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A Study on Consumer Preference and Satisfaction towards Electric vehicles with Reference to Coimbatore City

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A B S T R A C T

Electric vehicles (EVs) are a promising technology for achieving a sustainable transport sector in the future, due to their very low to zero carbon emissions, low noise, high efficiency, and flexibility in grid operation and integration. This chapter includes an overview of electric vehicle technologies as well as associated energy storage systems and charging mechanisms. Different types of electric-drive vehicles are presented. These include battery electric vehicles, plug-in hybrid electric vehicles, hybrid electric vehicles and fuel cell electric vehicles. The topologies for each category and the enabling technologies are discussed. Various power train configurations, new battery technologies, and different charger converter topologies are introduced. Electrifying transportation not only facilitates a clean energy transition, but also enables the diversification of transportation's sector fuel mix and addresses energy security concerns. In addition, this can be also seen as a viable solution, in order to alleviate issues associated with climate change. Furthermore, charging standards and mechanisms and relative impacts to the grid from charging vehicles are also presented.

Keywords: Electric vehicles, Eco friendly, Low emission

1. Introduction

Electric vehicles (EVs) use electricity as their primary fuel or to improve the efficiency of conventional vehicle designs. EVs include all-electric vehicles, also referred to as battery electric vehicles (BEVs), and plug-in hybrid electric vehicles (PHEVs). In colloquial references, these vehicles are called electric cars, or simply EVs, even though some of these vehicles still use liquid fuels in conjunction with electricity. EVs are known for providing instant torque and a quiet driver experience. Other types of electric-drive vehicles not covered here include hybrid electric vehicles, which are powered by a conventional engine and an electric motor that uses energy stored in a battery that is charged by regenerative braking, not by plugging in, and fuel cell electric vehicles, which use a propulsion system similar to electric vehicles, where energy stored as hydrogen is converted to electricity by the fuel cell.

All-electric vehicles do not have conventional engines but are driven solely by one or more electric motors powered by energy stored in batteries. The batteries are charged by plugging the vehicle into an electric power source and can also be charged through regenerative braking. All-electric vehicles produce no tailpipe emissions, although there are "life cycle" emissions associated with the electricity production. All-electric vehicles typically have shorter driving ranges per charge than conventional vehicles have per tank of gasoline. Most new BEVs are designed to travel about 100 to 400+ miles on a fully charged battery, depending on the model. For context, 90% of all U.S. household trips cover less than 100 miles. An all-electric vehicle's range varies according to driving conditions and driving habits. Extreme temperatures tend to reduce range because energy from the battery powers climate control systems in addition to powering the motor. Speeding, aggressive driving, and heavy loads can also reduce range.

2. Statement of problem

The Electric Vehicles are necessary in the current stage of life because the population of the country is increasing rapidly. This will create need for more vehicles and the need of more vehicles will increase the demand for fuel. The continuous use of Fuel will make the shortage in supply of it. All these aspects provide a way for the introduction of Electric Vehicles. The introduction of Electric vehicles also an Eco-friendly invention this will reduce the pollution in the environment. The Rapid increase in the Electric vehicles leads to heavy competition in the market. By considering the above elements the study is made to identify the consumer preference and satisfaction towards electric vehicles in Coimbatore city.

3. Objective of study

- To identify consumers preference and satisfaction towards Electric vehicles.

4. Research Questions

- Which Electric vehicles company does you satisfied?
- Which place did you prefer to purchase your Electric vehicles?
- Factor that promotes the shift to Electric vehicles?
- Satisfaction level towards Electric vehicles

5. Research methodology

Research methodology is a way to systematically solving a research problem. Research methodology deals with the research design used and methods used to present the study.

5.1 Sampling design

This study is intended to analyze consumer's preference and satisfaction towards Electric vehicles in Coimbatore city. The study is Descriptive in nature.

5.2 Sample size

175 Questionnaire were distributed out of that 163 questioners were fit for analysis from different respondents in the Coimbatore city.

5.3 Sample area

The area of the study refers to Coimbatore city.

5.4 Data collection

The data is collected from both primary and secondary data.

Primary Data: Primary data is collected directly from the people with the help of the questionnaire for the first time and that are original in nature.

Secondary Data: Secondary data is collected from various sources such as books, journals, articles, newspapers, websites etc…

5.5 Sampling method

The method used for collecting sample is convenient sampling.

5.6 sampling tools

- Simple percentage method
- Rank Analysis
- Chi square

6. Review of literature

Aman Mahajan , Neetu Kumari , Dr. Rashmi Mahajan(2021) A study on factors influence buying behavior of four wheeler electric vehicle in MadhyaPradesh : The research was to find the perception of potential buyers who will be in the position to buy their four wheeler electric car. Objectiveof the paper is to identify the relationship between the customer preference and factors. The factors considered in the paper are like price, mileage, purpose, colour, seating capacity, charging location, brand name etc. The research paper consists of 201 responses from Madhya Pradesh region. The result indicated that availability of charging points, cost of maintenance, mileage are the factors that have a significant relationship with the consumer preference.

Mohammed Tariq Nayaab,Dr. R. Satish Kumar (2022) Does Consumer Preferences Leads to Adoption Intention for Electric Vehicles:The article examines various factors affecting the adoption intention towards Electric Vehicles. The review analysis helped to understand the scenarios and future of EVs in India. The article has presented each study's objective, methodology and critical findings which was describing the covered areas and uncovered areas to be focused for the development of EVs industry in India.

Nombulelo dilotsotlhe(2022) Determinants of consumers purchase intensions of electric vehicles: The paper uses the consumption values theory to predict the purchase intention for plug-in hybrid electric vehicles (PHEVs) in Gauteng, South Africa. Data was collected from 286 respondents using the structured questionnaire and convenience sampling. Results indicate that functional, social, emotional and conditional values positively relate to customers' purchase intention of PHEVs, while the epistemic value was not positively related. The study provided helpful information to electric vehicle manufacturers, car dealerships, marketing managers and the government in developing strategies to encourage PHEV adoption.

Manjula.B, Shilpa.B, Sundaresh (2022) A Study on Barriers to Adoption of Electric Vehicles: The study aims to find out those barriers to the adoption of electric vehicles. To know the reasons for its less promotion and to create awareness among the users in India. The sampling method chosen was survey

method and the sample size for the project was 50.The statistical tool used for the study is percentage method. The study concluded that lack of charging stations was big barrier for EV adoption. Many people were ready to purchase the electric vehicle if infrastructure was developed. People had a belief that electric vehicles were eco-friendly. Service centers and charging stations should be developed and more infrastructure development was necessary.

John E. Anderson, Moritz Bergfeld, Do Minh Nguyen & Felix Steck (2022) Real-world charging behaviour and preferences of electric vehicles users in Germany: The paper and the findings fill the research gap and provide timely and relevant insights on charging behaviour and preferences on electric vehicles. The empirical approach with a quantitative research method was chosen.The survey was designed as an online questionnaire and hosted on the platform Survey Engine.The results showed the dominance of home charging. Public charging infrastructure was viewed to be insufficient. PHEV users in particular tend to charge every time upon arriving at home, while BEV users more strongly perceive the wide range of charging infrastructure and wish for more flexibility when making spontaneous trips.

Dr.N.S.Lissy, Dr.J.Mahalakshmi (2022) Consumer Perception of Electric Vehicles in India: The objective of the paper was to understand consumer perception and the factors important for the purchase of Electric Vehicles in India. Descriptive research methodology was used. Primary data of a sample population of 212 was collected using online questionnaire. The respondents were aware of global climate conditions and were ready to change their preference from conventional to eco-friendly vehicles. Cost was an important factor while considering the purchase of Electric Vehicle. Respondents were willing to consider Electric Vehicles as their future purchase option, if proper infrastructure was available. Initial cost of purchase, less number of charging stations and the time required to recharge the battery wascreating limitation in boosting consumer confidence.

Mr. S. Chandra Sekhar, Dr. J Murthy, Dr. Shaik Karim ,Mr. M. Subramanyiam Reddy, Dr.C. Bhupathi(2022) Factors Influencing Customers' Buying Behaviour: A Study of Electric Vehicles with reference to Tirupati City:The need for the study is to understand the consumer attitude and the purchase intention of e-vehicles. The consequence of the study was that EVs can cause remarkable impacts on the environment, the country's economy, and other related sectors.Convenient Samplingmethodwasusedforthesurvey through questionnaires. The study had found that factors like operating cost, driving range, charging duration, vehicle performance and brand diversity are majorly influenced the purchase decision of E-vehicles.

7. Analysis and Interpretation

Analysis of data is a process of inspecting, cleansing, transforming, and modelling data with the goal of discovering useful information, informing conclusion, and supporting decision-making. Data analysis is a process for obtaining raw data and converting it into information useful for decision-making by users. Data are collected and analysed to answer question, test hypotheses or disprove theories.

The following tools were used:

i. Percentage Analysis

ii. Chi-square Analysis

iii. Rank Analysis

7.1 Percentage method

$$\text{Formula} = \frac{\text{No. Of respondents}}{\text{Total no. of respondents}} * 100$$

Table no 1
Table showing Place preferred to purchase EV

Place of purchase	No. of Respondents	Percentage
Showroom	88	54.0
Direct second hand	39	23.9
Vehicle dealership	28	17.2
Others	8	4.9
Total	163	100.0

Source: primary data

Interpretation:

The above table shows the place preferred by the respondents to purchase Electric vehicle in which 54.0% of the respondents prefer showroom,23.9% of the respondents prefer direct second hand, 17.2% of the respondents prefer Vehicle dealership and 4.9% of the respondents prefer other places .

Majority 54.0% of the respondents prefer to purchase in showroom.

Exhibit no: 1
Exhibit showing Place preferred to purchase EV

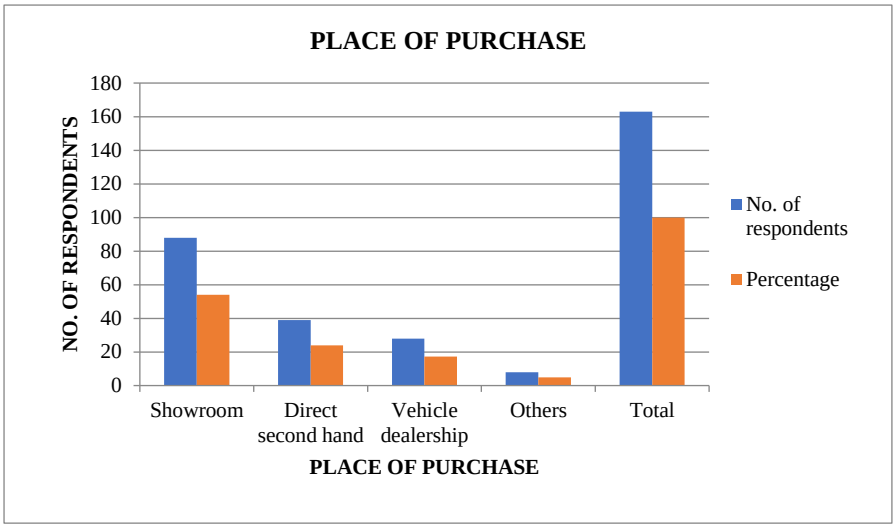


Table no 2

Table showing consumer satisfaction on EV companies

Source: primary data

EV company satisfaction	No. of Respondents	Percentage
Tata motors	55	33.7
Hero electric	47	28.8
Mahindra electric	36	22.2
Others	25	15.3
Total	163	100.0

Interpretation:

The above table shows the consumer satisfaction on EV companies in which 33.7% of the respondents satisfied with Tata motors,28.8% of the respondents satisfied with Hero electric, 22.2% of the respondents satisfied with Mahindra electric,15.3% of the respondents satisfied with other companies.

Majority 33.7% of the respondents satisfied with Tata motors.

Exhibit no: 2

Exhibit showing consumer satisfaction on EV companies

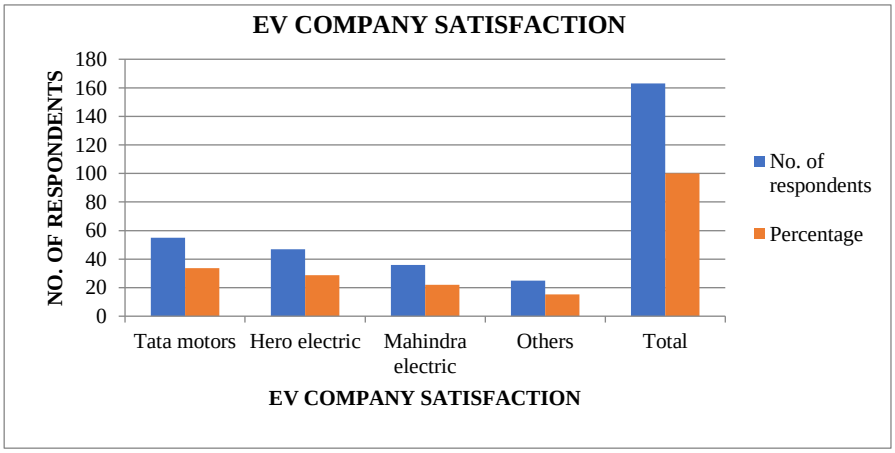


Table no: 3

Table showing Factors that promotes the shift to Electric vehicles

Factors that promotes the shift to Electric vehicle	No. of Respondents	Percentage
Higher maintenance costs	34	20.9
Limited range	45	27.6

Lack of charging infrastructure	40	24.5
Lower fuel costs	44	27.0
Total	163	100.0

Source: primary data

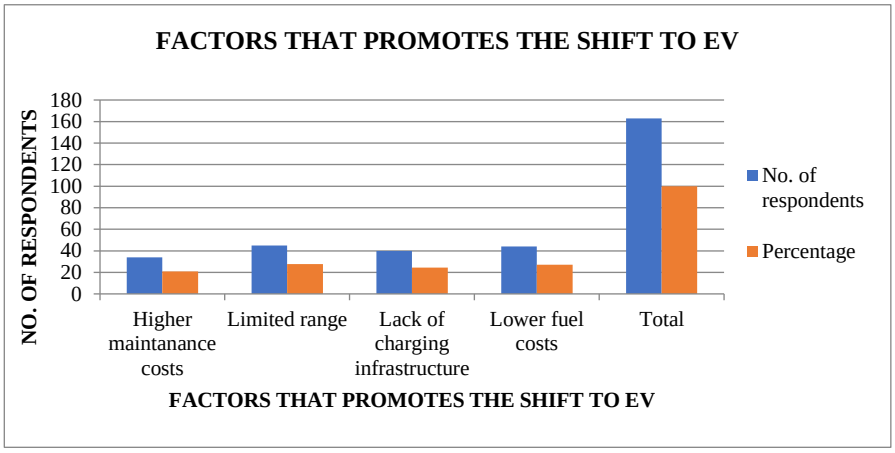
Interpretation:

The above table shows the factors that promote the shift to Electric vehicle in which 27.6% of the respondents says Limited range,27.0% of the respondents says Lower fuel cost,24.5% of the respondents says Lack of charging infrastructure,20.9% of the respondents says Lower fuel costs.

Majority 27.6% of the respondents the factors that promotes the shift to Electric vehicle was Limited range.

Exhibit no: 3

Exhibit showing Factors that promotes the shift to Electric vehicles



7.2 Rank analysis

A ranking is a relationship between a set of items such that, for any two items, the first is either 'ranked higher than', 'ranked lower than' or 'ranked equal to' the second. In mathematics, this is known as a weak order or total preorder of objects. It is not necessarily a total order of objects because two different objects can have the same ranking. The rankings themselves are totally ordered. For example, materials are totally preordered by hardness, while degrees of hardness are totally ordered.

Table no: 4

Table showing the satisfaction level of the respondents

Level of customer satisfaction	**Highly satisfied (1)**	**Satisfied (2)**	**Neutral (3)**	**Dissatisfied (4)**	**Highly dissatisfied (5)**	**Total**	**Rank**
Price	53	142	93	21	5	314	7
Mileage	30	200	87	12	5	334	6
Charging Station	37	126	132	60	20	375	1
Safety	35	152	111	40	25	363	3
Maintenance charge	38	150	99	60	10	357	4
After sales service	33	166	105	44	5	353	5
Availability of spare parts	36	136	135	44	15	366	2

Interpretation:

The above table shows the satisfaction level of respondents to the charging station ranked first and followed by Availability of spare parts ranked second, safety ranked third, Maintenance charge ranked fourth, after sales service ranked fifth, Mileage ranked sixth and Price ranked seventh.

7.3 Chi square analysis

The Chi square analysis is commonly used for testing relationships between categorical variables. The null hypothesis of the Chi-Square test is that no relationship exists on the categorical variables in the population; they are independent. There are several important considerations when using the Chi-Square analysis to evaluate a cross tabulation .Because of how the Chi-Square value is calculated, it is extremely sensitive to sample size. This can be addressed by always using categorical variables with a limited number of categories.

Formula:

$$\text{Chi – square value}(\sum) = \frac{(\text{Observed value} - \text{Expected value})^2}{\text{Expected value}} * 100$$

$$\text{Expected value} = \frac{\text{Row total} * \text{Grand total}}{\text{Grand total}}$$

Degree of freedom = (Row – 1) * (Column – 1)

Association between family monthly income and the satisfaction towards electric vehicle companies

Hypothesis

Null hypothesis H_0: There is no significant relationship between Family monthly incomes vs. the satisfaction towards electric vehicles companies.
Alternate hypothesis H_1: There is a significant relationship between Family monthly incomes vs.the satisfaction towards electric vehicles companies.

Table no. 5
Table showing the relationship between family monthly income and the satisfaction towards electric vehicles companies

Family monthly income	Which EV companies do you satisfied?				Total
	Tata motors	Hero electric	Mahindra electric	Others	
Up-to 25000	24	14	14	6	58
25001 – 50000	19	13	6	11	49
50001 – 1 lakh	7	11	11	5	34
Above 1 lakh	5	9	5	3	22
Total	55	47	36	25	163

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	12.192[a]	9	.203
Likelihood Ratio	12.519	9	.186
Linear-by-Linear Association	2.011	1	.156
N of Valid Cases	163		

Level of significance = 5% or 0.05
Degree of freedom = 9
Chi-square value X^2 =12.192
Table value = 16.919

Interpretation
In the above analysis, the calculated Chi-square value {12.192} is less than the table value {16.919} at the level of 5% significance. Hence, null hypothesis H_0 is accepted, thus, there is no significant relationship between Family monthly income and the satisfaction towards Electric vehicle companies

Association between occupation and the satisfaction towards electric vehicle companies

Hypothesis
Null hypothesis H_0: There is no significant relationship between occupation and the satisfaction towards Electric vehicle companies
Alternate hypothesis H_1: There is a significant relationship between occupation and the satisfaction towards Electric vehicle companies

Table no: 6
Table showing the relationship between occupation and the satisfaction towards electric vehicle companies

Occupation	Which EV companies do you satisfied?				Total
	Tata motors	Hero electric	Mahindra electric	Others	
Employee	10	18	9	7	44

Businessman	10	5	9	4	28
Professionals	7	4	6	2	19
others	28	20	12	12	72
Total	55	47	36	25	163

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	9.523 [a]	9	.390
Likelihood Ratio	9.544	9	.389
Linear-by-Linear Association	.917	1	.338
N of Valid Cases	163		

Level of significance = 5% or 0.05

Degree of freedom = 9

Chi-square value $X^2 = 9.523$

Table value = 16.919

Interpretation

In the above analysis, the calculated Chi-square value {9.523} is less than the table value {16.919} at the level of 5% significance. Hence, null hypothesis H_0 is accepted, thus, there is no significant relationship between occupation and the satisfaction towards Electric vehicles companies.

8. Findings, Suggestion and Conclusion

8.1 Findings

Percentage analysis

- 33.7% of the respondents satisfied with Tata motors.
- 54.0% of the respondents prefer to purchase in showroom.
- 27.6% of the respondents the factors that promotes the shift to Electric vehicle was Limited range.

Rank analysis

The satisfaction level of respondents to the charging station ranked first and followed by Availability of spare parts ranked second, safety ranked third, Maintenance charge ranked fourth, after sales service ranked fifth, Mileage ranked sixth and Price ranked seventh.

Chi-square Analysis

- The calculated Family monthly income and the satisfaction towards Electric vehicle companies Chi-square value {12.192} is less than the table value {16.919} at the level of 5% significance. Hence, null hypothesis H_0 is accepted, thus, there is no significant relationship between Family monthly income and the satisfaction towards Electric vehicle companies

- The occupation and the satisfaction towards Electric vehicle companies calculated Chi-square value {9.523} is less than the table value {16.919} at the level of 5% significance. Hence, null hypothesis H_0 is accepted, thus, there is no significant relationship between occupation and the satisfaction towards Electric vehicle companies.

8.2 Suggestion

According to the above study the consumer suggested to increase the charging station for Electric Vehicles. The increase in charging station will improve the satisfaction level of the consumers. The study conveys that the quality of the Electric Vehicles needs to improve because quality is the major disadvantage in the Electric Vehicles according to the study. The capacity of the Electric Vehicles is less compared to the fuel vehicles. The manufacturer needs to concentrate on the capacity of the Electric Vehicles. The battery lifetime is varies based on the price of the vehicle. The lower priced E-vehicles have very low battery life. So, the manufacturers will take some measures to overcome it.

8.3 Conclusion

The progress that the electric vehicle industry has seen in recent years is not only extremely welcomed, but highly necessary in light of the increasing global greenhouse gas levels. As demonstrated within the economic, social, and environmental analysis sections of this webpage, the benefits of electric vehicles far surpass the costs. The biggest obstacle to the widespread adoption of electric-powered transportation is cost related, as gasoline and the vehicles that run on it are readily available, convenient, and less costly. As is demonstrated in our timeline, we hope that over the course of the next decade technological advancements and policy changes will help ease the transition from traditional fuel-powered vehicles. Additionally, the realization and success of this industry relies heavily on the global population, and it is our hope that through mass marketing and environmental education programs people will feel incentivized and empowered to drive an electric-powered vehicle. Each person can make a difference, so go electric and help make a difference.

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