



**A STUDY OF END-OF-LIFE VEHICLE PREFERABLE PARTS  
FOR AUTO SERVICE WORKSHOP**



**BACHELOR OF MANUFACTURING ENGINEERING  
TECHNOLOGY (BMMW) WITH HONOURS**

**2023**



**Faculty of Mechanical and Manufacturing Engineering Technology**

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**A STUDY OF END-OF-LIFE VEHICLE PREFERABLE PARTS FOR  
AUTO SERVICE WORKSHOP**

**LING JING SENG**

**Bachelor of Manufacturing Engineering Technology (BMMW) with Honours**

**2022**

**A STUDY OF END-OF-LIFE VEHICLE PREFERABLE PARTS FOR AUTO  
SERVICE WORKSHOP**

**LING JING SENG**

**A thesis submitted  
in fulfillment of the requirements for the degree of  
Bachelor of Manufacturing Engineering Technology (BMMW) with Honours**



**Faculty of Mechanical and Manufacturing Engineering Technology**

**UNIVERSITI TEKNIKAL MALAYSIA MELAKA**

**2023**

## DECLARATION

I declare that this Choose an item. entitled “ a study of end-of-life vehicle preferable parts for auto service workshop” is the result of my own research except as cited in the references. The Choose an item. has not been accepted for any degree and is not concurrently submitted in candidature of any other degree.

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Date

: 11 January 2023

UNIVERSITI TEKNIKAL MALAYSIA MELAKA

## APPROVAL

I hereby declare that I have checked this thesis and in my opinion, this thesis is adequate in terms of scope and quality for the award of the Bachelor of Manufacturing Engineering Technology (BMMW) with Honours.

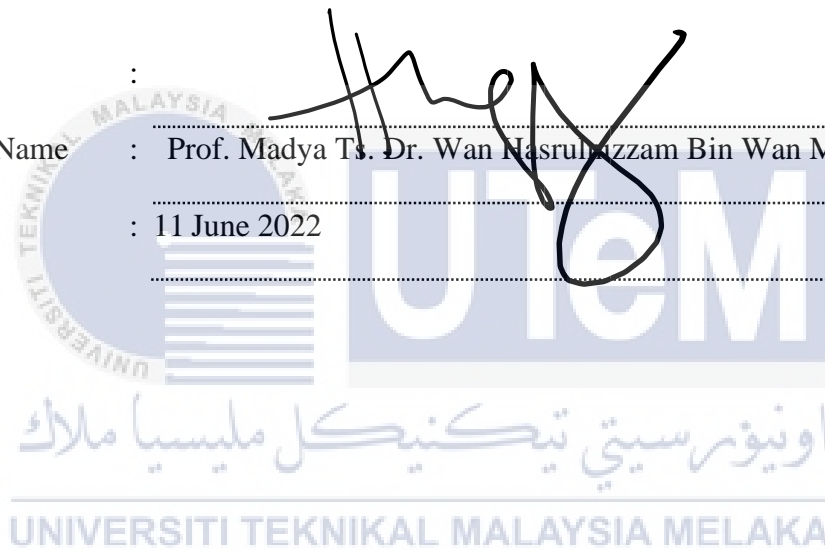
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Date :

11 June 2022



## DEDICATION

This dissertation is dedicated to my loving parents, my supervisor Professor Madya Ts Dr Wan Hasrulnizam Bin Wan Mahmood, and all those whose unfailing love, advice, and support have filled my spirit and motivated me to pursue and accomplish this work.



## **ABSTRACT**

*Automobiles that have reached the end of their useful lives and are now considered garbage are referred to as end-of-life vehicles (ELV). In addition, the materials and components that make up these things are considered to be garbage. Anything that have the intention of getting rid of, or are mandated to get rid of is considered waste. This includes materials that are being sent out to be recycled or reused. Because of the widespread use of vehicles around the globe, ELV have developed into a problem of global concern. However, there are currently very few nations and areas that have enacted regulations regarding ELV recycling. In contrast to countries such as Singapore, the European Union, Japan, Korea, China, and Taiwan, who have had ELV policies in place for some time now, the issue of ELV is not yet fully investigated in Malaysia. There is an urgent need to build a legal framework for the recycling of ELVs, in particular nations and areas where the number of people who own automobiles is quickly rising. This particular project discusses what is the perspective of ELV, the preferable parts of ELV, and the factor analysis for perspective of ELV in Auto Service Workshop (ASW) in peninsular and non-peninsular Malaysia. The methodology used in this project are involved observation, interview, questionnaire, and checklist. The primary stage of this research is done with the pre-visiting and pre-observation process, questionnaire is given to the respondent who are the owner in auto service workshop. After all the questionnaire is collected, the analysis of survey is conducted which are reliability, correlation, and factor analysis. To have a better understanding, the result is summarised and illustrated in the form of graph, table, and picture. From the finding, ELV can provide a huge business line to ASW in peninsular Malaysia, whereas implement of ELV will bring more pros compared to cons for ASW in non-peninsular Malaysia. The preferable part in peninsular Malaysia is engine due to the high demand in there, whereas for the non-peninsular Malaysia the preferable parts is vehicle battery. By the factor analysis, the 10 components of the perspective of ELV can be divided into three factors which are ELV concept, ELV business, and ELV management strategy. Knowledge about ELV may be broadly spread by the conduct of such studies. Many people, particularly in Malaysia, will be aware of the ELV in in order to preserve the natural environment in an appropriate manner. This research may offer readers with references, important insights, and possibilities, as well as a motivation to pay more attention to ELVs.*

## **ABSTRAK**

*Kereta yang telah mencapai akhir hayat bergunanya dan kini dianggap sampah dirujuk sebagai kenderaan akhir hayat (ELV). Di samping itu, bahan dan komponen yang membentuk perkara ini dianggap sebagai sampah. Apa-apa sahaja yang mempunyai niat untuk menyingkirkan, atau diberi mandat untuk menyingkirkan dianggap sebagai pembaziran. Ini termasuk bahan yang dihantar untuk dikitar semula atau digunakan semula. Oleh kerana penggunaan kenderaan yang meluas di seluruh dunia, ELV telah berkembang menjadi masalah yang membimbangkan global. Walau bagaimanapun, pada masa ini terdapat sangat sedikit negara dan kawasan yang telah menggubal peraturan mengenai kitar semula ELV. Berbeza dengan negara seperti Singapura, Kesatuan Eropah, Jepun, Korea, China, dan Taiwan, yang telah mempunyai dasar ELV sejak sekian lama, isu ELV masih belum disiasat sepenuhnya di Malaysia. Terdapat keperluan mendesak untuk membina rangka kerja undang-undang untuk kitar semula ELV, khususnya negara dan kawasan di mana bilangan orang yang memiliki kereta meningkat dengan cepat. Projek ini membincangkan apakah perspektif ELV, bahagian ELV yang diutamakan, dan analisis faktor untuk perspektif ELV dalam Bengkel Perkhidmatan Auto (ASW) di semenanjung dan bukan semenanjung Malaysia. Metodologi yang digunakan dalam projek ini adalah melibatkan pemerhatian, temu bual, soal selidik, dan senarai semak. Peringkat utama penyelidikan ini dilakukan dengan proses pra-lawatan dan pra-pemerhatian, soal selidik diberikan kepada responden yang merupakan pemilik bengkel servis auto. Setelah semua soal selidik dikumpul, analisis tinjauan dijalankan iaitu kebolehpercayaan, korelasi, dan analisis faktor. Untuk pemahaman yang lebih baik, hasilnya diringkaskan dan digambarkan dalam bentuk graf, jadual, dan gambar. Daripada penemuan itu, ELV boleh menyediakan barisan perniagaan yang besar kepada ASW di semenanjung Malaysia, manakala pelaksanaan ELV akan membawa lebih banyak kebaikan berbanding keburukan untuk ASW di bukan semenanjung Malaysia. Bahagian yang diutamakan di semenanjung Malaysia adalah enjin kerana permintaan yang tinggi di sana, manakala bagi bukan semenanjung Malaysia bahagian yang lebih disukai ialah bateri kenderaan. Dengan analisis faktor, 10 komponen perspektif ELV boleh dibahagikan kepada tiga faktor iaitu konsep ELV, perniagaan ELV dan strategi pengurusan ELV. Pengetahuan tentang ELV boleh disebarkan secara meluas dengan menjalankan kajian sedemikian. Ramai orang, khususnya di Malaysia, akan menyedari tentang ELV untuk memelihara alam sekitar dengan cara yang sesuai. Penyelidikan ini mungkin menawarkan kepada pembaca rujukan, pandangan penting dan kemungkinan, serta motivasi untuk memberi lebih perhatian kepada ELV.*



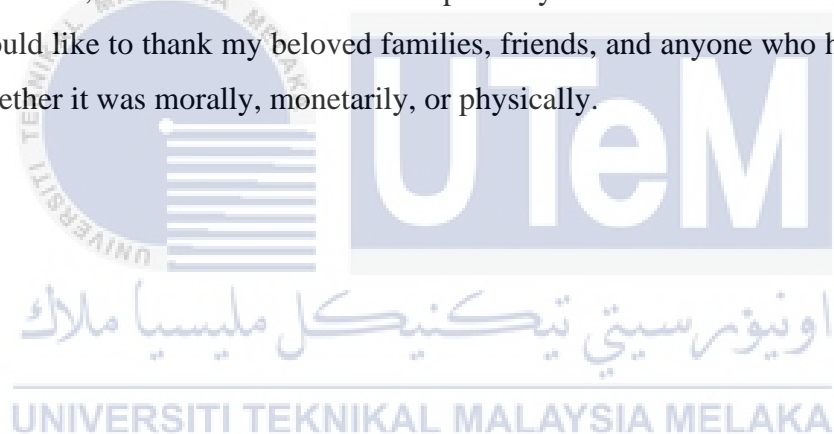
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## ***LIST OF SYMBOLS AND ABBREVIATIONS***

AATF	-	Authorized Automotive Treatment Facility
ASW	-	Auto Services Workshop
ATF	-	Authorized Treatment Facility
ATFs	-	American Authorized Treatment Facilities
BTS	-	Bartlett's Test of Sphericity
CFC	-	Chlorofluorocarbons
DOE	-	Department of Environment
EEV	-	Energy Efficient Vehicles
ELV	-	End-of-life vehicles
EPR	-	Extended Producer Responsibility
GM	-	Green Manufacturing
HCFC	-	Hydrochlorofluorocarbons
HVAC	-	Heating, Ventilation, Air conditioning
IR 4.0	-	Industrial Revolution 4.0
ISM	-	Interpretive Structural Modelling
KMO	-	Kaiser-Meyer-Olkin
MaaS	-	Mobility-As-A-Service
MFA	-	Material Flow Analysis
MIROS	-	Malaysian Institute of Road Safety Research
MOEJ	-	Japan's End-of-Life Vehicle Recycling Act
NAP	-	National Automotive Policy
NxGV	-	Next-Generation Vehicles
PAHs	-	Polycyclic Aromatic Hydrocarbons
PCBs	-	Polychlorinated Biphenyls
PVB	-	Polyvinyl Butyral
SCADA	-	State of California Auto Dismantlers Association
SSCM	-	Sustainable Supply Chain Management
VSP	-	Vehicle Scrap policy
WG	-	Waste Glass

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## CHAPTER 1

### INTRODUCTION

#### 1.1 Background

End-of-life vehicles (ELV) are cars or vehicles that have arrived the end of its lifespan and have been classified as garbage or waste, together with its components and materials. This waste including materials sent for recycling or reuse. This shows a need to be explicit about exactly what is meant by the word 'ELV'. In 2017, Anderson et al. published a paper in which they described ELV are spare components that will be resold, as well as reusable parts with a high Al, Cu, or Fe content, are removed. Electrical parts are often not replaceable or too expensive to disassemble and move, therefore they are left in ELVs. The residual ELV is sold to firms that specialise in automated treatment.

The purpose of the ELV is to encourage manufacturers to create and construct their own cars with the goal of minimising the usage of heavy materials like iron, steel, alloys, and other materials in modern vehicle production processes. As the result, the goal of ELV is to guarantee that materials are better reused and recycled to enhance the energy dialogue and prevent overconsumption of energy, as energy may be depleted at some point. According to various studies, the collection and transportation of wrecked and medium-aged automobiles from consumers for reuse, recycling, or disposal is known as the reverse flow of ELVs. These efforts are motivated not just by a goal to make a profit, but also by a desire to comply with recycling requirements.(Cruz-Rivera & Ertel, 2009; Chaabane et al., 2021).

The engine and motor of a vehicle are no longer usable when it approaches the end of its useful life. Thus, useless components can generate a million tonnes of garbage each year,

making it critical to develop strategies and methods to reduce environmental consequences. So, more information and practice should be given to residents in Malaysia to counter the negative consequences of unstable or unpredictable industrial environments. Thus, the purpose of the ELV is convert the unusable vehicle to its small components and can be recyclable, manufacturable, and reusable to save the environment. The aim of this study will outline the relationship between auto service workshop (ASW) and junk yard, the preferable parts from ELV in ASW, and procedures of operating the ELV products for ASW.

## 1.2 Problem Statement

Vehicles, which are vital to society, are becoming increasingly popular. Increased vehicle production, on the other hand, has an environmental impact throughout its life cycle. This impact may include the energy and resource consumption, waste generation during manufacture and use, and disposal at the end of its useful life. ELV are not effectively managed in Malaysia, as their number continues to rise, which can be seen by the increasing number of automobiles produced and registered each year. In Malaysia, improper disposal of end-of-life vehicles endangers the environment and social life.

The number of automotive sectors growth rapidly in Malaysia, as a result, the number of ELV also increasing and become a huge market in this country. Many people like to buy ELV parts rather than the new parts because the ELV parts is cheaper than the new parts in the market. Proper management of ELV can drive to the market growth and stimulate the economy Malaysia as it can contribute a new supply chain to the country. Thus, the Auto Services Workshop (ASW) is the important role in the supply chain which give a lot of services and repairs to the people when the vehicle is broken. The study is conducted to look for which preferable parts is the most likely by the ASW from ELV and most likely services the customers from the ASW.

ELV is one of the most typical types of hazardous waste found in households. ELV is seen to be risky due to the fact that it has the potential to harm the environment if it is not controlled correctly. Because of its intricate make-up, ELV is notoriously difficult to administer effectively. If a person does not have sufficient understanding about how to effectively handle ELV, it is anticipated that the value of ELV will continue to climb. For example, When ELV such as oil waste, coolant, and gear oil are disposed of, it might have an effect on the quality of the water.

Figure 1.1 shows the Process flow of ELV which is how the ELV works from a good car to their end of life. When a vehicle sustains damage, it will be inspected, and if it is still repairable, it will be sent to ASW; otherwise, it will be sent to ELV. The depollution procedure will take place before the vehicle is transported for the dismantling process. This will guarantee that no dangerous substances are released from the vehicle during the dismantling process. During the process of dismantling, all useable components are removed and transferred to a recycling or remanufacturing centre to be used in the production of a brand-new vehicle. Once the process of dismantling is finished, the car that has been sliced in two is gathered and placed in a “hulk” to be ready for the shredding process. The shredding process may leave behind chip residue that can be recycled once more; alternatively, the portions that were not recycled can be disposed of in a landfill.

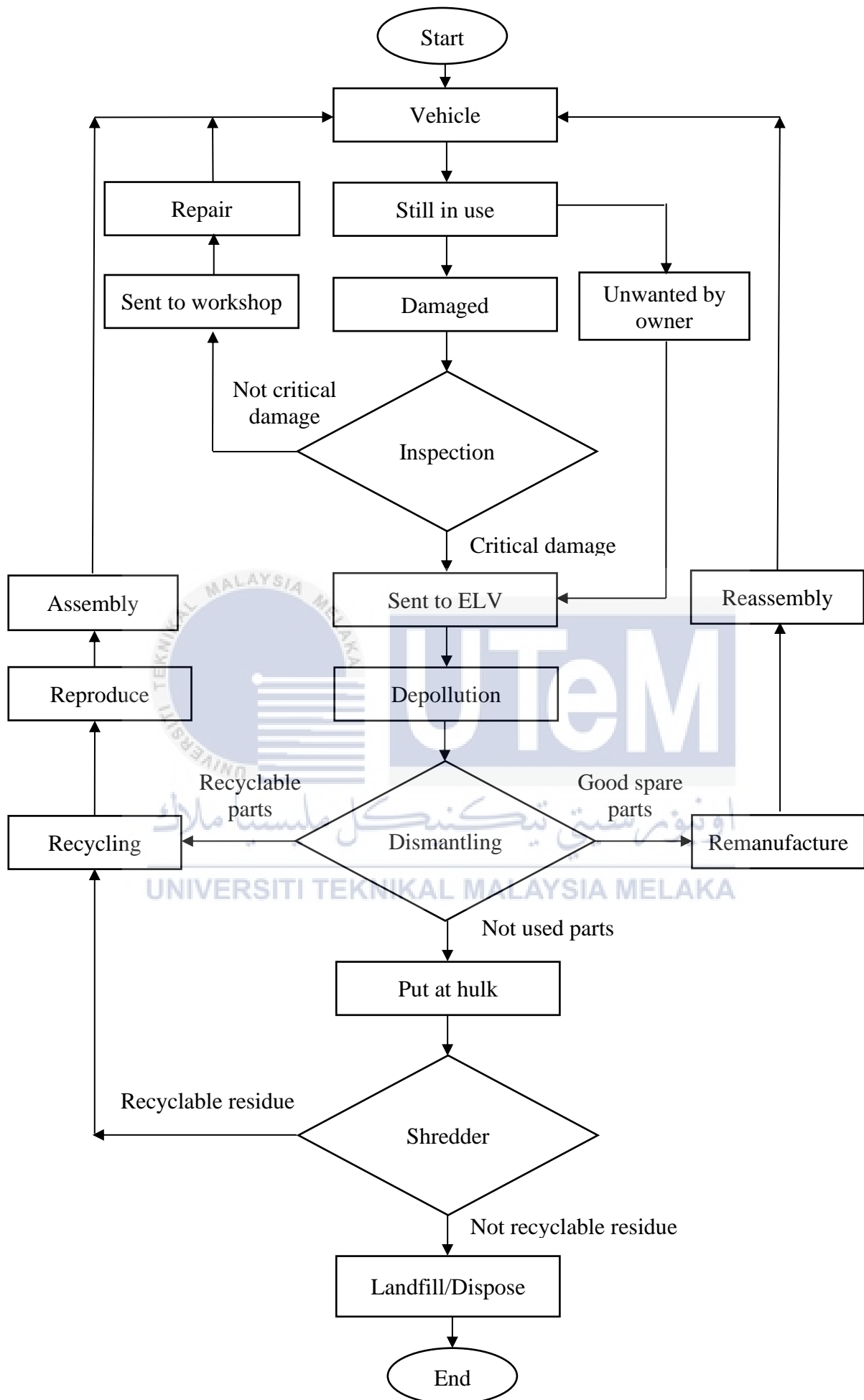


Figure 1.1 Example of ELV Process Flow

In Figure 1.2 below, the number of vehicles registered Malaysia is always higher than the vehicles assembled. The number of vehicles registered and assembled in Malaysia are increase steadily from 2010 until 2015 then has a fluctuation from 2016 until 2019. In year 2020 and 2021, the number of vehicles registered and assembled is drop rapidly. In summary, the number of vehicles registered is direct proportional to the number of vehicles assembled in Malaysia (STATISTIC, 2022).

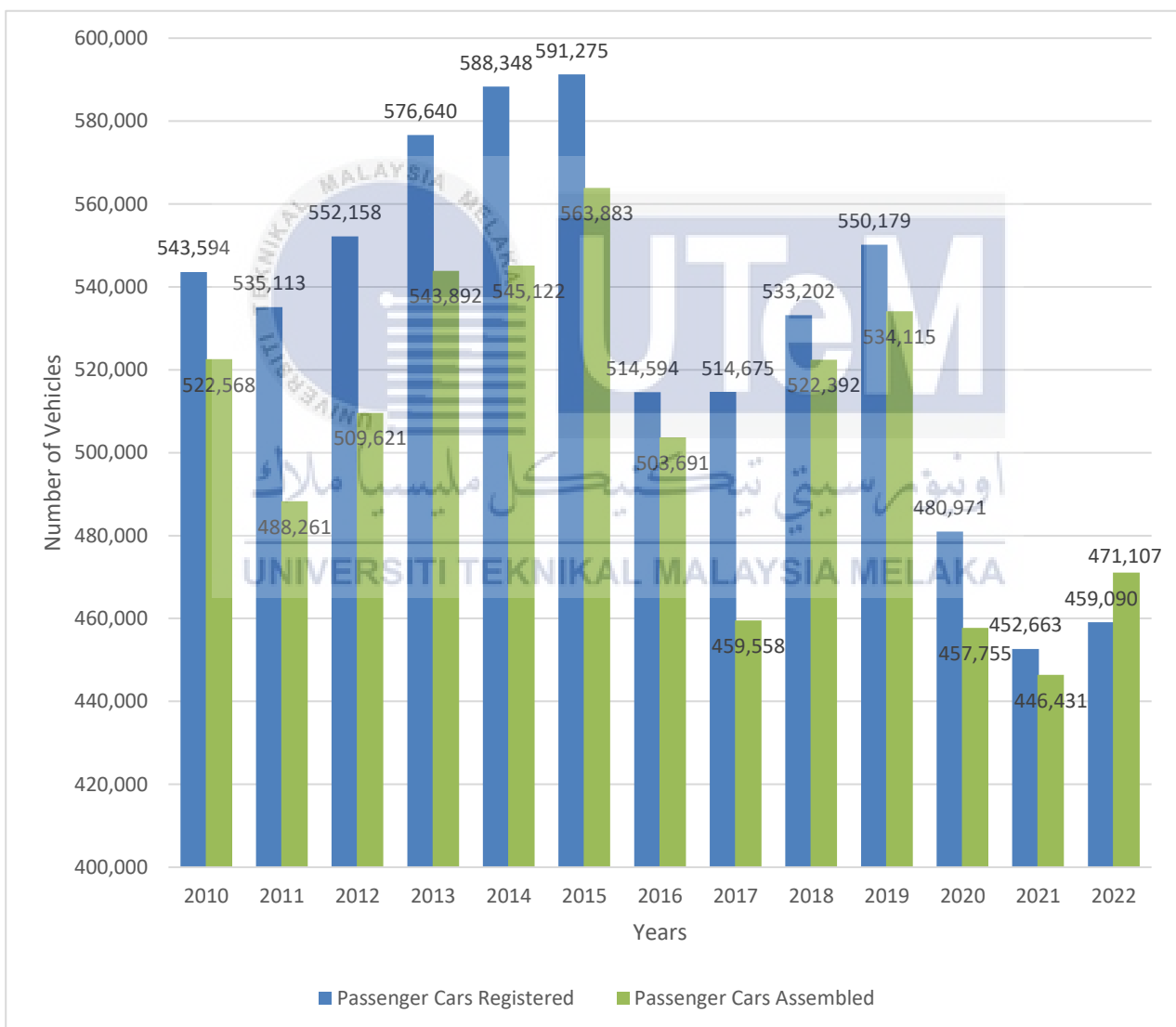


Figure 1.2 Total number of vehicles registered and assembled in Malaysia

### 1.3 Research Question

- i. What is the perspective of ELV in auto service workshop?
- ii. What is the preferable part of ELV for auto service workshop?
- iii. How to conduct the factor analysis for perspective of ELV in auto service workshop.

### 1.4 Objective

- ii. To identify the perspective of ELV in auto service workshop.
- iii. To investigate the preferable parts of ELV for auto service workshop.
- iv. To conduct the factor analysis for perspective of ELV in auto service workshop.

### 1.5 Significance of Study

- i. Knowing more about the perspective of ELV in auto service workshop.
- ii. Learnt the preferable parts of ELV for auto service workshop.
- iii. Learnt how to conduct the factor analysis for perspective of ELV in auto service workshop.

### 1.6 Scope

This study is conducted in ASW. In this study, there are two types of vehicles which are passenger vehicle and commercial vehicle. The study focuses on end-of-life vehicle (ELV) for passenger vehicles. ELV preferable parts for the ASW are the aspects that will be studied on this survey. Figure 1.3 shows the general scope of this study. In this study, there are four types of data collection which involve observation, interview, questionnaire, and checklist. The persons involved are mostly workers and owners of that workshop. After the data collection is done, reliability correlation, and factor analysis is conducted to determine the ELV

preferable parts from ELV. The period for doing this study is one year, which is start from March 2022 until Jan 2023.

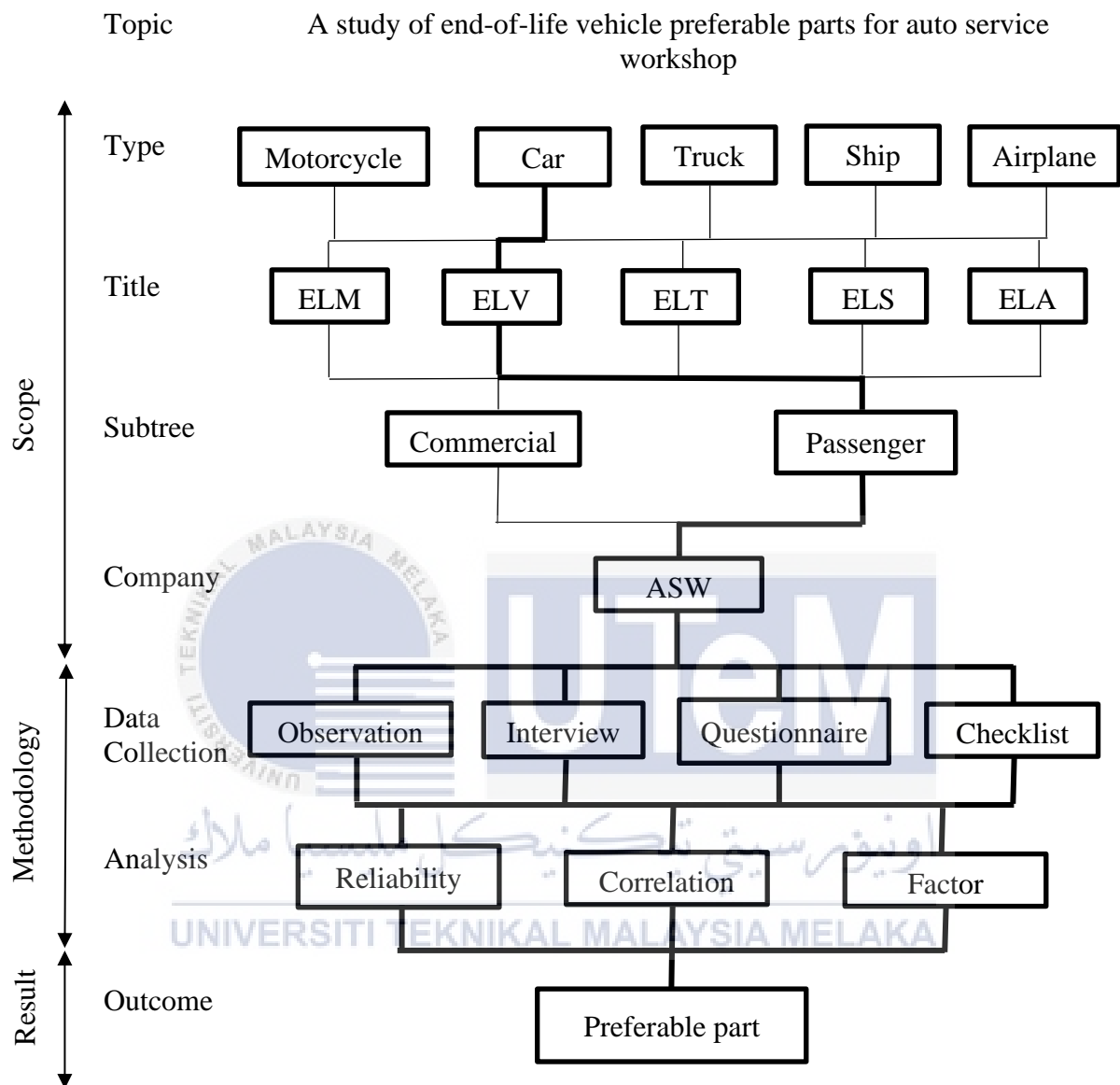


Figure 1.3 Scope of Study

## CHAPTER 2

### LITERATURE REVIEW

#### 2.1 Introduction

In this chapter, the study will discuss the meaning of ELV, procedure to manage the ELV, benefit of ELV, current practice of ELV in other countries and Malaysia, definition of ASW and preferable part by ASW from ELV, and how to involve the ASW by participating in ELV.

ELVs are classed as hazardous waste and have the potential to harm the environment if not properly managed. Because of their complicated structure and diverse substance, they are a form of trash that is extremely difficult to treat. ELV management is in charge of monitoring all activities and flows of material, economic, and data between and among the various entities that make up the ELV network. These entities include vehicle users, collection centres, permitted dismantling facilities, shredders, recycling centres, remanufacturing facilities, second-hand markets, and industrial landfill sites. As a consequence, important categories including “Life Cycle Assessment,” “Production Planning,” and “Material Selection” were separated into subcategories depending on their techniques (Karagoz et al., 2020). Figure 2.1 shows the vehicle arrived their useful lifespan and has been classified as a waste for ready to recycle or remanufacture.