DRIVERS AND BARRIERS OF GREEN MANUFACTURING IMPLEMENTATION IN KLANG VALLEY, MALAYSIA

Tan Sier Mei

Master of Business Administration

Universiti Tunku Abdul Rahman

Faculty of Accountancy and Management

April 2023

DRIVERS AND BARRIERS OF GREEN MANUFACTURING IMPLEMENTATION IN KLANG VALLEY, MALAYSIA

Tan Sier Mei

A research project submitted in partial fulfillment of the requirement for the degree of

Master of Business Administration

Universiti Tunku Abdul Rahman

Faculty of Accountancy and Management

April 2023

DRIVERS AND BARRIERS OF GREEN MANUFACTURING IMPLEMENTATION IN KLANG VALLEY, MALAYSIA

By

Tan Sier Mei

This project is supervised by:

Dr. Lim Wan Leng

Assistant Professor

Department of Accountancy

Faculty of Accounting and Management

DECLARATION

I hereby declare that:

(1) This Research Project is the end result of my own work and that due acknowledgement has been given in the references to all sources of information be they printed, electronic, or personal.

(2) No portion of this research project has been submitted in support of any application for any other degree or qualification of this or any other university, or other institutes of learning.

(3) The word count of this research report is 20,717.

Name of Student: TAN SIER MEI

Student ID: 20UKM06881

Signature: *Tan Sier Mei*

Date: 7th April 2023

ACKNOWLEDGEMENT

Firstly, I would like to thank the Faculty of Accountancy and Management, Universiti Tunku Abdul Rahman (UTAR) for having this research project as part of the main course in Master of Business Administration. This research project provides me the opportunity to learn and develop skills and knowledge that I do not acquire before.

Besides, I would like to express my deepest appreciation to my supervisor, Dr. Lim Wan Leng for giving me the chance to conduct this study under her supervision. She had provided varieties suggestion for my research and gave me a lot of help to solve the problem that I faced during the study. Without her diligent guidance, patience and advice, I might not be able to complete my research project on time.

Furthermore, I would like to thank all respondents who have been giving their sincere feedback and spending precious time and effort to fill in the online survey. Moreover, thanks to fellow course-mates and friends who have given their support and encouragement throughout the study. Most importantly, I would like to express gratitude to my parents and members for giving their support through the project.

DEDICATION

I wish to dedicate this research project to my family. They provided unconditional support, encouragement, motivation and affection to me throughout the entire process of this research.

Furthermore, I would like to dedicate this research study to my supervisor, Dr. Lim Wan Leng for her guidance, patience and advice. Truly I appreciated the valuable time and effort she had contributed in assisting me to complete the study.

Moreover, this research project should dedicate to my friends who have given their constant advice and encouragement. They also gave me a lot of help and advice on this project research.

TABLES OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

LIST OF ABBREVIATION

CO_2	Carbon Dioxide
DoSM	Department of Statistics Malaysia
GDP	Gross Domestic Product
GHG	Greenhouse Gases
GM	Green Manufacturing
GMP	Green Manufacturing Practices
IBM	International Business Machines Corp.
IEA	International Energy Agency
IPI	Industrial Production Index
IPPC	Intergovernmental Panel on Climate Change
MCO	Movement Control Order
MITI	Ministry of International Trade and Industry
MNC	Multinational Corporation
NASA	National Aeronautics and Space Administration
NAHRIM	National Water Research Institute of Malaysia
ppm	Part Per Million
SME	Small-to-Medium Enterprise

PREFACE

The basis of this study is part of the requirement for the Master of Business Administration Programme at Universiti Tunku Abdul Rahman (UTAR). The research project has been titled “Drivers and Barriers of Green Manufacturing Implementation in Klang Valley, Malaysia”.

This study intends to determine the drivers and barriers that facilitate and hinder the implementation of green practices in the manufacturing industry in Klang Valley, Malaysia. Throughout the study, researcher examined three drivers that facilitate the implementation of green manufacturing, there are legal requirements, top management commitment and company benefits. Moreover, cost constraints and lack of technology and skill were the barriers that hinder the implementation of green manufacturing, based on the findings.

On the other hand, this research provided a better understanding of the different factors that influence the implementation of green manufacturing among manufacturers in Malaysia. Thus, this study deliberates to help in developing a better understanding of how to promote the implementation of green manufacturing among manufacturers toward environmental sustainability in Malaysia.

ABSTRACT

Environmental issues, such as climate change is becoming a focal point nowadays. The process, services and products of manufacturers will bring numerous environmental hazards, such as water, land and air pollution, chemical exposures, and extreme weather. It also will affect human health and bring chronic diseases. Since the environmental awareness and concern from the public getting higher and the pressure from stakeholders on environmental sustainability to the manufacturers. Therefore, there are more manufacturers considering implementing green manufacturing, to sustain their business operations. The objective of this study is to determine the factors that influence the implementation of green manufacturing among manufacturers in Malaysia.

The quantitative analysis method was selected by using the technique of simple random sampling method to collect the samples. There were 241 valid responses collected from Klang Valley, Malaysia via an online google form. The data collected were analysed by using Statistical Package for Social Science (SPSS) software.

Based on the test results, legal requirements, company and economic benefits, cost constraints and lack of technology and skills showed significant influence to the implementation of green manufacturing. However, top management commitment was rejected as showed an insignificant relationship with the implementation of green manufacturing. Furthermore, firm size and type of business ownership had proven to be the moderators for the relationship between the independent variables and the implement green manufacturing. Hence, this study had explained the factors on influence the implementation of green manufacturing in Malaysia.

CHAPTER 1

INTRODUCTION

1.1 Introduction

The focus of this study is on the manufacturing sector in Malaysia. This research serves to explore what are the drivers and barriers of implementation green manufacturing (GM) by manufacturers in Klang Valley, Malaysia. Furthermore, this study also aims to understand the current green manufacturing practices (GMP) implemented by manufacturers. The next section will discuss the background of the manufacturing sector, problem statement, research question, research objective and significance of the study.

1.2 Background of the Study

The manufacturing sector plays an important role in Malaysia and had a great impact on economic growth in Malaysia. It had created approximately 2.3 million job opportunities in the nation. During the uncertain global economic circumstances, especially during the Covid-19 pandemic, the manufacturing sector was slightly slacked for months. As a result and in accordance to the report from the Ministry of International Trade and Industry (MITI), the Industrial Production Index (IPI) for the manufacturing sector showed a decreased of 0.2% in June 2021 as compared to May 2021 (29.8%), due to Movement Control Order (MCO), Nevertheless, according to the Department of Statistic Malaysia (DoSM), in the first half of the year 2022, the

manufacturing sales values rose by 16.3% to RM 1,00.2 billion as compared to the first half of the year 2021; the IPI of July 2022 had increased 12.5% year-on-year, Moreover, the report of DoSM also stated, the manufacturing sector contributed 24.3% to the nation, from -2.7% (year 2020) surged to 9.5% (year 2021). In the second quarter of 2022, the GDP of the manufacturing sector in Malaysia had grown to 9.2% as compared to the first quarter year 2021 (6.6%).

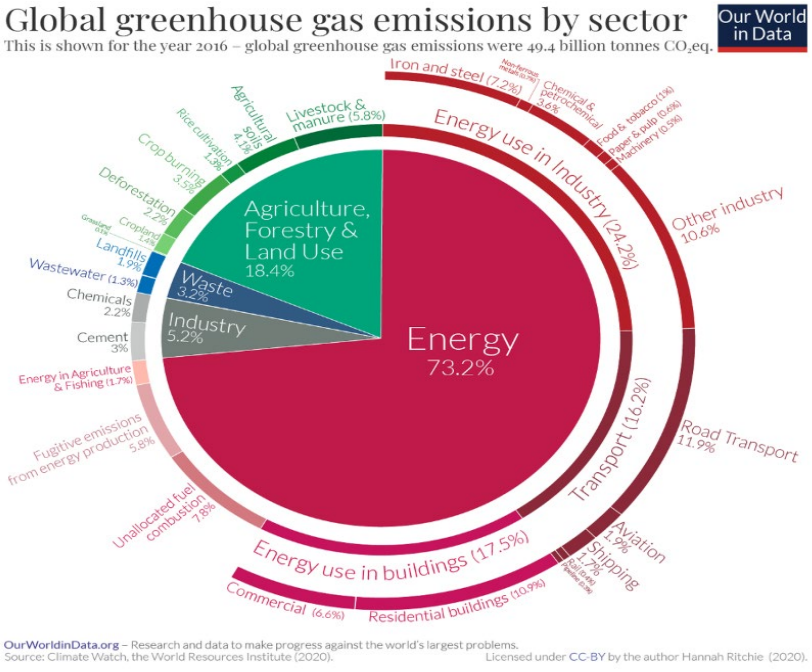
Manufacturing industry is one of key GDP drivers for Malaysia, it also a major contributor to greenhouse gas (GHG) emissions (Gyasi-Mensah and Xuhua, 2018). The tremendous growth of the global population and industrial economics had resulting in exponential growth in energy demand and causes climate change. GHG such as carbon dioxide, methane nitrous oxides, etc. was emitted from the process of burning fossil fuels during manufacturing. Global CO_2 emissions increased to 36.3 billion tonnes (+6% in the year 2021), which achieved the highest level in history (International Energy Agency (IEA), 2021). The GHG heat-trapped in the earth's atmosphere caused increasing in global temperature, known as global warming. According to The Intergovernmental on Climate Change (IPPC) Sixth Assessment report (2021) and reports from the National Aeronautics and Space Administration (NASA) (2022), found the global temperature was increased by approximately 1.1 ℃ since 1750, i.e. during the pre-industrial time; the total amount of CO_2 increased from 365 ppm (year 2002) to 419 ppm (August 2022); sea level rising for 101.4 mm when last measured in June 2022 and the ocean became warmer. The consequences of climate change brought a negative impact on the environment. e.g., rising sea water levels, ocean acidification, biodiversity loss, and air and water pollution, that cause influence economic activities, ecosystems, overall social well-being, loss of property, etc., due to the occurrence of natural disasters, including flash floods, earthquakes and cyclones.

Manufacturing is one of the sectors that brought significant economic growth to the world but is also one of the largest contributors to climate change. The manufacturing sector uses large amounts of energy and water and generates huge quantities of waste and GHG. The rapid growth of the manufacturing sector had enhanced the usage of

energy. The scarcity of natural resources and high-energy demands may hinder the pace of development (Shisara and Wijewardana, 2021).

The manufacturing industry is the most resources consuming sector among the other sectors and emitted approximately 30% of GHG from total worldwide GHG emission (Hannah et al, 2020). 24.2% of GHG were released from the energy used for manufacturing operations, such as iron and steel (7.2%), chemical & petrochemical (3.6%), food and tobacco (1%), non-ferrous metals (0.7%), paper & pulp (0.6%), machinery (0.5%) and other industry (10.6%). However, 5.2% of CO_2 and GHG were released from direct industrial processes of cement and chemical & petrochemicals industry, produced as a by-product of chemical processes. The remaining GHG were produced from other sectors, such as agriculture, forestry and land use (18.4%), energy-used buildings (17.5%), transport (16.2%), unallocated fuel combustion (7.8%), fugitive emissions from energy production (5.8%) and waste (3.2%) (Hannah et al, 2020).

Figure 1.1: Global Greenhouse Gas Emission by Sector



Source from (Hannah et al, 2020)

Nowadays, there are rapidly blooming global concerns about the environmental issue which had affected global climate change. The manufacturing sector is facing issues of the scarcity of natural resources, waste management issues and the challenge of the enforcement of stringent environmental regulations (Ghazilla et al., 2015). The enforcement and implementation of Environment Laws and Policy in worldwide to address the issue and aim for environmental sustainability. From the Yale Center Report 2022 for Environment Law and Policy, Malaysia ranked 130, out of 180 countries, with a score of 35.00% environment performance index. However, Singapore, Thailand and Indonesia were ranks of 44, 108 and 164 respectively. The environmental performance of Malaysia lagged behind as compared to Singapore and Thailand (EPI, 2022).

To achieve better environmental performance in the manufacturing sector to sustain the growth of the economy, restructuring of manufacturing practices is required to conserve energy and minimise pollution. The implementation of sustainable manufacturing practices will reduce pollution, conserve natural resources apply a green supply chain, etc, to bring less harm to the environment. Furthermore, the implementation of GMP will benefit the firm towards business sustainability and profit maximization.

The advantages of implementing GMP include reducing energy-related costs in the overall operation, by implementing the strategies of recycling, reducing the use of natural resources, minimise pollution and waste, using energy-efficient equipment (e.g., solar energy, LED lights), going for the paperless program, etc. The implementation of GM will boost the workforce morale and innovations, and lead to higher productivity. Moreover, the environmentally sustainable manufacturing companies able to enjoy variety of tax incentives and rebates. Companies carrying out business ethically and with compliance to regulations and requirements will attract more stakeholders and comfortable working together. The good reputation of the companies will bring a higher confidence level to the potential collaborators for collaborations. Furthermore, the image of a good corporate citizen, i.e. "giving back" to society and the community

could drive the company to be responsible for environmental sustainability and to avoid depleting natural resources to maintain an ecological balance. The sales revenue of the companies will increase due to the green image of the companies.

1.3 Problem Statement

The Paris Agreement was formed to address the global climate change issue and aims to substantially reduce the emission of GHG. The Paris Agreement works on 5 years cycle to increase the ambitious climate action worldwide. The target of the agreement for controlling the rise of global warming at 2 ^{o}C, a highly preferable rising of 1.5 ^{o}C. Around 200 countries were committed to the Paris Climate Agreement and Malaysia is one of them.

The objective of the 12th Malaysia Plan (12th MP) is to achieve a prosperous, inclusive and sustainable Malaysia. Former Prime minister Ismail Sabri Yaakob had announced that to reduce GHG emissions intensity per unit of GDP by 45% by 2030; and towards carbon neutral as early as 2050 to build resilience and adapt to the impacts of rising global temperature, which aligned with the 2015 Paris climate agreement in 12th MP (Leong, et al, 2021).

According to studies by the National Water Research Institute of Malaysia (NAHRIM) (2019), the rate of temperature increased for Peninsular Malaysia, Sabah and Sarawak from the year 1969 to 2009 were 1.1^{o}C, 0.6^{o}C and 1.2^{o}C respectively. However, the sea level rose 2.73 mm/year to 7.00 mm/year from the year 1993 to 2010. If the local government and relevant parties do not take any relevant action to reduce the emission of GHG, could worsen climate change. The projection climate change of annual mean surface temperature, maximum rainfall and sea level rise for Peninsular Malaysia, Sabah and Sarawak are as shown in Table 1.1. However, Figure 1.2 is showing the sea level rise projection for Port Klang, Selangor (NAHRIM, 2019). The rising sea level is one of the factors that cause the occurrence of flash floods. In the incident in December of 2021, the port operations in Port Klang were affected by a flash flood (Bernama, 2021). Port Klang is one of the wealthiest and most populous ports in Malaysia, the

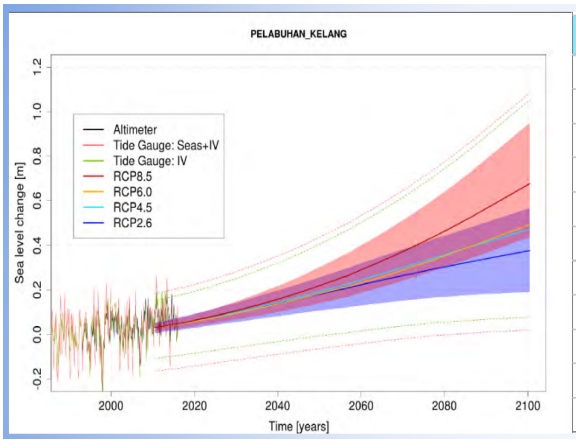
operation of ports affected had brought great impact on other sectors and the economics of the country as well. According to Malaysia: Flash floods Final Report (2022), from the end of December 2021 to June 2022, across Malaysia, there are overall losses due to flash flood estimated at MYR 6.1 billion.

Table 1.1: Summary of Projected Climate Change

Climate parameter	Peninsular Malaysia [RegHCM-PM]	Sabah [RegHCM-PM]	Sarawak [RegHCM-PM]	World [IPCC AR4]
Annual mean surface temperature	[2050] 1.0 – 1.5°C [2100] 2.52 – 2.95°C	[2050] 1.0 – 1.5°C [2100] 2.52 – 2.95°C	[2050] 1.0 – 1.5°C [2100] 2.52 – 2.95°C	[2100] 1.7 – 4.4°C
Max. Monthly Rainfall	[2050] +113mm (12%)	[2050] +59mm (5.1%) [2100] +111mm (9%)	[2050] +150mm (8%) [2100] +282mm (32%)	-
Sea Level Rise	[2100] 0.25 – 0.52m	[2100] 0.64 – 1.03m	[2100] 0.43 – 0.63m	[2100] 0.18 – 0.59m

Source from (NAHRIM, 2019)

Figure 1.2: Sea Level Rise Projections for Port Klang, Selangor



Year	RCP 2.6	RCP 4.5	RCP 6.0	RCP 8.5
2020	0.06 [0.03 - 0.10]	0.06 [0.03 - 0.09]	0.06 [0.03 - 0.09]	0.07 [0.04 - 0.09]
2030	0.10 [0.06 - 0.14]	0.10 [0.06 - 0.14]	0.10 [0.05 - 0.14]	0.11 [0.07 - 0.15]
2040	0.14 [0.08 - 0.20]	0.15 [0.09 - 0.20]	0.14 [0.08 - 0.20]	0.16 [0.10 - 0.22]
2050	0.18 [0.11 - 0.26]	0.19 [0.12 - 0.27]	0.19 [0.11 - 0.26]	0.22 [0.14 - 0.31]
2060	0.22 [0.13 - 0.32]	0.25 [0.15 - 0.35]	0.23 [0.14 - 0.33]	0.29 [0.19 - 0.41]
2070	0.27 [0.15 - 0.39]	0.30 [0.18 - 0.43]	0.29 [0.17 - 0.41]	0.38 [0.24 - 0.52]
2080	0.30 [0.17 - 0.45]	0.36 [0.22 - 0.51]	0.36 [0.21 - 0.50]	0.47 [0.30 - 0.65]
2090	0.34 [0.18 - 0.51]	0.42 [0.25 - 0.60]	0.42 [0.26 - 0.60]	0.57 [0.37 - 0.80]
2100	0.38 [0.19 - 0.57]	0.47 [0.28 - 0.68]	0.49 [0.30 - 0.70]	0.68 [0.44 - 0.95]
2081 - 2100	3.6 [1.0 - 6.1]	5.6 [2.9 - 8.5]	6.9 [4.1 - 9.9]	10.6 [6.7 - 15.3]

Source from (NAHRIM, 2019)

The manufacturing sector had brought growth to the economy of the nation (MITI, 2021); however, the environmental issue is a challenge to the manufacturing sector. Industrial growth, economic growth and technological revolutions had greatly impacted the degradation of the environment. Manufacturing activities had damaged the fragile environment as they contributed to global warming (Hannah et al, 2020), biological diversity losses due to raw materials extraction, land and water pollution due to waste generation, resource depletion, emission of air pollution and GHG that will have an adverse impact to human health. As toxic and dangerous materials released from manufacturing activities cause pollution of the environment and the planet's ecosystem. Manufacturing waste causes the occurrence of global environmental issues and became a threat to human health and livelihood.

In the year 2019, the incident of the Kim Kim River pollution contaminated Sungai Johor. The water pollution issue was caused by irresponsible manufacturer dumping manufactured hazardous waste into the rivers. The consequences of the pollution result in a total of 2,775 people exhibiting dizziness, nausea and vomiting and were admitted to the hospital (Chung, 2022). This incident also led to the pollution of Sungai Pasir Gudang, due to the remnant of toxic waste from Sungai Kim Kim (New Straits Times, 2019). The public is worrying about the pollution issue that might bring adverse health effects after consuming the water from the river (Chung, N.,2022).

Sungai Gong Rawang was polluted in the year 2020. It is due to two manufacturing companies dumping hazardous chemicals into the river. The water pollution causes the water-treatment plants required to be shut down for cleaning. Therefore, the water supply had disrupted and affected around 5 million users in 7 regions of Klang Valley. Local legal authorities convicted both directors from the two companies under Water Services Act 2006 and Environmental Quality Act 1974 (Malaymail, 2020). This not only affected the reputation of both companies; it also had brought an enormous impact on the business operations and daily activities of residents in Klang Valley.

Nowadays, environmental consciousness is increasing among the public. Environmental legislations also become increasingly stringent in response to environmental issues. With the impact of public pressure and stricter legislation, the

manufacturers should consider implementing sustainable and GMP to eliminate the activities that will be adverse to the environment, to ensure business sustainability.

1.4 Research Questions

Several research questions are proposed for this study which are shown below:

i. What are the various drivers that facilitate the implementation of GM in Malaysia?
ii. What are the various barriers that hinder the implementation of GM in Malaysia?
iii. Are there any correlation effect of the size, type of business ownership and type of industry on the implementation of GM among manufacturers in Malaysia?

1.5 Research Objectives

The main purposes of this study are:

i. To examine the drivers that facilitate the implementation of GM in Malaysia.
ii. To identify the barriers that hinder the implementation of GM in Malaysia.
iii. To analyse the correlation effect of the size, type of business ownership and type of industry on the implementation of GM in Malaysia.

1.6 Significance of the Study

The main purpose of the study is to promote and improve the implementation of GM among Malaysia manufacturers towards to "Carbon Neutral Goal" in manufacturing operations and ensure business sustainability.

This research could assess the environmental awareness levels of the manufacturers on environmental issues, such as climate change caused by manufacturing processes. This research will be taken as a reference to understand the current green knowledge and practices carried out by Malaysia manufacturers. Moreover, this study is able to determine manufacturers' perceptions on the achievement of a carbon neutral Malaysia by 2050. The 12th Malaysia is aiming to form a low carbon and climate resilient socioeconomic nation.

Furthermore, this study may help the researchers, environmental consultants, and local government to understand the lacking part of the manufacturing companies on the implementation of GM, especially SMEs. By knowing the gap, the relevant parties, i.e. local government, non-governmental organizations, etc. able to provide better support, such as, provide relevant technical knowledges and infrastructures that required by respective industries.

Klang Valley is located at Selangor; it is an urban conglomeration in Malaysia. Klang Valley consists of five major areas, there are Federal Territory of Kuala Lumpur, Klang, Petaling, Gombak and Hulu Langat. Klang Valley is the most consequential contributor to Malaysia's GDP and the most important manufacturing hub of Malaysia. According to the report from Asia Perspective, the manufacturing value contributed by Klang Valley in the year 2018 was 31.8%; however, according to analysis of the Department of Statistics Malaysia, it showed Selangor state had contributed 32% of Malaysia's manufacturing industry in the year 2021. Hence, Klang Valley selected as the key focus for this research.

CHAPTER 2

LITERATURE REVIEW

2.0 Introduction

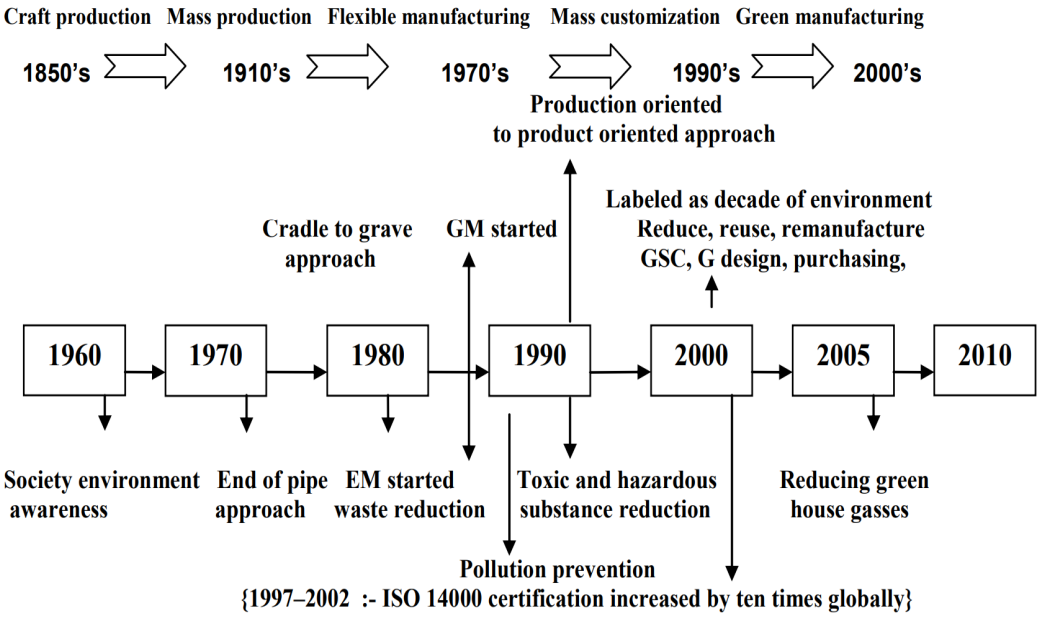
This chapter will discuss past studies on GM, including research on the drivers and barriers of implementing GM in the manufacturing sector. A conceptual framework is prepared. Several hypotheses will be developed and will be tested in the following chapter.

2.1 Literature Review of Green Manufacturing

2.1.1 Evolution of Green Manufacturing

The evolution of the manufacturing industry was continuous due to the dynamic business environment. The process of manufacturing evolution was shown in Figure 2.1. Craft production was implemented in the 1850s, followed by mass production (1910's), flexible manufacturing (1970's) and mass customization (1990's). The manufacturing industry greatly impacted the growth of the economy, and at the same time, also brought a negative impact on the environment. Hence, GM was introduced in the late 1990s with the aim of pollution prevention. This was followed by the introduction of control on the use of toxic and hazardous substances. ISO 14000 certification introduction in 1997 and control of GHG emission implementation in around 2005 (Rehman & Shrivastava, 2013).

Figure 2.1: Evolution and Overview of Green Manufacturing



Source from (Rehman & Shrivastava, 2013)

2.1.2 Green Manufacturing

GM can be defined as manufacturing practices during the manufacturing process that will not bring any harm to the environment or are adverse to human health (Adam et al., 2020). GMP in the manufacturing process can minimise the use of hazardous matter in process of production, technology and design, reduce the effect of pollution and climate change and lead towards global change (Saxena & Srivastava, 2022). The approach of GM is to minimise waste and pollution during the manufacturing process, by reducing hazardous materials, rationalizing materials and recycling or reusing the product or materials to improve the overall manufacturing efficiency. Moreover, the practices would able be diminishing the depletion of natural resources by reducing the extensive quantity of manufacturing waste entering landfills (Saxena & Srivastava, 2022).

The principles of GM encompassed less energy deterioration, zero environmental impact, efficient resource usage and zero pollution. Manufacturing with green

technology will improve environmental coordination and achieve economic advantage which minimizes environmental impact and resource depletion during the manufacturing processes (Yusuff et al., n.d.).

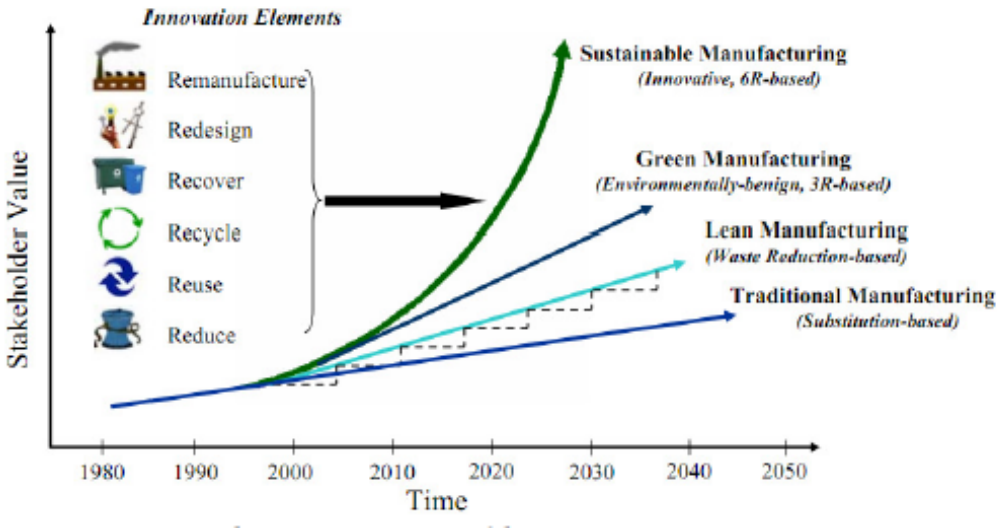
Sustainable manufacturing was developed in three dimensions: environmental, economic and social, as showed in Figure 2.2. It is also called as three pillars of sustainability -- triple bottom line (Dornfield, 2013). Achieving sustainable manufacturing, it will improve all three dimensions of environmental, economic and social performance in concurrently (Abualfaraa et al., 2020). GM was designed for environmental sustainability (e.g. environmental management, pollution prevention); socially conscious manufacturing was designed for social sustainability (standard of living, equal opportunity); however, mass manufacturing and lean manufacturing were designed for economic sustainability (e.g. profit, economic growth, cost saving) (Abualfaraa et al., 2020; Pang and Zhang, 2019). GM is part of sustainable development and will lead the organization towards competitive advantage and maintain its marketplace in the industries. It also is an effective tool that helps in brand building and promote acceptance by consumers. The implementation of GMP will bring advantages to the organization in strategic management and bring about sustainability (Saxena & Srivastava, 2022).

Figure 2.2: Different Manufacturing Modes Based on the Sustainability Triple Bottom Line

Source: Dornfield, D. (2013)

An increase in environmental consciousness and awareness is one of the greater impacts that encourages manufacturers to adopt GMP (Ghazilla et al., 2015). It is because the adaptation of GM will improve the efficiency of manufacturing by dealing with conserving natural resources and recycling materials leading to mitigating environmental issues. The sustainable innovation elements include the practices of reducing, reusing and recycling, recovering, redesigning and remanufacturing (Yusuff et al., n.d.). From the Figure 2.3, the greater numbers of the green innovations implemented will create higher value to the company. The sustainable manufacturing is the manufacturing focused on innovation and 6R-based, therefore, able to obtain higher value in shortest period, as compared to other manufacturing system. However, traditional manufacturing, which is focused on substitution-based require long time for value-creation than GM (environmentally-beings and 3R-based) and lean manufacturing (wasted reduction based).

Figure 2.3: Contribution of System Paradigms to the Values of Manufacturing Systems



Source from (Yusuff et al., n.d.)

2.1.3 Green Manufacturing Practices versus Lean Manufacturing Practices

According to Abualfaraa et al. (2020), the objective of GM is to reduce the environmental footprint and minimise health risks throughout the entire product life cycle, the operation's efficiencies are towards environmental sustainability. On the other hand, lean manufacturing is mainly focused on increasing value to customers while reducing the resources and time consumption and time via waste elimination, for economic growth to aim for profitability. The differences and similarities for both GM and lean manufacturing were stated in Table 2.1.

Table 2.1: The Differences and Similarities Between Green Manufacturing and Lean Manufacturing.

	Lean Manufacturing	Green Manufacturing
Principles	Pollution prevention, reduction of toxic substances.	Long-term thinking, elimination of wastes, people commitment and continuous improvements
Waste	Transport, inventory, motion, waiting, over-processing, over-production and defects.	Solid wastes, hazardous wastes, air emissions and wastewater discharges.
Methods/tools	Well-defined, documented and widely used standard methods and tools.	Life-Cycle-Assessment (LCA), Design of Environment (DfE) and EOL (End-of-Life) strategies are widely used, green practices are based on customised approaches.
Product design	Focus in increasing the product quality and performance and cost reduction.	Focus on decrease scrap in many areas of product life cycle by planning waste reduction from initial to final stages of the production.
Inventory	Replenishment frequencies are increases. Practicing JIT (just-in-time).	Reduce replenishment frequencies to minimise emission.
Pollution	CO_2 emission is not reduced.	Minimise pollution during the manufacturing process.
Supply chain	Maintain good collaboration with suppliers.	Suppliers' involvement is crucial, due to environmental footprint should minimised throughout the entire of product life cycle including the end-of-life stages.
Product end-of-life	No concern for product use impact or end-of-life recovery.	Includes end-of-life strategies into product life cycle for which the company is responsible.
Customers	Customers are focuses on good quality and low prices products or services.	Customers are focused on products or services that are produced in environmentally friendly way.

Source: (Abualfaraa et al., 2020)

2.1.4 Current Awareness Level on Environmental Sustainability

The increase of social pressure on environmental consciousness and the natural resources depletion issues had influenced manufacturers compelled to transform from traditional manufacturing processes to greener manufacturing processes. Transformation will bring numerous benefits to the organizations, such as reducing energy-related costs, tax incentives, attracting new customers, especially from developed countries, create good company image, etc., towards its business

sustainability and profitability. The topics of GM had been discussed and studied for more than 20 years, due to the environment consciousness is increasing. China is the one of countries focused on GM research, it had published around 1357 documents relevant to GM (Pei, et al., 2021).

IBM had conducted surveyed in February 2022, across 10 countries with a total of 16,349 respondents. The countries involved in the survey were Brazil, Canada, China, France, Germany, India, Mexico, Spain, United Kingdom and United States. The survey highlighted that "51% of environmental sustainability is more important to them" (IBM, 2022). According to Deloitte 2022 CxO Sustainability Report, 67% of companies are using more sustainable practices (e.g., recycled materials, lower-emitting products); 66% of companies had increased the efficiency of energy use; 57% of companies are using energy-efficient or climate-friendly machinery technologies and equipment and provide training employees on climate change and impacts; and 55% companies are practising reduction the amount of air travel post-pandemic. The survey was conducted across 21 countries (44% from Europe/ South Africa, 31% from Americas, and 24% from Asia Pacific) with more than 23,000 respondents, the industries encompass in the survey were consumer (21%), energy, resources & industrials (20%), financial services (19%), technology, media & telecom (19%) life sciences & health care (10%) and professional services (10%). Based on the analysis reports, it can prove that the awareness level on environmental sustainability of the society is getting higher, as compared to the past.

2.1.5 Organizational Innovation Theory

Innovation is a source of competitive advantage for an organization, as it helps the organizations to improve their existing method or techniques to generate new products or services that are better than before (Taques et al., 2021). Organizational innovation is called administrative or management innovation and can be defined as the implementation of a new organizational method in the organization's workplace, business practices or external relations with the process of learning and evolution,

implementation, leadership and creativity (Alves et al., 2018). Business practices can be explained as the new methods of procedures, including business routine activities. Workplace organization is the new method of responsibilities distributed to the employees in the organization. External relation is a new method of organizing relations with external parties, such as public institutions and other companies (Alves et al., 2018).

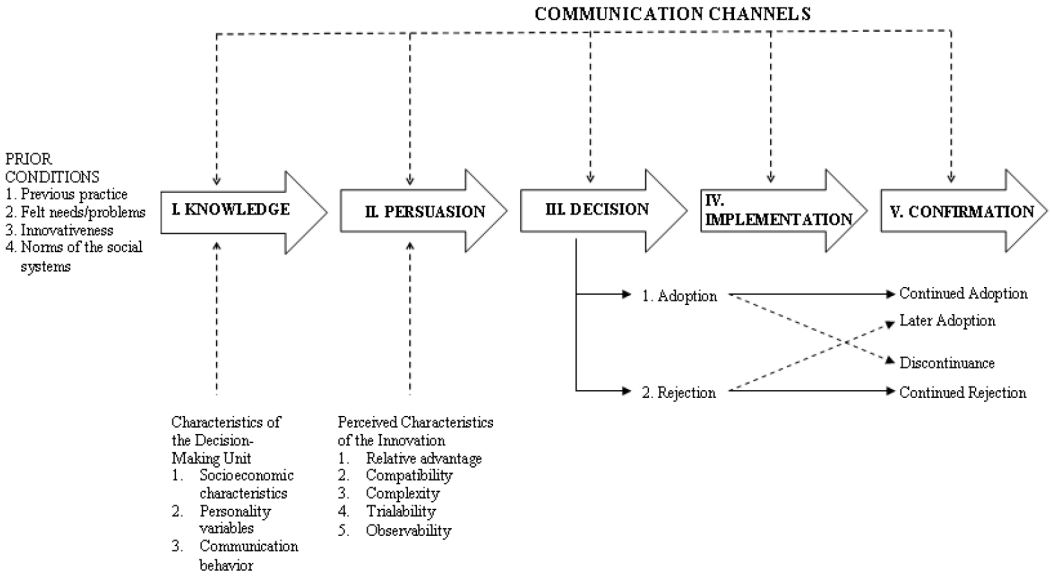
Organization innovation theory is the establishment of new management practices, including of adoption of new ideas on staffing, resource allocation and structuring of tasks to accomplish competitive advantages (Alves et al., 2018). The purpose of organizational innovation is to aim to increase the company's performance by reducing transaction costs, improving its business workflow efficiency, the use of knowledge in an effective way and to provide higher quality goods or services. Furthermore, organizational innovation also will help in organizational structures and influence human behaviours and beliefs, roles, procedures and new rules due to the diffusion of innovation and the dynamic of the business environment (Alves et al., 2018).

2.1.6 Diffusion of Innovation Theory

Diffusion of innovation theory is developed by E.M. Rogers in 1962, it can be defined as a social process of human response to learning about innovation communicated through certain channels over time (Dearing and Cox, 2018). Diffusion of innovation consists of four main elements: innovation, communication channels, time and social system (Sahin, 2006). Innovation is a process of generate new ideas, practices, products or service for creating new values. The communication channel is the second element, it is relatively important to provide a medium to share information among each other to reach mutual understanding. Third, time is referred to the rate of adoption either new ideas or practices, etc. Forth element is the social system. The social system is related to cultural system and environmental aspects, it will affect individuals' innovativeness rely on the category of adopters (Sahin, 2006).

Rogers (2003) commented adoption is a decision to "use of new idea" to create new value for the process; however, rejection is a decision to "not adopt the new idea". Innovation-decision process includes five steps, there are knowledge (exposure to the innovation and understanding), persuasion (process to form attitudes toward innovation), decision (early stage of adoption), implementation (making the change) and confirmation (reinforcement for change). The five stages of the process called as Innovation-Decision Process Model, as shown as below figure (Figure 2.4). This model is helping the decision maker to understand and analyses the feasibility of adaptation or introduction of new technologies or products into a new market at the right timing.

Figure 2.4: A Model of Five Stages in the Innovation-Decision Process

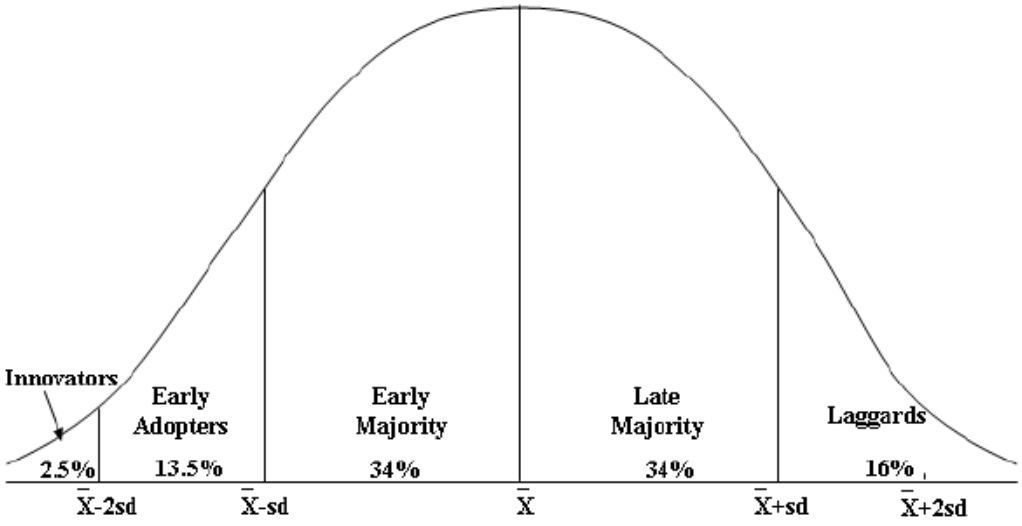


Source: Rogers (2003)

Figure 2.5 showed the adopter categorization based on innovation. There are five categories of adopter categorization according to Rogers (2003), it was including innovators, early adopters, early majority, late majority and laggards. In the very early stage, new ideas created in this stage may be facing a higher risk of unprofitable and unsuccessful circumstances, which is called as innovators. Next, is early adopters. The

early adopters may enjoy greater benefits as compared to innovators. The early adopters able to possess more information and skill about the innovation from innovators, thus, they able to hold the leadership position in the market. Third stage is early majority. The early majority play an important part in the diffusion, new ideas will be adopted when reach the level of average in the social system, but they will not be holding a leadership role. Followed by late majority, late majority is a sceptical group, new idea adaptation after the average members of a social system, usually the adaptation is due to the pressure from the stakeholders and to fulfil the requirements. The last adopt innovation is laggards. When the idea is adopted by laggard, the idea may be rendered obsolete and there might new idea be generated by innovators (Sahin, 2006).

Figure 2.5: Adopter Categorization Based on Innovativeness



Source: Rogers (2003)

2.1.7 Drives and Barriers of Implementation Green Manufacturing from the Literature

Several past studies were conducted to identify the main drivers that will facilitate the implementation of GM and to determine the barriers or obstacles that will hinder the

implementation GM by manufacturers. Below are the some of the examples past studies about the drivers and barriers of implementation GM.

From the studies of Singh et al. (2012), a structured questionnaire was prepared to extract drivers and barriers and a pilot study was conducted to check the reliability and validity. The five-point Likert scale questionnaire was distributed to 55 Indian different industries, and 30 valid responses were received. From the results, the top five drivers of implementing GM were included, employee motivation, health & safety, global climatic pressure & ecological benefits, environmental concerns & legislation, green image, global marketing & competitiveness and social & environmental responsibility. However, the top five barriers were lack of research & empirical studies, lack of customer, supplier & shareholder awareness, increment in overall cost or financial burden, lack of awareness in companies and inadequate coordination between different departments. The study was conducted in India, the organizational culture may be different from organizations in Malaysia. However, this study can be as reference.

Mittal et al. (2013) studied on comparison of drivers and barriers to GM between India and Germany. There were 13 drivers and 12 barriers identified such *as* environmental technology, cleaner technologies, environmentally begin manufacturing, environmentally conscious manufacturing, extended supply chain practices and environmentally conscious technology. The questionnaire was developed by GM and industry expert and academicians from India and Germany. The questionnaire was prepared in a six-rating Likert scale and translated into local languages to increase understandability. A pilot study was performed by 11 industrial experts during the Green Manufacturing Summit of the Confederation of India Industry. 1000 companies were approached, however, only acquired 5.4% of response rate. A total of 54 useful completed responses were obtained; 22 responses were from India and the remaining 32 responses were from Germany. From the result, the top five critical drivers for India and Germany were top management commitment, competitiveness, technology, public image, cost savings and cost savings, competitiveness, current legislation, top management commitment, and organizational resources respectively. However, the top

five critical barriers for India and Germany were low customer demand, weak legislation, high short-term cost, low enforcement, lack of organization resources, lack of awareness/information and high short-term cost, uncertain benefits, low customer demand, uncertain future legislation, lack of organization resources respectively. The study compared the manufacturing practices between a developing nation (India) and a developed nation (Germany). Even though the response rate of the survey was quite low, but there was 80% of the respondents from middle or senior management, the test result was reliable to as a reference for further study.

The study of Nordin et al. (2014) was emphasized on the drivers and barriers to sustainable manufacturing implementation in Malaysian manufacturing firms. The questionnaire was developed by the preliminary study by interview with three manufacturing practitioners, followed by distributed to the target audience with the position of operation managers, manufacturing managers, environmental, safety and health managers of manufacturing firms in Malaysia. A total of 56 respondents were received from the survey. Respondents were asked to choose the top five drivers and barriers that will facilitate or hinder implementing sustainability manufacturers. According to the studies of the research, environmental regulation, top management commitment, company image, economic benefits and environmental responsibility were the top five factors that facilitate the implementation of sustainable manufacturing. However, increment in overall cost, a lack of awareness and understanding in companies, and a lack of specific ideas on what to do and when to do it. lack of demand from consumers and customers and lack of employee commitment were the top five obstacles that will hinder the implementation of sustainable manufacturing. Top management commitment was the strongest driver, while additional increment cost was the greater problem for the implementation sustainability.

An analysis of drivers and barriers to GMP in Malaysian SMEs was done by Ghazilla et al. (2015). The drivers and barriers of implementing GMP were developed by 20 experts from the industry, and academicians from green manufacturing fields via the Delphi survey method. From the results, the factors that advocate the implementation

of GM are improved company image, improved competitiveness and enhanced product quality through *GMP*. Nevertheless, weak organizational structure to support GMP, as well as inadequate R&D, design and testing within the organization to support GMP, were the factors that impede the implementation of GMP by SMEs in Malaysia. The researchers emphasized studies on SMEs as large firms have higher awareness of the importance of environmental sustainability and more resources in the implementation of GM as compared to SMEs.

The target audiences for the studies of Nordin et al. (2014) and Ghazilla et al. (2015) were mainly focused manufacturers in Malaysia. Hence, the organizational culture is the same for the current study, as compared to the study conducted in other countries with different organizational cultures and practices. Even though, the researches were conducted approximately five years ago, the drivers and barriers identified from the past studies are appropriate as a reference for the current study.

Seth et al. (2018) focused on the drivers of GM in SMEs and large firms in India. GM drivers was determined via the interpretative structural modelling (ISM) approach. From the research, five critical GM drivers for SMEs including environmental regulation and stringent execution backed by legislation, penalties for the noncompliance of regulations and standards, financial incentives/assistance, use of cleaner production technology and its continuous updating, strategic and organizational changes for its competitiveness. However, five critical GM drivers for large firms encompass green process/product designs, packaging and 3R (Reduce, Reuse, Recycle) using technology, green supply chain supporting reverse logistics, materials management with the end-of-life-cycle consideration, effective and optimized utilization of resources; reduction in wastes, utility consumption and (GHG) emissions and environmental regulation and stringent execution backed by legislation. From the research able to know what the intention of implement GM by SMEs versus large firms.

2.1.8 Extracted Drivers and Barriers from the Literature

By referring the past studies by researchers on the topics of GM, found that legal requirements, top management and company and economic benefits are the main drivers that advocate the implementation of GM. However, cost and lack of technology and skills are the two main barriers that hindered the implementation of GM.

2.1.8.1 Drivers

2.1.8.1.1 Legal Requirements

The enforcement of stringent local environmental regulation is the main factor that encouraged manufacturers towards to adopt GMP (Nordin et al. (2014); Seth et al. (2018); Bhatia & Jakhar, (2021); Neri et al., (2021); and Ullah et al., (2022)). Malaysia's government is enforcing stricter environmental laws, for example, the amendment of the Environment Quality Act 1974 was amended, to increase the penalty for waste offenders up to RM 10 million or to imprison for a term not exceeding one year or both (The Edge Markets, 2022). Stricter environmental law is intended to prevent the re-occurrence of offences of the manufacturing activities will bring negative impacts to the environment.

Nowadays, the public is highly concern on the negative impact of manufacturing waste issue to the environment and humans. A large amount of manufacturing waste generated and GHG emitted from the manufacturing process causes pollution and greatly impacted the environment and the occurrence of climate change. The improper management of manufacturing waste will increase the risk of adverse health effect to human (e.g., asthma, allergy, chronic illnesses, etc.) and affect human daily living, such as water supply disruption due to contamination, flash flood and natural disaster due to global warming, etc. The pressure from public, politicians, local communities, non-governmental organizations and media on the environmental issue had compelled local government to strengthen the environmental regulation and requirements for manufacturers (Mittal et al., 2013 and Nordin et al., 2014). It is a tremendous driving

force for manufacturers to enforce and adopt the GMP to maintain the green image of company and for business continuity.

H1: There is relationship of legal requirements on the implementing of GM in manufacturers in Malaysia.

2.1.8.1.2 Top Management Commitment

Top management and owner of the company are highly committed to magnifying the organization's strategy and goals align their business operations to environmental performance, ethics and social values (Mittal et al., 2013). A cooperative organization structure with an availability adequate of human resources and green technology is relatively important to achieve environmental sustainability. An effective leadership of management teams will improve the capabilities and competency of the organization (Singh et al.,2012). It will drive the organization to the success of the implementation of GMP and towards its organization's goals. Hence, top management commitment and support are vitally important (Mittal et al., 2013 and Nordin et al. (2014).

The organization emphasizes and take their obligation to corporate social responsibility (CSR) in the business operation to address environmental issue. Top managements are aware to ensure achieving competitive advantages, they should play a positive role in the community and be concerned about the environmental and social impact of their business decisions. GMP such as reducing the consumption of scarcity of natural resources, the use of alternative energy sources for energy conservation, minimize GHG emissions and waste (Nordin et al., 2014 and Seth et al., 2018), were highly recommended for implementation in the manufacturing process. Hence, top management commitment also is one of the drivers that facilitate the implementation of GM (Hariyani & Mishra, (2022); Ullah et al., (2022); Agrawal & Vinodh, (2021); Bhatia & Jakhar, (2021); Foo et al., (2021), Jayashree et al., (2021); Seth et al., (2018); Ghazilla et al. (2015); Nordin et al. (2014); Mittal et al. (2013); and Singh et al. (2012)).

H2: There is relationship of top management commitment to the implementing of GM in manufacturers Malaysia.

2.1.8.1.3 Company and Economic Benefits

Environmental tax is one of the effective factors that encourage for manufacturers to implement GM to alleviate the environmental issues, as supported by the study of the United Nations Economic and Social Communication for Asia and the Pacific (UNESCAP) (Faculty of Economics and Muamalat, Universiti Sains Islam Malaysia, Negeri Sembilan, Malaysia et al., 2022). Malaysia government had introduced green technology incentives since Budget 2014, the scopes of incentives were divided into three, there are Green Investment Tax Allowance (GITA) Assets, Green Investment Tax Allowance (GITA) Projects and Green Investment Tax Exemption (GITE) Services. Companies are eligible to offset 70% of statutory income if granted with approval for GITA assets (MGTC, n.d.).

Moreover, the initiation of Green Technology Financing Scheme 2.0 (FTS) had aided companies, especially SMEs, in getting additional funds with low interest for business expansion and upgrading to better process performance and achieve higher efficiency. Furthermore, the implementation of GM enables the reduce the overall operation cost, create the environmentally friendly image to accomplish competitiveness and maintain the leadership position in the market.

The imposition of tax relief motivated manufacturers to tend to adopt GMP in the manufacturing process, towards achieving economic growth and also its organizational sustainable growth (Norfakhirah et al., 2022). The implementation of GM enables the reduce the overall operation cost, create an environmentally friendly image to accomplish competitiveness and maintain the leadership position in the market. Collaboration between government and manufacturers is relatively important, by providing financial assistance, tax incentives and support to manufacturers for achieving profitability and business sustainability, at the same time will lead to national economic growth.

In the dynamic global business environment towards green, the standard requirements of stakeholders on the products and services provided by the organization will require

change, to maintain business continuity. For example, the customer will demand environmentally friendly products with higher quality (Seth et al. 2018); suppliers adopting green supply chain practices due to able to comply with legislation in the global market (Mittal et al., 2013); pressure from shareholders and investors to adopt GMP for green competitiveness with cost reduction and maintain the market leadership position (Seth et al., 2018), etc. Internal and external stakeholders' involvement and green concerns is one of the main factors to promote GM (Seth et al., 2018) to grow the business and economy and bring profitability to the company.

H3: There is the relationship of the company and economic benefits on the implementing of GM in manufacturers in Malaysia.

2.1.8.2 Barriers

2.1.5.8.1 Cost Constraints

The increment in overall cost for adopting GMP is one of the factors drawbacks to the implementation of GM. An extensive amount of budget was required for investment in green technology, R&D, training and implementing costs (Karuppiah et al., (2021); Kaswan & Rathi, (2021); Purwandani & Michaud, (2021); Neri et al., (2021); Tanco et al., (2021); Ghazilla et al., 2015; Nordin et al., 2014; and Mittal et al. (2013)), companies may unable to allocate a huge budget for the investment. The investment may take several years to break even and generate a positive return. The long duration of the payback period will affect the organization’s overall performance and constraint the cash flow of the organization for contingency plans and other development projects.

Some of the top management and the owner of the company were emphasized on profit driven, they might not highly commit to the environmental sustainability. They are having a rigid and ungenerous perspective on their business, they believe their operation is just a small-scale, it will not contribute any negative impact to the environment (Singh et al., 2012 and Ghazilla et al., 2015). Top management myopia, non-flexible manufacturing and incompatibility of growth strategies and organizational structure are the factors that impediment the adaptation of GMP (Singh et al., 2012).

High internal politics and arguments among the organization, organization hesitating to change from traditional practices to green practices and refuse to invest on green technologies also will be hampering the execution of GMP (Ghazilla et al., 2015).

The nature of business of the company is preferable to be industrial-specific and will leads to low implementation of GMP (Ghazilla et al., 2015). Some of the products or services are high elasticity, thus, causes customers are more price sensitive and favour in cheaper products than green products (Mittal et al., 2013). Furthermore, shareholders and investors with short-sightedness only will prioritize short-term profitability and resistance to change. Moreover, poor demand from customers and the community (Nordin et al., 2014) and low pressure from shareholders and investors (Nordin et al., 2014 and Ghazilla et al., 2015), the absence of public pressure (Mittal et al., 2013) on the environmental concern, it had inhibited organization to allocate budget for adaptation of GMP in their business operations.

H4: There is relationship of cost constraints that hinder the implementing of GM in manufacturers Malaysia.

2.1.8.2.2 Lack of Technology and Skills

Lack of expertise, technical knowledge and skill and the absence of green technology also is one of the barriers to the implementation of GM (Karuppiah et al., (2021); Kaswan & Rathi, (2021); Tanco et al., (2021); Mittal et al. (2013); and Singh et al. (2012)). Not every company has the competency, knowledge, expertise and skill in green product development and processes. For example, the use of recyclable materials or the use of less hazardous chemicals as an alternative in the production design, during manufacturing and until the final production.

Moreover, inadequate environmental awareness and limited or not understandable GMP information also are obstacles of implementing GM (Nordin et al., 2014 and Mittal et al., 2013). With the absence of specific ideas and clear directions, the firm is impossible able to implement the GMP that aligns with the organization's business strategy to achieve competitiveness.

Furthermore, insufficient support and guidance from local government and regulatory authorities (Ghazilla et al., 2015) may retard the interest of manufacturers concern on environment issues; and take additional efforts to mitigate them. Confusing and unclear GMP implementation guidelines (Ghazilla et al., 2015) created ambiguous directions on the implementation of GM among manufacturers in Malaysia. Therefore, the exist of a large gap between the GMP of local manufacturers and Malaysia government, it is not aligned with the global environmental sustainability goals.

H5: There is relationship of lack of technology and skills that hinder the implementing of GM in manufacturers Malaysia.

2.1.8.3 Moderator Variables

The moderator variable is the variable that will affect the strength or direction of the relationship between independent and dependent variables. The selection of moderator variables should base on theoretical and literature support to avoid a complex study (Mamtaz et al., 2019). In the studies, firm size, type of business ownership and type of industry were chosen as moderators, as literature supported by the studies of Seth et al., (2018); Mittal et al. (2013); Ghazilla et al., (2015); and Nordin et al. (2014).

2.1.8.3.1 Firm Size

Firm size maybe is a moderating variable for the implementation of GM (Seth et al., 2018). Large firms may be easier to raise fund than small firm, to purchase the technology or equipment require to implement GM. Moreover, SMEs having limitation on green innovation and new product development as compared to large firms, due to large firm having adequate resources, such as expertise, information, technology, etc on GM, as compared to small firms.

2.1.8.3.2 Type of Business Ownership

The SMEs' operation of business may less concern on the environmental issue as compared to large firm, MNC and foreign company. The management of small firm, such as SME, place low commitment to the environmentally friendly practices is due

to their business operation size is relatively small as compared to large firm, thus, may not bring any significant negative environmental impact (Mittal et al., 2013). Furthermore, SME or family own business may have higher hesitation to transform from traditional practices to (Ghazilla et al., 2015).

2.1.8.3.3 Type of Industry

The nature of industry also may influence the implementation of GM. The industry that uses high consumption of direct energy for its operation may take initiative to implement the GM. It is because the fuel cost is drastically increase in recently, to maintain the profit margin and sustain the sales revenue, the company will look for alternative energy source to secure their business. However, some of the nature of business may lack of demand from internal and external shareholders (Ghazilla et al., 2015; and Nordin et al., 2014) and their current business operation do not carry high weight in the market on environmental impact, thus, place low interest on implementation GM.

2.1.9 Summary of Drivers and Barriers Extracted from Literature

The summarise of drivers and barriers of implementing GM with literatures support as stated as table 2.2 below.

Table 2.2: Drivers and Barriers of Implementation GM

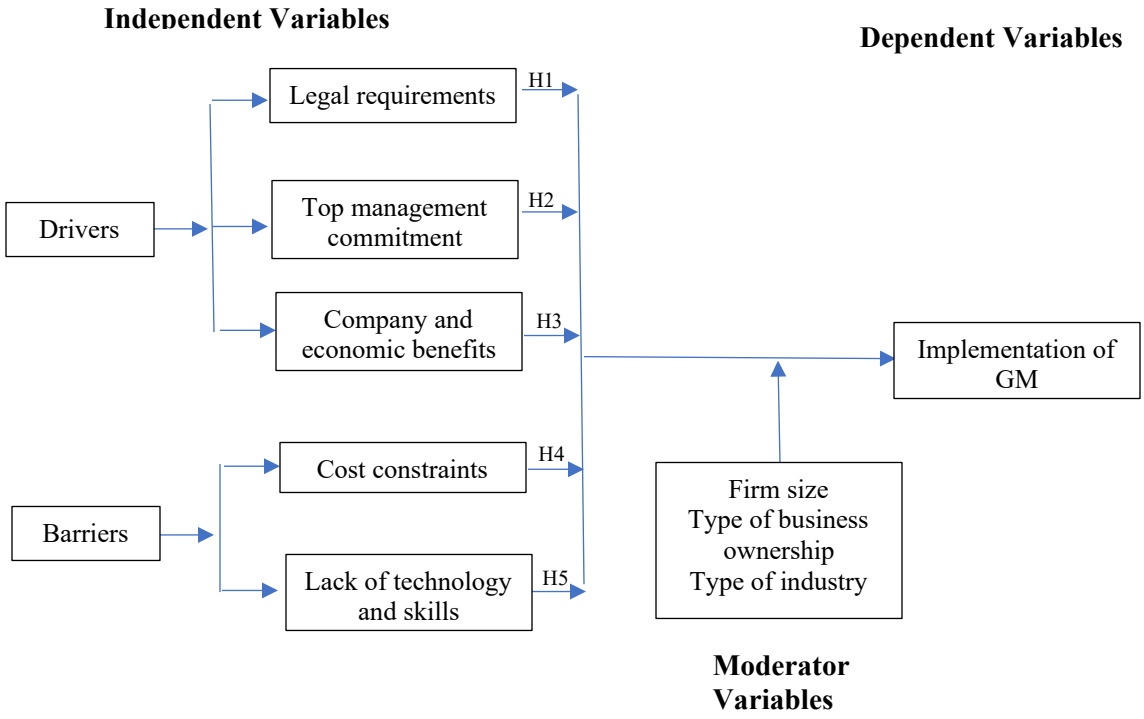
Independent variables		Literature(s) support
Drivers	Legal requirement	Ullah et al., (2022), Bhatia & Jakhar, (2021), Neri et al., (2021), Seth et al., (2018), Ghazilla et al. (2015), Nordin et al. (2014), Mittal et al. (2013), Singh et al. (2012)
	Top management Commitment	Hariyani & Mishra, (2022), Ullah et al., (2022), Agrawal & Vinodh, (2021), Bhatia & Jakhar, (2021), Foo et al., (2021), Jayashree et al., (2021), Seth et al., (2018), Ghazilla et al. (2015), Nordin et al. (2014), Mittal et al. (2013), Singh et al. (2012)
	Company and economic benefits	Ullah et al., (2022), Purwandani & Michaud, (2021), Seth et al., (2018), Ghazilla et al. (2015), Nordin et al. (2014), Mittal et al. (2013), Singh et al. (2012)
Barriers	Cost constraint	Karuppiah et al., (2021), Kaswan & Rathi, (2021), Purwandani & Michaud, (2021), Neri et al., (2021), Tanco et al., (2021), Ghazilla et al. (2015), Nordin et al. (2014), Mittal et al. (2013), Singh et al. (2012)
	Lack of technology and skills	Karuppiah et al., (2021), Kaswan & Rathi, (2021), Tanco et al., (2021), Mittal et al. (2013), Singh et al. (2012)

Source: Developed for the Research

2.2 Theoretical Framework

2.2.1 Proposed Conceptual Framework

Figure 2.6: Proposed Conceptual Framework



Source: Developed for the Research

2.3 Hypotheses of the Study

Hypotheses had developed based on literature studies, to evaluate the relationships among the different drives of implementing GM and also the relationships among the different barriers of implementing manufacturing practices in manufacturers in Malaysia. The hypotheses will be tested in the following chapter.

$H1_o$: There is no relationship of legal requirements on the implementing of GM in manufacturers in Malaysia.

$H1_A$: There is relationship of legal requirements on the implementing of GM in manufacturers in Malaysia.

$H2_o$: There is no relationship of top management commitment on the implementing of GM in manufacturers in Malaysia.
$H2_A$: There is relationship of top management commitment on the implementing of GM in manufacturers in Malaysia.

$H3_o$: There is no relationship of company and economic benefits on the implementing of GM in manufacturers in Malaysia.
$H3_A$: There is relationship of company and economic benefits on the implementing of GM in manufacturers in Malaysia.

$H4_A$: There is no relationship of cost constraints that hinder the implementing of GM in manufacturers in Malaysia.
$H4_A$: There is relationship of cost constraints that hinder the implementing of GM in manufacturers in Malaysia.

$H5_o$: There is no relationship of lack of technology and skill that hinder the implementing of GM in manufacturers in Malaysia.
$H5_A$: There is relationship of lack of technology and skill that hinder the implementing of GM in manufacturers in Malaysia.

2.4 Conclusion

This chapter is an assessment of the research on the explanation of the independent and dependent variables based on past research studies. Moreover, the conceptual framework and hypothesis had established according to the researcher prior studies. The hypotheses developed will be studied in next chapter to know the relationship between the independent and dependent variables.

CHAPTER 3

RESEARCH METHODOLOGY

3.0 Introduction

This chapter will discuss the research methodology of this study and discuss the data analysis to the relationship among the variables. The technique used to obtain and analyse data will be presented here, Then, the research design, data collection methods, variable and measurement, data scale of measurement, data processing and data analysis will be explored.

3.1 Research Design

Research design is a procedural plan, structure and strategy of investigation in an organized systematic way of finding the answer to research questions (Kumar, 2011). Research design can be defined as "Glue" and hold up all the elements in a research project to form a research plan (Akhtar, 2016). The functions of research design are to identify and/or develop of procedures and logistical arrangements required to study in the research project; and to ensure the quality of the path of study to yield valid and reliable results and met research objectives (Kumar, 2011).

Both descriptive and causality research methods were used in this research study. Descriptive research is to describe systematically the characteristic of a given population or area of interest towards an issue, causality research is to identify the

cause-and-effect relationship among the variables (Kumar, 2011). Descriptive research was used to examine the demographic profiles of the respondents, while causality research was used to prove the cause and effect of the relationship among the independent, dependent and mediator variables.

3.1.1 Research Approach

Deductive research is to associate all the research studies done and existing theories developed earlier and followed by analysis and testing of the data collected whether is aligned and supported by the theory and/or hypotheses developed (Saunders et al., 2012). A deductive approach is selected and used in this research. The hypotheses of this study are developed based on the literature review of past studies. The data collected will be analysed and test the hypotheses developed for this study tested (Saunders et al., 2012).

3.1.2 Strategy

Research data will be collected via survey by using a self-administered questionnaire. The self-administered questionnaire is an economic and time saving method of survey, as it does not require face-to-face interaction with respondents. Hence, it is comparatively convenient (Kumar, 2011). It is suitable for the researcher to collect standardised data to study a large population (Kumar, 2011. Moreover, the questionnaires survey method approach provided standardization of questions to respondents for the answer; and the data collected will be consistent and coherent to the specific focus of the study (Roopa & Rani, 2012). The collected primary data will be easy to understand, control and transform into statistical data for analyses. It will also protect and maintain the privacy of the respondents and advocate the willingness participation rate and answer the question more sincerely and comfortably (Roopa & Rani, 2012).

3.1.4 Method

The quantitative method was selected for this research to collect data from respondents, and to obtain a greater knowledge and understanding from the sampling as a

generalization of the targeted population (Kumar, 2011). A set of written questionnaires was prepared in electronic forms (e-form) with clear instructions to clarify how to answer the questions and distributed via email, WhatsApp and social media.

3.1.5 Time Horizon

A research study should plan and propose a time frame to ensure the research work can be completed in the stipulated timeframe (Kumar, 2011) and that the research topic findings are still fresh and valid. As the topic of environmental issues is demanding recently, due to the global climate change issue getting serious and affecting the social and environmental impact, this topic is highly concern by government and society. The survey period to collect data for this study is approximately two months.

3.1.6 Target Population

Population is the broad groups of people, or an entire set of units interested; however, the sample is represented a small number of people within the larger population (Weiers, 2011). Manufacturers located in Klang Valley, Malaysia are the target population for this study. The manufacturer's list in Malaysia was retrieved from the website of the Federation of Malaysian Manufacturers.

3.1.7 Sampling Method

The sampling method selected for data collection will affect the result of the research. This study utilises non-probability sampling method which involves non-random selection based on convenience or other criteria to collect data (Weiers, 2011 and Kumar, 2011). For this study probability sampling is inappropriate, due to each target respondent being impossible to have an equal opportunity to participate in this survey within the stipulated time frame.

According to Bagozzi & Yi (2012), the sample size for a study of above 100 is sufficient, and favourable if 200 and above. However, a larger sample size will end in higher accuracy of results. Hence, this study will aim for 200 and above respondents to

answer the survey questionnaire. Convenience sampling based on non-probability sampling was chosen as the method for the data collection in this study.

3.2 Data Collection Method

Data collection is a systematic process of gathering data and measuring information from target respondents or samples on the variables of interest to study (Zikmund, 2013). Data collection is the most important aspect of the research. The selection of data collection method used for collecting data should be appropriate to reduce the likelihood of an error occurring and ensure data collected is accurate and reliable. The inaccuracy of the data collected will lead to invalid results.

3.2.1 Primary Data

Primary data is the first-hand and real time data collected by the researcher for solving specific problem (Malhotra, 2010). Primary data is generated by collecting the data through conducting surveys, observations, questionnaires, interviews, experiments, etc.

Primary data is preferable by researchers as the data collected is more specific and relevant to the research problem and up-to-date (Onkvisit & Shaw, 2004). Primary data collection method is adopted for this research. The researchers surveyed by distributing the structured survey questionnaire to the targeted respondents.

3.2.2 Pilot Test

The pilot test is a rehearsal of the study by approaching a small number of sampling tests before executing a large survey of the main study. The purpose of the pilot study is to analyse and evaluate the feasibility of the study, to identify the potential issue and to obtain sufficient preliminary data to justify the large sample in the actual study (Hertzog, 2008). Besides this, the researchers were able to assess the validity and reliability of the content of the question to ensure obtained desired outcome (Saunders et al, 2012).

The pilot test is a vitally important process to evaluate and examine the feasibility of the questionnaire (Kumar, 2011). The objective of the pilot test is to ensure each question is clear, understandable, suitable in wording and meaningful are easy to understand by potential respondents (Kumar, 2011). Zikmund (2013) commented sample size for the pilot study should be between 1-1.5% of the sample size to be used in the study. The range of 10 to 30 samples is sufficient as a pilot study (Kieser and Wassmer, 1996; Amy et al, 2016).

A total 24 of experts from industry, academia and ISO consultants were invited to participate in the pilot study for this survey. Three-person ISO consultants & auditors, which had expertise in the ISO 14001 environment management systems and relevant sustainability knowledge to evaluate and well understand the concept of GMP in the organization's process. The 18 respondents are manufacturing industry experts, from the operation, quality control, R&D, environment, safety and health (ESH) department and sustainability committee in the company. The characteristic of this industry group of the pilot study is similar to the actual target respondents. In addition, three academicians from a local university were recruited mainly to comment on the suitability wording, format and layout of the questionnaire, and not as respondents for the pilot test of the survey questionnaire.

Cronbach's alpha is a convenient test used to estimate the reliability and consistency of measuring the respondents' responses. Based on the studies of Mat Nawi et al. (2020), Cronbach's alpha was divided into 5 rankings, which included excellent reliability (0.9 and above), very good reliability (0.8 to < 0.9), good reliability (0.7 to <0.8), moderate reliability (0.6 to < 0.7) and poor reliability (less than 0.6). The good reliability of the pilot test should be between 0.7 – 0.8 (Mat Nawi et al., 2020). The closer the Cronbach's alpha to 1 the greater the internal consistency.

Table 3.1: Rule of Thumb About Cronbach's Alpha Coefficient Size

Alpha Coefficient Range	Strength of Association
Less than 0.6	Poor
0.6 to < 0.7	Moderate
0.7 to < 0.8	Good
0.8 to < 0.9	Very Good
0.9 and above	Excellent

Source from (Mat Nawi et al., 2020).

The result of reliability statistic on the pilot test received from the 21 sets of questionnaires as showed as Table 3.2. The Cronbach's alpha above 0.7 is considered reliable. Hence the pilot testing showed a reliable result.

Table 3.2 Reliability Cronbach's Alpha For 21 Sample

Variable	Cronbach Alpha Coefficient	Number of items
Legal requirement	0.810	5
Top management commitment	0.799	5
Company and economic benefits	0.718	5
Cost constraint	0.826	5
Lack of technology and skill	0.786	5
Green manufacturing	0.768	5

Source: Developed for the Research

Data collected for pilot study will not be counted in main study. Thereafter, the questionnaire will be distributed to targeted respondents after some minor the amendment based on commented from the experts.

3.3 Variables and Measurement

The variables of the study were adapted from past studies researchers. Each variable is made up of its measurement items. There are total of 5 independent variables and 1 dependent variable in this study. The 5 independent variables are divided into two

sections, the first section is drivers of implementing GM, which are legal requirements, top management commitment and company and economic benefits. The other section is the barriers of implementing GM, i.e. cost constraints and lack of technology and skills.

Table 3.3: Drivers and Barriers of Implementation GM and Measurement Items

Construct	Sample of measurement items	Sources
Green manufacturing practices (5 items)	Use of hazardous chemicals in your product or manufacturing process.	Gupta et al., (2018)
	Recycle or reuse the product/materials during manufacturing process.	
	Minimize the usage of water and energy efficiency management during manufacturing process.	
	Minimize the waste generated during manufacturing process.	
	Use of efficient and clean technology during manufacturing process to reduce carbon footprint (CO_2).	
Drivers		
Legal requirements (5 items)	Pollution control, waste disposal management and landfill taxes were stricter by local government.	Seth et al. (2018); Ghazilla et al., (2015); Nordin et al. (2014); Mittal et al. (2013); Singh et al. (2012)
	The enforcement of penalties for the noncompliance of regulations and requirements.	
	Imposing high carbon emission discharge tax execution by local government.	
	The compulsory environmental regulation mandated by local government (e.g. hazardous and toxic regulation) for business continuity.	
	To comply environmental regulation in place by other countries (e.g., EU Directive, etc.) to secure oversea business.	

Top management commitment (5 items)	Top management having capabilities, awareness and culture on environmental issue.	Seth et al. (2018); Ghazilla et al., (2015); Nordin et al. (2014); Mittal et al. (2013); Singh et al. (2012)
	Management, owner or investors are highly committed to enhance environmental performance, ethics and social values.	
	Company's strategic and organizational willing to change align to environmental sustainability, to achieve competitiveness towards business sustainability.	
	Top management allocate sufficient organization resources e.g., skilled and motivated staff, healthy financial situation and performance measurements.	
	Top management encourage employee involvement and commitment through training and empowerment.	
Company and economic benefits (5 items)	Local governmental and authorities provide financial incentives to the company, such as investment subsidies, awards and R&D support.	Seth et al. (2018); Ghazilla et al., (2015); Nordin et al. (2014); Mittal et al. (2013); Singh et al. (2012)
	To achieve long term cost saving by adopt technologies on green process, product designs, packaging and 3 R s (Reduce, Reuse, Recycle) in the manufacturing process.	
	To achieve better process performances, higher product quality and higher efficiency in overall operation.	
	Effective and optimized utilization of resources to achieve economic benefits, cost reduction and competitiveness to maintain market leadership position.	
	To reduce total energy consumption in the manufacturing process due to the rising energy costs.	
Barriers		
Cost constraints	Large amount of short-term cost, inappropriate incentives and consist of hidden	Ghazilla et al., (2015); Nordin

(5 items)	costs for implement green manufacturing practices.	et al. (2014), Mittal et al. (2013); Singh et al. (2012)
	High investment cost for the development of new analytical tools, models & metrics and chemical analysis of exhaust.	
	Additional cost is needed on training for implementation of environmental sensitive processes, re-management of human resource.	
	Increment in overall cost for purchasing of costly environmentally friendly materials for manufacturing.	
	High cost and risky in adopting new green production measures.	
Lack of technology and skill (5 items)	Lack of skilled staff, expertise and specific ideas on how to implement green manufacturing in your company.	Ghazilla et al., (2015); Mittal et al. (2013); Singh et al. (2012)
	Inadequate financial resources or capital access to purchase green technology require for the manufacturing process.	
	Limited access of information, lack of new technology, materials and processes to support green manufacturing.	
	Inadequate R&D, technical knowledge, supports and testing facilities to convert manufacturing waste to green products.	
	Nature of business which is "industrial-specific" than towards "green trend", hence, leading to low green manufacturing practices.	

Source: Adopted from (Gupta et al., 2018)*; Seth et al. (2018); Ghazilla et al., (2015); Nordin et al. (2014); Mittal et al. (2013); and Singh et al. (2012).*

3.4 Data Scale of Measurement

The measurement scale is used to qualify and quantify data variables in statistics, there are four levels of measurement scale: nominal, ordinal, interval and ratio (Kumar, 2011). However, this study only applied the nominal scale, ordinal scale and interval scale.

3.4.1 Nominal Scale

Nominal scale also known as the categorical scale, is used for identification purposes and assigns numbers to attributes for easy identity and classification (Kumar, 2011). Nominal scale is the simplest type of scale, it does not carry any evaluation distinction and involves quantitative measurement. The demographic information, such as gender, designation, category manufacturing industry, etc. are measured by nominal scale.

3.4.2 Ordinal Scale

Ordinal scale has involved the ranking and ordering properties that enable the respondents to reflect the relative magnitude of the question. It has an evaluation connotation and can be measure by the degree of occurrence of the variables (Kumar, 2011). Some of the demography information, e.g. year of attachment and number of employees are measured by ordinal scale.

3.4.3 Likert Scale

Likert scale is one type of interval scale. It is a scale in which the levels are in ordered either arranged in ascending or descending, each numerically with equal interval differences between each value. Each measurement unit of the interval scale enables to measurement of individuals or responses in equally spaced intervals of the variables (Kumar, 2011). Likert scale is used to measure the attitude of respondents to indicate their point of view on a series of statements with the following options: (1) strongly disagree, (2) disagree, (3) neither agree or disagree, (4) agree and (5) strongly agree (Joshi et al., 2015). Five-point Likert scale measurement was used in the questionnaire on independent variables and dependent variables.

Table 3.4: Summary of Likert Scale Used to Measure Variables

Variables	Likert Scale
Dependent Variables Green manufacturing (GM)	(1) – Strongly disagree (2) – Disagree (3) – Neither agree or disagree (4) – Agree (5) – Strongly Agree
Independent Variables ***Drivers*** • *Legal requirements* • *Top management commitment* • *Company and economic benefits* ***Barriers*** • *Cost constraints* • *Lack of technology and skill*	

Source: Develop for this study

3.5 Data Processing

Data processing is to gather all the quantitative data from respondents and going through the process of questionnaire checking, data editing, data coding, data transcribing and data cleaning. Data obtained from the questionnaire survey will translate into useful information which can be easily understood and controlled by the researcher.

3.5.1 Questionnaire Checking

Questionnaire checking is required conduct before distributing to respondents to answer. This purpose of checking is to ensure the questionnaire is quality, free of error and comprehensive with met the research objectives. Questionnaire was evaluated by pilot study to improve its reliability and validity.

3.5.2 Data Editing

In this stage, raw data will be checked by the researcher to eliminate the mistake done by the respondent. Incomplete or missing data questionnaires will be segregated and

will not be taken into consideration in the final result for analyses. This action is to improve the quality and accuracy of the research results.

3.5.3 Data Coding

The coding process makes the data entry process become easier and more convenient. Data obtained from the survey will be coded into numerical values for each individual response to respective questions in the questionnaire before proceeding to the data analysis stages. In section I of the questionnaire, the gender "male" was coded with 1.0, "female" was coded with "2.0". The following variables: "designation", "job responsibilities", "years of attachment", "category of manufacturing industry", "certification/s certified by the company", "business ownership", "total number of employees in the company" will be coded as well. For the questions measured with an interval scale (Likert Scale) "strongly disagree" was coded 1.0", "disagree" was coded 2.0", "neither agree nor disagree" was coded 3.0", "agree" was coded 4.0", and "strongly agree" was coded 5.0".

3.5.4 Data Transcribing

Data transcribing is the activity transferring the coded data from questionnaire into SPSS software in order to interpret the results.

3.5.5 Data Cleaning

Data cleaning is carried out to determine and eliminate those data that are incomplete, inconsistent, invalid and outlier (Natarajan, Li, & Koronios, 2010). Even though, error data was removed in the earlier stage, however, there might be some error or missing data were overlooked and detected by SPSS software. Those errors and missing data will remove to obtain higher accuracy and reliability results.

3.6 Data Analysis

Data analysis is the process that the researcher converts all the data collected into a meaningful format by using appropriate statistical procedures (Kumar, 2011). The

researcher will be using Statistical Package for Social Science (SPSS) version 24 program in analysis. The data derived from the completed questionnaire will be coded before transfer into SPSS for analyses. The relevant analyse and desired results will be obtained after the analysis process.

3.6.1 Reliability

Reliability can be defined as the research instrument for the ability of producing similar and consistent results under repeated consistent conditions. The higher accuracy of an instrument will provide higher reliability results (Kumar, 2011). Reliability test is required to ensure whether the items in the questionnaire are related to each other, or vice versa. Reliability and quality of measurement will provide consistent and accurate results (Kumar, 2011); to draw the conclusion and meet the objective of the research objective.

Cronbach's alpha is used to determine the reliability or internal consistent of the measurement scale in a particular study is reliable. Cronbach's alpha reliability test value of 0.7 and above is considered good, if closer to 1 means a higher internal consistency (Sekaran & Bougie, 2016).

3.6.2 Hypotheses Testing

Hypotheses of the study were developed in Chapter 2 and those hypotheses will be tested by using the multiple regression to determine the relationship between the dependent variable and independent variables.

3.6.3 Descriptive Analysis

Descriptive analysis is a step that transforms the raw data information into values, or called codes into understandable form to analyse (Kumar, 2011). The application of descriptive analysis is to examine the similarity of the characteristic of the current data as compared to previous research studies (Heppner & Heppner, 2004). The purpose of descriptive analysis is to summarize the dependent and independent variables in a large of data into simple and meaningful data that is easy to interpret.

Descriptive statistics is divided into three categories. First, measure of central tendency, which measures the average or middle values of the data, e.g., mean, median and mode. Second, measure of variability. It is used to measure the spread of data and analyse by calculating standard deviation, variance, minimum and maximum variables, kurtosis and skewness of the data. Third, measure of frequency distribution, it is referred to the quantity of times data appear in the data set, follow by conversion into a percentage for comparison of the variables.

In the research, descriptive analysis is used to analyse demographic data in section I, such as gender, designation, job responsibilities, year of attachment in the organization, business ownership, etc. to understand the demography of the respondent and companies.

3.6.4 Central Tendency Analysis

The measurement of central tendency was referred to measure the centre to describe a whole set of data with a single value that represents the centre of its distribution. Arithmetic mean is commonly used to measure central tendency for both discrete and continuous data.

In the research, central tendency analysis was used to measure the arithmetic mean of independent and dependent variables, by summing all the values in the data set and dividing by the number of values in the data set (Zikmund, 2013).

3.6.5 Multiple Linear Regression Analysis

Multiple linear regression analysis is used to identify the relationship between independent, dependent and moderator variables. The intention of analysing the relationship is to understand the significant relationship of the independent variables (drivers and barriers) and the implementation of GM. The general equation of logistic regression is as below:

$$Y = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \ldots\ldots + \beta_m X_m$$

"Y" denotes as the dependent variable, "β_0" denote as constant, while "β_m" denote as the weight of the data.

Equation;

$$\hat{y} = b_0 + b_1 LR + b_2 TMC + b_3 CEB + b_4 CC + b_5 LTS$$

where

GM = Green Manufacturing

LR = Legal Requirements

TMC = Top Management Commitment

CEB = Company and Economic Benefits

CC = Cost Constraints

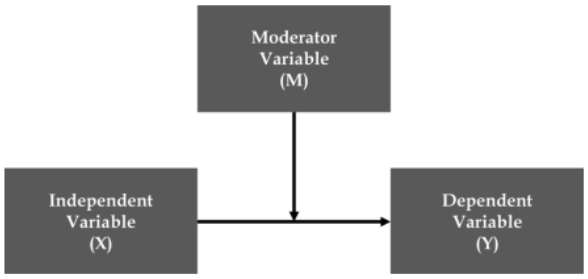
LTS = Lack of Technology and Skills

3.6.6 Moderator Analysis

Moderator analysis is a statistical method to evaluate how the impact of the mediator on the causal effect between the dependent variable and independent variables. It is used to examine the effect of the moderator that will alter the strength of the relationship between interdependent variables and dependent variables. The moderation effect will be tested by the regression coefficient of interaction.

The researcher is using the conceptual model Figure 3.1, moderator variables (M) is connected to the dependent variable (Y) and independent variables (X) (Mumtaz, et al., 2019) as below:

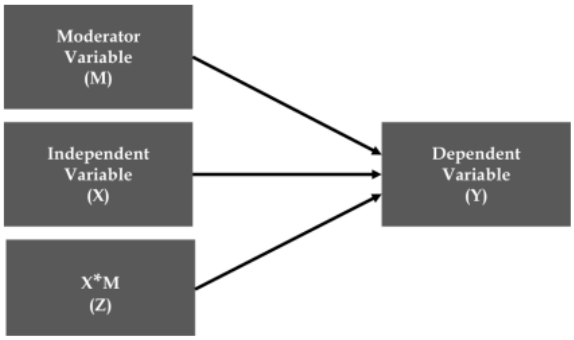
Figure 3.1: Conceptual Framework with Moderating Variable



Source from (Mumtaz, et al., 2019)

In the moderation statistical model, an interaction term (Z= X*M) will be included and pointed to dependent variables (Y), besides of independent variables (X) and moderator variables (Y) (Figure 3.2).

Figure 3.2: Moderation Statistical Model



Source from (Mumtaz, et al., 2019)

CHAPTER 4

RESEARCH RESULTS AND FINDINGS

4.0 Introduction

The data and information collected through a survey questionnaire will be presented in this chapter. Descriptive analysis is performed to describe the respondents' demographic characteristics and a reliability test is conducted for all the variables. In addition, the inferential analysis will be conducted to identify the relationship between dependent and independent variables.

4.1 Response Rate

Total of 910 survey questionnaires were sent out to manufacturer companies in Klang Valley between December 2022 to January 2023. Only 301 out of 910 responses, the response rate was approximately 33.08%. After conducting data cleaning, total of 241 responses are valid for this study.

Table 4.1: Response Rate

Questionnaire Distributed	910
Total Response Received	301
Total Response Rate (%)	33.08%
Total Valid Response	241
Total Valid Response Rate (%)	26.48%

Source: Developed for the Research

4.2 Descriptive Analysis

4.2.1 Respondents' Characteristics

4.2.1.1 Gender

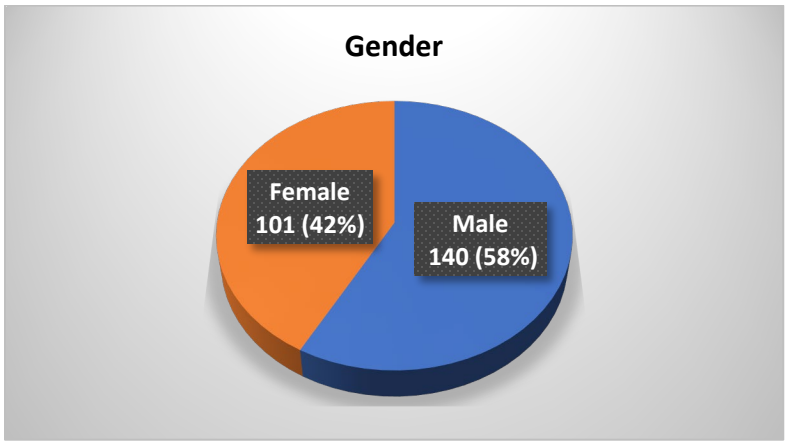
Table 4.2 and Figure 4.1 showed the gender ratio of respondents. There are 140 (58%) male respondents and 101 (42%) female respondents from the total 241 responses.

Table 4.2: Respondents' Gender

Gender	Frequency	Percentage
Male	140	58%
Female	101	42%
Total	**241**	**100%**

Source: Developed for the Research

Figure 4.1: Respondents' Gender



Source: Developed for the Research

4.2.1.2 Designation

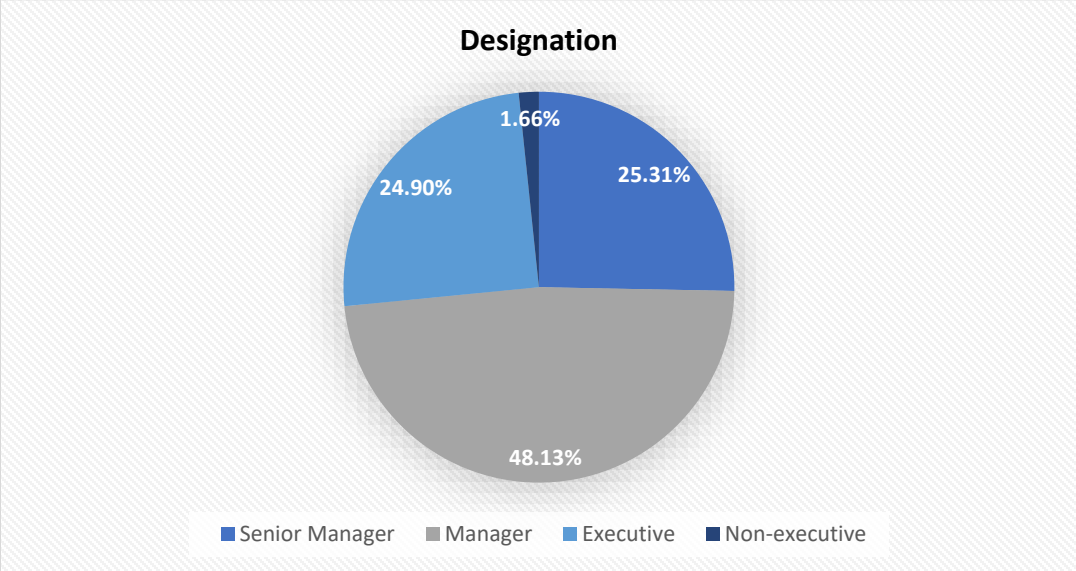
Table 4.3 and Figure 4.2 showed the designation of the respondents. Out of 241 valid questionnaires received, 116 of the respondents (48%) are manager level, 61 of the respondents (25.31%) are senior manager level, 60 of the respondents (24.90%) are executive level and 4 of the respondents (1.66%) are non-executive level.

Table 4.3: Respondents' Designation

Designation	Frequency	Percentage
Senior Manager	61	25.31%
Manager	116	48.13%
Executive	60	24.90%
Non-executive	4	1.66%
Total	**241**	**100.00%**

Source: Developed for the Research

Figure 4.2: Respondents' Designation



Source: Developed for the Research

4.2.1.3 Job Responsibilities

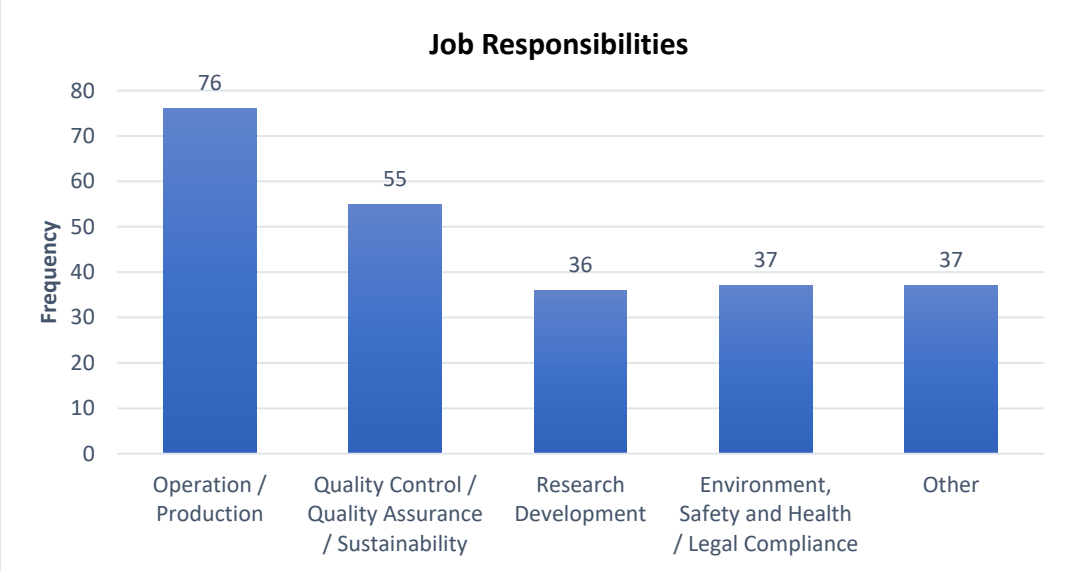
Table 4.4 and Figure 4.3 showed the job responsibilities composition for 241 respondents. The majority groups of the respondents' job responsibilities are from the operation or production department with 76 respondents, 31.54%, followed by the respondents from the department of quality control, quality assurance and sustainability with 55 respondents, 22.82%, environmental, safety and health, legal compliance department with 37 respondents, 15.35% and research development department with 36 respondents, 14.94%. The remaining 37 respondents, 15.35% are from other departments, such as human resources, finance, sales, and marketing.

Table 4.4: Respondents' Job Responsibilities

Job Responsibility	Frequency	Percentage
Operation / Production	76	31.54%
Quality Control / Quality Assurance / Sustainability	55	22.82%
Research Development	36	14.94%
Environment, Safety and Health / Legal Compliance	37	15.35%
Other	37	15.35%
Total	**241**	**100.00%**

Source: Developed for the Research

Figure 4.3: Respondents' Job Responsibilities



Source: Developed for the Research

4.2.1.4 Years of Attachment

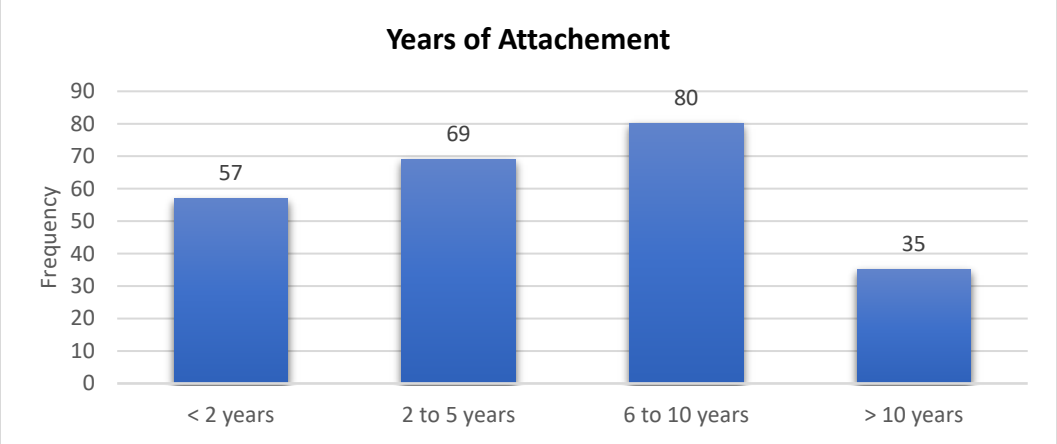
Table 4.5 and Figure 4.4 showed the statistic of respondents' total years of attachment in their current organization. The highest group of respondents' years of attachment are from 6 to 10 years, i.e. 80 respondents (33.20%). The second highest group is from the range of 2 to 5 years of 69 respondents (28.63%), followed by the groups less than 2 years and more than 10 years with 57 respondents (23.65%) and 35 respondents (14.52%) respectively.

Table 4.5: Respondents' Years of Attachment in Organization

Years of Attachments	Frequency	Percentage
< 2 years	57	23.65%
2 to 5 years	69	28.63%
6 to 10 years	80	33.20%
> 10 years	35	14.52%
Total	**241**	**100.00%**

Source: Developed for the Research

Figure 4.4: Respondents' Years of Attachment in Organization



Source: Developed for the Research

4.1.1.5 Category of Manufacturing Industry

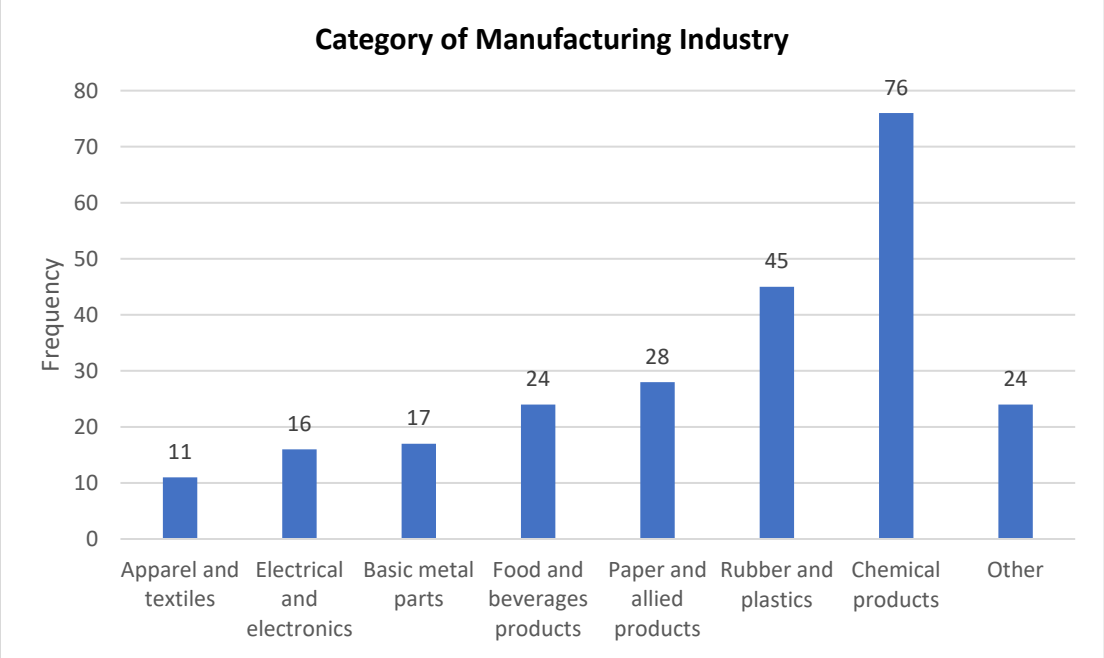
Responses to the questionnaires was received from a different categories of the manufacturing industry, there are include 76 respondents (31.54%) from chemical products manufacturers, 45 respondents (18.67%) from rubber and plastics industry, 28 respondents (11.62%) from paper and allied products industry, 24 (9.96%) from food and beverages products industry, 17 respondents (7.05%) from basic metal parts industry, 16 respondents from electrical and electronics industry, 11 respondents (4.56%) from apparel and textiles industry and the remaining 24 respondents (9.96%) are from other categories of manufacturing industry, e.g. automotive, building materials, filter, health care, etc.

Table 4.6: Category of Manufacturing Industry of the Respondents

Category of Manufacturing	Frequency	Percentage
Apparel and textiles	11	4.56%
Electrical and electronics	16	6.64%
Basic metal parts	17	7.05%
Food and beverages products	24	9.96%
Paper and allied products	28	11.62%
Rubber and plastics	45	18.67%
Chemical products	76	31.54%
Other	24	9.96%
Total	**241**	**100.00%**

Source: Developed for the Research

Figure 4.5: Category of Manufacturing Industry of the Respondents



Source: Developed for the Research

4.1.1.6 Business Ownership

Table 4.7 and Figure 4.6 showed the business ownership of the respondents. Majority of the respondents are from private enterprise companies with 164 respondents representing 68.05%, followed by 57 respondents (23.65%) from multinational

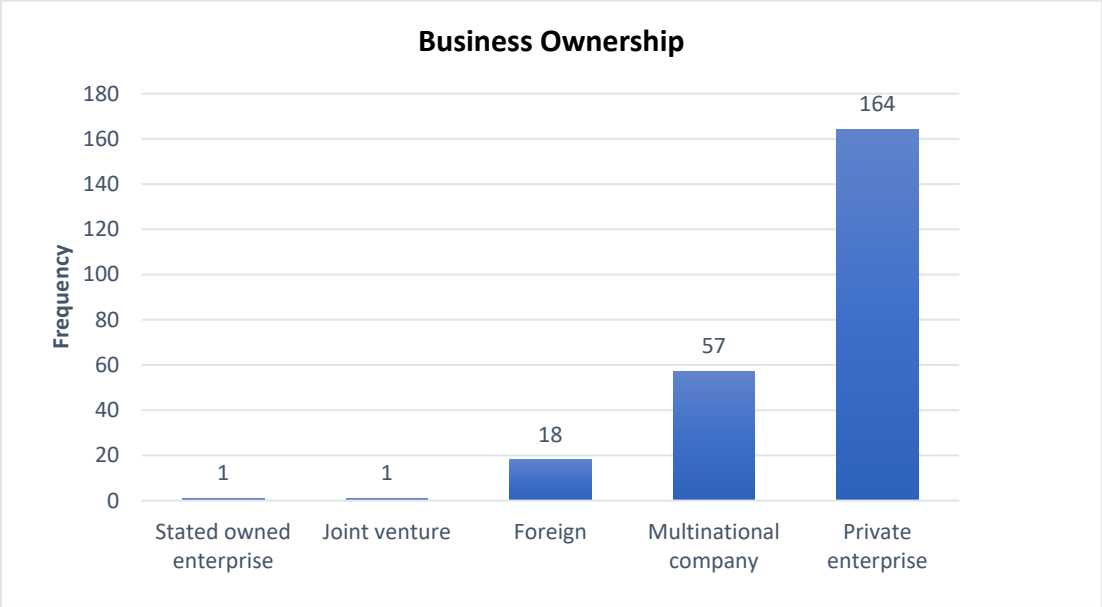
companies, 18 respondents (7.47%) from foreign companies, 1 respondent (0.41%) from joint venture companies and 1 respondent (0.41%) from stated-owned enterprise company.

Table 4.7: Business Ownership of the Respondents

Business Ownership	Frequency	Percentage
Stated owned enterprise	1	0.41%
Joint venture	1	0.41%
Foreign	18	7.47%
Multinational company	57	23.65%
Private enterprise	164	68.05%
Total	**241**	**100.00%**

Source: Developed for the Research

Figure 4.6: Business Ownership of the Respondents



Source: Developed for the Research

4.1.1.7 Firm Size

Table 4.8 and Figure 4.7 indicated the firm size of the company. There are total of 93 respondents 28.59% from large firms, which the company consist of more than 200

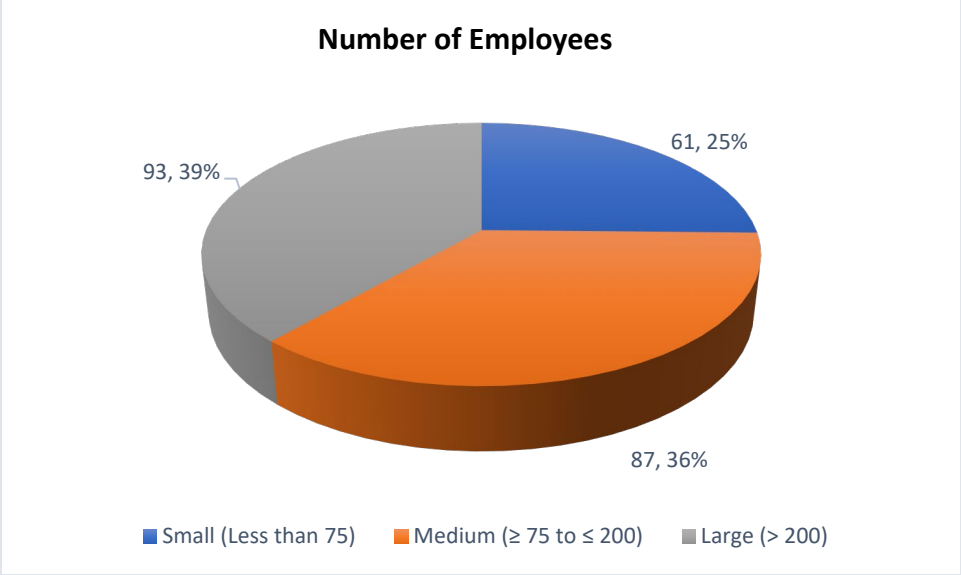
employees. 87 respondents (36.10%) are from medium size of firms, which the company consist of more than 75 and less than 200 employees. 61 respondents (25.31%) are from small firms, which the company consist of less than 75 employees. Data collected for this study are mainly from large and medium manufacturing companies.

Table 4.8: Respondent's Firm Size

Number of Employees	Frequency	Percentage
Small (Less than 75)	61	25.31%
Medium (≥ 75 to ≤ 200)	87	36.10%
Large (> 200)	93	38.59%
Total	**241**	**100.00%**

Source: Developed for the Research

Figure 4.7: Respondent's Firm Size



Source: Developed for the Research

Table 4.9 Summarized of Respondents' Characteristics

Demographic Factors	Categories	Frequency	Percentage
Gender	Male	140	58.00%
	Female	101	42.00%
Designation	Senior Manager	61	25.31%
	Manager	116	48.13%
	Executive	60	24.90%
	Non-executive	4	1.66%
Job responsibilities	Operation / Production	76	31.54%
	Quality Control / Quality Assurance / Sustainability	55	22.82%
	Research Development	36	14.94%
	Environment, Safety and Health / Legal Compliance	37	15.35%
	Other	37	15.35%
Years of attachment in organization	< 2 years	57	23.65%
	2 to 5 years	69	28.63%
	6 to 10 years	80	33.20%
	> 10 years	35	14.52%
Category of manufacturing Industry	Apparel and textiles	11	4.56%
	Electrical and electronics	16	6.64%
	Basic metal parts	17	7.05%
	Food and beverages products	24	9.96%
	Paper and allied products	28	11.62%
	Rubber and plastics	45	18.67%
	Chemical products	76	31.54%
	Other	24	9.96%
Business ownership	Stated owned enterprise	1	0.41%
	Joint venture	1	0.41%
	Foreign	18	7.47%
	Multinational company	57	23.65%
	Private enterprise	164	68.05%
Firm Size	Small (Less than 75)	61	25.31%
	Medium (≥ 75 to ≤ 200)	87	36.10%
	Large (> 200)	93	38.59%
Total no. of respondent companies = 241			

Source: Developed for the Research

4.2.2 Respondents' General Information

4.2.2.1 ISO Certification

Table 4.10 showed the number of certifications certified by the organization. According to the data obtained, there are 26 companies (10.79%) do not certify any ISO certification, however, 99 companies (41.08%) have one ISO certification, 63 companies (26.14%) have two ISO certifications, 46 companies (19.09%) having three ISO certifications and 7 companies (2.90%) having four ISO certification.

Table 4.10 Number of ISO Certification in an Organization

Number of ISO Certification	Frequency	Percentage
0	26	10.79%
1	99	41.08%
2	63	26.14%
3	46	19.09%
4	7	2.90%
Total	**241**	**100.00%**

Source: Developed for the Research

According to Table 4.11, there are total of 209 companies certified ISO 9001 Quality Management System, 90 companies certified ISO 14001 Environmental Management System, 63 companies certified ISO 45001 Occupational Health and Safety Management System, 1 company having ISO 14064 Greenhouse gases accounting and verification and 24 companies were certified by other certification, such as ISO 17025 General requirements for the competence of testing and calibration laboratories, ISO 13485 Quality Management System on medical devices and related service, Food Safety System Certification 22000, GMP (Good Manufacturing Practice), HACCP (Hazard Analysis & Critical Control Points) and Halal, which is adhered to Islamic law.

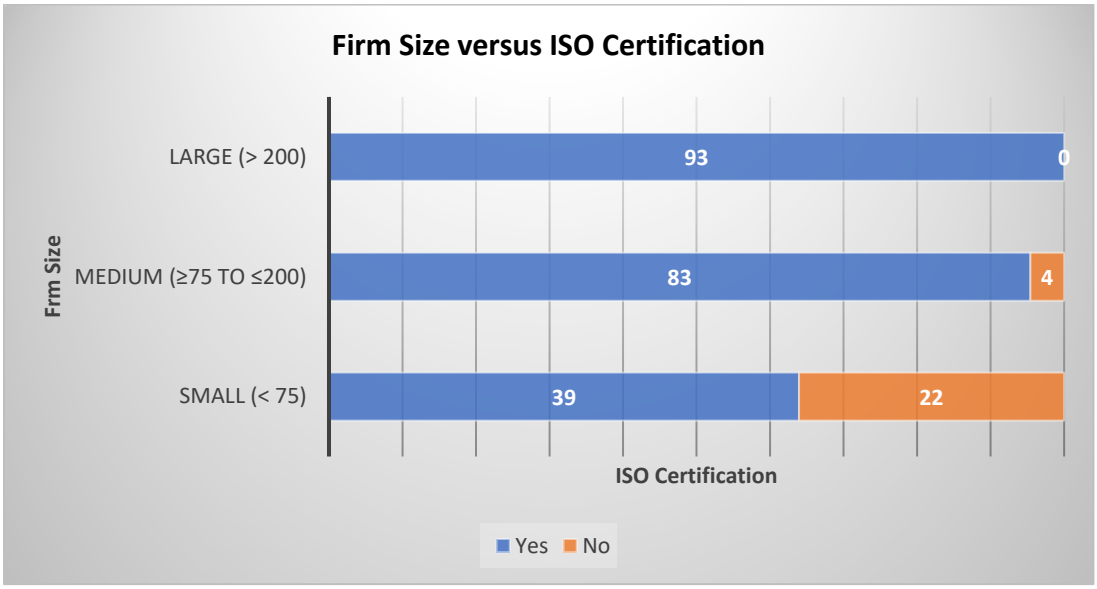
Table 4.11 Type of Certifications

Type of Certification	Frequency
ISO 9001 Quality management system	209
ISO 14001 Environmental management system	90
ISO 45001 Occupational health and safety management system	63
ISO 50001 Energy management system	7
ISO 14064 Greenhouse gases accounting and verification	1
Other (ISO 17025, ISO 13485, FSSC 22000, GMP, HACCP and Halal)	24

Source: Developed for the Research

Figure 4.8 showed the ISO certification versus firm size. It showed all 93 large manufacturing companies possessed at least one ISO certification. On average large manufacturing companies have approximately 2.15 numbers of ISO certifications. For medium size with numbers of employees more than 75 and less than 200, there are 83 out of 87 respondents certified by ISO certification, however, 4 out of 87 respondents were not certified. On average large manufacturing companies have approximately 1.53 numbers of ISO certifications. For small firms, which the company having less than 75 employees, there are 39 out of 61 respondents are certified ISO certification, and 22 out of 61 respondents are not certified.

Figure 4.8: Firm Size versus ISO Certifications

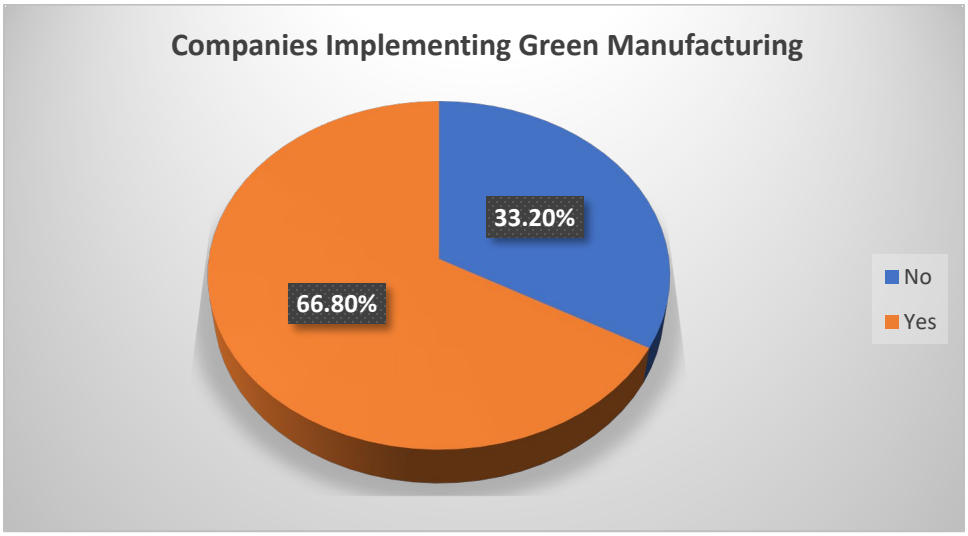


Source: Developed for the Research

4.2.2.2 Companies that Implementing Green Manufacturing

From the Figure 4.9 showed 66.80% of the companies are implementing GM, however, 33.20% are not implementing GM as according to the survey.

Figure 4.9: Companies Implementing Green Manufacturing



Source: Developed for the Research

4.2.2.3 Companies Implementing Green manufacturing versus Business Ownership

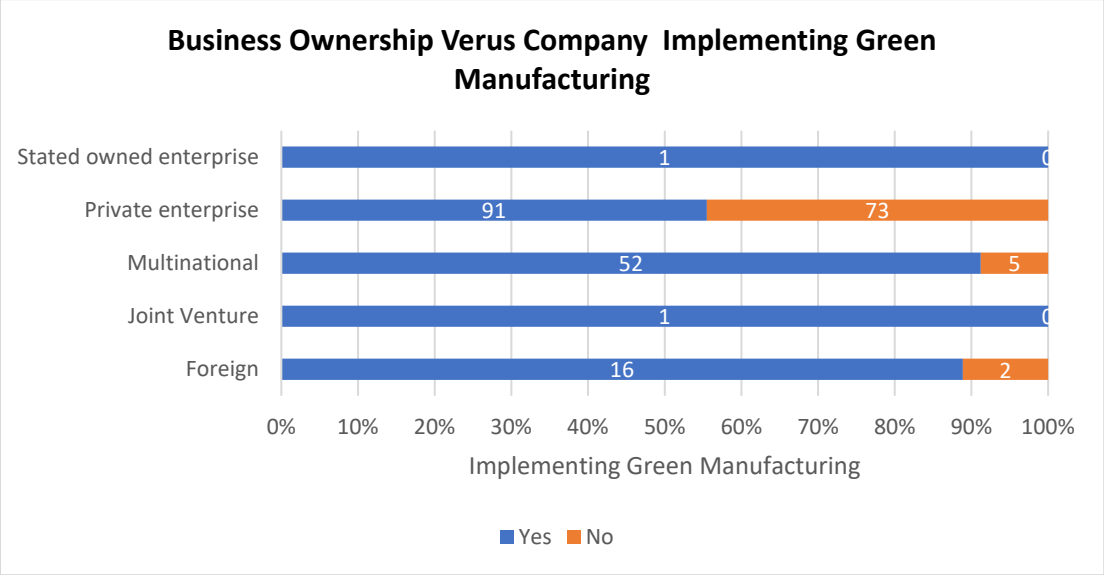
Based on Table 4.12 and Figure 4.10, there is only 1 respondent from state owned enterprise and joint venture company respectively, both of the respondents are implementing GM. Private enterprises are the largest group of respondents from the survey, there 91 out of 164 implemented GM and 73 out of 164 not implementing GM. MNC is the second largest group in the survey, 52 out of 57 respondents, which is represent 91% of total MNC respondents, were implementing GM, however, only 5 out of 57 respondents are not implementing it. Moreover, 16 out of 18 foreign companies are implementing GM and 2 out of 18 foreign companies are not implementing GM.

Table 4.12: Business Ownership Versus Respondent's Company Implementing Green Manufacturing

Green Manufacturing	Frequency	Percentage
Yes	**161**	**66.80%**
Foreign	*16*	*6.64%*
Joint Venture	*1*	*0.41%*
Multinational	*52*	*21.58%*
Private Enterprise	*91*	*37.76%*
State Owned Enterprise	*1*	*0.41%*
No	**80**	**33.20%**
Foreign	*2*	*0.83%*
Multinational	*5*	*2.07%*
Private Enterprise	*73*	*30.29%*
Total	**241**	**100.00%**

Source: Developed for the Research

Figure 4.10: Business Ownership Versus Respondent's Company Implementing Green Manufacturing



Source: Developed for the Research

4.2.2.4 Companies Implementing Green Manufacturing versus Firm Size

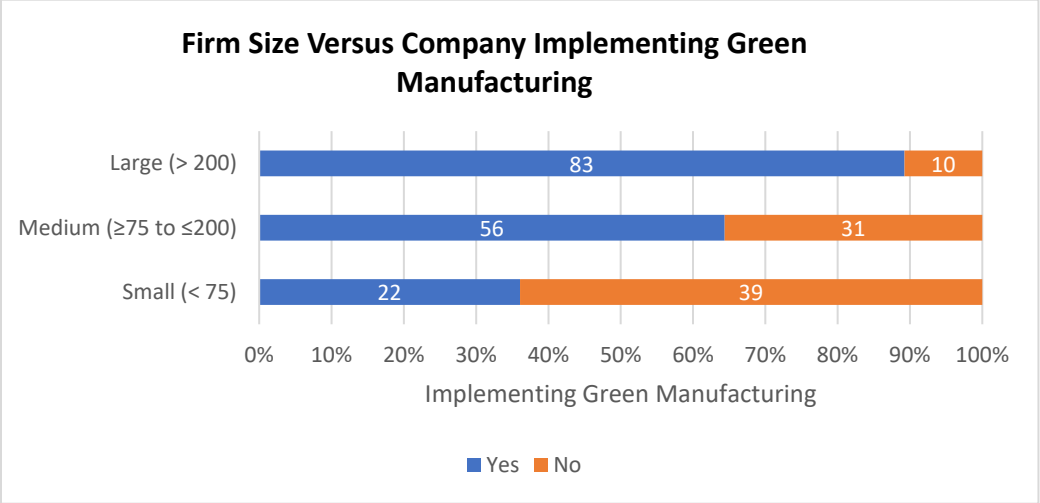
According to Table 4.13 and Figure 4.11, 83 out of 93 respondents (89.25%) for large firms are implementing GM, however, 10 out of 93 respondents (10.75%) are not implementing GM. For medium size firms, 56 out of 87 respondents (64.37%) are implementing GM and 31 out of 87 respondents (35.63%) are not implementing GM. For small firms, which a number of employees lesser than 75, there are 39 out of 61 respondents (63.93%) not implementing GM and 22 out of 61 respondents (36.07%) implementing GM.

Table 4.13: Firm Size Versus Company Implementing Green Manufacturing

Green Manufacturing	Frequency	Percentage
Yes	**161**	**66.80%**
Small (< 75)	*22*	*9.13%*
Medium (≥75 to ≤200)	*56*	*23.24%*
Large (> 200)	*83*	*34.44%*
No	**80**	**33.20%**
Small (< 75)	*39*	*16.18%*
Medium (≥75 to ≤200)	*31*	*12.86%*
Large (> 200)	*10*	*4.15%*
Total	**241**	**100.00%**

Source: Developed for the Research

Figure 4.11: Firm Size Versus Company Implementing Green Manufacturing



Source: Developed for the Research

4.2.2.5 Companies Implementing Green Manufacturing versus ISO Certification

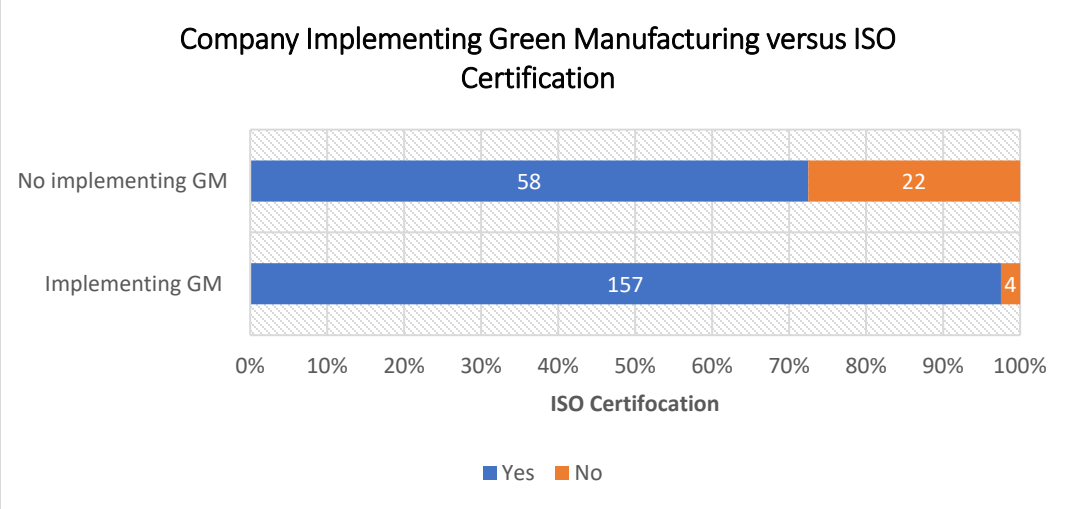
Table 4.14 and Figure 4.12 showed the companies that implement GM versus ISO certification. From the data, most companies that implementing GM are certified ISO certification, there are 157 out of 161 companies (97.52%) are implementing GM and with certified ISO certification, only 4 out of 161 companies (2.48%) that implementing GM but not ISO certified. Furthermore, there are 58 out of 80 companies (72.50%) that not implementing GM, with certified ISO certification and 22 out of 80 (27.50%) of the companies are not implementing GM and not ISO certified.

Table 4.14: Companies Implementing Green Manufacturing by ISO Certification

	ISO Certification	Frequency	Percentage
Implementing GM		**161**	**66.80%**
	Yes	*157*	
	No	*4*	
Not Implementing GM		**80**	**33.20%**
	Yes	*58*	
	No	*22*	
	Total	**241**	**100.00%**

Source: Developed for the Research

Figure 4.12: Companies Implementing Green Manufacturing by ISO Certification



Source: Developed for the Research

4.3 Central Tendencies Measurement of Constructs

4.3.1 Green Manufacturing

Table 4.15 showed the GM practised by the respondents. According to the data above, the statement "minimizing the waste generated during the manufacturing process" is the highest mean value of 3.71 and only 1 respondent is select "Strongly Disagree"; 104 and 70 respondents are select "Agree" and "Strongly Disagree" respectively. Followed by "recycle or reuse the product/materials during the manufacturing process" and "minimize the usage of water and energy efficiency management during the

manufacturing process", both are 3.73, then, the mean value for "use of non-hazardous chemicals in your product or manufacturing process" is 3.54. However, the "use of efficient and clean technology during manufacturing process to reduce carbon footprint (CO_2)" is the uncommon green practices conducted by the respondents, with a mean value of 3.10. There are 36 respondents (14.95%) select "Strongly Disagree", the highest number of respondents are select "Agree" which is 34.44% (83 respondents) and the second highest groups of respondents are select "Neither Agree nor Disagree" which is 24.48% (59 respondents).

Table 4.15: Green Manufacturing

Statements	N	SD (%)	D (%)	A/D (%)	A (%)	SA (%)	Mean	Standard Deviation	Rank (Mean)
Use of non-hazardous chemicals in your product or manufacturing process.	241	10 (4.15)	50 (20.75)	32 (13.28)	99 (41.08)	50 (20.75)	3.54	1.155	3
Recycle or reuse the product/materials during manufacturing process.	241	3 (1.24)	44 (18.26)	30 (11.62)	102 (40.66)	62 (26.97)	3.73	1.075	2
Minimize the usage of water and energy efficiency management during manufacturing process.	241	1 (0.41)	49 (20.33)	28 (11.62)	98 (40.66)	65 (26.97)	3.73	1.082	2
Minimize the waste generated during manufacturing process.	241	1 (0.41)	46 (19.09)	20 (8.30)	104 (43.15)	70 (29.05)	3.81	1.070	1
Use of efficient and clean technology during manufacturing process to reduce carbon footprint (CO_2)	241	36 (14.95)	38 (15.77)	59 (24.48)	83 (34.44)	25 (10.37)	3.10	1.230	4

(Note: "SD" represent Strongly Disagree, "D" represents Disagree, "A/D" represent Neither Agree nor Disagree, "A" represent Agree and "SA" represent "Strongly Agree")

Source: Developed for the Research

4.3.2 Local Requirements

From Table 4.16, the statement "the enforcement of penalties for the noncompliance of regulations and requirements" showed the highest mean (4.38). The second highest mean statement is "pollution control, waste disposal management and landfill taxes were stricter by local government", with a value of 4.34. The statement "the compulsory environmental regulation mandated by local government (e.g. hazardous

and toxic regulation) for business continuity" and "to comply environmental regulation in place by other countries (e.g., EU Directive, etc.) to secure oversea business" both are the third rank among the other statements, with the mean value of 4.32. "Imposing high carbon emission discharge tax execution by local government" was the last rank among the five statements and the mean value of 4.30. Based on the table above, there are a minority of the respondents select "Strongly Disagree" and "Disagree" for all five statements regarding the questions related to legal requirements.

Table 4.16: Local Requirements

Statements	N	SD (%)	D (%)	A/D (%)	A (%)	SA (%)	Mean	Standard Deviation	Rank (Mean)
Pollution control, waste disposal management and landfill taxes were stricter by local government.	241	0 (0.00)	4 (1.66)	22 (9.13)	104 (43.15)	111 (46.06)	4.34	0.712	2
The enforcement of penalties for the noncompliance of regulations and requirements.	241	1 (0.41)	3 (1.24)	16 (6.64)	105 (43.57)	116 (48.13)	4.38	0.703	1
Imposing high carbon emission discharge tax execution by local government.	241	1 (0.41)	3 (1.24)	35 (14.52)	86 (35.68)	116 (48.13)	4.30	0.792	4
The compulsory environmental regulation mandated by local government (e.g., hazardous and toxic regulation) for business continuity.	241	0 (0.00)	1 (0.41)	26 (10.79)	108 (44.81)	106 (43.98)	4.32	0.679	3
To comply environmental regulation in place by other countries (e.g., EU Directive, etc.) to secure oversea business.	241	0 (0.00)	2 (0.83)	27 (11.20)	104 (43.15)	108 (44.81)	4.32	0.702	3

(Note: "SD" represent Strongly Disagree, "D" represents Disagree, "A/D" represent Neither Agree nor Disagree, "A" represent Agree and "SA" represent "Strongly Agree")

Source: Developed for the Research

4.3.3 Top Management Commitment

Table 4.17 showed the statements for top management commitment as drivers for promoting the implementation of GM. The statements of "top management having capabilities, awareness and culture on environmental issue", "management, owner or investors are highly committed to enhancing environmental performance, ethics and social values" and "top management encourages employee involvement and commitment through training and empowerment" are the top three statements with the

mean value of 4.46, 4.35 and 4.30 respectively, as according to the response from the respondents. However, the statement "company's strategic and organizational willing to change align to environmental sustainability, to achieve competitiveness towards business sustainability" and "top management allocate sufficient organization resources e.g., skilled and motivated staff, healthy financial situation and performance measurements" are at the rank of fourth and fifth with the mean value of 4.28 and 4.23. From the table, most of the respondents select "Agree" and "Strongly Agree" for all the five above statements for the questions relating to top management commitment.

Table 4.17: Top Management Commitment

Statements	N	SD (%)	D (%)	A/D (%)	A (%)	SA (%)	Mean	Standard Deviation	Rank (Mean)
Top management having capabilities, awareness, and culture on environmental issue.	241	1 (0.41)	5 (2.07)	10 (4.15)	95 (39.42)	131 (54.36)	4.46	0.677	1
Management, owner, or investors are highly committed to enhance environmental performance, ethics, and social values.	241	1 (0.41)	4 (1.66)	16 (6.64)	108 (44.81)	112 (46.47)	4.35	0.716	2
Company's strategic and organizational willing to change align to environmental sustainability, to achieve competitiveness towards business sustainability.	241	0 (0.00)	6 (2.49)	20 (8.30)	115 (47.72)	100 (41.49)	4.28	0.721	4
Top management allocate sufficient organization resources e.g., skilled, and motivated staff, healthy financial situation, and performance measurements.	241	0 (0.00)	6 (2.49)	26 (10.790	115 (47.72)	94 (39.00)	4.23	0.739	5
Top management encourage employee involvement and commitment through training and empowerment.	241	1 (0.41)	3 (1.24)	19 (7.88)	117 (48.55)	101 (41.91)	4.30	0.704	3

(Note: "SD" represent Strongly Disagree, "D" represents Disagree, "A/D" represent Neither Agree nor Disagree, "A" represent Agree and "SA" represent "Strongly Agree")

Source: Developed for the Research

4.3.4 Company and Economic Benefits

Table 4.18 showed the statements for company and economic benefits as the drivers to facilitate the implementation GM. From the table, the statement "to reduce total energy

consumption in the manufacturing process due to the rising energy costs" is located the first rank among all the statements with a mean value of 4.42. Followed by the statements "to achieve long term cost saving by adopting technologies on the green process, product designs, packaging and 3Rs (Reduce, Reuse, Recycle) in the manufacturing process" and "to achieve better process performances, higher product quality and higher efficiency in overall operation" were located second ranked, the mean value for both statements were 4.30. However, the mean values for the statements "effective and optimized utilization of resources to achieve economic benefits, cost reduction and competitiveness to maintain market leadership position" and "local governmental and authorities provide financial incentives to the company, such as investment subsidies, awards and R&D support" are 4.28 and 4.20 respectively. According to the table above, majority of the respondents are select the "Agree" and "Strongly Agree" for all the five above statements for the questions relating to company and economic benefits.

Table 4.18: Company and Economic Benefits

Statements	N	SD (%)	D (%)	A/D (%)	A (%)	SA (%)	Mean	Standard Deviation	Rank (Mean)
Local governmental and authorities provide financial incentives to the company, such as investment subsidies, awards, and R&D support.	241	3 (1.24)	5 (2.07)	31 (12.86)	104 (43.15)	98 (40.66)	4.20	0.833	4
To achieve long term cost saving by adopt technologies on green process, product designs, packaging and 3 R s (Reduce, Reuse, Recycle) in the manufacturing process.	241	1 (0.41)	5 (2.07)	19 (7.88)	112 (46.47)	104 (43.15)	4.30	0.737	2
To achieve better process performances, higher product quality and higher efficiency in overall operation.	241	1 (0.41)	3 (1.24)	24 (9.96)	117 (48.55)	97 (40.25)	4.30	0.710	2
Effective and optimized utilization of resources to achieve economic benefits, cost reduction and competitiveness to maintain market leadership position.	241	0 (0.00)	3 (1.24)	12 (9.96)	117 (48.55)	97 (40.25)	4.28	0.690	3
To reduce total energy consumption in the manufacturing process due to the rising energy costs.	241	0 (0.00)	3 (1.24)	12 (4.98)	106 (43.98)	120 (49.79)	4.42	0.648	1

(Note: "SD" represent Strongly Disagree, "D" represents Disagree, "A/D" represent Neither Agree nor Disagree, "A" represent Agree and "SA" represent "Strongly Agree")

Source: Developed for the Research

4.3.5 Cost Constraints

Table 4.19 showed the mean value of responses for the question under the cost constraints as the barriers that hinder the implementation of GM. The statement "additional cost is needed on training for implementation of environmentally sensitive processes, re-management of human resource" is obtain the highest mean value (4.47) among other statements, follow by the statements of "high investment cost for the development of new analytical tools, models & metrics and chemical analysis of exhaust", "large amount of short-term cost, inappropriate incentives and consist of hidden costs for implement green manufacturing practices", "increment in overall cost for purchasing of costly environmentally friendly materials for manufacturing" and "High cost and risky in adopting new green production measures" are located at the

ranking of second, third, fourth and fifth with the mean values of 4.44, 4.40, 4.38 and 4.26 respectively. Based on the table above, there is more than 45% of respondents choose "Strongly Agree" for all five statements above on the cost constraints.

Table 4.19: Cost Constraints

Statements	N	SD (%)	D (%)	A/D (%)	A (%)	SA (%)	Mean	Standard Deviation	Rank (Mean)
Large amount of short-term cost, inappropriate incentives and consist of hidden costs for implement green manufacturing practices.	241	1 (0.41)	5 (2.07)	23 (9.54)	80 (33.20)	132 (54.77)	4.40	0.779	3
High investment cost for the development of new analytical tools, models & metrics, and chemical analysis of exhaust.	241	0 (0.00)	6 (2.49)	19 (7.88)	78 (32.37)	138 (57.26)	4.44	0.746	2
Additional cost is needed on training for implementation of environmental sensitive processes, re-management of human resource.	241	0 (0.00)	2 (0.83)	16 (6.64)	90 (37.34)	133 (55.19)	4.47	0.658	1
Increment in overall cost for purchasing of costly environmentally friendly materials for manufacturing.	241	1 (0.41)	3 (1.24)	24 (9.96)	88 (36.51)	125 (51.87)	4.38	0.750	4
High cost and risky in adopting new green production measures.	241	1 (0.41)	5 (2.07)	35 (14.52)	89 (36.93)	111 (46.06)	4.26	0.813	5

Note: "SD" represent Strongly Disagree, "D" represents Disagree, "A/D" represent Neither Agree nor Disagree, "A" represent Agree and "SA" represent "Strongly Agree")

Source: Developed for the Research

4.3.5 Lack of Technology and Skill

Table 4.20 showed the mean value of responses for the question under the lack of technology and skill as the barriers that hinder the implementation of GM. The statements of "lack of skilled staff and expertise to implement green manufacturing in your company", "inadequate financial resources or capital access to purchase green technology require for the manufacturing process" and "inadequate R&D, technical knowledge, supports and testing facilities to convert manufacturing waste to green products" were the top three among the statements with the mean of 4.38, 4.32 and 4.29 respectively. Followed by "limited access of information, lack of new technology, materials and processes to support green manufacturing" and "nature of business which

is "industrial-specific" than towards "green" trend, hence, leading to low green manufacturing practices" are the fourth and fifth ranked with mean values of 4.22 and 3.85. According to the table above, the majority of the respondents answered, "Strongly Agree" for the first four statements regarding the lack of technology and skill, however, for the fifth statement, the respondents mainly selected 25.73% of "Neither Agree nor Disagree", 39.83% of "Agree" and 26.97% of "Strongly Agree".

Table 4.20: Lack of Technology and Skill

Statements	N	SD (%)	D (%)	A/D (%)	A (%)	SA (%)	Mean	Standard Deviation	Rank (Mean)
Lack of skilled staff and expertise to implement green manufacturing in your company.	241	1 (0.41)	6 (2.49)	19 (7.88)	90 (37.34)	132 (51.87)	4.38	0.771	1
Inadequate financial resources or capital access to purchase green technology require for the manufacturing process.	241	1 (0.41)	8 (3.32)	23 (9.54)	89 (36.93)	120 (49.79)	4.32	0.813	2
Limited access of information, lack of new technology, materials and processes to support green manufacturing.	241	3 (1.24)	8 (3.32)	29 (12.03)	93 (40.66)	108 (44.81)	4.22	0.875	4
Inadequate R&D, technical knowledge, supports and testing facilities to convert manufacturing waste to green products.	241	1 (0.41)	4 (1.66)	28 (11.62)	98 (40.66)	110 (45.64)	4.29	0.769	3
Nature of business which is "industrial-specific" than towards "green" trend, hence, leading to low green manufacturing practices.	241	3 (1.24)	15 (6.22)	62 (25.73)	96 (39.83)	65 (26.97)	3.85	0.932	5

Note: "SD" represent Strongly Disagree, "D" represents Disagree, "A/D" represent Neither Agree nor Disagree, "A" represent Agree and "SA" represent "Strongly Agree")

Source: Developed for the Research

4.4 Reliability Test

According to Table 4.21, the value of Cronbach's alpha for all constructs is more than 0.80, which represents that reliability is good (Sekaran, 2016). The Cronbach's alpha value for dependent variable "green manufacturing" was 0.911 with 5 items. The value Cronbach's alpha for the independent variables, "legal requirements", "top management commitment", company and economic benefits", "cost constraints" and

"lack of technology and skill" were 0.890, 0.927, 0.884, 0.920 and 0.896 with 5 items respectively.

Table 4.21: Reliability Test

Variables	Constructs	Cronbach's Alpha	Items	No. of respondents
Dependent Variables	Green Manufacturing	0.911	5	241
Independent Variables	***Drivers***			
	Legal requirements	0.890	5	241
	Top Management commitment	0.927	5	241
	Company and economic benefits	0.884	5	241
	Barriers			
	Cost constraints	0.920	5	241
	Lack of technology and skill	0.896	5	241

Source: Developed for the Research

4.5 Inferential Analysis

4.5.1 Pearson Correlation Analysis

Based on the result of Pearson correlation coefficient analysis, the p-value for all the variables is less than 0.05, which represents significantly affected the dependent variable. According to Table 4.22, the legal requirements, top management commitment and company and economic are related moderate positively to GM with values of 0.309, 0.402 and 0.433 respectively. However, cost constraints and lack of technology and skills are related weak negatively to GM with values of -0.238 and -0.261 respectively. Based on the study, positive correlation coefficient variables represent both independent and dependent variables that tend to increase together or called direct relationships. Whereas a negative correlation coefficient signifies one variable tends to increase as the other decrease, or called inverse relationship.

Table 4.22: Pearson Correlation Coefficient for Drivers and Barriers for Implementation of Green Manufacturing

		Green Manufacturing
Legal requirements	Pearson Correlation	.309**
	Sig. (2-tailed)	.000
	N	241
Top Management Commitment	Pearson Correlation	.402**
	Sig. (2-tailed)	.000
	N	241
Company and Economic Benefits	Pearson Correlation	.433**
	Sig. (2-tailed)	.000
	N	241
Cost Constraints	Pearson Correlation	-.236**
	Sig. (2-tailed)	.000
	N	241
Lack of Technology and Skills	Pearson Correlation	-.261**
	Sig. (2-tailed)	.000
	N	241
Green Manufacturing	Pearson Correlation	1
	Sig. (2-tailed)	
	N	241

Source: Developed for the Research

4.5.2 Multiple Regression (Model Summary)

According to Table 4.23, the adjusted R^2 value of the model is 0.343, thus, the regression equation explained that the explanatory variables accounted for about 34.30% of the variation in the implementation of GM in Klang Valley, by using multiple regression analysis.

Table 4.23: Multiple Regression (Model Summary)

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.597[a]	.357	.343	.78265

Source: Developed for the Research

4.5.3 ANOVA Regression

Based on the Table 4.24, the significance p-value is 0.000, which is less than alpha 0.05. Hence, reject the null hypotheses and conclude the sample means are significant different.

Table 4.24: ANOVA Regression

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	79.893	5	15.979	26.086	.000[b]
	Residual	143.947	235	.613		
	Total	223.840	240			

a. Dependent Variable: Green Manufacturing
b. Predictors: (Constant), Lack of Technology and Skills, Top Management Commitment, Legal requirements, Cost Constraints, Company and Economic Benefits

Source: Developed for the Research

4.5.4 Multiple Linear Regression (Coefficient)

The multiple linear regression coefficient Table 4.25 provide the information to develop a multiple regression equation that explains GM implementation influenced by independent variables, legal requirements, top management commitment, company and economic benefits, cost constraints and lack of skills.

The equation is expressed as following:

$$GM = 1.950 + 0.262LR + 0.187TMC + 0.549CEB – 0.264CC – 0.359LTS$$

where

GM = Green Manufacturing

LR = Legal Requirements

TMC = Top Management Commitment

CEB = Company and Economic Benefits

CC = Cost Constraints

LTS = Lack of Technology and Skills

The value of the unstandardized coefficient (B) represents the degree to of each predictor affects the dependent variables and determines the positive and negative relationship between the dependent and independent variables.

Based on Table 4.25, exhibited a positive effect between legal requirements (0.262), top management commitment (0.187) and company and economic benefits (0.549) towards the GM implementation. However, there is negative relationship effects between cost constraints (-0.264) and lack of technology and skills (-0.359) towards implementation of GM. This means that when increased by in a single unit of legal requirements, top management and company and economic benefits, implementation of GM will increase by 0.262, 0.187 and 0.549 respectively. On the other hand, when increasing by a single unit of cost constraints and lack of technology and skill, the implementation of GM will decrease by 0.264 and 0.359 respectively.

Company and economic benefits is the variable that brings the greatest influence on the implementation of GM, as the value of unstandardized coefficient (B), 0.549 is the highest among the five variables. Follow by lack of technology and skills, cost constraints, legal requirements and top management commitment subsequently influence the implementation of GM.

Table 4.25: Multiple Linear Regression (Coefficient)

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.	Collinearity Statistics	
		B	Std. Error	Beta			Tolerance	VIF
1	(Constant)	1.950	.486		4.009	.000		
	Legal requirements	.262	.111	.162	2.357	.019	.578	1.731
	Top Management Commitment	.187	.125	.121	1.497	.136	.416	2.405
	Company and Economic Benefits	.549	.129	.341	4.266	.000	.428	2.337
	Cost Constraints	-.264	.114	-.179	-2.310	.022	.457	2.189
	Lack of Technology and Skills	-.359	.107	-.261	-3.345	.001	.449	2.226

a. Dependent Variable: Green Manufacturing

Source: Developed for the Research

4.5.5 Hypotheses Testing

From Table 4.26, the p-value for H1, H3, H4 and H5 were 0.019, 0.000, 0.022 and 0.001 respectively, which are less than 0.05. Hence, the hypotheses testing results for H1, H3, H4 and H5 are supported and proven to be significant. However, the p-value for H2 is 0.136 (>0.05), thus, reject H2, due to insignificant.

Table 4.26 Hypothesis Testing

Hypotheses Testing	Value (β)	p-value	Results
H1: legal requirements will influence the possibilities of implementation of GM	0.162	0.019	H1 is supported
H2: Top management commitment will influence the possibilities of implementation of GM	0.121	0.136	Reject H2
H3: Company and economic benefits will influence the possibilities of implementation of GM	0.341	0.000	H3 is supported
H4: Cost constraints will influence the possibilities of implementation of GM	-0.179	0.022	H4 is supported
H5: Lack of technology and skills will influence the possibilities of implementation of GM	-0.261	0.001	H5 is supported

Note: p-value less than 0.05 is accepted

Source: Developed for the Research

4.5.6 Moderator Variables Analysis

4.5.6.1 Firm Size

Table 4.27 showed the multiple regression model summary for both models, independent variables without interaction with the moderator of firm size (M1) and model 2, independent variables interacted with the moderator of firm size (M1). The

adjusted R^2 value for model 2 is 0.444, it has increased from 0.343 (model 1). The regression equation explained that the explanatory variables accounted from 34.30% of the variation to 44.40% of the variation in the implementation of GM if firm size was the moderator. The higher the R^2 means the stronger power between the independent and dependent variables.

Table 4.27: Multiple Regression (Model Summary)

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.597[a]	.357	.343	.78265
2	.666[b]	.444	.420	.73574

Source: Developed for the Research

Table 4.28 shows the significance p-value for model 1 and model 2 both are 0.000, which is less than alpha 0.05. Hence, reject the null hypotheses and conclude the sample means are significant different for both models.

Table 4.28: ANOVA Regression

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	79.893	5	15.979	26.086	.000[b]
	Residual	143.947	235	.613		
	Total	223.840	240			
2	Regression	99.337	10	9.934	18.351	.000[c]
	Residual	124.503	230	.541		
	Total	223.840	240			

a. Dependent Variable: Green Manufacturing
b. Predictors: (Constant), Lack of Technology and Skills, Top Management Commitment, Legal requirements, Cost Constraints, Company and Economic Benefits
c. Predictors: (Constant), Lack of Technology and Skills, Top Management Commitment, Legal requirements, Cost Constraints, Company and Economic Benefits, M1_CC, M1_TMC, M1_LTS, M1_Legal, M1_CEB

Source: Developed for the Research

Moderator variable is the variables that are able to bring effect on the strength, either strengthening or diminishing and direction (i.e. positive or negative) of the relationship between independent and dependent variables.

According to Table 4.29, the effect of the moderator of firm size has decreased the strength of legal requirements (from 0.262 to 0.142) and lack of technology and skills (from -0.359 to -0.590) towards implementation of GM. On the other hand, the exist of

firm size moderator has increased the strength of the company and economic benefits, from 0.549 increased to 0.832 and alter the relationship of top management commitment from positive (0.187) to negative (-0.74) towards implementation of GM. However, the interaction of moderator firm size to the cost constraints towards implementation GM remains the same, the unstandardized coefficient (B) for both models 1 and 2 are -0.264. Hence, the moderator firm size does not bring any effect on the variables of cost constraints.

Table 4.29: Multiple Linear Regression (Coefficient)

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.	Correlations			Collinearity Statistics	
		B	Std. Error	Beta			Zero-order	Partial	Part	Tolerance	VIF
1	(Constant)	1.950	.486		4.009	.000					
	Legal requirements	.262	.111	.162	2.357	.019	.309	.152	.123	.578	1.731
	Top Management Commitment	.187	.125	.121	1.497	.136	.402	.097	.078	.416	2.405
	Company and Economic Benefits	.549	.129	.341	4.266	.000	.433	.268	.223	.428	2.337
	Cost Constraints	-.264	.114	-.179	-2.310	.022	-.236	-.149	-.121	.457	2.189
	Lack of Technology and Skills	-.359	.107	-.261	-3.345	.001	-.261	-.213	-.175	.449	2.226
2	(Constant)	3.004	.492		6.105	.000					
	Legal requirements	.142	.176	.088	.807	.421	.309	.053	.040	.204	4.896
	Top Management Commitment	-.074	.186	-.048	-.396	.692	.402	-.026	-.019	.167	6.005
	Company and Economic Benefits	.832	.195	.517	4.271	.000	.433	.271	.210	.165	6.062
	Cost Constraints	-.264	.178	-.178	-1.480	.140	-.236	-.097	-.073	.167	6.006
	Lack of Technology and Skills	-.590	.174	-.429	-3.382	.001	-.261	-.218	-.166	.151	6.642
	M1_Legal	.075	.133	.283	.567	.572	.446	.037	.028	.010	103.142
	M1_TMC	.120	.142	.456	.847	.398	.443	.056	.042	.008	119.778
	M1_CEB	-.365	.150	-1.361	-2.440	.015	.443	-.159	-.120	.008	128.745
	M1_CC	.036	.128	.134	.284	.777	.380	.019	.014	.011	92.418
	M1_LTS	.213	.121	.760	1.750	.081	.371	.115	.086	.013	78.006

Source: Developed for the Research

4.5.6.2 Type of Industry

Table 4.30 showed a multiple regression model summary for both models, independent variables without interaction with the moderator of industry type (M2) and model 2, independent variables interacted with the moderator of industry type (M2). The adjusted R^2 model 2 had decreased from 0.343 (model 1) to 0.337. The regression equation explained that the explanatory variables accounted from 34.30% decreased to 33.70% of the variation in the implementation of GM when industry type as moderator.

Table 4.30: Multiple Regression (Model Summary)

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.597[a]	.357	.343	.78265
2	.604[b]	.364	.337	.78655

Source: Developed for the Research

Table 4.31 showed the significance p-value for model 1 and model 2 both are 0.000, which is less than alpha 0.05. Hence, reject the null hypotheses and conclude the sample means are significant different for both models.

Table 4.31: ANOVA Regression

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	79.893	5	15.979	26.086	.000[b]
	Residual	143.947	235	.613		
	Total	223.840	240			
2	Regression	81.546	10	8.155	13.181	.000[c]
	Residual	142.294	230	.619		
	Total	223.840	240			

a. Dependent Variable: Green Manufacturing
b. Predictors: (Constant), Lack of Technology and Skills, Top Management Commitment, Legal requirements, Cost Constraints, Company and Economic Benefits
c. Predictors: (Constant), Lack of Technology and Skills, Top Management Commitment, Legal requirements, Cost Constraints, Company and Economic Benefits, M2_TMC, M2_LTS, M2_LR, M2_CC, M2_CEB

Source: Developed for the Research

From Table 4.32, the moderator of industry type had brought a slight effect on company and economic benefits, cost constraints and lack of technology and skills, the unstandardized coefficients (B) have increased from 0.549 to 0.559, from -0.264 to -

0.247 and from -0.359 to -0.315 respectively, towards implementation of GM. It brought a greater impact on top management commitment by increased to 0.419 (model 2) from 0.187 (model 1). However, the interaction of industry type moderator has brought the positive relationship between legal requirements and implementation GM to become no relationship (the unstandardized coefficients (B) of model 2 is equal to 0.000).

Table 4.32: Multiple Linear Regression (Coefficient)

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.	Correlations			Collinearity Statistics	
		B	Std. Error	Beta			Zero-order	Partial	Part	Tolerance	VIF
1	(Constant)	1.950	.486		4.009	.000					
	Legal requirements	.262	.111	.162	2.357	.019	.309	.152	.123	.578	1.731
	Top Management Commitment	.187	.125	.121	1.497	.136	.402	.097	.078	.416	2.405
	Company and Economic Benefits	.549	.129	.341	4.266	.000	.433	.268	.223	.428	2.337
	Cost Constraints	-.264	.114	-.179	-2.310	.022	-.236	-.149	-.121	.457	2.189
	Lack of Technology and Skills	-.359	.107	-.261	-3.345	.001	-.261	-.213	-.175	.449	2.226
2	(Constant)	1.784	.521		3.422	.001					
	Legal requirements	.000	.210	.000	.000	1.000	.309	.000	.000	.163	6.153
	Top Management Commitment	.419	.273	.271	1.531	.127	.402	.100	.081	.088	11.367
	Company and Economic Benefits	.559	.268	.347	2.087	.038	.433	.136	.110	.100	10.025
	Cost Constraints	-.247	.224	-.167	-1.102	.271	-.236	-.072	-.058	.120	8.330
	Lack of Technology and Skills	-.315	.231	-.229	-1.363	.174	-.261	-.090	-.072	.098	10.174
	M2_LR	.066	.042	.769	1.560	.120	.121	.102	.082	.011	88.022
	M2_TMC	-.049	.052	-.567	-.943	.347	.139	-.062	-.050	.008	130.956
	M2_CEB	-.007	.052	-.077	-.130	.897	.150	-.009	-.007	.008	127.917
	M2_CC	.000	.044	-.002	-.005	.996	-.007	.000	.000	.011	91.551
	M2_LTS	-.012	.044	-.127	-.261	.795	-.023	-.017	-.014	.012	86.302

a. Dependent Variable: Green Manufacturing

Source: Developed for the Research

4.5.6.3 Business Ownership

Table 4.33 showed the multiple regression model summary for both models, independent variables without interaction with the moderator of business ownership (M3) and model 2, independent variables interacted with the moderator of business ownership (M3). The adjusted R^2 model 2 has increased from 0.343 (model 1) to 0.419. The regression equation explains that the explanatory variables accounted increase from 34.30% to 41.90% of the variation in the implementation of GM when industry type as moderator. The higher the R^2 means the stronger power between the independent and dependent variables.

Table 4.33: Multiple Regression (Model Summary)

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.597[a]	.357	.343	.78265
2	.666[b]	.444	.419	.73581

Source: Developed for the Research

The Table 4.34 showed the significance p-value for model 1 and model 2 both are 0.000, which is less than alpha 0.05. Hence, reject the null hypotheses and conclude the sample means are significant different for both models.

Table 4.34: ANOVA Regression

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	79.893	5	15.979	26.086	.000[b]
	Residual	143.947	235	.613		
	Total	223.840	240			
2	Regression	99.314	10	9.931	18.343	.000[c]
	Residual	124.525	230	.541		
	Total	223.840	240			

a. Dependent Variable: Green Manufacturing
b. Predictors: (Constant), Lack of Technology and Skills, Top Management Commitment, Legal requirements, Cost Constraints, Company and Economic Benefits
c. Predictors: (Constant), Lack of Technology and Skills, Top Management Commitment, Legal requirements, Cost Constraints, Company and Economic Benefits, M3_CC, M3_LR, M3_LTS, M3_CEB, M3_TMC

Source: Developed for the Research

Based on Table 4.35, showed the interaction of business ownership moderator brought effect on the strength of the relationship between legal requirements, company and economic benefits, cost constraints and lack of technology and skills towards implementation of GM, by increased from 0.262 to 0.305, from 0.549 to 0.648, -0.264 to -0.298 and -0.359 to -0.479 respectively. However, the business ownership moderator diminished the strength of the relationship between top management commitment and the implementation of GM. The value of the unstandardized coefficient (B) of top management commitment model 1 (without interaction with moderator business ownership) was 0.187 and decreased to 00.043 when interacted with moderator business ownership.

Table 4.35: Multiple Linear Regression (Coefficient)

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.	Correlations			Collinearity Statistics	
		B	Std. Error	Beta			Zero-order	Partial	Part	Tolerance	VIF
1	(Constant)	1.950	.486		4.009	.000					
	Legal requirements	.262	.111	.162	2.357	.019	.309	.152	.123	.578	1.731
	Top Management Commitment	.187	.125	.121	1.497	.136	.402	.097	.078	.416	2.405
	Company and Economic Benefits	.549	.129	.341	4.266	.000	.433	.268	.223	.428	2.337
	Cost Constraints	-.264	.114	-.179	-2.310	.022	-.236	-.149	-.121	.457	2.189
	Lack of Technology and Skills	-.359	.107	-.261	-3.345	.001	-.261	-.213	-.175	.449	2.226
2	(Constant)	2.497	.471		5.297	.000					
	Legal requirements	.305	.124	.189	2.456	.015	.309	.160	.121	.408	2.451
	Top Management Commitment	.043	.142	.028	.300	.764	.402	.020	.015	.285	3.505
	Company and Economic Benefits	.648	.140	.402	4.631	.000	.433	.292	.228	.320	3.122
	Cost Constraints	-.298	.135	-.201	-2.200	.029	-.236	-.144	-.108	.289	3.465
	Lack of Technology and Skills	-.479	.131	-.348	-3.661	.000	-.261	-.235	-.180	.268	3.733
	M3_LR	.000	.061	-.004	-.007	.994	.409	.000	.000	.010	103.554
	M3_TMC	.008	.073	.070	.113	.910	.405	.007	.006	.006	160.182
	M3_CEB	-.150	.076	-1.231	-1.980	.049	.404	-.129	-.097	.006	159.700
	M3_CC	.083	.061	.649	1.362	.175	.391	.089	.067	.011	93.770
	M3_LTS	.095	.056	.721	1.694	.092	.385	.111	.083	.013	74.848

a. Dependent Variable: Green Manufacturing

Source: Developed for the Research

4.6 Conclusion

This chapter presented the data collected from 241 valid responses from the survey questionnaire. Data collected were cleaned and inserted into SPSS for analyse. The findings of this research helped to determine the relationships of the independent, dependent and moderator variables and draw the conclusion about the research question of this study. The next chapter will summarise and discuss the findings and implications of the study. It will also point out the limitations and suggestions for future study.

CHAPTER 5

DISCUSSION AND CONCLUSION

5.0 Introduction

This chapter encompasses the outcome and the overall findings of the research. It consists of a summary of statistical analysis, inferential analysis and discussion of major findings. Besides, the implication and limitations of study and recommendations for future research will also be included in this chapter. Last but not least, a summary of the conclusion for this study is made.

5.1 Summary of Statistical Analysis

5.1.1 Descriptive Analysis

A total 241 of valid responses were obtained for this study. The respondents' demographic profiles were examined by gender, designation, job responsibilities and year of attachment to the organization. As discussed in the previous chapter, 58% of the respondents are male and 42% are female. Majority of the respondents are manager (48.13%) and senior manager (25.31%) position level, and the remaining 26.38% of respondents are executive and non-executive levels. According to the data, most of the survey questionnaires were answered by the managerial levels, respondents showed, thus the survey was sent to the relevant group of respondents who are usually responsible for functional strategy and connected to the organizational strategy.

Furthermore, a large population of respondents are from operation/production department (31.54%), followed by quality control/quality assurance/ sustainability

(22.82%), research development (14.94%), environment, safety and health/legal compliance (15.35%) and 15.35% from other departments such as HR, finance, commercial and marketing, etc. Production/operation department is one of the key departments in the manufacturing industry that manage the overall operation and is most well-versed with every single process of the manufacturing operation. However, quality control/quality assurance/ sustainability are the departments normally appointed by the organization to manage and control on organization's quality improvement and sustainability management. New product development including green initiative projects are the responsibility of the research development department. All the legal requirement compliances of the organization, including green practices are assisted and monitored by environment, safety and health/legal compliance. Hence, majority of survey questionnaires were answered by respondents that truly understood the meaning of GM and were involved in the operation processes, thus increasing the reliability and accuracy of the survey results.

Most of the respondents served in the company for 6 to 10 years (33.20%). The second largest group are served for 2 to 5 years (28.63%) in the company, followed by the groups of less than 2 years and more than 10 years with 23.65% and 14.52% respectively.

From the statistical data of Chapter 4, all 93 respondents (100%) from large firms, i.e. company with more than 200 employees, were certified ISO certification, 83 out of 87 respondents (95.4%) from medium firms, which has more than 75 and less than 200 employees, and 39 out of 61 respondents (63.9%) from small firms, with less than 75 employees were also ISO certified. Besides, there was 157 out of total of 241 respondents were having ISO certification implementing GM, which is equal to 65.1% of total responses. According to the data, a total of 161 out of 241 (66.80%) respondents implemented GM, where 83 respondents were from large firms, 56 respondents were from medium firms and 22 respondents were from small firms. However, 80 out of 241 respondents were not implementing GM, where the majority were from small and medium firms, with 39 respondents and 31 respondents respectively, and only 10 respondents were from large firms, which represented 4.15% out of the total respondents. This showed that ISO certification and the size of the company may affect the implementation of the GM. For example, the implementation of ISO 14001 in a

company will emphasize the protection of the environment during manufacturing processes and its services and goods produced. This action will be beneficial to the company by increasing effectiveness, profitability, and green image with regards to improving customer satisfaction (Mabrouk & Ibrahim, 2021).

Moreover, business ownership is one of the factors that influence the implementation of GM based on the data analysed. For multinational company, 52 out of 57 respondents were implementing GM, which represent 91.2%, with 16 out of 18 respondents (88.9%) from foreign companies, and only 1 respondent (100%) from joint venture and statement owned enterprise were implementing GM. However, 91 out of 164 respondents from private enterprise (55.5%) was implementing GM. Most of the private enterprise were local small firms, and therefore might lack of resources to implement GM in the manufacturing processes. Multinational and foreign company have better resources and environmental sustainability awareness as compared to local small firms.

5.1.2 Scale Measurement

The scale measurement was measured based on the reliability test, the value of Cronbach's alpha for all constructs is more than 0.80, according to total of 30 items of the independent and dependent variables. The results obtained is reliable as the value of Cronbach's alpha is within the range of 0.8 to 1.0.

5.2 Inferential Analysis

5.2.1 Pearson's Correlation Analysis

Legal requirements, top management commitment and company and economic benefits showed positive relationships toward the implementation of GM. On the other hand, cost constraints and lack of technology and skills show a negative relationship toward the implementation of GM. The significance p-values for all the independent variables are 0.000.

5.2.2 Multiple Linear Regression Analysis

From the multiple linear regression analysis, the R^2 value is 0.343, where 34.3% of variation on implementing GM can be explained by legal requirements, top management commitment, company and economic benefits, cost constraints and lack of technology and skills. Moreover, the ANOVA table shows regression model is significant, as the p-value <0.05, while the F value is equal to 26.086.

Referring to the multiple linear regression, the coefficient values for legal requirements, top management commitment, company and economic benefits, cost constraints and lack of technology and skills were 0.262, 0.187, 0.549, -0.264 and -0.359 respectively. The equation is expressed as follows:

GM = 1.950 + 0.262LR + 0.187TMC + 0.549CEB – 0.264CC – 0.359LTS

where

GM = Green Manufacturing

LR = Legal Requirements

TMC = Top Management Commitment

CEB = Company and Economic Benefits

CC = Cost Constraints

LTS = Lack of Technology and Skills

5.2.3 Moderators Analysis

Based on the moderator analysis performed, firm size and business ownership brought a greater influence on the strength of the relationship between independent and dependent variables. However, the type of industry brought a slight effect on the relationship between independent and dependent variables, as it reduced the variation of explanatory variables from 34.30% to 33.70% in the implementation of GM. Moreover, some of the VIF values (Table 4.32) were greater than 10 indicating that multiple regression is problematic (Vittinghoff et al., 2012), when independent

variables interacted with industry type. Therefore, industry type is not the moderator for the implementation of GM.

5.3 Discussion on Major Findings

Table 5.1 was showed the results of the hypotheses testing.

Table 5.1 Results of the Hypotheses Testing

Hypotheses	Value (β)	Decision
H1: Local legal regulation and requirement will influence the possibilities of implementation of GM	**β** = 0.162 p-value = 0.019 (<0.05)	Supported
H2: Top management commitment will influence the possibilities of implementation of GM	**β** = 0.121 p-value = 0.136 (<0.05)	Not supported
H3: Company and economic benefits will influence the possibilities of implementation of GM	**β** = 0.341 p-value = 0.000 (<0.05)	Supported
H4: Cost constraint will influence the possibilities of implementation of GM	**β** = -0.179 p-value = 0.022 (<0.05)	Supported
H5: Lack of technology and skills will influence the possibilities of implementation of GM	**β** = -0.261 p-value = 0.001 (<0.05)	Supported

Source: Developed for the Research

5.3.1 Findings on the Hypotheses

H1*: There is a positive relationship between legal requirements and implementation of GM in manufacturers in Malaysia.*

From the result found that legal requirements has positive relationship with implementation of GM. This result is supported by the studies of Nordin et al. (2014); Seth et al. (2018); Bhatia & Jakhar, (2021); Neri et al., (2021); and Ullah et al., (2022), where legal requirements is one of the drivers that facilitate the implementation of GM. National and international standards and regulations were stringent at present, to ensure both products and processes of the operation will not harm the environment for business sustainability and continue to compete in the market (Seth et al., 2018).

H2*: There is a positive relationship between top management commitment and implementation of GM in manufacturers in Malaysia.*

This research found that top management commitment has no positive relationship with the implementation of GM. According to Seth et al. (2018), top management commitment along with stakeholder involvement is one of the highest influences powers. Top management is able to provide a great influence on corporate environmentalism and pursue GM implementation (Nordin et al., 2014). However, the results from this study were found not significant enough to encourage the implementation of GM. This could be due to the majority (61.41%) of the respondents are from the small and medium firms. Nevertheless, 50% of the respondent to Seth et al. (2018) studies were from large firms. According to past studies, top management commitment of large firms is higher as compared to SMEs. Large firms will place more attention environmental concern for maintaining the green image of the company, green supply chain, considerations on materials management with end-of-life cycle and optimized utilization of resources as compared to SMEs (Nordin et al., 2014).

H3*: There is a positive relationship between company and economic benefits and implementation of GM in manufacturers in Malaysia.*

Based on the result, company and economic benefits has a positive relationship with the implementation of GM. It has the strongest effect among all the independent variables. As supported by studies by Seth et al. (2018), the implementation of GM practices in manufacturing processes will enhance productivity and lead to higher efficiency, profitability and sustainability. Furthermore, adopting GM in the manufacturing process

will prove the companies' capability, positioning and reliability in the marketplace (Singh et al., 2012).

***H4**: There is a negative relationship between cost constraints and implementation of GM in manufacturers in Malaysia.*

According to this research, cost constraints is found to have a negative relationship with the implementation of GM. This finding is supported by studies of Nordin et al. (2014) and Singh et al. (2012)., where past studies indicated that the increment of overall cost is one of the main barriers to the implementation of GM. Various hidden costs and risks of adopting new green practices may affect the performance of the company and bring an adverse effect on the cost of a product, hence, it had created resistance for the organization to change and adopt GM practices in their business operation.

***H5**: There is a negative relationship between lack of technology and skills and implementation of GM in manufacturers in Malaysia.*

This research found that a lack of technology and skills has a negative relationship with the implementation of GM. The lack of idea, including environment awareness and understanding of green trends and green technology in the organization is the critical barrier that demotivates the implementation of GM (Nordin et al. 2014). Furthermore, the studies of Seth et al. (2018) mentioned, inadequate exposure to green technology and also the lack of professionalism and lack of research focus will frustrate the implementation of GM.

5.3 Implications of the Study

This research evokes the intention to investigate the current environmental consciousness among manufacturers in Malaysia. Hence, this research contributed to the study of the drivers and barriers that facilitate and hinder the implementation of GM in the manufacturing processes. From the findings, company and economic benefits

showed significant positive relationship with the implementation of GM, with p-value = 0.000. Legal requirements is the second significant drivers that facilitate the implementation of GM and with positive relationship. Cost constraints and lack of technology and skill, both are barriers that hinder the implementation of GM and showed significant negative relationship to the implementation of GM. Top management commitment is not significant influence on the implementation of GM for this study.

Based on the data collected, a high percentage of the respondents are implementing GM practices in the operations. The enhancement of environmental awareness among the public had convinced greater numbers of organizations to be willing to change their business operation toward green practices and put more effort into environmental, social and governance (ESG). The initiative of switching business operations to social concern on conservation of environmental aspects will navigate the company to earn a good reputation, cost saving and value-added. The implication of the diffusion of innovation theory on the implementation of green technology in Malaysia's manufacturing industry was implicit, as most respondents are aware of environmental concerns and strive to change.

The implementation of GM is aligned with the objective of the manufacturing strategy which is to pursue continuous improvements and meet best practices. The intention of organizational innovation is aiming to achieve a competitive advantage for business sustainability. Implementation of GM practices will lead to the minimization of operation cost, lead time, processes, ecological footprint of the products and services. On the other hand, the quality, product life cycle and social sustainability will be maximised. Hence, it will drive the organization and economic to accomplish profit maximization (Hariyani & Mishra, 2022).

Majority of the manufacturers in Malaysia mainly focused on waste, energy and water management, i.e. by reducing the usage of water, energy and hazardous chemical during the processes. However, the monitoring of carbon footprint emission is one of the GM practices that had not been implemented by a large group of respondents. This may be due to the process of calculation and management being complicated and still an

immature stage. GHG emissions were divided into three categories, there were Scope 1 (direct emission from owned or controlled sources, the product or services produced by own), Scope 2 (Indirect emissions from the generation of purchase energy) and Scope 3 (all indirect emissions that occur in the value chain) (Teske & Nagrath, 2022). The manufacturers have difficulty calculating the actual GHG emission of the products/services produced. Especially for Scope 3 emissions, to monitor the GHG emission of the value chain, which included upstream activities (e.g. transportation and distribution, purchased goods and services, business travel, etc.) and downstream activities (e.g. procession of sold products, end-of-life treatment of sold products, etc.). Moreover, the life carbon assessment (LCA) data collection work was initiated by large firms in European countries and is now still in mid of progress of collecting data. The database of carbon footprint conversion factors for all materials using in manufacturing is not available at this moment. This is the greater issue that will hinder the company from manage of GHG emissions during manufacturing processes, especially SMEs in Asia. Therefore, this had shown that a lack of technology, skill, resources may slow down the progress of the implementation of GM.

5.4 Limitation of the Study

Time constraints and resources limitation are the main issues in this research. To ensure the research would be completed within the stipulated time frame, the scope of the study was narrowed down and mainly focused on Klang Valley. Thus, the generalisability of the current findings to manufacturers in Malaysia is somewhat limited.

Moreover, the data collection was collected during the end and beginning of the year, which was during the seasonal holidays, which slowed the pace and progress of collecting data as compared to the planned schedule.

Conduct a quantitative survey among manufacturers within one to two months of data collection also is part of challenges for this study. Survey questionnaires should be in a form that eases to understanding, clear, simple, and informative to minimise ambiguous responses. Additional follow up were required, such as sending reminder emails to respondents, etc. to increase the response rate during the challenging timeline.

5.5 Recommendations for Future Research

For future studies, the researcher should consider the as discussed in this section.

Firstly, the researcher should consider increasing the sample size. Sample size will affect the validity and reliability of the results. The larger sample size will provide a smaller margin of error and standard deviation and enhance the consistency and reliability of the study. The researcher is recommended to study the boarder geographic area, and is not advisable solely focus on Klang Valley. Besides this, the duration of the research could be lengthened to provide a longer time to follow up with target respondents and reduce the non-response bias.

In theory, manufacturers located in urban areas may have better accessibility to information and resources about green technology and environmental awareness, as compared to manufacturers located in rural areas. However, the study of GM practices of manufacturers located in rural areas, the countryside and East Malaysia could also be included for future study. Then, the study may reflect the level of GM implementation among manufacturers in Malaysia as a whole. Furthermore, future studies could also identify the gap of green practices among manufacturers in urban and rural areas in the context of the 12th Malaysia Plan, to achieve carbon neutral status by 2050.

Firm size and business ownership are the moderators of the implementation of GM based on the study. The researcher may consider furthering the study on GM practises implementation by SMEs. Large firms usually consist of better resources and are easier to get funding than small size. Large firms may have higher environmental consciousness as there is higher involvement in the association and society meeting on areas related to the environmental. Therefore, further study could be carried out to understand the environmental awareness level and green practices implemented among different firm size companies.

Business ownership also is one of the factors that may influence the implementation of GM. The foreign and MNC companies prioritized the operation of the company in a sustainable manner over local companies. The sustainability strategy and pressure from stakeholders and top management is the strong influential factor compelling the

company to implement GM. Thus, further studies focusing on local versus foreign or MNC manufacturers on green practices are also recommended.

Despite this, the type of industry was not the moderator of implementation GM from the findings in this study. It may be due to the data collected that comprised too many industries and a small sample size. Hence, the data collected was not sufficient for the study. The researcher may consider narrowing down the scope and focus on specific manufacturing industries that generating a high amount of waste and GHG during the manufacturing process, such as using a large quantity of fuel during operations, producing hazardous chemicals, etc. Those industries will bring greater impact and adverse environmental and human health if lack of proper control measures on manufacturing waste management. Therefore, this is a worthwhile future study area.

5.6 Conclusions

In conclusion, this research has fulfilled the objective on determine the drivers and barriers that influence the implementation of GM. The drivers of implementation of GM comprised of legal requirements, top management commitment and company and economic benefits, while the barriers that will hinder the implementation of GM are cost constraints and lack of technology and skill. Analysis conducted with the data gathered included frequency analysis, Pearson analysis, multiple regression analysis and moderator analysis.

Findings revealed that there are two significant drivers that have a positive relationship with the implementation of GM in Klang Valley, i.e. legal requirements and company and economic benefits. However, the cost constraints and lack of technology and skill showed negative relationships toward the implementation of GM in Klang Valley. In fact, company and economic benefits is the most important driver to facilitate the implementation of GM, when compared to other independent variables. Firm size and business ownership possessed a moderating effect on the implementation of GM.

Lastly, but not least, the implication and limitations of the study, including of recommendations for the future study are discussed for the benefit of future researchers.

REFERENCES

2021 – 2025 A prosperous, inclusive, sustainable Malaysia. (2021, July) *Twelfth Malaysia Plan*. Retrieved October 08, 2022, from https://pulse.icdm.com.my/wp-content/uploads/2021/09/Twelfth-Plan-Document_compressed-1.pdf

2022 EPI results. (2022). *Environmental Performance Index.* Retrieved October 16, 2022, from https://epi.yale.edu/epi-results/2022/component/epi

Abualfaraa, W., Salonitis, K., Al-Ashaab, A., & Ala'raj, M. (2020). Lean-green manufacturing practices and their link with sustainability: A Critical Review. *Sustainability*, *12*(3), 981. https://doi.org/10.3390/su12030981

Adam, D. H., Supriadi, Y. N., & Siregar, Z. M. E. (2020). Green manufacturing, green chemistry and environmental sustainability: *A Review*. *9*(04), 4.

Agrawal, R., & Vinodh, S. (2021). Prioritisation of drivers of sustainable additive manufacturing using best worst method. *International Journal of Sustainable Engineering*, *14*(6), 1587–1603. https://doi.org/10.1080/19397038.2021.1944396

Akhtar, M. I. (2016). Research Design. *Research in Social Science: Interdisciplinary Perspectives*, 68.

Albaum, G. (1997). The Likert scale revisited: An alternate version. *Market Research Society. Journal of the Market Research Society, 331*. Retrieved on November, 22 2022 from https://faculty.ksu.edu.sa/sites/default/files/likert20.pdf

Alves, M. F. R., Galina, S. V. R., & Dobelin, S. (2018). Literature on organizational innovation: Past and future. *Innovation & Management Review*, *15*(1), 2–19. https://doi.org/10.1108/INMR-01-2018-001

Amy, L. W.M Steven, A.J., Cindy, L.C. and Michael, J. C. (2016). Estimating the sample size for a pilot randomised trial to minimise the overall trial sample size for the external pilot and main trial for a continuous outcome variable. *Statistical Methods in Medical Research 1-17*. https://doi: 10.1177/0962280215588241

Balancing sustainability and profitability. (2022). *IBM Institute for Business Value*. Retrieved on October, 22, 2022 from https://www.ibm.com/thought-leadership/institute-business-value/report/2022-sustainability-consumer-research

Bagozzi, R. & Yi, Y. (2012). Specification, evaluation, and interpretation of structural equation models. *Journal of the Academy of Marketing Science*, 40 (1), 8 - 34.

Bernama. (2021). Operations in Port Klang affected by floods – PKA. *New Strait Times.* Retrieved January, 02, from https://www.nst.com.my/news/nation/2021/12/755559/operations-port-klang-affected-floods-pka

Chung, N. (2022). 3 years on, residents still fear pollution at Sungai Kim Kim. *Free Malaysia Toda*y. Retrieved October 09, from https://www.freemalaysiatoday.com/category/nation/2022/03/07/3-years-on-residents-still-fear-pollution-at-sungai-kim-kim/

Dearing, J. W., & Cox, J. G. (2018). Diffusion of innovations theory, principles, and practice. *Health Affairs*, *37*(2), 183–190. https://doi.org/10.1377/hlthaff.2017.1104

Deloitte 2022 CxO sustainability report. (2022). Retrieved on October, 22, 2022 from https://www2.deloitte.com/content/dam/Deloitte/global/Documents/2022-deloitte-global-cxo-sustainability-report.pdf

Dhawan, S. (2010). Research methodology for business and management studies. *Sawatik Publishers and Distributors. Available in EBSCO Data base*.

Dornfield, D. (Ed.), 2013. Green manufacturing: Fundamentals and applications. *Springer Science & Business Media.*

Environmental Quality (Amendment) 2022 bill tabled in Dewan Rakyat. (2022). *The Edge Markets.* Retrieved on October, 23, 2022 from https://www.theedgemarkets.com/article/environmental-quality-amendment-2022-bill-tabled-dewan-rakyat

Faculty of Economics and Muamalat, Universiti Sains Islam Malaysia, Negeri Sembilan, Malaysia, Mohd Hasnu, N. N., Muhammad, I., & Faculty of Economics and Muamalat, Universiti Sains Islam Malaysia, Negeri Sembilan, Malaysia. (2022). Environmental Issues in Malaysia: Suggestion to Impose Carbon Tax. *Asia-Pacific Management Accounting Journal*, *17*(1), 65–95. https://doi.org/10.24191/APMAJ.V17i1-03

Field, A. (2009). Discovering statistics using SPSS (3rd ed.). SAGE Publications.

Foo, P., Lee, V., Ooi, K., Tan, G. W., & Sohal, A. (2021). Unfolding the impact of leadership and management on sustainability performance: Green and lean

practices and guanxi as the dual mediators. *Business Strategy and the Environment*, *30*(8), 4136–4153. https://doi.org/10.1002/bse.2861

Ghazilla, R. A. R., Sakundarini, N., Abdul-Rashid, S. H., Ayub, N. S., Olugu, E. U., & Musa, S. N. (2015). Drivers and barriers analysis for green manufacturing practices in Malaysian SMEs: A preliminary findings. *Procedia CIRP*, *26*, 658–663. https://doi.org/10.1016/j.procir.2015.02.085

Global climate change. Vital signs of the planet. (2022). *National Aeronautics and Space Administration (NASA)*. Retrieved October 09, from https://climate.nasa.gov/vital-signs/carbon-dioxide/

Global energy review: CO_2 emissions in 2021. (2021). *International Energy Agency*. Retrieved October 09, from https://iea.blob.core.windows.net/assets/c3086240-732b-4f6a-89d7-db01be018f5e/GlobalEnergyReviewCO2Emissionsin2021.pdf

Gross domestic product (GDP) by state 2021. (2022, June). *Department of Statistic Malaysia*. Retrieved October 08, 2022, from https://www.dosm.gov.my/v1/index.php?r=column/cthemeByCat&cat=491&bul_id=L3NnMU44VnA0YjRxVXhuYUpZTmVnZz09&menu_id=TE5CRUZCblh4ZTZMODZIbmk2aWRRQT09

Gupta, S., Dangayach, G. S., Singh, A. K., Meena, M. L., & Rao, P. N. (2018). Implementation of sustainable manufacturing practices in Indian manufacturing companies. *Benchmarking: An International Journal*, *25*(7), 2441–2459. https://doi.org/10.1108/BIJ-12-2016-0186

Gyasi-Mensah, W. and Xuhua, H. (2018), "Towards developing a green manufacturing environment: what is Ghana doing?", Environmental Management and Sustainable Development, Vol. 7 No. 2, pp. 170-180.

Hannah, R., Max, R. & Pablo, R. (2020). CO_2 and greenhouse gas emission. Retrieved October 09, from https://ourworldindata.org/emissions-by-sector

Hariyani, D., & Mishra, S. (2022). Organizational enablers for sustainable manufacturing and industrial ecology. *Cleaner Engineering and Technology*, *6*, 100375. https://doi.org/10.1016/j.clet.2021.100375

Heppner, P. P., & Heppner, M. J. (2004). *Writing and Publishing Your Thesis, Dissertation, & Research: A Guide for Students in the Helping Professions*. Belmont, CA: Brooks/Cole.

Hertzog, M. A. (2008). Considerations in determining sample size for pilot studies. *Research in Nursing & Health*, *31*(2), 180–191. https://doi.org/10.1002/nur.20247

Impact of climate change to sea level rise in Malaysia. (2019). *National Water Research Institute of Malaysia.*

IPCC sixth assessment report (2021). Retrieved October 09, from https://www.ipcc.ch/report/ar6/wg1/

Jayashree, S., Reza, M. N. H., Malarvizhi, C. A. N., & Mohiuddin, M. (2021). Industry 4.0 implementation and triple bottom line sustainability: An empirical study on small and medium manufacturing firms. *Heliyon*, *7*(8), e07753. https://doi.org/10.1016/j.heliyon.2021.e07753

Joshi, A., Kale, S., Chandel, S., & Pal, D. (2015). Likert scale: Explored and explained. *British Journal of Applied Science & Technology*, *7*(4), 396–403. https://doi.org/10.9734/BJAST/2015/14975

Karuppiah, K., Sankaranarayanan, B., & Ali, S. M. (2021). On sustainable predictive maintenance: Exploration of key barriers using an integrated approach. *Sustainable Production and Consumption*, *27*, 1537–1553. https://doi.org/10.1016/j.spc.2021.03.023

Kaswan, M. S., & Rathi, R. (2021). Investigation of life cycle assessment barriers for sustainable development in manufacturing using grey relational analysis and best worst method. *International Journal of Sustainable Engineering*, *14*(4), 672–685. https://doi.org/10.1080/19397038.2021.1929550

Kieser, M., & Wassmer, G. (1996). On the use of the upper confidence limit for the variance from a pilot sample for sample size determination. Biometrical Journal (Biometrische Zeitschrift), 38, 941–949.

Kumar, D. R. (2011). *Research Methodology*. *A step-by-step guide for beginners* (3rd ed.). SAGE Publication.

Leong, Y. Y., Michael, J. P. and Woo, W. T. (2021). My say: Viewing the 12th Malaysia Plan through the lens of decarbonisation. *The Edge Markets*. Retrieved October 09, from https://www.theedgemarkets.com/article/my-say-viewing-12th-malaysia-plan-through-lens-decarbonisation?type=opinion

Mabrouk, N. B., & Ibrahim, S. (2021). Drivers, barriers and incentives to implementing environmental management systems in the manufacturing industry. *Management Science Letters*, *11*(8), 2255–2266. https://doi.org/10.5267/j.msl.2021.4.003

Malaysia: Flash floods - final report (2022). International Federation of Red Cross and Red Crescent Societies. Retrieved January, 02, from https://reliefweb.int/report/malaysia/malaysia-flash-floods-dref-operation-ndeg-mdrmy008-final-report

Malaysian Green Technology and Climate Change Corporation (MGTC). (n.d.). Retrieved on October, 23, 2022 from https://www.mgtc.gov.my/what-we-do/green-incentives/green-investment-tax-incentives-gita-gite/

Malaysia's manufacturing environment & investment Guideline. (2020). *Asia Perspective.* Retrieved October 08, 2022, from https://www.asiaperspective.com/ap21/wp-content/uploads/2020/06/malaysia-manufacturing-environment-report-part-one-160620.pdf?x92351

Manufacturing most affected industrial sector hit by Covid-19: MITI. (2021, October). *The Edge Markets*. Retrieved October 08, 2022, from https://www.mida.gov.my/mida-news/manufacturing-most-affected-industrial-sector-hit-by-covid-19-miti/

Malhotra, N. K. (2010). *Marketing Research: An Applied Orientation* (6th ed.). Pearson Prentice Hall.

Mat Nawi, F. A., Abdul Malek A. Tambi, Muhammad Faizal Samat, & Wan Masnieza Wan Mustapha. (2020). A review on the internal consistency of a scale: the empirical example of the influence of human capital investment on malcom baldridge quality principles in tvet institutions. *Asian People Journal (APJ)*, *3*(1), 19–29. https://doi.org/10.37231/apj.2020.3.1.121

Mittal, V. K., Egede, P., Herrmann, C., & Sangwan, K. S. (2013). Comparison of drivers and barriers to green manufacturing: A case of India and Germany. In A. Y. C. Nee, B. Song, & S.-K. Ong (Eds.), *Re-engineering Manufacturing for Sustainability* (pp. 723–728). Springer Singapore. https://doi.org/10.1007/978-981-4451-48-2_118

Monthly manufacturing statistics Malaysia, July 2022. *Department of Statistic Malaysia.* Retrieved October 08, 2022, from https://www.dosm.gov.my/v1/index.php?r=column/cthemeByCat&cat=90&bul_

id=d28xTWhFYk5YaXN4ZkphRGNLMkZ3dz09&menu_id=SjgwNXdiM0JlT3Q2TDBlWXdKdUVldz09

Mumtaz, A. M., Cheah, J. H., Ting, T. R. H., Chuah, F. and Cham, T. H. (2019). Moderation analysis: Issues and guidelines. *Journal of Applied Structural Equation Modeling,* 3(1), i-xi.

Natarajan, K., Li, J., & Koronios, A. (2010). Data mining techniques for data cleaning. In D. Kiritsis, C. Emmanouilidis, A. Koronios, & J. Mathew (Eds.), Engineering asset lifecycle management: Proceedings of the 4th World Congress on Engineering Asset Management (WCEAM 2009), 28-30 September 2009 (pp. 796–804). London: *Springer London.*

Nordin, N., Ashari, H., & Hassan, M. G. (2014). Drivers and barriers in sustainable manufacturing implementation in Malaysian manufacturing firms. *2014 IEEE International Conference on Industrial Engineering and Engineering Management*, 687–691. https://doi.org/10.1109/IEEM.2014.7058726

Norfakhirah, N. M. H. and Izlawanie, M. (2022). Environmental issue in Malaysia: Suggestion to impose carbon tax. *Asia-Pacific Management Accounting Journal. Vol. 17 (1). https://www.doi.org/10.24191/APMAJ.V17i1-03*

Onkvisit, S., & Shaw, J. J. (2004). *International Marketing: Analysis and Strategy.*

Pang, R., & Zhang, X. (2019). Achieving environmental sustainability in manufacture: A 28-year bibliometric cartography of green manufacturing research. *Journal of Cleaner Production*, *233*, 84–99. https://doi.org/10.1016/j.jclepro.2019.05.303

Paris agreement. (2015). United Nations. Retrieved October 09, from https://unfccc.int/sites/default/files/english_paris_agreement.pdf

Pasir Gudang pollution caused by leftover toxic waste from Sungai KimKim, minister says. (2019). *New Strait Time.* Retrieved October 09, from https://www.straitstimes.com/asia/se-asia/pasir-gudang-pollution-caused-by-leftover-toxic-waste-from-sungai-kim-kim-minister-says/

Pei, Z., Yu, T., Yi, W. and Li, Y. (2021). Twenty-year retrospection on green manufacturing: A bibliometric perspective. *The Institution of Engineering and Technology.* https://doi.org/10.1049/cim2.12038

Purwandani, J. A., & Michaud, G. (2021). What are the drivers and barriers for green business practice adoption for SMEs? *Environment Systems and Decisions*, *41*(4), 577–593. https://doi.org/10.1007/s10669-021-09821-3

Rehman, M. A. A., & Shrivastava, R. L. (2013). Green manufacturing (GM): Past, present and future (a state of art review). *World Review of Science, Technology and Sustainable Development*, *10*(1/2/3), 17. https://doi.org/10.1504/WRSTSD.2013.050784

Rogers, E.M. (2003). *Diffusion of innovations* (5th ed.). New York: Free Press.

Roopa, S., & Rani, M. (2012). Questionnaire designing for a survey. *The Journal of Indian Orthodontic Society*, *46*, 273–277. https://doi.org/10.5005/jp-journals-10021-1104

Sahin, I. (2006). Detailed review of rogers' diffusion of innovations theory and educational technology-related studies based on rogers' theory. *The Turkish Online Journal of Educational Technology*, *5*(2), 10.

Saxena, A., & Srivastava, A. (2022). Industry application of green manufacturing: *A Critical Review*. https://doi.org/10.5281/ZENODO.6207141

Saunders, M., Lewis, P., & Thornhill, A. (2012). *Research methods for business students* (6th ed.). Essex: Pearson Education Limited.

Sekaran, U., & Bougie, R. (2016). *Research methods for business: A skill-building approach* (7th ed.). Chichester, West Sussex: John Wiley & Sons.

Seth, D., Rehman, M. A. A., & Shrivastava, R. L. (2018). Green manufacturing drivers and their relationships for small and medium (SME) and large industries. *Journal of Cleaner Production*, *198*, 1381–1405. https://doi.org/10.1016/j.jclepro.2018.07.106

Shisara, M.A.K.K. and Wijewardana, Y.N.S. (2021). Expertise green manufacturing practices towards sustainability. *Journal of Technology and Value Addition, Volume 3 (1).*

Singh, A., Singh, B., & Dhingra, A. K. (2012). *Drivers and barriers of green manufacturing practices: A Survey of Indian Industries*. *01*(01), 16.

Sungai Gong pollution: Two company directors to be charge tomorrow. (2020). *Malaymail.* Retrieved October 09, from https://www.malaymail.com/news/malaysia/2020/11/02/sungai-gong-pollution-two-company-directors-to-be-charged-tomorrow/1918700

Taherdoost, H. (2017). *Determining Sample Size; How to Calculate Survey Sample Size*. *2*, 4.

Tanco, M., Kalemkerian, F., & Santos, J. (2021). Main challenges involved in the adoption of sustainable manufacturing in Uruguayan small and medium sized companies. *Journal of Cleaner Production*, *293*, 126139. https://doi.org/10.1016/j.jclepro.2021.126139

Taques, F. H., López, M. G., Basso, L. F., & Areal, N. (2021). Indicators used to measure service innovation and manufacturing innovation. *Journal of Innovation & Knowledge*, *6*(1), 11–26. https://doi.org/10.1016/j.jik.2019.12.001

Teske, S., & Nagrath, K. (2022). Global sector-specific Scope 1, 2, and 3 analyses for setting net-zero targets: Agriculture, forestry, and processing harvested products. *SN Applied Sciences*, *4*(8), 221. https://doi.org/10.1007/s42452-022-05111-y

Ullah, S., Khan, F. U., & Ahmad, N. (2022). Promoting sustainability through green innovation adoption: A case of manufacturing industry. *Environmental Science and Pollution Research*, *29*(14), 21119–21139. https://doi.org/10.1007/s11356-021-17322-8

Vittinghoff, E., Glidden, D.V., Shiboski, S.C., McCulloch, C.E. (2012). *Regression methods in biostatistics: Linear, logistic, survival, and repeated measures models* (2nd ed). Springer.

Weiers, R. M. (2011). *Introduction to Business Statistics* (7th ed). South-Western Cengage Learning.

Yusuff, R. B. M., Vahabzadeh, A. H., & Panjehfouladgaran, H. (n.d.). *Environmental Conscious Manufacturing for Sustainable Growth*. 7.

Zikmund, W. G. (2013). *Business Research Methods* (9th ed). South-Western: Thomson.

APPENDICES

APPENDIX A

Section I: Respondent and company background

Please choose the most appropriate answer for the following question.

1. Your company is manufacturing company?
    - Yes
    - No

2. Gender
    - Male
    - Female

3. Designation
    - Senior Manager
    - Manager
    - Executive
    - Non-Executive

4. Job responsibilities
    - Operations / production
    - Quality Assurance / Sustainability
    - Research and development
    - Environment, Safety and Health / Legal compliance
    - Others *(Please specify)* _____.

5. Years of attachment in organisation
    - < 2 years
    - 2 – 5 years
    - 6 – 10 years
    - > 10 years

6. Category of manufacturing industry
    - Electrical and electronics
    - Apparel and textiles
    - Food and beverages products
    - Rubber and plastics
    - Chemical products
    - Paper and allied products
    - Basic metal parts
    - Others *(Please specify)* _____.

7. Certification/s certified by the company.
   (Multiple choice)
   - o ISO 9001:2015 Quality management system
   - o ISO 14001:2015 Environmental management system
   - o ISO 45001: 2018 Occupational health and safety management system
   - o ISO 50001:2018 Energy management system
   - o ISO 14064:2018 Greenhouse gases accounting and verification
   - o Others *(Please specify)* .

8. Business ownership
   - o Stated owned enterprise
   - o Joint venture
   - o Private enterprise
   - o Multinational company
   - o Foreign

9. Total number of employees in your company
   - o Small (Less than 75)
   - o Medium (≥ 75 to ≤ 200)
   - o Large (> 200)

10. Is your company currently implementing green manufacturing?
    (Green manufacturing is to minimize negative impact bring to environment during manufacturing process, by reduce the use of natural resource recycling, reuse material, reduce pollution and reduce emissions)
    - o Yes
    - o No

11. What are the green practices had implemented in your company?

Please indicate the level of opinion with each following statement by choosing the most appropriate statement in describing your personal view on the green practices implemented in your company.

1 – Strongly disagree
2 – Disagree
3 – Neither agree nor disagree
4 – Agree
5 – Strongly agree

	1	2	3	4	5
Use of hazardous chemicals in your product or manufacturing process.					
Recycle or reuse the product/materials during manufacturing process.					
Minimize the usage of water and energy efficiency management during manufacturing process.					
Minimize the waste generated during manufacturing process.					
Use of efficient and clean technology during manufacturing process to reduce carbon footprint (CO_2).					

Section II: Drivers of implement green manufacturing practices in the organisation

13. *Please indicate the level of opinion with each following statement by choosing the most appropriate statement in describing your personal view on the drivers that will advocate the implementation of green manufacturing practices in your company.*

    1 – Strongly disagree
    2 – Disagree
    3 – Neither agree nor disagree
    4 – Agree
    5 – Strongly agree

(a) Legal requirements

	1	2	3	4	5
Pollution control, waste disposal management and landfill taxes were stricter by local government.					
The enforcement of penalties for the noncompliance of regulations and requirements.					
Imposing high carbon emission discharge tax execution by local government.					
The compulsory environmental regulation mandated by local government (e.g. hazardous and toxic regulation) for business continuity.					
To comply environmental regulation in place by other countries (e.g., EU Directive, etc.) to secure oversea business.					

(b) Top Management commitment

	1	2	3	4	5
Top management having capabilities, awareness and culture on environmental issue.					
Management, owner or investors are highly committed to enhance environmental performance, ethics and social values.					
Company's strategic and organizational willing to change align to environmental sustainability, to achieve competitiveness towards business sustainability.					
Top management allocate sufficient organization resources e.g., skilled and motivated staff, healthy financial situation and performance measurements.					
Top management encourage employee involvement and commitment through training and empowerment.					

(c) Company and economic benefits

	1	2	3	4	5
Local governmental and authorities provide financial incentives to the company, such as investment subsidies, awards and R&D support.					
To achieve long term cost saving by adopt technologies on green process, product designs, packaging and 3 R s (Reduce, Reuse, Recycle) in the manufacturing process.					
To achieve better process performances, higher product quality and higher efficiency in overall operation.					
Effective and optimized utilization of resources to achieve economic benefits, cost reduction and competitiveness to maintain market leadership position.					
To reduce total energy consumption in the manufacturing process due to the rising energy costs.					

Section III: Barriers that hinder the implement green manufacturing practices in the organisation

14. Please indicate the level of opinion with each following statement by choosing the most appropriate statement in describing your personal view on the barriers or obstacles that hinder the implementation of green manufacturing practices in your company.

1 – Strongly disagree
2 – Disagree
3 – Neither agree nor disagree
4 – Agree
5 – Strongly agree

(a) Cost constraints

	1	2	3	4	5
Large amount of short-term costs, inappropriate incentives and consist of hidden costs for implement green manufacturing practices.					
High investment cost for the development of new analytical tools, models & metrics and chemical analysis of exhaust.					
Additional cost is needed on training for implementation of environmental sensitive processes, re-management of human resource.					
Increment in overall cost for purchasing of costly environmentally friendly materials for manufacturing.					
High cost and risky in adopting new green production measures.					

(b) Lack of technology and skill

	1	2	3	4	5
Lack of skilled staff, expertise and specific ideas on how to implement green manufacturing in your company.					
Inadequate financial resources or capital access to purchase green technology require for the manufacturing process.					
Limited access of information, lack of new technology, materials and processes to support green manufacturing.					
Inadequate R&D, technical knowledge, supports and testing facilities to convert manufacturing waste to green products.					
Nature of business which is industrial-specific than towards green trend, thus, leading to low green manufacturing practices.					

APPENDIX B

UNIVERSITI TUNKU ABDUL RAHMAN DU012(A)
Wholly owned by UTAR Education Foundation Co. No. 578227-M

Re: U/SERC/268/2022

14 December 2022

Dr Lim Wan Leng
Department of Accountancy
Faculty of Accountancy and Management
Universiti Tunku Abdul Rahman
Jalan Sungai Long
Bandar Sungai Long
43000 Kajang, Selangor

Dear Dr Lim,

Ethical Approval For Research Project/Protocol

We refer to your application for ethical approval for your research project (Master student's project) and are pleased to inform you that your application has been approved under Expedited Review.

The details of your research project are as follows:

Research Title	Drivers and Barriers of Green Manufacturing Implementation in Klang Valley, Malaysia
Investigator(s)	Dr Lim Wan Leng Tan Sier Mei (UTAR Postgraduate Student)
Research Area	Social Sciences
Research Location	Klang Valley
No of Participants	300 participants (Age: 24 - 60)
Research Costs	Self-funded
Approval Validity	14 December 2022 - 13 December 2023

The conduct of this research is subject to the following:

(1) The participants' informed consent be obtained prior to the commencement of the research,

(2) Confidentiality of participants' personal data must be maintained,

(3) Compliance with procedures set out in related policies of UTAR such as the UTAR Research Ethics and Code of Conduct, Code of Practice for Research Involving Humans and other related policies/guidelines; and

(4) Written consent be obtained from the institution(s)/company(ies) in which the physical or/and online survey will be carried out, prior to the commencement of the research.

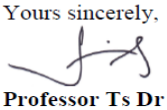
Kampar Campus : Jalan Universiti, Bandar Barat, 31900 Kampar, Perak Darul Ridzuan, Malaysia
Tel: (605) 468 8888 Fax: (605) 466 1313
Sungai Long Campus : Jalan Sungai Long, Bandar Sungai Long, Cheras, 43000 Kajang, Selangor Darul Ehsan, Malaysia
Tel: (603) 9086 0288 Fax: (603) 9019 8868
Website: www.utar.edu.my

Should you collect personal data of participants in your study, please have the participants sign the attached Personal Data Protection Statement for your records.

The University wishes you all the best in your research.

Thank you.

Yours sincerely,



Professor Ts Dr Faidz bin Abd Rahman
Chairman
UTAR Scientific and Ethical Review Committee

c.c Dean, Faculty of Accountancy and Management
Director, Institute of Postgraduate Studies and Research

Kampar Campus : Jalan Universiti, Bandar Barat, 31900 Kampar, Perak Darul Ridzuan, Malaysia
Tel: (605) 468 8888 Fax: (605) 466 1313
Sungai Long Campus : Jalan Sungai Long, Bandar Sungai Long, Cheras, 43000 Kajang, Selangor Darul Ehsan, Malaysia
Tel: (603) 9086 0288 Fax: (603) 9019 8868
Website: www.utar.edu.my