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CONSUMERS PREFERENCES OF GREEN VEHICLES AND INFLUENCE OF GREEN INNOVATION TOWARDS ENVIRONMENTAL ISSUES IN MALAYSIA

SHARUL SHAHIDA SHAKREIN BINTI SAFIAN

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MALAYSIA

By

SHARUL SHAHIDA SHAKREIN BINTI SAFIAN

**Thesis Submited to the School of Graduate Studies, Universiti Putra
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April 2019

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The use of the green concept in the automotive industry and its practice in supply chain management as an energy-efficient transport innovation, and to improve environmental performance in the automotive industry context have the potential to alleviate environmental issues. Currently, environmental degradation has affected everyone, in which the poor have been more than ever before vulnerable to violent weather, floods, and a changing climate condition. As such, the significance of green technology has become a growing concern, especially in developing countries, because growth has come at the expense of the environment. Therefore, the purpose of the present study is to determine the effect and influence of greening the local automotive industry towards solving environmental issues in Malaysia.

In order to achieve this purpose, this study intends to attain three distinct objectives. The first objective is to investigate the willingness to pay (WTP) and preferences among Malaysians in using green vehicles through the choice modelling (CM) and contingent valuation method (CVM) that have been previously used to evaluate the willingness to pay (WTP). The second objective of this study is to predict the customers' intention to purchase green vehicles, using an extended model of the theory of planned behaviour (TPB). Meanwhile, the third objective of the present study is to examine the influence of greening the suppliers through green innovation towards environmental performance and competitive advantage among local manufacturers in the automotive industry.

In achieving these objectives, a sample of 433 respondents through face-to-face interview and an online survey from 150 companies among Malaysian automotive manufacturers was interviewed through an email of questionnaire about green vehicles and green practices. The data were analysed using the Economic Valuation Method for

the first objective while the Structural Equation Model (SEM) for both the second and third objectives to verify the significance of the proposed relationship.

The result of this study for objective one shows that, Malaysians are willing to pay the price increase in road tax by 6.49% maximum level for non-green vehicles, while the highest marginal value of 36.03% from a range of drivers suggests otherwise where people are concerned about their driving range, showing the preferences towards green vehicles. The findings of the second objective on the other hand, show a significant positive attitude of consumers towards the purchasing of green vehicles. It was also discovered that subjective norm, perceived behavioural control and personal moral norm are also positively influencing the purchase intention of humans, except for habit which is found to be negatively influenced by the purchase intention. Further findings confirm the appropriateness of the TPB model used in this study. Hence, this provides evidence that the extended TPB model has a good explanatory power in predicting consumers' intention to purchase green vehicles. For the third objective, the study found that greening the supplier through green innovation contributes significantly to the environmental performance while operational and environmental performances have a major effect on the competitive edge of the companies.

This study casts light on one of the recent green urban management evaluation mechanisms. The study concludes with the identification of green policy proposals for improving the environmental performance and urban management. This research could be considered as part of the initiatives and guidelines for other ASEAN countries and that it could pave the way to identify appropriate policies to enhance the quality of green city urban systems within the Malaysian context.

ii

Abstrak tesis yang dikemukakan kepada Senat Universiti Putra Malaysia sebagai memenuhi keperluan untuk ijazah Doktor Falsafah

PILIHAN PENGGUNA KEPADA KENDERAAN HIJAU SERTA PENGARUH INOVASI HIJAU TERHADAP ISU ALAM SEKITAR DI MALAYSIA

Oleh

SHARUL SHAHIDA SHAKREIN BT SAFIAN

April 2019

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Penggunaan konsep hijau dalam industri automotif dan amalannya dalam pengurusan rantaian bekalan sebagai inovasi pengangkutan tenaga yang cekap, dan untuk meningkatkan prestasi alam sekitar dalam konteks industri automotif berpotensi untuk mengurangkan isu-isu alam sekitar. Pada masa ini, kemusnahan alam sekitar telah menjejaskan semua pihak, di mana golongan miskin lebih terdedah kepada cuaca panas, banjir, dan keadaan iklim yang berubah-ubah. Oleh itu, kepentingan teknologi hijau telah menjadi kebimbangan yang semakin meningkat, terutamanya di negara-negara membangun, kerana pembangunan telah mengorbankan alam sekitar. Oleh itu, tujuan kajian ini adalah untuk menentukan kesan dan pengaruh penghijrahan industri automotif tempatan ke arah menyelesaikan isu alam sekitar di Malaysia.

Untuk mencapai matlamat ini, kajian ini bertujuan untuk mencapai tiga tujuan yang berbeza. Objektif pertama adalah untuk menyiasat kesediaan untuk membayar dan keutamaan di kalangan rakyat Malaysia dalam menggunakan kenderaan hijau melalui pemodelan pilihan dan kaedah penilaian kontingen yang sebelum ini digunakan untuk menilai kesanggupan membayar. Objektif kedua kajian ini adalah untuk meramalkan niat pelanggan untuk membeli kenderaan hijau, menggunakan model teori tingkah laku yang dirancang yang telah diperluaskan. Objektif ketiga kajian ini adalah untuk mengkaji pengaruh penghijauan pembekal melalui inovasi hijau terhadap prestasi alam sekitar dan kelebihan daya saing di kalangan pengeluar tempatan dalam industri automotif.

iii

Dalam mencapai matlamat ini, sampel sebanyak 433 responden melalui temu bual secara bersemuka dan tinjauan dalam talian daripada 150 syarikat di kalangan pengeluar automotif Malaysia telah ditemuramah melalui e-mel soal soal selidik mengenai kenderaan hijau dan amalan hijau. Data ini dianalisis dengan menggunakan Kaedah Penilaian Ekonomi bagi objektif pertama dan dengan menggunakan Model Persamaan Struktur bagi objektif kedua dan ketiga untuk mengesahkan kepentingan hubungan yang dicadangkan.

Keputusan kajian ini menunjukkan bahawa rakyat Malaysia sanggup membayar kenaikan harga cukai jalan sebanyak 6.49% maksimum bagi kenderaan bukan hijau, manakala nilai marginal tertinggi sebanyak 36.03% dari pelbagai pemandu menunjukkan sebaliknya, bahawa orang prihatin terhadap jarak pemanduan mereka, dan mereka menunjukkan keutamaan terhadap kenderaan hijau. Penemuan objektif kedua menunjukkan sikap positif pengguna terhadap penggunaan kenderaan hijau. Ia juga mendapati norma subjektif, kawalan tingkah laku yang dilihat dan norma moral diri juga positif dalam menggerakkan niat manusia, kecuali untuk tabiat yang didapati dipengaruhi secara negatif oleh niat membeli. Penemuan selanjutnya menilai kesesuaian model TPB yang digunakan dalam kajian ini. Oleh itu, ini memberikan bukti bahawa model TPB yang dilanjutkan mempunyai kuasa penjelasan yang baik dalam meramalkan niat pengguna untuk membeli kenderaan hijau. Untuk tujuan ketiga, kajian mendapati bahawa penghijauan pembekal melalui inovasi hijau menyumbang secara signifikan kepada prestasi alam sekitar sementara prestasi operasi dan persekitaran mempunyai kesan besar ke atas daya saing syarikat.

Kajian ini menyoroti salah satu daripada mekanisme penilaian pengurusan bandar hijau baru-baru ini. Kajian ini membuat kesimpulannya dengan mengenal pasti cadangan dasar hijau untuk meningkatkan prestasi alam sekitar dan pengurusan bandar. Penyelidikan ini boleh dianggap sebagai sebahagian daripada inisiatif dan garis panduan untuk negara-negara ASEAN yang lain dan ia dapat membuka jalan untuk mengenal pasti dasar-dasar yang sesuai untuk meningkatkan kualiti sistem bandar hijau dalam konteks Malaysia.

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First and foremost, I would like to dedicate my gratitude to my supervisor, Dr. Hanny Zurina Hamzah who has given me a great help throughout the completion of this thesis. Her kindness, patience, support and dedication have been inspiring and encouraging. I really enjoyed working under her supervision. Futhermore, I would like to thank Associate Professor Abdul Rahim Abdul Samad and Associate Professor Shivee Ranjanee a/p Kaliappan as my supervisory committee members for their valuable suggestions and constructive comments. I sincerely appreciate their fruitful advice and never-ending support.

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v

This thesis was submitted to the Senate of Universiti Putra Malaysia and has been accepted as fulfilment of the requirement for the degree of Doctor of Philosophy. The members of the Supervisory Committee were as follows:

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ix

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

xv

DEFINITION OF THE KEY TERMS

Green vehicle

A green vehicle, clean vehicle, eco-friendly vehicle or environmentally friendly vehicle is a vehicle that produces less harmful effects to the environment. It is equivalent than vehicles that running on gasoline, diesel, or certain alternative energizes.

Value Chain

The procedure or activities by which an organization increases the value. It is including production, marketing, and the arrangement of after-sales service.

Supply Chain

The sequence of procedures associated with the production and dissemination of a commodity for an organization

Green Supply Chain Management

The coordinating environmental practices into supply chain management. It is including product structure, material sourcing and determination, manufacturing procedures, delivery of the final product. It is also about end-of-life management of the product after its useful life

Green Concept

Green concept is a sustainability. Means that, green concept consists of the adaption towards environmentally friendly products and services, the choice of more natural contractors and the setting of environmental guidelines as necessities in an agreement or daily activities

Green Develoment

The advancement concept that cautiously thinks about social and natural effects of improvement. It is characterized by three sub-classes: natural responsiveness, resource efficiency, and community and social affectability.

Green Manufacturing

The renewal of production procedures and the establishment of environmentally-friendly tasks inside the assembling field. Green producers investigate, create, or use advancements and practices to diminish their effect on environment.

CHAPTER 1

INTRODUCTION

1.1   Background of the study

Environment plays an important role in the lives of human beings because a good environment ensures healthy living. It matters because the environment is seemingly the only massive home that accommodate humans, and that it provides air, food, and other basic necessities that determine human survival. Humanity's entire life support system is reliant on the well-being of all the environmental factors. Keeping it clean and neat is our responsibility, and it is necessary to do so because we can get fresh air, reduce pollution etc. By contrast, an unclean environment will lead to poor societal conditions, the emergence of diseases and many more. Environmental issues are often associated with toxic wastes, pollutions and many more which are hotly debated, cutting across the different walks of life, locally and internationally. Everybody considers vehicles as a necessity in our day to day life human endeavour. However, in most cases, people are often unaware that vehicles also have a role in contaminating and harming our common habitat (Kazdin, 2009). The production of environmentally friendly green vehicles is an answer to this problem because it produces lesser emissions (Chapman, 2007). Generally, many individuals are reluctant to surrender their vehicles or reduce the time spent in driving.

A lot of countries have transformed from an agrarian-based rural economy towards an industrial-based urban economy (Cohen, 2016) in the matter of decades or half a century. In effect, various human activities carried out in these countries now emit detrimental particulates and gases (e.g. ozone, nitrogen dioxide) and thus severely cause air pollution (Duh et al., 2008) The World Health Organization (WHO) noted that annually, poor air quality has been the reason for more than seven million premature deaths all over the world, with developing nations receiving higher impacts (WHO, 2014). The detrimental impacts on human health have a lot to do with the polluted environment, which leads to the degradation of life satisfaction (MacKerron & Mourato, 2009). Comparable to other developing nations, Malaysia is also facing fast-paced industrial development and urbanization, and its aim is to become a developed country by the year 2020 (Yusof & Bhattasali, 2008). This economically beneficial development process, however, has also destroyed the atmosphere while comprehensive data on pollutant emissions are restricted, and it is found that mobile sources identified as the main contributor (70–75%) to urban air pollution (Afroz et al., 2003), (DOS, 2016).

Official statistics for 2013 named respiratory illnesses the second highest principal cause of both hospitalization (12.4% of cases) and mortality (21.7%) in Malaysia (MOH, 2014). There is also a steady growth of evidence for the impacts of air pollution in Malaysia on health especially with regard to respiratory organs (Abidin et al., 2014). Furthermore, in hazy occassions in several states, a positive correlation has been observed between pollution levels and increases of asthma, acute respiratory infection, and conjunctivitis outpatient visits (Afroz et al., 2003). Other lines of evidence show

Malaysian commuters who are vulnerable to the haze reported substantially greater adverse health experiences, with multiple health complaints (Wong et al, 2017). The 2015 Southeast Asian haze event reported serious health impacts, with smoke exposure during the episode estimated to have resulted in thousands of deaths in Malaysia (Koplitz et al., 2016), substantially higher than the fatal number estimated from the 2006 Southeast Asian haze (Koplitz, 2016).

Despite the burgeoning concern of the current environmental issues, there has been an increased level of awareness regarding environmental issues based on the worsening situation in developing countries, due to their environmental problems that are considered to be the most severe among other countries (Leach, Mearns, & Scoones, 1999). These days, consumers are extremely worried about air contamination, climate change, and environment due to the toxic gas emitted by vehicles. Accordingly, the number of firms willing to build up or produce the green products is also increasing (Stefan & Paul, 2008). As a result of growing ecological challenges and mounting pressures to consider the impact of human activities on the natural environment, firms around the world have increasingly adopted more sustainable business and marketing practices (Kotler, 2011). In order to commercialize the feasibility of using alternative fuel vehicles (AFVs), governments or policy makers are the major stakeholders in the ecofriendly products, which may impact the likelihood as well as the significant effect on the probability of business reasonability in developing countries (Bryne & Polonsky, 2001).

As a result, numerous ecological laws, policies and strategies are being implemented and some have shown satisfactory progress. The present commitments of different social backgrounds in developing countries towards the reduction of carbon dioxide (CO_2) emissions have a tendency to be criticized. Government, industry players and consumers are being evaluated, comparatively to know which role each one of them is playing in harming the environment.

It is rather fortunate that pollution is controlled in Malaysia through various environmental policies and laws, such as the Environmental Quality Act 1974, with some by-legislations like the Malaysian Ambient Air Quality Standard 2013, also the Environmental Quality (Clean Air) Regulations 2014. These regulatory approaches act to reduce and supervise pollutants that have been emitted from various sources in different sectors (Mustafa, 2011). While such a framework seems to be strudy and well-regulated, Malaysia's suffering from air pollution is ongoing. As pointed out by Inglehart (1995), government efforts and policies designed to resolve environmental issues can only be regarded as achievable and fruitful if citizens give full support to protect and sustain the environment. Thus, government efforts to improve air quality in Malaysia will be assisted by a better understanding of the awareness and support for environmental protection that come from the country's citizens. Studies based in Malaysia on air pollution have mainly emphasised the environmental and atmospheric aspects of pollution, particularly in terms of quantifying the pollutants' level and nature (Awang et al., 2000), (Azmi et al., 2010), rather than the social aspect of pollution such as the attitudes of the citizens.

2

There are some environmental concerns that have been widely discussed in Malaysia namely increasing carbon dioxide emissions from vehicles, deforestation, open burning, excessive waste production and river pollution. These issues have demanded greater ownership and what some term "environmental citizenship", a form of citizenship that highlights the significance of the environment and one that transcends national territorial borders. It stresses the need to have citizens who are really aware about taking care of the environment and try to maintain and preserve the earth by being part of "green" activities and saving our planet.

Environmental NGOs of course, have taken it as great news when it was declared that environmental education will be a core part of the school curriculum in Malaysia some time soon. This is irrefutably a move in the right direction in terms of developing "environmental citizens". The momentum has begun and Malaysia has so much potential in showing to our neighbouring countries that development and preservation can be consistent. There is no reason to stop now. Previous studies of environmental economics underpin the fact that, green vehicles fundamentally release less emission to the environment than conventional vehicles (Sampaio, Rosa, & Almeida, 2007). There is information asymmetry between sellers and buyers when buyers want to pick green vehicles over conventional ones due to the absence of knowledge and information about the green vehicles. As a result, this leads to a static sale of green vehicles throughout the years (refer to Table 1.2).

As indicated by Beliveau (2010), green vehicles have the ability to ensure the quality of the environment in various ways when it comes to reducing carbon dioxide. It is imperative to note that, green vehicles do not just bolster environmental protection, but also lessen fuel consumption and give better mileage. For instance, the driving range of green vehicles is around 30km/litre compared to the non-green vehicles which is only 20km/litre. In order to address the global warming problem, green technologies must be promoted for a cleaner environment. For example, solar based energy, non-petrol-expending (e.g. Bikes) and green vehicles have helped in making the environment more conducive for everybody to live in. Green vehicles have been viewed as environmentally friendly because of their fuel-saving specification (Hefffner, 2007). CO_2 emission has increased rapidly over the past few decades. Almost 30 billion tonnes of CO_2 have entered the atmosphere as a result of human activities each year (Goodall, 2007).

3
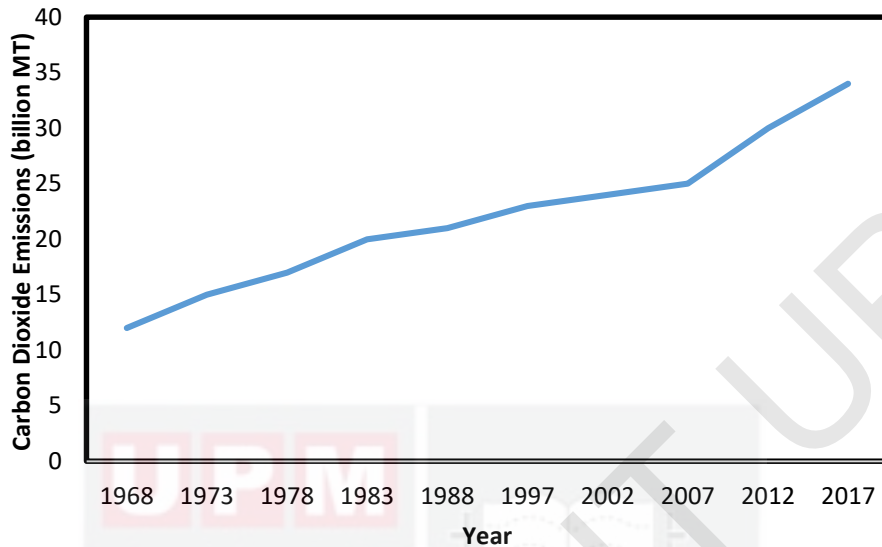
Figure 1.1: CO$_2$ Emissions (billion MT) between 1968 and 2017
[Source: BP Statistical Review of World Energy (2017)]

As evidently shown in Figure 1.1, the growth rate of CO$_2$ emissions over the past decades is increasing compared to the previous decades due to companies' source of energy and none usage of green vehicles. Before the year 2007, the annual increase had never reached one-billion new metric tonnes of CO$_2$, but since 2007, one-billion tonnes of CO$_2$ have been released into the communities or the environment which made the increase to be three times greater than previous years.

Obviously, environmental problem has been identified as one of the important global issues. Automobile assembly plants in the worldwide are currently facing increasing pressures in the environmental arena because it has been highlighted as one of the major manufacturing industries that mainly contributes to the environmental problems (Geffen & Rothenberg, 2000). There is no way that the overall emission targets set by the government can be achieved without focusing on the transportation industry because the emissions from transportation alone are on the increase yearly (Porter & Kramer, 2011). Another reason is that, the transportation sector generates the largest share of greenhouse gas emissions.

The emissions from transportation primarily come from burning fossil fuel for our cars, trucks, ships, trains, and planes. Over 90 percent of the fuel used for transportation is petroleum-based, which includes gasoline and diesel (Ribeiro et al., 2007). The automotive industries take great efforts in terms of minimizing the impacts on the environment by producing more green vehicles, however, unfortunately the efforts are not properly communicated within the society as it is not often received with a thorough understanding towards its goals. Harmful gases pollute the quality of air as a result of

4

productions which contributes to more environmental issues (Gungor & Gupta, 1999). In addition, increasing fuel consumption has significantly increased the greenhouse gas (GHG) emissions due to the surplus of CO_2 that is released into the air (Von Blottnitz & Curran, 2007).
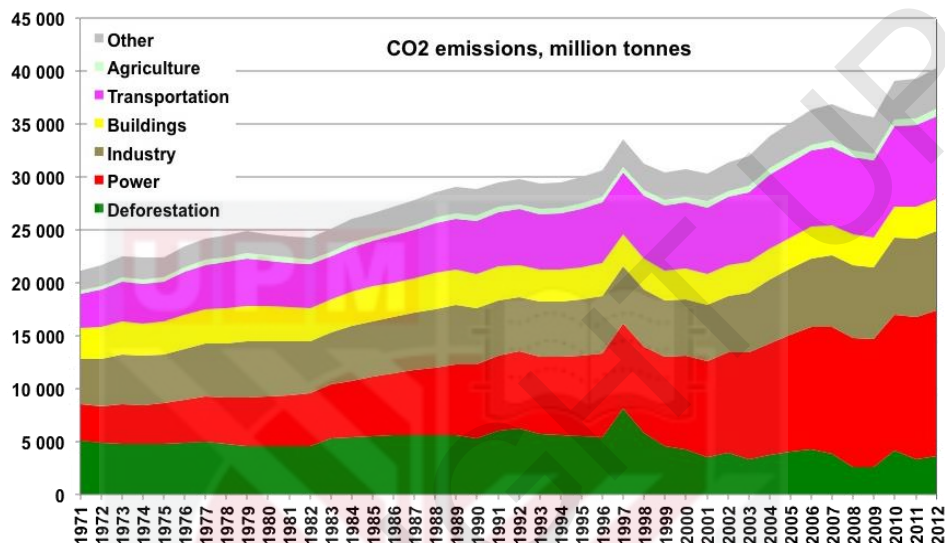
Figure 1.2: CO₂ emissions (MT) by economic activities 1971-2012
[Source: BP Statistical Review (2013)]

Figure 1.2 shows the CO_2 emission by economic activities between 1971 and 2012 in the world. The emission trend is increasing over the years due to the expansion of the manufacturing of goods and services that uses a considerable amount of energy (Medlock III & Soligo, 2001). This energy comes in the form of power, gas oil; coal and crude oil; which adversely affects the air quality. This phenomenon leads to an increase of negative externality.

Figure 1.3 demonstrates the projected energy demand for four sectors projected energy demand in Malaysia between 2000 and 2020. In general, each economic sector differs in terms of the development rates of its activities (Oh, Pang, & Chua, 2010). The emissions have been on the increase along with the GDP growth due to the increase in energy usage. The CO_2 emission correlates with the increase in energy demand (Lin & Li, 2011). According to Safaai et al., (2011), electricity generation, transportation, industrial and residential sectors are the primary sectors that contribute significantly to the CO_2 emissions in Malaysia. It is projected that in 2020, CO_2 emissions would reach 285.73 million tonnes and the electricity generation is anticipated to emit the most CO_2 (43.45 %) since it is extensively used for power generation. Then it is followed by transportation (30.25%), industrial (26.26%) and residential sectors (0.03%) (Safaai et al,. 2011).

5
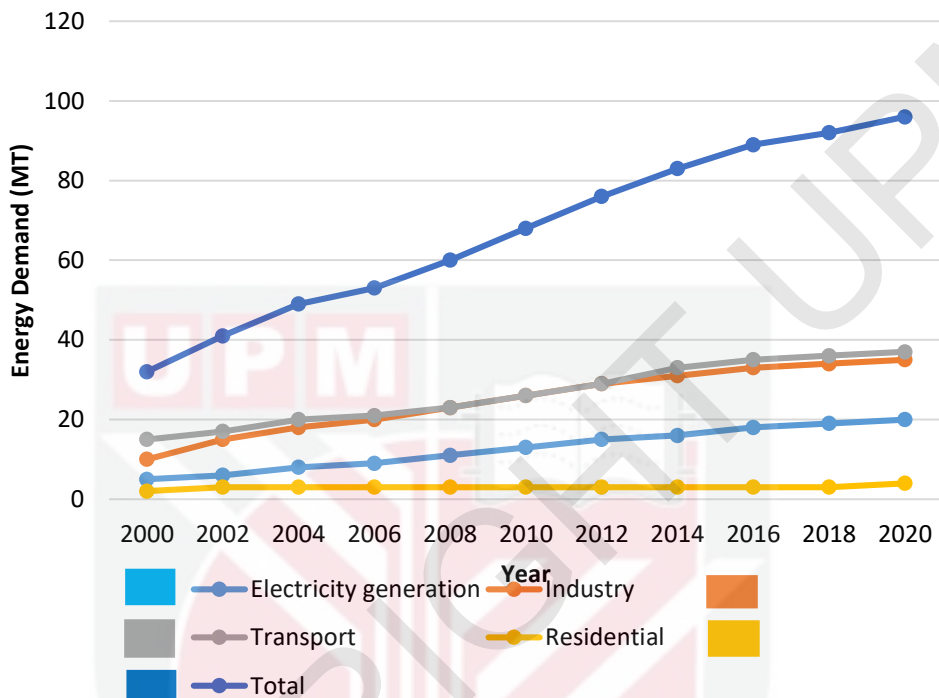
Figure 1.3: Projected energy demand (MT) for four sectors in Malaysia
[Source: BP Statistical Review (2017)]

Electricity generation, transportation, industrial and residential sectors are the primary sectors recognized to add to the CO_2 emissions in Malaysia (Safaai et al., 2011). In view of the projected CO_2 emissions in Malaysia, in 2020, these emissions would yield 285.73 million tonnes of CO_2. The significant sector, which releases the most CO_2 emission in 2020 will originate from electricity generation (43.45%) since it has been extensively used as the fundamental fuel for power generation. The CO_2 emission contribution is then followed by transport (30.25%), industrial (26.26%) and lastly, residential sectors (0.03%) (Safaai et al,. 2011).

Environmental problems arise due to both direct and indirect causes. The problems are caused by patterns of production, by industries, also by the pattern of consumption and consumer behaviour when buying goods and services. As the consumption of goods and services increased tremendously across the world, this leads to the natural resource depletion and severe damages to the environment (Chen & Chai, 2010). In order to minimize the negative impact on the environmental impact, it is vital to inculcate environmentally responsible purchasing against unplanned purchasing among

6

consumers, which can adversely damage the environment. It is asserted that household purchases of goods and services account for 40% of the environmental damages (Grunert, 1995). Consumers could prevent more environmental damages by purchasing more green products such as green vehicles.
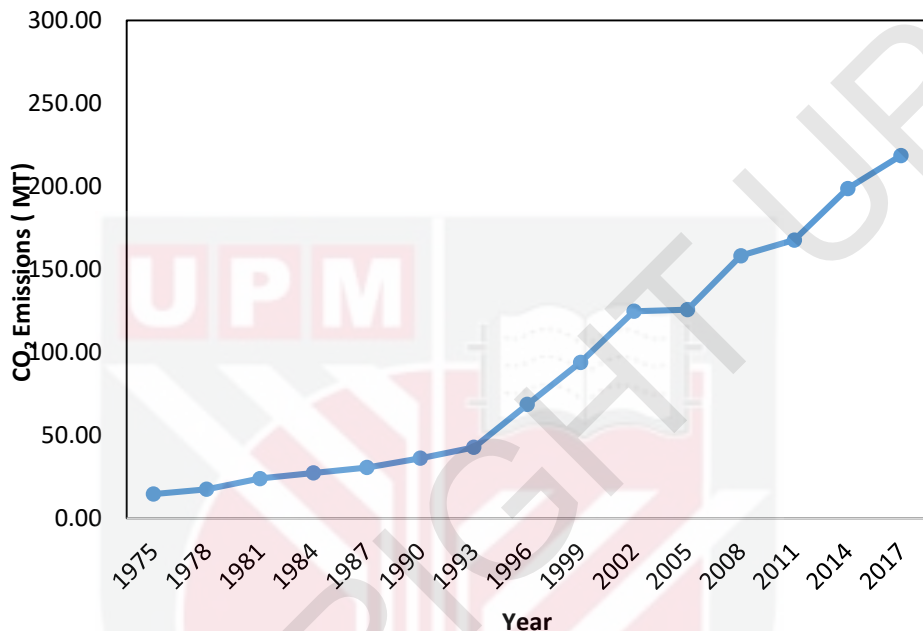
Figure 1.4: CO$_2$ emissions in Malaysia between 1975 and 2017
[Source: BP Statistical Review (2017)]

The burning of fossil fuels, deforestation for agriculture and industrial activities have pushed up the level of CO$_2$ to about 400 ppm today from 280 parts per million (ppm) from 200 years ago (Ehleringer et al., 2002). Malaysia is not exempted from encountering the same environmental issue, particularly the increasing level of CO$_2$ emissions. This situation is evidently indicated in Figure 1.4, which shows the trend of CO$_2$ emissions from year 1975 to the year 2017 in Malaysia. The CO$_2$ emission increased sharply until the year 2002 and slowed down in 2005. However, the emission continued to increase tremendously from the year 2012 onwards. On average, Malaysia emitted 93,060.54 kt CO$_2$ with a minimum value of 14,601.99 kt CO$_2$ in 1975 and a maximum value of 215,389.30 kt in 2017. In 2018, CO$_2$ emissions for Malaysia was 266,251.5 kt. It increased from 105,454.3 kt in 2002 to 266,251.5 kt in 2018 growing at an average annual rate of 5.10 %. The energy use by households (direct and indirect) had increased dramatically in the last few years and contributed to the CO2 emission.

7

1.2   An Overview of the Global Automotive Industry

In 2012, International Organisation of Motor Vehicle Manufacturers reported that the total vehicle manufactured globally was 84.1 million units and the total sales were 82.1 million units. The main three countries for vehicle production and sales are China, the United States of America (USA) and Japan. As shown in Figure 1.5, the global automotive increase forecast for 2018 is expected to increase to 100 million units in 2018 from 85.5 million units in 2013. On average, the additional units are estimated almost 3 million units every year. As such, being a fast industrializing country, transportation makes a vital contribution to the economy and plays a vital role in daily activities, which further increase motor vehicle ownerships (Ong, Mahlia, & Masjuki, 2012).
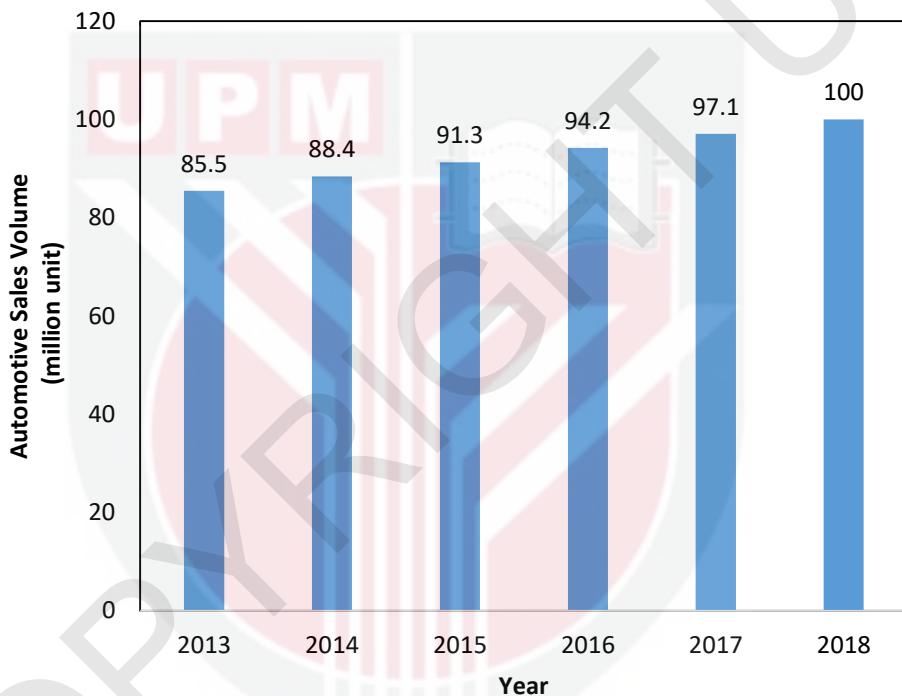
Figure 1.5: Global Automotive Industry Forecast between 2013 and 2018
[Source: Calculated from IHS automotive estimates & market line forecast (2012)]

Based on the Malaysian Performance Investment Report (2016), Malaysia is positioned at the 18th rank as vehicle manufacturer and placed 20th in vehicle sales globally. According to the world data on different car brands, Toyota recorded the highest total sales to 8.91 million units. Volkswagen ranked the second, which sold 8.61 million units, while General Motors recorded total sales of 7.65 million units. In 2013, the total vehicle sales were recorded at 82.8 million units. China is the biggest automotive market with total sales of 19.3 million units in 2012. China additionally engaged in joint ventures with major automotive producers such as Toyota, Volkswagen, and General Motors.

8

Table 1.1: ASEAN Automotive Industry 2014 compared with 2018

Country/ Region	Population (Million)	GDP per capita (US$)	Vehicle Production ('000 units)	Vehicle Sales ('000 units)	Product Champion
Thailand	68	6,022	1,800	880	1-ton pickup
Indonesia	255	3,513	1,300	1,210	SUV, MPV, Big trucks
Malaysia	30	10,934	600	670	Passenger car
The Philipines	99	2,855	60	230	-
Vietnam	92	2,007	40	130	Motorcycle
Myanmar	53	1,480	4.325	1.8	Motorcycle
Laos	7	1,666	-	14.7	Motorcycle
Cambodia	15	1,085	-	4.1	Motorcycle

[Source: BMI, OECD, OICA, Thailand Automotive Institute/PwC (2014)]

Based on Table 1.1, Malaysia is ranked third after Thailand and Indonesia. The total vehicle production and sales in 2014 were due to the Malaysian population, which was around 27.73 million and gross domestic product (GDP) grew at an average of 6% in the course of the last 20 years (Ong et al., 2012). In terms of the passenger car category in ASEAN, Malaysia is the third biggest automotive market after Indonesia and Thailand. Thailand has maintained its position as an ASEAN pioneer in producing automobiles. Thailand recorded the highest vehicle production in 2014 in ASEAN. As for the domestic sales, with 81% expansion in its total industry volume (TIV) in the previous years. Japanese automotive manufacturers, such as Toyota, Honda, Daihatsu, Nissan, Suzuki, Mazda, Mitsubishi, Subaru, Isuzu, Kawasaki, Yamaha and Mitsuoka, are the major automotive players in both Thailand and Indonesia. These automakers upgrade their car parts and segments inventory network or supply chain through their complementation strategy inside ASEAN. The Japanese related organizations represent about 77% and 81% of the supply chain, separately in Thailand and Indonesia (Russell, 2005).

1.2.1 Automotive Industry in Malaysia

According to World Economic Forum's (WEF) Global Competitiveness Report (GCR) 2014-15, Malaysia ranked behind South Korea, the People's Republic of China, Taiwan, Thailand and Indonesia. Proton as the first national car of Malaysia was established in 1983. To date, more than one million units of Protons have been sold in 51 countries around the world. The Malaysian automotive industry remains protected from 140% to 300% on car production and high local content necessity (Zaharizan, 2011).

In the meantime, the foundation of the national car venture, Proton and Perodua, has changed Malaysia from an insignificant motor car constructing agent into a car producer. The industry supported the advancement and updating of innovative and designing capacities which additionally upgrade the allure of Malaysia as the base for worldwide automotive manufacturers. The industry itself, has delivered up to 614,664 vehicles, including 563,883 passenger vehicles (PVs) and 50,781 commercial vehicles (CVs) in 2015 from 596,418 in 2014 (545,122PVs and 51,296CVs, respectively) according to the World Economic Forum's (WEF) Global Competitiveness Report (GCR) 2014-15. The increase in the percentage of sales of cars registered a peripheral growth of 3.05% year on year. The sales of cars year-on-year was almost stagnant. Unfortunately, unlike 5 years ago CAGR (2010-2015), the automobile industry only indicated a yearly growth of 2% as presented below.
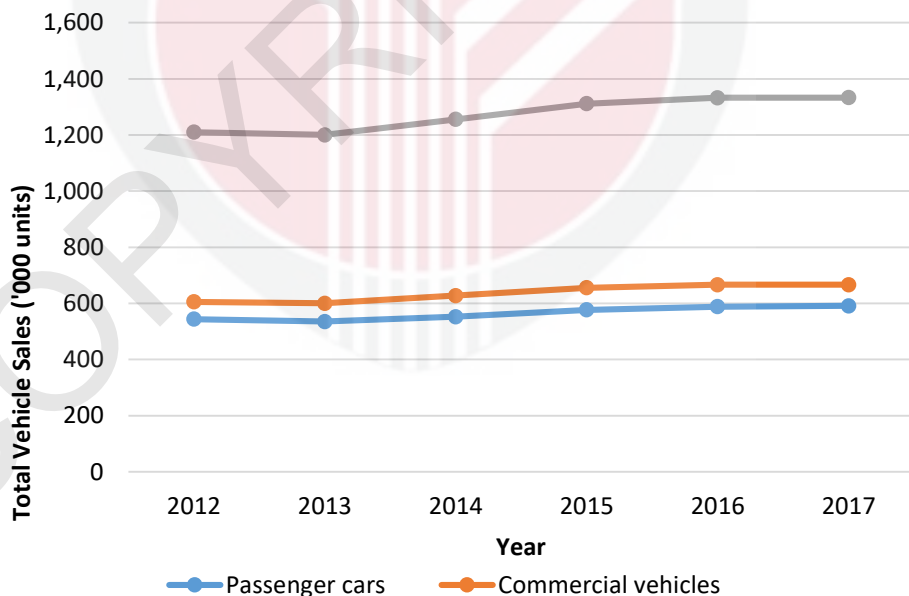
Figure 1.6: Total Vehicle Sales in Malaysia between 2012 and 2017
[Source: Malaysia Automotive Institute (MAI) (2016)]

According to Figure 1.6, it is observed that total vehicle sales (including passenger and commercial vehicles) are increasing between 2012 and 2017. This situation also suggests an increasing vehicle buying trend among Malaysians, altogether witnessing an increasing number of private vehicle ownerships (refer to Figure 1.7). This development in private vehicle ownership certainly will worsen the level of, CO_2 emissions due to the increasing number of vehicles on the road apart from traffic congestions (Barth & Bariboonsomsin, 2008). CO_2 emissions can be lowered by improving traffic operations, specifically through the reduction of traffic congestion. In addition, by encouraging the populations to use environmentally friendly vehicles and the use of carbon-neutral alternative fuels, the CO_2 emissions could be significantly reduced in the future.
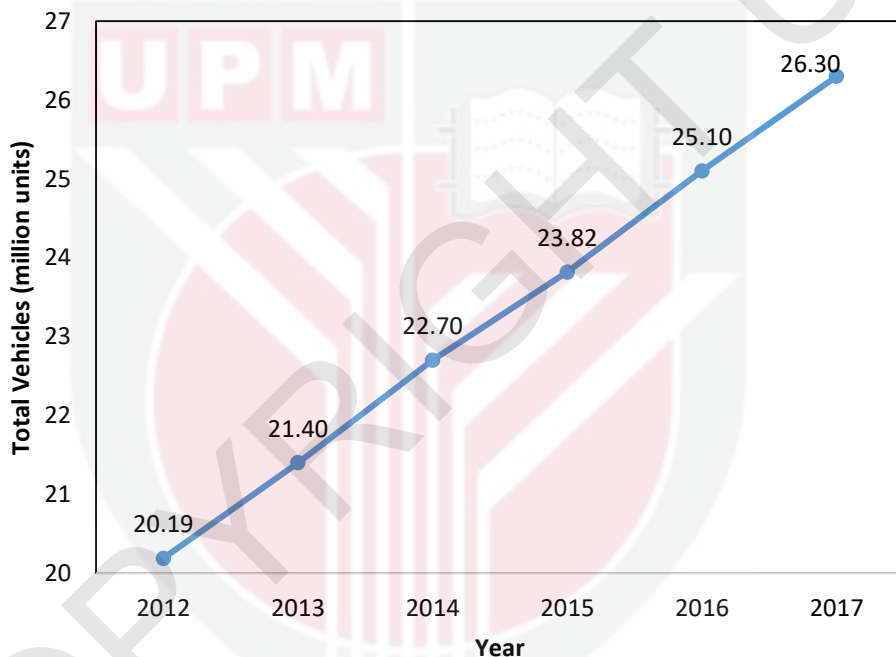
Figure 1.7: Total Vehicles in Malaysia between 2012 and 2017
[Source: Road Transport Department Malaysia (2016)]

According to Figure 1.7, total vehicles in Malaysia show an increasing trend from 2012 to 2017 as it will contribute to environmental issues. Malaysia is committed to reduce 40% of carbon intensity by 2010 (Chua & Oh, 2010). In order to achieve the goal, Malaysia must work to increase fuel efficiency, preserve the environment, and conserve environmental resources. The transformation and the initiative to go green is imperative to the overall aspect from consumers and also the supply chain of the domestic automotive industry in order to overcome the problem regarding carbon emissions from vehicles. Other than that, the tax system on vehicles or road tax may also be granted one of the indirect medium to overcome this issue. This is because every vehicle is required

to pay a road tax according to the engine capacity (cc), so a special tax should be set up for non-green vehicles based on the rates itslef.

1.2.2 Price list of Road tax in Malaysia

Below is the price list of road taxes in Malaysia based on the types of vehicles and engine capacity (cc) which give more insight as to why green vehicles are needed:

For private registration in Peninsular Malaysia			
Engine Capacity (cc)	**Base Rate**	**Progressive rate (per cc)**	**Total road tax**
1000 and below	RM20.00	-	RM20.00
1001 to 1200	RM55.00	-	RM55.00
1201 to 1400	RM70.00	-	RM70.00
1401 to 1600	RM90.00	-	RM90.00
1601 to 1800	RM200.00	RM0.40	RM200.40 to RM280.00
1801 to 2000	RM280.00	RM0.50	RM280.50 to RM380.00
2001 to 2500	RM380.00	RM1.00	RM381.00 to RM880.00
2501 to 3000	RM880.00	RM2.50	RM882.50 to RM2130.00
3001 and above	RM2130.00	RM4.50	RM2134.50 an above

Source: Road Transport Department Malaysia (2016)

For company registration in Peninsular Malaysia			
Engine Capacity (cc)	**Base Rate**	**Progressive rate (per cc)**	**Total road tax**
1000 and below	RM20.00	-	RM20.00
1001 to 1200	RM110.00	-	RM110.00
1201 to 1400	RM140.00	-	RM140.00
1401 to 1600	RM180.00	-	RM180.00
1601 to 1800	RM400.00	RM0.80	RM400.80 to RM560.00
1801 to 2000	RM560.00	RM1.00	RM561.00 to RM760.00
2001 to 2500	RM760.00	RM3.00	RM763.00 to RM2260.00
2501 to 3000	RM2260.00	RM7.50	RM2267.50 to RM6010.00
3001 and above	RM6010.00	RM13.50	RM6023.50 an above

Source: Road Transport Department Malaysia (2016)

Below is the comparison of price list of road tax between petrol and diesel:

Engine Capacity (cc)	Petrol (RM)	Diesel (RM)
1000 and below	RM20.00	RM20.00
1001 to 1200	RM55.00	RM110.00
1201 to 1400	RM70.00	RM140.00
1401 to 1600	RM90.00	RM180.00
1601 to 1800	RM200.40 to RM280.00	RM400.80 to RM560.00
1801 to 2000	RM280.50 to RM380.00	RM561.10 to RM780.00
2001 to 2500	RM381.00 to RM880.00	RM782.20 to RM1880.00
2501 to 3000	RM882.50 to RM2130.00	RM1886.00 to RM4880.00
3001 and above	RM2134.50 and above	RM4890.80 an above

Source: Road Transport Department Malaysia (2016)

Based on the list price, it shows that the total amount of road tax depending on the types and cc of the vehicles and this applies to other countries as well. It means, the higher the cc of the vehicles, the higher amount of road tax as well as higher cc of the vehicles will contribute a higher level of emissions towards the environment in the case of non-green vehicles. As a result, the green concept is the main contribution to be discussed in this research based on green vehicles and the green manufacturing industry record in Malaysia.

1.2.3   Scope of the Study

There are two research areas between green vehicles which is green innovation on transportation elements and green supply chain management (GSCM) in the manufacturing process. Both are important as well as the fact that they have their own contribution to the environmental issues and awareness among society. Studies concerning public perception, awareness, and attitudes (including WTP) towards air pollution are distinctive in Malaysia. Thus, this study attempts to go into this topic by understanding the public's perception of current air pollution, their environmental awareness, and attitudes on environmental protection. The rationale for doing this study is that the implementation of any programme or legislation would be in vain without public awareness and support for environmental protection. In brief, only citizens who are well aware of the situation and fully dedicated to their right to a quality environment could then initiate carrying out possible environmental protection practices. More detailed insights obtained from this type of study can help to frame and design the policy options deemed most suitable. As a result, it is important to study the implication of green development towards these two different fields; green innovation on vehicles and supply chain (industry).

1.3   Green Development

The most widely definition is that of our common future: sustainable development is development which meets the needs of the present without compromising the ability of future generations to meet their own needs' (Bruntland, 1987). Green development is a development concept that considers social and environmental impacts of development. The concept of sustainability lies at the core of the challenge of environment and development, and the way governments, business and environmental groups respond to it (Adams, 2008). There are three sub-categories: environmental responsiveness, resource efficiency, and community and cultural sensitivity that define green development. Environmental responsiveness has high regard to the intrinsic value of nature, and mitigates the damage to an ecosystem. Resource efficiency makes reference to the use of fewer resources to preserve both the energy and the environment. Community and cultural sensitivity identifies with the unique cultural values that each community hosts and carefully considers in real estate development, as opposed to discernable signs of sustainability, like solar energy. Green development is evident in various forms, however it generally leans on solution multipliers: features of a project that offer additional benefits, ultimately cushioning the blow of the environment onto the projects. In this study, the process of green development consists of two categories which is consumers and industry. Green vehicles stand to be the green concept for the consumers issue while Green Supply Chain Management (GSCM) is the green concept for the industry issue.

A common criticism of green development is that it can increase cost and create delay. The vehicles design and additional operations and maintenance fees, and etc can all increase the cost. Furthermore, green development has not been getting great reviews at the industry level. In the long run high-performance processes have proven to save energy, but they are quick to increase up-front capital costs also, and manufacturers are often unable to develop certain portions of upgrade level because of the conservation easements. There is the likelihood that green development creates a burden to both consumers of green vehicles and also the industry activities of supply chain. However, the main benefit of green vehicle is that it produces less pollution, thereby there will be less harmful effects on the environment. However, green vehicle can save more than the environment by saving money in their pockets. This makes driving the right vehicle more important than ever as added to the fact that vehicles can be considered an essential item in the society. Driving green vehicle is a great way to live life healthily. A green vehicle emits less harmful chemicals into the air, as it emits low carbon compounds when running. Depending on the industry case, with the increasing concerns about the environment in the last decade, environmental pollutants should also be considered alongside the development of the industry and in the SCM operational process. All solutions are better to be merged in a comprehensive supply chain procedure (Fallah and Mohajeri, 2014). Due to this, the Green Supply Chain Management (GSCM) as well as supply chain management prove to be an important factor and it is directly linked to productivity and competitive positions.

1.3.1   Green Vehicles

"Green vehicles" can be defined as vehicles that utilize alternative fuels (other than petrol or diesel). Moreover, some of the green vehicles are associated with the alternative types of drive (other than the conventional internal combustion engines, knows as ICE). Alternative fuels usually include biofuels, environmental gas, hydrogen and electricity from the grid, whereas alternative engines include hybrid and electric engines. Hybrid vehicles consume less gasoline and emit less pollution per mile than traditional engines with similar performance (Gallagher & Muehlegger, 2011).Hybrid car is designed and developed to function by utilizing more than one source of energy to move. While it principally has an inner burning and an electric engine, it is an alternative decision to utilize radio waves, electromagnetic fields, hydrogen, fluid nitrogen and petrol.

As the name suggests, the definition of an electric vehicle is where it keeps running on electricity (Kurani, Turrentine, & Axsen,. 2008). Sometimes referred as all-electric vehicles (EVs), the vehicle is powered by no less than one electric engine. The electric vehicle gets its energy from rechargeable battery packs. The engines are propelled by at least one electric engine controlled by rechargeable battery packs. Building upon these features, a green vehicle (or in other words clean vehicle, eco-friendly vehicle or environmentally-friendly vehicle) is a road motor vehicle that produces less harmful effects to the environment. It is in contrast with the conventional internal combustion engine vehicles which run on gasoline or diesel, or one that uses certain alternative fuels.

EVs have a few preferences over conventional vehicles in terms of energy efficiency, environmental friendliness, performance benefits and lower energy dependence. It can convert up to 59% to 62% of electrical energy from the network to control the wheels. On the other hand, traditional fuel converts 17% to 21% of the energy into gas to control the wheels (Armaroli and Ciavola, 2011). Electricity from atomic, hydro, sun based or wind-controlled plants causes no air pollutions. Electric motors provide peaceful, smooth operation and stronger acceleration. It also requires less maintenance compared to ICEs.

Additionally, the innovation doubles the mileage of routine vehicles. This mix offers the stretched-out range and capacity to refuel anticipated by purchasers from a routine vehicle. It utilizes the battery to give additional speeding up when required. When ceased, the gas engine closes off and keeps running on the electricity and battery. The pragmatic advantages of Hybrid Electric Vehicle (HEVs) include enhanced efficiency and lower discharges in comparison to the conventional vehicles. At the same time, green vehicles emit less carbon dioxide and different gasses, are known to worsen the greenhouse impact on the environment (Momoh, 2009).

Apart from HEV, alternative fuel vehicles (AFVs) can conceivably give an essential commitment to this target. They can help diminish greenhouse gas (GHG) outflows and danger to air quality and human wellbeing. At the same time, it can improve the energy security of nations and give governments new wellsprings of economic development and intensity. The main benefit of using the green vehicles is less dependent on the gasoline.

15

At the same time, it improves the gas mileage, especially in comparison to the gas-guzzling SUVs that are currently found in abundance (Ramish, 2005). Vehicles like Honda Insight are able to travel more than 65 miles per gallon. Since fuel consumption is a criterion in car purchase, one way to conserve fuel is by not accelerating quickly, but by slowly coming to stop in order to recapture braking energy or using high octane gasoline (Ribeiro et al., 2007). Albeit growing enthusiasm on the AFVs among the policy makers, organizations and purchasers, their economic and environmental advantages remain inconclusive. EVs do confront the significant battery-related challenges in terms of the driving range, recharging time, battery cost and bulk and car weight.

1.3.2 Green Vehicles in Malaysia

Malaysian Automotive Institute (MAI), (2011) reported that Malaysia intends to upgrade its automotive sector through the production of electric cars by building up a lucrative export exchange as well as effectively fighting carbon outflows at home. The local automotive industry will confront the rivalry from different nations in the region which green automotive activities are equally significant. Currently, there are only several electric vehicles in Malaysia (Sang & Bekhet, 2015). The figure evidently suggests that Malaysians still demonstrate low interest towards the use of electric vehicles in comparison to hybrid vehicles.

In year 2011, the Malaysian government advanced the establishment of a local green vehicle manufacturing limit (Olugu & Wong, 2011). Both the government and industry accept that such a campaigning for green vehicle malfunction will help widen the base of the sector. MAI anticipates that the sector's commitment to the economy would be boosted by year 2020 via the revival of the industry, combined with higher local and global requests (Wad & Govindaraju, 2011). The effort will stimulate the production and domestic utilization of green vehicles. The restructuring of the National Automotive Policy (NAP), which is the government's long term plan for the industry will present a few new changes and directions.

In 2011 Malaysian government introduced 100% import and excise duty exemption for hybrid and electric cars, starting from January 1st until December 31st, 2013. The facilities, however, has ended since the original purpose of offering such tax exemptions has not been satisfied. As a result, total green vehicle sales dropped in 2013 compared to the previous years. Malaysia Automotive Association (MAA) also indicated that the green vehicle market enjoyed tremendous sales in the past few years due to the introduction of duty exemptions. This is evidently illustrated in Table 1.2.

The tax exemption for the completely assembled green vehicles imported into Malaysia ended on 31 December 2013 (Segawa, 2014). Currently, the tax reduction only applies to hybrid and electric vehicles that are assembled in Malaysia, which is referred as CKD (Completely Knocked Down). The Malaysian government has also declared that the tax exemptions for fully imported electric and hybrid vehicles are removed. This drastic step has to be taken since the objective of giving the incentive or tax exemptions was not met.

The Government initially offered tax exemptions on imported green vehicles to encourage automotive manufacturers to invest in Malaysia and assemble their vehicles locally. Since the incentive did not imply any significant results in the past four years (2010-2014), the Malaysian government decided to pull back the incentives altogether (Felker & Jomo, 2014).

The decision to end tax exceptions was part of the National Automotive Policy (NAP) that was uncovered on January 20th, 2014. Automobile manufacturers who want to take advantage of the tax exemptions must assemble their hybrid and electric vehicles in Malaysia. A good example includes the Honda Jazz manufacturing company, which was set up in Malacca 14 years ago since 2003. It continued by including the Ministry of International Trade and Industry (MITI) and other government officials in a dialogue with three automobile manufacturers to start CKD gathering operations in the nation. Ideally, this action was to bring a significant greater venture to Malaysia.

On top of the tax exemption, the excise duties were also imposed on the completely build units (CBU) of imported hybrid vehicles beginning 2013. The present excise duties on the CBU of hybrid vehicles can be somewhere in the range of 65% to 105% contingent upon the engine displacement. The excise duties on electric vehicles depend on the power yield of the vehicles. Additionally, the excise duties would not be modified by the legislature (Kasipillai &Chan, 2008). It will be overhauled if, and just when, the monetary condition of the nation permits it.

Table 1.2 shows the total green vehicle sales of six car models in Malaysia for the period of 2013-2015. The table illustrates that the percentage of sales had decreased by 11.7% from 2013 to 2014. Similar decreases in green vehicle sales were also seen in the 2014-2015 period where the sales, were reduced by 44.5% from the previous period. Although other competitors could hardly make a good business in the period of 2013-2014, Honda topped the green vehicles sales performance by selling 676 additional units (19%) in the same period. Despite a significant drop in the overall green vehicle sales for the period of 2014-2015, the green vehicles sales performance in the following period witnessed a huge success recorded by Nissan and Toyota by registering 1,328 units from 1,079 units and 1,996 units from 502 units, respectively.

Table 1.2: Total Green Vehicle Sales and Sale Changes in Malaysia 2013-2015

Car Model	Sales			Changes in Sales			
	2015 (unit)	2014 (unit)	2013 (unit)	Δ unit (2014-2015)	Δ% (2014-2015)	Δ unit (2013-2014)	Δ% (2013-2014)
Audi	0	90	640	(90)	(100)	(550)	(86)
BMW	0	1	4	(1)	(100)	(3)	(75)
Honda	2	4,235	3,559	(4,233)	(100)	676	19
Lexus	7	100	299	(93)	(93)	(199)	(67)
Nissan	1,328	1,079	n/a	249	23	1,079	n/a
Toyota	1,996	502	2,301	1,494	298	(1,799)	(78)

| Total | 3,333 | 6,007 | 6,803 | (2,674) | (44.5) | (796) | (11.7) |

Source: MAI (2016)

During the first six months of 2014, green vehicle sales fell to 11.7% with a total of 6,007 units from 6,803 units in the previous year (refer to Table 1.2). This implies that an effective approach should be taken to enhance the production and use of green vehicles since the demand for green vehicles is expected to rise rapidly due to its growing popularity (Rosli& Kari, 2014). Most of the urban people are mindful of the effect of motor vehicles on the environment. It is concurred that the increased use of motor vehicles adds to the issues of the environment such as, ozone depletion, acid rain, oil soil, noise contamination, air contamination and the greenhouse impact (Molina, 2004). Most of the users are aware of the risks brought by the extensive use of motor vehicles to the environment. Unfortunately, none of those reasons stated earlier have an effect on people's behaviour despite having some evidence that indicates its negative effects on the environment (Anable, 2005; Hagman, 2003; & Tertoolen et al., 1998), and that it is not enough to change the behaviour of urban people as they are reluctant to utilize more sustainable ways of transportation such as walking or cycling.

Green vehicles are considered to be environmentally friendly products especially when we are talking about the worldwide global warming. After so many dialogues and considerations, Malaysia has withdrawn the exception of the green vehicle import and excise duty starting from the year 2013. Subsequently, it is important to make affordability a primary concern. As a matter of fact, the costs of green vehicles are much higher than the conventional ones. Green vehicles are just reasonable to those high-income purchaser groups, preventing other customers from acquiring green vehicles. However, the maintenance cost of green vehicles is relatively lower than the conventional vehicles unless they break down. In fact, the maintenance cost may actually be lower, but if something goes wrong with the system after its warranty has expired, the cost could be higher because green vehicles cost more up front than conventional vehicles of similar size. Consumers have debated on whether the higher gas mileage really saves people's money, but the answer depends on some factors such as the price of gas, how much we drive and how long we keep the vehicle.

1.3.3   Green Supply Chain Management

Green Supply Chain Management can be defined as bringing together the environmental thinking into supply-chain management. Green Supply Chain Management (GSCM) which takes environmental issues into consideration is the extension of the traditional SCM. Slack et al. (2009) defined Supply Chain (SC) as the linked operations to the source and to the provision of goods and services to the end users. The GSCM is defined as the achievement of economic, environmental, and social goals in the systemic coordination of key inter-organizational business processes to boost the performance in the long term for the organization and its partners in the supply chain (Ageron, et al., 2012). GSCM proves to be a concerted effort across the enterprise and it is more than simply carrying out some ecological practices, but rather a coherent approach to improve both the environmental and organizational performance of all management levels (Zhu,

et al., 2007). Srivastava (2007), defined GSCM as integrating environmental considerations into SCM and these considerations include product and service design, procurement, manufacturing processes, distribution, and end-of-life management of the product to attain sustainable competitive advantage.

Nowadays, Green Supply Chain Management has become increasingly important following the impact of environmental issues, where consumers will be consulting the companies about how green the manufacturing and supply chain of the products are. Lowering the cost for waste disposals in the supply chain process also cuts the cost. There are many reasons for the existence of the supply chain and those include specialization. For example, automotive dealerships usually do not have the skills and ability to manufacture vehicles. Opportunity Cost also serves as one of the reasons as an automotive manufacturer can produce tires and make them sell, but he might decide not to pursue this because it will distract him from producing cars which is his core business. A lot of effort goes into producing computer chips, and chip manufacturers remunerate that cost over all of the chips sold. Since automobiles do not normally use a lot of computer chips, automotive companies do not have the scale to amortize that cost by themselves. Lastly, the reason for states regulations or laws is to prevent automotive manufacturers from selling vehicles directly to consumers. This is because in some states, only dealers can do this.

The Automotive Value Chain

Product Designing, Resources purchase, Production, Marketing and Distribution and finally Customer Service are the sole activities of the automotive value chain. Product designing has become the key features within the industry. Since cars are almost standardised these days, with the right tools of strength and power, the firm is simulatneously attempting to offer cars that are not only powerful but also using less fuel. When it comes to the Resource purchase, the right material is crucial. As demonstrated in Porter's Five Forces, suppliers have very low authority, in other words the organisation has the upper hand, in selecting its preferable price over the supplier. The Production serves to be the main element in the manufacturing process to produce products according to the needs of the market. However, its methods would have shown an inadequacy, if firms produce more than the demand. Marketing & Distribution is efforts that do an efficient job of pleasing the public. This could include displaying cars in showrooms, announcement and etc. Customer Service & Support will generally offer support services to the customers after a sale. Support activities like human resources, communication and consumer crediting sustain the daily operations but they are not directly implicated in the manufacturing process of vehicles.

The Automotive Supply Chain

Cars or vehicles can be said to be one of the largest purchases a person makes, or maybe the second-largest, after a house. That makes the automotive supply chain a little different from other supply chains. In the context of the automotive supply chain, it consists of dealerships and manufacturers. Companies that sell vehicles are called dealers. Sometimes one company will own multiple dealership locations. It is worthy of note that these dealerships are unique and they are mostly independent from the auto manufacturers. Dealerships are really good when it comes to their customer service, because generally, dealers can understand the needs of their specific geography and customer base, and vehicle maintenance and repair. Meanwhile, automotive manufacturers are all about the brands and they are commonly referred to as OEMs (original equipment manufacturers), which is an unfortunate misnomer. Although these manufacturers produce some original equipment, their real strength lies in designing, marketing, ordering the car parts from suppliers, and assembling the final product. The "design" part of that equation becomes a little hazy when it comes to software. Some of the software comes as part of subsystems that are specified by the OEM and they are built by suppliers. On the other hand, some of the software is built by manufacturers directly.

The need for GSCM especially in the automotive industry is due to the increasing environmental constraints due to global warming as well as pollution from the transportation and industry activities as the major contribution. GSCM is also beneficial for organizations and as corporate social responsibility. Furthermore, GSCM boosts eco-friendly elements and increases the stakeholders' environmental awareness. Consumers and clients' demand and the alternative way of response to increasing fuel prices are also booming.

According to the Global Supply Chain Group: "At the core of Green Supply Chain Management lies the principle of reducing waste by increasing efficiencies. Effective resource and supplier management can lower the production costs, promote recycling and not to mention reuse the raw materials" (Carter & Rogers, 2008). GSCM is a progressively widely-diffused practice among companies that are seeking to improve their environmental performance. Regarding the increasing global awareness of environmental protection, businesses have adopted their GSCM to improve their core competitive advantage. GSCM is a progressively widely-diffused practice among companies seeking to improve their environmental performance. By using this, we can curb air pollution and makes environment clean and from this, the cost of the final will not be too high.

Green Supply Chain Management (GSCM) functions as one of the recent innovations to improve the capabilities of the Supply Chain Management. GSCM implementation is very important when it comes to controlling Air pollution , reducing wastages, Improving the quality of product, having Green Sourcing & Procurement, Green Manufacturing, Green Warehousing, Green Distribution, Green Packaging, and green transportation Product manufactured by industries should be green or pollution-free. Environmentally

friendly product designs, issues regarding manufacturing must also be addressed to have a fully-formed concept of green manufacturing i.e. the design of product should be environmentally eco-friendly. GSCM is a progressively widely-diffused practice among companies intending to improve their environmental performance. With regard to the increasing global awareness of environmental protection, businesses have resorted to their GSCM to improve their core competitive advantage.

New green manufacturing paradigm captures various planning activities to migrate from a less green into a greener and more eco-efficient manufacturing (Deif, 2011). Pursuing green manufacturing in the production of goods is very beneficial in the alleviation of environmental problems. Manufacturing companies have been implementing various environmentally friendly strategies and "green" products, consistent with the growing concern on the environmental issues for the society and governments around the world (Zhu & Sarkis, 2006). At the same time, there is an increasing demand from consumers that require their suppliers to create products that do not contain dangerous and poisonous substances. This, to some extent, has triggered certain level of awareness among manufacturers to produce green products to lessen the negative effects on the environment. Some companies or manufacturers like Sony Malaysia instill Green Supply Chain Management (GSCM) practices so that they can increase both monetary and operational advantages (Abdullah et al., 2016). By adopting GSCM, the organizations can diversify their products, enhance the quality and also reduce the cost of production (Shrivastava, 1995). Thus, in line with this background, this study will focus on consumers' perspectives as transportation users, as well as the manufacturers in the Malaysian automotive related companies because these automakers are playing a crucial part in reducing emissions in Malaysia.

In order to reap such benefits, green manufacturing should be incorporated in every aspect of the manufacturing processes (Tan et al., 2002). The expression "green" manufacturing can be understood in two approaches. Firstly, the manufacturing of green products, which utilizes renewable energy and clean technology equipment of numerous types with a lesser rate of CO_2 emission. Secondly, the manufacturing and usage of green products reduce waste and pollution by limiting the use of environmental resources, recycling and reusing what is considered as wastes. Achieving sustainable and green standard is not just a trend or pattern. The standard also allows the manufacturers to develop and implement sustainable and green practices that help organizations become more efficient, competitive and profitable. Manufacturers also realize numerous practical short-term financial benefits in implementing environmentally conscious products.

While the level of environmental awareness is increasing, the level of environmental disclosure and stakeholder demanding for environmental data is also on the rise (Russo & Fouts, 1997). New development in the ISO 14000[1] standards which is ISO 14001 helps organizations to implement environmental management. Environmental Management

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[1] A series of environmental management standards developed and published by the International Organization for Standardization (**ISO**) for organizations. The **ISO 14000** standards provide a guideline or framework for organizations that need to systematize and improve their environmental management efforts.

21

System (EMS) also forms the primary basis for the Green Supply Chain Management (GSCM) and in compliance with EMS, organization complements GSCM. It means that a company's environmental performance and its environmental reporting should be considered the strategic issues in business strategy, particularly for a developing country like Malaysia. Thus, many companies are under external pressure to enhance their environmental performance.

The idea of greening the supply chain or GSCM, is typically understood by the industry as a task force for their environmental performance. GSCM on their part will work with only those who meet their regulatory standards. The main impetuses for actualizing the idea into the organization's operations are numerous. They also include a scope of "receptive administrative motivations to proactive, vital and competitive advantage reasons" (Sarkins, 1999). These ideas additionally incorporate the notion of working cooperatively with providers in several ways. It includes green item outlines, holding awareness workshops, helping providers develop their own environmental programs and several others. These activities are quite distinct from the environmental activities that organizations attempt to implement with the sole aim of adapting to their own particular environmental responsibilities, being consistent, and having a competitive advantage.

Besides, the activity also emerges from the understanding that clients and other partners do not generally draw a line between an organization and its providers. There have been instances where organizations have been considered to be in charge of the environmental liabilities of their providers (Roa, 2002). However, there has been a conscious need to incorporate environmental concern into the economic concern of the methodology, with a specific end goal so as to help in contributing to the sustainability of the organization's future. Many environmentalists trust that the environmental sustainability and responsibilities of the organization rely upon these organizations, as shown by the providers (Godfrey, 1998). Having in mind the end goal to green the supply chain from the professional's perspective, companies have incorporated the thoughts of purchasing green products, having total quality management, regarding the empowerment of workers, having client focus, continuous improvement and zero waste, life cycle analysis, environment marketing and others.

Consumers nowadays have become more conscious about the environment (Laroche, Bergeron, & Barbaro-Forleo, 2001). Thus, implementing green and sustainable practices will promote the company's offerings more effectively, improve the company's reputation, attract new customers, and increase sales. The original equipment manufacturers (OEMs) or suppliers have rolled out numerous initiatives for the public to help attract a whole new base of customer, which result in the increase of sales. Thus, it is also important for the manufacturers to seek a government contract in which green manufacturing standards often become a factor.

Other than that, technology and social media developments also enable the buyers to easily and publicly promote or criticise companies for their green practices (Harmon & Auseklis, 2009). Besides, the varieties of tax credits and rebates on both federal and state levels are offered to encourage the manufacturers to proactively implement more

22

sustainable improvement (Chapman, 2008). There are also a variety of other incentives available for the business. Manufacturers will also gain benefits while discovering various approaches to make operations greener. An automotive industry has considerable innovations for "green" technologies (Bergmiller, 2006). While considering various approaches to reduce operational costs and mitigate its carbon, water and energy footprints, the industry may also utilize alternative propulsion technologies to lower the emission or light-weight composites to enhance the fuel economy. OEM and suppliers later realize that being environmentally conscious means being financially savvy and moving towards a leaner and greener manufacturing.

In this regard, businesses should implement environmental administration and incorporate green development into business procedures by bearing in mind that the end goal is to assemble and maintain competitive advantage. Nonetheless, green administrative development may not really represent greater environmental protection. Along these lines, top-level administration should concentrate on the green item and process development.

1.4   Problem Statement

The number of private vehicles increases, along with an improved standard of living, as shown in Figure 1.5. As Malaysians perceive vehicles as necessity goods, the perception will relatively increase the number of private vehicles on the road. It implies that, Malaysians are still not conscious about the adverse impact due to emissions produced by the private vehicles, particularly by the conventional vehicles (Kasipillai & Chan, 2008). It contributes to the damage of the environment. It seems very difficult to reduce the number of private vehicles as it is considered an important need in daily life.

Based on the above matter, initiatives that can be rolled out to reduce environmental pollution are through the green vehicle adoption or mandatory payments of road tax for non-green vehicles. However, Malaysian consumer acceptance towards environmentally friendly products is still low. Besides, the market for green vehicles in Malaysia is considerably lower than that for the non-green vehicles, as evidently illustrated in Table 1.2. The issues of the willingness to adopt green technologies remain unresolved. This study will, therefore, provide future insights to the local automotive industry on the consumer level of acceptance and preferences of green vehicles.

Based on the Transportation Policy in encouraging the use of public transportation, it proves to be relatively insignificant in overcoming the environmental issues (Timilsina & Dulal, 2011). Furthermore, rising gasoline prices also does not seem to reduce the number of private vehicles on the road (Ariffin & Zahari, 2013). On the account of petrol costs in Malaysia, the variance of the costs suggests no significant effects on the society, keeping in mind that the end goal is to diminish their dependence on the non-green vehicles (Kingham et al., 2001). However, the total vehicle sales in Malaysia continue to increase year by year, as depicted in Figure 1.6. Consequently, the level of CO_2 emissions continues to increase. The fuels itself cause more damages, which include

23

carbon discharges from the vehicles. The number of the private vehicles on the road remains high. The situation implies that the Malaysians are still not conscious about the negative impacts of the vehicles due to emission particularly from non-green vehicles.

The research also focuses on the prediction of the consumer's intention to purchase green vehicles by using an extended model of the theory of planned behaviour (TPB) in combating environmental degradation. This will determine the most significant factor regarding preferences towards green vehicles in the society. The concept of green products is still at its infancy, although the sales of green vehicles are expected to increase in the next few years in Malaysia (Rezai, 2013). There is only little knowledge about the consumers' green consumption pattern in Malaysia.

Industrial process is the main player and another element that contributes to the emission. The manufacturing process in the automotive industry also contributes to pollution if no control or guideline is obeyed by the industry. The standard (ISO 14000), in fact, allows the manufacturer to develop sustainable and green practices that help the organization become more ecologically efficient, competitive and profitable. Green innovation towards the industrial process becomes the standard procedure to make sure that industry players can achieve green requirements. In the case of green vehicle implementation, it is impossible to make a requirement that all automotive manufacturers should produce green vehicles only due to the fact that our automotive industry still lacks the expertise. At the same time, producing green vehicles does not necessarily mean that the the emission level can be reduced immediately because the industrial process itself is still new in its implementation and a lot of environmental aspects still need to be considered. In order to control industry players' activities, the green innovation or the standard on manufacturing specifically the automotive industry should be implemented. The green standard known as Green Supply Chain Management (GSCM) which is important to spur the industry should become more compliant, productive, high standard as the global player and market incentive. This green alternative could help the industry to become more competitive, but how far GSCM will influence the condition of Malaysian automotive manufacturers when the condition did not achieve some standards of quality, is still yet to be known. The GSCM truthfully helps the industry to become competitive with other developing countries.

This study will help determine whether or not adopting these environmental measures towards automotive related suppliers is worth the effort of these automotive related suppliers in terms of the economic and environmental performance. In addition, the relationship between Green Supply Chain Management (GSCM) practice and both economic and environmental performances may be moderated by other organizational practices. The fact that enthusiasm for green manufacturing is expanding tremendously within research and industrial communities shall be emphasised.

Research questions of this study: "What are the maximum level of percentage that consumers are willing to pay for non-green vehicles and their preferences towards green vehicles? Does 'habit' have a significant effect towards the extended theory of planned behaviour (TPB) on the prediction of the consumer's intention to purchase a green

vehicle? Has Green Supply Chain Management (GSCM) influenced the environmental performance and competitive advantage among automotive related manufacturers in Malaysia?"

Research Objectives:

The general objective of this study is to assess the consumer's awareness on green vehicles and the influence of green innovation among automotive related manufacturers in Malaysia.

The specific objectives are:

1. **To investigate** the willingness to pay (WTP) among the private vehicle users and their preferences towards green vehicles in Malaysia;
2. **To identify** consumer's intention to purchase green vehicles among Malaysians using an extended model of the theory of planned behaviour (TPB); and
3. **To examine** the influence of green innovation on operational, environmental performance and competitive advantage among automotive related manufacturers in Malaysia.

1.5   Significance of Research

This study analyses the willingness-to-pay (WTP) towards the adoption of green vehicles among private vehicle owners and the greening movement among automotive manufacturers in Malaysia. This research includes some variables, which affect their decisions by adjusting their preferences in the future. This study will make two major contributions to the economic and automotive (green vehicles) literature that will be referred to later by other researchers. Since there is less discussion associated with green vehicles and green manufacturing in the existing literature, the present study contributes significantly in both aspects.

This study adds to the body of knowledge based on three specific objectives; that is related to the academic significance, the first objective addresses the issues about the pollution from vehicles using the mandatory payment method (road tax price) and attributes which lead to the investigation of the maximum value of the willingness to pay (WTP) among consumers to reduce the emissions and to delve into the best attributes (green vehicles) most popular among consumers. As far as the theoretical significance is concerned, the second objective complements the extant literature on the intention to purchase by including "habit" in the extended model of Theory Planned Behaviour (TPB) which means, to understand consumer's behaviour towards green vehicle adoption. Based on the third objective, the study adds to the body of the existing literature on green innovation by considering too the "operational performance" in the GSCM framework to show that green innovation will also reflect on the companies' operational activities as well as the implication on competitive advantage.

Firstly, the study enhances the body of knowledge in the green vehicles, specifically in understanding the preferences and awareness towards the current environmental problems among the Malaysian private vehicle users. In this regard, this study seeks to characterize the Malaysian vehicle users' perceptions towards the green vehicle industry. Such perceptions include their commitment in terms of awareness towards the current environmental issues and local automotive industry. This study intends to look at the associations between the perceptions and their acceptance and willingness-to-pay. By implication, the findings from this study would provide some insights to help our nation. at the same time to develop our economy positively as a result of improved human capital and work efficiency, which are attributed to healthy living and a cleaner environment.

Secondly, the study contributes towards planning a strategic marketing. By focusing on the market for green vehicles in the local automotive industry, the findings from this study would help the policy makers to think of better ways in mitigating the current environmental issues. This finding will certainly generate important data that are useful to help authorities in planning an efficient utilization of green vehicle resources. Reasonably, the implications would favourably support the vehicle manufacturers by promoting green vehicles in the Malaysian market as a whole.

Lastly, this finding will help the authorities promote green technologies in the society more effectively. Such promotion is highly anticipated as environmental sustainability becomes the central focus of this study. Apart from that, it also highlights the environmental advantages and cost-related green vehicles in Malaysia. The environment must be viewed as a critical figure in the process of improvement and as one of the real major pillars during the process of development.

1.6   Organization of Thesis

This thesis is structured as follows. **Chapter 1** discusses the background of the study, research problem, research objectives and the significance of the study. As the study intends to look at the currently debated environmental issue, namely CO_2 emissions as a result of an increased adoption of non-green vehicles and non-green manufacturing by the automotive related suppliers, this researchconcisely delineates the background of the local automotive industry as well as its related policies. Concepts of green vehicles and green manufacturing from the global and local perspectives are briefly discussed before the research problem is highlighted.

Chapter 2 provides a review of the related literature, both theoretical and empirical. This chapter begins with arguments for and against environmental evaluation. It also discusses the issues of economic evaluation and the basic premise of total economic value (TEV) in detail. The varieties of techniques for economic valuation are also briefly clarified. The discussion on the speculation is subsequently presented, followed by the suitable research framework. This chapter concludes by discussing the several roles and aspects that need to be highlighted towards achieving sustainable adoption of green technology.

Chapter 3 discusses the research methodologies used to achieve the three research objectives. At the beginning, the study discusses two different surveys. After that, this study discusses both the Contingent Valuation Method (CVM) and Choice Modelling (CM) as these valuation methods are generally adopted and capable of capturing the non-market values to be used for the cost-benefit analysis (CBA). Subsequently, the confirmatory factor analysis (CFA) that builds up causal connections among the constructs as well as empirical investigation of the questionnaire are also discussed before explaining the Structural Equation Modelling (SEM). The chapter concludes by discussing the survey methods, the scope of the study, data collection and data analysis.

The empirical results are presented in **chapter 4** which include a respondent's profile, the estimated willingness to pay (WTP) values, the marginal values of the choice experiment (CE), consumer's attitude toward green vehicles and the influence of greening suppliers and green innovation towards environmental issues. The final **chapter 5** presents the summary and concluding remarks of the study, with policy implications and recommendations for future studies also included in this chapter.

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172

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