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A study of impact of perception of quality of Electric Vehicles on purchase intention with reference to Madhya Pradesh, India

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ABSTRACT

An Electric Vehicle is defined as a vehicle which is driven by electricity contrary to the conventional Internal Combustion Engine vehicles which are driven by petrol or diesel. The electric vehicles require electricity which is drawn from batteries. But this is not only difference between an Electric Vehicle and an Internal Combustion Engine vehicle. The difference can exist on performance and other quality parameters. These quality parameters affect the perception of customers which in turn affect the real purchase intention of customers. These customers could be both the users of Electric Vehicles as well as non-users of Electric Vehicles. The quality parameters which are included in this paper are derived from the eight dimensions of quality proposed by Garvin. These eight dimensions of quality are Performance, Features, Durability, Reliability, Serviceability, Aesthetics, Conformance and Perceived Quality. These eight dimensions of quality may affect the perception of total quality strongly. If the battery's performance of Electric Vehicles in terms of serviceability very positive but same isn't true for durability and reliability, the purchase intention may not be positive. So the paper attempts to throw light on overall total quality perception of customers taking into account these eight dimensions and how this perception affects the real purchase intention of customers. Moreover, these perceptions must take into account the area of customers- rural or urban. It is because the condition of road may vary as per region and so in turn the perception of customers related to safety or any dimension of quality may not be similar. Objective of the study was to study the total quality perception of customers and its impact on purchase intention, study the difference in perception of users and non-users of Electric Vehicles regarding the quality, and compare the perception of rural and urban customers regarding the quality of Electric Vehicles. It has been found that total quality perception of customers affects the purchase intention positively. The rural and urban customersperceive the total quality positively. The users of Electric Vehicles perceive the total quality better than non-users.

Keywords: Electric Vehicle, Dimensions of quality, Purchase intention.

INTRODUCTION

An Electric Vehicle is defined as a vehicle driven by electricity contrary to conventional Internal Combustion Engine vehicles driven by petrol or diesel. Electric Vehicles require electricity which is drawn from batteries. During the last few decades, these vehicles have become trendy owing to awareness of environmental issues and rising costs of petrol and diesel coupled with sustainability issues. So basically Electric Vehicles are perceived as solutions to these issues. Governments and companies across the globe are responding to these concerns and are promoting Electric Vehicles and making the customers aware. But at the same time, the quality of Electric Vehicles should be studied and what the customers perceive about the quality of Electric Vehicles. As the perception of quality has different aspects, definitions, and dimensions a study is required to understand the perception of customers on these aspects, definitions, and dimensions. Moreover how this perception affects the purchase intention should be studied. Customers may perceive the quality of Electric Vehicles without even using them based on word of mouth, personal opinion, judgement, etc.

Quality

The definition of quality is very customer-centric. Management gurus have propounded various definitions and dimensions. As per one definition, quality is defined as value for the price paid. It means when the customer perceives receiving considerable value from the product in the context of the price paid, the product is said to have quality. This definition of quality holds for price-sensitive customers. As per one

definition, quality is defined as fitness for use. It means when the product meets the intended function the product is said to have quality irrespective of durability. Similarly, Garvin (1987) proposed eight dimensions of quality. These eight dimensions of quality are Performance, Features, Durability, Reliability, Serviceability, Aesthetics, Conformance and Perceived Quality.

Source: https://hbr.org/1987/11/competing-on-the-eight-dimensions-of-quality

Garvin's 8 dimensions of quality

Performance - it pertains to a product's characteristics when really used or consumed by the customer. For example, in the case of Electric Vehicles, it may mean how the acceleration is achieved, how the charging takes place, how long the fully charged Electric Vehicle runs, etc.

Features - These are secondary characteristics that form the basis or reason of performance For example, in the case of Electric Vehicles, it may mean features of battery, features of motor, features of wheels, overall safety features, etc. These affect the perception of quality because based on features, the product performs. For example- If the battery backup is not adequate, battery charging will be required frequently.

Durability - it pertains to a product's life or how long the product lasts before a new purchase or replacement. So the amount of time before which the product works satisfactorily indicates the durability of any product. In the case of Electric Vehicles, it may mean how long the customer finds the product working satisfactorily and does not need replacement.

Reliability - it pertains to a product's functioning in case of any urgency or in general use. If the product malfunctions, it is not said to be reliable. The product failure is considered a big quality defect. So to be reliable, a product must require very little frequent repair and maintenance. In the case of Electric Vehicles, it may mean how the product performs if the road situation is not very good. It also means the average time between failures. Clearly, reliability and durability are interrelated.

Serviceability - it means how easily a product is serviced and repaired in case of requirement. In the case of Electric Vehicles, it may mean how easily the product gets to service stations, and how fast and cheaper the repair and maintenance work are completed. It means the number of service stations for Electric Vehicles should be adequate with the adequate number of people with adequate skills and competence for giving service.

Aesthetics - it means the looks, appearance, and external design of a product which affects the buying intention of customers. Electric Vehicles are designed differently than conventional vehicles which also makes them appear different. This dimension of quality is very customer-centric as it has nothing to do with durability and reliability. It is a subject of personal opinion and judgement. But since this is also a dimension of quality that affects buying intention, it is required to study the customers' perception regarding the looks and appearance of Electric Vehicles.

Conformance - it means the degree to which a product meets the desired or specified specifications and dimensions like length, weight, height, thickness, etc. It also means specifications in terms of time required to deliver, and time required to serve. In the case of Electric Vehicles, it may mean the weight of the battery, shape, and size of the battery, dimensions of the wheels, dimensions of the motor, and overall dimensions of the vehicle, etc.

Perceived Quality- it pertains to a product's overall public image, reputation, and brand name. It also means what the name of the brand really signifies. For example- an Electric Vehicle is considered an environmentally friendly product. This dimension of quality checks whether the customers really perceive Electric Vehicles as environmentally friendly products.

REVIEW OF LITERATURE

Kanujiya P.K. et. al. (2024) found in their study that respondents had mixed reactions towards the durability of Electric Vehicles. Most of the respondents perceive Electric Vehicles as better than petrol and diesel-run vehicles in terms of efficiency and performance. Electric Vehicles are also perceived to be causing less damage to the environment as compared to conventional vehicles. The main reason for purchasing Electric Vehicles was environmental benefits in terms of fewer carbon emissions and less dependency on petrol and diesel. The main reason for the non-adoption of Electric Vehicles was the lack of adequate charging stations. Social media was the prime reason for creating awareness among the customers for the Electric Vehicles.

Gupta A. et. al. (2024) found in their studies that the majority of customers find Electric Vehicles as environmentally friendly, and safe to use. But the cost of Electric Vehicles was more and not much convenient to use. Electric Vehicles also lack adequate battery capacity so they are not fit for long-distance travel. The majority of customers also felt that Electric Vehicles exhibit less power level.

Bisaria C. (2023) found in his study that challenges for Electric Vehicles' adoption are High initial investment, Lack of charging infrastructure, Range anxiety, Battery technology, and Competition. Customers have doubts regarding the performance and reliability of Electric Vehicles especially for long-distance travel. Customers needed lower operating costs and the potential for long-term savings which was missing in Electric Vehicles.

Adhikary S. et. al. (2022) found in their studies that the majority of respondents consider Electric Vehicles as the solution for environmental damage caused by

petrol and diesel vehicles. Respondents are aware of environmental concerns. Electric Vehicles are also perceived as cost-efficient but lack of infrastructure, limited range, and long recharging time are some issues related to their adoption.

Sriram K.V. et. al. (2022) found in their study that buying criteria for most buyers of personal vehicles were purchase price, fuel efficiency, maintenance, and service cost as well as comfort features among which the main factor was its high price. The other main issue was the range per charge offered. They also found that Indian society lacks awareness of government policies, and also lacks awareness of technology regarding Electric Vehicles. If the knowledge of Electric Vehicles is more, the adoption will also be more. Financial barriers, Performance of vehicles, and Lack of charging infrastructure were also some factors found to have impacted the adoption of Electric Vehicles.

Digalwar A. K. et. al. (2021) found that the factors affecting the adoption of Electric Vehicles in India were Technological, Social, Cultural, Economic, Political, Geographical, and Environmental out of which Technological and environmental were the most important. Range, power, seating and luggage capacity, and battery-swapping technology were the most important factors in the technological field. Also, the factors of greenhouse gas emissions, noise, and global warming were found to be important in the Environmental domain.

Bansal P. et. al. (2021) concluded in their study that Indian Consumers are willing to pay additional prices to reduce the charging time, improve driving range, to save on future operating costs. Driving range and fast charging time are the factors that affect willingness to pay. Attitudes like environment-friendliness and social norms also affect the chances of Indian consumers to adopt Electric Vehicles.

Varghese A.T. et. al. (2021) found out that there is a relationship between awareness level and purchase intention of Electric Vehicles. Factors like environmental concern, value for money, driving range, and infrastructure have a positive impact on purchase decisions. However, the majority of respondents feel the driving range, price range, and charging infrastructure are not adequate in the Indian market which are roadblocks in the adoption of Electric Vehicles. Indian customers also lack trust in the technology of Electric Vehicles. The majority of customers were still planning to buy Electric Vehicles over the next ten years.

Agrawal V. & Das S. (2021) found in their study that a shortage of infrastructure like charging stations and electric systems is the prime reason that affects the adoption of Electric Vehicles negatively. Range and charging time also play a significant impact. Electric Vehicles are also vulnerable to malware attacks while charging which is a concern for security and safety. Also, the body of Electric Vehicles needs to be protected from collision and must be reliable.

Tupe O. et. al. (2020) observed in their study that customers are willing to buy Electric Vehicles if adequate infrastructure is available. Cost of purchase, inadequate charging stations, and longer time required to recharge batteries were key hindrances affecting the adoption of Electric Vehicles. Influential factors that affect the purchase decision are performance, fuel efficiency price, technical features, and how environmentally friendly the vehicle is. They also found style, size, and brand as moderately influential factors.

Research Gap identification

Among the papers reviewed, it has been found that most research has been done on the general perception of customers regarding Electric Vehicles. A research gap is seen in the perception of the quality of Electric Vehicles especially in the purview of Garvin's eight dimensions of quality. Little research has been done considering Garvin's eight dimensions of quality directly. These eight dimensions as discussed above affect the perception of quality in different ways. Research is required to study the perception of quality based on those dimensions and how that perception is related to purchase intention.

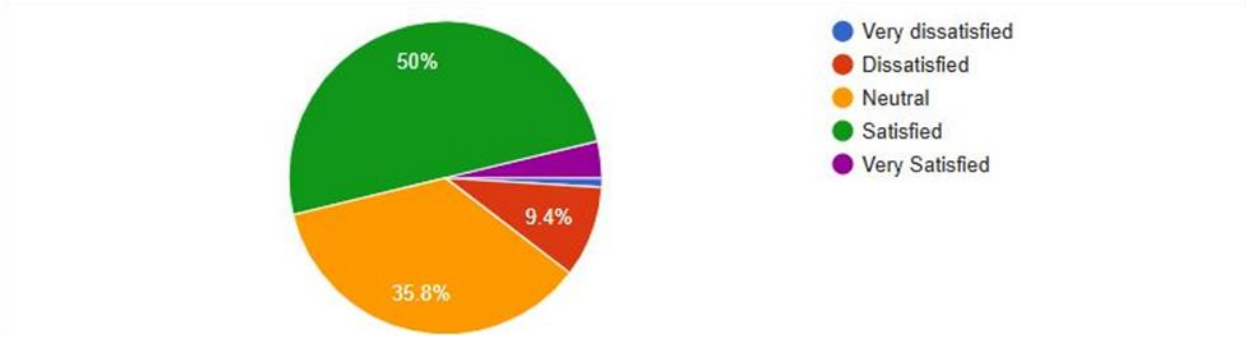
Objectives of study

- To study the total quality perception of customers of Madhya Pradesh regarding Electric Vehicles.
- To study the difference in perception of users and non-users of Electric Vehicles regarding the quality.
- To compare the perception of rural and urban customers regarding the quality of Electric Vehicles.
- To study the impact of perception of quality of Electric Vehicles on purchase intention.

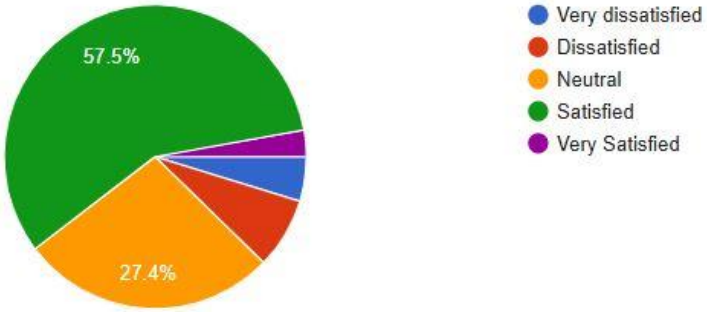
RESEARCH METHODOLOGY

A survey method has been carried out for the research. The research is descriptive and the Convenience Sampling Method has been applied. Questionnaires in the form of multiple-choice questions were sent to respondents in the state of Madhya Pradesh, India through emails and social contacts. Responses were in the form of a 5-point Likert scale. Questions were related to demographic information and the perception of respondents regarding various dimensions of quality. A total of 106 responses were received. Tools like T-Test, Regression Analysis, and Percentage Analysis were applied through SPSS and MS Excel.

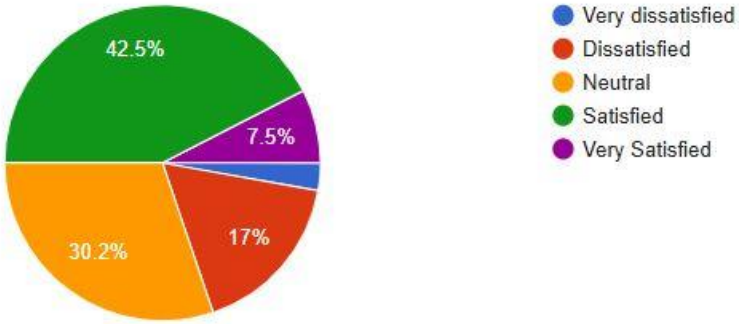
Findings



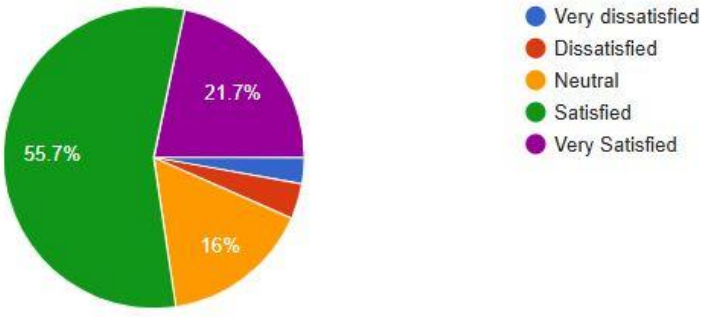
It has been found that 50 % of respondents are satisfied with the battery performance in terms of the charging speed of batteries of Electric Vehicles and 3.77 % are very satisfied. So it is found that the majority of the respondents feel positive about the battery performance of Electric Vehicles in terms of charging speed.



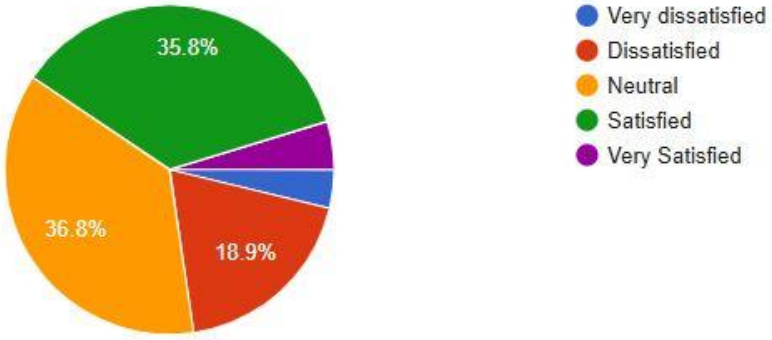
It has been found that 57.5 % of respondents are satisfied with the battery performance in terms of distance travelled after fully charged and 2.83 % are very satisfied. So it is found that the majority of the respondents feel positive about the battery performance of Electric Vehicles in terms of distance travelled after fully charged.



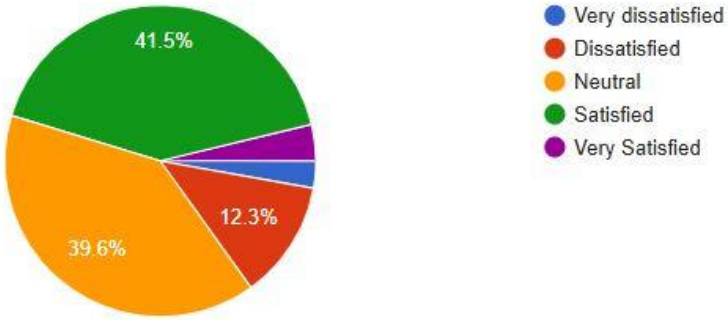
It has been found that 42.5 % of respondents are satisfied with the safety features of Electric Vehicles and 7.5 % are very satisfied. 30.2 % of respondents have given a neutral opinion which means on the safety dimension, respondents have mixed opinions.



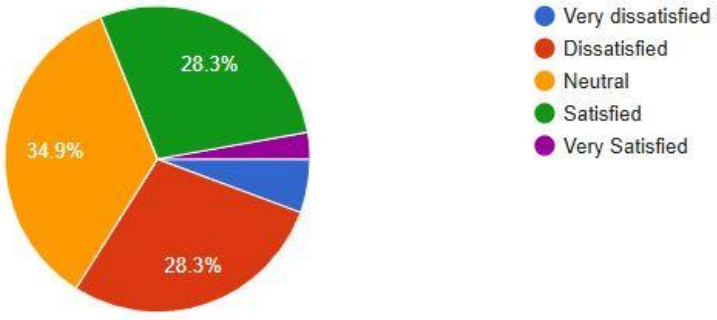
It has been found that 55.7 % of respondents are satisfied with the looks and appearance of Electric Vehicles and 21.7 % are very satisfied. So it means the majority of the respondents feel positive about the looks and appearance of the Electric Vehicles.



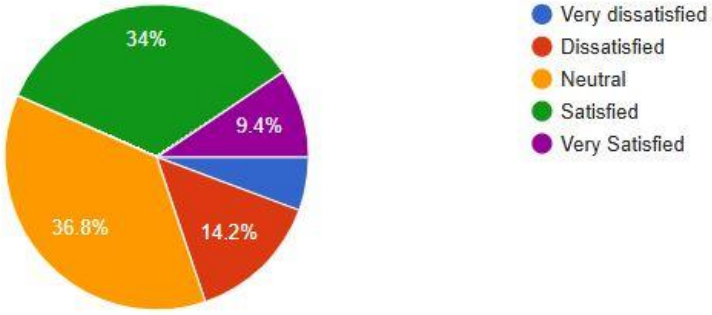
It has been found that only 35.8 % of respondents are satisfied with the serviceability of Electric Vehicles and only 4.7 % are very satisfied. It means on the dimension of serviceability; respondents don't feel much positive about the Electric Vehicles.



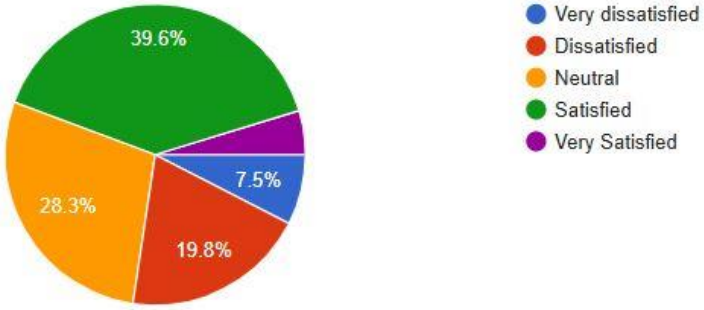
It has been found that only 41.5 % of respondents are satisfied with the battery life or durability of batteries of Electric Vehicles and only 3.77 % are very satisfied. 39.6 % of respondents have given a neutral opinion which means the respondents don't feel very positive about the Electric Vehicles' quality's dimension of durability.



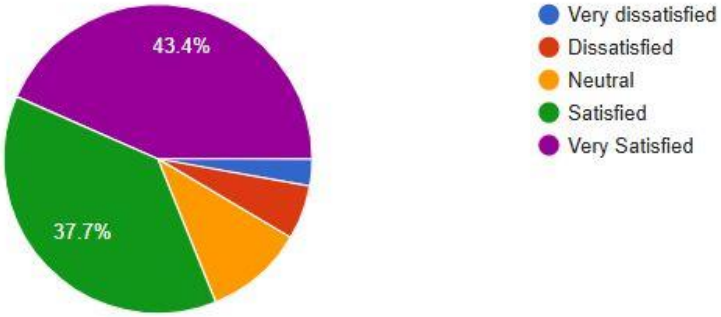
It has been found that only 28.3 % of respondents are satisfied with the reliability of Electric Vehicles on roads during times of urgency and only 2.83 % are very satisfied. It means on reliability issues of Electric Vehicles, the respondents don't feel positive.



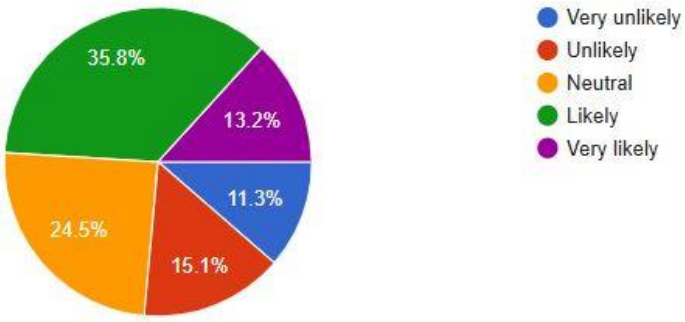
It has been found that only 34 % of respondents are satisfied with the maintenance cost of Electric Vehicles and only 9.4 % are very satisfied. It means the majority of the respondents don't feel value for the price paid.



It has been found that only 39.6 % of respondents are satisfied with the purchase price of Electric Vehicles and only 4.71 % are very satisfied. It means respondents don't feel value for the price paid.



It has been found that 37.7 % of respondents are satisfied with the environmental benefits of Electric Vehicles and 43.4 % are very satisfied. It means that the majority of respondents feel very positive about the dimension of perceived quality and perceive Electric Vehicles as an alternative source for conventional vehicles for green concern.



It has been found that only 35.8 % of respondents are likely to purchase an Electric Vehicle over a conventional vehicle if willing to purchase a new vehicle and only 13.2 % are very likely to purchase an Electric Vehicle over a conventional vehicle. This is not a positive inclination towards willingness to purchase an Electric Vehicle over a conventional vehicle.

Hypothesis

H01: There is no significant impact of the total quality perception of respondents regarding Electric Vehicles on their purchase intention.

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.503a	0.253	0.246	1.04349

a. Predictors: (Constant), Total quality perception

ANOVAa

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	38.379	1	38.379	35.247	.000b
	Residual	113.243	104	1.089		
	Total	151.623	105			

a. Dependent Variable: Willingness to purchase

b. Predictors: (Constant), Total quality perception

Coefficientsa

Model		Unstandardized Coefficients		Standardized Coefficients		
		B	Std. Error	Beta	t	Sig.
1	(Constant)	-0.754	0.681		-1.107	0.271
	Total quality perception	1.171	0.197	0.503	5.937	0.000

a. Dependent Variable: Willingness to purchase

Interpretation: To test the impact of the total quality perception of respondents regarding Electric Vehicles on their purchase intention, Regression Analysis was applied. The value of P = 0.000 < 0.05, we reject the Null hypothesis. It means the hypothesis that there is no significant impact of total quality perception of respondents regarding Electric Vehicles on their purchase intention is rejected and we conclude that total quality perception and purchase intention are related. The value of R is positive which indicates they are positively related. The value of R square is 0.253 which means though they are positively related; the impact of total quality perception on purchase intention is moderate.

The relation between the two is represented by the equation:

Willingness to purchase = Total quality perception (1.171) + 0.503

H02: There is no significant difference in the perception of users and non-users of electric vehicles regarding the perception of total quality.

t-Test: Two-Sample Assuming Unequal Variances		
	USERS	NON USERS
Mean	3.64375	3.317567568
Variance	0.268346774	0.237084413

Observations	32	74
Hypothesized Mean Difference	0	
df	56	
t Stat	3.029875912	
P(T<=t) one-tail	0.001849077	
t Critical one-tail	1.672522304	
P(T<=t) two-tail	0.003698154	
t Critical two-tail	2.003240704	

Interpretation – To test the difference in the perception of users and non-users of electric vehicles regarding the perception of total quality, a T-Test has been applied. As the P value 0.003698154 < 0.05, we reject the Null hypothesis. It means the hypothesis that there is no significant difference in the perception of users and non-users of electric vehicles regarding the perception of total quality is rejected. Further, the mean value of users is 3.64375 > the mean value of non-users. So it is interpreted that users perceive the quality of Electric Vehicles better than non-users.

H03: There is no significant difference in the perception of rural and urban respondents regarding the total quality of the Electric Vehicles.

t-Test: Two-Sample Assuming Unequal Variances		
	Rural	Urban
Mean	3.357143	3.425
Variance	0.213407	0.276621
Observations	14	92
Hypothesized Mean Difference	0	
df	19	
t Stat	-0.5023	
P(T<=t) one-tail	0.310614	
t Critical one-tail	1.729133	
P(T<=t) two-tail	0.621228	
t Critical two-tail	2.093024	

Interpretation – To test the difference in perception of rural and urban respondents regarding the total quality of Electric Vehicles, a T-Test has been applied. As the P value is 0.621228 > 0.05, we fail to reject the null hypothesis. This means the rural and urban respondents perceive the total quality of the Electric Vehicles similarly.

Summary of hypothesis:

	Null Hypothesis	Result
H01	There is no significant impact of the total quality perception of respondents regarding Electric Vehicles on their purchase intention.	Rejected
H02	There is no significant difference in the perception of users and non-users of electric vehicles regarding the perception of total quality.	Rejected
H03	There is no significant difference in the perception of rural and urban respondents regarding the total quality of Electric Vehicles.	Accepted

CONCLUSION AND DISCUSSION:

It has been found from the study that the total quality perception of customers regarding Electric Vehicles and purchase intention are positively related but the impact of total quality perception on purchase intention is moderate. Also, the customers' perception regarding various dimensions of the quality of Electric Vehicles was studied. The battery performance in terms of the charging speed of batteries, and also in terms of distance travelled after fully charged satisfies the customers. From the safety angle, the customers have not given a very satisfactory opinion. Probably this is because of a lack of trust in the technology of Electric Vehicles which is also revealed in the study by Varghese A.T. et. al. (2021). Serviceability of Electric Vehicles, durability or battery life, and reliability of Electric Vehicles at times of urgency are not perceived satisfactorily by the customers. Customers have very positive opinions regarding the looks and appearance of Electric Vehicles and also with the perceived quality in terms of Environmental Concerns of Electric Vehicles. On Environmental Concerns, the study agrees with the study of Kanujiya P.K. et. al. (2024). The customers also feel that the maintenance cost and

purchase price of Electric Vehicles don't offer much value for the price which is also common in the study of Varghese A.T. et. al. (2021). Out of the dimensions of quality, the Reliability of Electric Vehicles at the time of urgency has received a negative opinion which is consistent with the study of Bisaria C. (2023). The study also reveals that users and non-users perceive the quality of Electric Vehicles differently. As per our findings, users perceive the quality of Electric Vehicles better than non-users. We also found in our study that rural and urban customers perceive the total quality of Electric Vehicles similarly. Also, few customers have shown interest in purchasing Electric Vehicles over conventional vehicles which is not in agreement with Varghese A.T. et. al. (2021) according to whom the majority of customers were willing to purchase Electric Vehicles over conventional vehicles despite the hurdles of driving range, price range, and charging infrastructure. Our study pinpoints the issues of Reliability, Durability, Safety, Serviceability, maintenance cost, and purchase price as factors of quality which are hurdles in the way of adoption of Electric Vehicles. Our study also pinpoints the looks and appearance of Electric Vehicles, battery performance in terms of the charging speed of batteries, and also in terms of distance travelled after fully charged, the Environmental Concerns as factors of quality that contribute to the way of adoption of Electric Vehicles.

Limitations of study

The sampling method used was the Convenient Sampling method. A total of 106 responses were received. Out of these 106 respondents, only 32 (30.2%) have used or owned Electric Vehicles. So, biases cannot be ignored. It was also not incorporated in the study how long the users or owners of Electric Vehicles have been using Electric Vehicles. Out of 106 responses, only 14 (13.2%) are from rural regions. The rest are from urban regions. The rural regions have not got sufficient representation in the sample.

Implication of study

The study figures out the dimensions of quality on which the Electric Vehicles have not received better feedback like issues of Reliability, Durability, Safety, Serviceability, maintenance cost, and purchase price. So the steps and actions would be taken to sort out these issues. These factors are important dimensions of quality. It has also been found in the study that perception of the total quality of Electric Vehicles has a positive impact on the purchase intention of the customers. So addressing the issues of Reliability, Durability, Safety, Serviceability, maintenance cost, and purchase price may take place by manufacturers and distributors of Electric Vehicles to boost their adoption. These require improvement in technology, upgradation of battery, manufacturing cost reduction measures, and easy and convenient servicing. The dimensions of quality like the looks and appearance of Electric Vehicles, battery performance in terms of the charging speed of batteries, and also in terms of distance travelled after fully charged, the Environmental Concerns have received better feedback. So these factors may continue to contribute to better adoption of Electric Vehicles in the future.

Also, the study reveals that users perceive the quality of Electric Vehicles better than non-users. So the study may significantly mean the word-of-mouth promotion by the users. The majority of people have not shown a willingness to purchase Electric Vehicles over conventional vehicles in the future. So, the users of Electric Vehicles may be made to act as influencers of purchase decisions of non-users. Users may be made to stick to Electric Vehicles by advertisements, addressing the issues of quality dimensions that have not received positive feedback.

Scope for future study

We have studied the impact of total quality perception of Electric Vehicles on real purchase intention. Future research should involve the study of the impact of demographic variables (age, gender, income, profession) on the perception of the total quality of Electric Vehicles. In our study, we have considered only one demographic variable (area) and studied the differences in the perception of rural and urban respondents. However, the representation of rural respondents wasn't adequate to generalize the study. So future research should be conducted on a greater sample size. The sample had both the users and non-users of the Electric Vehicles. Future research should study the perception of users and non-users separately or exclusively. A study should also be conducted to understand the willingness of rural and urban customers to purchase Electric Vehicles over conventional vehicles separately or exclusively.

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