A Study on Scope and Adaptability in Usage of E-Vehicles

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Abstract

Electric vehicles (EVs) represent a transformative shift in transportation, focusing on sustainability, efficiency, and innovation. Powered by electricity instead of traditional fossil fuels, EVs significantly reduce greenhouse gas emissions and dependence on non-renewable energy sources. With growing environmental awareness and advancements in battery technology, EVs have become a cornerstone of the global transition to eco-friendly mobility. Governments, automakers, and consumers are increasingly embracing electric vehicles for their environmental benefits, lower operating costs, and role in creating a sustainable future. Electric vehicles (EVs) are a critical technology that India is utilizing to reduce carbon emissions, combat air pollution, and create a brighter future. A favorable regulatory environment and expanding infrastructure for charging have helped the electric vehicles market in India to grow dramatically in recent years. This study focuses on the customer perception towards adaptability to the new technology and further scope it would bring to the transportation industry.

Keywords: *E-Vehicles, Technology, Sustainability, Customer Satisfaction*

Introduction

Evolution of Electric Vehicles

Electric vehicles (EVs) have a long and fascinating history, dating back to the 19th century. The first electric vehicle was developed in the 1820s, making EVs one of the earliest forms of powered transportation. However, they faced significant challenges in terms of battery technology and infrastructure, which limited their widespread adoption. In the early 20th century, EVs gained some popularity due to their smooth and quiet operation compared to internal combustion engine vehicles. However, the discovery of large oil reserves and advancements in gasoline engines eventually overshadowed EVs. The modern era of electric vehicles began in the late 20th and early 21st centuries, with renewed focus on sustainability and environmental concerns. Companies tackled key challenges such as limited range and long charging times by investing in advanced battery technologies like lithium-ion. Governments around the world also incentivized the adoption of EVs to reduce carbon emissions. One of the major breakthroughs came with the launch of Tesla's Model S in 2012, which proved that EVs could combine performance, range, and luxury. Companies like Nissan, BMW, and General Motors also contributed significantly to the EV revolution. By the mid-2020s, electric vehicles crossed major milestones, including affordability and accessibility for the mass market. Today, electric vehicles are seen as a crucial component in the global effort to combat climate change, with sales

growing exponentially and technological advancements continuing to push the boundaries of what EVs can achieve.

Growth of Electric Vehicles in India

The EV revolution in India gained momentum in the 2010s with government initiatives like the FAME scheme, promoting EV adoption and infrastructure. The need to reduce environmental impact and reliance on fossil fuels drives industry growth. Government support includes incentives for battery manufacturing, charging networks, and clean energy R&D. States offer tax benefits and encourage electric public transport. Indian companies focus on affordability, range, and safety to compete globally. Battery recycling and disposal are being addressed per international guidelines. Green policies and liberalization foster industry growth, attracting global investment. Advancements in EV models make them more accessible to consumers. EV sales are rising, and infrastructure is expanding. India is becoming a key player in the global shift to sustainable mobility.

Advancements in Electric Vehicles Technology

Recent advancements in electric vehicle (EV) technology have significantly enhanced their performance, efficiency, and integration into modern energy systems.

Battery Technology

Innovations in battery chemistry, such as the development of solid-state batteries, have led to higher energy densities, extending vehicle ranges. Additionally, the introduction of silicon anodes is projected to improve battery performance and longevity.

Smart Charging and Vehicle-to-Grid (V2G) Technology

V2G technology enables EVs to not only draw power from the grid but also supply unused energy back, aiding in grid stability and optimizing energy distribution. This bi-directional interaction allows EVs to serve as mobile energy storage units, contributing to more resilient and efficient power systems.

Autonomous and Connected EVs

The integration of autonomous driving capabilities and advanced connectivity features is transforming EVs into intelligent transport solutions. These vehicles can communicate with infrastructure and other vehicles, enhancing safety, reducing traffic congestion, and paving the way for future mobility innovations.

Review of Literature

Kumarasamy and Krishnamoorthi (2024) conducted a study on factors influencing consumer perception towards electric vehicles in Chennai. The study found that respondents tend to compare the features of electric vehicles with their cost, and many perceived electric vehicles to be more expensive than traditional vehicles. These findings provide valuable insights into the cost-related factors influencing consumer decisions in the electric vehicle market.

Meyyammai, Vinotha, Anantha Kumar (2023) examined consumer perception towards electric vehicles with special reference to Chennai city. The study provides valuable insights for the government, automotive manufacturers, dealers, and marketers. This research contributes to understanding how demographic factors, particularly age, affect attitudes towards electric vehicles and offers guidance for stakeholders in the industry. The findings revealed a significant relationship between age group and the factors influencing consumers' perceptions of electric vehicles.

Jose, Cyriac, and Joseph (2022) explored customer attitudes and perceptions towards electric vehicles. The study revealed that most respondents held a positive attitude towards electric vehicles, and even non-owners expressed willingness to purchase them in the future. These findings emphasize the growing acceptance and potential for increased adoption of electric vehicles among consumers.

Mrinal Pandey, Midhun Mohan, and Subha (2021) examined customer perception towards the purchase intention of electric cars in India. The findings indicated that perceived monetary benefits and personal innovativeness significantly influence consumers decisions to purchase electric cars, while perceived environmental benefits, costs, and risks were found to have no significant impact.

Need for the Study

In the current scenario, electric vehicles (EVs) have revolutionized the automobile industry and have gained significant attention and awareness. The efficiency and sustainability of EVs are considered crucial elements, especially for the growth and development of the transportation sector. Due to increasing concerns about environmental pollution and fuel dependency, customers are shifting towards electric mobility. Therefore, it is important to analyze the purchase intention of customers regarding electric vehicles

Scope of the Study

The scope of this study is to analyze the customer perception towards electric vehicles in Chennai. Customers in Chennai tend to have varied preferences based on factors such as price,

performance, brand, government incentives and environmental concerns, which influence their decision to purchase electric vehicles. This study mainly focuses on identifying the factors influencing the customer behaviour and preferences regarding the selection of electric vehicles from various brands and models available in Chennai.

Objectives of the Study

- To analyze the most influential factors which induces customer to purchase electric vehicles.
- To find out the challenges faced by customers while using electric vehicles.
- To study the scope of E-vehicles consumption of customers in Chennai.

Research Methodology

Data Collection

The study is based on both primary and secondary data. Primary data was collected through well-structured questionnaire. Secondary data were collected through books, websites, magazines, journals, newspaper etc.

Sample Design

A sample of 150 respondents has been selected for the study. Convenient sampling method was used to collect the data based on various demographic factors like gender, age, education, occupation and marital status.

Data Analysis and Interpretation

Table 1

Demographic Profile of the Respondents

Variables	Frequency		Percentage
Gender	Male	79	52.7%
	Female	71	47.3%
Age	18-28	81	47.3%
	28-38	58	38.7%
	38-48	5	3.3%
	Above 48	6	4%

Qualification	School	42	28%
	UG/PG	64	42.7%
	Diploma	24	16%
	Professional/PhD	20	13.3%
Occupation	Students	71	47.3%
	Salaried	67	44.7%
	Professional	6	4%
	Business	6	4%
Annual Income	Below 4 lakhs	79	52.6%
	4-6 lakhs	57	38%
	6-8 lakhs	7	4.7%
	Above 8lakhs	7	4.7%
Marital Status	Married	86	57.3%
	Unmarried	64	42.7%

The above table shows that 52.7% of the respondents are male and 47.3% of the respondents are female. It is observed that 47.3% of the respondents are under 18-28years, 38.7% of the respondents are under 28-38 age groups, 3.3% of the respondents are under 38-48 age groups and 4% of the respondents are above 48 age groups. It is inferred that 28% of the respondents belongs to the school level category, 42.7% of the respondents belongs to under graduate category/ post graduate category, 16% of the respondents belongs to the diploma category and 13.3% of the respondents belongs to the professional or PhD category. It is found that 47.3% of the respondents are Students, 44.7% of the respondents are Salaried and 4% of the respondents belongs to Business and Professional category. Also, 52.6% of the respondents' income level are less than 4 lakhs, 38% of the respondents are earning between 4-6 lakhs, 4.7% of the respondents are earning between 6-8 lakhs and above 8 lakhs. In addition, 57.3% of the respondents are married and 42.7% of the respondents are unmarried.

Table 2

General Information Regarding E-Vehicles

Variables	Frequency		Percentage
Brand Preference	Ather Energy	10	6.7%
	Bajaj Auto	10	6.7%
	Hero Electric	8	5.3%
	Hyundai	11	7.3%
	Mahindra Electric	14	9.3%
	Mg Motors	7	4.7%
	Ola Electric	7	4.7%
	Tata Motors	63	42%
	Tesla	20	13.3%
E-Vehicle Preference	Bike	55	36.7%
	Car	32	21.3%
	Scooter	63	42%
Period of Usage	Below 2years	89	59.3%
	2-4years	43	28.7%
	Above 4years	18	12%
E-Vehicles models	Battery electric vehicles	80	53.3%
	Plug in hybrid electric vehicles	19	12.7%
	Hybrid electric vehicles	51	34%

The above table shows that 6.7% of the respondents are using Ather energy brand, 6.7% of the respondents are using Bajaj auto brand, 5.3% of the respondents are using Hero electric brand, 7.3% of the respondents are using Hyundai brand, 9.3% of the respondents are using Mahindra electric, 4.7% of the respondents are using MG motors brand, 4.7% of the respondents are using Ola electric brand,

42% of the respondents are using Tata motors and 13.3% of the respondents are using Tesla.36.7% of the respondents prefer bike, 21.3% of the respondents prefer car and 42% of the respondents prefer scooter. It is also found that 59.3% of the respondents are using the electric vehicles below 2years, 28.7% of the respondents are using the electric vehicles between 2-4 years and 12% of the respondents are using above 4 years. In addition, the above table that 59.3% of the respondents are using the electric vehicles below 2years, 28.7% of the respondents are using the electric vehicles between 2-4 years and 12% of the respondents are using above 4 years.

Table 3

Factors Inducing Customers to Purchase Electric Vehicles

Factors	N	Min	Max	Mean	Std. Dev
Environmentally friendly	150	1	5	4.22	.926
Smoother driving experience	150	1	5	4.03	.915
Modern lifestyle	150	1	5	3.91	.944
Technological advancement	150	1	5	4.05	.929
Government subsidies encourage EV adoption	150	2	5	4.06	.771
Information on EVs is transparent	150	1	5	3.91	.777
Availability of charging stations builds trust	150	1	5	3.83	.901
EV brands provide reliable after-sales service	150	2	5	3.81	.862
Save on fuel cost	150	2	5	4.24	.808
Warranty and maintenance plans	150	2	5	3.93	.748
Tax and financial benefits	150	2	5	3.90	.825
Resale value	150	1	5	3.69	.983

From the above table, it is observed that the Save on fuel cost is the top most factors which influence customer to purchase the electric vehicles (4.24) and the least factor which influences customer to purchase the electric vehicles is Resale value (3.69).

Table 4

Challenges Faced by Customers while using Electric Vehicles

Statement	N	Min	Max	Mean	Std. Dev
Extreme weather conditions	150	2	5	3.92	.863
Limited charging stations	150	1	5	3.95	.885
High upfront cost of EV	150	2	5	3.95	.846
Range anxiety	150	2	5	3.82	.795
Slow charging speed	150	1	5	3.87	.917
Battery durability concern	150	2	5	3.85	.862
Limited model options	150	2	5	3.97	.827
Not preferred for long- distance travel	150	1	5	3.95	.968
Limited service and repair options	150	1	5	3.96	.881

From the above table, it is observed that the Limited model options is the top most challenges faced by customer to purchase the electric vehicles (3.97) and the least challenges faced by customer to purchase the electric vehicles is Range anxiety (3.82).

Table 5

Scope of E-Vehicles Consumption of Customers in Chennai

Statement	N	Min	Max	Mean	Std. Dev
Reliable mode of transportation	150	1	5	4.12	.759
Affordable long-term investment	150	2	5	3.95	.792
Suitable for daily commuting	150	2	5	4.13	.805
Safer compared to traditional vehicles	150	1	5	3.91	.889
The design and aesthetics of EVs are appealing	150	2	5	3.99	.827
Quieter and reduce noise pollution	150	1	5	4.15	.839

From the above table, it is observed that the Quieter and reduce noise pollution is the top most perception of customer to purchase the electric vehicles (4.15) and the least perception of customer to purchase the electric vehicles is safer compared to traditional vehicles (3.91).

Table 6

Association between Gender and Factors Inducing the Customers to Purchase Electric Vehicles

	Value	df	Asymptotic Significance (2-sided)
Pearson Chi-Square	30.198[a]	28	.354
Likelihood Ratio	36.773	28	.124
N of Valid Cases	150		

As the Pearson chi square value is 0.354, which is more than significant value of 0.05. Therefore, it indicates that there is no association between gender and the factors inducing the customers to purchase electric vehicles.

Table 7

Association Between Qualification and Factors Inducing the Customers to Purchase Electric Vehicles

	Value	df	Asymptotic Significance (2-sided)
Pearson Chi-Square	116.924[a]	84	.010
Likelihood Ratio	73.266	84	.792
N of Valid Cases	150		

As the Pearson chi square value is 0.010, which is less than significant value of 0.05. Therefore, it indicates that there is association between qualification and the factors influencing the buying behavior of customers towards electric vehicles.

Table 8

Association between Occupation and Scope of E-Vehicles Consumption of Customers in Chennai

	Value	df	Asymptotic Significance (2-sided)
Pearson Chi-Square	37.136[a]	42	.684
Likelihood Ratio	37.298	42	.677
N of Valid Cases	150		

As the Pearson chi square value is 0.684, which is more than significant value of 0.05. Therefore, it indicates that there is no association between occupation and perception of customers towards electric vehicles.

Table 9

Association Between Annual Income and Scope of E-Vehicles Consumption of Customers in Chennai

	Value	df	Asymptotic Significance (2-sided)
Pearson Chi-Square	35.976[a]	42	.732
Likelihood Ratio	36.001	42	.731
N of Valid Cases	150		

As the Pearson chi square value is 0.732, which is more than significant value of 0.05. Therefore, it indicates that there is no association between annual income and perception of customers towards electric vehicles.

Table 10

Association Between Age and Challenges Faced by Customers while using Electric Vehicles

	Value	df	Asymptotic Significance (2-sided)
Pearson Chi-Square	65.612[a]	63	.386
Likelihood Ratio	59.415	63	.605
N of Valid Cases	150		

As the Pearson chi square value is 0.386, which is more than significant value of 0.05. Therefore, it indicates that there is no association between age and challenges faced by customers towards electric vehicles.

Table 11

Association between Martial Status and Challenges Faced by Customers while using Electric Vehicles

	Value	df	Asymptotic Significance (2-sided)
Pearson Chi-Square	24.679[a]	21	.261
Likelihood Ratio	22.231	21	.386
N of Valid Cases	150		

As the Pearson chi square value is 0.261, which is more than significant value of 0.05. Therefore, it indicates that there is no association between marital status and challenges faced by customers towards electric vehicles.

Table 12

Relationship between Factors Inducing the Customers to Purchase Electric Vehicles and Scope of E – Vehicles Consumption of Customers

		Factors	**Perception**
Factors	Pearson Correlation	1	.758**
	Sig. (2-tailed)		<.001
	N	150	150
Perception	Pearson Correlation	.758**	1
	Sig. (2-tailed)	<.001	
	N	150	150

From the above table, it is observed that the Pearson correlation coefficient between "Factors" and "Perception" is 0.758, which means statistically significant at the 1% level. The p-value (Sig. 2-tailed) is < 0.001, which is less than the threshold of 0.01. This indicates a strong positive correlation between the two variables, which means the "Factors" increase the "Perception" also tends to increase.

Table 13

Relationship between Scope of E-Vehicles Consumption of Customers and Challenges Faced by Customers

		Challenges	Perception
Challenges	Pearson Correlation	1	.644**
	Sig. (2-tailed)		<.001
	N	150	150
Perception	Pearson Correlation	.644**	1
	Sig. (2-tailed)	<.001	
	N	150	150

From the above table, it is observed that the Pearson correlation coefficient between "Challenges" and "Perception" is 0.644, which means statistically significant at the 1% level. The p-value (Sig. 2-tailed) is < 0.001, which is less than the threshold of 0.01. This indicates a moderate to strong positive correlation between the two variables, which means the "Challenges" increase the "Perception" also tends to increase.

Table 14

Relationship Between Factors Inducing the Customers to Purchase Electric Vehicles and Challenges Faced by Customers

		Challenges	Perception
Challenges	Pearson Correlation	1	.613**
	Sig. (2-tailed)		<.001
	N	150	150
Perception	Pearson Correlation	.613**	1
	Sig. (2-tailed)	<.001	
	N	150	150

From the above table, it is observed that the Pearson correlation coefficient between "Factors" and "Challenges" is 0.613, which is statistically significant at the 1% level. The p-value (Sig. 2-tailed) is < 0.001, which is less than the threshold of 0.01. This indicates a moderate to strong positive correlation which means the "Factors" increase the "Challenges" also tend to increase.

Suggestion

- Tata Motors and Tesla are the most preferred brands among customers when purchasing electric vehicles. Therefore, other brands should focus on improving their market presence and brand reputation to stay competitive in the electric vehicles market.
- Saving on fuel costs, environmental friendliness, and technological advancements are the top factors influencing customers decisions to purchase electric vehicles. Brands should emphasize these factors in their marketing strategies to attract more customers.
- Limited model options, high upfront costs, and slow charging speeds are the major challenges faced by customers. Brands should focus on expanding their product range, offering affordable financing options, and improving charging infrastructure to address these concerns.
- Battery electric vehicles are the most preferred type of electric vehicles among customers. Brands should continue to innovate in battery technology and offer longer warranties to build consumer trust and satisfaction.
- The majority of respondents prefer electric scooters over bikes and cars. Manufacturers should focus on expanding their scooter offerings and improving features like range, comfort, and affordability to cater to this demand.
- Limited charging stations and range anxiety are significant concerns for customers. Governments and private companies should collaborate to expand charging infrastructure and educate customers about the actual range capabilities of electric vehicles.
- The majority of respondents have been using electric vehicles for less than 2 years. Brands should focus on retaining these customers by offering excellent after-sales service and maintenance plans.
- The scope of safety in electric vehicles is relatively low compared to traditional vehicles. Brands should emphasize safety features in their marketing and work on improving the safety standards of electric vehicles to boost customer confidence.

Conclusion

In the past, traditional vehicles powered by internal combustion engines dominated the transportation sector. Customers are increasingly drawn to EVs due to their potential to reduce carbon emissions and contribute to a more sustainable future. However, there has been a radical change in recent years with the rise of electric vehicles. Advancements in technology, growing environmental awareness, and supportive government policies have driven this shift. Electric vehicles are becoming increasingly popular due to their environmental benefits, cost-efficiency, and alignment with the global

push toward sustainable development. The present study aimed to analyze the major factors influencing the adoption of electric vehicles and to identify the challenges faced by customers. It also sought to assess the satisfaction levels of electric vehicle users. Online reviews, expert opinions, and peer recommendations play a significant role in influencing purchasing decisions. The majority of customers prefer electric vehicles due to their lower running costs, reduced environmental impact, and incentives provided by governments. Factors such as charging infrastructure availability, Smoother driving experience, and modern lifestyle also play a critical role in shaping purchase decisions. By focusing on innovation, affordability, and consumer education, the EV industry can overcome existing challenges and capitalize on the growing demand for sustainable transportation solutions and more efficient future.

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