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A Study of Consumer Perception and Purchase Intention of Electric Vehicles

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Abstract

Contemporary environmental concerns are thrusting the manufacturing and sales of Electric vehicles. Combination of Indian skilled and semiskilled technological base, a platform of large customer base, and relatively cheaper production and labor cost, has fascinated almost all global electric vehicle manufacturers and component suppliers,to start operations from India — Bosch, AVL and Cummins. To study Commercial success and purchase intention of electric vehicle by Indians, there is a need to study the factors influencing the consumer acceptance of these vehicles. Various factors that influence the purchase decision of car buyers are individual perception on dimensions like environmental issues, cost, trust, technology advancement, infrastructure, and society acceptance. The results shows that environmental concerns and consumer trust on technology are antecedent factor for perception about Electric vehicle purchase and the factors which give adoption blow back are cost, infrastructure, social acceptance. Thus to promote sales of electric vehicle government has to play a leading role by creating environmental policy, infrastructure andsubsidized cost of vehicle or lower the bank rate of interest rate.

1. Introduction

Contemporary environmental concerns are thrusting the manufacturing and sales of Electric vehicles. Year2018 have revolutionized the Indian manufacturer'sconception towards Electric Vehicle as best alternatives to the fuel cars (conventional diesel/petrol combustion engine). For example the Nissan Motors are developing 20 new models of EV and various Indian domestic players like Tata Motors, Mahindra & Mahindra, TVS Motors and Bajaj Auto are trying to strongly hold the leverage of high growth period of electric vehicles into theirstrategic competitive advantages in the market. This new emerging market has led to various strategic alliances (Tata Motors with Fiat, M&M with Ford and Renault, Bajaj Auto with Kawasaki, and TVS with Suzuki, Jaguar Land Rover by Tata Motors, Ssangyong by M&M, and KTM by Bajaj Auto).

Combination of Indian skilled and semiskilled technological base, a platform of large customer base, and relatively cheaper production and labor cost, has fascinated almost all global electric vehicle

manufacturers and component suppliers ,to start operations from India — Bosch, AVL and Cummins being a few examples, and the result would give thrust to infrastructural development.To study Commercial success andpurchase intention of full electric vehicle by Indians, there is a need to study the factors influencing the consumer acceptance of these vehicles.Various factors that influence the purchase decision of car buyers are situation like regulatory environment, personal current psychological factors, like attitude, perception, and society acceptance and consideration levels.“Although some empirical studies of the consumer acceptance of hybrid vehicles have been conducted, there is little research that considers the perception of an expected situation; in particular, there has been little attention on the perception of full electric vehicles”.From Environmental perspective, increase in high CO2-emissions and depletion of Fossil reserves , the roll out of Electric vehicle can be perceived as a safety measure and future security(Neumann et al 2010).

Technology to be used in the upcoming EV is very mature and uptrend leading to high distance coverage with efficiency and comfort. (Class, Winter et al 2010). The potential of electric mobility has been studied in recentresearch from a technical (Werther, Frischknecht, labeye et al 2011) economic (Kley et al 2011), logistic (Ehrler et al 2012), environmental (Sourkounis et al 2011) andinner-urban (Schaumann, Solarat al 2013) point of view. However, research showed also that there isconsiderable struggle for electric vehicles to create appropriate markets , at leastPublic Perception and Acceptance of Electric Vehiclesin India. Changing is the trend from acceptance of fuel cars to EV requires a massive propagation and trust building on the electric Vehicle segment. Still,however, there is a strong negativity in acceptance of EV (Hiffman 2014).

The first parameter for strong push back in not accepting EV may be the experiences, comfort, safety and reliability on traditional fuel cars. And second Indian concept of avoiding risk and uncertainties for adoption of new technology .Thirdsocial reasons comes into being.

The study tries to correlate the EV purchasers’ psychological and situational factors, that effect the purchase intension of consumers regarding electric vehicles, and find relationship existing between them. The result draws a high influence from Government policies and promotions designed to promote electric vehicles to reduce carbon emissions from transport.

Review Of Literature : History repeats itself” a famous quote has been proved right, by powerful emergence of EV again in Indian transport industry. The use of electric vehicles was in life before 1918 but it almost completely vanished with the development of gasoline-powered internal combustion engine vehicles .These fuel led cars put the story of electric vehicle manufacturing on to a sleep mode. But year 2017 has again revived the story, with the concept of making EV for longer distance drives too and upliftment in a vehicle maintenance support system by Government. Technology perception and adoptions has two aspects first is the attribute of technology and second is of the adopter. In management perspective it can be explained through “innovation diffusion theory (IDT) (Rogers, 1962) and subsequent extensions (such as the TOE framework, Tornatzky and Fleischer, 1990).These relates to adoption of new technology based on usefulness (performance expectancy), ease of use (effort expectancy)Social influence and facilitating conditions(Venkatesh and Davis, 2000; Venkatesh et al., 2003)”. These parameters also play a very crucial role in adoption of Electric Vehicles.

There has been a considerable increase in research on EVs and adoption the last few years. In a recent study, Rezvani et al(2015) review work discusses the adoption of electric vehicles using various theoretical framework, he explained consumer EV adoption behavior from various theoretical perspectives like mix, planned and symbolic behavior. The maximum studies on EV adoption are revolving around technological, individual, social parameters. Axsen et al(2012)did a quantitative online survey based on lifestyle practice theory on 711 representative household in California, USA and found that adoption of this new technology of EV is based on Pro-environmental lifestyle, technology oriented lifestyle and Openness to change.

Burgessetal (2013) did a qualitative research on the adoption model of EV in 55 private drivers of UK, and found that major factors which leads to purchase are Technical ,Cost , individual and social factors.Caperollo and Kurani (2011) worked through rounded theory on 36 households in

California, USA for 4-6 Weeks and found that the basic reason of non adoption of electric vehicles was confusion in how battery works, not finding appropriate charging stations nearby, avoidance of acceptance of new technology and driving habits.

Carley et al.(2013) did research on 2,302 individuals of USA with driving license and found that the adoption and perception varies based on education, gender, age, experience, environmental beliefs he explained that the various factors which steps down the purchase of EV as compared to traditional vehicles are the cost parameters, infrastructure non availability and recharging time. His study was based on Rational Choice Theory.Egbue and long (2012) did awareness survey on 481 students, staff and teachers of technical university regarding the acceptance level of new technology and found that the factors like environmental awareness, technology awareness, experience with EV and expectation about sustainability of EV plays a major role while buying an EV.

Graham –Roweet al (2012) based on his qualitative semi structured interview method studied 40 UKnon commercial and ICE drivers and found that the main force that relates purchasing intentions are environmental parameters, cost of vehicle, cost of fuel, battery material electricity source,performance, safety and the upgraded technology. The research done by Jensen et al (2013) on 369 Danish drivers explains that the acceptability of EV depend on hands on experience, purchase cost, fuel cost , driving range and driving speed of the EV.

Kupra et al (2014) gave new dimension to elaborating the research from Political scenario by studying 911 residents of USA. He found that the acceptance of EV would increase tremendously by having a political belief,concern for energy independence and climate change. He suggested that tax incentives can further enhance the sales.

Lane and Potter (2007) studied UK residents, consumers and potential consumers of Electric Vehicle based on theory of planned behavior and value-belief-norm theory He found that performance, ease of use, safety, reliability , energy efficiency of EV are the main contributors towards increased sale of EV. There was no relevant study that backed the perception and adoption process in Indian Consumers.

2. Framework in Consumer Perception and Adoption of EV

Adoption of any Innovation by consumers is based on awareness and perception regarding the innovation. The literature review shows that the perception and adoption of Electric vehicles in various parts of the world is studied by focusing on reducing Co emission (Pro Environmental lifestyle), technology (Speed, distance, efficiency), cost (EV and Fuel), infrastructure (charging points) and social acceptance. The Current Exploratory study focused on Perception and adoption of Electric Vehicle in India by comparing the use, features, acceptance,and reliability of traditional cars with upcoming Electric vehicles. It would help in Growth of technology and this is the most relevant topic for modern India. This study enables to understand and explore the driving parameters that would lead to change in adoption of electric vehicle in changing Indian ideologies.

3. Methodology

3.1 Sample and Procedure

An internet based survey was framed and conducted to collect sample for the study. The Purposive random sampling techniques were used and sample comprised of owner of fuel cars and have the intension of getting feedback was based on perception and adoption of upcoming electric vehicles. Data was collected from service and business class people, who are almost every day use fuel cars. Based on sample it was assumed that the entire population was well aware of technology used in fuel cars and potential benefits of using electric cars.A total of 247 respondents filled the survey, with varied demographics like location, education level, salary etc. out of which 14 were rejected because of

incomplete information and the remaining 233 were used for the study. The sample had significantly higher participation of males (73%) and the female number was only 27%. Respondents sample was within age group of 24-47 years of age.

3.2 Tools Used

A survey questionnaire was developed comprising 35.questions which were responsible for identifying various aspects of the research.Independent variable is the choice of adoption of electric vehicle and dependent are the benefits or barriers to acceptance of EV. As both, benefits and barriers might be based on environmental, cost, comfort, trust and technology, social acceptance, infrastructure availability argumentations for both cars and electric cars.

We assume that these factors have direct influence on individual choice of vehicle. The first section of questionnaire was related to demographics of respondents. Respondent's views about various parameters that effect purchase decision was analyzed in second section and finally in third section respondents view about technology adoption was measured.

Analysis of the Data

The collected data were tabulated as per the research design to meet out the objectives of the study and suitable statistical tools were used to analyze the data.

Environmental Concern

Environment is decorating day by day, and the crown for the same can be placed on head of technological advancement. People now, are well aware of the harmful effect of environment degradation and are put effort to safeguard the same. These concerns are even visible during purchase decision of consumer products especially transport vehicles. Government of every country is also concerned for the same aspect and is either prohibiting the use of vehicles responsible for higher degree of pollution. In India, apart from driving license, pollution check is equally important. Kahn's [70] study indicated that "environmentalists are more likely to purchase hybridelectric vehicles than non-environmentalists". Jensen *et al.* [48] argued that "environmental concern hasa positive effect on the preference for electric vehicles both before and after experiencing an electricvehicle". Peters and Dutschke [56] found that "having environmental advantages is a motivator foradopting electric vehicles". Bockarjova and Steg [35] stated that "people are more likely to adopt an electric vehicle when they expect electric vehicles to decrease environmental risks". Environmentalconcern is a basic dimension which motivated manufactures to build electric vehicles, government to thrust its production and consumer to increase its sale.

The current study reveals that correlation between environmental concerns and adoption of electric vehicle is 0.53 means as the concern for the environment among fuel car users will increase the adoption of electric vehicle will also increase.

$$\sum(X - M_x)(Y - M_y) = 39.638$$

$$r = \sum((X - M_y)(Y - M_x)) / \sqrt{((SS_x)(SS_y))}$$

$$r = 39.638 / \sqrt{((187.612)(28.862))} = 0.53$$

Low Cost of Vehicle

Purchase decision of vehicles always come under Rational Model Of purchase , which means that the vehicle which provides Value For Money is always sort after. But in Regards to Electric Vehicle a very interesting phenomenon is studied that the initial heavy cost of Electric Vehicle is responsible for negative perception of Electric Vehicles and on contrary long run fuel saving and effectiveness leads to a little positive thrust to perception and adoption. But theory of Time Value of Money actually creates a negative perception in minds of consumers. This can lead to a new model, which can be purposed to Government of India," to safeguard the future of country , environmental need to be protected for which government is fueling manufactures to make Electric Vehicles. But this cannot be successful ,

until and unless consumers purchase it. To increase sale government must facilitate people with free or subsidized loan, free insurance , free parking"This would generate a new vision for purchase intention. Evidence of same can be taken from Norway-Global leader of Electric Vehicle Market Share.In2007, EU ministers agreed to outline three 2020 goals: to cut carbon emissions by 20%, increase the share of renewables inthe energy mix to 20% and improve energy savings by 20%. In line with these goals, the European Commission supports aEurope-wide electro-mobility initiative, Green eMotion, worth €41.8 million, to exchange and develop know-how and facilitatethe market roll-out of electric vehicles in Europe (European Commission, 2012). In addition to such supports, nationalgovernmental bodies develop their own supportive policies for reducing the emissions and enhancing the adoption of EVs.For example Sweden has a goal for 2030 to become fossil fuel independent.The current study reveals that the correlation betweenlow cost and purchase intention is significant means if the cost of the vehicle will go down the intention to purchase the decision will go up. Here it is the responsibility of the electric vehicle producers to produce low cost vehicle by minimizing various variable costs and also government must offer some subsidy to the customer and or provide bank loans at reduced interest rate. These measures will definitely be useful in increasing the buying intention of potential customer,

$\sum(X - M_x)(Y - M_y) = 21.966$
$r = \sum((X - M_y)(Y - M_x)) / \sqrt{((SS_x)(SS_y))}$
$r = 21.966 / \sqrt{((118.241)(28.862))} = 0.37$

Comfort

Another important parameter which is sought after while buying a vehicle is comfort levels in using it. This parameter is highly personalized, because the level of comfort and even perception of Comfort varies from individual to individual .Research literature reviews that purchase of vehicle is dependent upon comfort levels while using a vehicle. But as electric vehicles, are not well adopted in India, it isbased on assumption that the vehicle would give a high level of comfort, this perception is driven based on technology advancements. Many participants stated they would only consider purchasing an electric vehicle once it has achieved certain levels of market penetration. And it was found that comfort and intention to buy is positively correlated means if the driving and owning of the vehicle is comfortable then the consumer may buy the electric vehicle. But here the government has to lay very vital role and during the interaction with the potential electric vehicle buyers it was observed that they are apprehensive in using electric vehicle because of lack of availability of electricity in various cities and the cost of the lectricty is also very high.

$\sum(X - M_x)(Y - M_y) = 14.034$
$r = \sum((X - M_y)(Y - M_x)) / \sqrt{((SS_x)(SS_y))}$
$r = 14.034 / \sqrt{((128.241)(28.862))} = 0.2307$

Trust

To build trust on an engine or machine which is being used is very easy , but to imagine a product and then put trust on it becomes very difficult. Similarly in Indian Market people have trust on technology but trust parameter is lacking on electric vehicles. Trust is an important dimension , which had to made stronger and stronger with passage of time, but is this trust is broken it would lead to fall in market share and the organization would not be able to stand back . No relevant literature review is about trust parameter on Electric vehicle is there. The current study reveals that there is no correlation between Trust and perception of Electric Vehicles because the commercial use of electric vehicle is yet to come and the consumers has to see various aspects of the vehciles and then will develop trust in them.

$\sum(X - M_x)(Y - M_y) = 12.155$
$r = \sum((X - M_y)(Y - M_x)) / \sqrt{((SS_x)(SS_y))}$
$r = 12.155 / \sqrt{((121.888)(28.862))} = 0.297$

Technology

From the respondents feedback it is analyzed that people rely and have faith on technology but the technology is move at a rate that it keeps on depleting soon, because of change at a very high pace people are not ready or are confused to choose a technology. This can be concluded as people perceive that changing technology is very good and beneficial but adoption of the same is very slow.

$\sum(X - M_x)(Y - M_y) = 18.353$

$r = \sum((X - M_y)(Y - M_x)) / \sqrt{((SS_x)(SS_y))}$

$r = 8.353 / \sqrt{((239.06)(28.863))} = 0.4901$

Infrastructure

Infrastructure is a basic requirement for any new vision to be converted into reality. Lack of infrastructure makes an innovation die at its induction stage. Infrastructure required for creating positive perception for electric vehicles and finally its adoption is roads, recharging stations, battery exchange and service stations. Non availability rather poor conditions of existing infrastructure are compelling consumers not to shell out their money into adoption of electric vehicle.

$\sum(X - M_x)(Y - M_y) = 10.207$

$r = \sum((X - M_y)(Y - M_x)) / \sqrt{((SS_x)(SS_y))}$

$r = 10.207 / \sqrt{((123.241)(28.784))} = 0.1714$

Social Acceptance

Society plays a very prominent role in purchase decisions, the product or services adopted by society becomes an instant hit but if society does not accept it even survival becomes very difficult. Social acceptance was taken from very divergent views based on demographics of respondents. Educated, salaried respondent of urban areas considered it good option but high income urban respondent was ready to buy only if it comes in high end model, public image was considered. Acceptability among young respondents was comparatively higher but acceptability level among rural respondents is comparatively lower. Respondents were of opinion that acceptability would be measured only if vehicle start running on roads, but currently the acceptability is of the idea.

$\sum(X - M_x)(Y - M_y) = 9.897$

$r = \sum((X - M_y)(Y - M_x)) / \sqrt{((SS_x)(SS_y))}$

$r = 9.897 / \sqrt{((163.31)(28.784))} = 0.1443$

Table 1: Showing Rank Order of Preference in Buying Electric Vehicle

CONTENTS	R score	RANKING ORDER
Environment Concern	0.53	1
Cost of Vehicle	0.37	3
Comfort	0.23	5
Trust	0.29	4
Technology	0.49	2
Infrastructure	0.17	6
Social Acceptance	0.14	7

Conclusion

Based on the analysis, electric vehicle manufacturers and Government of India have to invest more on social acceptance of the vehicle by creating more infrastructural facilities, putting more thrust on technology, that can create trust in vehicles. The result clearly depicts that the population is well aware of the environmental benefits. Now responsibility lies on shoulders of Government and manufacturers that parallel to investing in manufacturing of vehicles, Consumer perception has to created by providing the above said facilities so that dream can be converted to reality, people start adopting electric vehicle and safeguard the future of India from several respiratory problems including

asthma,lung cancer, Chest pain, Congestion, throat inflammation, Cardiovascular disease, Respiratory disease.

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