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"A Study on Customer Satisfaction of Two-Wheeler Electric Vehicles in Gadag District of Karnataka State."

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Abstract:

The electric vehicle segment is progressively growing in the Indian market. Many players are carving out their own niches in this segment by launching customer-centric vehicles. It is essential to understand the customer and their acceptance of the electric vehicle. This study is focused on to measure the customer satisfaction of two-wheeler segment of electric vehicles. The study proposed the conceptual framework to measure the customer satisfaction with twenty-five different variables of electric vehicles. This study was conducted in Gadag district of Karnataka State with 55 sample size. Cronbach's alpha was used to assess the reliability of the data collection tool. The data was analysed using one sample T-test to check the Hypothesis assumed during the study. This study found that customers are highly satisfied with two-wheeler electric vehicles, despite expressing concerns about issues like the availability of spare parts.

Keywords: Customer Satisfaction, Electric Vehicles, Two-Wheelers Electric Vehicles, Buying Behaviours, eco-friendly vehicles.

Introduction:
Customer satisfaction is a crucial factor for any product or service and plays a significant role in the two-wheeler electric vehicle industry. The EV has gained the more popularity due to its eco-friendly nature, cost effectiveness and easily useable, reliability, comfort, design, features, customer service, colour and also offer numerous advantages over traditional internal combustion engine, produce zero emissions, offer smooth and quiet rides, charging infrastructure etc.
Understanding customer satisfaction provides valuable insights into the needs, preferences, and expectations of electric two-wheeler users. This information can help manufacturers and policymakers improve their products, services, and policies to better meet customer requirements. Customer satisfaction plays a critical role in driving the adoption and growth of electric two-wheelers. Satisfied customers are more likely to promote electric vehicles through positive word-of-mouth recommendations, encouraging others to purchasing an electric two-wheeler. By identifying and addressing factors influencing customer satisfaction, the sector can incline towards more customers adoption and market acceleration. The key aspects influencing customer satisfaction is the performance of the electric vehicle such as acceleration, top speed, range and battery efficiency, Reliability play an important roles in determining the customer satisfaction. Customer expect their electric vehicles should perform good without any unexpected breakdowns or malfunctions, any issues related to the battery, motor or any other components can significantly impact customer satisfaction. Therefore, the manufacturer must ensure the durability and reliability of their vehicles to build confidence in the customer.

Present status of the electric vehicles:
Market Growth: The electric vehicle market has experienced rapid growth in recent years. EV sales have been consistently increasing, due to the factors such as advancements in technology, declining battery costs, government incentives, and environmental concerns. Major automakers have been expanding their electric vehicle offerings, introducing new models with longer driving ranges and improved features.

Increasing Model Variety: The electric vehicle market has become more diverse, offering a wide range of options to consumers. Electric cars, electric SUVs, electric crossovers, and electric pickup trucks are increasingly available from various manufacturers. The expansion of electric vehicle choices caters to different consumer preferences, driving needs, and price points.

Battery Technology Advancements: Battery technology is essential for electric vehicle performance, driving range, and charging speed. Significant advancements in lithium-ion battery technology have led to higher energy density, longer

ranges, and faster charging capabilities. Ongoing research & development efforts focus on improving battery efficiency, reducing costs, and enhancing sustainability through new materials and technologies.

Infrastructure Development: The expansion of charging infrastructure is main factor play a role in buying the electric vehicles. Governments, private companies, and utilities are investing in the installation of public charging stations, both fast chargers and regular chargers, in urban areas, along highways, and in parking facilities. Efforts are ongoing to establish standardized charging protocols and enhance charging speeds to make EV charging more convenient and efficient.

Government Support and Policies: Governments globally are enacting policies to boost electric vehicle adoption and curb greenhouse gas emissions. Many nations offer financial incentives like purchase rebates, tax credits, and exemptions from tolls or congestion charges to incentivize consumers to opt for electric vehicles.

Review of Literature:
Dr. K. Selvaraju et.al. (2021) identifies that the demand for the electric vehicles is increasing day by day due to its features such as zero emission of carbon, low noise, high efficiency. The consumer needs the low price, high brand, good charging infrastructure, and smoothly running vehicles for them. These electric vehicles are important to reduce the greenhouse gases and remain sustainable in the environment, due to this the consumer are getting aware of the environment and shifting from regular vehicles to electric vehicles, plug- in hybrid vehicles, hybrid electric vehicles and fuel cell electric vehicles, and becoming more concisions about the environment. Dr. D. Sivasakthi et.al. (2020) have reveals in their study conducted in Coimbatore city that electric vehicles reduce the air pollution and noise pollution and the battery which has used in the vehicle has low maintenance cost, can run for long distance, faster, affordable price, lightweight and introducing of new technology, no usage of the fuels. Most of the customers are satisfied with the quality, price, performance, servicing, and maintenance of the vehicle, easy to drive, light weight etc due to these features most of the consumer are willing to buy the electric vehicles and in 2030 electric vehicles are the one which will be in the first position in the entire vehicles.
Navaneeth M et.al (2021). have pointed out in their study that, battery development is crucial for the advancement of the EV industry, as it determines range, cost, safety, and performance. Lead acid batteries were initially used but had limited cycle life and were bulky. Nickel Cadmium batteries offered lighter weight, cost efficiency, and better power-to-weight ratio. Nickel metal hydride batteries further accelerated EV growth with their smoother electrode process. Lithium-ion (Li-ion) cells became a strong alternative due to higher energy density, longer life, and no memory effect. A study conducted by Amrut P. Bhosale et.al. (2019) reveals that, the factors that influence the consumer to buy the electric vehicles are environmentally friendly, low cost, safety measures, no registration required, some of the factors that do not influence the customer to buy the EV are high cost, lack of charging stations, lack of awareness about the battery, range, improve in the quick charging technology, battery swapping stations, new policies, etc.

Objective: To Study the customer satisfaction on two-wheeler Electric vehicles

Hypothesis:
H1: The customers are satisfied with two-wheeler electric vehicles.
H0: The Customers are not-satisfied with two-wheeler electric vehicles.

Methodology:
- **Primary Data**- The data has been collected through well designed and administered questionnaires filled 55 respondents who are using both electric bikes and conventional bikes.
- **Secondary Data**- The primary sources of secondary data include various journals and research articles.
- **Sampling Method**- A random sampling method was used to collect primary data from the respondents.
- **Sample Point**- In this study the persons who are using both electric bike and regular bikes are chosen as a sample points.
- **Sample size**-In this study total of 55 samples are collected from Gadag District, Karnataka state.
- **Sample description** – The Respondents are from diversified background such as students, businessman, workers, housewives.
- **Data collection tool** – Questionnaires consisting of 25 different questions were asked to respondents. The data collection was self-administered during the study. Three-point Likert scale was used to record the responses with 1-Agree, 2-Neutral and 3-Disagree.

Framework: Following framework was used in the study to measure the customer satisfaction of two-wheeler electric vehicles

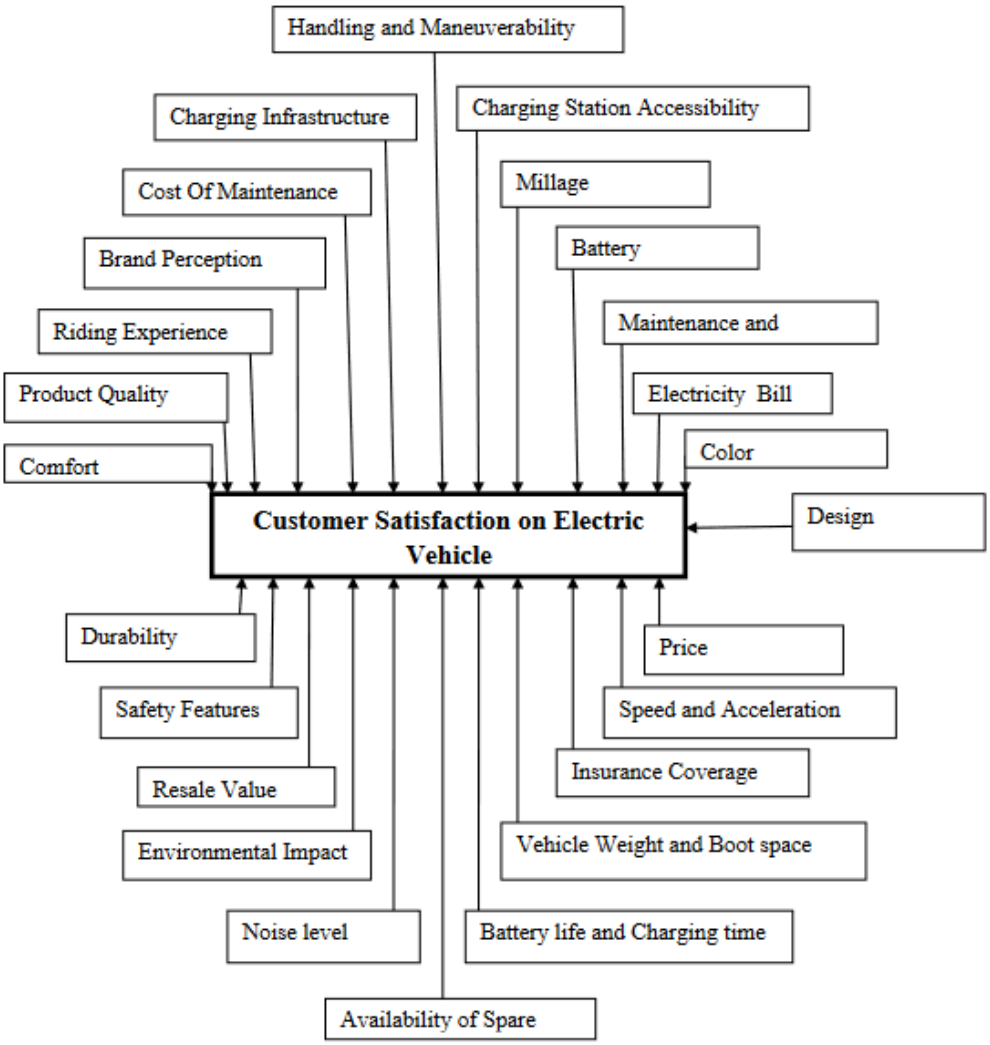

Figure 1: Framework used to measure the customer satisfaction.

Description of the variables- used in the framework:

Environmental Impact: Refers to the positive impact of electric vehicles on the environment. EVs produce zero emissions, reducing air pollution and greenhouse gas emissions compared to traditional vehicles. Environmental benefits are often a motivating factor for individuals choosing to purchase electric vehicles.

Speed and Acceleration: Refers to the capabilities and characteristics of an electric vehicle related to power, speed, and acceleration. Electric vehicles are renowned for delivering rapid and seamless acceleration, frequently surpassing traditional combustion engine vehicles in this regard.

Millage: The fear or concern of an electric vehicle driver that it will run out of battery charge before reaching their destination. Range anxiety is a psychological barrier that some potential EV buyers may experience. It can be alleviated through improvements in driving range, the availability of charging infrastructure, and accurate range estimation.

Charging Infrastructure: Refers to the network of charging stations and related infrastructure that allows electric vehicle owners to recharge their vehicles' batteries. Charging infrastructure includes various types of charging stations, such as home chargers, workplace chargers, and public chargers, and plays a crucial role in the convenience and usability of electric vehicles.

Brand Perception: Refers to the perception and reputation of a specific electric vehicle manufacturer or brand. Brand reputation can influence customer satisfaction as consumers often consider the reliability, quality, and customer support associated with a particular brand when making purchasing decisions.

Battery life and charging time: Refers to the performance and durability of the battery pack in an electric vehicle. Battery performance includes factors such as driving range, charging speed, energy efficiency, and longevity. A well-performing battery is crucial for customer satisfaction as it directly impacts the usability and practicality of an electric vehicle. And the time required to recharge an electric vehicle's battery. Faster charging speeds can enhance customer satisfaction by reducing downtime and providing more convenience, especially on long trips or when using public charging infrastructure.

Price: Refers to the total costs associated with owning an electric vehicle, encompassing purchase price, financing, insurance, maintenance, and charging expenses. Understanding and effectively managing ownership costs are crucial factors in customer satisfaction, influencing the affordability and sustainability of electric vehicle ownership over time.

Resale Value: Refers to the estimated value of an electric vehicle when it is sold or traded in. Resale value is influenced by factors such as vehicle depreciation, market demand.

Safety Features: Refers to the advanced safety systems and features incorporated into electric vehicles. These may include collision avoidance systems, lane-keeping assist, adaptive cruise control, and other driver-assistance technologies. Robust safety features can enhance customer satisfaction by providing a safer driving experience.

Handling and Manoeuvrability: Refers to the responsiveness, agility, and ease of manoeuvring an electric vehicle. Good handling characteristics, precise steering, and a smooth ride contribute to a satisfying driving experience and overall customer satisfaction.

Maintenance and Servicing: Refers to the ongoing maintenance and service expenses associated with owning an electric vehicle. Lower maintenance costs, such as reduced need for oil changes and fewer mechanical components to maintain, contribute to customer satisfaction by offering potential cost savings over the vehicle's lifespan.
Design: Refers to the aesthetic appeal, exterior design, and overall styling of an electric vehicle. The visual appeal, sleekness, and modern design elements of an EV can contribute to customer satisfaction by evoking a sense of pride and enjoyment in owning a visually appealing vehicle.

Noise level: Electric vehicles generally offer lower levels of noise inside compared to traditional internal combustion engine vehicles. A comfortable and quiet machine significantly contributes to customer satisfaction.

Vehicle weight and boot space: Refers to the availability of storage compartments and cargo space in an electric vehicle. Factors such as trunk size, foldable seats, and storage compartments impact the practicality and usability of the vehicle. Sufficient storage space enhances customer satisfaction by accommodating luggage, groceries, and other items. And the vehicle should have minimum weight to ride it.

Charging station accessibility: Refers to the different methods and locations available for charging an electric vehicle. Charging options include home charging stations, workplace charging, public charging stations, and fast-charging infrastructure. The availability of convenient and accessible charging options is essential for customer satisfaction.

Riding Experience: Refers to the overall feel and enjoyment of driving an electric vehicle. Factors that contribute to a positive driving experience include smooth acceleration, responsive handling, and a comfortable ride. A satisfying driving experience can enhance customer satisfaction with the electric vehicle.

Comfort: Refers to the design and comfort of the seats in an electric vehicle. Factors such as seat materials, adjustability, lumbar support, and legroom contribute to customer satisfaction by providing a comfortable and ergonomic seating experience during short and long drives.

Electricity bill: Charging an electric vehicle requires electricity, and the cost of electricity can vary depending on location, time of use, and utility rates. However, electric vehicles generally offer lower fuel costs compared to traditional gasoline or diesel vehicles. Additionally, off-peak charging rates or special electric vehicle charging tariffs may be available, further reducing charging costs.

Availability of spare parts: Electric vehicle manufacturers collaborate with OEM suppliers to ensure a consistent supply of original spare parts. This partnership helps maintain the quality and compatibility of the components, ensuring that customers can access genuine parts for their vehicles.

Battery technology: Most electric vehicles on the market today utilize lithium-ion batteries, which offer a high energy density, allowing for longer driving ranges. These batteries are lightweight and can be configured in various shapes and sizes to fit different vehicle designs.

Durability: Durability involves the strength and resilience of the vehicle's structure. Electric vehicles are designed to withstand various stresses and loads encountered during normal operation, including road vibrations, impacts, and external forces. A robust and well-engineered structure ensures the vehicle's longevity and ability to handle everyday driving conditions.

Colour: The colour of an electric vehicle is often a matter of personal preference, chosen to align with the owner's style and taste. Different colors can convey various moods or aesthetics, enabling owners to express their individuality through their vehicle's appearance.

Analysis and Discussions:
The reliability analysis: It was performed for the data collection tool which was used in the study. Individuals' items have a Cronbach's alpha value of more than 0.77 and over all scale reliability value (Alpha) is 0.794. This indicates high level of internal consistency. The individual items alpha values are in the following table -1

Table 01: The reliability analysis of data collection tool (Cronbach's Alpha)

Variable Name	Cronbach's Alpha Value	Variable Name	Cronbach's Alpha Value
1.Sufficient storage (Boot space) for belongings	0.792	14. Charging time	0.774
2. Availability of spare parts	0.786	15. Vehicle is appealing	0.780
3. Accessibility of charging stations	0.789	16. Comfortable ride	0.796
4. Noise level	0.786	17. Handling and Manoeuvrability	0.787
5. Overall quality and durability	0.793	18. Breaking system	0.780
6. Acceleration and speed performance	0.806	19. Battery life	0.793
7. Stability and balance while riding.	0.783	20. Safety features	0.798
8. Seating comfort	0.781	21. Maintenance	0.788
9. Headlights and visibility	0.789	22. Feature and performance	0.792
10. Warranty after sales	0.789	23. Will recommend to others	0.770
11. Performance over traditional vehicles	0.796	24. Overall satisfaction	0.783
12. Performance expectation	0.778	25. Colour varieties	0.797
13. Range per charge	0.777	**Overall scale reliability (Cronbach's alpha)**	**0.794**

The dataanalysed with MS Excel and SPSS 20 for Mean, Mode and Standard Deviation, and T Test was applied to either accept or reject the hypothesis assumed in the study. The significance level chosen was 95 percent.

Table 2: Hypothesis testing by applying one sample T-test

Variables	T- value	df	Sig. (2-tailed)
1. Sufficient storage (Boot space) for belongings	-6.114	54	.000
2. Availability of spare parts	-1.839	54	.071
3. Accessibility of charging stations	14.959	54	.000
4. Noise level	-21.000	54	.000
5. Overall quality and durability	-12.000	54	.000
6. Acceleration and speed performance	-3.985	54	.000
7. Stability and balance while riding.	-15.882	54	.000
8. Seating comfort	-10.265	54	.000
9. Headlights and visibility	-21.000	54	.000
10.Warranty after sales	-5.901	54	.000
11.Performance over traditional vehicles	-30.594	54	.000

12.Performance expectation	-10.987	54	.000
13.Range per charge	-5.590	54	.000
14.Charging time	-5.901	54	.000
15.Vehicle is appealing	-14.147	54	.000
16.Comfartable ride	-37.829	54	.000
17.Handling and Manoeuvrability	-15.882	54	.000
18.Breaking system	-19.243	54	.000
19.Battery life	-12.393	54	.000
20.Safety features	-54.000	54	.000
21.Maintenance	-37.829	54	.000
22.Feature and performance	-8.704	54	.000
23.Will recommend to others	-12.186	54	.000
24.Overall satisfaction	-9.000	54	.000
25.Colour varieties	-3.364	54	.001

From the above table analysis, all the variables have significance value less that 0.05, except the second variable "Availability of spare parts". Furter for 54 degree of freedom the critical value of T is 2.00. From table 2, All the variable has the T values more than the critical value of T (CV= 2.00) except the second variable. The T value for second variable is -1.839.
According to the analysis it is concluded that "H1-The customers are satisfied with two-wheeler electric vehicles" will be accepted. And "H0: The Customers are not satisfied with two-wheeler electric vehicles" will be rejected. The emphasis must be given more on "Availability of spare parts" for the two-wheeler electric vehicles either by the manufacturer or by the dealer. This issue can be sorted out by improving the supply chain of the two-wheeler electric vehicles.

Limitation and future scope: The electric vehicle segment is evolving in the Indian markets. All the electric vehicles must under the different phases of product life cycle. At this point of time all the vehicles are new or less than 3-4 years old. However, the results may vary over time. There is an adequate future scope to conduct the same study near future. This study was restricted to the geographical area of Gadag district of Karnataka state. The study may be conducted in the other parts of the country with different respondent size and demographics.

Conclusion: Electric vehicle segment is expanding slowly in the Indian market. During the study the efforts are made to understand the customer satisfaction about electric vehicle of two-wheeler. A detailed conceptual framework was employed to comprehend the factors significantly influencing customer satisfaction in this segment. The study yielded the results that the customer is very much satisfied with their electric vehicles. They have expressed the concern that availability of spare-parts for the vehicle are not adequately available in the market. This can be resolved by the dealers or manufactures by making them available adequately in the market time to time.

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