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A STUDY ON CONSUMERS PERCEPTIONS TOWARDS TRANSITION FROM INTERNAL COMBUSTION(IC) ENGINE VEHICLES TO ELECTRIC VEHICLES IN THE BENGALURU CITY

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Abstract
This study is done primarily with the objective of consumers perceptions towards transition from internal combustion (IC) engine vehicles to electric vehicles in the Bengaluru city. This study is done by assessing the current expectations of consumers with respect to electric vehicles, consumers awareness on fame scheme & electric vehicle charging stations and factors influencing consumers to buy electric vehicles. The research design is descriptive in nature and primary data was collected using the questionnaire method from a sample size of 90 consumers. Secondary data was collected from websites, magazine, articles, and books. The collected data was assessed by statistical tools like, Chi-square, Correlation, One way-Anova was used. It is founded that majority of 54.4 per cent of consumers are not aware of any electric vehicles charging stations and 47.8 per cent of consumers are interest in adopting to change their IC engine vehicle to electric vehicle in the future. It is suggested by due to lack of public charging infrastructure & renewable energy sources, government & automakers should improve and increase the public charging infrastructure & renewable energy sources to charge electric vehicles and automakers &government should take initiative to promote more about electric vehicles, fame scheme /nemmp 2020 and its charging stations to public to create an awareness by implementing these suggestions consumers will prefer electric vehicles instead of internal combustion engine vehicles.

Keywords: Consumers, Electric Vehicles, Bengaluru City.

1. Introduction

India today is one of the top ten automotive markets in the world and given its burgeoning middle class population with buying potential and the steady economic growth, accelerating automotive sales is expected to continue. In the last couple of years, there has been a lot of discussion around the prices of fuel – apart from the deregulation of petrol prices. Moreover the threat of disruption of supplies from the Middle-East has heightened the debate on energy security and brought the focus on to alternate drive train technologies.

There seems to be a lot of interest on the part of Internal Combustion Engine (ICE) based manufacturers to adopt electric technology, not just supplemental to the ICE, but as a stand-alone offering. There are also specialized EV manufacturers that have come up all over the world.

Assessing future demand for electric vehicles was somewhat challenging since it meant testing consumer preferences for a product with which they are largely unfamiliar. For this reason, focused on consumers who are aware of electric vehicles and electric vehicle users familiarity with EV technologies and products; with their opinions around price, range, factors, charging infrastructure with the consumer's imagined "fit" of an EV in his or her lifestyle given a range of demographic parameters.

2. Review of Literature

I. Rajiv P, Dr.Kavitha(2016)

The study is based on Customers perception towards Electric vehicles (2-wheelers) in Vellore City with respect to GO Green BOV. The basic objectives of the study are to analyze consumer perception towards Electric two wheelers and develop strategies for improving B2B sales of Electric Two wheelers and to identify the means to enhance the consumer awareness level towards electric vehicles. Most of the respondents are not convinced about the product benefit as they perceive the product to be of Inferior quality and majority of the existing customers are facing problem with after sales servicing and support. The study suggests the company to educate the people about the product and potential benefits. Improve the product quality as well the battery life.

II. Rafia Afroz & Muhammad Mehedi Masud & Rulia Akhtar1 & Md. Ashraful Islam & Jarita Bt Duasa(2015)

This paper examines whether attitudes towards electric vehicles (ATEVs), subjective norms (SNs) and perceived behavioural control (PBC) have significant associations with consumer purchase intention (PI) and the purchase behaviour of environmentally friendly vehicles (EFVs). The results from the survey questionnaires are analysed using confirmatory factor analysis (CFA) and structural equation modelling (SEM). The findings of this paper indicate that ATEV, SN and PBC significantly influence PI. This finding also indicates that environmental consequence and individual preferences do not influence the PI of the respondents.

III. Kenneth Lebeau, Joeri Van Mierlo, Philippe Lebeau, Olivier Mairesse and Cathy Macharis(2013)
Nowadays, Electric Vehicles (EVs) receive a lot of attention. However, their market breakthrough is not straightforward. This paper presents the results of a large-scale data collection (survey with 1196 respondents) held in Flanders (Belgium). The results include perceptions on the advantages and disadvantages of Battery Electric Vehicles (BEVs), the acceptable driving range, the acceptable charging time (both slow and fast), the acceptable maximum speed, the role of the government in the introduction of BEVs, the preferred governmental tools to maximise sales and the consumers Willingness to Pay (WTP).

IV. Vidyadhar Gulhane, M.R. Tarambale and Y.P Nerkar (2006)
Published " A Scope for Research and Development Activities on Electric Vehicle Technology in Pune City" Proc. IEEE, 2006 describing, the various vehicle manufacturers are doing research on electric vehicles, its design with respect to electric motor, motor controller and the Government media in supportive to it. This paper also describes the disadvantages of electric vehicle usage in its reliability and also durability in India.

V. Altenburg, Tilman (2014)
The research project "Technological trajectories for low-carbon innovation in China, Europe and India" explored to what extent, how and why technological pathways differ across countries. Case studies were conducted in electro mobility and wind power technologies. This case study deals with electro mobility in Germany. Germany adopted a National Electro mobility Strategy to make it a lead market and lead provider for electro mobility. The lead market target, however, is not likely to be achieved – due to the German industry's and consumers' preference for high-powered cars and due to limited government commitment to accelerate the transition via ambitious emissions targets or subsidies.

3. Need of the Study
The Electric Vehicle (EV) industry is still is nascent stage in India. There is a lot of need to create awareness among the general public to make this alternative model success. While it is for sure that sooner or later the electric vehicle will emerge as a strong component, for the time being there is the need for educating the consumers to arouse a need for the product.

4. Objectives of the Study
- To study on consumers perceptions towards transition from internal combustion(IC) engine vehicles to electric vehicles in the Bengaluru city.
- To study on factors influencing consumers to buy electric vehicles.
- To study on consumers awareness on FAME scheme & electric vehicles charging stations.
- To study the current expectations of consumers with respect to Electric Vehicles.

5. Research Methodology
Bengaluru city has been selected purposively for the present study. The data have been collected from 90 consumers by using convenience sampling technique through structured questionnaire. The design was a descriptive study. The collected data was assessed by statistical tools like, Chi-square, Correlation and One way-Anova was used.

6. Results and Discussion
6.1 Percentage Analysis
Table-1 Socio-Economic Profile of Consumers

Socio-Economic Profile	Number of Consumers	Percentage
Gender		
Male	60	66.70
Female	30	33.30
Age		
18 – 22 years	22	24.40
23 – 26 years	22	24.40
27 – 30 years	21	23.30
31 - 34 years	19	21.10
Above 35 years	6	06.70
Occupation		
Student	27	30.00
Self-Employed	20	22.20
Employed	34	37.80
Housewife	4	04.40
Retired	5	05.60

Monthly Income		
Rs.50,000 – Rs.1 lakh	39	43.30
Rs.1 lakh – Rs.1,50,000 lakhs	20	22.20
Rs.1,50,000 lakhs – Rs. 2 lakhs	13	14.40
Rs. 2 lakhs – Rs. 2.5 lakhs	14	15.60
Above 2.5 lakhs	4	04.40

The socio-economic profile of consumers was analyzed and the results are presented in Table-1.The results indicate that 67.7 Per cent of consumers are males and the remaining of 33.3 per cent of consumers are females. It indicate that 24.4 per cent of consumers are in the age group of 18 – 22 years followed by 23 – 26 years (24.4 per cent), 27 – 30 years (23.3 per cent), 31- 34 years (21.1 per cent) and above 35 years (6.7 per cent).It is observed that 37.8 per cent of consumers are employed, followed by students (30 per cent), self -employed (22.2 per cent), retired (5.6 per cent) and housewife (4.4 per cent).The results reveal that 43.3 per cent of consumers belong to the monthly income group of Rs.50,000 – Rs.1 lakh followed by Rs.1 lakh – Rs.1,50,000 lakhs (22.2 per cent), Rs.2 lakhs – Rs.2.5 lakhs (15.6 per cent), Rs.1.50,000 lakhs - Rs.2 lakhs (14.4 per cent) and above Rs.2.5 lakhs (4.4 per cent).

6.2 Chi-Square Test

A) Gender of the Consumers and Factors Influencing Them to Buy Electric Vehicles

Table-2 chi-square tests for gender of the consumers and factors influencing them to buy electric vehicles

	Value	**df**	**Asymp. Sig. (2-sided)**
Pearson Chi-Square	16.129[a]	9	.064
Likelihood Ratio	18.230	9	.033
Linear-by-Linear Association	1.943	1	.163
N of Valid Cases	90		
a. 14 cells (70.0%) have expected count less than 5. The minimum expected count is 1.00.			

Interpretation

The calculated value is 16.129, significant value P (0.064) and degrees of freedom 9. The significant value P is greater than 0.05 so, null hypothesis is accepted. Hence, there is no significant association between gender of the consumers and factors influencing them to buy electric vehicles.

B) Monthly Income of the Consumers and Their Price Expectation of Electric Vehicles to Buy

Table-3 Chi-Square Tests for Monthly Income of the Consumers and Their Price Expectations of Electric Vehicles to Buy

	Value	**df**	**Asymp. Sig. (2-sided)**
Pearson Chi-Square	76.291[a]	16	.000
Likelihood Ratio	47.908	16	.000
Linear-by-Linear Association	31.903	1	.000
N of Valid Cases	90		
a. 19 cells (76.0%) have expected count less than 5. The minimum expected count is .09.			

Interpretation

The calculated value is 76.291, significant value P (0.000) and degrees of freedom 16. The significant value P is less than 0.05 so, null hypothesis is rejected. Hence, there is significant association between monthly income of the consumers and their price expectations of electric vehicles to buy.

6.3 Correlation

A) Gender of the Consumers and Their Interest in Buying Electric Vehicles

Table-4 correlations for gender of the consumers and their interest in buying electric vehicles

		Gender	Would you be interested in buying Electric Vehicle?
Gender	Pearson Correlation	1	.079
	Sig. (2-tailed)		.459
	N	90	90
Would you be interested in buying Electric Vehicle?	Pearson Correlation	.079	1
	Sig. (2-tailed)	.459	
	N	90	90

Interpretation
The results shows r is 0.079 since r is positive, there is strong and positive relationship between gender of consumers and their interest in buying electric vehicles.

B) Age of the Consumers and Their Interest in Adopting to IC Engine Vehicle to Electric Vehicle in the Future

Table-5 Correlations for age of the consumers and their interest in adopting to ic engine vehicle to electric vehicle in the future

		Age	Will you adopt to change your Internal Combustion (IC) Engine vehicle to Electric vehicle in the future?
Age	Pearson Correlation	1	.044
	Sig. (2-tailed)		.678
	N	90	90
Will you adopt to change your Internal Combustion (IC) Engine vehicle to Electric vehicle in the future?	Pearson Correlation	.044	1
	Sig. (2-tailed)	.678	
	N	90	90

Interpretation
The results shows r is 0.044 since r is positive; there is strong and positive relationship between age of consumers and their interest in adopting to IC engine vehicles to electric vehicles in the future.

6.4 One Way-Anova
A) Gender of the Consumers and Factors Influencing Them to Buy Electric Vehicles

Table-6 Anova for gender of the consumers and factors influencing them to buy electric vehicles

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	3.584	9	.398	1.941	.058
Within Groups	16.416	80	.205		
Total	20.000	89			

Interpretation
The F-value is 1.941, significant value P (0.058). The significant value P is greater than 0.05 so, null hypothesis is accepted. Hence there is no significant difference between gender of the consumers and factors influencing them to buy electric vehicles.

B) Age of the Consumers and Factors Influencing Them to Buy Electric Vehicles

Table-7 Anova for age of the consumers and factors influencing them to buy electric vehicles

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	25.439	9	2.827	1.984	.052
Within Groups	113.950	80	1.424		
Total	139.389	89			

Interpretation
The F-value is 1.984 and significant value P (0.052). The significant value P is greater than 0.05 so, null hypothesis is accepted. Hence there is no significant difference between age of the consumers and factors influencing them to buy electric vehicles.

C) Occupation of the Consumers and Factors Influencing Them to Buy Electric Vehicles

Table-8 Anova for Occupation of the Consumers and Factors Influencing them to buy Electric Vehicles

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	20.069	9	2.230	1.941	.058
Within Groups	91.931	80	1.149		
Total	112.000	89			

Interpretation
The F-value is 1.941 and significant value P (0.058). The significant value P is greater than 0.05 so, null hypothesis is accepted. Hence there is no significant difference between occupation of the consumers and factors influencing them to buy electric vehicles.

7. Findings

a) Percentage Analysis

- Majority of 67.7 Per cent of consumers are males and the remaining of 33.3 per cent of consumers are females.
- Majority of 24.4 per cent of consumers are in the age group of 18 – 22 years.
- Majority of 43.3 per cent of consumers belong to the monthly income group of Rs.50,000 – Rs.1 lakh.
- Majority of 37.8 per cent of consumers are employed.

b) Chi-Square

- The significant value P (0.064) is greater than 0.05 so, null hypothesis isaccepted. Hence, there is no significant association between gender of the consumers and factors influencing them to buy electric vehicles.
- The significant value P (0.000) is less than 0.05 so, null hypothesis isrejected. Hence, there is significant association between monthly income of the consumers and their price expectations of electric vehicles to buy.

c) Correlation

- The r is 0.079 since r is positive, there is strong and positive relationship between gender of consumers and their interest in buying electric vehicles.
- The r is 0.044 since r is positive, there is strong and positive relationship between age of consumers and their interest in adopting to IC engine vehicles to electric vehicles in the future.

d) One way-Anova

- The significant value P (0.058) is greater than 0.05 so, null hypothesis is accepted. Hence there is no significant difference between gender of the consumers and factors influencing them to buy electric vehicles.
- The significant value P (0.052) is greater than 0.05 so, null hypothesis is accepted. Hence there is no significant difference between age of the consumers and factors influencing them to buy electric vehicles.
- The significant value P (0.058) is greater than 0.05 so, null hypothesis is accepted. Hence there is no significant difference between occupation of the consumers and factors influencing them to buy electric vehicles.

8. Suggestions

- Automakers and government should take initiative to promote more about electric vehicles, FAME scheme (faster adoption of manufacturing electric vehicles)/NEMMP 2020 (national electric mobility mission plan) and its charging stations to public to create awareness.
- Due to lack of public charging infrastructure & renewable energy sources, government & automakers should improve and increase the public charging infrastructure & renewable energy sources to charge electric vehicles.
- Automakers should make a variety of electric vehicles types in each segment (electric two wheeler vehicle, electric three wheeler vehicle, electric passenger vehicle, electric commercial vehicle).

- Electric vehicle battery manufacturers has to increase the efficiency range and to manufacture the advanced technologies battery.
- To promote electric vehicles, government should offer financial incentives to purchase electric vehicles.
- Various companies should take initiatives to promote electric vehicles as a part of their corporate social responsibilities

9. Conclusion

The perception of people towards EVs is still unsatisfactory as a major section of our society is still unaware of various alternative technologies used in automobiles. the current EVs don't meet the consumer's expectations to a larger extent. In this study various key factors influencing consumers to buy electric vehicles are reducing co2 emissions, price, size, technology features and due to lack of public charging infrastructure & renewable energy sources, government & automakers should improve and increase the public charging infrastructure & renewable energy sources to charge electric vehicles. The Government Initiatives taken for the promotion of EVs is still in developing stage and is up to papers, though various agencies have been formed and various plans have been brought by them but still its implementation is not yet done. marketing of such products will really play an important role as a stepping foot towards greener environment and finally the future of the electric vehicles is green.

10. References

1. Altenburg, T. / D. Fischer / S. Bhasin(2012): Sustainability-oriented innovation in the auto industry: advancing electromobility in China, France, Germany and India, in: Innovation and Development 2 (1), 67–85.
2. Barber, K. F. 1993. An overview of the electric and hybrid vehicles R&D program at the US Department of Energy. Paper presented at the 10th International Electric Vehicle Symposium. December 3-5. Hong Kong.
3. Chaudhary, A. (2014): Electromobility in India: attempts at leadership by businesses in a scant policy space, Bonn: DIE (Discussion Paper 15/2014).
4. Fukuyama, T. 1992. Fast Recharge Batteries and the Future Outlook for Electric Vehicles.
5. Nissan Motor Company, Ltd. Transportation Research Laboratory, Japan.
6. Harbauer, W. 1992. Modern Drive Systems for Electric Vehicles – Criteria for Selection and Practical Application. Pp. 23-78 InEVS Vol 11, No. 3. Florence.
7. IEA (International Energy Agency) (2013): Global EV outlook: understanding the electric vehicle landscape to 2020, Paris.
8. Kleinert, I. (2012): Ready for change? : Electric vehicle technologies challenge the German automotive innovation system, paper presented at the 20th Gerpisa International Colloquium, Krakov.
9. Lu, J. (2012). Electric vehicle charging infrastructure assignment and power grid impacts assessment in Beijing Energy Policy, 51, 544–557.