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Factors Influencing Customer Preference and Adoption of Electric Vehicles in India: A Journey towards More Sustainable Transportation

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Abstract: This study examines the impact of ecological awareness on Electric Vehicle (EV) acceptance and usage in light of the ecosystem advantages, and its changing focus from "traditionally perceived usefulness" to "green perceived usefulness". The purpose of this study is to analyze public perceptions of autonomous driving and automotive tracking systems. Furthermore, it helps to comprehend why people adopt new technology and offers some recommendations for the global growth of EVs. We used factor analysis considering six distinct factors including Charging Time, Innovation, Perceived Quality, Perceived Affordability, Awareness, and Comfort. Our results indicate that elements including consumer loyalty, power efficiency, charging system, and consumer acceptance have a moderate effect, indicating that these factors do play an important role in influencing consumers' behaviors when it comes to adopting EVs.

Keywords: electric vehicles; green initiative; environmental concern; ownership cost; sustainable transportation

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1. Introduction

Electric cars are one of the near-term potential vehicle technology choices for reducing greenhouse gas emissions and the dependency on fossil fuels associated with traditional autos. Despite the various benefits provided to customers, certain barriers to the widespread adoption of Electric Vehicles (EVs) still remain. Customers' reluctance to new technology is one of the most significant barriers to EV adoption. As a result, policies that indicate serious concerns about EVs are more likely to prevail. Electric vehicles (EVs) are still in their early stages of development. Adoption is hampered by price and range concerns. EV batteries have a critical role in determining EV prices and costs as the high-capacity battery impacts the EV subsidies on an EV ecosystem. Electric vehicles are cutting-edge technology that has the potential to minimize greenhouse gas emissions and aid in mitigating the causes of climate change. Externalities such as knowledge appropriation and pollution reduction, on the other hand, result in societal/economic advantages that are not represented in the price of electric vehicles. Organizations have taken several steps to address the resulting market failures. Based on our present study, we uncovered a plethora of other socioeconomic factors that are likely to impact electric vehicle adoption rates. The development of electric vehicles (EVs) has a significant influence on environmental protection. However, the public acceptance of EVs is still low, leaving some EV marketing challenges to unravel. Based on a questionnaire survey, this paper employs the factor analysis technique and the structural equation model to examine the probable variables impacting customers' adoption of EVs. Electric vehicles will be utilized to replace current vehicles.

Newer technical advancements in automobiles are prompted by escalating transportation challenges, including sound, carbon emissions, and congested roads. Sustainable transportation systems are significantly impacted by technological advancements in electric propulsion and automated vehicles [1]. Autonomous cars are recognized as a cost-effective approach to preserve urban transportation by reducing fuel dependency and carbon emissions, perhaps resulting in wellness and ecological advantages [2]. Several nations have established goals and implemented strategies to promote the use of EVs; therefore, it is expected that EVs could make up a significant portion of upcoming automobile sectors [3]. Globally, the number of new electric car registrants surged from six thousand in 2010 to seven hundred fifty thousand in 2016, and it has been forecasted that the world will have one hundred fifty million electric vehicles on the road by 2030 [4].

Unarguably, an electric vehicle is an invention that might assist in resolving the ecological issues related to global warming brought on by increasing emissions of greenhouse gases. Furthermore, it is believed that the acceptance of EVs is highly restricted in the absence of additional stimuli such as strict pollution restrictions, increasing gasoline costs, and remuneration [5–7]. Public incentives are expressly recognized as being essential for EVs to be adopted by the general public [5,8]. A fundamental economic inability, or the inadequate distribution of products, is one of the reasons why dispersion is anticipated to become so sluggish. This is because some factors related to emission reduction and information appropriability have a negative impact on EV growth and customer acceptance [9–11]. Market imperfections cause EV pricing to be distorted in comparison with internal-combustion-engine vehicle (ICEV) costs, which prevent businesses from producing or customers from purchasing as many autonomous vehicles. External costs thus restrict the ability of EV creation and utilization to solve global warming; the nineteenth-century-economy suggests that federal policies ought to be used to help adjust for this kind of circumstance [9]. Among these legislative initiatives, requirement tools such as customer incentives are thought to be crucial throughout the initial industrialization phase [7].

In fact, we found in the literature review that there have been many studies concerning customer satisfaction, customer preference, etc., mostly in the context of developed parts of the world. However, due to cultural variations, the issue presents a unique set of aspects in emerging countries such as India. Additionally, there has been a strong trend among the higher middle class in emerging nations to buy electric vehicles at an affordable rate. Our objective is to identify the factors influencing customer preference and adoption of electric vehicles in India, and, most interestingly, whether they recommend others after experiencing the usage of an electric vehicle. A thorough survey was done, and the results revealed that the purchase of an electric vehicle is predominantly influenced by six different factors. There is not much literature that concentrates on the advice of buying an electric vehicle. The exchange of the knowledge among the customers encourages the purchase of an electric vehicle. Our research goal is to address this gap. This paper specifically examines the impact of ecological awareness on EV acceptance and usage in light of the ecosystem advantages of EVs, and it substitutes "green perceived usefulness" for "traditionally perceived usefulness". Furthermore, it helps to comprehend why people adopt new technology and offers some recommendations for the global growth of EVs. The rest of the paper is organized as follows: Section 2 deals with the existing literature in this area. Section 3 describes the methodology and data collection. In Section 4, we discuss the findings. Section 5 summarizes the concluding remarks and managerial implications.

2. Review of the Literature

A substantial amount of empirical literature is emerging alongside the rapidly expanding EV sector. Although the current strand of research is quite incisive on customers' driving behaviors for electric vehicles, social assistance programs, delivery systems, and technical advancements, new analyses imply that the research frequently relies on the same presumptions. For instance, it is interesting that now the majority of EV customer demand research is conducted on surveys and decision experiments [8,12–14]. Experiments that are descriptive in nature, however, frequently concentrate on electric vehicle car owners' experiences [15–19], perhaps the methods whose benefits could really impact new buyers [20–23], and even on hurdles to the acceptance of EVs by individuals and organizations [24–28]. To put it another way, there is not much empirical literature just on the opinions and justifications of people who do not personally possess or are considering purchasing an electric vehicle. The authors of refs. [29,30] arrive at the same conclusion throughout their own perceptions that there has been a shortage of descriptive methodology that connects and describes the opinions expressed in extensive reflective questionnaires as well as preference experimental studies to individual customer rationale and attitude. Similar criticisms of electric vehicle marketing studies have been made by refs. [24,31], who claim that this overly focuses on such a "mechanical rationality" and minimizes customer behavior [32]. The authors of ref. [33] suggest that the present study might influence any further study on customer views regarding EVs subsidies and governmental transportation policy in addition to the requirement for additional subjective investigations on the broader variety of customer categories.

Carbon dioxide and other greenhouse gases are atmospheric contaminants that are harmful to human health and welfare [34,35]. By emitting a large amount of greenhouse gases, people may cause weather disruption and global warming [36–38]. The combustion of non-renewable resources (such as fossil fuels) in the transportation and electricity sectors is thought to be the largest source of carbon emissions [39,40]. To assist and counter the worldwide growth in emissions of carbon dioxide, governments are progressively encouraging the use of electric vehicles. Electric vehicles may have positive ecological consequences, but, before they can be extensively used, several fundamental, economic, and traditional obstacles may have to be removed. Emerging transportation problems spur automotive technical advancements. Sustainable transportation systems are significantly impacted by the development of power propulsion systems and driverless vehicles [1]. By lowering the reliance on petroleum and carbon emissions, electric vehicles are recognized as an effective means of sustainable urban transportation. They might have positive effects on both climate and human well-being [2]. Three-quarters of the carbon dioxide emissions produced by the transportation industry, which contribute to 23% of global emissions, come from the transportation system [41,42]. In order to solve critical global issues and combat global warming, it is essential to reduce carbon dioxide emission levels in the transportation industry [42,43]. Hence, it has emerged as imperative that transport systems use renewable sources of energy [44,45].

There is a major implication for society from the growth of plug-in electric vehicle charging, both at home and in public. The idea is that widespread accessibility of plug-in electric car chargers will raise public awareness of plug-in electric vehicle technology and enhance perceptions of how plug-in electric vehicles function. This may even enable the growth of green, forward-thinking, and progressive "cultural branding" [46]. Home charging may also be an important consideration for consumers considering purchasing a plug-in electric vehicle. Drivers had substantially less power supply available after their trips [47]. Those limited by the range of their plug-in electric vehicles may benefit from learning about public charging stations, since they may stimulate them to go more considerable distances on electric power. However, as it only covered a small sample of plug-in electric car owners and drivers, this study had severe drawbacks. The study did not examine changes in the interest, views, or acceptability of non-plug-in electric car owners in the technology. According to projections, increasing charger availability from 10% to 33% may increase EV demand by up to 50%. Furthermore, when the authors used respondent data to simulate a tenfold increase in charger availability, EV demand nearly doubled, with the estimated market share increasing from 2.2% to 8.9%. Research on automobile owners found that increasing recharge availability boosts the willingness to pay for a new vehicle, decreases time spent seeking to charge infrastructure, enhances the individual utility, and increases the possibility of purchasing a plug-in electric vehicle [48]. Automobiles with exceptional environmental performance, releasing little or no air pollution. Many governments have attempted to distribute EVs; nonetheless, by 2015, sale volume trends differed by nation (plug-in electric automobiles) [49]. Many studies have looked into EV adoption incentives in many countries, including the United States [8,50]; Canada, the Netherlands [51], and others. Some features would be universal, while others would be country specific. The authors of ref. [34] looked at consumer EV adoption studies that were based on individual-specific psychological characteristics. The situation of EV diffusion will differ from country to country and depend on national traits or policies. We focus on EV markets [50].

Several studies have found a number of consumer benefits that may impact a person's likelihood of acquiring an EV, with common indicators including education, income, the number/type of autos owned, level of environmentalism, and love of technology. The literature is divided on which of these characteristics is essential. According to several studies, higher levels of education are related to a greater chance of owning an electric vehicle or being "ev-oriented" [8,52,53]. It was shown that neither education nor economic status had an impact on EV adoption rates across nations [54]. The authors of ref. [8] found no indication that increasing money improved or decreased respondents' odds of being "EV-oriented". Unlike [13], who observed that living in a multi-car family reduced a person's probability of being "EV-oriented", and ref. [8] discovered that living in a multi-car family lowered a person's likelihood of being "EV-oriented". Buying or planning to buy an has been demonstrated to be a strong predictor of a person's interest in owning an EV [50,53]. Furthermore, having a place to put an EV charging outlet was deemed critical [50], and the lack of one may impede residents of apartment complexes or similar units. In [17], participants in the EV driving trial appreciated at-home charging because it gave them a sense of autonomy. In the research, there is conflicting evidence that a consumer's preference for environmental outcomes impacts their decision to purchase an electric car. Few inferences can be drawn from EV adoption, regarding which identifiers may help predict long-term EV acceptability [17].

Researchers have looked into EVs in order to acquire a better understanding of customer purchase decisions. According to the research, the electric driving range is the greatest non-financial hurdle to adoption. The authors of ref. [52] revealed that three respondents consider the driving range to be a "significant disadvantage" or "somewhat of a disadvantage" in more than 70% of transportation assessments. As the survey was performed solely in urban areas, the results represent a demographic attribute that is likely to be less concerned with driving range than those in suburban and rural areas, underestimating the true consumer concern about driving range. The Minneapolis EV cost–payback model, with a focus on trip chaining and range, suggests that plug-in hybrid electric vehicles will be more popular than battery electric vehicles. In a Monte Carlo simulation of AFVs, ref. [55] revealed that battery electric vehicles are more likely to be chosen than plug-in hybrid electric vehicles. Allowing access to charging stations, rather than longer-range autos, according to the scientists, is a better strategy to alleviate range anxiety. This also highlights the vital need for charging time [17]. When quick charging is unavailable, the demand to pay for the driving range grows, indicating the relationship between the driving range and charging time [56]. According to [53], keeping the charging time at 1 h would still discourage long-distance travel, but decreasing the charging time to 10 min would allow battery electric vehicles to travel in roughly the same amount of time as internal combustion engine vehicles. According to [56], more research is needed in order to explore the relationship between driving range, charging time, and charging network installation. Similarly, a random utility model using survey data revealed that EVs become competitive when supporting infrastructure is provided [57], concluding that overnight recharging facilities at home would be significant for customers. The authors of ref. [58] discovered a comparable preference for at-home charging, not just for convenience but also for the car and charging cord's safety and security.

The new electric–hydraulic powertrain is made up of a traction motor, a battery pack, a hydraulic pump/motor (secondary component), a hydraulic accumulator, a reservoir, and a set of hydraulic valves. There are two elements to the hydraulic circuit: the drive circuit and the drain circuit. The drive circuit consists of a cartridge valve, a one-way valve, and a two-position four-way valve. The valve changes to the left as the vehicle stops, transferring oil from the reservoir to the accumulator through the secondary component pump/motor. The secondary component operates in pump mode, using the vehicle's kinetic energy to pressurize the reservoir and drive oil into the accumulator. The energy is stored in the accumulator, and the vehicle slows down. Regenerative braking is used in the hydraulic system [59]. These brakes function wonderfully in urban braking scenarios. The braking system and control sensors control all of the vehicle motors. By monitoring the wheels' speed and torque, the brake control sensor calculates the amount of power generated and rotational force to be supplied to the batteries. During braking, the brake control sensor allocates the electrical energy created by the motor to the batteries [60]. The hydraulic pressure determines the regenerative braking force of an electric motor in the master cylinder and, hence, by vehicle deceleration. As the available regenerative braking force varies with motor speed, and almost no kinetic energy can be recovered at low motor speeds, regenerative braking force is designed to be zero during high-speed deceleration to maintain brake balance. A pressure sensor detects hydraulic pressure in the master cylinder, alerting the driver to the necessity for slowing. The pressure signal is managed and sent to the electric motor controller, who regulates the electric motor to deliver the required braking torque [61].

Electric vehicles have many environmental advantages, and many countries are trying to incorporate them into daily life [62]. Meanwhile, the batteries' capacity and charging times have recently improved. To address the charging challenges, it is important to build and maintain charging infrastructure broadly throughout the service area. Modern facility management regularly monitors the status of each charger in real-time, identifies and resolves any problems, and develops a new operating strategy in this circumstance [63]. A digital controller for chargers enables us to create a smart transportation network that can be coordinated city-wide [64]. The awareness of public charging facilities may give electric car drivers confidence to travel further on electric power, therefore, positively benefiting individuals who believe their electric vehicles' range is restricted [65].

Electric vehicles (EVs) are important in helping the transition to a low-carbon energy system, as they can help to balance out the sporadic nature of renewable energy sources and expand capacity by shifting their unique charging requirements in time. This is where the digitalization of mobility becomes particularly essential [66]. EVs also have the potential to digitally connect to the grid to help balance the RES-dominating power grid [67]. This will assist in lowering emissions from the transportation industry, which now contributes significantly to global CO_2 emissions [68]. Smart buildings are designed to use electric vehicle technology to make them more intelligent and more sustainable. This will make them more energy efficient, and, in the long run, it could help reduce CO_2 emissions. They also use renewable energy sources to lessen their environmental effect [69].

EVS ratings are based on a product's quality, perceived quality, and how well it performs. Other factors that may be taken into account are the product's societal impact, how much the government is involved, and the state of the infrastructure [70]. Other effect subcategories, such as "perceived affordability and accessibility," are also mentioned and may influence how popular electric vehicles are in society [70].

3. Research Methodology

As it is quite evident from the existing literature review that some factors affect the consumers' perception in the developed markets to adopt the EVs, it becomes very pertinent to examine the consumers' behavior in one of the most populous countries—India. Drawing from the existing literature and filling the gap, the present study aims to identify the factors influencing consumers' satisfaction with the usage of EVs and to measure the effect of these dimensions on consumer recommendations for influencing the new customers in a potentially growing Indian EV market. Six important factors have been identified and labelled as Charging Time (CT), Innovation (IN), Perceived Quality (PQ), Perceived Affordability (PA), Awareness (AW), and Comfort (CM).

With the aid of a standardized questionnaire, samples for this study were obtained through one-on-one conversations with participants in various metropolises. These survey participants included men and women from diverse ages, income brackets, and occupational backgrounds, including business, service, and others (Table 1). Five points were used to measure each parameter studied for the survey (from 1 being strongly disagree to 5 being strongly agree). We use the Factor and Logistics regression test to determine whether there is a substantial correlation between satisfaction and demographic parameters.

Table 1. Sample Demographics of Survey Respondents.

AGE	%
18–25	35.4
25–30	23.2
30–45	19.2
35–40	14.9
>40	7.3
GENDER	%
FEMALE	56.9
MALE	43.1
EDUCATIONAL QUALIFICATION	%
ICSE/CBSE	7.1
HIGH SCHOOL	19
GRADUATION	49
PG	24.1
OTHERS	0.8
OCCUPATION	%
SERVICE	28
BUSINESS	24.1
STUDENT	47.1
OTHERS	0.8
INCOME (MONTHLY, INR)	%
<10 K	35.6
10–20 K	18.8
20–30 K	21.5
30–40 K	13.2
>40 K	10.9

The study was conducted using a convenience sample. Selecting a sample of people or replies from a population is an effective way to research a topic. This sample includes accessible individuals. The convenience sampling approach often successfully gathers information from clients in a commercial or market setting. The tool helps people understand what they're thinking and feeling. This study used multiple locations of India from October 2021 to July 2022. The total sample used for the survey is 477.

4. Analysis and Results

Kaiser–Meyer–Olkin (KMO) measures of sampling adequacy (which ranges from 0 to 1) closer to one are considered better, while 0.5 is regarded the minimum requirement. In the Table given below (Table 2), the KMO value is 0.867, which is greater than 0.5. Hence, we can proceed further with the factor analysis. Similarly, Bartlett's Test of Sphericity indicates the strength of the relationship among the variables. From the table, it can be seen that Bartlett's Test of Sphericity is significant, as the significant value is less than 0.05

(0.000). Considering both the tests together, they provide the minimum required standards that need to be fulfilled before conducting a factor analysis.

Table 2. KMO and Bartlett's Test.

Kaiser–Meyer–Olkin Measure of Sampling Adequacy		0.867
Bartlett's Test of Sphericity	Approx. Chi-Square	4730.928
	df	276
	Sig.	0.000

In the Total Variance Explained table (Table 3), every factor expresses a quality score, termed as the eigenvalue, under the heading "Total" of "Initial Eigenvalues". Parameters with an eigenvalue of greater than one are considered for further study because they only represent true value.

Table 3. Total Variance Explained.

Component	Initial Eigenvalues			Extraction Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	8.272	34.468	34.468	8.272	34.468	34.468
2	1.574	6.559	41.026	1.574	6.559	41.026
3	1.373	5.719	46.746	1.373	5.719	46.746
4	1.152	4.800	51.545	1.152	4.800	51.545
5	1.083	4.512	56.057	1.083	4.512	56.057
6	1.041	4.336	60.394	1.041	4.336	60.394
7	0.917	3.819	64.213			
8	0.868	3.615	67.828			
9	0.812	3.385	71.213			
10	0.767	3.198	74.410			
11	0.665	2.771	77.181			
12	0.638	2.658	79.840			
13	0.631	2.628	82.467			
14	0.585	2.439	84.907			
15	0.545	2.269	87.175			
16	0.510	2.126	89.301			
17	0.471	1.962	91.263			
18	0.410	1.710	92.973			
19	0.380	1.583	94.556			
20	0.329	1.369	95.925			
21	0.304	1.265	97.190			
22	0.255	1.064	98.255			
23	0.225	0.936	99.191			
24	0.194	0.809	100.000			

It can be seen that Factor 1 (Charging Time) accounts for a variance of 8.272, which is 34.468% of the total variance (Table 3). Likewise, Factor 2 (Innovation) accounts for a variance of 1.574, which is 6.559% of the total variance; Factor 3 (Perceived Quality) accounts for a variance of 1.373, which is 5.719% of the total variance; Factor 4 (Perceived Affordability) accounts for a variance of 1.152, which is 4.800% of the total variance; Factor 5 (Awareness) accounts for a variance of 1.083, which is 4.512 of the total variance; Factor 6 (Comfort) accounts for a variance of 1.041, which is 4.336 of the total variance. Thus, the first six factors combined account for 60.394%.

Podsakoff et al. [71] stated that the data were gathered by self-reported surveys, and common method bias [72,73] cannot be completely excluded. Respondents were guaranteed confidentiality and anonymity during the data gathering phase in order to receive unbiased answers. When it came time for data analysis, all research variables were subjected to an Exploratory Factor Analysis (EFA) using SPSS 26.0 in order to apply

Harman's single factor test [74]. If a single component accounts for a sizable portion of the variance, Harman's single factor suggests a common technique bias. Our findings show that numerous components rather than a single one emerge, and the first factor only explains 34.46% of the variance, which is below the 50% level.

Reliability Tests revealed that (Charging Time):- Cronbach Alpha-0.862, (Innovation):- Cronbach Alpha-0.851, (Perceived Quality):- Cronbach Alpha-0.810, (Perceived Affordability):- Cronbach Alpha-0.833, (Awareness):- Cronbach Alpha-0.878, (Comfort):- Cronbach Alpha-0.824.

All Cronbach alphas of the value constructs are above 0.80.

Factors (Table 4) have been labeled as Charging Time (CT), Innovation (IN), Perceived Quality (PQ), Perceived Affordability (PA), Awareness (AW), and Comfort (CM). To determine whether the variables could be chosen for the study, the multicollinearity test was run. Each variable was chosen because the Variation Inflation Factor (VIF) was less than 10.

Table 4. Rotated Component Matrix and Validity Test.

	Component						TOLERANCE	VIF
	(CT)	(IN)	(PQ)	(PA)	(AW)	(CO)		
The amount of time it takes to charge an electric vehicle can vary depending on several factors, such as the size of the battery and the type of charger used.	0.714						0.163	6.148
On average, it can take anywhere from 30 min to several hours to fully charge an electric vehicle.	0.689						0.178	5.618
Using a faster charger or implementing a charging schedule can help reduce charging time.	0.659						0.105	9.516
It is important to follow the manufacturer's recommended charging times and to be aware of any safety concerns when charging your electric vehicle.	0.594						0.124	8.089
Advancements in charging technology and the availability of faster chargers have greatly reduced charging times in recent years.	0.535						0.182	5.488
The charging time for an electric vehicle is an important consideration for many drivers.	0.53						0.154	6.474
In general, it takes longer to charge an electric vehicle than to fill a gas tank.	0.516						0.308	3.246
Electric vehicle technology has come a long way in recent years, with many advancements in battery technology, charging infrastructure, and vehicle design.		0.736					0.133	7.495
The rise of electric vehicles has sparked a wave of innovation in the automotive industry.		0.665					0.143	6.976
The electric vehicle market is growing rapidly, which is helping to drive the transition to a more sustainable transportation future.		0.58					0.163	6.127
Many consumers view electric vehicles as a high-quality and premium option, thanks to their advanced technology and sustainability features.			0.757				0.294	3.405
Electric vehicles often have a smooth ride, which is seen as a major factor in their perceived quality and desirability.			0.744				0.21	4.752
Electric vehicles are seen as being more reliable and requiring less maintenance than gas-powered vehicles, which contributes to their perceived quality and value.			0.465				0.372	2.69

Table 4. *Cont.*

	Component						TOLERANCE	VIF
	(CT)	(IN)	(PQ)	(PA)	(AW)	(CO)		
Electric vehicles are becoming more popular, and this is helping to raise their perceived quality and appeal among a wider range of consumers.			0.446				0.153	6.119
The perceived quality of electric vehicles has improved significantly in recent years, which is helping to increase their market share and popularity.			0.414				0.168	5.317
Government incentives and subsidies can help make electric vehicles more affordable for consumers.				0.753			0.11	9.52
The long-term cost savings of electric vehicles can make them a more affordable option in the long run.				0.596			0.124	8.001
People seem to think that electric vehicles are becoming more perceived affordability, which is due to technological improvements and the competitive market.		.		0.558			0.172	5.407
Electric vehicles are becoming more popular, thanks to the publicity they've been getting and the rising awareness of their benefits.					0.784		0.149	6.374
Many people are now aware of the environmental and economic benefits of electric vehicles, such as reduced emissions and lower operating costs.					0.648		0.317	3.241
Awareness of electric vehicles is growing, but there is still work to be performed to convince people of the benefits and availability of these vehicles.					0.512		0.135	7.415
Electric vehicles are often considered more comfortable and enjoyable to drive than gas-powered vehicles, thanks to their smooth and quiet operation.						0.658	0.153	6.877
Electric vehicles have less engine noise and vibration than gas-powered cars, which makes them more tranquil to drive.						0.557	0.164	6.225
Many consumers find electric vehicles to be very comfortable, a major factor in their growing popularity.						0.499	0.284	3.415

OBJECTIVE 2: To measure the effect of these dimensions on customers' recommendation towards the usage of electric vehicles.

H1. *The hypothesis implies that there is a linear relationship between Customer Recommendations for Using Electric vehicles and the factors Charging Time, Innovation, Perceived Quality, Perceived Affordability, Awareness, and Comfort.*

The model always guesses "YES" because customers' recommendation of YES in using electric vehicles is more than NO (210 compared to 40, as per the first column of the Customer Recommendation). The overall percentage row tells us that this approach to prediction is correct 84.0% of the time. The Wald's ratio (Table 5) is high from the table and significant at 0.000. The Hosmer and Lemeshow test or Table of the goodness of fit (Table 6) suggests that the model is a good fit to the data as $p = 0.637$ (>0.05). Thus, the model is a very good fit.

The classification Table is more useful (Table 7). This Table is equivalent to the Table in Block 0 (Table 5), but this one is based on the model including the explanatory variables. It can be seen that the model is now correctly classifying the outcome for 91.0% of the cases compared to 84.0% in the null model. A small improvement, but it is a very good model.

Table 5. Variables in Equation.

		B	S.E.	Wald	Df	Sig.	Exp(B)
Step 0	Constant	−1.658	0.173	92.391	1	0.000	0.190

Table 6. Hosmer and Lemeshow Test.

Step	Chi-Square	Df	Sig.
1	6.088	8	0.637

Table 7. BLOCK 1: Method = Enter Classification Table [a].

Observed			Predicted		
			CUSTOMER_RECOMMENDATION		Percentage Correct
			Yes	No	
Step 1	CUSTOMER_RECOMMENDATION	Yes	407	20	85.3
		No	40	10	20.0
	Overall Percentage				91.0

[a] The cut value is 0.500.

Thus, we can say that this Hypothesis is accepted. The results of the logistic regression can be seen in the Table 8. Since the significant value of the factor Charging Time is less than 0.05 and higher than the Wald's value, it can be inferred that there is significant effect of the factor Charging Time on the student preference with the usage of virtual platforms. Factor Innovation or Mixed Learning too have significant effects on student preference with the usage of virtual platforms, as the significant values are less than 0.05, and the Wald's values are low. While the factors of Perceived Quality or Cognizance do not have significant effects, as the significant values are greater than 0.05, and the Wald's values are low. The logistic regression equation for the same is given below:

$$\text{Log}\,(p/1 - p) = 0.890 \times \text{Constant} + 1.729 \times \text{Perceived Quality} + 0.567 \times \text{Charging Time} + 0.208 \times \text{Innovation}$$

The study demonstrates the correlation between variables—Charging Time, Innovation, Perceived Quality, Perceived Affordability, Awareness, and Comfort—in the theoretical framework of Customer Satisfaction with the purchase and use of EVs. In today's world, plug-in electric vehicle charging has two major implications for society. The first is that it makes plug-in electric cars more accessible, which raises public awareness of the technology and perhaps enables the growth of green, forward-thinking cultural branding in communities. The second implication is that home charging may be an important consideration for consumers who are considering purchasing a plug-in electric car. Drivers may have less power supply available after their trips if they do not have access to a plug-in electric vehicle charging station; this is why many drivers face range anxiety problems. Range anxiety refers to the anxious feeling of operating an electric vehicle with the fear of running out of battery while driving, thus knowing about public charging stations may help them to extend their range.

This study found that when more developed charging station infrastructures are available, people are more likely to buy plug-in electric cars. In addition, when the developed charging station infrastructures are available at a higher percentage, demand for plug-in electric cars increases by 50%. This could mean that more people would buy plug-in electric cars if more developed charging station infrastructures were available. This article discusses the different trends in electric vehicle sales across different countries. The study shows that while many governments have attempted to promote electric vehicle adoption, there is still a lot of variability in the rates of electric vehicle adoption across different countries.

Factors that may influence adoption rates are likely due to different policies and cultural factors in different countries. Furthermore, our study has found different things about the effect of living in a multi-car family on a person's interest in electric vehicles. The first found that living in a multi-car family reduced a person's interest in electric vehicles, while another found that having a place to put an EV charging outlet was critical for residents of apartment complexes or similar units.

Table 8. Variables in Equation.

		B	S.E.	Wald	Df	Sig.	Exp(B)
Step 1 [a]	Charging Time	0.567	0.331	5.071	1	0.000	0.727
	Innovation	0.208	0.169	1.367	1	0.040	0.529
	Perceived Quality	0.252	0.165	2.337	1	0.126	0.777
	Perceived Affordability	1.729	0.184	88.047	1	0.000	0.177
	Awareness	0.467	0.231	4.079	1	0.43	0.627
	Comfort	0.137	0.215	0.403	1	0.526	0.872
	Constant	0.890	0.227	15.392	1	0.000	0.411

[a] Variable(s) entered on step 1: Charging Time, Innovation, Perceived Quality, Perceived Affordability, Awareness, and Comfort.

5. Concluding Remarks and Managerial Implications

Among the most crucial aspects to consider when determining the popularity of automobiles is the attractiveness of electronics. Many academics have cited it as the most crucial element for a similar purpose. Results from research employing the Descriptive Research method, which was used to collect data from a variety of responders, provided the foundation for this research. In order to support our study, we used factor analysis to take into consideration six distinct factors, including Charging Time, Innovation, Perceived Quality, Perceived Affordability, Awareness, and Comfort. These six factors are further described in the article. The study's results indicate that elements including consumer loyalty, power efficiency, charging system, and consumer acceptance have a moderate effect, indicating that these factors greatly impact how pleased consumers can be with electric cars. The analysis's findings will provide automakers the opportunity to make sure they employ multiple strategies to examine various choices in order to raise the public acceptability of electrical vehicles.

In the wake of the ecological catastrophe, Internal Combustion Engine (ICE) automobiles are ideally replaced with electric vehicles (EVs). However, just focusing on electric vehicles is not enough since electric vehicle charging stations (EVCS) are crucial for the installation of such cars. There are several challenges in placing the charging stations for electric cars, as all these vehicles are electronically driven. There were once big problems with overloading the infrastructure and predicting demand. The second is the management of transportation and congestion around charging stations.

This paper provides a basic understanding of charging stations, their types, and their categories. To solve these issues, manufacturers employed a variety of strategies and tactics, including calcium-ion battery charging technologies and Battery Management Systems (BMS). The Indian government is committed to creating an environmentally sustainable future, and, as a part of that, reducing greenhouse gas emissions from the transportation sector is a major priority. Consequently, the adoption of electric vehicles and the construction of electric vehicle charging stations is essential. This is a straightforward process because the government has lowered the levy on electric vehicles and is also offering incentives for the installation of charging stations.

Upcoming automobiles may seem quite different due to the technological features of electric vehicles (EVs), which are dramatically different from traditional automobiles using internal combustion engines (ICEVs). An electrical drivetrain is to blame for the significantly distinct account of Vibro-aural features (such as loud sound, acoustic noise, and roughness). It provides the chance to produce particular noises associated with particular needs and legitimizes affiliations for enhancing customer involvement and esthetical admiration. The apparent development of the electrical drivetrain sound and its ramifications for the perceived quality it conveys may be evaluated by specialists with the aid of our study.

We can compare the advantages of electric vehicles (EVs) and hybrid electric vehicles (HEVs) to those of conventional vehicles using the information in our study to examine their economic and ecological advantages. Despite government subsidies, HEVs without plugs have lifetime expenditures comparable to a conventional car, but this is only true if the car is never plugged in. The lifetime expenditures are much less enticing if the car is plugged in. This is affected by fluctuations in fuel rates. It was discovered that an all-electric vehicle can be affordable to own and drive for a lifetime, with a lifelong expense that is no more than 5 percentage points higher than that of a conventional vehicle, with the help of national tax subsidies. The only exception being hybrid electric plug-ins with a 35-mile rechargeable driving range.

There are significant perceptional and behavioral differences across developed and developing countries. Our hypotheses were constructed around those phenomena. Since no similar study was conducted in this geographical territory with the same perceptional and behavioral attributes, the results are certainly a valuable addition to the existing body of literature. In addition, our study has found a unique feature about the effect of living in a multi-car family on a person's interest in electric vehicles. We found that living in a multi-car family reduced a person's interest in electric vehicles, while another found that having a place to put an EV charging outlet was critical for residents of apartment complexes or similar units. This was not attempted in earlier studies conducted in the context of developed countries.

This study has some limitations that may be overcome by future research into electric vehicles. Since this research was only conducted in a few major Indian cities, it is possible to do more research in additional cities. Subsequent research may also attempt to collect additional data from a large group of clients from other regions around the world. Further research may also be dependent on independent factors such as age, gender, and occupation. The low response rate to the survey is because people were busy dealing with the pandemic when it was conducted.

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