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Markov Chain Analysis to Identify the Market Share Prediction of New Technology: A Case Study of Electric Vehicle Usage in Batu Pahat, Johor, Malaysia

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Abstract: Electric cars are thought to be an effective way to reduce greenhouse gas emissions. Electric vehicle drives have several benefits over traditional internal combustion engines, including reduced local pollution, improved energy efficiency, and less reliance on oil. However, there are considerable challenges to the quick adoption of electric vehicles, such as battery technological constraints, high purchasing prices, and a lack of charging infrastructure. The purpose of this study is to predict the future market share of electric vehicles among road users. In this research study, the quantitative method is used as the research methodology by distributing questionnaires to road users and car dealers in Batu Pahat. The data will be analyzed by Statistical Package for the Social Sciences (SPSS). The most chosen dominant factor that influcing the purchase willingness towards electric vehicle in Batu Pahat, Johor is individual environmental awareness and the least chosen is purchase cost. To attract or increase the number of purchasing electric vehicle in Batu Pahat, government may provide government financial incentives.

Keywords: Markov Chain, Market Share, Technology, Electric Vehicle

1. Introduction

A car that is powered by one or even more electric engines or friction engines is known as an electric vehicle (EV). An electric vehicle (EV) is powered by an electric engine rather than an internal combustion engine that burns a mixture of gasoline and gases to produce electricity. Electric vehicles work by plugging into a charging station and drawing power from the system. They store energy in rechargeable batteries, which are used to fuel an electric engine that spins the wheels. Electric vehicles move more quickly than conventional fuel-powered vehicles, trying to make the users feel easier to drive. Electric vehicles can reduce greenhouse emissions and fuel demand while helping to solve environmental issues.

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"According to the research study, the global electric vehicle market in 2019 was approximately USD 140 billion. The market is expected to grow at a CGAR of 22% and is anticipated to reach around USD 700 billion by 2026" (Adnan, 2017). The global electric vehicles market is expected to grow significantly shortly because of the rapidly increasing year on year market penetration of electric vehicles worldwide; favorable policies, subsidies and incentives implemented by plenty of governments and the rapid institution of services agreement electric vehicles. Norway has the highest rate of plug-in electric vehicle purchase rate per capita consumption, preceded by California, the Netherlands, Sweden, and China. Certain models which we have in Malaysia, such as Honda HR-V and Volkswagen Golf, are also accessible as electric vehicle models in other countries, as Honda Everus VE-1 and Volkswagen E-Golf. For anyone confused, Malaysia has two distinct electric vehicles which are Nissan Leaf and BMW i3s. Both are available for RM188,888 and RM278,800.

One of the most significant achievements in the history of internal combustion engines is the automobile. This accomplishment resulted in a dramatic increase in the car industry because of high societal needs. The automobile industry, as well as other industries that sustain it, is becoming a popular company to work in a community. Nevertheless, as the amount of people who use automobiles grows, so does the amount of toxic gaseous emissions that pollute the environment. Electric vehicles are currently being introduced as a solution for the problem of dependency on fossil fuels, increasing carbon dioxide emissions, and other environmental issues. Electric vehicles have low running prices as they need lesser moving elements for maintaining and are conjointly environmentally friendly as they use very little or no fossil fuels like hydrocarbon or diesel. whereas some electrical vehicles used lead-acid or nickel metal binary compound batteries, the quality for contemporary battery electric vehicles is currently thought of to be atomic number 3 particle batteries as they need a bigger longevity and square measure wonderful at retentive energy, with a self-discharge rate of fifty per month.

Electric vehicles (EV) had quite a tough time being a widely available commodity. With many manufactures' latest suggestions of new products, the need for accurate forecasts of market size is higher than before. While public understanding of global warming grows, new political initiatives to fund scientific efforts aimed at addressing these issues have emerged. Malaysia is one of the world's most energy-intensive countries and it faces a significant challenge in improving energy quality while still working to reduce carbon emissions. The electric vehicle industry is still in its early stages of development in Malaysia. Nevertheless, the Malaysian government's electric vehicle policies and the acceleration of new product releases lead to the country's electric vehicle sector development. Malaysia's government intends for the country to be a major position in the world electric vehicles industry by 2030. Regrettably, challenges such as high price, lack of infrastructure, and technical limitations continue to be impediments to the development of the electric vehicles industry in Malaysia.

As air pollution grows, issues concerning modern technology development, leading to environmentally friendly products. Electric vehicle (EV) technology is one of the technologies mentioned. As a side effect of the electric motor launch vehicle, electric vehicles have low carbon concepts. In this context, low carbon theories can be applied mostly to a constructed electric vehicle, as well as to transferring a carbon vehicle to an electric version. The electric vehicle changeover could be developed depending on the specified storage capacity based on daily journey distance. The capacity of the battery divided by the average energy consumption of each kilometer can be used to predict the range distance from fully to low charged EV batteries. Speed target depends on the electric motor power used (Choi et al., 2011)

Electric vehicles are now broadly acknowledged as the future solution for sustainable transportation, especially in regard to automobiles transport vehicles. This is subject to the vehicles' subject pollution feature, which reduces environmental pollution caused by transportation processes within major urban centers while also making an important contribution to reducing pollution. Electric vehicles are on the verge of massively lowering pollution levels from the transportation sector. The number of electric vehicles on the road is steadily increasing, but there is a wide and significant acknowledgement by automotive buyers is based on the performance they can provide.

According to the survey conducted by Rakuten Insight, almost a quarter of Malaysian respondents were likely to pay the same amount for an electric vehicle as a conventional car. Around 17% of those respondents said that they were willing to pay up to 10% more for an electric vehicle than a traditional vehicle (Kaleg, 2015).

Therefore, to achieve the research objectives the key factors that influence the purchase willingness towards electric vehicles in Batu Pahat, Johor are determined. Consequently, the future market share of electric vehicles among road users is predicted.

This study was conducted at Batu Pahat, Johor. The respondents targeted in this study focused on road users and car dealers in Batu Pahat, Johor. This study used a quantitative method. A survey questionnaire was designed to collect primary data intended from 380 respondents for this study. The sample was selected randomly based on Krejcie and Morgan (1970).

2. Literature Review

2.1 Introduction

According to Leong *et al.* (2011), literature reviews are a comprehensive evaluation of the subject and the not only a necessity for education yet also needed for the preparation of a research study and for the contextualization of research findings. The literature review included the definition of the topics and terms. In fact, a literature review should be a critical review of the relevant literature from the previous studies of general review. In this chapter, the market share theory, Markov process and drawbacks of electric vehicles were discussed. Apart from that, the benefits of electric vehicles and factors of electric vehicles conversion were also established.

2.2 Market Share Theory

Market share and profitability can be explained as market power advantages. Market power is present when a firm is able to raise its prices or offer inferior products because its rivals are not able to offer customers a reasonable alternative (Dyer et al., 2006). So it's now obvious that market forces will enable companies to get their profits because they can charge customers with a premium price on the electric vehicles.

2.3 Markov Process

Markov process is a stochastic process whose movement over a period of time in a chain is described by a set of transition probabilities and depends only on the state where the process was before. The basic concept of the Markov chain is a stochastic movement, so any system that fulfils the Markov process description can be referred to as Markov' movement. The Markov chain model has been widely used in various decision-making issues as statistical analysis, forecasting techniques and decision-making (Dyer *et al.*, 2006). Certain features inherent in the transition probability matrix (MKP) allow information on the pattern of process movements such as the equilibrium distribution, the mean of the first route time and the degree of convergence to the equilibrium distribution are obtained. As a forecasting technique, the Markov chain model requires the process to be stationary. For example, the factors responsible for producing such movements do not change significantly at least in the forecasting period even without knowing specifically those factors. Compared to econometric methods that require knowledge of the interactions of these factors, the Markov chain model is an advantage.

There are several approaches for predicting the market acceptability of electric conversion vehicles, and one is the Markov Chain. The Markov Chain is a simple approach since it does not require any historical data and requires only a basic computation (Grinstead, 1997). Due to the extreme benefits, the approach is used in this paper. The Markov Chain analysis results can lead to the effective launch

of new technological items to acquire and use the commercial viability of Li-ion batteries. Furthermore, the data analysis will assist proactive business research of technology development in Malaysia.

Markov Chain is a mathematical tool for anticipating changes in some elements based on prior changes (Holland *et al.*, 2016). The Markov Chain approach is used in this investigation since the result is a percentage of market share projection. According to study (Kaleg *et al.*, 2015), which examined the Markov Chain technique as a novel approach for estimating market share, the Markov Chain model may generate nearly accurate findings with an error rate of less than 5%.

In the Markov Chain craftsmanship industry, it's utilized to figure out when the best time to do road repair. The regularity of which roads are repaired and maintained raises the expense to the Public Works Department, whereas less or no road construction increases traffic accidents. The challenge is being addressed using dynamic programming techniques to provide a yearly optimal rule base as a two-year alternative decision-making framework.

2.4 Electric Vehicles (EV)

Based on the current 2011 energy forecast, the transportation sector's proportion of total oil demand will climb from 40% in 2008 to 54% by 2035 assuming current trends persist. The Energy Information Agency, on the other side, predicts that growing fuel prices within the next twenty years might approach $5.50 a gallon in a high price situation. As a result, technologies aimed at lowering transportation sector oil usage, including plug-in hybrid electric vehicles or all-electric vehicles, are beginning to gain support in the market and may eventually replace diesel engine cars. According to several economic forecasts, electric vehicles might account for up to 86% of new light-vehicle sales by 2030, based on current oil prices and the comparative purchase price of internal combustion engine cars.

Electric vehicles have a higher cost of production than combustion engine vehicles, so they are not the first preference for a significant proportion of customers at the present time. Furthermore, due to the relatively moderate advancement of batteries performance in relation to certain other technologies, the overall production price of generation vehicles will not fall significantly in near future. According to certain industry sources, the overall cost of ownership of Li-ion powered electric vehicles, which includes the initial purchase price, gasoline, service and other expenditures during the lifetime of the vehicle, is cheaper than that of combustion engine cars during the life of the vehicle. Nevertheless, when it comes to car purchases, the majority of buyers wish to concentrate on the initial investment rather than the entire selling price. One way for the government or private enterprises to promote electric vehicles more marketable is to provide subsidies or funding to buyers.

The electric car is gaining popularity around the world due to its ability in combating climate change. Malaysia's transportation sector produces the second-highest amount of carbon emissions (Adnan *et al.*, 2017). Malaysia ratified the Kyoto Protocol in 2002, promising to decrease CO2 carbon emissions by 40% by 2020, compared to 2005 levels. One of the steps taken to meet that dedication was the advent of the electric vehicle (Leong *et al.*, 2011). As a result, measures have been implemented to encourage the use of electric vehicles. This involves the Malaysian National Automotive Policy and rewards refund taxes for electric vehicles imports. Electric vehicles can now be charged at home using a single-phase socket outlet for Level 2 charging.

2.5 Benefits of Electric Vehicles

While electric vehicles grow more popular, their prices are falling fast, and there are several advantages for users who make the move. From the environmental effect to the benefits of petrol, insurance, and maintenance expenses, electric cars have the potential to save you a substantial sum of money.

(a) Reduce car emissions to help the environment

Humans have consistently had a detrimental influence on the environment and converting to an electric car is one approach to avoid additional environmental harm. Carbon dioxide emissions from traditional vehicles increase greenhouse gas carbon dioxide levels and hasten global warming. While you are driving an all-electric car, there is no carbon dioxide is released into the environment, and hybrid electric automobiles use their battery to considerably increase the distance people can travel with a gasoline-powered engine.

Electric cars can run on energy generated from renewable sources like sunlight, water and wind whereas gasoline could only be made through heavy extraction and transportation procedures. Electric cars are also more ecologically beneficial than traditional automobiles since the huge battery within your electric car could be reused. People may assist to protect our natural environment by reducing your carbon emissions and pollution effect by purchasing an electric vehicle.

(b) Lower maintenance costs

Although the cost of an electric vehicle could be close to most other comparable petrol or diesel automobiles, the cost of ownership is much lower, especially over the vehicle's lifetime. From tax deductions and particular government subsidies to improved fuel economy, cheaper power costs, and fewer maintenance requirements, an electric vehicle might cost significantly less than your present vehicle.

Hybrid electric vehicles are designed to become as productive as possible, with three major components generating the vehicle: an onboard charger, a generator and a motor. This implies less wear and tear on the vehicle and much less strain on the engine, with lesser components prone to breakage. All of this means that your electric vehicle will seldom need to be maintained, and your operating and repair costs will be modest.

(c)Reduce noise pollution

Not only has air pollution been reduced. The fact that electric automobiles are substantially quieter than gasoline and diesel vehicles means that noise pollution may be considerably decreased, benefiting either neighbourhood or city centre regions. Living near major highways may no longer be a detriment while looking for a new house in the future, but rather a desirable feature for those who want to enjoy the benefits of transportation options.

In reality, because electric vehicles are really quiet, they are already obliged by law to include an Acoustic Vehicle Alert System (AVAS) that emits an artificial sound to alert their existence to pedestrians when reversing or travelling at less than 12mph (19km/h).

(d) Convenient home charging

The advantage of electric cars is that they can be charged anywhere there is an adequate electrical socket or plug. This means people may charge at public, work or home areas utilizing charge stations.

After installed, you will be able to charge your electric vehicles by just plugging in the charging wire after you have stopped the car. Most electric vehicles can charge to maximum capacity in around 5-10 hours using a 7kW home charging socket, so your car will be ready to go. Fast chargers can accelerate the process much more, charging most automobiles to roughly 80% in about an hour.

Electric vehicles owners tell us that they like the freedom that comes with driving an electric vehicle. Not just for the flexibility of charging while the vehicle is parked at home or work and never need to stand in line at the pump again, but also for the financial savings.

2.6 Drawbacks of Electric Vehicles

Even though proof of the benefits is obvious, there are certain drawbacks that each individual should consider before making an electric car their next significant purchase.

(a) Recharge points

Electric fueling stations are still in the early phases of development. Because not many sites you travel on a regular basis have electric fueling stations for your car, if you are on a long journey or plan to visit relatives in a rural or suburban region and run out of energy, it may be more challenging to find a charging station. You can be stuck in your current situation.

Nevertheless, before charging stations become more common, make sure to have a charging station map of where you stay and where you usually go so that you can charge your electric vehicle whenever you need to.

(b) Silence as a disadvantage

Individuals prefer to hear noises coming from behind them, thus silence might be a negative. An electric automobile, on the other hand, is silent and in certain situations can cause an accident.

(c) Longer recharge time

Filling up a petrol tank at a petrol station can take about five minutes, however, charging an electric car's battery takes significantly longer. An electric automobile might take up to 15 hours to completely charge, regardless of the type. Models that are newest and more costly may charge in as fast as four hours. Nevertheless, installing a charging station in your garage make this more practical and charging equipment are available to assist speed up the process.

(d) Increased electricity cost

Electric vehicles may potentially be expensive on your energy bill if you do not properly analyze your alternatives. If you have not made up your mind about the electric vehicles you intend to buy, you might be making a bad decision. Electric vehicles might often require a large charge to work correctly, which might have a negative impact on your monthly power consumption.

(e) Shorter driving range

Despite automakers' efforts to extend the range of electric vehicles, they still have a limited range than regular vehicles. An electric automobile can typically go between 60 and 100 miles on a single charge. Based on the fuel economy of the vehicle and the capacity of the petrol tank, some vehicles may travel up 10 400 miles on a single tank of petrol.

2.7 Factors of Electric Vehicles Conversion

Electric vehicle conversion is the process of replacing a car's combustion engine and related parts with an electric engine and batteries, resulting in an all-electric vehicle. The conversion of an internal combustion engine car to a battery electric vehicle has some primary goals.

(a) Minimize the emission

The first is to minimize the emissions of existing automobiles on the road, as electric vehicles do not emit any pollutants. High petroleum use in Malaysia's transport industry not only raises issues about national renewable energy but also creates several worries about the environmental consequences of greenhouse gas emissions.

(b) Minimize the massive quantity of garbage produced

The second goal is to minimize the massive quantity of garbage produced when automobiles reach the end of their lifespan since older automobiles or those written off in a vehicle accident are often discarded. This generates a significant quantity of metal, plastic, and fabric waste while also consuming a significant amount of energy to recycle discarded components into valuable components.

(c) Price

Another important driver of the rising electric car conversion industry is price. In recent years, the cost of electric car batteries and motors has decreased, and the cost of conversion is currently significantly less than the cost of acquiring a new electric automobile.

2.8 Previous Study

According to the research of Markov chain analysis to identify the market share prediction of new technology: A case study of electric conversion motorcycle in Surakarta, Indonesia. In 2017, Indonesian motorcycle sales totalled 113,030,793 units, an increase of 4% over the previous year. The internal combustion engine (ICE) or burning fuel technique is employed. Motorcycles are the largest contributors to greenhouse gas emissions; hence this technology is linked to the energy problem and global warming. By replacing petrol with a Lithium-Ion battery package as the energy source, an electric conversion motorbike might be a solution to the concerns. This has the potential to be a profitable business in the future since it can tackle problems that are threatening the planet, such as the energy crisis and global warming. Market share must be estimated in order to anticipate a technology's market share. The population of Surakarta was used to test market share predictions. This survey of 100 people revealed probable categories of electric conversion motorcycles as a consequence of the findings. The expected market share for the first period is 36 per cent, 44.24% for the second period, and 46.51% for the third quarter. The third stage is the stability phase, during which the demand for electric motorcycles will remain steady. People in Surakarta have responded positively to electric conversion motorcycles.

Based on the research, the results showed motorcycle sales in Indonesia climbed by 4% every year, affecting the energy crisis and increasing greenhouse gas emissions. Bikes equipped with internal combustion engine technology (traditional motorcycles) have several negative consequences, including increasing government subsidies and expensive operating maintenance costs. Electric motorbikes might be the solution to these issues. With a selling price of roughly USD 1,410, it is clear that the market for electric conversion motorcycles in Indonesia is extremely significant. Market share forecasting was requiring estimating the economic viability of electric conversion motorcycles.

The market share forecast of electric conversion motorcycles can be one part of developing a new technology business in Indonesia based on the findings of this study. Future research might look at other technological and economic issues to evaluate if the product is viable.

3. Research Methodology

3.1 Research Design

The researcher should determine the research design before starting the study. There are three types of designs which are qualitative, quantitative and mixed-method (Rezvani et al., 2015). The approach chosen in the analysis would include guidelines for the strategies and steps of the project.

In this research, the method used to conduct the analysis is quantitative research. Quantitative research is the method to generate numeral data and transform it into statistical results. According to Tie et al., (2015), the approach will focus on the data collection from the problem of a large population

and analyzes the data while ignoring the emotions of the person and the environment of it. The data collection process will be conducted by the forms of survey such as questionnaires, online surveys, mobile surveys and others. Therefore, this research will be focused on the questionnaires that are distributed to respondents to collect the data thus achieving the research objectives.

3.2 Research Population and Sample

In this research, the target population in this research will be the road users and car dealers in Batu Pahat, Johor. The car dealers in Batu Pahat, Johor are KCT Auto Enterprise, BR Jaya by Mercedes-Benz Malaysia, MGL Auto Enterprise and so on.

The size of the sample in this research will be determined by referring to the Krejcie and Morgan table. According to Krejcie & Morgan (1970), the sample size of this study is 380 road users and car dealers in Batu Pahat, Johor.

3.3 Sampling Method

For sampling method, it consists of two types which are random sampling and non-sampling. Based on the research of Dimvati (2018), probability sampling refers to the method that every person in the population will have a chance to be selected while non-random sampling is focusing on the smaller samples and more details and specifies. In this research, a non-random sampling technique was used in this study. Non-random sampling is divided into 4 types which included quota sampling, snowball sampling, judgement sampling and convenience sampling. The method used to collect data is convenience sampling. The researchers choose the method because of the simplicity of sampling and the ease of research.

3.4 Data Collection

Data collection is the essential part of research to ensure the research process runs smoothly for achieving the research objectives. It is the process of collecting data from the relevant sources, hypothesis testing and evaluating the outcome. This research consists of two types of data which are primary data and secondary data.

(a) Primary data

There are three approaches for the researchers to collect primary data which are observation, interviewing and questionnaire. In this research, the researcher uses a questionnaire to collect primary data. The questionnaire is distributed to the road users and car dealers in Batu Pahat, Johor. The purpose of the questionnaire is to identify the factors that affect to future share of electric vehicles among road users in Batu Pahat, Johor.

(b) Secondary Data

Based on the study, secondary data is obtained from the Internet and library resources. The sources were obtained from journals, books, reports, published articles and official websites. The implementation of secondary data is playing important role in research as it improves the degree of the validity and reliability of research. In this research secondary, data will be used to achieve the research objective.

3.5 Pilot Study

The questionnaire used in this research was developed by referring to the relevant previous studies and literature review. Hence, a pilot test will be carried out before the distribution of the questionnaire to measure the validity and reliability of the questionnaires. It is the final critical step in data collection as it helps to improve the reliability of the survey questionnaires. A total of 30 questionnaires were used for the pilot test.

3.6 Research Instrument

The questionnaire is an instrument that includes a series of questions with the purpose of collecting information from respondents. The data collected from the questionnaire were used to determine the factors that affect the future market share of electric vehicles among road users. The questionnaire is divided into two parts, which are Part A and Part B. Part A is the demographic information of respondents. Part B consists of the item related to the future market share of electric vehicles among road users.

3.7 Data Analysis

In this research, the data collected from the questionnaire were analyzed by using descriptive statistics. Descriptive analysis is the method that simplifies, summarizes and organizes the numerical data. The software that is used to analyze data is Statistical Package for Social Sciences (SPSS) and forecasting techniques.

4 Results and Discussion

4.1 Survey Return Rate

The questionnaires were distributed to the road users and car dealers in Batu Pahat in the form of softcopy, Google Form. There were around 156,236 residents in Batu Pahat and based on Krejcie and Morgan (1970), sample size of 380 respondents is needed. Total of 217 sets of questionnaires from the issued 380 have been collected with the assistance of the targeted respondents. Hence, the questionnaire survey return rate obtained a 57.11% in this study. The data was tabulated in Table 1.

Table 1: Survey return rate

Population	Sample Size	Questionnaire Distribute	Valid Questionnaire Returned	Percentage (%)
156,236	380	380	217	57.11%

4.2 Reliability and Validity Analysis

The reliability and validity test is conducted for both pilot study and actual study to ensure the reliability and consistency of the questionnaires.

(a) Reliability and validity of pilot study

Table 2: Reliability test for pilot test

N of Items	N of Respondents	Cronbach's Alpha (α)

20	30	0.729

Based on Table 2 above, the Cronbach's Alpha value for the pilot test was 0.729. The number of respondents needed in this test is 30 students. The result shows that the value obtained in the pilot test was acceptable for reliability of the questionnaire research

(b) Reliability and validity for actual study

Table 3: Reliability Test for actual study

N of Items	N of Respondents	Cronbach's Alpha (α)
20	221	0.903

Based on Table 4.3 above, the Cronbach's Alpha value for the actual test was 0.903. The number of respondents needed in this test is 221 students. The result shows that the value obtained in the pilot test was good for reliability of the questionnaire research.

4.3 Part A: Demographic Analysis

Descriptive analysis is the method that simplifies, summarizes and organizes the numerical data. The demographic data and information collected in the questionnaire were analyzed by using descriptive analysis. The demographic information including gender, race, nationality, year of study and institution of study will be discussed in the sections below.

(a) *Summary statistics of demographic analysis*

There were 122 out of 217 (56.2%) respondents were males. Besides, there were 95 female respondents (43.8%) who took part in the research. The results concluded that female respondents were more than male respondents.

In the age group, most of the respondents who are from 25 – 34 years old (32.7%) and followed by 60 respondents (27.6%) who are from 18 – 24 years old. There are only 2 respondent (0.9%) from ≥ 65 years old.

Most of the respondents in this study were Chinese with the number of 86 respondents (39.6%). The second followed by Malay with 72 respondents with the percentage of 33.2% and 59 of Indian respondents (27.2%).

There were 109 out of 217 (50.2%) respondents were married and 103 respondents (47.5%) were single. Besides, there are only 5 respondents (2.3%) were divorce.

Most of respondents' educational level are diploma or degree, 103respondents (47.5%) and 87 respondents (40.1%) have only secondary education. There are 18 respondents (8.3%) have primary education and for postgraduate is 9 respondents (4.1%).

In terms of the number of vehicles owns, 164 respondents had only 1 vehicle and there are 2 respondents (0.9%) have 3 vehicles. There are 30 respondents (13.8%) having 2 vehicles. However, 21 respondents in this study are not owning any vehicles.

For personal income, the number of respondents with more than RM5,000 salary is relatively small, 12 respondents. There are 106 respondents' monthly income is within RM1,001 to RM3,000, 48.8%. Besides, there are 51 respondents' monthly income is lesser then RM1,000.

From the experience of vehicle purchase, the feedback of the purchase of electric vehicles is still a minority, only 4 respondents have bought (1.8%). There are 182 respondents (83.9%) purchased the petrol vehicles, and 15 respondents (6.9%) bought diesel vehicles and the hybrid vehicles are 16

respondents (7.4%). It is another way to understand that the electric vehicle market still has great opportunity to develop, the prospect may be optimistic.

There are 82 respondents (37.8%) had 3 to 5 years drive experience and followed by 6 to 8 years' experience, 68 respondents (31.3%). 37 respondents (17.1%) have less than 3 years driving experience, and 25 respondents (11.5%) have 9 to 12 years' experience. Only 5 respondents (2.3%) have more than 13 years driving experience.

For this study we known that main usage of the car users is commuting, 89 respondents (41.0%), and 62 respondents (28.6%) used the vehicles for family reasons. Besides, there are 30 respondents (13.8%) bought the vehicles for business and 29 respondents (13.4%) used it for entertainment. Only 7 respondents (3.2%) used the vehicles for travel.

For this study we known that main usage of the car users is commuting (35.2%), and 36 respondents (29.5%) used the vehicles for family reasons. Besides, there are 24 respondents (19.7%) bought the vehicles for business and 13 respondents (10.7%) used it for entertainment. Only 4.9% of respondents used the vehicles for travel.

4.4 Part B: Analysis of the Dominant Factor that influence the purchase willingness towards the electric vehicles in Batu Pahat, Johor.

This section is to analyse the dominant factor that influence the purchase willingness towards the electric vehicles in Batu Pahat, Johor. Part B consists of 20 Likert Scale question and the method used to analyse the results would be descriptive analysis.

(a) Personal factors

Table 5: Descriptive analysis (Personal factors)

Descriptive Statistics			
	N	Mean	Std. Deviation
I am willing to buy electric vehicles.	217	3.78	1.121
I choose to purchase electric vehicle is because I love to try new thing.	217	3.58	1.116
The higher driving range of electric vehicle will provide me with more satisfaction.	217	3.88	0.991
Driving electric vehicle can reduce monthly spending compare with gasoline.	217	3.89	1.044
I have plans to purchase an electric vehicle in the coming ten years.	217	3.94	1.161
Valid N (listwise)	217		

Table 5 indicated the descriptive analysis for the education dimension. The table shows the five items in this group with their mean and standard deviation respectively. The highest mean is scored by item 5, I have plans to purchase an electric vehicle in the coming ten years with a mean value of 3.94. Meanwhile, I choose to purchase electric vehicle is because I love to try new thing had the lowest mean which is 3.58. The second highest mean are the higher driving range of electric vehicle will provide me with more satisfaction,3.88 and driving electric vehicle can reduce monthly spending compare with

gasoline with a mean value of 3.89. Lastly, I am willing to buy electric vehicles had the mean value of 3.78.

(b) Purchase cost

Table 6: Descriptive analysis (Purchase cost)

Descriptive Statistics			
	N	Mean	Std. Deviation
I can afford an electric vehicle.	217	3.11	1.175
I think the price of electric vehicle in Malaysia is reasonable now.	217	3.25	1.128
In general, the price of electric vehicle is more expensive than conventional vehicle.	217	4.06	0.828
Under a similar price, I prefer to buy electric vehicles compared to conventional vehicles.	217	3.98	1.023
Compared with conventional vehicles, electric vehicles are more attractive.	217	3.93	1.065
Valid N (listwise)	217		

Table 6 showed the descriptive analysis of the second dimension, purchase cost. In general, the price of electric vehicle is more expensive than conventional vehicle scored the first ranking with a mean value of 4.06. The second highest will be under a similar price, I prefer to buy electric vehicles compared to conventional vehicles with a score 3.98. Then, I can afford an electric vehicle is the minimum mean value of 3.11. The item of I think the price of electric vehicle in Malaysia is reasonable now had a mean value of 3.25 and compared with conventional vehicles, electric vehicles are more attractive scored a mean value of 3.93.

(c) Individual environmental awareness

Table 7: Descriptive analysis (Individual environmental awareness)

Descriptive Statistics			
	N	Mean	Std. Deviation
I think the electric vehicles are helpful for environmental protection.	217	4.41	0.903
I have strong environmental awareness.	217	4.18	0.911

I am willing to pay more to buy environmentally friendly products.	217	4.23	0.883
I think that our consumption should be responsible for the environment.	217	4.35	0.858
Driving electric vehicles can reduce the current environmental pollution.	217	4.38	0.837
Valid N (listwise)	217		

In Table 7, the descriptive analysis for the dimension of individual environmental awareness is showed. There is an outstanding mean value of 4.41 which is scored by item 1, I think the electric vehicles are helpful for environmental protection. The lowest mean value is the I have strong environmental awareness (4.18). The other three items, I am willing to pay more to buy environmentally friendly products, I think that our consumption should be responsible for the environment and driving electric vehicles can reduce the current environmental pollution had a mean value 4.23, 4.35 and 4.38 respectively.

(d) Perceived social factor

Table 8: Descriptive analysis (Perceived social factor)

Descriptive Statistics			
	N	Mean	Std. Deviation
Other people are positively impressed that I drive electric vehicle.	217	4.12	0.940
Driving electric vehicles improves the good ways I am perceived by others.	217	4.09	0.861
I am proud when I am driving electric vehicle.	217	3.84	0.999
Others perceive me as a fashion person when I am driving an electric vehicle.	217	3.91	1.035
Other perceive me as an environmentally friendly person when I am driving an electric vehicle.	217	4.24	0.956
Valid N (listwise)	217		

Table 4.8 presented the descriptive analysis for the dimension of perceived social factor. I am proud when I am driving electric vehicle with a value of 3.84. The highest mean value is scored by other perceive me as an environmentally friendly person when I am driving an electric vehicle with a value of 4.24 and the second highest will be the other people are positively impressed that I drive electric vehicle scored the minimum mean value of 4.12. Thus, driving electric vehicles improves the good ways I am perceived by others scored a 4.09 mean value. The fourth item, other perceive me as a fashion person when I am driving an electric vehicle had a mean value of 3.91.

5. Discussions and Conclusion

In this research, questionnaires are used to determine the dominant factor that influencing the purchase willingness towards electric vehicle in Batu Pahat, Johor. There are four factors with 20 items in Part B of the questionnaire which are personal factors, purchase cost, individual environmental awareness, and perceived social factor. The respondents ranked the score with their perception that they were strongly agree. Agree, moderate, disagree and strongly disagree.

The most chosen dominant factor that influcing the purchase willingness towards electric vehicle in Batu Pahat, Johor is individual environmental awareness and the least chosen is purchase cost. Personal factors gained a mean value of 3.6672 and the second highest mean value, 3.8541 was the perceived social factor.

To attract or increase the number of purchasing electric vehicle in Batu Pahat, government may provide government financial incentives. The policies of government financial incentives can improve consumers' willingness to purchase electric vehicles and are beneficial to consumers' adoption of electric vehicles. As consumers, they are rational when buying large or expensive products. The Malaysia government released a series of financial incentives, such as tax credits and tax exemptions. To some extent, it helps consumers reduce purchase costs and budget constraints. After a rational analysis, consumers feel that it is less than the original expenditure, so they may be more willing to purchase an electric vehicle.

5.1 Limitation of Research

There are some limitations faced when conducting the research in this study. First, the researcher faced difficulties in the data collection process. The researcher was difficult to collect the questionnaire from the respondents. As some of the respondents were not willing to answer the questionnaire or they thought that it was merely a waste of time, so the research only received total 122 questionnaires out of 380 questionnaires. In addition, due to the limitation of time and finance, the research only covers car dealers and road users. Besides, the research location also limits in Johor state only. Hence, limitations should be taken into consideration for future studies.

5.2 Recommendations

(a) Recommendations for government

For this kind of research, government usually plays an important role for sustaining and improving the sector. The government of Malaysia should strength the environmental awareness with encourage consumer to purchase the electric vehicle as this type vehicle will be Malaysia next engine for upcoming economic growth. Besides, there is also recommendation for the car dealers collaborate with government to consider the new aspects to attract consumers during this pandemic situation. By doing so, there will be more consumers may choose electric vehicle than conventional vehicle thus will help to reduce current environmental pollution.

(b) Recommendation for future researchers

There are some directions and suggestions for the related research to make improvements when conducting the future research of EV vehicle. Future research should be done with a more diverse and bigger sample size. For instant, future research should cover all of the public and private universities in Malaysia. Apart from that, this research only focus on five dimension of the factors which are education, image of country destination, availability of facilities, government initiative and weather/seasonal and intention one time only. Future research can be done with the combination of pre- and post-data of the respondents. Furthermore, the future also can be conducted in the form of qualitative method. By having an interview session with the respondents, the result data will be more accurate and precise.

5.3 Conclusion

In this research, the target respondents are the road users and car dealers that located at Batu Pahat, Johor. The questionnaire was distributed by the researcher through social media such as Facebook, WhatsApp, and E-mail. The actual sample size were 380 respondents however there are only 122 respondents were willing to participate in the research and answer the questionnaire to determine the dominant factors that influencing the purchase willingness towards electric vehicle in Batu Pahat, Johor. Based on the analysis, there are 67 respondents are female and the rest of 54 respondents are male. Majority of the respondents in this research is Malaysia and most of the respondents are Chinese with number of 55 respondents. Other that, there are 48.8% of respondents are married and 47.1% of them have diploma or degree education. 71.1% of respondents owning 1 vehicle and 37.2% of respondents have 6 to 8 years driving experience. Most of the respondents' monthly income is between RM1001 to RM3000. The main usage of the vehicle to 35.5% respondents is commuting and only 5% respondents used vehicle to travel

The effect on the ecosystem is now taken seriously by the community. In conclusion, electricvehicles (EV) that can reduce emissions has gained popularity. Electric vehicles have become one method of reducing harmful gas emissions caused by internal combustion engines. Nowadays, people are searching for the best alternative to the emissions crisis caused by diesel engines in automobiles. Electric vehicles (EV) have emerged as an effective option for reducing the use of diesel engines. Due to the constraints in the efficiency of electric vehicles, a proposal to develop electric vehicles must be completed. It is necessary to determine a successful control technique.

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