# POLITEKNIK BANTING SELANGOR

# VERTICAL CAROUSEL STORAGE BOX

**MUHD IKHWAN AFIQ BIN HUSIN**

**(24DTP22F1015)**

**AMIRUL FAUZHAN BIN GAFFAR**

**(24DTP22F1056)**

**MEOR IRFAN SYAZWI BIN MEOR ISHAM**

**(24DTP22F1048)**

**MOHD AIDIL HAFIZ BIN ZAILAN**

**(24DTP22F1021)**

This report was submitted to the Mechanical Engineering Department as part of the requirements for the award of the Mechanical Engineering Diploma

## MECHANICAL ENGINEERING DEPARTMENT

## DECEMBER 2024

**STATEMENT OF AUTHENTICITY AND PROPRIETARY RIGHTS**

**RESEARCH OF MECHANICAL VERTICAL CAROUSEL STORAGE BOX**

We, **MUHD IKHWAN AFIQ BIN HUSIN (NO KP: 041016-10-0593), AMIRUL FAUZHAN BIN GAFFAR (NO KP: 040320-12-0121), MEOR IRFAN SYAZWI BIN MEOR ISHAM (NO KP: 040804-08-0365), MOHD AIDIL HAFIZ BIN ZAILAN (NO KP: 040923-06-0455)** is a Mechanical Engineering Diploma student, Polytechnic Banting Selangor, whose address is **Persiaran Ilmu, Jalan Abdul Samad 42700 Banting, Selangor**. (Here in after referred to as 'the Polytechnic')

1. We acknowledge that the 'Project above' and the intellectual property in it are the result of our original work/design without taking or copying any intellectual property from other parties.

2. We agree to release the ownership of the intellectual property of 'the Project' to 'the Polytechnic' to meet the requirements for the awarding of the **Mechanical Engineering Diploma** to us.

Done and truly acknowledged
By that;

1. MUHD IKHWAN AFIQ BIN HUSIN ……..
   (NO KP: 041016-10-0593) IKHWAN
2. AMIRUL FAUZHAN BIN GAFFAR ……..
   (NO KP: 040320-12-0121) FAUZHAN
3. MEOR IRFAN SYAZWI BIN MEOR ISHAM ……..
   (NO KP: 040804-08-0365) MEOR
4. MOHD AIDIL HAFIZ BIN ZAILAN ……..
   (NO KP: 040923-06-0455) AIDIL

In front, MADAM NURUL HAYATI BINTI JAMIL ……..
As our group supervisor MADAM HAYATI

## ACKNOWLEDGEMENT

This thesis becomes a reality with the kind support and help of many individuals. We would like to extend our sincere thanks to all of them. Foremost, we want to offer this endeavour to Allah S.W.T. Almighty for the wisdom he bestowed upon us, the strength, peace of our mind and good health in order to finish this research. Even though there is many challenges and obstacles that we have been face in order to finish up our final year project assignment during fabrication and paperwork, we manage well to overcome it with our own patience, struggles and strength among the group members.

We would like to express our gratitude towards our respected supervisor, Madam Nurul Hayati binti Jamil for the encouragement, guidance, invaluable support and motivations which helped us in completion of this project. I would also like to drop our sincere appreciation to the role of the staff of Mechanical Workshop for giving the permission to use all required machinery and the necessary material to complete this project.

Thank you as well to the team for coming up with this idea together successful. Without your encouragement and support, we wouldn't have been able to complete this work as well as our other friends. In addition, many thanks to our colleagues who worked hard to produce this work and exchanged ideas to help us complete this project. Finally, we believe that the work we undertake will broaden our knowledge and improve our cooperation and responsibility.

Thank you.

# ABSTRACT

In the pursuit of optimizing storage solutions and enhancing space utilization, the Vertical Carousel Storage Box presents an innovative approach to traditional storage systems. This project aims to develop a vertically aligned, rotating storage mechanism that maximizes vertical space, thereby providing an efficient and ergonomic way to store and retrieve items. The system incorporates a series of interconnected storage compartments that rotate around a central axis, allowing users to access items at various heights with minimal physical effort.

The design leverages modern materials and engineering techniques to ensure durability, smooth operation and safety. Additionally, the project explores the integration of smart technologies, such as automated control systems and manually, to enable inventory management. The Vertical Carousel Storage Box is particularly suited for environments with limited floor space where efficient space utilization is critical.

This project not only addresses the spatial constraints but also enhances organizational efficiency and user convenience. By reducing the need for extensive physical movement and providing a systematic storage and retrieval process, the Vertical Carousel Storage Box project promises to revolutionize contemporary storage solutions, making them more adaptable to the evolving needs of modern living and working spaces.

# TABLE OF CONTENT

## LIST OF TABLES

| | LIST OF FIGURE | |
|---|---|---|
| **NO. FIGURE** | **TITLE** | **PAGES** |
| 1.2.1 | Less storage racks | 11 |
| 1.2.2 | Irregular equipment | 11 |
| 1.2.3 | Old design | 12 |
| 1.2.4 | Exposed equipment | 12 |
| 1.2.5 | Small space | 12 |
| 1.2.6 | Missing Equipment | 13 |
| 2.2.1 | Existing storage box | 16 |
| 3.2 | Flow chart | 20 |
| 3.3.1 | Questionnaire section | 21 |
| 3.4.3 | Sketching design | 28 |
| 3.4.3 | Chosen sketch design | 28 |
| 3.4.4 | Detail design | 29 |
| 3.4.5 | Final design | 30 – 31 |
| 3.4.6 | Prototype | 32 |
| 3.7 | Milestone chart | 38 |
| 3.8 | Gantt chart | 38 – 39 |
| 3.9.1 | Weld the main frame | 40 |
| 3.9.2 | Grind unnescessary | 40 |
| 3.9.3 | Drilling holes | 41 |
| 3.9.4 | Weld the base | 41 |
| 3.9.5 | Attach the bearing | 42 |
| 3.9.6 | Attach sprocket and chain | 42 |

# CHAPTER 1 INTRODUCTION

## 1.1 INRODUCTION

Storage box are durable and reusable containers which workshop items and components. They’re available in a variety of sizes to hold an assortment of objects, so they provide a great way to save space and keep areas tidy and organised. The function of a storage box is to organize and protect belongings, keeping them safe and easily accessible.

There have been many problems in recent years with the use of storage boxes in nearby workshops such as in polytechnic workshop, where got the concept for this project, vertical carousel storage box (V.C.S box). People's carelessness in picking up equipment and difficulty picking up items in the storage box is the cause. The workshop around here and the workshop at the polytechnic will be great if the storage box is improved. The concept for a vertical carousel storage box appears at that time. To improve the convenience of storage box users, we intend to build a storage box which may replace the existing storage box. We want to replace it with a storage box that can rotate, which can make it easier and less careless for the workshop, instead normal storage box that uses the old way.

Transform your workshop chaos into organized bliss with the humble storage box. From screws to saws, every tool finds its sanctuary, ensuring efficiency and creativity flow freely in your creative space (Workshop Wonders Magazine, 2022).

## 1.2 PROBLEM STATEMENT

The reason why we choose this storage box idea to be improve for our final year project:

**Workshops have less equipment storage racks**

Workshops with fewer equipment storage racks often struggle to maintain organization and accessibility for tools and materials.

Figure 1.2.1: Less storage racks

**Irregular equipment**

Irregular equipment in the workshop can disrupt workflow and create challenges in maintaining efficiency and safety standards.

Figure 1.2.2: Irregular equipment

**An old design**

An old design in the workshop may limit functionality and hinder productivity, prompting the need for modernization to meet evolving demands.

Figure 1.2.3: Old design

**Exposed equipment**

Exposed equipment in the workshop poses safety hazards, miss equipment and increases the risk of accidents, highlighting the importance of proper enclosure and protective measures.

Figure 1.2.4: Exposed equipment

**Small space**

A small space cannot accommodate many items which can cause items to be out of place.

Figure 1.2.5: Small space

**Easy to missing equipment**

Equipment that is easy to misplace in the workshop can lead to delays in projects and frustration among workers, emphasizing the importance of implementing clear tracking systems and storage solutions.

Figure 1.2.6: Missing equipment

## 1.3 OBJECTIVE

The objective of this project is to design vertical carousel storage box to get easy and to develop vertical carousel storage box that can move vertically 360degree. This project also to maximize storage efficiency by utilizing vertical space while improving organization and accessibility.

## 1.4 SCOPE OF PROJECT

Vertical Carousel Storage Box is suitable use for workshop staff. This product is used in workshops such as automobile workshops and repair workshops. Use when wanting to put and pick up stuff and use for staff to avoid them of body illness.

## 1.5 EXPECTED OUTCOMES

The implementation of vertical carousel storage box in the workshop is expected to yield several beneficial outcomes. By maximizing vertical space utilization, these storage solutions will efficiently organize tools, equipment, and materials, reducing clutter and streamlining workflow processes. With easy access to items through the carousel rotation mechanism, workers will spend less time searching for tools, thereby enhancing productivity.

# CHAPTER 2

# LITERATURE REVIEW

## 2.1 INTRODUCTION

Picture a workspace where tools are strewn across workbenches, materials are piled haphazardly in corners, and pathways are obstructed by an assortment of debris. This scene is not uncommon in many workshops, whether they belong to seasoned artisans or budding DIY enthusiasts. The accumulation of clutter is often a consequence of busy schedules, limited storage solutions, and the perpetual cycle of projects in various stages of completion.

The solution we can do is, build a tool rack that can be used to store workshop tools in order to prevent the workshop from being cluttered.

Organization is not about perfection; it's about efficiency, reducing stress, and clutter, saving time and money, and improving your overall quality of life (Christina Scalise, Organize Your Life and More, 2011).

## 2.2 FUNCTION OF STORAGE BOX

A storage box serves the purpose of organizing and storing various items. It keeping them safe and easily accessible while reducing clutter in your living or working space. It also helps in maintaining order, protecting belongings from damage or dust, and optimizing space utilization.

### 2.2.1 EXISTING DESIGN

The picture below shows the design of the existing storage box:


Figure 2.2.1: Existing storage box

Sources: https://www.fixturescloseup.com/2018/06/01/fill-your-toolbox-withgreat-stanley-tools/

For a workshop storage box, a sturdy design with compartments for tools and equipment is essential. Basic design, for the material is durable plastic or steel for longevity. Existing design features is multiple compartments or drawers for organizing different tools and parts. It mechanism, some designs include a locking mechanism to secure valuable tools and the dimensions large enough to accommodate various tools but still manageable in size.

## ADVANTAGES OF EXISTING STORAGE BOX

The organization is keeps items neatly organized, easier to find what you need quickly (Sull and Donald N, 2021). Meanwhile, sorting and categorizing items, reducing clutter and making easier to locate thing we needed (Blodgett and Jenifer, 2019). It has protection from dust, moisture, pests, and other environmental factors that could damage stored items (Sull and Donald N, 2021). Meanwhile, the shield belonging from dust, moisture, sunlight and potential damage, extending their lifespan (Blodgett and Jenifer, 2019). It also has space optimization where consolidating items into one container, storage boxes help maximize space, especially in small or crowded areas (Sull and Donald N, 2021). Meanwhile, by utilizing vertical space and enabling stacking, storage boxes help maximize available storage area, particularly in smaller spaces (Blodgett and Jenifer, 2019).

## DISADVANTAGES OF EXISTING STORAGE BOX

It Limited visibility where items stored in closed storage boxes may be forgotten, leading to difficulty in finding specific items when needed (Hall and Tara, 2017). Meanwhile, storing items in boxes can make it harder to access them quickly, the boxes are stacked or stored in a tight space (Marie Kondo ,2014). It is potential for overcrowding where without proper organization and periodic decluttering, storage boxes can become overcrowded, making it challenging to maintain an organized space (Hall and Tara, 2017). Meanwhile storage boxes can help organize belongings, they can also become a hiding place for clutter if not regularly sorted through and maintained (Marie Kondo ,2014). It also space constraints where storage boxes help optimize space, relying too heavily on them may lead to a dependence on storing items rather than actively using or decluttering them (Hall and Tara, 2017). Meanwhile, using storage boxes may require additional space to store the boxes themselves, especially if they’re not stackable or collapsible (Marie Kondo ,2014).

## 2.3 TECHNOLOGY USED BY EXISTING STORAGE BOX

First of all, injection molding where involves injecting molten material (typically plastic) into a mold cavity, then solidifies to form the desired shape of the storage box (Dieter and George E, 2012). Meanwhile, involves injecting molten material often plastic, into a mold cavity. Once cooled and solidified, the material takes the shape of the mold (Ulrich, Karl T, Eppinger and Steven D, 2015). It has interlocking systems. Feature interlocking mechanisms or snap on lids that securely lock the box, preventing accidental opening (Dieter and George E, 2012). Meanwhile, the mechanism on their lids or side, ensuring a secure closure. include snap on locks, tabs, or grooves that fit together keep the box tightly sealed (Ulrich, Karl T, Eppinger and Steven D, 2015). It also weatherproofing where technologies such as sealing gaskets or UV-resistant materials to protect contents from moisture, dust, sunlight, and other environmental elements (Dieter and George E, 2012). Meanwhile, features to protect contents from moisture, dust, and other environmental factors. Include sealed seams, waterproof coatings, or UV-resistant materials (Ulrich, Karl T, Eppinger and Steven D, 2015). It has modular systems where offer modular storage solutions that allow components to be combined and rearranged to create custom storage solutions (Pahl, Gero, Beitz and Wolfgang, 2013). Meanwhile, modular system has individual components that can be combined and configured in various ways to create custom storage solutions (Dieter and George E, 2012). Storage rack use stacking systems where designs boxes with interlocking grooves or stacking rails for stability when stacked (Pahl, Gero, Beitz and Wolfgang, 2013). Meanwhile, use interlocking grooves or stacking rails to maximize space utilization and stability when stacking boxes (Dieter and George E, 2012). It also use foldable systems where produce foldable storage boxes with hinges or folding panels that enable them to collapse or fold flat when not in use (Pahl, Gero, Beitz and Wolfgang, 2013). Meanwhile, to saving space during storage and transportation (Dieter and George E, 2012).

# CHAPTER 3

# METHODOLOGY

## 3.1 INTRODUCTION

The methodology for the vertical carousel storage box project encompasses a systematic approach aimed at efficiently designing and implementing a storage solution tailored to meet the specific needs of workshop environments. Through a combination of research, analysis, and iterative design processes, this methodology aims to identify key requirements, explore innovative concepts, and validate solutions to deliver a functional and optimized storage system. By outlining clear steps for conceptualization, prototyping, testing, and refinement, this methodology ensures a structured and effective path towards achieving project objectives while fostering collaboration and stakeholder engagement throughout the development process.

Research methodology refers only to the practical “how” of any particular area research. More specifically, it is about how researchers systematically design studies ensure valid and reliable results that address the goals and objectives of the research. In this moment, we are doing and getting some necessary research about pineapple planters. The methodological chapter should justify the design choice, by showing that the choice methods and techniques are the most suitable for the purposes and objectives of the research, and will provide valid and reliable results. Good research methodology provides scientific results findings, while poor methodology does not.

## 3.2 FLOW CHART

Figure below shows the flow chart process:

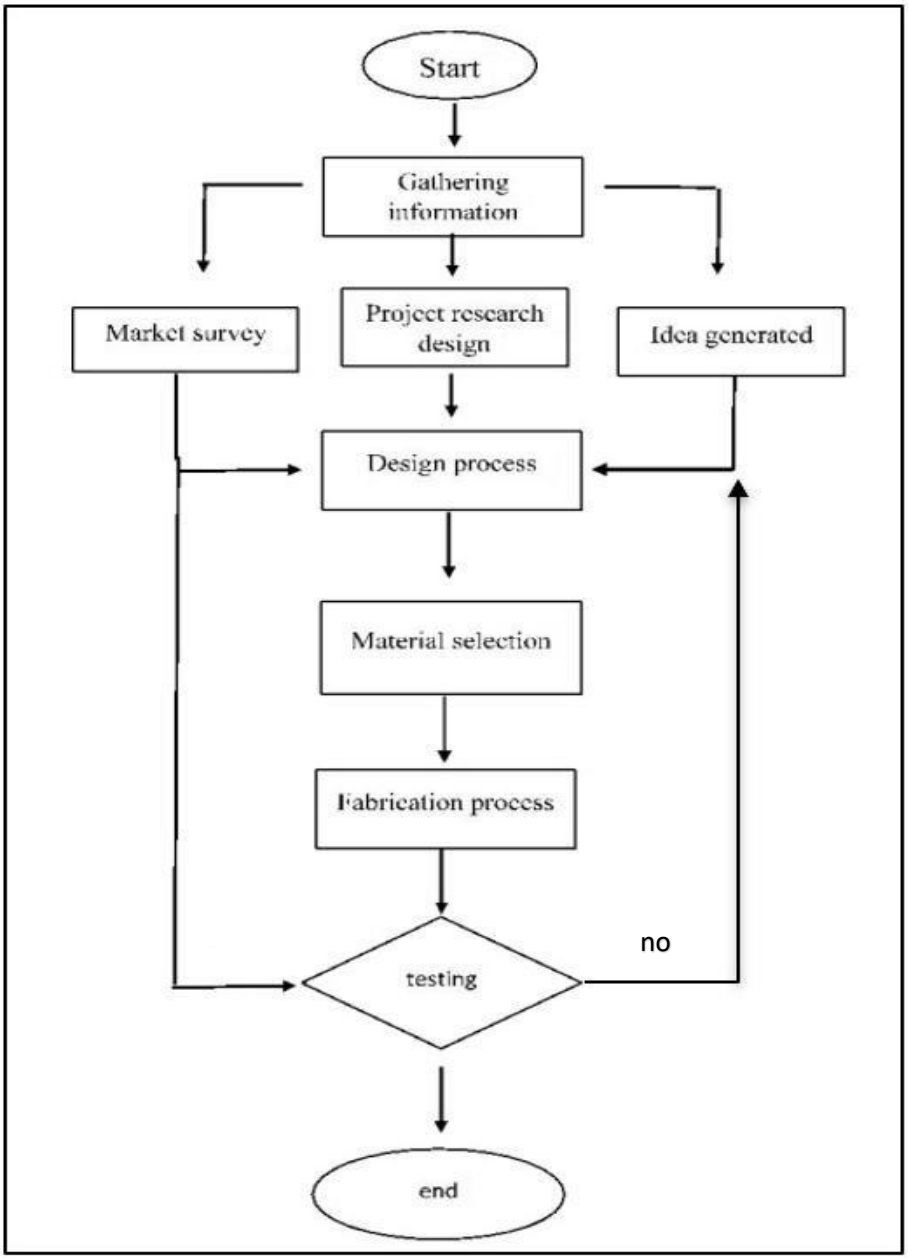



Figure 3.2: Flow chart

## 3.3 GATHERING INFORMATION

Gathering information for a vertical carousel storage box project involves researching various designs, dimensions, and features to ensure optimal functionality within the workshop space. Additionally, exploring supplier options, pricing, and user reviews can provide valuable insights into the reliability and effectiveness of different carousel systems. Conducting site assessments and consulting with stakeholders will further refine requirements and tailor the project to specific needs and constraints. Overall, thorough information gathering lays the foundation for a successful implementation of the vertical carousel storage box project.

### 3.3.1 MARKET SURVEY

A market survey was conducted, and a total of 20 people responded to the questions asked. Market research was delivered to Banting Selangor area who were involved in the workshop's activities. The market study's questions are geared toward respondents' exposure to storage rack and their opinions on storage rack. A suggestions area is also included if respondents have any suggestions. From the figures 3.3.1 knowledge about storage rack below, can determine that most workers are uninformed of the storage rack and its function. Therefore, will be able to get information for our research from this group of workers.

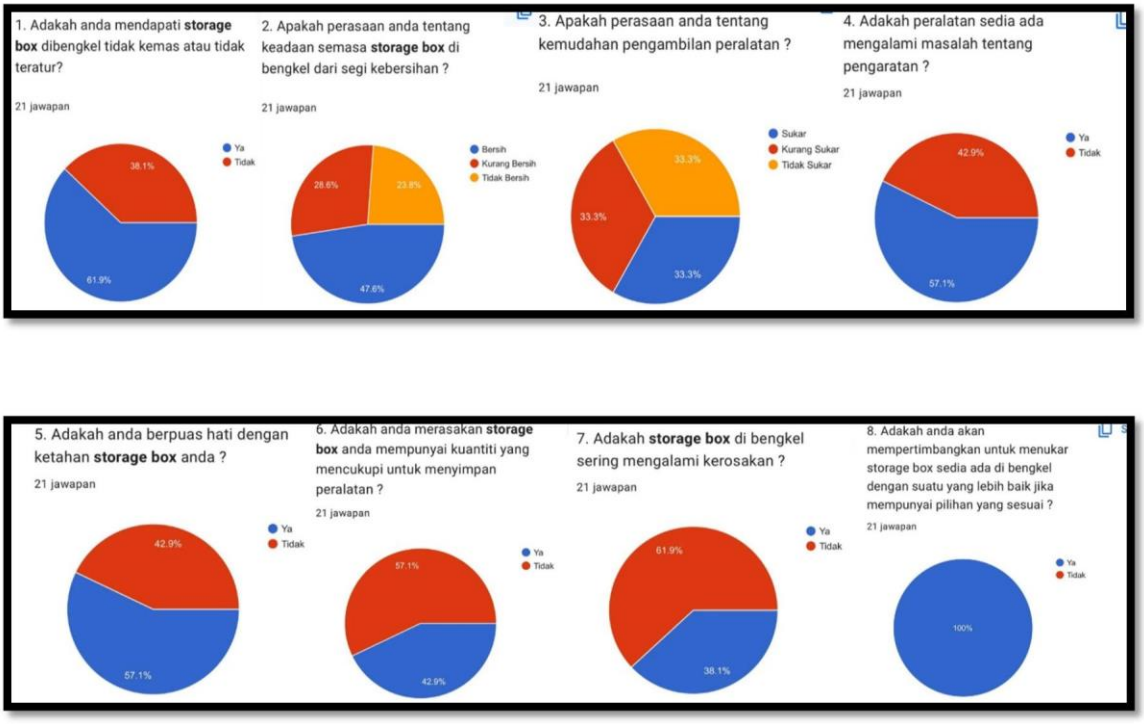



Figure 3.3.1: Questionnaire section

**RESPONDENTS**

- AUTOMOTIVE WORKSHOP WORKERS: 7 people
- EMPLOYEE OF THE CARVING WORKSHOP: 5 people
- HOUSING RESIDENTS: 3 people
- REPAIRSHOP WORKSHOP OWNER: 5 people

### 3.3.2 INTERVIEW

An interview session has been conducted at the outdoor workshops and also the Banting Polytechnic workshop regarding the disadvantages and advantages of existing storage racks. For outdoor workshops, interview session was conducted at Rb Surenren Workshop at Sungai Manggis, Banting and the name of the entrepreneur is Mr Surenren. and this conducted on March 24, 2024, which is Sunday. From the questionnaire, this project were able to find out the needs in the workshop and improvements for the workshop storage rack. From that, a new design will be built for the storage rack that could overcome the problems they faced.

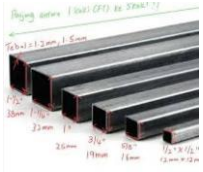
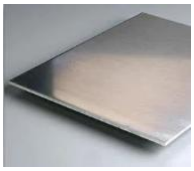
## 3.4 DESIGN PROJECT

Embarking on the design project for a vertical carousel storage box presents an exciting opportunity to revolutionize organization and efficiency within the workshop environment. By integrating innovative design concepts with practical functionality, our goal is to create a storage solution that maximizes space utilization while streamlining access to tools and materials. Through careful planning, rigorous research, and creative problem-solving, we aim to deliver a vertical carousel storage box that not only meets but exceeds the expectations of our clients, enhancing productivity and workflow efficiency.

To design the Vertical Carousel Storage Box, Inventor application was used. Size in millimeters to calculate the dimension based on Figure 3.4.2: Final design, where each part has been assembled one by one. The dimensions are all provided based on the design process shown in figures.

### 3.4.1 DESIGN SPECIFICATION

Here are the material specifications and the characteristics:

| Materials | Characteristics |
|---|---|
| **Mild Steel Hollow**  | Mild Steel material and the size is 1x1 inch (1.5mm). |
| **Metal Plate**  | Metal material and size is 4x4 feet (1.5mm). |
| **Screw**  | Steel material and length is 1 inch. |
| **Sprocket**  | Mild Steel material and have 22T and 40T size. |

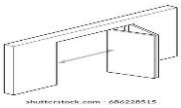
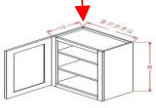
| | |
|---|---|
| **Chain**<br>  | Alloy Steel material and 428 chain size. |
| **Refrigerator Door Trip Switch**<br>  | 3 Ampere |
| **Speed contsroler**<br>  | 240 Volt |
| **wire**<br>  | 450 Volt |
| **Motor**<br>  | 19 watt |
| **Push Button Up, Stop, Down**<br>  | 230 Volt |

| | |
|---|---|
| **Plastic Box**<br>  | 2x0.8x0.8 feet for the size. |
| **Trolley Wheel**<br>  | 100 mm diameter. |
| **Handle**<br>  | 150 mm length. |
| **Hinges**<br>  | 2mm thickness |

Table 3.4.1: Design specification

### 3.4.2 MORPHOLOGY CHART

Table below shows our process to choose material:

| no | PART | CONCEPT 1 | CONCEPT 2 | CONCEPT 3 |
|---|---|---|---|---|
| 1 | PLASTIC BOX |  |  |  |
| 2 | LAMP / SENCOR |  |  <br>  |  <br>  |
| 3 | MOTOR |  |  |  |
| 4 | PUSH BUTTON |  |  |  |
| 5 | HANDLE |  |  |  |
| 6 | DOOR |  |  |  |

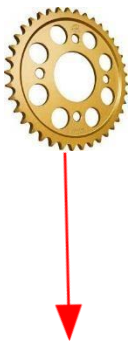
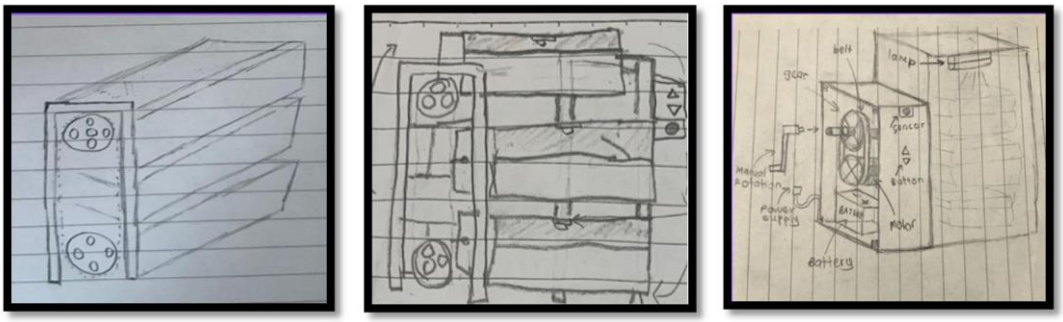
| | | | | |
|---|---|---|---|---|
| 7 | WHEEL |  |  |  |
| 8 | SPROCKET |  |  |  |
| 9 | HINGES |  |  |  |
| 10 | CHAIN |  |  |  |
| | | CG 1 | CG 2 | CG 3 |

Table 3.4.2: Morphology chart

### 3.4.3 SKETCHING DESIGN

The sketching below is done using hand drawing for the initial sketching and one of those sketching will be chosen to be used as a guide for the design of this project.




**A** **B** **C**

Figure 3.4.3: Sketching design

Of the three sketching above, drawing C was chosen to be used as a design guide for this project because the sketching is more detail and easy to understand.

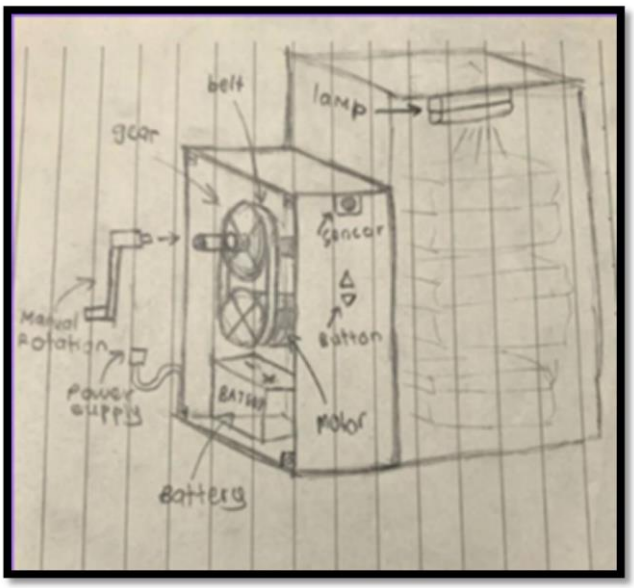



Figure 3.4.3: Chosen sketch design

### 3.4.4 DETAIL DESIGN

The drawing below is a drawing done using the Inventor application and each material has been labelled.

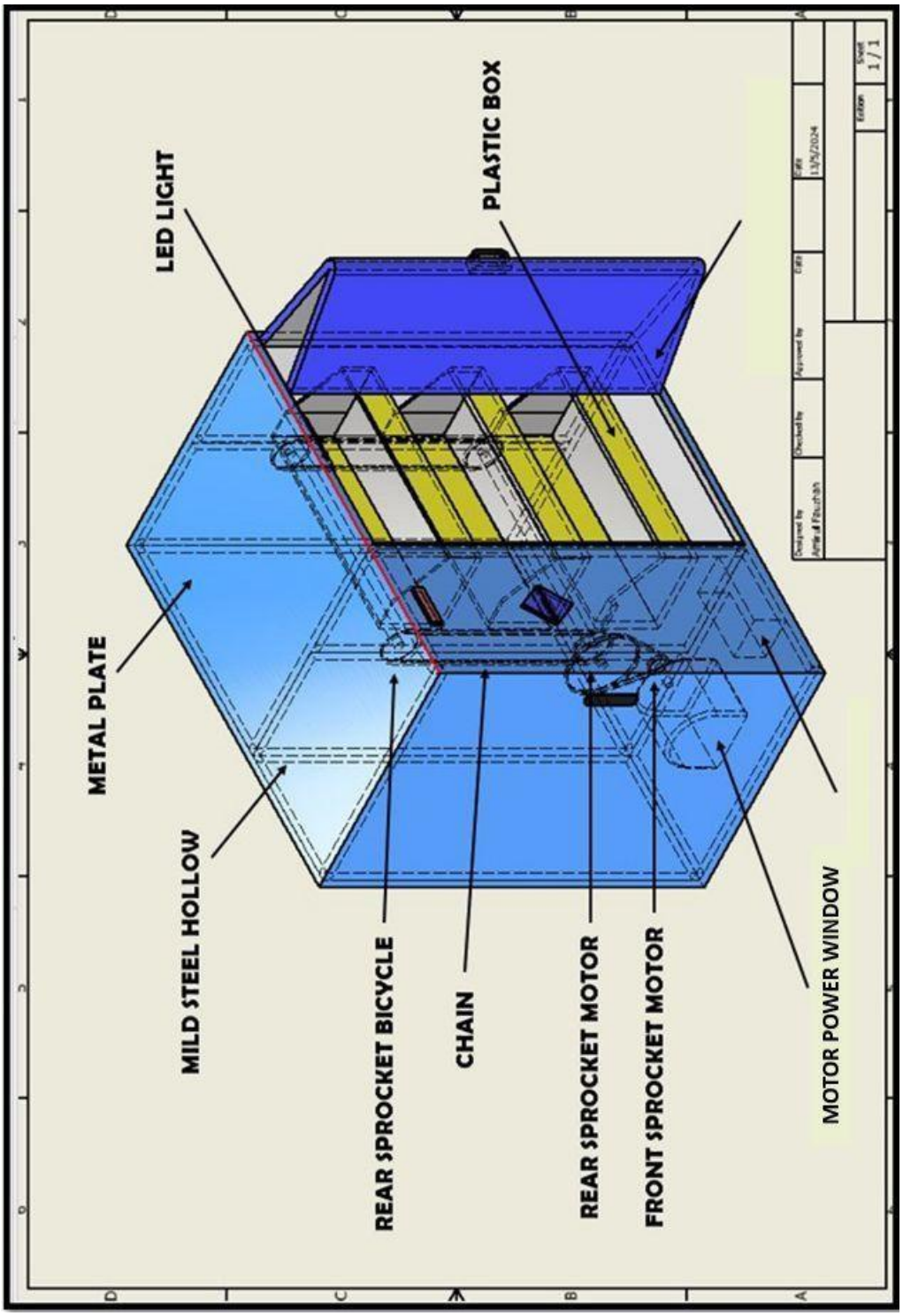
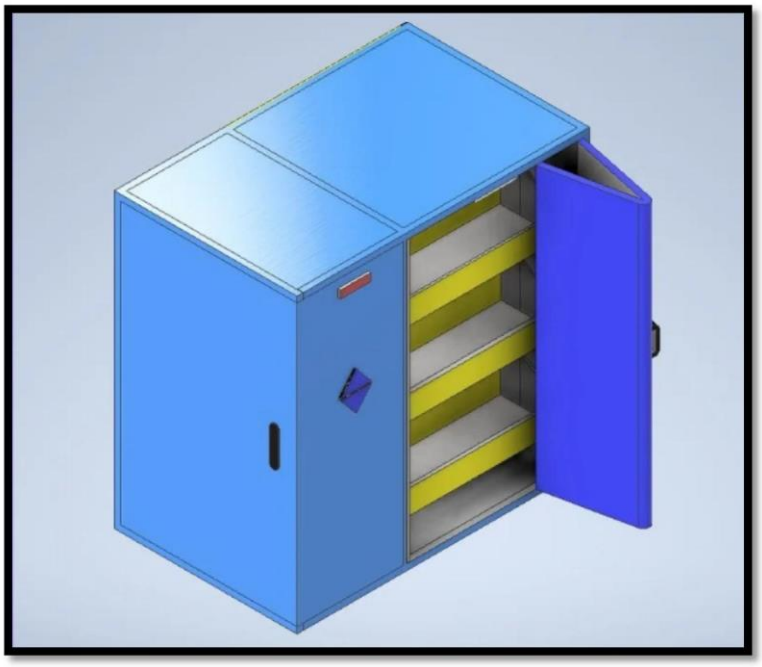
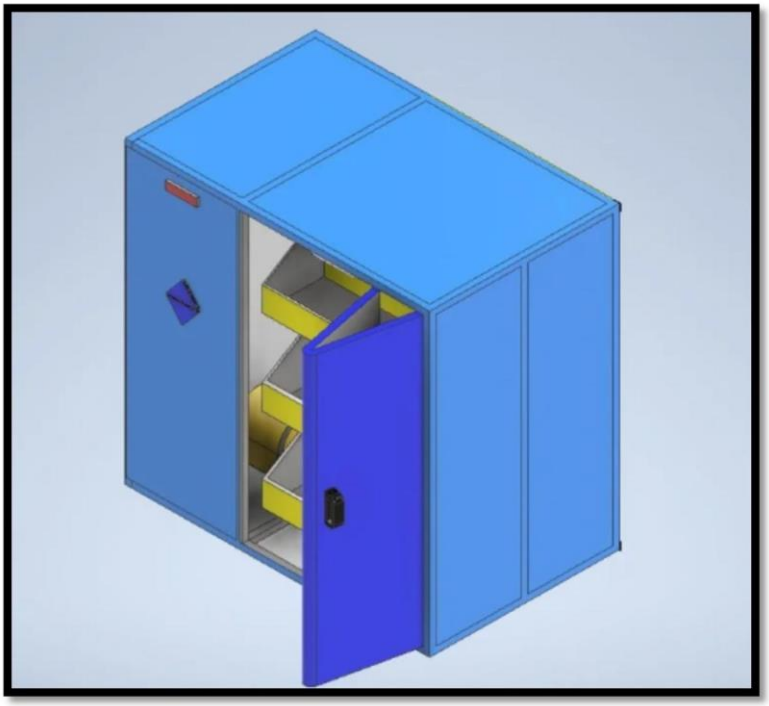



Figure 3.4.4: Detail design

### 3.4.5 FINAL DESIGN

The drawing below is the final drawing for this project and shows the measurements from each view. This drawing was done using the Inventor application





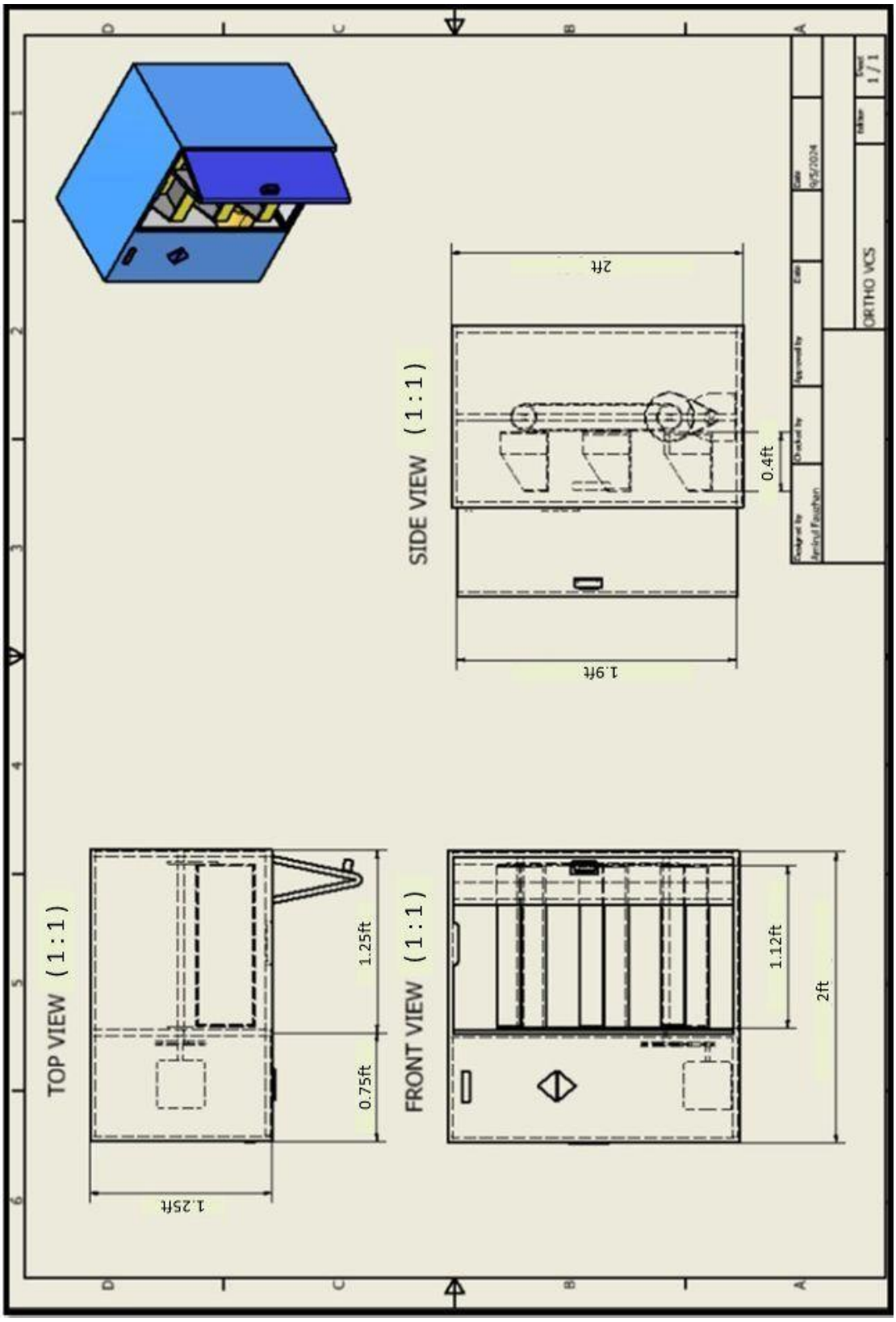



Figure 3.4.5: Final design

### 3.4.6 PROTOTYPE

The figure below shows a prototype built using boxes, paper and sticks:

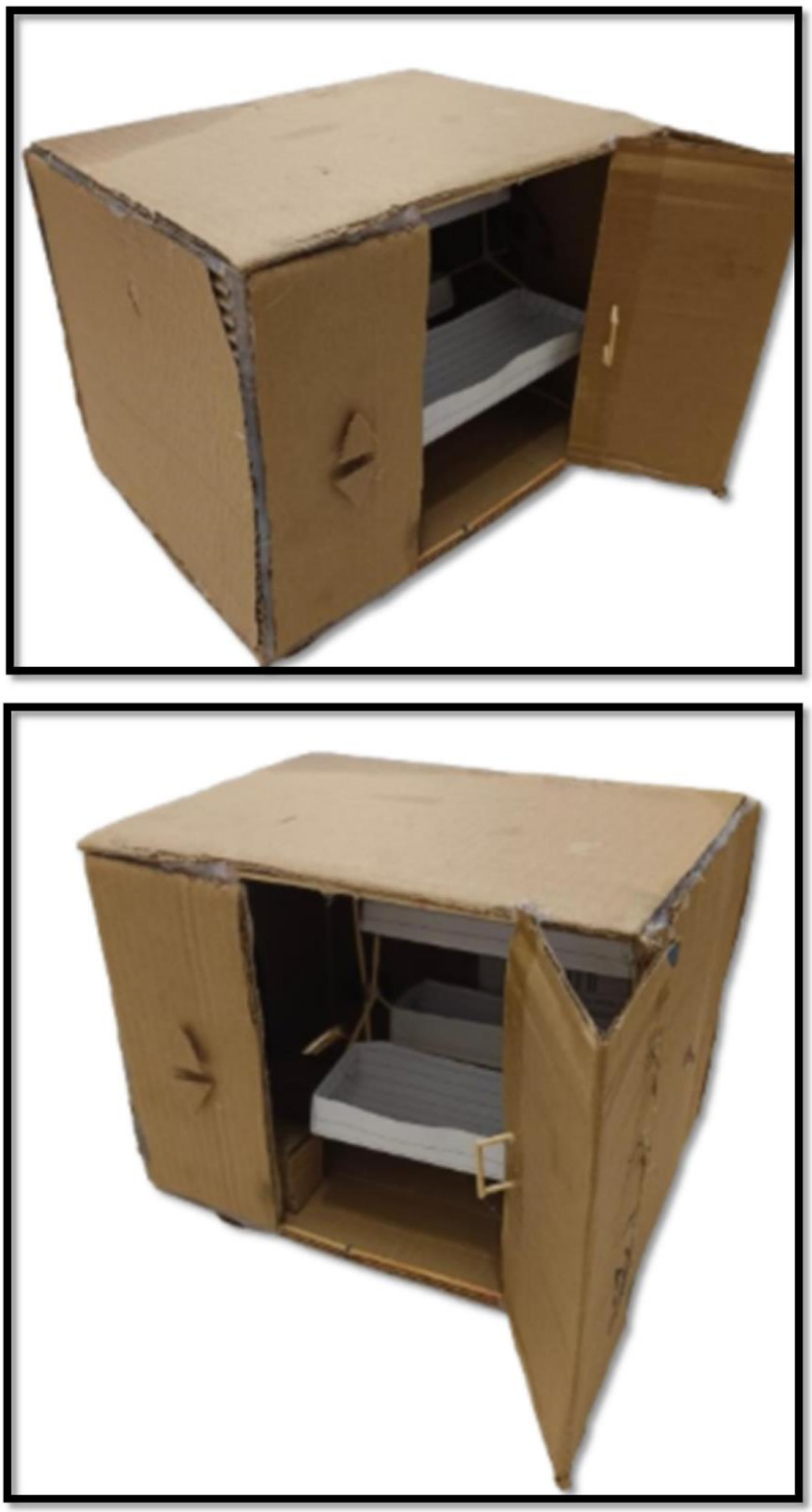
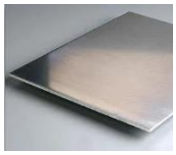


Figure 3.4.6: Prototype

## 3.5 MATERIAL SELECTION

Table below shows materials that we choose:

| Materials | Descriptions |
|---|---|
| **Mild Steel Hollow**  | To make a frame. This material was chosen because of its strong structure, light and suitable to accommodate high loads. |
| **Metal Plate**  | This material was chosen because it is stronger than other materials to be used as a cover and base. |
| **Screw**  | Suitable for connecting existing materials and easy to maintain. |
| **Sprocket**  | For the rotation part because this material is stronger. |
| **Chain**  | To connect the existing sprockets and materials that can withstand high loads. |

| | |
|---|---|
| **6 Pin Socket On/Off/On**<br>  | For control the power by allowing or stopping electricity flow and For control the rotation movement up and down. |
| **LED Hinges**<br>  | To give light inside the storage box and can reduce electricity consumption. |
| **Fan capasitor motor**<br>  | changes the speed of the motor by adjusting the power it receives. |
| **Motor**<br>  | For move the sprocket rotation and the motor is single phase. |
| **L Shape Bracket**<br>  | For connect the body part from moving. |
| **Wire cable**<br>  | used to transmit electricity, signals, or mechanical force. |

| | |
|---|---|
| **Plastic Box**<br>  | For store tools and can handle high loads. |
| **Trolley Wheel**<br>  | For easy to move the position of storage box and can withstand high load. |
| **Handle**<br>  | For hold the door and easy to install. |
| **Hinges**<br>  | For allow the window to move, close and open the door. |
| **Carbinet Door Hatch**<br>  | For lock the door when closed and avoid it from moving. |

| | |
|---|---|
| **Steel Rod Sub**  | For the sprocket to moving 360degree. |
| **Door Hasps**  | To use the padlock on it. |
| **Door Padlock**  | To lock the door when not use it anymore. |

Table 3.5: Material selection

From the material selection list, have five main material that chosen to make this project a success. Mild Steel Hollow was chosen because of its strong structure, light and suitable to accommodate high loads. Metal Plate material was chosen because it is stronger than other materials to be used as a cover and base. Plastic Box for store tools and can handle high loads. Trolley Wheel was chosen for easy to move the position of storage box and can withstand high load. This Battery for save electric energy and rechargeable.

## 3.6 FABRICATION

The table below shows the fabrication process that will be done:

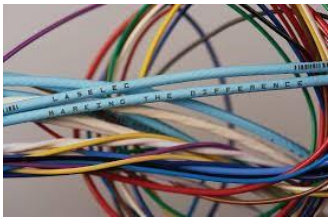
| PROCESS | FUNCTION | PICTURE OF PROCESS |
|---|---|---|
| **Welding process** | Is the process for the assemble all the metal part such as frame and cover using the welding method. |  |
| **Drilling process** | Is the process for make a hole and screw the parts. |  |
| **Grinding process** | Is a process of cutting the part and for the finishing to get a smooth surface. |  |
| **Painting process** | Is a visual art, which is characterized by the practice of applying paint, pigment, color or other medium to a solid surface. |  |
| **Wiring process** | Is an electrical installation of cabling and associated devices such as switches, distribution boards, sockets and light fitting in a structure. |  |

Table 3.6: Fabrication

## 3.7 MILESTONE CHART

Figure below shows the project milestone chart:

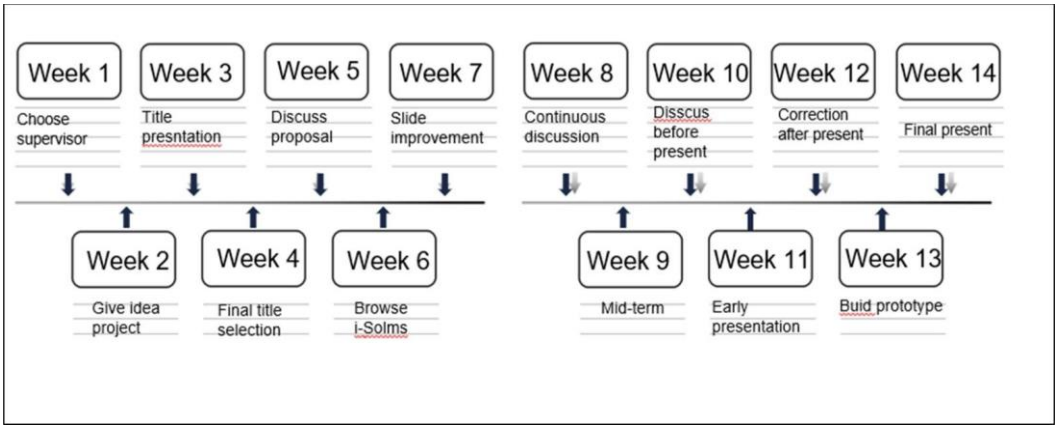
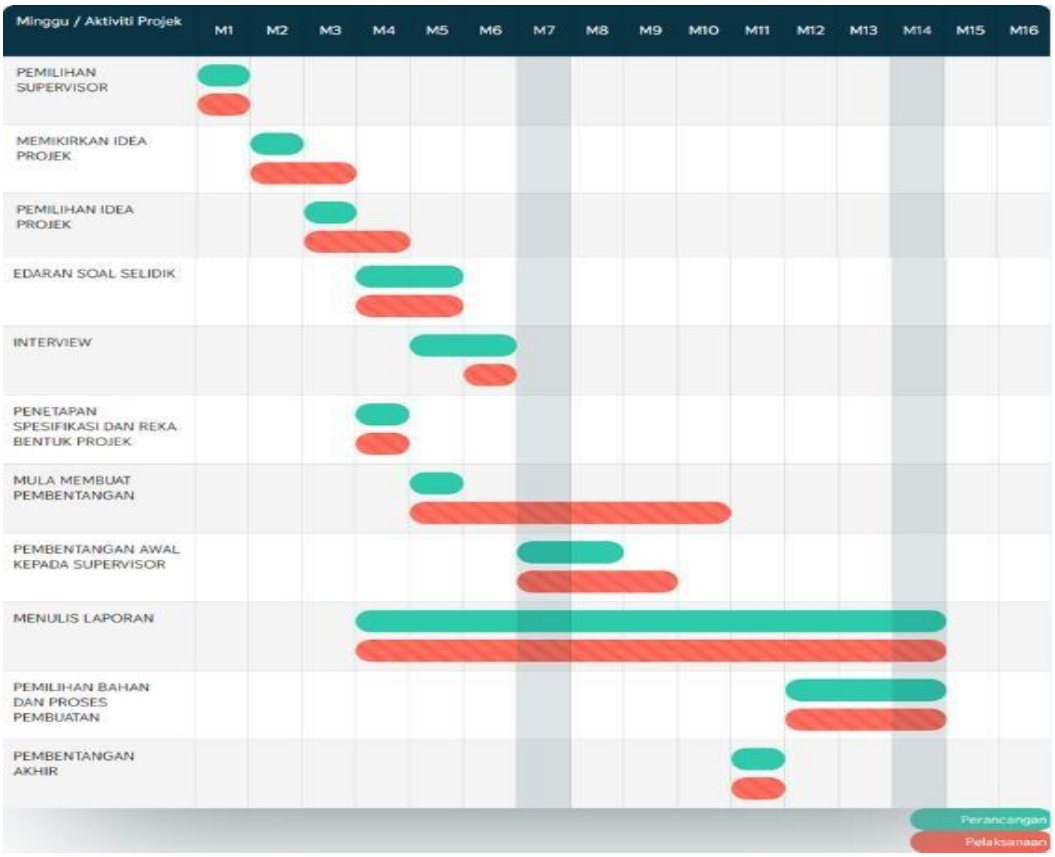



Figure 3.7: Milestone chart

## 3.8 GANTT CHART

Figure below shows the project Gantt chart:

PROJECT 1



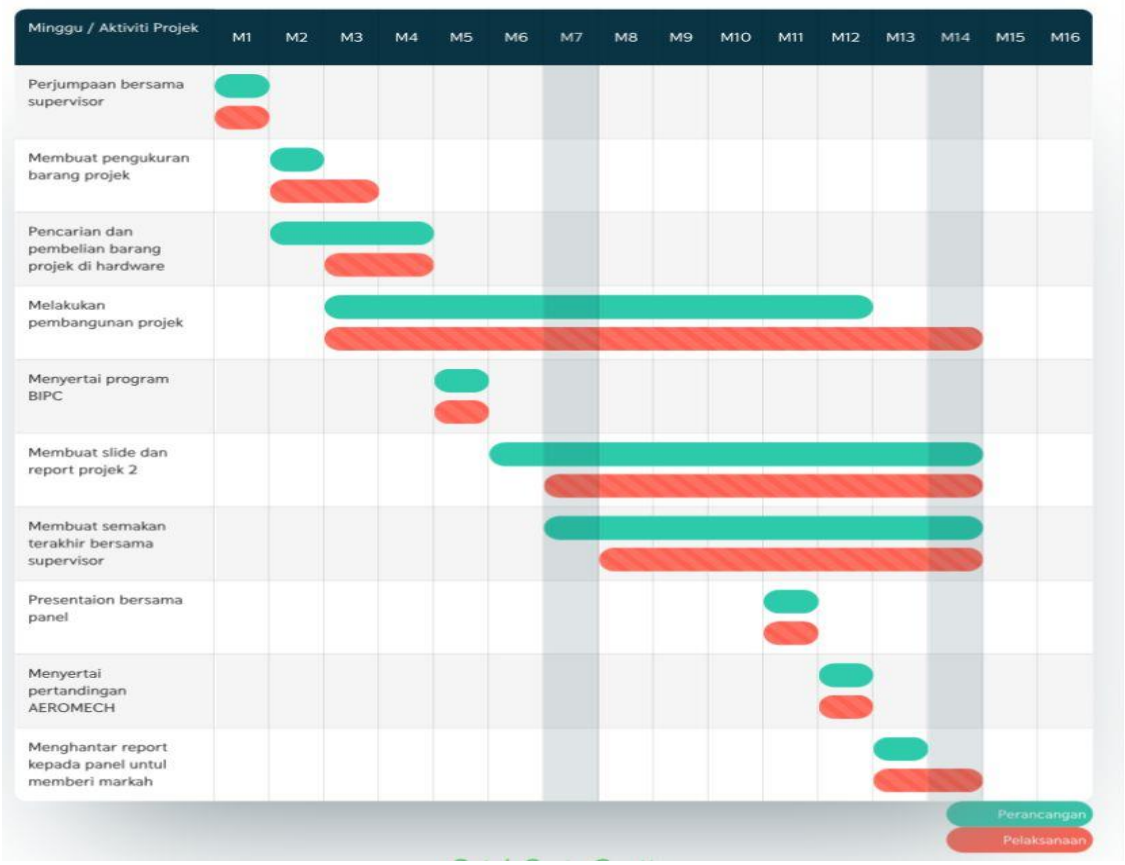



Figure 3.8: Gantt chart

## 3.9 METHOD

1.WELD THE MAIN FRAME

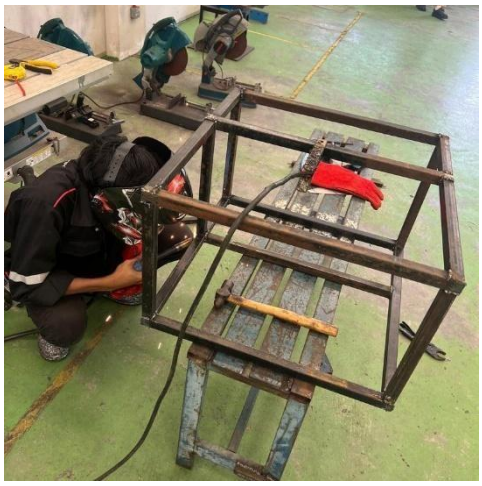


Figure 3.9.1: Weld the main frame

Start by aligning the metal parts of the frame securely using clamps to hold them in position. Ensure the joints are clean and free of debris. Using either MIG, TIG, or arc welding, depending on the material and thickness, begin with tack welds at key points to prevent shifting. Then, proceed with a full weld along the seams, maintaining consistent speed and heat for a strong, uniform bond. After welding, inspect the joints for any gaps or imperfections and grind smooth if necessary.

2.GRIND UNNESCESSARY PART

Figure 3.9.2: Grind unnescessary part

To grind unnecessary parts, first, secure the workpiece to ensure it doesn't move during grinding. Use an angle grinder with an appropriate grinding disc, and carefully move it over the unwanted material,

applying even pressure. Focus on removing excess material while avoiding over-grinding the surface. Once the unwanted parts are ground off, smooth out the edges to ensure a clean and even finish.

3. DRILLING HOLES

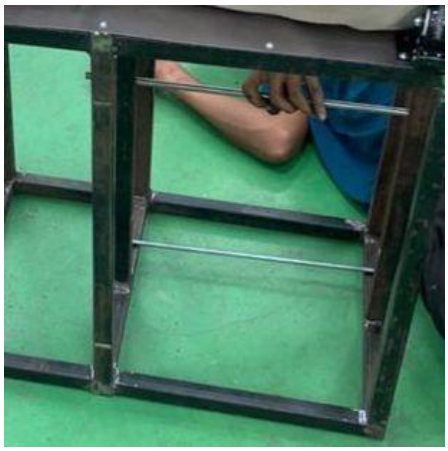


Figure 3.9.3: Drilling holes

To drill holes for the steel rod sub, first mark the drilling points on the metal surface with precision, ensuring correct alignment. Secure the workpiece firmly using a clamp or a fixture to prevent movement. Select a drill bit suitable for metal and the diameter of the rod, and apply cutting oil to reduce friction and heat. Begin drilling at a slow speed, gradually increasing as needed, while keeping the drill bit straight. After drilling, deburr the edges of the holes to remove any sharp metal shavings.

4. WELD THE BASE

Figure 3.9.4: Weld the base

The metal frame is being welded to create a sturdy base to support the structure, including the chains and rotating mechanism. Ensuring a solid weld here is crucial for stability and durability, as it will bear the weight of the shelves and items stored on them. Proper

alignment and strong, consistent welds along the joints will help prevent any shifting or instability.

5. ATTACH THE BEARING

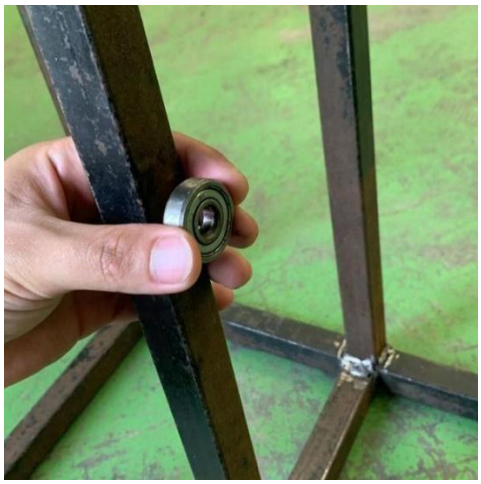


Figure 3.9.5: Attach the bearing

To attach the bearing to the frame, first ensure that the bearing housing and mounting area on the frame are clean and free of debris. Align the bearing with the designated holes on the frame, making sure it's positioned correctly. Insert the bolts or fasteners through the bearing housing and into the frame, tightening them evenly to secure the bearing firmly in place. Check that the bearing rotates smoothly and is properly seated without any misalignment.

6. ATTACH SPROCKET AND CHAIN

Figure 3.9.6: Attach sprocket and chain

To attach the sprocket and chain, first, position the sprocket onto its designated shaft and secure it with bolts or a locking mechanism. Ensure that the sprocket is aligned with the drive system. Next, place the chain over the sprocket, ensuring it fits properly into the teeth. Adjust the chain tension by moving the sprocket or tensioner as needed, ensuring the chain is neither too tight nor too loose.

Finally, test the system by rotating the sprocket to ensure smooth movement of the chain without slipping or binding.

7. SCREW THE WHEELS

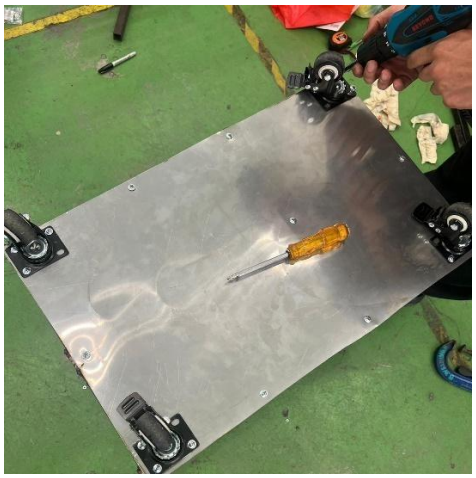


Figure 3.9.7: Screw the wheels

To screw the wheel in place, first align the wheel's holes with the corresponding holes on the mounting surface or hub. Insert the screws or bolts into the holes and hand-tighten them to ensure proper alignment. Then, use a wrench or screwdriver to fully tighten the screws in a crisscross pattern to evenly distribute the pressure and secure the wheel. Make sure all screws are tightened firmly, but avoid over-tightening to prevent damage. Once secured, check that the wheel rotates smoothly.

8. WELD THE BRACKET ON CHAIN

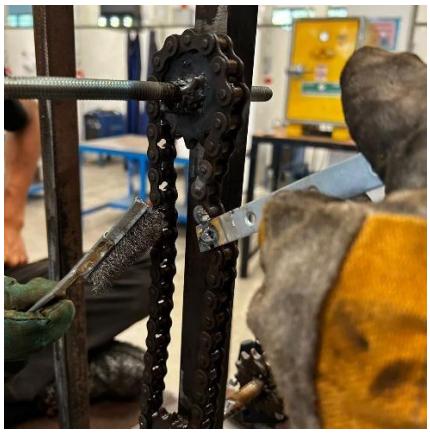


Figure 3.9.8: Weld the bracket on chain

To weld the bracket onto the chain for the Vertical Carousel Storagebox, first, ensure that both the bracket and chain surfaces are clean and free of rust or debris. Secure the chain in place using a clamp to prevent movement during welding. Position the bracket against the chain where it needs to be attached, then use a MIG or TIG welding machine to create strong welds at the attachment points. Make sure to maintain a consistent arc length and speed for even welds. After welding, inspect the joints for any defects and grind down any rough edges for a smooth finish.

9. USE A WIRE AS CONNECTOR

Figure 3.9.9: Use a wire as connector

Enhances its functionality by ensuring reliable electrical connections. This method involves securely attaching wires to the components within the carousel, allowing for seamless communication between different parts, such as motors and control panels. Proper insulation and organization of the wiring will prevent short circuits and ensure the system operates efficiently, improving overall performance.

10. WELD THE MOTOR

Figure 3.9.10: Weld the motor

To weld the motor onto the, begin by ensuring the motor aligns correctly with the designated mounting points. Use appropriate welding techniques, such as MIG or TIG welding, to create strong, durable joints that can withstand operational stresses. The motor's primary function is to facilitate the automated movement of the carousel, enabling efficient storage and retrieval of items, thereby optimizing space utilization and enhancing productivity in material handling operations. Proper welding ensures the motor remains securely attached, ensuring reliable performance.

11. SCREW THE BRACKET FOR MOTOR

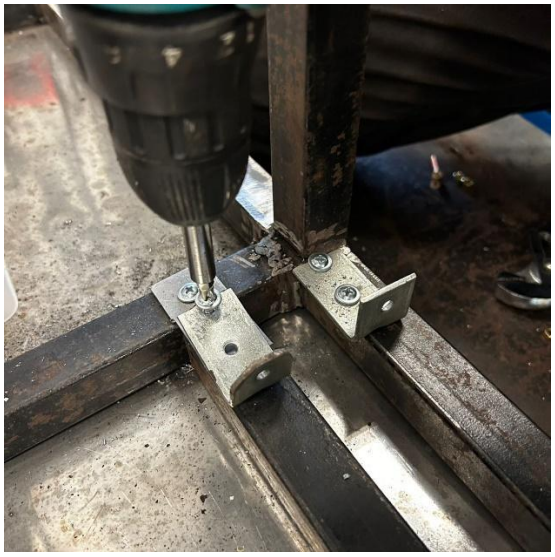


Figure 3.9.11: Screw the bracket for motor

To secure the motor, screw the bracket for the motor firmly into place. This ensures that the motor operates efficiently and maintains stability during its rotational movements. Properly fastening the motor not only enhances performance but also prolongs the lifespan of the device, preventing unnecessary wear and tear.

12. ATTACH THE BOX AT BRACKET

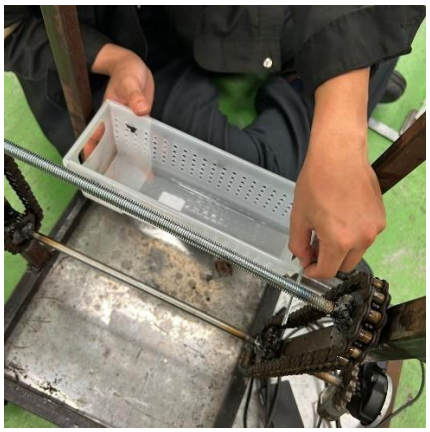


Figure 3.9.12: Attach the box at bracket

To attach the box to the bracket of your Vertical Carousel Storagebox, align the box with the bracket's mounting points and secure it using the provided screws or fasteners. This installation not only ensures that the box is held firmly in place but also optimizes the storage system's function, allowing for efficient organization and easy access to your items.

13. WELD THE DOOR

Figure 3.9.13: Weld the door

Secure the door in place and ensure proper alignment with the frame. Apply an appropriate welding method, such as MIG or TIG, to create a sturdy, seamless bond that maintains the door's structural integrity and ensures secure access. This welded door enhances the storagebox's functionality by providing reliable access, improving safety, and protecting the contents inside from environmental factors, ensuring long-term durability. Then attach the door to the body.

14. SCREW THE WALL

Figure 3.9.14: Screw the wall

To attach the wall securely, the wall panel need to be screwed to the main body. This step reinforces the structural integrity of the storage box, making it more stable and sturdy. By firmly securing the wall panel to the body, the box can support the weight of stored items and operate smoothly, ensuring that each compartment can be accessed without wobbling or shifting. This setup optimizes organization and safety for tool and equipment storage.

15. PUT THE INDICATOR LAMP

Figure 3.9.15: Put the indicator lamp

This lamp will light up when the door is open, providing a clear visual signal to users. The indicator helps ensure that the door is properly closed after each use, which is important for both safety and protection of stored items. This feature is particularly useful in busy workspaces, where the indicator can prevent accidental mishaps by reminding users to secure the door before rotating the storage compartments.

## 16. COMPLETED PROJECT

Figure 3.9.16: Completed project

This project is a compact, efficient storage solution designed to maximize organization and accessibility. With its rotating shelves, the storage box allows users to access items easily by turning the carousel to the desired section, eliminating the need to dig through cluttered compartments. This design is perfect for storing tools, equipment, and supplies in a small space, providing a practical and sturdy storage option that keeps everything within reach and neatly organized.

# CHAPTER 4
# RESULTS AND DISCUSSIONS

## 4.1 Design and Analysis

**a) Frame and analysis:**
The Vertical Carousel storage box frame has been precisely developed and built to ensure robustness and endurance. The frame is solid due to meticulous material selection and technical considerations, giving a solid basis for the whole machine.

**b) Portability with wheels:**
Including wheels in the design of the storage dramatically enhances its manoeuvrability. This capability enables the device to be easily moved and positioned in different workstation areas. The addition of wheels improves the storage by allowing it to adjust anywhere.

**c) Lightweight materials :**
A lightweight frame design made of steel sheets and hollow materials was used to improve the machine's handling and mobility. This deliberate move improves transportation convenience and guarantees that the equipment stays controllable without jeopardising its structural integrity.

**d) Motor Power window:**
The drawer inside the storage rotates using a motor-powered window that can move clockwise and anti-clockwise.

**e) LED Lamp**
use a same mechanical system like refrigerator lamp.

## 4.2 Description of final design or solution

## Overview of the system:

1. **Structure and frame**
   The storage box has a sturdy, durable frame made of lightweight, hollow materials for simple handling. The close open frame adds versatility and ease for maintenance.

Figure 4.2.1: Storage support frame

2. **Wheels for portability**
   Because the storage box is equipped with wheels, it can be easily moved and positioned as needed, giving flexibility in its location within a foreman setting.

Figure 4.2.2: Wheel

## Operation:

1. **Preparation**
   Put in the appropriate place and connect the power supply to make the motor power window function
2. **Adjustments**
   Adjust the storage box door to take the equipment inside
3. **Positioning**
   Use the wheel to move close to the place you want to use for convenience and not take up a lot of space
4. **Push start button**
   Activate the push start button to move the box inside to rotate vertically and there is an option button to set the movement to clockwise and anti-clockwise
5. **Monitor**
   Pay attention to which part we want and be ready to stop the operation
6. **Tools collection**
   After completing the movement turn off the push start button and ready to pick the tools carefully

## 4.3 engineering drawing/project picture

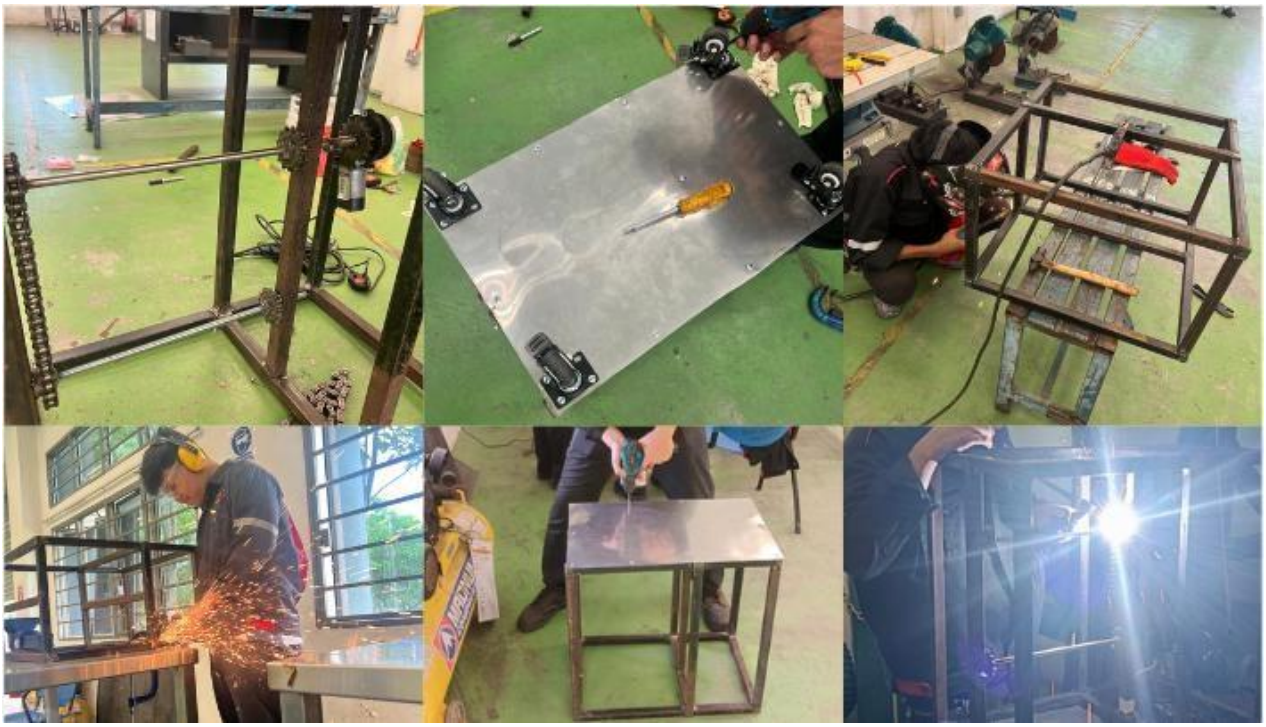


Figure 4.3: Project picture

## 4.4 bill of material

| NO. | ITEM | QUANTITY | UNIT COST (Rm) | COST (Rm) |
|---|---|---|---|---|
| **1** | M19 screw | **4** | **RM2.70** | **RM10.80** |
| **2** | Sprocket 13T | **5** | **RM5.00** | **RM25.00** |
| **3** | Chain | **1** | **RM15.00** | **RM15.00** |
| **4** | L shape bracket | **1** | **RM2.40** | **RM2.40** |
| **5** | Stainless steel handle | **1** | **RM2.90** | **RM2.90** |
| **6** | M2 screw | **2** | **RM2.00** | **RM4.00** |
| **7** | Hinges | **4** | **RM1.60** | **RM6.40** |
| **8** | Cabinet door hatch | **1** | **RM1.20** | **RM2.40** |
| **9** | steel sheets | **3x9** | **RM30.00** | **RM30.00** |
| **10** | Hollow steel | **31.5 feet** | **RM1.50/feet** | **RM47.25** |
| **11** | Steel rod sub | **2 feet** | **RM10.00** | **RM20.00** |
| **12** | Sprocket 36T | **1** | **RM25.00** | **RM25.00** |
| **13** | Door Hasps | **1** | **RM2.70** | **RM2.70** |
| **14** | Door Padlock | **1** | **RM3.00** | **RM3.00** |

Table4.4: Bill of material

## 4.5 project costing

Project costing

| NO. | ITEM | QUANTITY | UNIT COST (Rm) | COST (Rm) |
|---|---|---|---|---|
| **1** | Motor power window | **1** | **RM32.00** | **RM32.00** |
| **2** | 6 Pin Rocket ON/OFF/ON | **1** | **RM5.00** | **RM5.00** |
| **3** | Led hinges | **2** | **RM2.40** | **RM4.80** |
| **4** | Wheels | **1** | **RM23.00** | **RM23.00** |
| **5** | Plastic Box | **4** | **RM7.00** | **RM28.00** |

Table 4.5: Project costing

**TOTAL : RM196.85 + RM92.80**
**= RM 289.65**

## 4.6 impact/ usefulness and application of the project

**the vertical carousel storage box offer a compelling value proposition to customers in the workshop industry, with numerous advantages and benefit that substantially impact operational efficiency and overall business success.**

1. **Increased productivity:**
   The vertical storage box the typical labour intensive vertical movement process , resulting in significant production gains. This project allows businesses to create tools easy to pick up and gain close space. Workshop demand and increasing production smoothly.
2. **improved profitability:**
   The vertical storage box reduce operational expenses by streamlining operation and minimizing big space. also allowing staff to work faster and more effectively.
3. **Reduced manpower requirement:**
   Establish standard operating procedures for efficient workflows, and consider batch picking to minimize trips to the carousel. Regular maintenance and predictive analytics can prevent downtime, reducing the need for emergency support.

## 4.7 Commercial Ability and Market Potential

Commercial ability and market potential for the vertical carousel storage box

1. **Target customer:**
   The primary target customer for the storage box for new workshops and small workshop rooms
2. **Market demand:**
   The demand for vertical carousel storage box need for efficient space management and inventory control across various industries. vertical carousels offer a space-saving alternative that enhances accessibility and reduces retrieval times
3. **customer need :**
   these systems offer an effective solution by condensing storage vertically, thereby freeing up valuable floor space, while also aiming to minimize labor costs associated with manual picking.
4. **Compatibility with the target market:**
   These sectors often face challenges related to limited storage space. as businesses increasingly prioritize efficiency, cost reduction, and scalability, the versatility and adaptability of vertical carousels position them as a valuable asset.

## 4.7 DISCUSSION

The Vertical Carousel Storage box is an innovative storage solution we designed to maximize vertical space while enhancing accessibility and organization. However, several challenges can arise during its operation. For instance, the sprocket. The sprocket has 25 teeth while another has 26 teeth, it can lead to uneven rotation and misalignment, causing operational inefficiencies. This issue can be resolved by ensuring that all sprockets are uniform in teeth count, promoting synchronized movement. Additionally, if the rotation speed is too fast, it can result in instability and increased wear on components; this can be mitigated by adjusting the motor speed settings or incorporating speed controllers to maintain optimal rotation rates. Another common problem is when welds tear off due to excessive stress or improper welding techniques; addressing this requires using the appropriate welding method and ensuring thorough inspections of welds to prevent failures. By tackling these challenges effectively, the Vertical Carousel Storage box can operate efficiently, providing a reliable and safe storage solution.

# CHAPTER 5

# CONCLUSION

## 5.1 CONCLUSION

To summarise, The Vertical Carousel Storage Box is an innovative storage solution we created to maximize vertical space in warehouses, manufacturing facilities, and other environments where storage efficiency is crucial. Unlike traditional systems that occupy substantial floor space, it utilizes a rotating carousel mechanism to store items vertically, allowing easy retrieval at an ergonomic height. This reduces the need for employees to bend, stretch, or climb, improving both efficiency and workplace safety.

One of the system's main advantages is its ability to increase storage density, enabling businesses to store more items in a smaller footprint and free up floor space for other operations. The structured organization within the carousel reduces the risk of misplaced inventory, enhancing inventory control and operational efficiency. The automation feature allows users to retrieve items quickly, further improving productivity and minimizing downtime.

In addition to optimizing space and efficiency, our Vertical Carousel Storage Box enhances workplace safety by reducing manual lifting and repetitive tasks that can lead to injuries. It can also be integrated with inventory management systems for real-time tracking and control. With various customization options, including automation and software integration, this system is a valuable investment for businesses seeking to improve storage, safety, and operational workflow.

In conclusion, we hope that our storage box can serve community as a good thing and provide a upper hand for other. Last but not least, we also hope that our project can make a better change and be the most realible allies to serve other people out there.

## 5.2 **SUGGESTION AND IMPROVEMENT**

Based on other opinions, this is some suggestion and improvement that we can apply to our storage box to make it better;

- **Make the storage box can be remotely controlled**

  The Vertical Carousel Storage Box can be upgraded with remote control, letting users operate it from up to 50 meters away. This makes it easier to manage inventory without needing to be next to the unit. Operators can use a handheld remote or smartphone app to rotate the carousel or retrieve items from a distance, saving time and reducing physical effort. It also improves safety by letting users control the system from a distance, reducing the risk of accidents during operation.

- **Add a handle on the top to make it easy to push and pull**

  The Vertical Carousel Storage Box can have a handle added to the top for easy pushing and pulling. This makes it simple to move the unit around a workspace without needing extra equipment. The handle allows operators to reposition the storage box as needed, making it more mobile and flexible. The handle makes the storage box even more convenient and practical.

- **Change the wall of the storage box to hard glass for make it easy to see through inside it**

  The Vertical Carousel Storage box can be upgraded with hard glass walls, making it easy to see the items inside. This transparent design allows users to quickly identify and locate stored items before opening the unit. The durable glass not only looks modern but also keeps the storage box sturdy. Clear walls improve organization and efficiency and reducing the time spent searching for items. This feature also helps with inventory management by providing quick visibility of stock levels.

- **why aren't the lights connected with a direct wire**

  For emergencies if there is no electricity

- **Why is the rack tilted?**

  Because the chain is not the same length and the chain space is too big/more heavy and more stable

- **rational to the use of VCS near the workshop?**

  Rational because old people can use it

# REFERENCES


Stanley Tools. Retrieved from https://www.fixturescloseup.com/2018/06/01/fill-your-toolbox-with-greatstanley-tools/

Shopee. Retrieved from https://shopee.com.my/?utm_campaign=-&utm_content=Main-mobile-malaysia--&utm_medium=affiliates&utm_source=an_12374090013&utm_term=atjrxg61gacf&gad_source=1

Sull, Donald N. (2012). **Practical Storage Solutions**. New York: Sterling Publishing Co., Inc.

Blodgett, Jennifer (2019). **Storage Solutions: Over 100 Creative Ideas for Utilizing Space Around the Home**. London: Ryland Peters & Small.

Hall, Tara (2017). Declutter Your Life: How Outer Order Leads to Inner Calm. New York: Bloomsbury Publishing.

Marie Kondo, "The Life-Changing Magic of Tidying Up: The Japanese Art of Decluttering and Organizing" (2014). This book discusses the benefits of decluttering but also acknowledges potential downsides, including overreliance on storage solutions.

Ulrich, Karl T., and Eppinger, Steven D. (2015). **Product Design and Development**. New York: McGraw-Hill Education. This book provides insights into product development processes, including the technologies used in manufacturing various products, such as storage boxes.

Pahl, Gero, and Beitz, Wolfgang. (2013). **Engineering Design: A Systematic Approach**. Berlin, Heidelberg: Springer. This book offers insights into engineering design principles, including system mechanisms used in various products like storage boxes.

Dieter, George E. (2012). **Engineering Design**. New York: McGraw-Hill Education. This textbook provides an overview of engineering design principles, including the mechanisms used in the design and manufacturing of products like storage boxes.

Workshop wonders magazine, 2022

**JABATAN KEJURUTERAAN MEKANIKAL**

JADUAL AGIHAN TUGASAN INDIVIDU KUMPULAN PROJEK

| SUB-CHAPTERS | DESCRIPTION |
|---|---|
| **NAME OF STUDENT:** MUHD IKHWAN AFIQ BIN HUSIN | |
| **1.1** | **Introduction** |
| **2.1** | **Introduction** |
| **3.1 – 3.3.1** | **Introduction, Flow Chart, Gathering Information, Market Survey** |
| **3.9 – 4.2** | **Method, Design and analysis, Description of final design or solution** |
| **NAME OF STUDENT:** AMIRUL FAUZHAN BIN GAFFAR | |
| **1.2 – 1.3** | **Problem Statement and Objective** |
| **2.2** | **Function of Storage Box** |
| **3.3.2 – 3.4.2** | **Interview, Design Project, Design Specification, Morphology Chart** |
| **4.3 – 4.6** | **Engineering drawing/project picture, Bill of material, Project costing, Impact/usefulness and application of the project** |
| **NAME OF STUDENT:** MEOR IRFAN SYAZWI BIN MEOR ISHAM | |
| **1.4** | **Scope of Project** |
| **2.2.1** | **Existing Design** |
| **3.4.3 – 3.4.6** | **Sketching Design, Detail Design, Final Design, Prototype** |
| **4.7 – 4.8** | **Commercial ability and market potential, Discussion** |
| **NAME OF STUDENT:** MOHD AIDIL HAFIZ BIN ZAILAN | |
| **1.5** | **Expected Outcomes** |
| **2.3** | **Technology Used by Existing Storage Box** |
| **3.5 – 3.8** | **Material Selection, Fabrication, Milestone Chart, Gantt Chart** |
| **5.1 – 5.2** | **Conclusion, Suggestion and improvement** |

TAJUK PROJEK: **VERTICAL CAROUSEL STORAGE BOX**

Pengesahan Penyelia Projek: …….

Nama: MADAM NURUL HAYATI BINTI JAMIL