



## JABATAN KEJURUTERAAN MEKANIKAL

DJJ 6143  
PROJECT 2

### **TITLE**

Final Report of EZM Wheelchair

### **SUPERVISOR**

Pn. Siti Khalijah binti Jamal

### **TEAM MEMBERS**

<b>NAME</b>	<b>M. NUMBER</b>
CHEW PAH YI	08DKM18F1094
FHELICIAN LING LEH JIE	08DKM18F1097
GAN DHONG SYEN	08DKM18F1116

JUN 2020

**POLITEKNIK SULTAN SALAHUDDIN ABDUL AZIZ SHAH**

**EZM WHEEL CHAIR**

**NAMA**

**NO. PENDAFTARAN**

CHEW PAH YI

08DKM18F1094

FHELICIAN LING LEH JIE

08DKM18F1097

GAN DHONG SYEN

08DKM18F1116

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

**JABATAN KEJURUTERAAN MEKANIKAL**

**JUN 2020**

## AKUAN KEASLIAN DAN HAK MILIK

**TAJUK : EZM WHEELCHAIR**

**SESI : JUNE 2020**

1. Kami, **1. CHEW PAH YI (08DKM18F1094)**  
**2. FHELICIAN LING LEH JIE (08DKM18F1097)**  
**3. GAN DHONG SYEN (08DKM18F1116)**

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 harga intelek daripada pihak-pihak lain.
3. Kami bersetuju melepaskan pemilikan harta intelek 'projek tersebut' kepada 'Politeknik tersebut' bagi memenuhi keperluan untuk peanugerahan **Diploma Kejuruteraan Mekanikal** kepada kami.

Diperbuat dan dengan sebenar-benarnya diakui

Oleh yang tersebut;

a) CHEW PAH YI	)	.....
(No. Kad Pengenalan: 000130-13-0939)	)	CHEW PAH YI
b) FHELICIAN LING LEH JIE	)	.....
(No. Kad Pengenalan: 980516-13-5827)	)	FHELICIAN LING LEH JIE
c) GAN DHONG SYEN	)	.....
(No. Kad Pengenalan: 001221-14-0379)	)	GAN DHONG SYEN

Di hadapan saya, SITI KHALIJAH BT JAMAL	)	.....
(720310067282)	)	
sebagai penyelia projek pada tarikh: //2020	)	SITI KHALIJAH BT JAMAL

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Last but not least, as the saying goes, a teacher affects eternity, he or she will never tell where their influence stops. Once again, thank you so much!

## **ABSTRACT**

Based on the official website of Department of Health of Malaysia, the number of elderly will be double from 7% to 14% within 28 years in our country as opposed to Sweden who has been for 112 years with the same change (United Nations, 2007). Senior citizens defined as individual who aged 60 and above (United Nations, 1982). The senior citizens issues are discussed through a variety of ways, especially through health aspects. Health problems of the elderly will occur when if the need for healthy life cannot be met or achieved. Bedridden elderly patients not only suffer physical changes, but even changed from the social, economic and emotional. For family members, they also felt the challenge in terms of patient care and management of these bedridden patients. At Hospital Kuala Lumpur, the number of bedridden elderly patient cases that has been referred to Medical Social Work Department is 83 cases on 2014. The number has been increased 19% compared on 2013. The factor that affect the elderly bedridden cases are stroke, cancer, fall incident and ageing. The medical field related to disease of the elderly is Geriatric.

# **CHAPTER 1 : INTRODUCTION**

## **1.1 Research Background**

prepared by : Fhelician Ling Leh Jie

A wheelchair is a chair with wheels, used when walking is difficult or impossible due to illness, injury, old age related problems, or disability. These can include spinal cord injuries (paraplegia, Hemiplegia, and quadriplegia), broken leg(s), cerebral palsy, brain injury, Osteogenesis imperfecta a.k.a. brittle bones, motor neurone diseases (MND), multiple sclerosis (MS), muscular dystrophy (MD), Spina bifida, and many more. Wheelchairs come in a wide variety of formats to meet the specific needs of their users. They may include specialized seating adaptations, individualized controls, and may be specific to particular activities, as seen with sports wheelchairs and beach wheelchairs. The most widely recognized distinction is between powered wheelchairs, where propulsion is provided by batteries and electric motors, and manually propelled wheelchairs, where the propulsive force is provided either by the wheelchair user/occupant pushing the wheelchair by hand ("self-propelled"), by an attendant pushing from the rear using handle(s), or by an attendant pushing from the side use a handle attachment.

## **1.2 Problems Statement**

prepared by : Gan Dhong Syen

1. It is difficult for a paralyzed individual to move from a lying position onto the wheelchair.
2. Disabled individuals are having difficulty in using the toilet with the current designs of wheelchair.
3. It is difficult for the guardians to assist patients to move from their supine position onto the wheelchair

### **1.3 Research Objectives**

prepared by : Chew Pah Yi

1. To create a new generation of wheelchair which it will be able to disintegrate and split specifically to ease the movement of bed ridden patients.
2. To build a wheelchair that allow the users to defecate, shower, and move around easily.
3. To achieve the standard level of safety of the product with a load of 100kg – 150kg by using different safety features.

### **1.4 Research Questions**

prepared by : Fhelician Ling Leh Jie

Due to the fact that we need to gather opinions from the public about wheelchair for bedridden patients, these questions will be asked in the form of Google Forms as a survey so that we will be able to collect the data required.

1. Have you ever experienced sitting on a wheelchair due to any forms of sicknesses or injuries?
2. Do you have any relatives who are paralyzed and have to sit on a wheelchair?
3. Is it difficult to transfer a bedridden individual from the bed to the wheelchair?
4. Do you agree that changes should be made to the current design of wheelchair to ease the mobilization of the occupants of wheelchairs?
5. Give a suggestion for modifications that can be applied to the design of current wheelchair.

## **1.5 Scope of Research**

prepared by : Gan Dhong Syen

Due to the fact that there is no current design of any wheelchairs in Malaysia that is able to ease the mobilization of disabled individuals, especially bedridden patients from one place to another, we are trying to help by creating a whole new design of wheelchair. This wheelchair will be able to disintegrate and split in order to ease the mobilization of patients. It would be much more convenient for bedridden patients and their guardians as well for them to transfer from one place to another due to versatility and flexibility of the ingenious and unique design of the wheelchair. Therefore, this would be able to save time and energy of both the guardian and the patient at the same time!

## **1.6 Chapter's Summary**

prepared by : Chew Pah Yi

As for the conclusion for the first chapter, the ability and functions of the newly designed wheelchair is highly anticipated. The design is focused mainly to improve the mobilization of disabled individuals, save the time of theirs, and make the world a better place for them to live in.

## **CHAPTER 2 : LITERATURE REVIEW**

### **2.1 Introduction to wheelchair**

prepared by : Fhelician Ling Leh Jie

The World Health Organisation define a wheelchair as ‘a device providing wheeled mobility and seating support for a person with difficulty in walking or moving about’. Thus, the purpose of a wheelchair is to improve personal mobility. The aim of wheelchair design is to produce wheelchairs that perform well and can provide appropriate seating and postural support without compromising strength, durability and safety. This can be achieved when government authorities, manufacturers, engineers, designers, service providers and users fulfil their respective roles with respect to design.

Wheelchair designs vary greatly to take account of the diverse needs of users with design features, such as the overall length, weight, frame type and width, seat configuration, wheel and castor type, arm and footrests, axle position and propulsion mechanism, all having an influence function. To ensure wheelchairs are appropriate, designers and providers must thoroughly understand the needs of the intended users and their environments. According to Visagie et al (2015) design features must be matched to the user`s functional ability and posture support needs, and also to the environmental and durability requirements. Achieving an ideal match between user, wheelchair design and environment might be as difficult as it is important.

Users` needs are best met when there is a variety of models from which to choose. Wheelchairs should be designed to enable their users to participate in as many activities as possible. As a minimum, a wheelchair should enable the user to lead a more active life without having a negative effect on their health or safety. Comfort and safety are two important factors affecting the quality of life of long-term users.

## 2.2 General considerations

prepared by : Gan Dhong Syen

Wheelchairs should be designed to enable their users to participate in as many activities as possible. As a minimum, a wheelchair should enable the user to lead a more active life without having a negative effect on their health or safety. Comfort and safety are two important factors affecting the quality of life of long-term users. Common wheelchair parts are shown in Fig. 1. A cushion is to be considered an integral part of a wheelchair, and is therefore to be included with all wheelchairs, in particular for wheelchair users with sensory issues to prevent the development of life-threatening pressure sores.

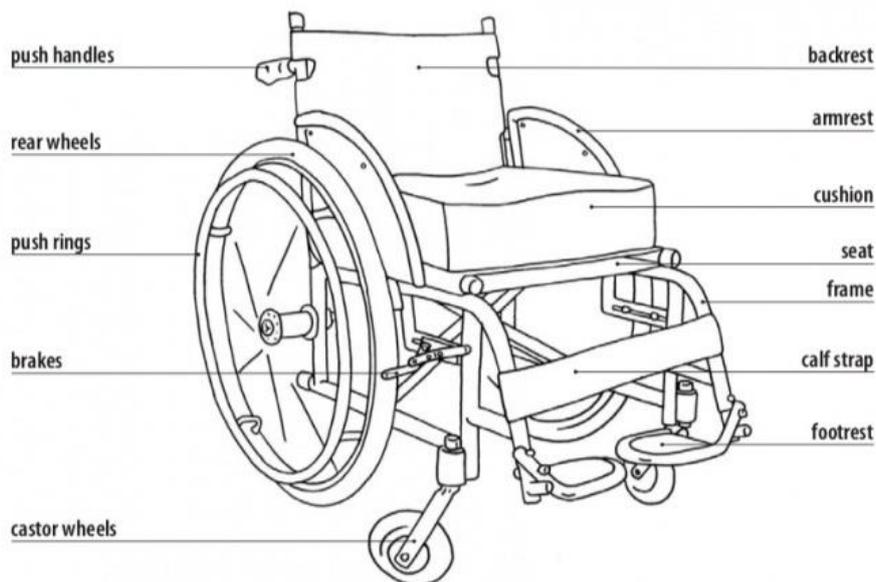


Figure 2.2(a)

## 2.3 Users' health and safety

prepared by : Chew Pah Yi

Although it may seem that any wheelchair is better than no wheelchair, this is not true when the wheelchair causes or contributes to injury or other health risks. The health and safety of users should never be compromised in order to reduce costs. A wheelchair should be designed to ensure the user's safety and health. There are many ways in which users can be injured by their own wheelchairs, as illustrated by the following examples:

A wheelchair with an inadequate cushion or no cushion can cause pressure sores;

- ✓ *Unstable wheelchairs can tip either forward or backwards, leading to users falling out and potentially injuring themselves;*
- ✓ *Shoulder injuries, either through overuse or increased loading can result from a wheelchair that is too wide, too heavy or set up incorrectly for the wheelchair user;*
- ✓ *Sharp edges on surfaces can cause a break in the skin, which in turn can lead to infection.*
- ✓ *Poor design can result in places on the wheelchair where the user can get their fingers or skin pinched.*
- ✓ *Wheelchairs that cannot endure daily use in the user's environment may fail prematurely and can injure the user.*

## 2.4 Suitability for Use

prepared by : Fhelician Ling Leh Jie

Wheelchairs should be appropriate for the environment in which they will be used and for the specific people who will use them. One wheelchair design will not suit everyone. When designing or selecting wheelchairs, it is necessary to think about the environment and the way in which the wheelchair may be used. Consider the following;

- ✓ Pushing for long distances over rough roads.
- ✓ Going up and down many kerbs every day.
- ✓ Accessing built environments: narrow doorways, small turning areas, steep ramps, desks and tables, bathroom facilities (e.g. sitting and squatting toilets).
- ✓ Exposure to moisture such as rain, high humidity, snow, ice, hail and body fluids such as urine and sweat.
- ✓ User showering while sitting in the wheelchair.
- ✓ Exposure to extreme temperatures.
- ✓ User transporting goods on the push handles, upholstery, footrests or other parts of the wheelchair.
- ✓ Passengers riding on footrests and armrests.
- ✓ People lifting the wheelchair by one armrest, footrest or push handle when the wheelchair is occupied.
- ✓ Transporting the wheelchair in confined spaces or other cramped or crowded conditions.

## 2.5 Functional Performance

prepared by : Gan Dhong Syen

Functional performance is how a wheelchair performs for different users in different environments. The functional performance of a wheelchair is determined by its unique design and features. There are many compromises to consider when designing or selecting for different uses but overall the manual wheelchair should be configured to optimise stability and manoeuvrability for everyday function. Stability is necessary to ensure client safety and security in chair use. Manoeuvrability affects access to tight spaces and the ease of propulsion. Manoeuvrability and stability in the wheelchair can be altered by adjustment of the rear axle and the front castor positions in relation to the centre of mass of the wheelchair and client. In practice an appropriate wheelchair configuration for a given client should balance their need for stability and manoeuvrability. As there is a fine balance between stability and manoeuvrability, wheelchair configuration should be assessed for indoor activities and outdoor use in various environments, and should also be reviewed over time according the changes in the client's wheelchair skills, experience and health status (e.g. adjusting axle position to compensate for weight gain or loss).

This section provides information on the key features of a wheelchair that affects the main categories of performance and how to evaluate them. It also outlines compromises that need to be considered when choosing different design features. To meet the functional performance needs of individual users, a range of wheelchair designs and sizes are needed.

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## **CHAPTER 3 : METHODOLOGY**

### **3.1 Introduction to Methodology**

prepared by : Chew Pah Yi

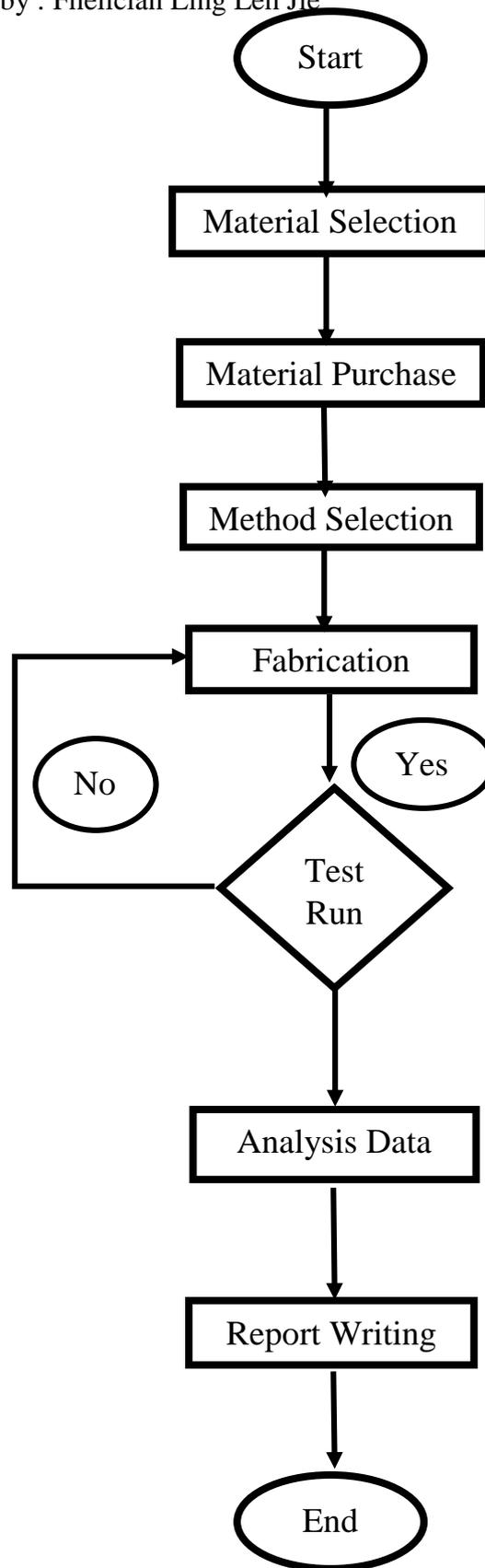
What is the methodology? A methodology is a plan-of-attack, especially when that plan-of-attack is used repeatedly. This might be obvious, but the word methodology is related to the word method. In fact, a methodology is a system of methods followed consistently. Scientists, for example, use various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

As the main part of this chapter, we will be showing the processes, methods, details and information throughout the journey of ours in the making of the superb EzM wheelchair as our Final Year Project. Throughout this chapter, there will be a flow chart, a Gantt chart showing our weekly progress and the sketching of the design of the product.

Besides that, materials selection, fabrication, accessories selected, cost of materials and operation methodology will be shown as well in this chapter to provide in depth information about the product.

### 3.2 Flow Chart

prepared by : Fhelician Ling Leh Jie



### 3.3 Flow Chart Explanation

prepared by : Gan Dhong Syen

#### 3.3.1 Material selection

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

##### ✓ Stainless Steel

Stainless steel is an alloy of Iron with a minimum of 10.5% Chromium. Chromium produces a thin layer of oxide on the surface of the steel known as the 'passive layer'. This prevents any further corrosion of the surface. Increasing the amount of Chromium gives an increased resistance to corrosion.

Stainless steel offers many advantages to the architectural/ornamental metal user. The major advantages include its high corrosion resistance allowing it to be used in rigorous environments. It is resistance to fire and heat allowing it to resist scaling and retain strength at high temperatures.

Hygienic, non-porous surface coupled with the easy cleaning ability of stainless makes it the primary choice for applications which require strict hygiene control, such as hospitals, kitchens, and other food processing plants. Aesthetic appearance provides a modern and attractive appearance for most architectural metal applications.

Its bright and easily maintained surface making it an easy choice for applications demanding an attractive surface at all times. Its strength to weight advantage that allows it to be used with a reduced material thickness over conventional grades, often times generating cost savings.

The ease of fabrication due to the use of modern steel- making techniques that allow stainless steel to be cut ,machined, fabricated, welded, and formed, as readily as traditional steels. A long term value created by its long useful life cycle often yields the least

expensive material option.

✓ **Aluminium**

Aluminium is a soft, lightweight, silvery metal. It is an element in the boron group on the periodic table of elements, with the symbol Al and atomic number 13. On the earth's crust, aluminium is the most abundant metal, and the third most abundant of all elements on the earth's crust, after oxygen and silicon. It accounts for 8% of the weight of the Earth's solid surface.

One of aluminium's special properties is that it is able to resist corrosion. This is because a thin surface layer of aluminium oxide forms when the metal is exposed to air; this layer prevents the additional oxidation that would otherwise cause rust.

Aluminium is a good thermal and electrical conductor. It is a lightweight metal, having about one-third the density and stiffness of steel. It is ductile and malleable, which means it can be easily machined, cast, and extruded. Under normal circumstances, aluminium is not soluble in water or alcohol. Aluminium also has a high reflectance, making it useful for mirrors. In addition, because aluminium retains its full silvery reflectance in powdered form, it is often used for silver paints.

Aluminium easily forms alloys with elements such as copper, zinc, magnesium, manganese and silicon. Today, many metal materials that are referred to as "aluminium" are actually alloys. Aluminium foil, for example, is usually an alloy of 92% to 99% aluminium. Because of their high strength-to-weight ratio, aluminium alloys are important for the aerospace industry and other areas of transportation and building.

### **3.3.2 Material purchase**

The process of materials purchasing is crucial to collect and obtain all the materials needed. Insane amount of researches are done regarding places that supply quality and reasonable priced products. Wasting of money, time and energy can be avoided if it is well planned. We contacted the suppliers regarding the availability of materials and calculated the

amount and price of the materials. After negotiating the final price of the materials, the purchases could be made eventually.

### 3.3.3 Method selection

We tried to figure out the best way to connect all the different parts of the product including riveting, welding, casting, 3D printing and much more. After a long discussion with all the groupmates, the final decision was to weld the parts all together. We started to find out suitable places around Shah Alam that provide welding services. Eventually, we chose Ban Fong Metal Fabrication & Trading Sdn. Bhd.



Figure 3.3.3(a): Ban Fong Fabricating Workshop located in Klang, Selangor.



Figure 3.3.3(b): Equipment available and working environment in the workshop.

### 3.3.4 Fabrication

During fabrication, anthropometric data for adults in was implemented in the design of the wheelchair. Although people living with disabilities usually have distorted frames, this work considers average adult structure in order to accommodate various forms of deformation, and create room for future improvements in body frames as their health conditions improve.

The fabrication of the components and parts of the wheelchair will be connected via welding techniques. Gas metal arc welding (MIG) and Gas Tungsten Arc Welding (TIG) will be used to connect either steel or aluminium rods as the frame and backbone of the product. Some of the joints were also connected with rubber spacer so that the structure of the wheelchair will be more sturdy and wont wiggle and squeaking.

Some of the small components might be installed by using screws, bolt, nut and rivet. Rubber will be installed to the handle and caster wheel

in order to increase frictional force against the ground so that it will be able to catch firmly even on a slippery floor.

Plastic footplate and mattress might be installed to the wheelchair in order to improve the comfortability of the patient depending on the cost and budget of the product. Plastic toilet bowl option were also available. Seat belt will also be installed at the back of the seat to prioritize safety.



Figure 3.3.4(a): Steel cutting process for each of the parts of the wheel chair.

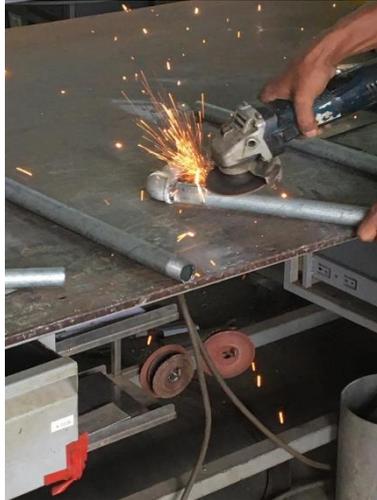


Figure 3.3.4(b): Grinding and resurfacing process to make sure that the surfaces are ready for the welding process.



Figure 3.3.4(c): Welding process of the upper part / main frame of the wheel chair.



Figure 3.3.4(d): Welding process of the lower part / base / wheel of the wheel chair.



Figure 3.3.4(e): Drilling process of the seating area.



Figure 3.3.4(f): Drilling process of the backseat.

### **3.3.5 Test run**

Test run is carried out to determine the strength and end result of the product. In this test run, we placed a load of 100 kilograms on the wheelchair and observe the state of it. By moving it for at least 500 meters of travelled distance with the load on, we observed no cracking, bending, or any mechanical failure of the wheelchair. The product passed the test successfully with encountering any failure or damage.

### **3.3.6 Data analysis**

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

### **3.3.7 Report writing**

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

### 3.4 Design of EzM wheelchair

prepared by : Chew Pah Yi

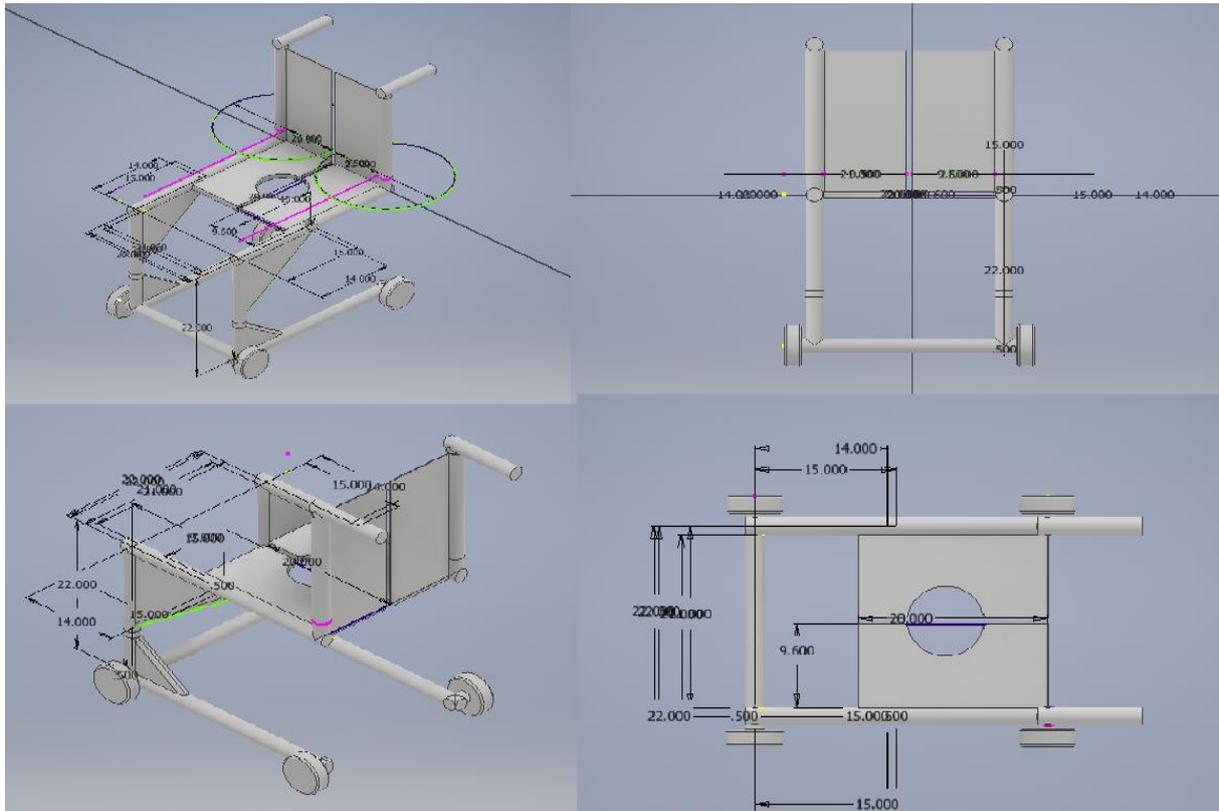


Figure 3.4(a): The sketching and model done by using different software such as AutoCAD and Inventor to portrait the shape and structure of the product.



Figure 3.4(b)&(c): The pure skeleton of the wheelchair before painting, upgrades and decorations.



Figure 3.4(d): This is the final product of the entire team after upgrades in terms of safety, paintings, decorations and test runs.

### 3.5 Design Description

prepared by : Fhelician Ling Leh Jie

Wheelchairs should be appropriate for the environment in which they will be used and for the specific people who will use them. One wheelchair design will not suit everyone. When designing or selecting wheelchairs, it is necessary to think about the environment and the way in which the wheelchair may be used. EzM wheelchairs are specialized for those who suffered from bedridden.

The health and safety of users should never be compromised in order to reduce costs. Although it may seem that any wheelchair is better than no wheelchair, this is not true when the wheelchair causes or contributes to injury or other health risks. A wheelchair should be designed to ensure the user's safety and health. There are many ways in which users can be injured by their own wheelchairs, as illustrated by the following examples:

- A wheelchair without a cushion or with an inadequate cushion can cause pressure sores. This in turn may require the user to spend many months in bed; without appropriate care and treatment this often leads to bedsores, secondary complications and even premature death.
- Unstable wheelchairs can tip and lead to users falling and injuring themselves.
- Wheelchairs that are too wide or are unduly heavy can cause shoulder injuries.
- Sharp edges on surfaces can cause cuts that in turn can lead to infection.
- Poor design can result in places on the wheelchair where the user or others can get their fingers or skin pinched.
- Wheelchairs that cannot endure daily use in the user's environment may fail prematurely and can injure the user.

#### Strength and durability

- Wheelchairs used outdoors are subjected to greater wear and tear than those designed for indoor use or use on smooth roads and paths. A wheelchair must be strong enough not to suffer a sudden failure while being used. The wheelchair should be built to have the longest possible useful life and require the fewest repairs. A wheelchair should be designed so it can be repaired near the user's home if it fails, and replacement parts should be easily available.

### Suitability for use

- Wheelchairs should be appropriate for the environment in which they will be used and for the specific people who will use them. One wheelchair design will not suit everyone. When designing or selecting wheelchairs, it is necessary to think about the environment and the way in which the wheelchair may be used.

## **3.6 Accessories Selection**

prepared by : Chew Pah Yi

### ✓ Caster Wheel

A caster wheel is an undriven, single, double, or compound wheel that is designed to be attached to the bottom of a vehicle to enable that object to be moved. They are available in various sizes, and are commonly made of rubber, plastic, nylon, aluminium, or stainless steel.

Casters are used in numerous applications, including shopping carts, office chairs, hospital beds, and material handling equipment. High capacity, heavy duty casters are used in many industrial applications, such as platform trucks, carts, assemblies, and tow lines in plants. Generally, casters operate well on smooth and flat surfaces.

Ergonomic casters are designed with consideration for the operating environment and the task to be performed so that any injurious effects on the operator are minimized. Long-term repetitive actions involving resisting casters can contribute to strain injuries. Improper specifications can also contribute to reduced service life of casters.

Many parameters play a role in how well the caster performs. Parameters such as tire hardness, tread width and shape, the length of the trailing offset (the 'caster') and wheel diameter all affect the effort required to start the platform moving. Harder wheels will make the caster easier to roll by reducing deformation resistance. A less inflated tire offers more deformation resistance and thus more effort is required to move the attached platform. Turning effort is affected by the amount of caster and by the wheel diameter.

Enhancements to traditional caster design include toe guards, track wipers, reinforced legs, steering tubes, swivel locks and

brakes, all implemented in an effort to reduce operator injuries in the workplace.

✓ Seat Belt

A seat belt (also known as a seatbelt or safety belt) is a safety device designed to secure the passenger of a vehicle against harmful movement that may result during a collision or a sudden stop. A seat belt reduces the likelihood of death or serious injury in a collision by reducing the force of secondary impacts.

A seatbelt applies an opposing force to the seaters to prevent them from falling out or making contact from the collision.

✓ Seat Cushions

Seat cushions can be made of standard foam, which is better than nothing, but not ideal for long periods of sitting. For the best support and comfort, you'll want to look for something made from memory foam or gel, or a combination of the two. They're both made of the same basic material, called viscoelastic, but gel provides better heat dissipation, although it tends to be more expensive and more prone to breaking down.

Ergonomic seat cushions make it easier to sit with good posture, which in turn helps your body develop a better natural posture (the kind you don't have to think about). Having good innate posture makes you less prone to chronic pain and increases energy and focus. It makes you feel happier and more confident, and it gives you a more attractive appearance. It even helps you age more gracefully, so when your friends are using walkers, you'll still be strutting your stuff.

Tailbone and Pelvis – the most common type of seat cushion goes under your buttox to support your tailbone and pelvis, giving you an ergonomic base to sit on. Lumbar – lumbar support can also be beneficial for people with low back pain, and can help with posture by maintaining the curves in your back and the rotation of your hips, keeping you from slumping.

### **3.7 Interview & research**

prepared by : Gan Dhong Syen

We did some interview with a lot of related authorities such as professional welders, nurses, old folks' home and many more. Most of the people support our project and believe in our vision in order to create a unique concept of wheelchair that will be able to cater the needs of bed-ridden or paralyzed patients.

Nurses and guardians in the old folks' home often complaint about the trouble of carrying paralyzed patients around with the ordinary wheelchairs that are available on the market and they believe that with our creation and concept of creating a specialized wheelchair for them, it would definitely tackle the problem of mobilization of these patients.

Mr. Wong, the founder of Ban Fong Fabrication company, agreed on our project and was very interested in it. This is due to the fact that he never expect wheelchair to be equipped with specifications and design like this before, thus believing that this could help those in need.

### 3.8 Cost & Materials

prepared by : Fhelician Ling Leh Jie

No.	Material & Equipment	Amount	Price
1.	Galvanised Iron Pipe	1 pipe 1 meter	RM51.60 RM7.80
R	Connecting Joints	10 pieces	RM16
3.	Bolt & Nut	2 packets	RM3.80
4.	Plywood	1 piece	RM20
5.	Matress	1 piece	RM9
6.	Sandpaper	2 pieces	RM1.20
7.	Mini saw	1 piece	RM5
8.	Caster Wheel	4 pieces	RM16
9.	Spray Paint	1 can	RM10.90
<b>TOTAL</b>			<b>RM133.50</b>

### 3.9 Operational Methodology

prepared by : Gan Dhong Syen



#### 3.9.1 Threading

Threading is the process of creating screw threads for fastening things together. Threaded parts are incredibly common, and for good reason : threads allow parts to be joined together easily and at a low cost. They can be created using a variety of methods, and are used with dozens of different types of fasteners.

#### 3.9.2 Welding

Welding is a fabrication or sculptural process that joins materials, usually metals or thermoplastics, by using high heat to melt the parts together and allowing them to cool causing fusion. Welding is distinct from lower temperature metal-joining techniques such as brazing and soldering, which do not melt the base metal.

#### 3.9.3 Installation by screw & spraying paint

Small parts of the wheelchair are installed by using screws, rivets and nuts. Tightening the screws would increase the strength of design when all the joints are tightened. After that, the mainframe is spray with white paint to improve its appearances and protect it from rusting. This process is easy where even an inexperienced trainee can learn and carry the task with less problem along the process. Screws, nuts and rivets are simple mechanical machines that can be used to connect joints and provide extra stability and strength to support load on all the joints combined.

### 3.10 Gantt Chart

prepared by : Chew Pah Yi

	PLANNING
	EXECUTE

Weekly Plans	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Project briefing & materials purchase	PLANNING EXECUTE														
Measure & cut GI pipe for mainframe		PLANNING EXECUTE													
Welding process of mainframe			PLANNING EXECUTE	PLANNING EXECUTE	PLANNING EXECUTE										
PITEX & myIPO application						PLANNING EXECUTE	PLANNING EXECUTE								
Screwing & spraying of the wheel chair								PLANNING EXECUTE							
PITEX product video									PLANNING EXECUTE						
Final touch up on safety & comfort features										PLANNING EXECUTE					
Product testing & discussion											PLANNING EXECUTE				
Finishing final report												PLANNING EXECUTE			

### **3.11 SUMMARY**

prepared by : Fhelician Ling Leh Jie

The conclusion for this project is that the process of building EzM wheelchair has taught us about handling a project and exposed us to a real work field surrounding. Besides that, this wheelchair will bring a lot of benefits to all the user of wheelchairs. The design which is user-friendly will bring more comfort to occupants in terms of mobilization and self-independent without have to depends too much on their guardians. There are still room of improvements for every invention which in fact will enhanced the knowledge that we gained from this project.

## **CHAPTER 4 : RESULTS & ANALYSIS**

### **4.1 Introduction**

prepared by : Gan Dhong Syen

In this chapter, we will exhibit the data and analysis that have been obtained from product testing of the wheelchair. This is to ensure all the objectives and scope of research are achieved. We analyse every single data that we obtained to ensure that this project is successful.

### **4.2 Advantages & Disadvantages**

prepared by : Chew Pah Yi

Every project has its own advantages and disadvantages. We believe that each advantages can bring benefits and assistance to those who's using it. Hence for the disadvantages, this is where improvements must be made so that the product will be more reliable and accountable for its user in the future.

#### Advantages

This wheelchair is able to disintegrate or split on the mainframe which made mobilization of occupant would be much more easier.

#### Disadvantages

The disadvantages of this wheelchair is that it is too heavy due to the material used to build the wheelchair. Hence, improvements must be made on the material selection in the future so that the product can be lighter and portable.

### **4.3 Results & Analysis**

prepared by : Fhelician Ling Leh Jie

The project of EZM Wheelchair is designed to improvise the design of current wheelchair. This project aims to develop a wheelchair with new capabilities and designs specifically for bed ridden patients. The innovations of this wheelchair is focus on the disintegrate or split function on the seat and mainframe which ease the mobilization of occupant by employing movable double cylinder support structure. The ingenious idea of implementing the 'Double Cylinder System', (DCS) enables the wheelchair to be able to rotate freely and separate the upper and lower parts of the wheel chair. While doing so, DCS will be able to maintain the rigid structure of the wheel chair while being versatile at the same time in order to achieve safety standard.

### **4.4 Product Testing**

prepared by : Gan Dhong Syen

This design is expected to able to support load up to 150kg. Test and analysis on EZM Wheelchair is carried out based on analysis of structure deflection. The project mainframe is made of metal. (Galvanised Iron) Pipes is used as the mainframe where GI Pipe has minimum yield strength of 50,000 psi and a minimum tensile strength of 55,000 psi which can support to heavy loads. Plus, GI Pipes come in cheaper price compares to other metal. This project can hold load of at least 100kg after test and analysis based on structure deflection conducted on it. Finally, it can be concluded that the stated objectives were achieved and implemented effectively.

## **4.5 Conclusion**

prepared by : Chew Pah Yi

The conclusion for this chapter is that there are advantages and disadvantages of this project. All hopes that the advantages of this product can bring benefits and convenience to the community. While for the disadvantages, we will encourage the younger generations to take this as rooms for improvements for this product and conduct more research on this project. This project will be a beneficial in the future. More test and analysis should be conducted so that the product will be more accountable in the future.

## **CHAPTER 5: DISCUSSION**

### **5.1 Introduction**

prepared by : Fhelician Ling Leh Jie

In this chapter, we will explain about the results and findings from the product testing. Based on the data and analysis obtained, we will discuss about the improvements and changes that can be made to this product in order for it to be more reliable, user-friendly and last longer.

### **5.2 Discussion**

prepared by : Gan Dhong Syen

With references and observations made on the data obtained, the first improvements that should be made to this product is the material of the mainframe. Though the mainframe we selected is strong which can support heavy load, it cannot be deny that it made the structure of the wheelchair is too heavy. This cause the wheelchair to be not portable and it is difficult for the occupants to bring this wheelchair whenever they are travelling. So, other material such as stainless steel which is lighter and stronger can be considered as alternatives to the current material. This can ensure the future wheelchair is more portable and user-friendly.

The next improvement that should be made on this wheelchair is the double supporting cylinder. Bearings should be added to this cylinder so that it can last longer and more durable. The current features on the wheelchair have the probability to go wear as there are frictional force between the cylinder and the mainframe.

The next improvement is that we can install electric motor on the wheelchair. With that, the power will be generated by the motor and the occupants will no need to use their own force to move the wheelchair. This can of course bring convenient to the occupants.

### **5.3 Conclusion**

prepared by : Chew Pah Yi

Through this project, it helps develop creativity and critical thinking among us in figuring out solutions to any problems. Problems related to existing projects can be solved through some modifications and fabrications applied to the current design. Innovations made on EZM Wheelchair is not just convenient to the bed ridden patient to move, but also to the guardian. The 'split' feature on the wheelchair will ease the guardian to assist the bed-ridden patient to sit on the wheelchair. The process would save a lot of time and energy compared to last time. There is still room for improvement which can be added to this project to make it more effective, durable and user-friendly. This project has a big potential in market and should be commercialized for advanced research and development.

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# APPENDIX