usually, the length of the key increases with the size of the socket, but not necessarily in direct proportion. The inch-based set is considered standard in the industry; however, the metric sizes are used as a standard in Europe.

William G. Allen patented a cold forming a female hexagonal recess into screw heads for the Allen Manufacturing Company of Hartford, Connecticut. The company advertised it as the "Allen safety set screw".

At the beginning of the 20th century, the most common type of fastener used in industry was a bolt with a square head. The corners of these fastener heads tended to catch on workers' clothing, leading to frequent accidents. This situation created an opportunity for someone to develop a turning tool and a fastener without corners on its head and reduce the risk of workplace accidents.

The hex key was increasingly used in the manufacturing industry. It was not until World War II and the resulting massive increase in industrial production that it became commonly used. Since then, hex fasteners have become standard on many products such as cars, bicycles, and furniture. Hex keys will often be included with self-assembly furniture these days as they are cheap to produce.

## ADVANTAGES OF HEX KEY

Hex keys create significant torque when used, which is how they can tighten and loosen hex screws easily. As shown in the image above, hex keys resemble the shape of the letter L. To use a hex key, you grab the long arm and twist it. This twisting motion creates torque that either tightens or loosens the hex screw depending on the direction in which it's turned.

Hex keys can fit into small and compact spaces where more comprehensive tools, such as traditional screwdrivers or socket wrenches, isn't possible. Furniture, for example, is often sold with one or more hex keys. When assembling the furniture, owners use the hex keys to install fasteners and connect the various pieces. The small and cramped spaces of furniture allow hex keys to fit inside and turn the pins quickly.

## DISADVANTAGES OF HEX KEY

The hexagon is typically a smaller diameter than would be used with a corresponding external hex cap, making it more likely to round off its contact surfaces if over-torqued. It is much more difficult to turn a damaged (rounded or otherwise) internal fastener than an external one.

### 2.3.2 PLIERS

Prepared by Amirul Akmal



Figure 2.3.2 – Pliers

Pliers are a multi-purpose hand tool with opposing jaws for gripping, bending and cutting. The two cross metal limbs provide tough leverage for multiplying the strength of the user's hand. Pliers are an essential part of every toolbox, as they have multiple uses. The primary use of pliers is for gripping. Pliers also work at loosening or tightening bolts, holding objects for stabilization, or removing pins, and other fasteners. The jaws are highly adjustable and can open wide for gripping pipes and large nuts.

Pliers are considered an ancient invention and believed to have developed from tongs or pincers, with two blade-like pieces joined with a flexible strip. It is thought they were first used for holding objects during smelting metal. These early developments in pliers paved the way for more refined styles such as needle-nose and circlip pliers. What began as a simple, hand-forged pair of tongs has developed into a range of specialized, sophisticated tools used around the world

The modern design of pliers, with two levers, joined at a pivot point for cutting and gripping, is thought to have been invented by the ancient Romans. This basic design has not changed much since then. Now, pliers come in many shapes and sizes, often with added features. Combination pliers combine a standard gripping tool with a cutting tool. Other pliers may have special functions, like wire stripping pliers, or round nose pliers designed to create neat circles when bending materials like wire.

## ADVANTAGES OF PLIERS

Pliers suit various jobs from detail work like jewellery to more brute force tasks like gripping and turning. Pliers cut through wires, staples, nails and other materials with relative ease. Electricians use a plier to cut through an electrical cable's insulation and strip off a short segment to expose the bare wire within. Pliers can also be used for bending or straightening objects such as sheet metal, nails and wires. The cross braces of the pliers allow for higher torque power to bend and twist.

## DISADVANTAGES OF PLIERS

Pliers should not be used on nuts or bolts. A wrench will do the job better and with less risk of damage to the fastener. There are many types and sizes, each designed for specific uses, and it is best to get the right plier for the right job, which make it take up more room in the toolbox. Pliers are not suitable to use as a hammer. They may crack or break by such abuse from hammering.

### 2.3.3 SCREWDRIVER

Prepared by Amirul Akmal



Figure 2.3.3.1 – Screwdriver

Screwdrivers are a household essential and a vital part of any toolkit. The screwdriver can be either manual or powered and used to drive screws into a variety of surfaces such as walls, wood, metal or porcelain. A typical model consists of a handle and shaft ending in a tip. The shaft is usually constructed from tough steel to resist bending and twisting.

Screwdrivers date back to the early 15th century when they were invented to tighten the newly-invented screws used in metal suits of armor and engines for war. However, not much has changed in the technology of screws and their drivers. The only real developments during the past several hundred years was an increase in the variety of drives, improvements of metals used in their manufacture, and the design of more efficient screwdriver handles. Today, much of modern technology and industry's success depends on the humble screw and its corresponding driver.

The screwdriver was a way to transfer motion. Today it is used as an easy way to fasten things together. Woodworkers began using hand screwdrivers use increased to match the increase in the production of machine-made screws. There are more than 20 different types of screwdrivers, each with its purpose and design. A screwdriver is classified by its tip, shaped to fit the driving surfaces and slots on the corresponding screw head.

## SCREWDRIVER MULTI-BIT



Figures 2.3.3.2 – Multi-Bit Screwdriver

The screwdriver multi-bit was an excellent invention for any mechanic. Before the screwdriver multi-bit was invented, you would have to buy individual screwdrivers. These screwdrivers would become very expensive, very fast because you were paying for the whole product rather than just the tip. The problem with flathead screwdrivers and even Philips screwdrivers is that they are effortless to strip.

When the screwdriver multi-bit finally came out, it was the most famous invention of the time. The screwdriver bit is just the tip. People could buy a universal screwdriver with many screwdriver bits that would allow them to change out the bits. Not only is this more convenient than having to lug around several screwdrivers, but it saves on screwdriver cost if the heads get stripped.

## ADVANTAGES OF SCREWDRIVER

One of the benefits of screwdrivers is the easy use of the tool. Screwdrivers are simple and don't require any training for its usage. It's a versatile tool and has various uses in the industry with different shapes and sizes. Moreover, it doesn't need any battery or electric supply for the operation, which means its energy-efficient and requires minimum maintenance.

## DISADVANTAGES OF SCREWDRIVER

Screw heads can become stripped and worn down, with repeated use of a screwdriver. It's prone to slipping and falls off from the hand easily that damages the screw or surrounding spaces.



## **CHAPTER 3**

### **METHODOLOGY**

#### **3.1 INTRODUCTION**

The research methodology is the precise procedures or techniques used to identify, select, process, and analyse information about a topic. In a research paper, the methodology section allows the reader to evaluate a study's overall validity and reliability. According to ("methodology - definition of methodology in English from the Cambridge English Dictionary," n.d.), the methodology is defined as a system of ways of doing, teaching, or studying something. Obviously, the word methodology is related to the word method. A methodology is a system of methods followed consistently and employed a deductive research approach.

This chapter, there has been a lot of changes that be made and learning to complete the year-end project. Flowcharts and Gantt charts are both practical tools to plan projects. However, when it comes to project execution, both charts have different uses and applications. For an elaborate plan with a longer duration, a Gantt chart is better, while a flow chart suitable for short term and project subtasks. Noticeably the flow chart and Gantt chart used as a reference or table during the final project. Flow charts display a stage by stage progression and sequence of events to be systematic during work. The Gantt chart refers to the division of work throughout all the final semester 15 weeks to run as planned

Methodology chapter justifies the design choices by showing that the chosen methods and techniques are acceptable for the objectives and research aims. Moreover, this chapter also will show two methods of fabrication to carry out the final year project. The material selection is very crucial to minimise cost and meet product performance. Through testing, prepare to do further modifications until the product is market-ready and safe to use. Product testing also followed by collecting and analysing information about the user's behaviour, preferences, and opinions about the product.

### 3.2 FLOW CHART

The work procedure of this project is planned in a systematic flowchart. The diagram shows an overview of the methodology, and the description is present below:

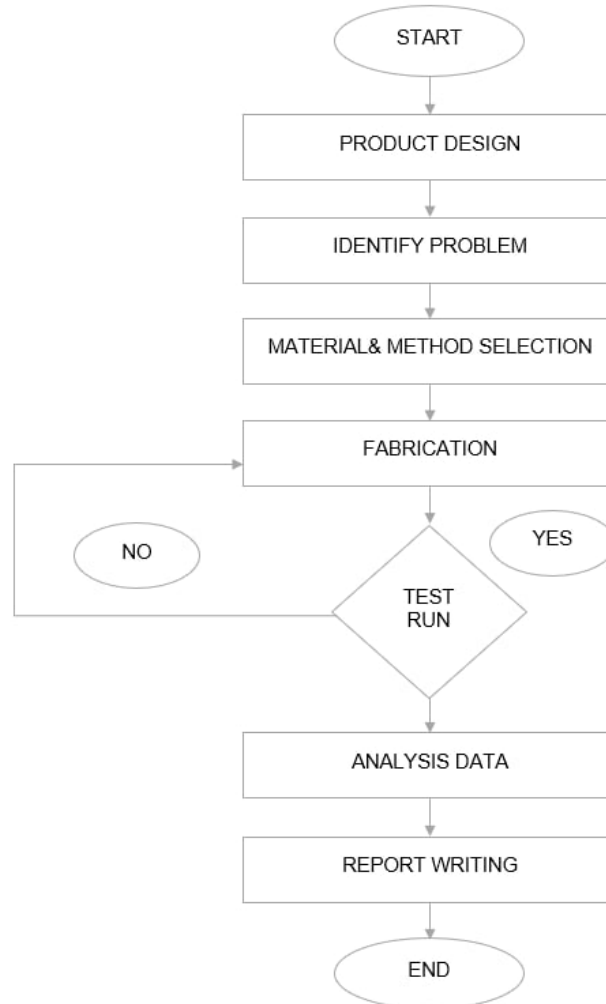


Figure 3.2 – Flow chart

As can be seen from the diagram, a flowchart gives an exact visual representation of different project stages and decisions needed to perform a process. Each step in the series is noted within a diagram shape, and the arrows show the direction of flow. In case of a decision, the yes and no indicate how to tackle different possible outcomes. This chart allows anyone to view the chart workflow and logically follow the process from beginning to end.

### 3.3 FLOW CHART EXPLANATION

#### 3.3.1 Product Design

The development and introduction of new product design are both risky and costly. It is necessary to have a complementary fact to meet up with the competition in the product design market. The decision made at the design stage of a new product can have a long term influence on the project organisation. The product should also be designed to be functional, attractive, and have suitable dimensions. This project come up with a new design of multi-tools with a solution to redesign the currently available product. Redesigning means changing some aspect of the design so that it can be manufactured at a lower cost. Studying product design gives broad theoretical knowledge and practical skillset that useful for production methods and materials selection.

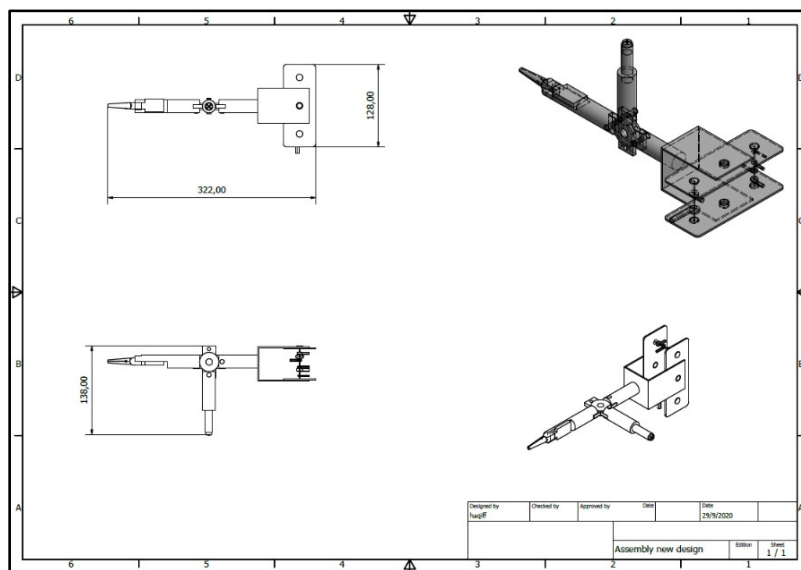


Figure 3.3.1.1 – Design drawing

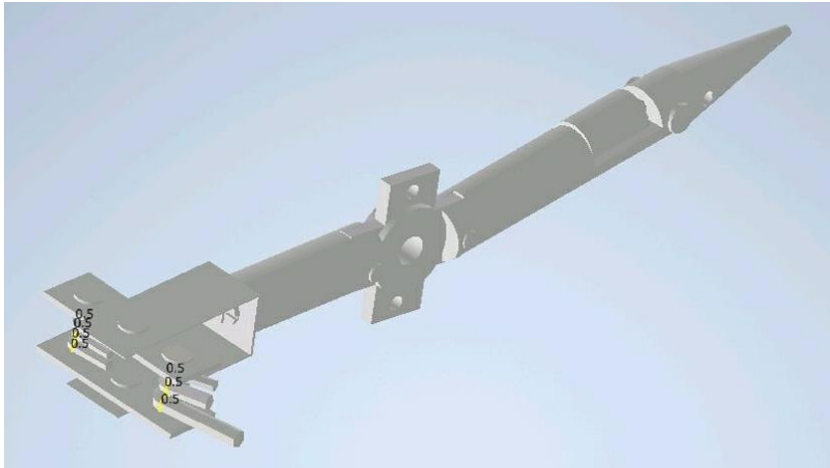


Figure 3.3.1.2 – Design

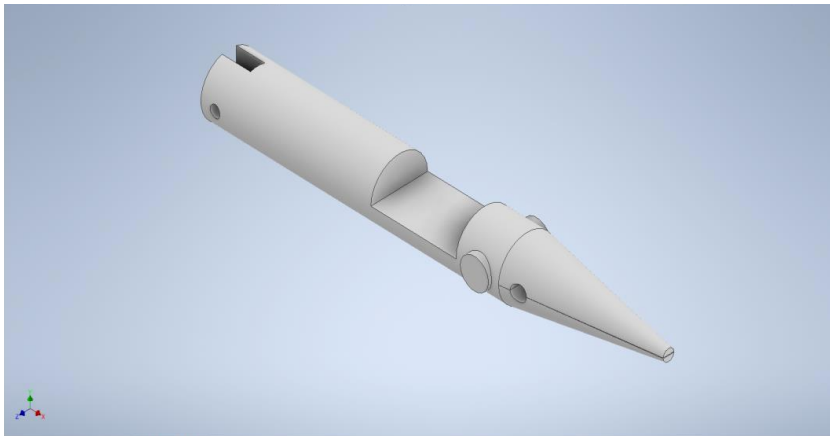


Figure 3.3.1.3 – Plier design

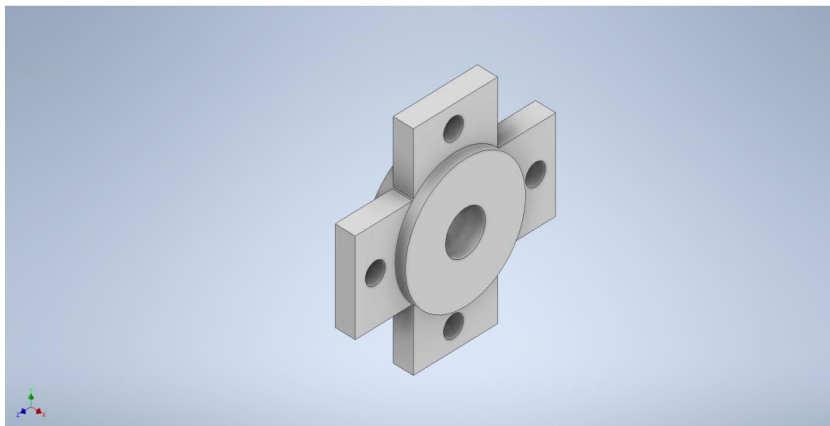


Figure 3.3.1.4 – Bearing design

### 3.3.2 Material Selection

This chapter shows a systematic procedure for selecting materials, leading to the best matches for the design requirements. Presenting in this format will allow for easier material selection and design. There are many kinds of materials used in the construction of a multi-tool. The opportunities for innovation are immense, and making a rational choice is vital. Material selection begins with the identification and prioritisation of critical design criteria. In many cases, the procedures used in selecting a multi-tool material requires consideration of many of the material properties and depending upon the requirements for each specific application. Attribute features heavily influence the material selection, and the material must be tough, affordable price, withstand tensile loads and resist corrosion.

#### 1. Carbon Steel Body



Figure 3.3.2.1 – Body

Carbon steel divided into low carbon steel, medium carbon steel, and high carbon steel, depending on the carbon content. The greater the tools' hardness, the higher the carbon content, and the lower the toughness. The Mixitiny multi-tool body, manufacture via High-carbon steel because it has high hardness and high strength. On the body part, each body has necessary tools attached such as Allen key, plier and screwdriver. When finished, the body will be locked on the bearing using screws and bolts. It can be opened if we do not want to use the tool to one part

#### Specifications

- I. 3-piece of body
- II. Material: Carbon steel
- III. Weight 0.07 kg

## 2. Hex Key



Figures 3.3.2.2 – Hex key

A hex key is a simple tool used to drive bolts and screws with hexagonal sockets in their heads. Each key is used with screws of a specific socket size, with rather tight tolerances, so it is often sold in kits. The hex key is a small hand tool and always missing from sets. Due to this, the hex key is included in the Mixitiny multi-tool.

### Specifications

- I. 8-piece hex key wrench set
- II. Complete with keyring holder to keep wrenches organised.
- III. Chrome-plated steel.
- IV. Hex key size chart:

Hex Key Size	Length (mm)	Thread Size
2	47	M2
3	48	M4
4	50	M5
5	65	M8
6	68	M10
8	70	M12

Table 3.3.2 – Hex key size

### 3. Bearing



Figure 3.3.2.3 – Bearing

Rolling bearings support and guide rotating or oscillating machine elements transfer loads between machine components. They provide high precision and low friction and enable high rotational speeds while reducing noise, heat, energy consumption, and wear. Bearing is used to determine the angle we want. For example, if we're going to open the screw / Allen key at a difficult angle, we need a 90-degree angle to open it. Bearing plays an essential role as it will make it easier for the user to use it

#### Specifications

- I. 1-piece wheel bearing anti-rust red sealed
- II. Material: Iron
- III. Weight: 0.063kg
- IV. Outer diameter: 22mm
- V. Inner diameter: 8mm
- VI. Width: 7mm

#### 4. Pliers



Figures 3.3.2.4 – Plier

Pliers are hand tools designed for a fully complete application and can be used for various tasks, including lock, grip, twist, hold, bend or cut materials such as wires. Pliers appear in many sizes and styles, depending on their application. Pliers are a multifunction tool, make it a compatible tool for the project.

#### Specifications

- I. Type: needle nose pliers
- II. Length: 8 inches / 20.5 cm
- III. Weight 0.23kg
- IV. Material: Carbon Steel
- V. Handle Style: Straight



## 5. Screwdriver



Figures 3.3.2.5 – Screwdriver

The screwdriver was a process to transfer motion to loosen or tighten screws. There are many head types and lengths to choose from, depending on their purpose and design. A screwdriver is classified by its tip, shaped to fit the driving surfaces and slots on the corresponding screw head. A screwdriver is the most familiar tool found in any toolbox or household, universal screwdriver with a bunch of screwdriver bits that would allow them to change out the bits which is comes with six popular bits therefore suitable for the Mixitiny Multi-tool.

### Specifications

- I. 1 screwdriver body piece and 6 precision bits
- II. Length: 140mm
- III. Material: Plastic handle and carbon steel
- IV. Weight: 0.12kg
- V. Bits Included: 1/8 Inch Slotted, 3/16 Inch Slotted, 1/4 Inch Slotted x 2 Phillips Bits

### 3.3.3 Method Selection

The method selection is an essential part of the overall design production. Method selection is the strategic decisions of selecting the kind of production method to have in production and operations to satisfies the needs of the product. The goal of the method selection is to realise the procedure of a process that fulfils the needs of the product and contributes many possibly beneficial ways discovered, hence the development of a better product for users. Picking the right methods can decrease operational costs and improve product quality.

Two methods could be carried out:

#### 1. Fitting



Figure 3.3.3.1 – Fitting

Fitting is linked to the assembly of parts after obtaining the dimension or shape to the necessary size or form to secure the required fit, marking the work to provide cutting and drilling guidelines. The cutting Tools were for removing or cutting the unwanted pieces of the product. This method is compatible with the product size and improves accuracy while saving some funds. Fitting used as dimensioning and tolerancing when an assembly is designed. In engineering terms, the "fit" is the clearance between two mating parts, and the size of this clearance determines whether the parts can move or rotate independently from each other and temporarily or permanently joined together.

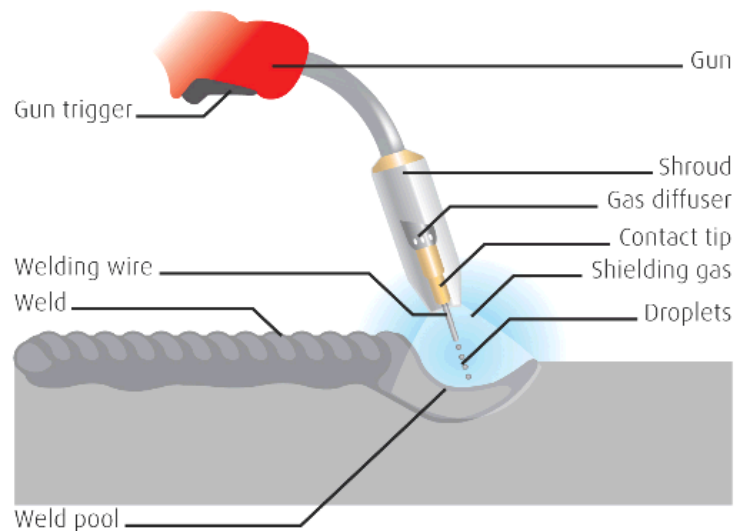


Figure 3.3.3.2 – MIG welding component

## 2. MIG Welding

Metal Inert Gas or known as MIG welding, is an arc welding process that uses a continuous solid wire electrode heated and fed into the weld pool from a welding gun. The two base materials are melted together, forming a joint. The gun provides a shielding gas alongside the electrode helping protect the weld pool from airborne contaminants. MIG welding is a versatile technique perfect for the thin project sheet and small components. Welding is a popular process because the pieces of metal can be any shape or size. This method is easy to learn, produces less welding fumes, has high electrode efficiency and requires less heat input. However, the equipment is costly, the process does not work effectively on thick materials, and it requires an external shielding gas.

### 3.3.4 Fabrication

Fabrication is the act of taking raw stock material and turning it into a part for use in an assembly process. In other words, it is the process of making something from scratch rather than assembling something. There are many different types of fabrication processes that cuts, shapes, or moulds metal material into a final product. The method used depends on both material and the desired product. This project fabrication referred to the design and customised the metal parts of a multi-tool needs.

#### 1. Abrasive Saw Cutting

There are many ways to cut nowadays with a wide range of complexity and price. An abrasive saw is a power tool used to cut the project plier part. The cutting action is performed by an abrasive disc, similar to a thin grinding wheel.



Figures 3.3.4.1 – machine preparing



Figures 3.3.4.2 – Cutting process

#### Procedures

- I. Ensure all adjustments to the machine are secure before making a cut
- II. Use the vice to clamp the work and properly support the over-hanging portion of the workpiece level with the base of the machine.
- III. For the safest and most efficient cutting, make sure that the cut-off wheel contacts the centre of the workpiece.
- IV. Ease the abrasive disc against the plier when starting to cut. Do not force tool.
- V. When the cut is complete, raise the wheel completely from the plier.

## 2. Filing

A hand file is a hand saw with an extensive blade. Just like a saw, it cuts material using teeth. A typical hand file is made from a bar of high-carbon steel with its teeth pressed, cut, or raised into the steel. As a result, when those teeth are rubbed across another piece of softer material, the teeth will dig into the material and pull bits away. Filing is a process smoothing or shaping a surface using a tool with a rough surface or surfaces. Rasps are used for rapid removal of material and leave a much coarser finish.



Figure 3.3.4.3 Filling tool

### Procedures

- I. Ensure that the material is securely held in the vice and is not going to get damaged due to the grip in the vice
- II. Select the suitable file and file diagonally to as close to the construction line by adding force to remove access material
- III. file the material on both its horizontal and vertical side until getting flat surface and correct measurement.
- IV. Once the majority access material removed, begin to use the flat face of the half-rounded file to remove fewer obstructing pieces of waste material.
- V. When too close to construction line change to the flat file and begin the straightforward and backstrokes to smooth the edges of the metal
- VI. Repeat these steps on each edge of the material

### 3. Welding

Welding is a fabrication process whereby two or more parts are fused utilising heat, pressure or both forming a join as the parts cool. Welding is usually used on metals and thermoplastics but can also be used on wood. The completed welded joint may be referred to as a weldment.



Figure 3.3.4.4 – Welding process

#### Procedure

- I. Set the shielding gas flow rate, and proper amperage
- II. Use small diameter wire for thin body material to weld the tool
- III. Keep the gun straight as possible when welding to avoid poor wire feeding and Use both hands to steady the gun when a weld
- IV. Keep wire feeder tight enough to feed wire and Keep a 1/4 to 3/8 electrode extending from the tip of the contact tube
- V. Control of weld bead keep the wire directed at the leading edge of the weld pool

### 3.3.5 Product Testing

As with any product, multi-tools must go through a long process of development before the product make it into the hands of users. Product testing is the last phase of a project's design cycle. Once the prototype has been designed and thoroughly developed, the product required to be tested for any flaws and work correctly, if the results are dissatisfied, changes need to be made. During the testing phase, several methods will be employed to ensure that the product operates as expected and intended to determine the limitations and weaknesses of the product. The variety of tests performed to measure the performance and properties of a product. It is not difficult to test against real-world scenarios because the results are surprisingly predictable for Mixitiny Multi-tool.

#### 1. Stress Rupture and Creep Testing



Figure 3.3.5.1 – Creep Testing

It provides critical information for the project, enabling students to prevent failures by giving insights into the effect of long-term stress on materials and products to see how many times the product can perform before it wears out. The testing is through a manual use to make sure the in-hand fit is right.

## 2. Field Testing



Figures 3.3.5.2 – Screwdriver and Hex key testing

The second testing method in Mixitiny multi-tool product development process is field testing. For this part, students take the tools directly to people for real-life testing on the job site. This test allows not only to ensure that the tools function as intended but also to get feedback from the user who knows their own needs and tools. Given that they are the ones who use and rely on these tools daily, our end-users' feedback is one of the most critical parts of the product development process.

### 3.4 GANTT CHART

A Gantt chart is a visual view of tasks scheduled overtime. Gantt charts are used for planning projects and a useful way of showing what work is scheduled to be done on a specific day. Gantt Chart also helps to view the start and end dates of a project in a straightforward table



## GANTT CHART

Weeks	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
<i>Events</i>															
<i>Briefing and Project Planning</i>															
<i>Project Design</i>															
<i>Materials Selection</i>															
<i>Method Selection</i>															
<i>Fabrication</i>															
<i>Test Run</i>															
<i>Analysis of Data</i>															
<i>Innovation Video</i>															
<i>PITEX Report</i>															
<i>Report Writing</i>															
<i>Report and Logbook Submitting</i>															

Table 3.4 – Gantt



## **CHAPTER 4**

### **RESULT AND DISCUSSION**

#### **4.1 INTRODUCTION**

This section describes the students' supplemental data to create datasets and illustrates the use of different data types that help in project development. The numerical data also give information on whether the effort was successful and any changes compared to the early proposed idea approach. The best approach to data analysis is, to begin with, the most comprehensive information. For example, the most compelling reports begin by describing the design, analysis, and graphing involved. The information is likely to be accurate and detailed. The student will have specific knowledge of the data sources, and the obstacles found during analysis.

This project has achieved its objectives and scope. The tool has been focused on motorcycle workshop workers and motorcycle riders to bring handicrafts in small quantities to use and take it anywhere as EDC. Motorcyclists can easily carry this hand tool as it has all the crucial tools. For workshop workers, it will minimize the amount of equipment in their toolbox. This tool has all the main tools such as driver screw, plier and hex key. Several aspects need to be considered to make this equipment. Among the elements that are taken into account in making this equipment are the parts of the accessory body, plier connection and the hex key plate

## 4.2 METHODS

### Data Collection

Data collection is the process of gathering and measuring information on variables of interest, in an established systematic way that enables an individual to answer stated research questions, test hypotheses, and evaluate outcomes. The data collection component of research is common to all fields of study, including engineering and social sciences, business, etc. While methods vary by discipline, the emphasis on ensuring accurate and honest collection remains the same.

Data used for this analysis comes from the survey at [https://docs.google.com/forms/d/1et6aljyn-SQOAh\\_bqzj3tLOpREgn9mkvkzkRXXM0eIE/edit](https://docs.google.com/forms/d/1et6aljyn-SQOAh_bqzj3tLOpREgn9mkvkzkRXXM0eIE/edit). Data was downloaded on Sunday, November 22 2020, from Google Form.

### Graphs

Graphics are extremely helpful in translating data. Graphs are a standard method to illustrate relationships between variables in the data visually. The purpose of a graph is to present data that are too numerous or complicated to be described adequately in the text and less space.

A pie chart shows classes or groups of data in proportion to the whole data set. The entire pie represents all the data, while each slice or segment represents a different class or group within the whole. Each slice should show significant variations. The number of categories should be generally limited to between 3 and 10.

### 4.3 ANALYSIS

The analysis results for this project by using observation questionnaires among students and the general public to ensure that this project is done well with features that can solve people's problems.

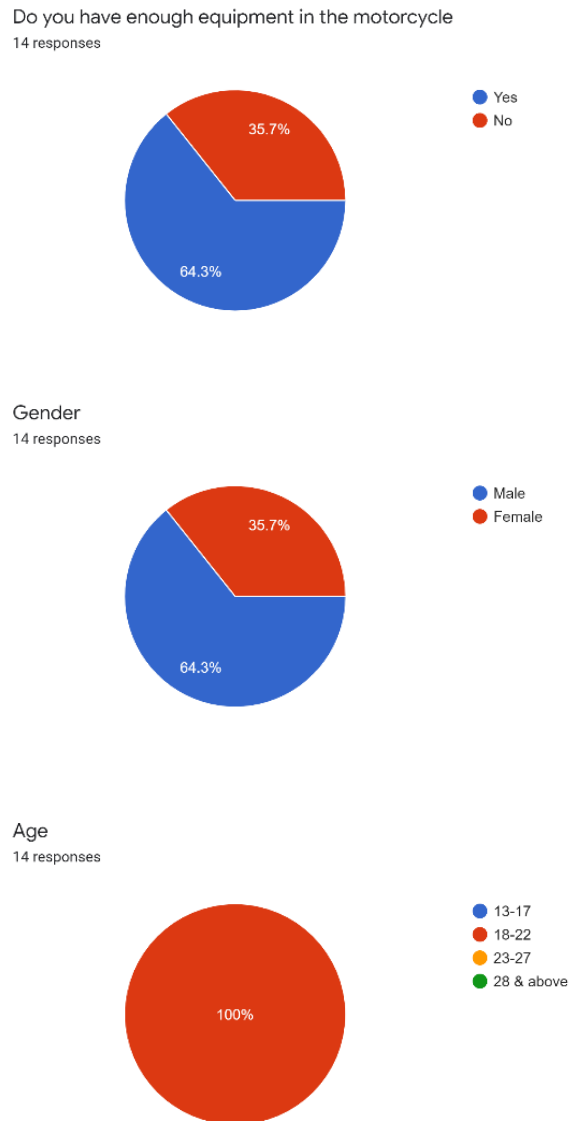
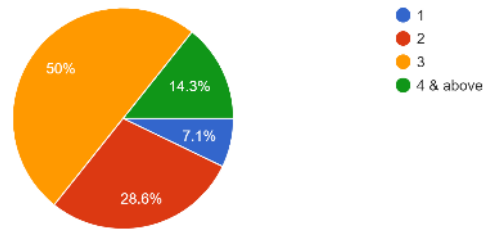


Figure 4.3.1 – Results for question 1,2 and 3

From this result of the analysis is 14 respondents answer this question. 64.3% is female, and 35.7% is male answer the question. The respondent age is 18-22 years old. The respondent with enough equipment in the motorcycle is 64.3% and has insufficient equipment in 35.7%.

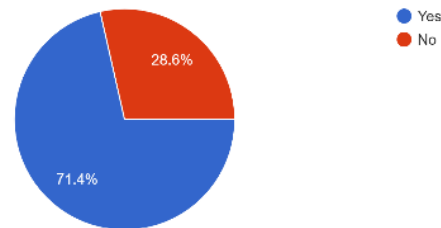
How much equipment did you bring?

14 responses



Is it difficult to carry a lot of equipment?

14 responses



Do you always carry equipment wherever you go?

14 responses

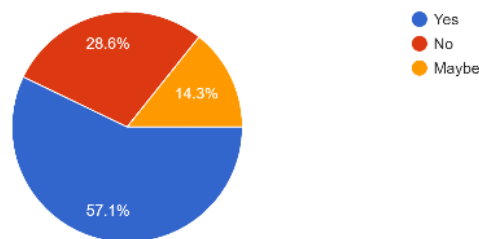


Figure 4.3.2 – Results for question 4,5 and 6

From the question 4,5 and 6. The respondent answer how much equipment they brought. They are 50% who brought three equipment, 28.6% bring two equipment, 14.3% bring four and above and 7.1% who only bring one equipment. This because they find it challenging to carry a lot of equipment and consume space. In question 6, respondent answer difficulty in taking a lot of equipment. Answer yes in 71.4% and 28.6% for the answer no. In question 7, the respondent answer did they always have equipment wherever they go. 57.1% still carry their equipment, 28.6% who do not carry their equipment, and 14.3% will carry them if needed.

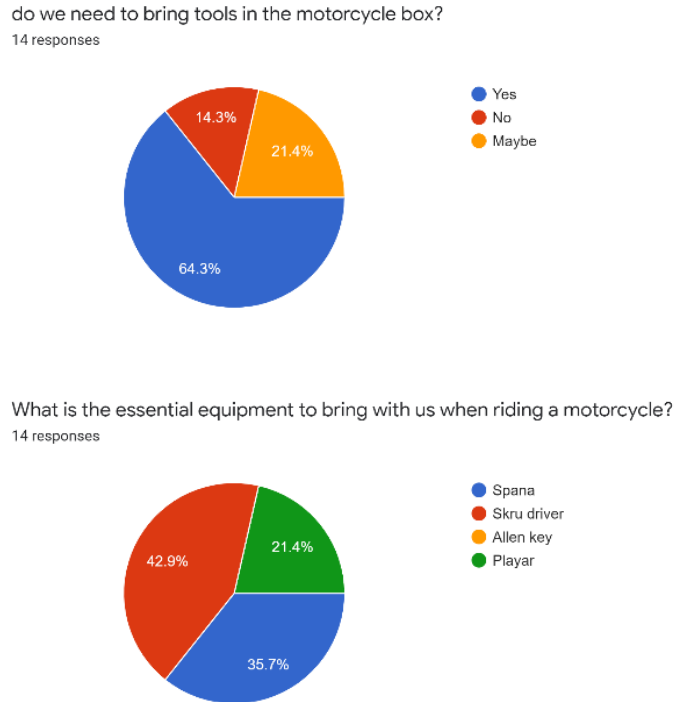


Figure 4.3.3 – Results for question 7 and 8

The respondent answer question do they need to bring tools in motorcycle box. 64.3% who answer yes and always bring their tools, 14.3% do not bring their tools and 21.4% who answer maybe. In this question, the respondent answer what essential equipment to bring with them when riding a motorcycle is. They are four essential tools such as spanner, screwdriver, hex key, and plier. 42.9% who always bring a screwdriver, 35.7% bring spanner, 21.4% bring plier, and no one brings hex key. The respondent answers the question because it will easy to tighten the components easy to open all the bolt and nut and a lot of nut needs to be loosened if needed.

#### 4.3.1 Analysis Summary

From this observation questioners, this product will help people bring the tools efficiently and in small quantities. This project will allow them to get all the necessary tools because if they want to open the screw or Allen key in their motorcycle. This product will be useful for riders who always ride their motorcycle. It will be a problem with motorcycles if we are always riding. This design is easy to put in the motorcycle's box because it has tiny tools.

### 4.3.2 Design Description

Next, design description. At this point, The conceptual design of the products that can perform a wide variety of tasks as a single tool. A design comparison shows that the students have the analytical skill to design a different product consider a range of similar products and adds a few notes about each product design. A comparison usually involves a few designs and also includes detailed notes. The advantages and disadvantages are carried out by the design and some criteria like portability, construction method and cost.

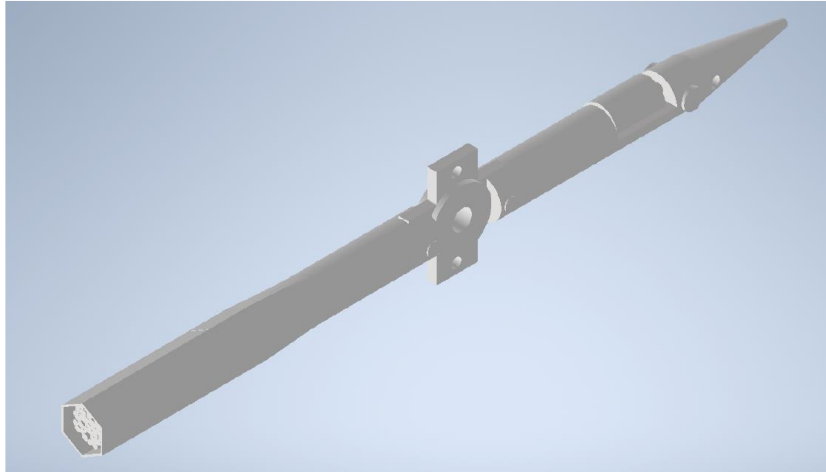


Figure 4.3.2.1 – Design A

#### Advantage

- The design aims for maximum utility of a set of tools while being more comfortable to carry and crams as much function into a reasonably sized tool.
- The design improving ergonomics and making it feel like a proper, single tool.

#### Disadvantage

- The design is costly to compile the hex key. It costs more than any other design evaluated.
- Requires a few steps to take out the hex key in the housing and time-consuming to remove the hex key locking mechanism.

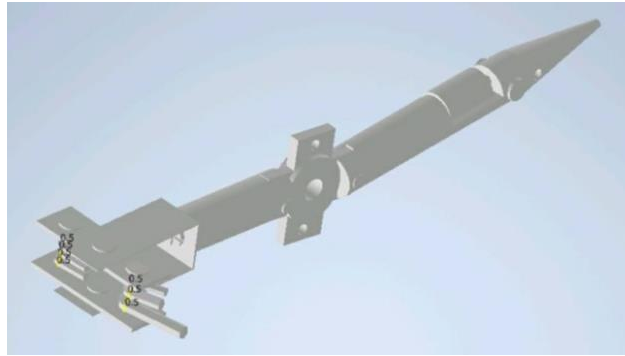


Figure 4.3.2.2 – Actual design



Figure 4.3.2.3 –Working product

#### Advantage

- An entirely new design for Multi-tool and straightforward to use.
- A cheap, effective and one-piece multi-tool design
- The design is practical and clean, with only a few tools, all of which are executed well for everyday carry.
- let's users wield all the tools with a single hand which is very convenient
- With the added weight, this design did the best with rusted and stuck bolts, and it cut the wire with ease

#### Disadvantage

- The handle or housing represents extra weight to it but never found it unwieldy or awkward to carry.
- A downside is that it's much more challenging to deploy the individual tools.
- cannot use two different tools at the same time very easily



#### **4.4 IMPLEMENTATION AND USING METHOD**

The Mixitiny multi-tool is a tool that combines various functions of tools in one compact package. Some of the tools are hex key, pliers, and multi-bit screwdrivers. This product is very suitable for especially motorcyclists and home uses. The design used is very up-to-date and easy to carry anywhere in a motorcycle boot and a bag daily. It has four adjustable edges for the desired work angle in the middle part of the product, which makes it unique and versatile. The part that represents the bearing can be removed and reassembled.

The main feature is the hex keys. It is used to drive bolts and screws with hexagonal sockets in their heads. Stick the L shape's short end into the bolt head and press down to turn the bolt.

Furthermore, to safely use pliers, close the jaw around the object by pressing the handles closer together without any contact with the plier's jaw and pivot.

Next, how to use a multi-bit screwdriver that comes with Mixitiny multi-tool is Inserting the tip of the screwdriver into the head of the fastener to verify it securely fits. As a reminder, do not use a screwdriver as a punch, pinch bar, or pry. In the end, it's up to the user to wield the product due to the Mixitiny multi-tool versatility.

#### **4.5 BENEFITS AND ADVANTAGES**

One of the main advantages that Mixitiny multi-tools have is various tools such as hex key, pliers, and screwdrivers. These tools are the most common tool found in any toolbox of mechanics or even at home, which is must-have basics tools that anyone owns. This new product eliminates the need to select and purchase a separate set of workshop equipment, which is expensive, and the extra features don't justify the price tag. The conventional tool is regularly misplaced and lost because of small size and separated from it set after use. Hence, the Mixitiny Multi-tool keeps everything together and prevents losing any of the individual items when needed.

This project will incorporate all of these tools and suitable for mechanics, motorcyclists, and home uses. The Mixitiny Multi-tool is the essential tool you need for all sorts of simple repair tasks and ideal for DIY projects at home. The attributes of the Mixitiny multi-tool is compact and feel sturdy in the of users. It has just enough things you need on it without being unhandy and well-executed for everyday carry. This product lets users wield their tools easily with one hand with a straightforward, user-friendly design.

The product manufactured by Politeknik Sultan Abdul Aziz Shah students, which already available in Malaysia. Therefore, buying Malaysian products may directly encourage domestic consumption, which will help the overall Malaysia economy. Thus, indirectly raise the public awareness of the quality of goods and services offered in Malaysia on par with international standards.

## 4.6 COSTING

For this costing is to help the project on that track without going over budget. This will get a detailed list of the estimates, and it's used to control the spending. This table will help ultimately to get actual costs and to manage the project cost. The table below shows the costing for this project

NO	MATERIAL / EQUIPMENT	QUANTITY	PRICE
1	SCREWDRIVER	1	RM20.00
2	PLIER	1	RM7.00
3	HEX KEY	1 SET	RM15.00
4	BEARING	1	RM10.00
5	ALUMINIUM PLATE	2	RM30.00
6	METAL BODY	3	RM180.00
7	CASING BEARING	1	RM45.00
TOTAL			RM 307

Table 4.6 – List of component and cost

## **CHAPTER 5**

### **CONCLUSIONS AND RECOMMENDATIONS**

#### **5.1 INTRODUCTION**

The conclusion allows presenting the last word on the issues and innovation have raised in the report paper. Concluding paragraphs should be clear and sum up the project's impact, which supports making an excellent final impression on a positive side. The conclusion also helps to refocus the reader's attention to the most important points and supporting evidence after reading the paper.

This chapter covers the conclusion for the overall of this project. The conclusion will be concluded the future recommendation and improvement for future innovation with a better result for the multi-tool design. In promoting a good explanation, the following sections also present the project's discussion and recommendations to improve quality.

## 5.2 DISCUSSION

The Mixitiny project aims to develop innovative multi-tool and improve the existing project to be more affordable, accessible, and high-quality. The Innovation of Mixitiny multi-tool is the compact design without being unhandy, thus more attractive to the consumer. The Mixitiny multi-tools are saving weight and space over a set of individual tools to perform the same function as traditional tools.

The product practically tested as compact enough to carry and functional when used. The project's effectiveness is used during regular movements for quick access to many useful tools in a compact package. The project can be expanded among motorcycle enthusiasts or even mechanics. Advertising and commercialisation are recommended to help inform the customers about the Mixitiny multi-tool availability in the market.

On the other hand, the project's unique feature is having a variety of tools such as hex key, pliers, and screwdrivers that combines several individual functions in a single unit. Each of the tools is designed to suit their purpose and are appropriately sized for the product. This project will incorporate all these tools and suitable for mechanics, motorcyclists, and home uses. Furthermore, this product offer functionality at a reasonable price, bid 20% cheaper than its competitor, which is more expensive, and the extra features don't justify the price tag.

## **5.3 PROBLEM**

There will almost always be unexpected problems and questions that crop up in any project's life cycle because every project is different and unique. Most importantly, deal with the problem quickly and effectively.

### **5.3.1 Problem and Challenges**

The biggest problem that can be identified when doing project 2 is

- I. Assembly method
  - Connection parts on each component
  - Material to be emphasised for connection to welding
- II. Rusty materials
  - The material causing the project duration will be short
  - Reduce the quality level of the project

### **5.3.2 Solving Problem**

- Identified several connecting methods that we can use to overcome this problem among them are welding method and bolt and nut method
- Recognised suitable materials to solve the problem occurred such as aluminium and alloy
- For materials that are easily corroded and cause short project life we use the colour spray to slow down the rusting process

### 5.3.3 Others Problem

When planning to complete a project, several aspects need to be emphasised to give satisfaction to users. Besides, it can improve the quality of the product produced. However, some problems need to be faced with completing the project, for example:

- Reasonable price
- Useful products to users
- Quality
- Manufacturing costs
- The process involved

### 5.4 RECOMMENDATION

After completing this project, "Mixitiny Multi-Tool" can formulate and portray some of our suggestion and views after getting the result. Talking to prospects has helped the project a lot and stayed inspired to employ a more strategic product development approach. The popular ways to make product improvements are to add new product features or improve existing ones.

Among the following suggestions are:

- i. Understand in more detail and depth about the project
- ii. Make more in-depth research to get the best results in the field of design
- iii. Obtain more detailed information by conducting research and discussions with the experts
- iv. Pay more attention to the size and amount of space that the product will be taking up.
- v. Look for alternative materials in the product handles to save weight and the quality of the tools.
- vi. Add more function into the product while maintaining a reasonably sized tool
- vii. Attach safety locking mechanism to close each tool securely and lock into place when open.

## 5.5 CONCLUSION

The plan will not happen by itself. The process of making a carefully designed multi-tool is quite complicated because of the various obstacles and problems. Additionally, this project improving students existing skills while spends value time learning new things. The supervisor, Puan Asnizah, is responsible for monitoring the project progress and chasing up overdue activities.

This report has documented the development, features, method and use of the Mixitiny multi-tool as a complete everyday carry tool that can be utilised to tackle the task and benefited everyone. The design challenges the new framework through revolutionary design based on ancient utility with regular tools options.

Mixitiny Multi-tool is made of a steel base material. This product introduces a new multi-tool development composed of plier, screwdriver, hex key, and rotary bearing onto a steel body to provide portability to the user. The product adopts a compact and sturdy mechanical strength that guaranteed in a higher durable product. Finally, the stated objectives and aims were achieved and implemented effectively. Apart from that, Mixitiny Multi-tool creates new opportunities to introduce and sell the products to interested customers.



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## APPENDIX