

Analysing Consumer Behaviour for Purchasing of Electric Two-wheelers in Kolkata in Post Lockdown Scenario

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ABSTRACT

Due to the pandemic (Covid-19), the two-wheeler industry has achieved descend growth after the lockdown phase. After the lockdown phase, the demand for two-wheelers has been increased significantly. The Electric two-wheeler market segment has seen significant growth as it offers a pollution-free ride than its IC Engine operated counterparts. The perception and acceptance of electric two-wheelers are focusing on environment-friendly (Zero emission) technology, the technical specification of the scooter (speed, max distance travelled, charging time, battery capacity), maintenance cost (battery replacement), infrastructure (charging points) and social acceptance etc. The objective of the study is to find the perception of electric 2-wheelers among consumers and factors which affect the buying behaviour in Kolkata.

Keywords: Zero-emission, Adoption, Range, Reliability

A. Introduction

The two-wheeler market in India has developed a huge potential in the last decade. There is an increasing demand in urban and rural areas that have been seen predominantly. A relatively low competitive price and maintenance are some of the leading factors for driving the growth of the Indian market. Due to the pandemic (Covid-19), the two-wheeler industry has achieved descend growth after the lockdown phase. After the lockdown phase, the demand for two-wheelers has been increased significantly. The Electric two-wheeler market segment has seen significant growth as it offers a pollution-free ride than its IC Engine operated counterparts. The perception and acceptance of Electric two-wheelers are focusing on environment-friendly (Zero emission) Technology, the technical specification of the scooter (Speed, max distance travelled, charging time, battery capacity), Maintenance cost (battery replacement), infrastructure (charging points)

and social acceptance etc. The electric two-wheelers in India can be classified based on a low-speed two-wheeler (Max speed up to 25 Km/ hr) and high-speed. High-speed vehicle Max speeds greater than 25 Km/hr. Low-speed two-wheelers have lower power motor and battery capacity whereas high-speed vehicles have higher power motor and high capacity. The battery used in electric two-wheelers can also be characterised as an electric two-wheeler. The market may be divided into two types of batteries: lithium-ion and lead acid. Lead Acid accounted for the largest share till 2019 but nowadays most of the companies wanted to shift their high-speed vehicle to Lithium-Ion battery and this segment is also expected to increase at a rapid pace in the coming years (Chan, et al, 2001). The market has been divided into two types of vehicles: electric scooters and electric motorbikes. In comparison to motorcycles, the electric scooter category dominates the city's electric two-wheeler market. Hero Electric, Okinawa Autotech Pvt. Ltd, Ampere Vehicles, and Electrotherm India (Yo Bikes), among others, are major participants in the Electric Two-Wheeler Market. The study's goal is to determine if customers would accept any innovation based on their awareness, knowledge, and perceptions of the items (Yong et al,2014).

Due to public attention of the limited amount of fuel energy in the world and the emission of greenhouse gaseous by the internal combustion engine vehicles, people started to look for environmentally friendly vehicles that can be powered using alternate rechargeable energies. As electricity is one of the sustainable energies, the concept of vehicles using electricity to power up the car was introduced. Although electricity is the sustainable energy to power up the motors of the vehicles, the concept of an electric vehicle was not introduced to the world until the year of 1859. In the same year, the rechargeable battery named lead-acid battery was first conceived by Gaston Planté . Batteries play an important role to the evolution of the electric vehicles as it is a must for the electric vehicles to carry a portable item that stores electricity in order to have the electricity supply to its motor. Typically, an electric motor consists of a rotor, stator, windings, air gap and commutators/converters. Depending on different arrangement of these components different types of electric motors are constructed Those electric motors that do not require brushes for commutation or energy conversion are called brushless permanent magnet motors. Furthermore, motors can be categorized according to the shape of their back-EMF. Their shape can either be sinusoidal or trapezoidal. Based on these shapes, they can be Permanent Magnet AC Synchronous Motors (PMSM) or Brushless DC motors (BLDC) respectively. For an Electric motor to be successfully deployed as the drive for EVs, it should be highly efficient, it should have great power density and should be cost effective. However, the specification of the motors depends on its application purpose. This application could range from home, regular vehicular and heavy duty vehicles. Furthermore, the performance of motors depends mainly on vehicle duty cycle, thermal characteristics and the cooling mechanism (Wadekar, S).

Hero Electric

Electric Hero It is India's oldest and largest maker of electric two-wheelers. Both high speed and low-speed scooters are available under this brand. Popular products under this brand are Optima, Nyx and Flash

Okinawa Autotech Pvt. Ltd.

It is a growing electric 2 wheeler manufacturing company and established in 2015. Both High speed and low-speed scooters are available in companies' line up. Popular products under this brand are I-praise plus, praise go, ridge+.

Tork Motors

It is a high-performance electric vehicle and charging infrastructure manufacturing startup based out of Pune, India. Backed by a successful racing background and 8 years of groundbreaking research and development, TORC Motors will be launching India's First Electric Motorcycle - 'KRATOS'. Proudly manufactured and assembled in India.

Revolt Motors

In with the new, is something achieved by a few. Merging passion with purpose, Revolt on the road will give city dwellers a revolutionary way to commute and connect, charting the future for generations to come.

Its identity is founded at the convergence of two directions — the back arrow signifying learnings and values of the past and, the forward arrow, clean energy for the future. Together, like its namesake, Revolt takes the Revolution ahead, going against the grain to herald in a new dimension of the next-gen mobility.

Greaves Electric Mobility Private Limited

With the foresight and passion to revolutionise everyday mobility, Ampere set out to take action back in 2008. Company realised their dream of a sustainable future and set in motion a chain of events that would later bring Eco-Friendly Mobility within everyone's grasp.

Through research and innovation, company design Electric vehicles that power India through New Age Energy. Take charge of your journey with Ampere's sustainable mobility and ride towards a cleaner and greener planet.

Ather Energy

Ather Energy is an Indian electric vehicle company, headquartered in Bangalore. It was founded by Tarun Mehta and Swapnil Jain in 2013. It manufactures two electric scooters - the Ather 450X and the Ather 450 Plus. It has also established electric vehicle charging infrastructure across the country called Ather Grid.

B. Objective of the Study

This investigative study focused on the perception and adoption of Electric Vehicle in (two-wheeler segment) by comparing the use, features, acceptance, and reliability of traditional IC engine fitted two-wheelers with Electric scooters in Kolkata. It would help in the widening of technology and this is the most significant topic in recent years. This study enables us to understand

and explore the driving parameters that would lead to a change in the acceptance of electric scooters in changing beliefs.

C. Literature Review

Beatriz Junquera, Blanca Moreno, Roberto Alvarez(2016) in research work on an electric vehicle which focused on technical specification and consumer perception in terms of buying behaviour in Spain, but their study was mostly based on four-wheelers (Janquera,B. et al 2016). In the research work on electric vehicles focused on consumer perception and purchase intention of 4 wheelers in India (Sripad, S et al, 2019) in his research work focused on the challenges and future of the electric vehicle in India. But in India, the growth of electric two-wheelers is more prominent than electric four-wheelers.

Electric vehicles (EV), as a promising way to reduce the greenhouse effect, have been researched extensively. With improvements in the areas of power electronics, energy storage and support, the plug-in hybrid electric vehicle (PHEV) provides competitive driving range and fuel economy compared to the internal combustion engine vehicle (ICEV). Operating with optimised control strategies or utilising the concept of the energy management system (EMS), the efficiency of the PHEV could be significantly improved. In this review paper, the operating process of the various types of EVs will be explained. Battery technology and supercapacitor technology will also be discussed as a possibility to increase the energy capacity of PHEV(Ding, N., 2017).

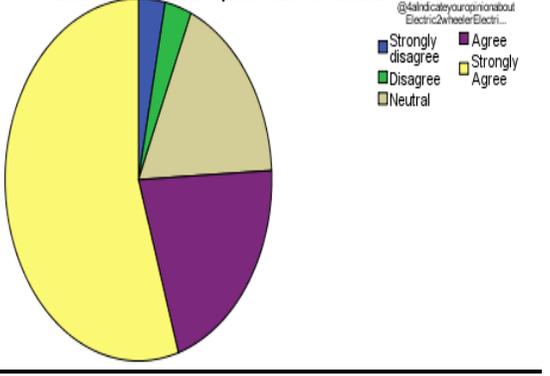
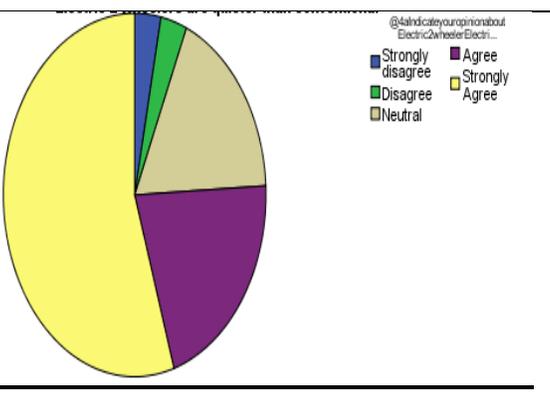
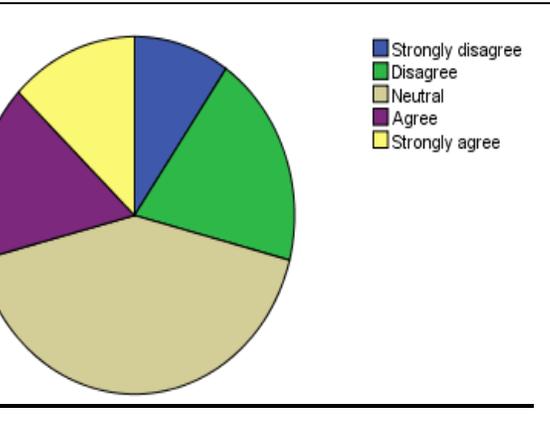
A vehicle is considered Green when it is more environmentally friendly than the traditional petroleum combustion engine, in which includes any nontraditional vehicle like, HEV, Plug In, EV, Fuel Cell, Bio fuel etc. that improves fuel economy. The development of electric vehicle has been over a hundred years but failure to gain the public acceptance in various stages due to various reasons which explained. While EV was never mass produced, Hybrid electric vehicle gains the momentum in recent years. Ford has launched its second generation of HEV and GM also announced the debut of the Volt in 2010. Comparing to the regular HEV, Plug in is the new trend in hybrid auto development due to extend travel range in electrical mode and a possibility of a zero emission as long as travel distance is less than charging threshold. However, more recently, an electrification trend in automotive industry has been evolved and will revolutionize the industry. With the correct policy and government help and advancement of electric vehicle technology, the prospect of Electric Vehicle will be bright and the focus point of future development (Situ, L., 2009, May).

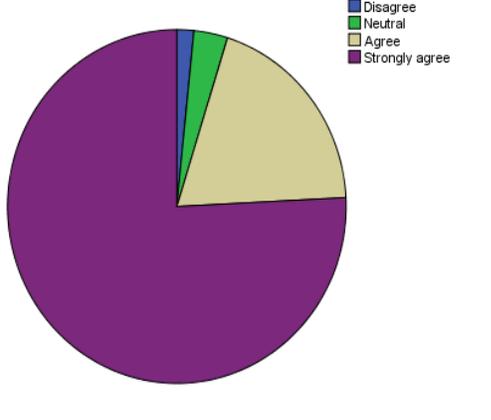
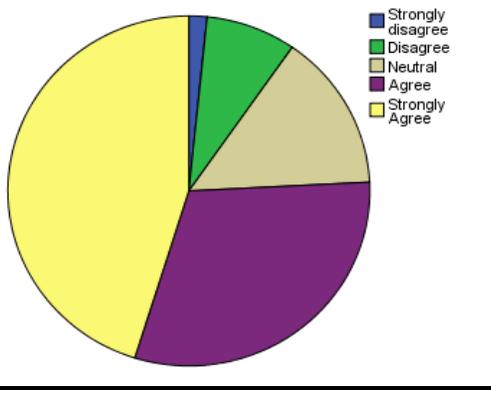
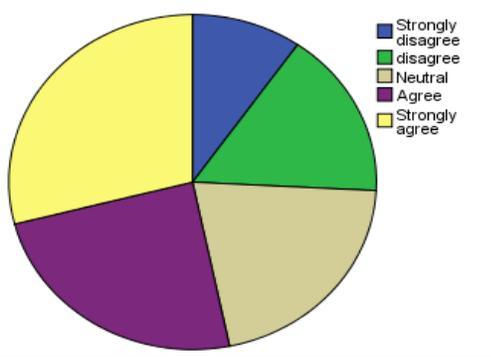
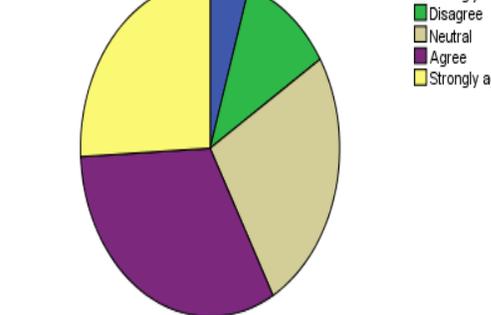
D. Methodology

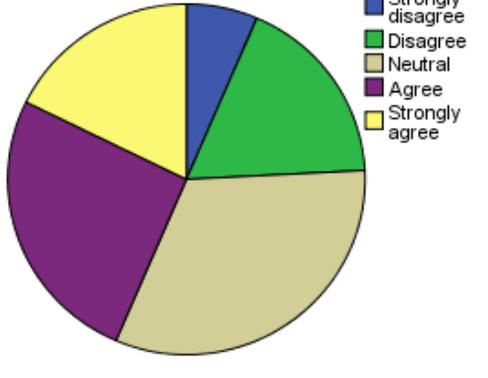
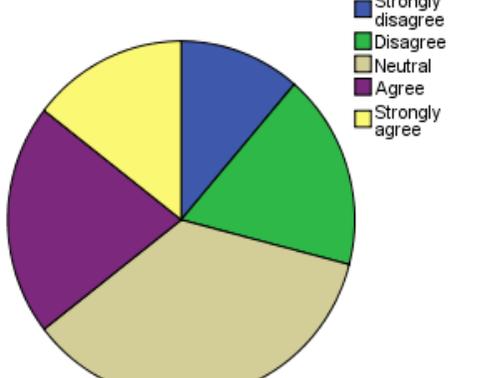
The study of descriptive research is carried out for finding the attitude among the consumers about the electric two-wheelers in Kolkata. This study is conducted considering various performance parameters of electric vehicles like acceleration, power, range, charging time etc. The acceptance decision based among the consumers based on various parameters also studied. The target respondent is mainly young and middle-aged people, who used two-wheelers as a commuter in

their day-to-day activities and intend to buy two-wheeler in near future. The survey was conducted through the internet with a questionnaire format to get the response (Chan, C. C.,1993).

E. Results and Discussion

 <p>@44Indicateyouropinionabout Electric2wheelerElectri...</p> <ul style="list-style-type: none"> Strongly disagree Disagree Neutral Agree Strongly Agree 	<p>a) About 75.8 % respondent believes that Electric two-wheelers are quieter than conventional two-wheelers and practically it is true that electric motor creates less sound & smooth than the internal combustion engine</p>
 <p>@44Indicateyouropinionabout Electric2wheelerElectri...</p> <ul style="list-style-type: none"> Strongly disagree Disagree Neutral Agree Strongly Agree 	<p>b) About 75.8 % respondent believes that Electric two-wheelers are quieter than conventional two-wheelers and practically it is true that electric motor creates less sound & smooth than the internal combustion engine</p>
 <ul style="list-style-type: none"> Strongly disagree Disagree Neutral Agree Strongly agree 	<p>c) In point of acceleration of the electric two-wheelers about 41% of the respondent doubts the acceleration of electric two-wheelers. The automakers have to concentrate to improve the acceleration of the two-wheelers by improving motor parameters which most of the consumers are not satisfied with or doubtful.</p>

	<p>d) Electric vehicles are pollution-free vehicle (green vehicle) about more than 95% of the respondent agree about that concept of the electric vehicle. It is an environmentally friendly motor.</p>
	<p>e) The running cost is a parameter that will be the prime concern in buying decision-making process. About 75% of the respondent agree that the running cost of an electric two-wheeler is much less than conventional two-wheelers. This should be the prime concern in today's life because fuel prices increase day by day.</p>
	<p>f) About 53% of the respondent believe that the purchase cost of the Electric two-wheelers is less than the Conventional two-wheelers.</p>
	<p>g) In point of technology advancement, about 58% of respondent agree that electric two-wheelers nowadays has adopted more improved technology and for which they can deliver the better range in a single charge.</p>

	<p>h) The consumer can often judge the vehicle in terms of Max. speed especially at a young age. But about 50% of the population not confident enough about the max speed of the vehicle.</p>
	<p>i) Product reliability is an important perception among consumers. In the case of the electric vehicle, most consumers' concern about reliability. More than 63 % of the population of this survey sceptical about the reliability of the electric two-wheelers, which has hampered the buying behaviour of electric two-wheelers.</p>

Correlation table

Buying an electric bike/scooter in future	Pearsons correlation	Significant level
Electric two-wheelers are quieter than a conventional two-wheeler	-0.169	0.190
Electric two-wheelers have excellent acceleration	-0.336	0.008 **
Electric two-wheelers are pollution free	0.088	0.494
Electric two-wheelers have low running cost	0.043	0.742
Electric two-wheelers have low purchase cost	-0.215	0.093
Electric two-wheelers have improved technology & better range	-0.298	0.019*
Electric two-wheelers have a good maximum speed	-0.205	0.111
Electric two- wheelers are reliable	-0.365	0.004**

** . Correlation is significant at the 0.01 level (2-tailed).

* . Correlation is significant at the 0.05 level (2-tailed).

Model Summary									
Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Change Statistics				
					R Square Change	F Change	df1	df2	Sig. F Change
1	.375 ^a	.141	.096	1.349	.141	3.168	3	58	.031
a. Predictors: (Constant), reliability, improved technology, acceleration									

From the above correction table, the results were statistically significant, strong negative correction between buying behaviour and acceleration of the electric scooter ($r = -0.336, n=62, p<0.01$) and strong negative correction between buying behaviour and reliability of the electric scooter ($r = -0.356, n = 62, p<0.01$) and moderate negative correction between buying behaviour and improved technology ($r = -0.298, n=62, p<0.05$). From this it is correlation table buying behaviour is negatively related to reliability to the vehicle and acceleration and technology.

From the above model of regression analysis, R^2 for the overall model was 14.1%, a small size effect is reported in the model.

ANOVA						
Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	17.297	3	5.766	3.168	.031 ^b
	Residual	105.542	58	1.820		
	Total	122.839	61			
a. Dependent Variable: buying behavior of an electric two wheeler in future						
b. Predictors:(Constant), reliability, improved technology, acceleration						

The model was whole significant to predict the buying behaviour of electric two-wheeler $F(3,58) = 3.168, p < 0.031$ as shown by ANOVA table R^2 for the overall model was 14.1% and adjusted R^2 was 9.6% A small size effect is reported by the model of variation in buying behaviour is accounted by the combination of predictor variables (acceleration of two-wheeler, advanced technology of two-wheelers and reliability of two-wheelers)

Coefficients													
Model	Unstandardized Coefficients		Standardized Coefficients	t	Sig.	95.0% Confidence Interval for B		Correlations			Collinearity Statistics		
	B	Std. Error	Beta			Lower Bound	Upper Bound	Zero-order	Partial	Part	Tolerance	VIF	
1	(Constant)	4.437	.617		7.190	.000	3.202	5.673					
	acceleration	-.212	.210	-.169	-1.009	.317	-.633	.208	-.333	.131	.123	.529	1.890
	reliability	-.228	.206	-.192	-1.107	.273	-.641	.184	-.344	.144	.135	.490	2.040
	improved technology	-.086	.191	-.069	-.454	.652	-.468	.295	-.267	.059	.055	.639	1.566
.Dependent Variable: Would you like to buy an electric bike/scooter in future													

From this model, it is clear that consumers have a negative impact on reliability, acceleration and improved technology & range of electric two-wheelers. Consumers not ready to accept these parameters which were not up to the satisfaction level compared to the conventional two-wheelers.

In final model is as below:

$$Y = B_0 - 0.212(\text{acceleration}) - 0.228(\text{Reliability}) - 0.086(\text{Improved technology})$$

Where Y (buying behaviour)

$$\text{Buying behaviour} = 4.437 - 0.212(\text{acceleration}) - 0.228(\text{Reliability}) - 0.086(\text{Improved technology})$$

To accelerate the buying behaviour of electric two-wheelers, all three parameters (acceleration, reliability and improved technology) must be positively related. The negative perception about these parameters compared to the electric two-wheelers among the consumers' barrier to the growth of electric two-wheelers.

Crosstab									
		Parameters							Total
		price	Charging time	Range	Max. speed	Look & Design	Riding quality	Service Network	
Buying behaviour	Definitely	2	2	4	2	0	0	3	13
	Likely to buy	7	0	5	0	0	3	1	16
	Considering if convinced	2	3	9	0	0	2	1	17
	Unlikely to buy	0	0	3	0	1	0	3	7
	Won't buy	0	3	2	0	0	0	1	6
	Already have	0	1	2	0	0	0	0	3
Total		11	9	25	2	1	5	9	62

From the above table, About 40.3% of respondent believes that range is the most important parameters while selecting the electric vehicle. The range is the distance travelled by a vehicle in a single charge. About 17.7% of respondent believes that the price of the electric vehicle is the deciding parameters while buying an electric vehicle. About 14.5% of the respondent thinks that charging time is the most important parameter of the electric two-wheelers while choosing the vehicle. 14.5% of respondent beliefs the service network of the brand is important parameters while choosing the vehicle.

Chi-Square Tests			
	Value	df	Asymptotic Significance (2-sided)
Pearson Chi-Square	47.509 ^a	30	.022
Likelihood Ratio	45.960	30	.031
Linear-by-Linear Association	.024	1	.876
N of Valid Cases	62		

a. 39 cells (92.9%) have an expected count of less than 5. The minimum expected count is .05.

From this report, there is good evidence of the relationship between buying behaviour and the parameters that affect the decision-making process while selecting the electric vehicle

(Chi square = 47.509 ,df =30 , p <0.05)

F. Conclusion

From this study it is clear that electric two-wheelers are lagging in technology advancement, acceleration and reliability compared with conventional two-wheelers. There is a negative

perception of acceleration, reliability and technology advancement among the consumers .they still rely on the conventional two-wheelers on these parameters. It is a big barrier to the growth of the electric two-wheeler market. Another important barrier to the development of Electric two-wheelers is most of the product line is coming from non branded and recently developed organisation (start-up organisation), consumers are hard to believe in the after-sales support & reliability of the product line. Range (distance travelled in a single charge), price, charging time is the most important parameters to impact the buying decision and other comparative factors like zero-emission, the soundless machine does not affect the decision-making process (these are not statistically significant).

G. Recommendation

The OEM should improve their product line with improved range, fast charging technology and performance. This can be only done by proper research and development.

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