

Statistical methods for market research (ST3188)

Research Proposal



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Executive summary

The electric vehicle industry has become a rapidly growing market for the past couple of years. Tesla is the leading brand in the electric vehicle market for more than a decade now. But the market for EVs became more competitive when huge-scale automotive companies moved to EV manufacturing.

Tesla's objective is to "accelerate the transition to sustainable energy around the globe".

This research aims to understand drivers' attitudes towards electric cars, and brand perception of tesla among drivers of different manufacturers to acquire more customers as well as retain the current customer base and to help understand the market potential for a new product line by identifying the evolving consumer appetite.

The research model includes a literature review and a deep identification of factors affecting the business objective founded by previously completed researches. From that the research questions were designed and the hypothesis comes next to find any relationship between the factors. A graphical review showing what are the factors affecting the research problems will be the analytical model.

Research design will include why the survey methods are been chosen over other survey methods. The advantages and disadvantages of using specific methods will be discussed in research design.

Sampling design will include population that will be mainly targeted for the research and the sampling frame. Size of the samples will be calculated by considering the factors that can affect the bias in response, completion rates, and incident rates.

Surveys will be done using web-based online surveys and face-to-face survey methods. The information found will be analyzed using regression analysis, factor analysis, and cluster analysis.

Findings obtained from the analysis will help in the decision-making on how to increase customer attitudes toward EV, how to have a higher brand perception, and what factors affect the most when introducing a new product line in the future.

1.0 Introduction

Tesla is a multinational automotive and energy company located in Texas, United States. formed in 2003 by Martin Eberhard, Marc Tarpenning, and Elon Musk, the company has 6 large-scale vertically integrated factories on 3 continents with 100,000+ workforce around the world.

Tesla's products alternate through the electrical range from electric cars, electric SUVs, solar panels, solar roof tiles, and many more. The key competitors to the company are Ford, Rivian, GM, NIO, and Volkswagen. (About, 2022)

According to CEO Elon Musk, the mission of the company is to “switch to sustainable transport by bringing compelling mass-market electric cars to market as soon as possible”. (Musk, 2013)

1.1 Research aims

- Understand drivers' attitudes toward electric cars.
- Identify the brand perceptions among motorists of different manufacturers to assist with customer acquisition and retention.
- Help understand the market potential for new product lines and evolving trends in consumer appetites.

1.2 Business objectives

- Accelerate the transition to electric cars globally while acquiring a bigger market share than its competitors.
- To retain existing customers and acquire new customers in the long run.
- Diversify tesla's existing product range and, utilize its research and development budget.

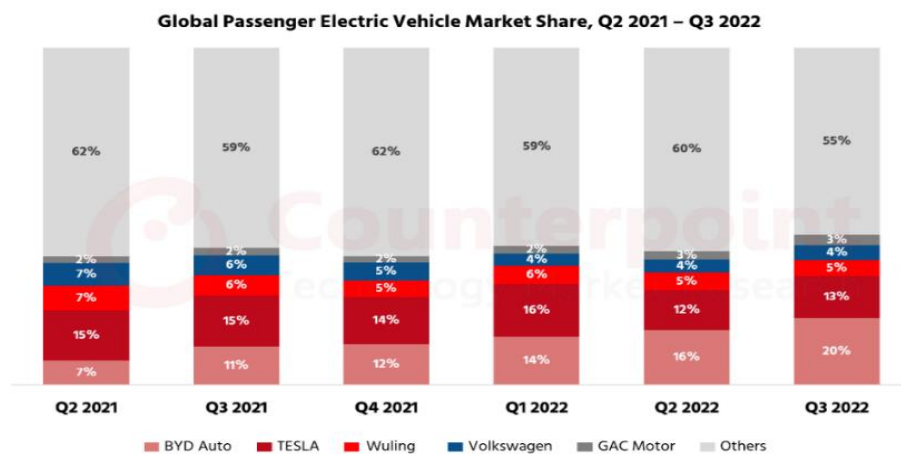
2.0 Business context

The world EV market size in 2021 was around USD 180 billion and is expected to reach USD 860 billion by 2027 with a compound annual growth rate of approximately 17.02%. (Statista, 2019)

Electric vehicles can be segmented into 4 types as **Battery Electric Vehicles (BEVs)**, **Hybrid Electric Vehicle (HEV)**, **Plug-in Hybrid Electric vehicles (PHEV)**, and **Fuel Cell Electric Vehicle (FCEV)**. (Versaw, 2022)

Since tesla has only 4 straightforward lineups to choose from. It became a major threat to the company by its competitors. as a result, rapidly growing automotive company BYD auto became the first company to surpass tesla in electric vehicle market share (including all 4 segments) in Q2 of 2022. (Mukherjee et al., 2022).

Tesla's 4 models are Model S, Model 3, Model X and Model Y. In a tesla, there are mainly 4 things to decide which are, the interior, full-self-driving, wheel, and color options. (Brown, 2020) The minimized interior of tesla is preferred by customers and it has been a good marketing strategy ever since the first tesla. Though Tesla is still ahead in BEV market share it is important to diversify its existing product range to remain at the cutting edge of competition. (Idea Theorem, 2022)



Global quarterly market share

The primary income demography of Tesla is for customers with higher incomes. About 83% of Tesla owners are men, where it is only 49% of drivers for other manufacturers. For Tesla, roughly 70% of consumers are 34 years old or less. (Kay, 2022)

Supercharging network of Tesla is considered a major competitive advantage because it has more locations, more units per charging station, and the capability of providing up to 200 miles of range in just 15 minutes. (Ali, 2022) China has the largest market for electric vehicles, therefore more than 10,000 Tesla supercharging stalls are in China. That is one-fourth of the total stall worldwide. (Kane, 2022)

The company always highlights the eco-friendliness of its product. Tesla doesn't have any franchises or third-party interactions, therefore consumers always receive true information. (Papia, 2022)

3.0 Problem Definition

3.1 Marketing decision problem

1. How to accrue more market share to compete in the fast-evolving electric vehicle market?
2. How can the company improve its brand perception to make its existing customers brand loyal and further acquire new customers?
3. The company is keen on understanding how it should diversify its current product range further and identify where it should direct its research and development budget.

3.2 Marketing research problem

1. What are the factors that **influence customer attitudes** toward electric car adoption?
2. Identity how important is **brand perception** for tesla to acquire new customers and make its current customer base remain loyal to the brand?
3. what factors should be further analyzed using the company's research and development budget to meet the current and future **consumer appetite**?

4.0 Research model

4.1 literature review

primary factors that influence drivers to adopt battery-electric vehicles fall under 3 groups, demographical, situational, and psychological, factors. (Wenbo, Long, Chen, & Geng, 2017)

Demographical factors include individual variables (e.g., customers' age, household incomes, gender, education, etc.) and family variables (capability of charging vehicles at home). The study found that young and medium-aged, highly educated male consumers have higher intentions to adopt an EV. Low-income households are more likely to benefit from an EV even though they are still less likely to adopt one. The study found that low-income EV buyers are more sensitive to incentives and that purchase incentives have become more substantial over time. Home charging accessibility is cost-efficient, safer, and convenient. Since most EVs come with a level 1 charger it'll take more time depending on the battery size. But installing a level 2 charger will help reduce paying higher prices for third-party power providers and faster charging at home. (Wenbo, Long, Chen, & Geng, 2017)

Situational factors include technical features, cost, government policies, driving range, and charging. Government policies include financial support, free parking, and driving privileges. The study has found that EV adoption increases when more strong policies were implemented. Economic incentives influence customers to adopt EVs because they can save money for them. It also suggests that cutting off or reducing purchase tax and VAT, are the most powerful incentives in inspiring adoption. Guiding consumers to plan their travel time and distance, how to use charging infrastructure to satisfy customer demand, and how to guide consumers to calculate the cost according to their driving routines can solve issues in driving range and charging. (Wenbo, Long, Chen, & Geng, 2017)

Psychological factors include experience and perceived behavioral control. With more realistic experience, drivers are more optimistic towards the performance of EVs than earlier and didn't consider charging a dilemma. However, they were more concerned about the capability of BEVs to reach their travel requirements. (Wenbo, Long, Chen, & Geng, 2017)

Maintenance costs for electric vehicles are 10% - 15% less than for an internal combustion vehicle. And electric vehicles have a cost-benefit because even the highly efficient conventional hybrids can only use 45% to 50% of gasoline energy density. Although an electric car can use around 90% of the energy reserved in its batteries. Since electric cars produce far less greenhouse gas than conventional cars, their environmental friendliness is a crucial advantage for a company's brand perception. (Hirsch, 2022)

EVs are attractive because the front of an electric car looks more elegant and futuristic than gas-powered vehicles. The main exterior deviations between electric and conventional vehicles are the removal of the front engine, grill, exhaust pipe, and fuel tanks. And because of no engine in front, there's space for a second trunk, therefore it is more reliable. (Oswald, 2019)

Lithium-ion batteries are a key component in the glory of EVs because of their higher energy densities and long service lives. But nowadays LIBs are pricey and have a limited capacity to output the performance necessary to improve EV development. Short driving range by a single charge and long charging time are the key issues of the wide consumer market. highly productive and powerful LIBs have open safety concerns because of their high flammability. All-solid-state batteries (ASSB) where solid electrolytes have been used instead of liquid organic electrolytes is a higher-level battery system. In addition to their nonflammability, ASSBs have higher energy densities, which will help in more range by a single charge. Therefore, ASSBs are a promising option that next-generation consumers will prefer over a vehicle with lithium-ion batteries because of the benefits they receive. (Sun, 2020)

Self-driving cars are the key technology to reducing road accidents. The on-road analysis results in California indicate that more than 3.7 million miles were analyzed for autonomous vehicles by different companies between 2014 and 2018. 128 accidents were reported over 3.7 million miles, and roughly 63% of accidents happened when driving in self-driving mode. But only 6% of the total accidents are straightly related to EVs, while 94% of the accidents are caused by pedestrians, cyclists, motorbikes, and combustion engine vehicles. Therefore, the study implies that altering and avoiding safety risks caused by other parties and improving the technology to an extent where they can be installed in a new future product, will be a successful step in making safe decisions to prevent fatal accidents and meet the forthcoming consumer appetite, where consumers will prefer it over a non-self-driving car. (Wang et al.)

4.2 Research questions

Research problem 1

1. What factors will influence customer attitudes toward EVs?
 - a) How does household income affect customer attitude?
 - b) Is there a correlation between home charging accessibility and customer attitude toward Electric vehicles?
 - c) How do government policies for electric vehicles work as an incentive to influence customer attitude?
 - d) How does Experience affect customer attitude?

Research problem 2

2. What are the factors that will increase the brand perception towards electric vehicles?
 - a) How does style and design affect the brand perception of an automotive company?
 - b) Is there a correlation between eco-friendliness and brand perception?
 - c) Does an electric vehicle being energy efficient have an impact on the company's brand perception?
 - d) Does a product with low maintenance cost have a significant effect on its company's brand perception?

Research problem 3

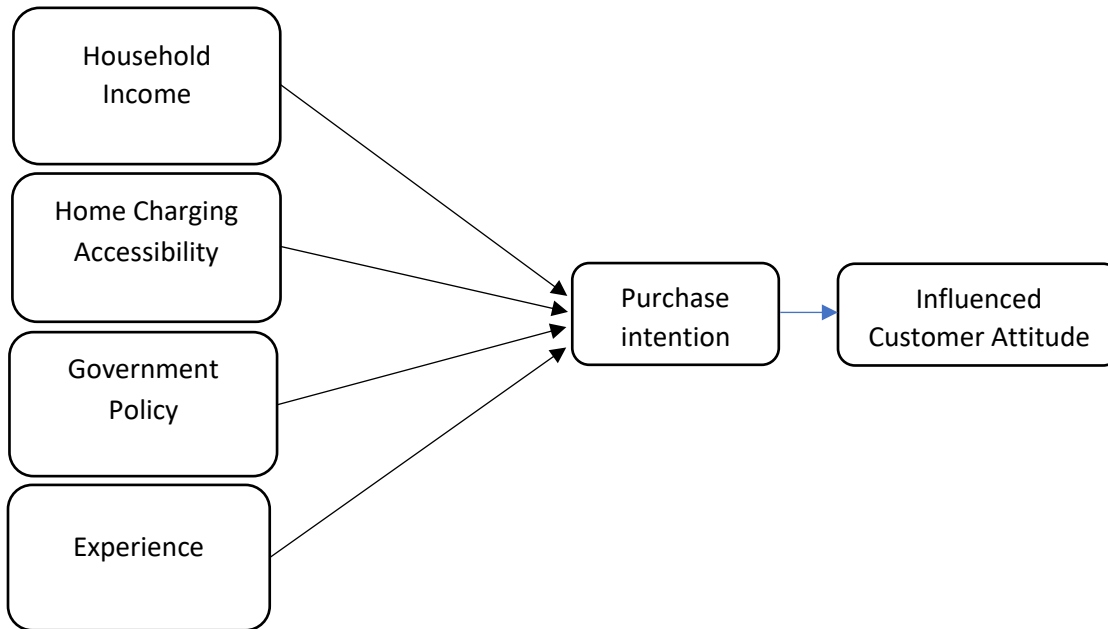
3. What factors should be considered when introducing a new product line to meet the current and future consumer appetite?
 - a) How does a new product line with new and improved battery technology will impact future consumer appetite?
 - b) Will a new product line with improved autonomous driving technology impact the future consumer appetite?

4.3 hypothesis

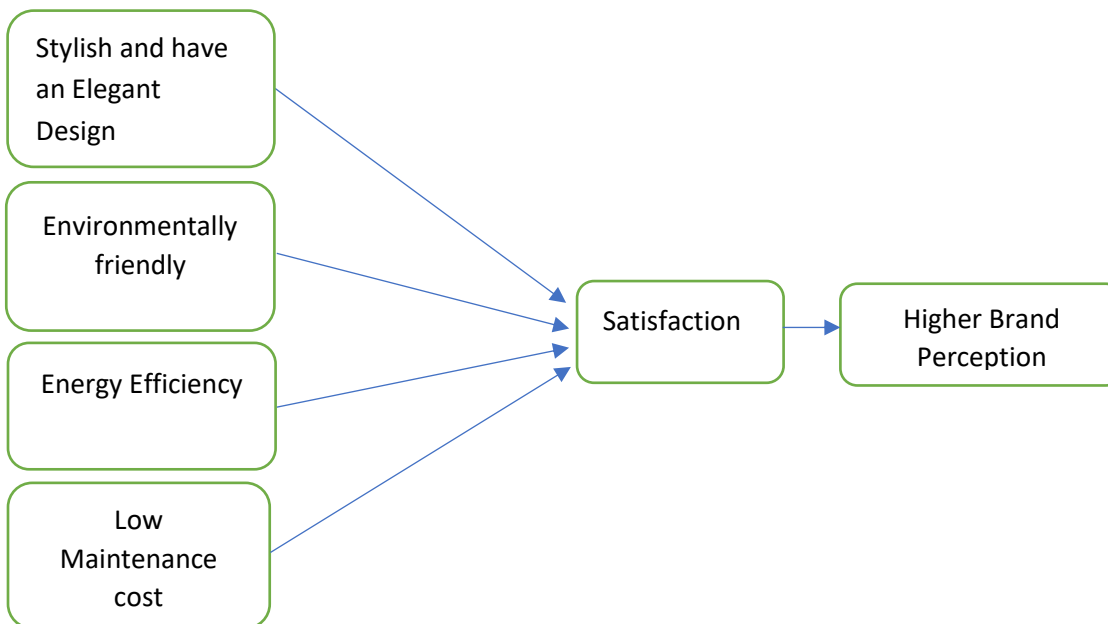
For research problems

- 1) **H1:** Household income has a significant impact on customers' attitudes.
- 2) **H2:** Home charging accessibility has a positive impact on customer attitude.
- 3) **H3:** There is a relationship between government policies and customer attitudes toward electric cars.
- 4) **H4:** Experience has a significant effect on customer attitudes.
- 5) **H5:** The style and Design of a product have a significant impact on the brand perception of the company.
- 6) **H6:** A product being environmentally friendly has a positive impact on the company's brand perception.
- 7) **H7:** There is a relationship between the energy efficiency of a product and its brand perception.
- 8) **H8:** There is a relationship between low maintenance cost and brand perception.
- 9) **H9:** A new battery technology has a significant impact on future consumer appetite.
- 10) **H10:** Improved autonomous driving technology has a positive impact on future consumer appetite.

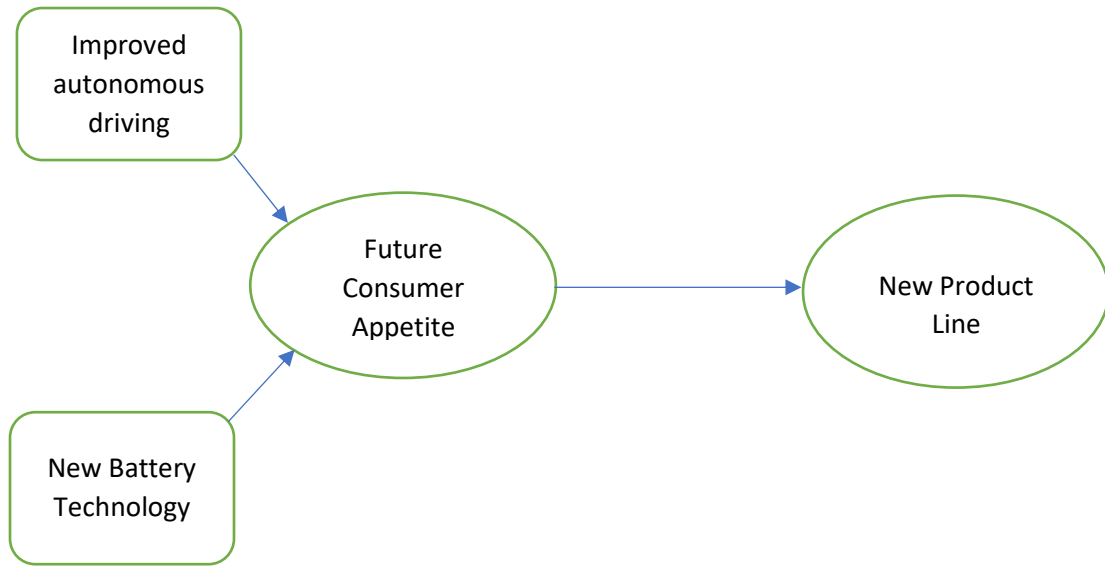
4.4 Analytical model



analytical model for research problem 1



analytical model for research problem 2



analytical model for research problem 3

5.0 Research design

Since the information needed is clearly defined with specific hypotheses to test and relationships to examine, the research will be conclusive-descriptive in nature. Under descriptive, a multiple cross-sectional design will be used because it's important to take samples from tesla, other EV and non-EV customers. Since the time constraint for the research is 6 months, the longitudinal design won't show much difference because customer attitudes, consumer appetite, and customers' brand perception towards the company won't drastically change in a short time window. (Malhotra et al., 2017)

For the fieldwork research, an online methodology and face-to-face interview will be chosen. Since the sample size is large and it's hard to give participants any visual prompt, telephone interviews will be time-consuming. Email surveys have some limitations since customers have to type the answers and then again reply with the answers. Disadvantage of focus group discussion is that the group may not expose to anything of significance. A face-to-face survey will be used to interview non-tesla customers because it's convenient for the participant to come to the interviewer than for the interviewer to find participants. In web surveys, there are lot of advantages compared to email surveys. Which are adding checkboxes and data entry fields to prevent participants from choosing multiple answers and using graphical images in the survey. Using web surveys is more portable for customers as well. (Malhotra et al., 2017)

6.0 sampling design

6.1 Target population

The target population for the research will contain electric car customers and other vehicle customers around the globe.

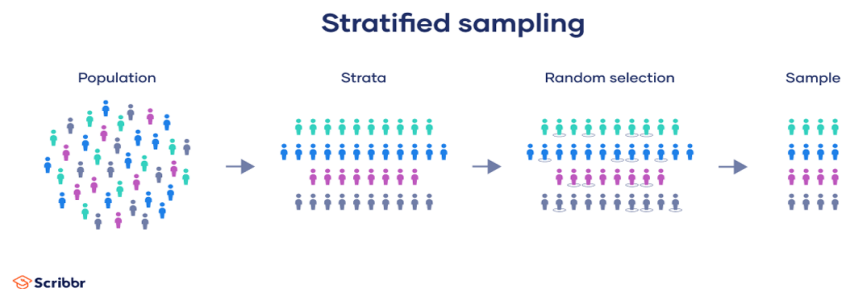
6.2 Sampling frame

The sampling frame for tesla customers will be a collection gathered from the online and retail stores database of tesla.

The sampling frame for other electric car customers will be EV consumers who own an EV other than tesla. For non-EV vehicles, it'll be drivers who own any non-electric vehicle.

6.3 Sampling technique

A stratified sampling technique (probability sampling) will be used to survey Tesla customers. In stratified sampling, a heterogeneous population will be partitioned into homogeneous sub-populations(strata). And the sample will be selected from each stratum.



A judgmental sampling technique (non-probability sampling) will be used to survey the other electric car and non-electric car customers. In judgmental sampling, the researcher or expertise will be selecting the participants to be contained in the sample by assuming that they represent the population of interest.

6.4 Sample size

For problem identification research, the minimum sample size to use is 500. (Malhotra et al., 2017). The desired final sample size for tesla customers will be 5000. And for other EV customers and non-EV customers, the desired final sample sizes will be 1000 each. But to obtain that sample size the incident rate and completion rate have to be considered.

$$\text{Initial sample size} = \frac{\text{final sample size}}{\text{Incident rate} \times \text{Completion rate}}$$

(Assumption: Initial sample sizes will be calculated with incident and completion rates for online survey is 25% and 40%, incident and completion rate for face-to-face survey is 33% and 70%)

Therefore, the Initial sample sizes will be as follows,

Segmentation	Initial sample size
Tesla customers	50,000
Other electric car customers	4330
Other ca customers (PHEV, Internal combustion engine)	4330

These sample sizes can then be used to construct confidence intervals from survey estimates.

To increase response rates,

- Reminder emails, sending free charging vouchers as an incentive for tesla customers will increase the level of response rate to the survey.
- For non-tesla customers, using prepaid-monetary incentives will be more effective to increase response rates and reduce response bias.

6.5 Survey method

An online web-based survey method will be used on tesla customers. Since we are using stratified sampling the customers in the sample will be grouped by model they own, age, income level, etc., and samples will be selected from each group to decrease population bias.

Face-to-face interviews will be the most convenient method to survey other EV drivers and non-EV drivers because it's incident rate, completion rate, and response rate are the highest compared to other survey methods. Other EV consumers will be surveyed in public charging stations (except tesla superchargers). Therefore, the researcher will have the ability to reach higher number of participants because the time for charging an EV usually takes some time. The same method will be used for non-EV owners because it'll be convenient to survey them in gas stations. Since we are using judgmental sampling the participants for the research will be selected by expertise. The target areas will be mainly in the U.S.A., Europe, and China.

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¹ (Assumption: Tesla has a collection of customer database with customer age, model they brought and income level)

7.0 Multivariate analysis

Bivariate regression analysis can be used to identify the relationships between the dependent (customer attitude) variable against the 4 independent variables. First, a scatter diagram will be plotted to determine the relationships between variables. Then a general model will be created.

$$Y = \beta_0 + \beta_1 x + \varepsilon \text{ (General model)}$$

Then the estimated predictor values of y_i will be calculated from the sample observations. After calculating the slope **b** and intercept **a**, the standardized regression coefficients will be calculated. After estimating the parameters, it can be tested for significance. The strength will be determined by the coefficient of r^2 . To check the accuracy, the standard error will be calculated. (Malhotra et al., 2017)

Since stratified sampling is used as the sampling technique, we'll be using cluster analysis to find any relationships between every 2 factors. In cluster analysis, only two clusters were analyzed per time. First form the problem, then select a distance measure. There are several procedures to do cluster analysis (Hierarchical, agglomerative, single linkage, etc.). Then decide how many clusters to make. After interpreting and profiling the clusters, it's compulsory to assess the reliability and validity of the solutions. (Malhotra et al., 2017)

8.0 Information gathered by the researcher

- Demographic data of all 3 customer segments will be gathered such as age, gender, and household income per month.
- Overall satisfaction of tesla consumers with the model they own will be identified.
- Detailed data for each attribute of the product will be accumulated from all 3 segments.
- Effectiveness of government policies on EVs will be understood.
- Does improving new battery technology and autonomous driving technology affect the consumers to buy a new product will be identified.
- Non-EV consumers' awareness of electric vehicles will be identified.
- Data about non-EV consumers' experience with EVs will be gathered.
- How much a non-EV consumer is willing to pay assuming they are buying one will be gathered.
- Geographical data, where other EV customers and non-EV customers live will be gathered.
- How EV's environment-friendly features affect consumers will be identified.

9.0 Further research

Knowing that fossil fuel will run out in the future, The eternal solution in the automotive industry will be electric vehicles. Therefore, a market for electrified public transport will be a good market potential. Since it will take more time to charge larger batteries, a technology where the batteries can be swapped and used continuously will help solve the charging issue in electric vehicles in public transport.

10.0 Questionnaires

- The survey is conducted to identify how consumer's attitudes, perceptions of the brand, and future consumer appetite of tesla owners, EV owners and non-EV owners.
- The first part of the questionnaire is for the customers who own a tesla. The survey technique will be a web-based online survey.

(Assumption – Tesla's customer base contains the model they own, customers' occupations, the year they brought the vehicle, and the area or the country they live in. But the factors like age and household income level will be requested, because those variables change over time.)

Tesla customers

You are invited to take part in this survey for the company Tesla. This will take about 15-20 minutes to complete.

1) What's your age?

- ☐ 20-30 years
 ☐ 30-40 years
 ☐ 40-50 years
 ☐ 50+ years

2) What is your gender?

- ☐ Male
 ☐ Female
 ☐ Other







3) What is your monthly household income in USD?

- ☐ < 4k USD
 ☐ 4k – 7k USD
 ☐ 7k – 10k USD
 ☐ 10k + USD

4) did government policies on electric vehicles such as free parking, reduced purchasing tax rates and reduced value-added tax affect your decision of buying a tesla positively?

- ☐ Yes
 ☐ No

5) How much do you rate the design and look of your car on a scale of 1 – 7?






Not Very stylish and elegant        Very stylish and elegant






1 2 3 4 5 6 7

6) What was your previous car?

☐ A BEV ☐ A PHEV ☐ Internal combustion engine vehicle ☐ FCEV

7) How satisfied are you with your tesla on the following factors? (Please put a ✓)

Very Unsatisfied 	Unsatisfied 	Neutral 	Satisfied 	Very satisfied 
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The range on a single full charge					
Time takes to charge full at home					
Tesla supercharging system					
Tesla self-driving system					
Quality of the interior					
The technology of controlling everything from the infotainment screen					
Space inside the car					
Tesla maintenance cost compared to your previous vehicle used					

8) How do you scale your overall satisfaction with your tesla?

very unsatisfied ☐ ☐ ☐ ☐ ☐ ☐ ☐ Very Satisfied

1 2 3 4 5 6 7

9) Will you buy a new tesla product if it has fully self-driving capability with a 100% accident-free rate?

☐ Yes ☐ No

10) will you buy a new tesla product if it's fitted with a new battery, where the range on a single charge is increased by a larger margin compared to your car and the charging speed is faster?

☐ Yes ☐ No

11) What else do you hope should improve or add to a new product, where you will switch from your current tesla?

Thank You!

- The second part of the questionnaire will be for customers who don't have a tesla but owns a battery electric vehicle. This will be a face-to-face interview survey.

Other electric car customers

You are invited to take part in this survey for the company Tesla. This will take about 15-20 minutes to complete.

1) What is your age?

- ☐ 20-30 years
 ☐ 30-40 years
 ☐ 40-50 years
 ☐ 50+ years

2) Where do you live?

3) What is your gender?

- ☐ Male
 ☐ Female
 ☐ Other

4) What is your monthly household income in USD?

- ☐ < 4K USD
 ☐ 4K – 7K USD
 ☐ 7K – 10K USD
 ☐ 10K + USD

5) What factors inspired you to choose your current electric car?

6) How much did you spend on your current car?

- ☐ <\$30K
 ☐ \$30K-\$50K
 ☐ \$50K-\$70K
 ☐ \$70K+

7) Did government policies on electric vehicles such as free parking, reduced purchasing tax rates and reduced value-added tax affected your decision of buying an EV positively?

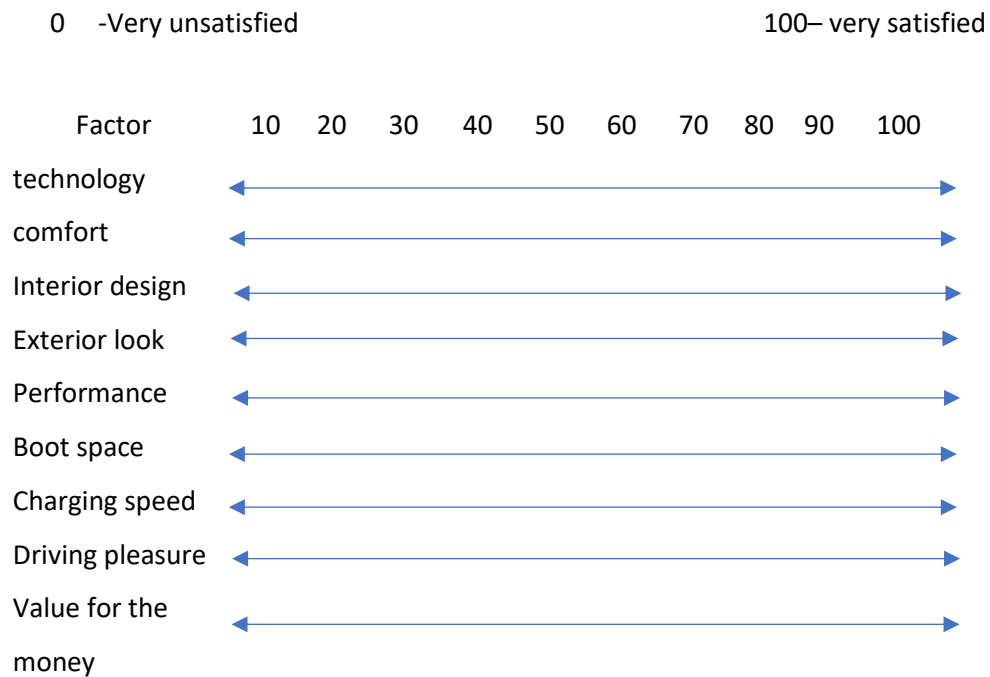


Yes



No

8) How happy are you with the following factors on your present EV? (Please put a ● on the axis)



9) are you aware of these facts about tesla? (Please put a ✓)

Facts	Yes	No
Tesla's supercharging network can give you 200 miles of range in 15 minutes.		
Tesla's supercharging network is the world's largest DC fast-charging network.		
Tesla model y was the best-selling electric car in 2021.		
Tesla's self-driving system is the most improved autonomous driving technology in the world.		
Tesla has the highest mi/kwh ratio among top competitors.		

Thank You!

- third part of the questionnaire will be focused on non-electric car customers. It includes hybrid car owners, PHEV car owners, and internal combustion car owners, etc. the research survey method will be a face-to-face interview.

Other vehicle customers (PHEV vehicles, internal combustion engine vehicles, etc.)

You are invited to take part in this survey for the company Tesla. This will take about 15-20 minutes to complete.

1) What is your age?

- ☐ 20-30 years
 ☐ 30-40 years
 ☐ 40-50 years
 ☐ 50+ years

2) What is your gender?

- ☐ Male
 ☐ Female
 ☐ Other

3) Where do you live?

4) What is your monthly household income in USD?

- ☐ < 4K USD
 ☐ 4K – 7K USD
 ☐ 7K – 10K USD
 ☐ 10K + USD

5) If you are buying an EV, how much are you willing to pay for one?

- ☐ <\$20K
 ☐ \$20K-\$40K
 ☐ \$40K-\$60K
 ☐ \$60K+

6) How much range on a single charge you would expect at that price point?

- ☐ 200-300km
 ☐ 300-400km
 ☐ 400-500km
 ☐ 500km+

7) How much do you spend on fuel for your vehicle per month?

☐ < \$75 ☐ \$75 – \$100 ☐ \$100 – \$125 ☐ \$125+

8) Have you ever experienced the performance and the comfort of an electric car, if you haven't would prefer to experience one in one of our showrooms?

☐ Yes ☐ No

9) are you aware of these facts about electric cars? (Please put a ✓)

Facts	Yes	No
Electric cars are 10%-15% less in maintenance cost than fuel cars.		
Electric cars don't emit any greenhouse gasses.		
It's 3.5 times cheaper to charge an EV than the cost of fueling a gas-powered vehicle.		
Electric cars have a trunk space in front.		
Tax-free policies for EVs implemented by the government.		
Higher performance due to instant power supply by the batteries.		
Installing a level 2 charger at home will charge an electric car to 100% in around 4 hours.		

10) If government purchase tax and value-added tax gets cut off, would you prefer buying an EV?

☐ Yes ☐ No

Thank You!

11.0 Technical Appendix

Justification for the information gathered by the researcher

- Age can be used to identify which age group has more intentions to adopt EVs and which doesn't.
- Reactions to the features in a tesla can be used to identify what should be improved and what should be added to the products in the future to meet the evolving consumer appetite.
- Participants' income level can be analyzed through a regression analysis to find any relationship between 2 variables.
- Non-EV drivers expected price for an EV can be analyzed through cluster sampling using their income as the other variable to understand what they want.
- Where non-EV consumers live can be taken into account and find, whether are there sufficient charging stations in that area and how near is to a tesla maintenance center.

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