

Customer Satisfaction Among Electric Vehicle Users: An Empirical Study in Lucknow

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Abstract

Electric Vehicles (EVs) are increasingly regarded as a sustainable and promising mode of transportation for the future because they generate lower carbon emissions, produce less noise, offer greater energy efficiency, they provide chances for connection with contemporary electrical grids. EVs have been increasingly popular in recent years because of their small size, economical operating costs, and relatively affordable prices. The growing adoption of EVs has also increased the need to understand users' perceptions and levels of satisfaction with these vehicles. This survey looks at consumer satisfaction among electric vehicle users in Lucknow. Data gathered from primary and secondary sources served as the study's foundation. The findings aim to provide insights into the factors influencing customer satisfaction and the general user experience of electric vehicles.

This paper studies the degree of contentment customers derives from use of their e-vehicles in Lucknow. Data gathered from primary and secondary sources forms the basis of the study. The findings aim to provide insights into the factors influencing customer satisfaction and the general user experience of electric vehicles. Both primary and secondary sources of information were taken into account for the study. Secondary data was acquired from government reports, scholarly journals, research articles, and other relevant publications. Primary information was acquired from 200 electric vehicle users in Lucknow using a structured survey intended to evaluate customer satisfaction using the Service Quality (SERVQUAL) dimensions of tangibility, reliability, empathy, assurance, and responsiveness. Simple random sampling was used to choose the responders. Descriptive statistics, index estimation, correlation analysis, regression analysis, and correlation matrices were employed to examine the association between customer satisfaction as the variable that is reliant on the identified service-quality dimensions as independent variables. The regression analysis produced an R^2 value of 0.9186, indicating that the chosen explanatory elements together explain approximately 91.86% of the variation in customer satisfaction. The reported coefficient for assurance (X4) was 0.302, indicating a positive contribution of assurance to overall customer satisfaction. Further, X4 demonstrated a favourable correlation with customer satisfaction (Y), with a correlation coefficient of 0.579568. The correlation values for X1 and X5 were 0.540, indicating a favourable correlation between these factors and customer satisfaction. Therefore, it may be stated that Electric Vehicles (EV) are helpful for a clean environment as they keep environment clean; cost-effective and incur low maintenance costs. These features make Electric vehicles (EVs) the best alternative mode of transportation.

Keywords: Electric Vehicles, Customer Satisfaction Index, Multiple Regression Model, Log Linear Model, Correlation Matrix, and Charging Facilities

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Introduction

India is the 10th-largest automotive market in the world, and with a middle-class population with buying power and steady economic growth, accelerated automotive sales is anticipated to continue.

An electric vehicle that is battery-operated and rechargeable with electricity powers an electric vehicle (EV). In electric vehicles, Batteries are used, and these give power to the engine of EVs, because of this, operating costs are now extremely low, and using EVs also protects the environment.

Electric vehicles (EVs) are now required for both people as well as for environment protection. Diesel and petrol vehicles contribute significantly to air and noise pollution, which is dangerous to human, animal, and plant health. Electric Vehicle is a promising technology that is good for achieving a Eco-friendly transportation sector for the future, because of great efficiency, minimal noise, flexibility in grid operation and integration, and extremely low to zero carbon emissions, EVs are highly favored by the general population. Adoption of Electric vehicle (EV) is also influenced by costs, infrastructure, and safety concerns. Electric vehicles (EV) have the potential to promote environmentally friendly urban transportation, thereby encouraging their use and adoption. As demand for sustainable, eco-friendly transportation grows, understanding the factors that enhance satisfaction among consumer is of great importance for manufacturers and policymakers.

E-vehicle usage is increasing among vehicle customers due to environmental pollution concerns. In Lucknow, Uttar Pradesh, a cost-effective experiment was opted to gauge consumer satisfaction with EVs.

Customer Satisfaction is a means to value the level of happiness a customer derives from a company's services, products, and product reliability. Customer satisfaction is measured by the company's product, service, and product reliability. Customer satisfaction information includes services, product quality, and its features. SERVQUAL Model of Customer Services considers five points, i.e., reliability, assurance, tangibility, empathy, and responsiveness, as key dimensions of service quality.

SERVQUAL model is used for services which as follows:

Reliability:

First dimension of SERVQUAL is related with the ability of the service provider to deliver services to consumers as per their promise i.e. on time, and error free.

Assurance:

Second dimension of SERVQUAL is concerned with the level of confidence customers have in the service provider i.e. the ability to provide expert advice and resolve issues.

Tangibility:

Third dimension of SERVQUAL is concerned with the tangible aspects of the service i.e. the appearance of

vehicle, Level of clean city's environment, and the quality of equipment.

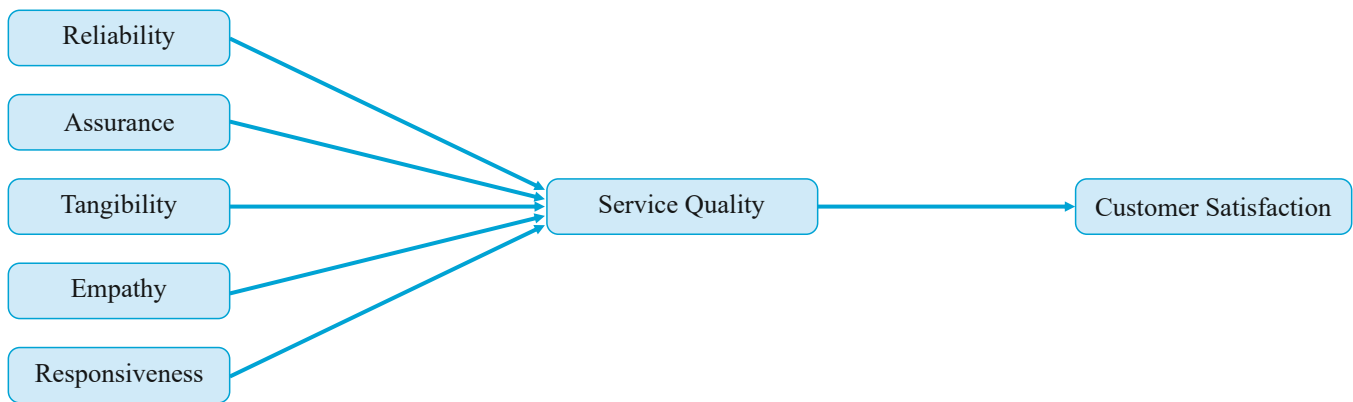
Empathy:

Fourth dimension of SERVQUAL refers to the level of understanding and caring service provider has for their customer needs and concerns.

Responsiveness:

Fifth dimension of SERVQUAL is concerned with the intention with which service provider assists customers and respond promptly to their need.

By highlighting these dimensions of service quality, Customer satisfaction and loyalty can be increased by service providers (agencies) creating a great service experience.



Source: Adapted Structural Model

Fig 1: Rater Scale

Review of Literature

Authors	Year	Purpose and Methodology	Result
Shuqin. W & Gangliu	2012	A carefully thought-out structural questionnaire was used to gather primary data. SPSS software was used to analyze the collected data. SEM was applied to evaluate the relationships among service quality, relationship value and relationship quality.	According to the study, customer satisfaction is positively impacted by service quality, while responsiveness is negatively impacted.
Ernest Emeka Izogo and Ike-Elechi Ogba	2014	Primary data were used and collected. The statistical tools were applied in study, as Cronbach's internal consistency, exploratory factor analysis, and the t-test.	The results found that service quality have significant predictors of customer loyalty and satisfaction
Giri. S & Thapa. K	2016	In this study methods such as quota and convenience sampling are utilized. The data gathered were examined through various statistical techniques such as correlation, Kano Model Analysis, frequency analysis, ANOVA, and independent simple t-tests, among others.	The study observed that warranty, washing bikes, spare parts supply, and service camp were important dimensions which required for after-sales service.
Verma. K. K & Singh.J	2024	The study reported the present position of registration of electric vehicles in Uttarakhand over the last 10 years, i.e. from 2014 to 2023. The classified into electric two-wheeler, electric three-wheeler and electric four-wheeler. The Vahan Dashboard was used to gather secondary data. The data analysis with the help of 5-year changes, 10-year changes and the CAGR of electric vehicles over a decade	The study concluded that the growth of electric vehicles increased by 245 per cent in 2021 and 505 per cent in 2022, more than 100 per cent. It is concluded that consumers' interest shifted from non-electric vehicles to electric vehicles.
Chaudhary. P & Rathore. C	2025	The study examined the e-commerce that impact the consumer purchasing behaviour by increasing use of digital sales promotional strategies. The goal of this study is to assess the efficacy of significant promotional instruments such as coupons, discounts, and other offers. A well-structured questionnaire was used to gather primary data from 396 respondents.	According to the survey, online consumers benefit from digital promotional tools.
Verma. K. K & Singh.J	2025	The status of electric and non-electric vehicles in Dehradun was reported. It segmented vehicles into the categories of two-wheelers, three-wheelers, and four-wheelers. Secondary source of information collected from Dehradun RTO office is used in this paper. Data are analysed by using the simple growth rate, five-year changes and ten-year changes of electric and non-electric vehicles.	According to the analysis, the number of electric vehicles grew between 2015 and 2024, while a decrease was observed in non-electric vehicles. The study concludes that consumers' purchasing interest shifted toward electric vehicles.

Research Gap

After reviewing the literature, we found that no study has examined customer satisfaction with e-vehicles in the study area.

Objectives

- To study customer satisfaction with e-vehicles.
- The SERVQUAL model is used to assess customer satisfaction.

Research Methodology

Nature of study:

This research paper is quantitative in nature

Data Collection: Information was gathered from both primary and secondary sources. A well-structured questionnaire was designed to gather primary data about customer satisfaction with electric vehicles, while data from secondary sources was collected from government papers, journals, and articles. With the application of a 5-point Likert scale measure the customer satisfaction level, Strongly Disagree (SD), Agree(A), Neutral(N), Agree(A), and Strongly Agree(SA).

Sample Size

The study was conducted utilizing responses obtained from 200 electric vehicle users residing in Lucknow district.

Sampling Technique

The respondents were chosen using a straightforward random sampling technique. The opinions and answers of the chosen individuals were documented for additional examination.

Analysis of Data

Information relating to the demographic and general characteristics of EV owners was collected to understand their purchasing behaviour and perceptions towards electric vehicles. Customer satisfaction was examined across important dimensions such as reliability, assurance, tangibility, empathy, and responsiveness demonstrated by dealers and concerned authorities. The collected data were organised and analysed systematically to examine different aspects of EV ownership and satisfaction. The analysis included the sources and use of funds for purchasing electric vehicles, the method through which the vehicles were acquired, the Customer Satisfaction Index (CSI) is calculated, and a multiple regression model is used to identify the variables related to customer satisfaction. In order to assess the strength and direction of the relationships between the selected variables, a correlation matrix was also created.

Statistical Tools

Several statistical techniques were employed to assess the satisfaction level of EV users and to find the relationships among the study variables. Satisfaction indices were calculated to find out the overall level of

customer satisfaction. Regression analysis, correlation analysis, log-linear modelling, and correlation matrices and descriptive statistics were used to interpret the data. The article's analysis and discussions are based on the results obtained with these techniques

Customer Satisfaction of Vehicle Users

Maximum = Mean + SD and Minimum = Mean - SD

The formula used for the satisfaction Index of vehicle users

Table-1 Classification of respondents based on mode of purchase of e-vehicles:

Mode of Purchase	No. of respondents
Self-Finance	101 (50.5)
Loan	99 (49.5)
Total	200 (100)

Source: Author's Primary data collection, Figures included in parenthesis show the proportion of the total

Table 1 revealed the detailed classification of respondents who purchased types of vehicles with their own funds and borrowed funds (loans). As may be seen from the table that 51 per cent of respondents made purchases using their own money to purchase electric vehicles in the study area, whereas 49 per cent of respondents took loan facilities. They may be facing problems regarding loans. In this condition, it may be advisable for financial institutions not to create hardship or an unsociable atmosphere for the loan holder.

Table-2 Mode of purchase of electric vehicles and their use by Respondents

Type Used	Purchase Mode	No. of respondents
Personal	Cash	34(17.00)
	Finance	34(17.00)
	Total	68(34.00)
Commercial	Cash	67(33.50)
	Finance	65(32.5)
	Total	132(66.00)
Grand Total		200(100)
Vehicles Family Ratio		1:1.04

Source: Author's Primary data collection, Figures in parentheses indicate the percentage of the total

Table No. 2 examines the details of the mode of electric vehicle purchase for sample households, whether purchased with cash down or with financial assistance from financial organizations (e.g., banks), relatives, friends, and so on the table shows that 34% of Customers used Electric Vehicles for their personal work,

whereas 66 per cent of the Electric Vehicles were used for Commercial purposes. 17% respondents purchased electric vehicles on cash down for personal use, however, 33.5% of owners of electric vehicles spent their personal funds on Commercial purposes.

Further, as may be observed from the table that the ratio is 1:1.04, indicating that 1 vehicle was available per family. The table further shows that the respondents purchased personal electric vehicles for cash and avoided taking assistance from any financial institution. Statistics reveal that when people purchase an E V for commercial purpose, they turn to a financial institution for help.

Table-3 Customer Satisfaction Index of Electric Vehicle users

Variable	Category of Index	Index value	No. of respondents(n=200)
Reliability	Low	Less than 423.46	32 (16.0)
	Medium	Between 423.46 and 676.35	128 (64.0)
	High	More than 676.35	40 (20)
Assurance	Low	Less than 459	39(19.5)
	Medium	Between 459 and 675.35	108(54)
	High	More than 675.35	53(26.5)
Tangibility	Low	Less than 460.13	51(25.5)
	Medium	Between 460.13 and 754.85	101(50.5)
	High	More than 754.85	48(24)
Empathy	Low	Less than 485.78	43(21.5)
	Medium	Between 485.78 and 772.34	114(57)
	High	More than 772.34	43(21.5)
Responsiveness	Low	Less than 479.24	40(20)
	Medium	Between 479.24 and 755.82	99(49.5)
	High	More than 755.82	61(30.5)
Customer Satisfaction	Low	Less than 2438.14	40(20)
	Medium	Between 2438.14 and 3749.2	111(55.5)
	High	More than 3749.2	49(24.5)

Source: Author's Primary data collection , Figures in parentheses indicate the proportion of the total

The customer satisfaction index of electric vehicle users was estimated, and five variable were considered: Reliability, Assurance, Tangibility, Empathy, and Responsiveness, which together affect consumer satisfaction. The index values were divided into three parts: lower index, medium index, and higher index values.

Table 3 shows that the medium index value for the related factors associated with the satisfaction level of electric vehicle users is reliability (64%), followed by assurance (54%), tangibility (50.5%), and responsiveness (49.5%). Most of the individuals who responded belong to the medium index value range. This suggested that the characteristics of electric vehicles were at a level of satisfaction for the sample householders in the Lucknow survey area. The study index value also suggests that the current features of electric vehicles need to be improved in the future, given changing behaviour among vehicle owners and the need for time.

Table – 4 ANOVA of Customer satisfaction of Lucknow survey area.

	df	SS	MS	F	Significance F
Regression	5	0.001218	0.000244	438.3283	1.3E-103
Residual	194	0.000108	5.56E-07		
Total	199	0.001326			

Source: Author's Calculation

Table -5 Multiple Regression Model of Customer Satisfaction in Lucknow

Particular	Details/Value	Correlation Coefficients					R2
Intercept	0.571684	x1	x2	x3	x4	x5	0.91868
Variable	5	0.08576	0.302083	0.112649	0.079134	-0.38169	
		(0.008176)	(0.021815)	(0.01606)	(0.002921)	(0.019735)	
D.F	194						
Calculated t Value		11.49005	14.84777	8.03339	26.08886	-195405	

Source: Authors' Calculation

Customer Satisfaction regression models were estimated by applying a statistical model as linear, double log and semi-log were tested the best fit model was then chosen based on the correlation coefficient's relationship and degree of significance. Multiple regression coefficient value R^2 was statistically significant at 1,5 or 10% level of significance. Among the above models, the double log/log-linear model was the best fit for analysis and interpretation. From the above table, it can be seen that the R^2 value was 0.9186, which indicates that together, the explanatory factors explained 91.86% of the variation in the explained variables. The multiple regression model with independent variable. i.e. (x_1) reliability, (x_2) assurance, (x_3) tangibility, (x_4) empathy, (x_5) responsiveness, was used to ascertain the effect on the dependent variable, it has been calculated the result of the model, the regression value shows that the regression coefficient (R^2) having 91.86 percent effect on dependent variable with 5 percent level of significance by the explanatory variable together this indicated all the variables having a close relationship with the dependent variable i.e. consumer satisfaction. As observed from the table that the variables responsiveness attributed a negative relation but were highly significant at 1 percent level of significance with consumer satisfaction.

Table-6 Correlation Matrix of Customer Satisfaction with E-Vehicles

	Y	X1	X2	X3	X4	X5
Y	1					
X1	0.184984	1				
X2	0.428963	0.359468	1			
X3	0.02845	0.011325	0.001992	1		
X4	0.579568	0.037896	-0.29531	-0.15701	1	
X5	-0.53729	0.540158	-0.18436	0.036413	0.10717	1

Source: Authors' Calculation

A correlation matrix is a table that displays the correlation coefficients between multiple variables. It displays each pair of variables linear relationship's strength and direction. The correlation coefficient, which goes from -1 to +1, shows how much two variables change together.

The degree and direction of a relationship between two variables were ascertained using correlation analysis. A perfect positive relationship is represented by a correlation coefficient of +1, a perfect negative relationship by a coefficient of -1, and the absence of a linear relationship is indicated by a coefficient of 0. A negative correlation indicates that the variables typically move in opposite directions, whereas a positive correlation indicates that they typically move in the same direction. A thorough picture of the correlations between the variables is given by the correlation matrix, which displays the coefficients for every possible pair of variables.

Interpretation of Correlation Matrix

Every variable has a perfect connection with itself, therefore the diagonal elements are always equal to 1. In contrast, the off-diagonal elements show the degree and direction of association between different variables.

Values:

The stronger the association between the variables, the closer the correlation coefficient is near +1 or -1. The closer to 0, the weaker the relationship.

Use of correlation matrix:

- The correlation matrix helps us to identify patterns and relationships between variables
- Correlation matrices can also be used for other statistical analyses, such as factor analysis, regression, etc.
- Correlation matrices can be used to evaluate the multicollinearity in regression analysis.

The direction and intensity of the linear link between two or more variables can be ascertained using a correlation matrix.

Table 6 reveals the correlation matrix of the variables related to consumer satisfaction with electric variables. The explanatory variables i.e. reliability(x_1), assurance(x_2), tangibility(x_3), empathy(x_4), and responsiveness(x_5). From the table, the diagonal elements show that the correlation matrix is +1, indicating that each variable is perfectly correlated with itself. The correlation between the variables is displayed by the off-diagonal elements. The correlation coefficient of various combinations of the variables, such as x_1 and x_2 , x_1 and x_3 , x_1 and x_4 , x_1 and x_5 , and y variables. The correlation coefficient (r) for x_1 and x_4 (-0.29531), x_2 and x_5 (-0.18436), and x_3 and x_4 (-0.15701). The correlation coefficient's value (r) of x_1 and x_4 (-0.29531), x_2 and x_5 (-0.18436), and x_3 and x_4 (-0.15701). This indicated that the relationship between the x_2 variable (i.e., assurance) and the x_4 variable (i.e., empathy) is weakly negative. The same inverse weak relation exists between x_2 and x_5 variables. It is further observed from Table 6 that the inverse relationship between (x_3) tangibility and (x_4) empathy variables existed, but at weak levels. A favorable association was seen with different associations of variables, a feeble positive correlation(r) was (0.001992) between x_2 and x_3 . The positive strong relationship between the independent variable (X_4) and the explained variable(y), with the correlation coefficient's value (r) is 0.579568, followed by the r value 0.540 to 158 of X_1 and X_5 . The inverse strong correlation between the variables y and x_5 was seen in the table, with an r coefficient (r) of (+1) and (-1), indicating a stronger relationship between the variables.

Finding

In the survey, 50% of respondents bought electric vehicles on their own. 66 percent of households use e-vehicles for commercial use or for domestic use.

According to the survey, the satisfaction index for electric vehicles was estimated, and five variables were considered that together affect customer satisfaction. The values of the index were split into three categories: low, medium, and high. Table No. 3 revealed medium index the associated factors' values are correlated with the satisfaction level of EV holders, i.e., reliability (64%), assurance (54%), tangibility (50.5%), and responsiveness (49.5%). The maximum number in the sample falls within the medium index value range. The results show that Lucknow families surveyed had a generally good level of satisfaction with certain EV attributes. However, the index results show that EV quality must be continuously improved in order to keep up with changing driving habits and car owners' expectations. The chosen explanatory factors together explained 91.86% of the difference in customer satisfaction, as per regression analysis's R^2 value of 0.9186. At the 1% significance level, the assurance dimension revealed a statistically significant and positive coefficient of 0.302, indicating that assurance significantly influenced total customer satisfaction. On the other hand, responsiveness demonstrated a roughly 38.16% negative correlation. The results suggest that customers were not happy with the response of service staff, especially when it came to workshop and billing-related services, where they believed the service quality fell short of their expectations. At the 1% level, the response variable was statistically significant.

Conclusion

As per the substantial environmental advantages, electric vehicles are growing in popularity as a means of

transportation. According to the Customer Satisfaction Index, more advancements in EV quality and service are required to fulfil the requirements and demands of the vehicle owners. With an R^2 of 0.9186, the regression results confirm a strong explanatory power, suggesting that the explanatory factors together explained 91.86% of the variation in customer satisfaction. The workshop and billing staff's poor customer service was reflected in responsiveness, which turned out to be a major negative predictor. The correlations between the correlation matrix provides more illustrations of the research variables.. Notably, the independent variable X4 exhibited a positive association with the dependent variable Y, with a correlation coefficient of 0.579568, indicating a moderately strong positive relationship.

The inverse strong correlation between the explained variable(y) and the independent variable's responsiveness (x_5).Electric vehicles help create a cleaner environment because they do not emit carbon dioxide and are cost-effective, with low maintenance costs. Electric vehicles are the best substitute mode of transportation.

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