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A SYSTEMATIC STUDY ON THE USAGE OF ECO-FRIENDLY CARS IN THE PERSPECTIVE OF SUSTAINABLE DEVELOPMENT IN AUTOMOBILE INDUSTRIES

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ABSTRACT

With global warming and health concerns on the rise because of the substances the vehicles produce, it is important to adopt the right vehicles that are eco-friendly. The holistic transition from conventional fuel cars to electric cars is crucial for implementing the concept of sustainable development. In the present time, the organizations in the automobile sector are playing a leading role in imparting the idea of sustainable development in the area of productions, operations, supply chain etc. Now the eco-friendly cars are a lot more affordable than they were in the past, and their use is a way to protect the environment and health of people. Hybrids and battery-operated cars are considered to be eco-friendly cars. Electric cars do not burn any fuel. Hybrid cars are somewhat divergent from any other fuel cars or electric vehicles in the sense that they possess two engines, and rely on electricity more often, which means that they burn less fuel than conventional cars. This study seeks to find out the factors that influence the adoption of sustainable measures in the automobile industry through the use of eco-friendly cars through the exploratory factor analysis, and also the interrelationship among the factors and extent of dependability on each other.

KEYWORDS: Conventional fuel cars, exploratory factor analysis, hybrid cars, multiple regression, sustainable development.

1. INTRODUCTION

Indian automobile industry had its inception in the 40's, but due to economic liberalization including FDIs and FIIs, it has seen a considerable growth in the last two decades. They are a lot more affordable than they were in the past, and this investment is a way to help the health

and the world (KPMG, 2019). Hybrid and electric vehicles are not widely available on car rental fleets yet; however, one can check ecofriendly car rental before booking to make an informed decision when renting a car (Lee, 2017). Hybrids and battery-operated cars are considered to be the eco-friendly cars (Ramey, 2018). Electric cars do not burn any fuel. Hybrids, on the other hand, are different from conventional and electric vehicles. The fact that hybrids possess two engines and rely on electricity more often means that they burn less fuel than average car (Polk.com, 2019).

It is quite imperative that technology in all aspects of business is advancing at a very fast pace and it is also can be witnessed that the limited natural resources needed to be utilized in the most optimized manner hence the proper efficient use of technology is the demand of the day. Government has also have taken these issues forward and taken all the possible routes in to the account in order to make sure that there is no ambiguity exist when it comes to uphold the economic concerns for the environmental issues.

When it comes to Indian automobile market, it very much predictive that most of the market and the segment are pre-dominated by few factors, like affordability, optimized consumption of fuel, more safety factors etc. (Reints, 2019). Automakers are much more aware and considered these factors not only seriously but with utmost sincerity. That is why most of the companies have launched the four wheelers in the most affordable pricing segment (Sharma, 2017).

An integrated model withstanding the conglomeration of two different concepts sustainability and an economic car to be ruling in the Indian market, it takes lot of research and a non-primitive dynamic strategy which not only satisfy the demand and the requirement of the customers, it will also safeguard the environmental interests, making the entire scenario more cardinal and crucial (Taufique, 2014). The conventional vehicles being one of the major rationales of the depletion of the ecological conditions of the environment, still a dearth of reasons is associated with the choice of electric vehicles over the conventional one. As these categories of cars are solely depended on the charging points the companies should have the charging stations or the companies should come with residential charging facilities and in this matter government may take lead role in encouraging such facilities.

2. Literature review and research gap

The automobile industry has been the major influencer and contributor to the economy, at the same time automobile industry is also known as the sector which emits maximum toxic gases in the environment as explained by Barbarossa (2016). Hence the organizations some time

update their operations to green eco-friendly structure for various operational synergies, but they certainly failed due to some barriers which are caused by some endogenous and exogenous factors as stated by Balon (2012).

As per Bhalla (2018), modern time environmental issues have fueled the production and marketing of electric vehicles from the year 2018. The concept of electric vehicle has revolutionized the Indian auto-mobile industry and also it had stated the perception that electric vehicles are the best substitute of conventional fuel cars as stated by Barry and Damor-Ladkoo (2016). From economical perspective, Boracci and Giorgi (2018) had explained that, the Indian market is considered to be the best market around the globe for global auto makers as it consist of cheap labors, geo-economical advantages, huge customer-base and also cheaper production cost, hence it is very much favorable for the automobile industries to implement such concept in the market

It is evident that environmentally friendly cars can and must have an instrumental role in reducing the emission of greenhouse gases in the environment, but it cannot be expected to have an immediate effect, with proper awareness and policies it can be achieved as stated by Gayathri (2016).

Hundal (2015) had opined that, in the last few years the concern towards ecological aspects and its degradation has been insulated more then ever. In spite of the fact, that there are multiple differences in the opinion, especially among female consumers but still when it comes to safeguard the natural resources irrespective of different perception, they have illuminated harmonical uniformity of opinion, stated by Brough (2016). To understand the consumer's purchase intentions with regards to eco-friendly products is very challenging, as explained by Hyun (2018). According to Kassim (2016), most of the prospective customers are aware of the gravity of the situation and accepted the new technology for a better world. Kenan (2017) had observed that in Indian market which is a price sensitive market for the auto-makers, will have a intrinsic impact on the consumer's purchase inclination towards electric vehicle.

As the environmental issues have been the major concerns for almost all the sectors in the society the organizations and the employees must work together with collaboration in order to achieve the sustainability spectrum within the organization as stated by Searcy (2009).

There are more pertinent branches of branches of management, however among all other, operations management stands out especially when it comes to technical front as per Seuring (2008).

As per Sukati (2012), sustainable development is the structured centralized process of inflow of goods, services, information that is transformed from raw materials to finished goods and then distributed to end customer.

According to Verma (2006), due to the present challenging condition and market saturation the structure of supply chain has become more composite in nature and along with that understanding and controlling, monitoring with this situation has become more difficult.

Sustainable development in context of cross-cultural dimension is a new concept in the recent trends, as observed by Beniflah (2017). Most of the research concentrated on the supply chain even emphasized on the sustainability aspects in terms of the sustainable development, but there are very limited literatures available on the environmental aspects in context of eco-friendly cars and acceptability in the market. This research seeks to find out the factors that are essential and plays a pivotal role in implementing environmentally friendly practices in the organization along with an integrated model of customers' perception towards eco-friendly cars and its acceptability in the market.

3. Objective of the study and research hypotheses

Primary objective of this study is to pinpoint the factors considered in the purchase decision of the customers towards electric vehicles. First it is necessary to determine the demographic characteristics of prospective buyers in changing automobile industry with respect to eco-friendly cars. Among all the other parameters waiting timing is crucial because as being an electric car it is very much important how much waiting time is concerned when it comes to demographic profile**.** The research hypotheses considered in this study are as follows:

H_1: Gender has an impact on the perception that there is a technology today to make an affordable electric car (in other words, perceptions are not equal for men and women).

H_2: Gender has an impact on agreeability to wait for a longer time for an electric car to be completely charged (i.e., agreeability scores are different for men and women).

H_3: Income group has a role in purchase decision of an electric car in terms of their willingness to buy (i.e., willingness scores are different across the income levels).

H_4: Educational qualification has an effect on the knowledge of prevention to global warming (i.e., knowledge levels are different for different education levels).

The statistical tests of the above research hypotheses will, respectively, examine if there is an influence of demographic characteristics on (i) awareness of customers towards eco-friendly cars, and (ii) purchase decision relating to eco-friendly cars.

4. METHODOLOGY

This study encompasses the analyses using a coalescence of exploratory and descriptive research designs with a significant focus on making use of inferential statistical procedures. The primary data was collected from eighty employees from numerous organizations of Kolkata and the secondary data was collected from websites, journals, magazines etc. The variables concerned for comparison are measured as percentage scores. Exploratory factor analysis (EFA), independent sample tests, *F*-tests based on analysis of variance (ANOVA), multiple regression model, have been used to analyze the data with the help of the statistical software SPSS v.25.

A structured set of questionnaires were used for collecting the primary data, which was consists of questions for demographic profile of the respondents which includes gender, income group, educational level, and the perception scores towards eco-friendly cars, willingness to buy, agreeability to wait for a longer time to completely recharge the battery of electric cars, which appears to be one of the main issues in willingness to use an electric car. The data had been collected through Likert's five-point scale and continuous rating scale.

First the relationship between main demographic characteristics of the prospective buyers and their purchase decision, awareness level has been examined using independent sample tests, and ANOVA.

Next an exploratory factor analysis (EFA) has been done to identify the factors that mainly motivate the respondents to purchase environment-friendly cars. For the purpose of scale reliability, Cronbach alpha has been also obtained. The Kaiser-Meyer-Olkin (KMO) measure and Bartlett's test have been used, respectively, for assessing sampling adequacy and testing sphericity.

Finally a multiple regression model has been used to establish a relationship between willingness to buy an electric car and the major factors, extracted by the method of factor analysis, which may influence the purchase decision, from which it will also be evident that which of the extracted factors have more effect on willingness of customers to buy an eco-friendly car.

5. DATA ANALYSIS: RESULTS AND DISCUSSION

This section discusses the results of (i) hypothesis testing on effect of important demographic characteristics on awareness level of the customers and their purchase decision, (ii) factor analysis, which identifies major factors that affect the purchase decision, and (iii) multiple

regression analysis, from which how the willingness of a customer depends on various identified factors can be obtained.

Testing effect of different demographic characteristics on relating to awareness levels and purchase decision

Independent sample *t*-tests and *F*-tests based on analysis of variance have been conducted to tests the hypotheses stated in Section 3. The tests have been performed to examine if there exists a significant impact of (i) gender on the perception regarding the technology exist for manufacturing an affordable electric car, (ii) gender on the agreeability on longer waiting time for an electric car to be completely charged, (iii) income on the purchase decision of an electric car, and (iv) educational qualification on the knowledge of prevention to global warming. The findings of the tests are presented together in Tables 1 and 2 below.

Table 1: **Independent sample *t*-tests on gender-wise awareness score and agreeability scores.**

Variable concerned	Variances of two groups	Observed value of *t*-statistic	df	Sig.
Awareness scores (about existence of technology of making affordable electric cars)	equal	-0.247	78	0.806
	unequal	-0.240	64.262	0.811
Agreeability scores (to wait for longer time for an electric car to be charged completely)	equal	-0.482	78	0.631
	unequal	-0.490	77.837	0.625

Independent sample *t*-tests have been performed to test the research hypotheses H_1 and H_2. Both the hypotheses have been tested. In all cases *p*-values have been found to be very high (far more than 0.05, the level of significance), as seen in the last column of Table 1. According to these there is no impact of gender on awareness or agreeability to wait for longer time to recharge the car batteries in a megacity like Kolkata.

Table 2: *F*-tests based on ANOVA.

Groups	Variable concerned	Observed value of *F*-statistic	Sig.
Income groups	purchase willingness score	3.969	0.023
Educational qualifications	knowledge score (of prevention to global warming)	6.583	0.002

Analysis of variance has been conducted to aid in *F*-tests for testing research hypotheses H_3 and H_4. The results are shown in Table 2. In both the cases, *p*-values come out to be less than

0.05, indicating that there is an effect of (i) income group on purchase decision and (ii) educational level on knowledge of prevention of global warming.

Exploratory factor analysis

Study reveals that there are twelve essential parameters that are used for understanding the factors that influence the implementation of sustainable development in automobile industries. Every industry has their unique method of operation, though it may differ from industry to industry. In order to understand the consistency of the data collected, Cronbach alpha has been computed as a measure to assess the reliability, which ranges from 0 and 1.

Table 3. Reliability Statistics.

Cronbach alpha	Cronbach alpha based on standardized items	Number of items
0.746	0.744	12

Table 3 shows the value of Cronbach alpha as 0.746, which is a high value from which it can be inferred that there is a presence of internal consistency of the items in the scale, and also it does not mean that the scale is one-dimensional and also the scales used for measuring sustainability in supply chain management in automobile industry is reliable enough to understand and interpret.

The KMO measure of sampling adequacy has been used to indicate the proportion of variance in variables that might be caused by underlying factors, e.g., high values (close to 1.0) generally indicate that a factor analysis may be useful with the data.

Table 4. KMO and Bartlett's test result.

Kaiser-Meyer-Olkin measure of sampling adequacy	0.720
Pearsonian chi-square test-statistic (for Bartlett's test of sphericity)	375.400
Degrees of freedom (df)	66
p-value (for statistical significance)	.000

Table 4 shows that the *p*-value in Bartlett's test is less than 0.05, as a result of which it can be concluded that the statements are significant at level 0.05 (two-tailed test).

In this research, EFA has been used to explore the various dimensions of consumers' perception towards electric vehicles. Principle component analysis has been used with varimax rotation depending on the assumption that any extracted factor important to attributes of the electric vehicles should be inter-related. Eigen value of 1 has been used as cut-off value for extraction. Four-factor structure with the extracted factors explaining 70.8%

of the total variance has been identified. The KMO measure yields a value of 0.72, indicating that the data were suitable for factor analysis.

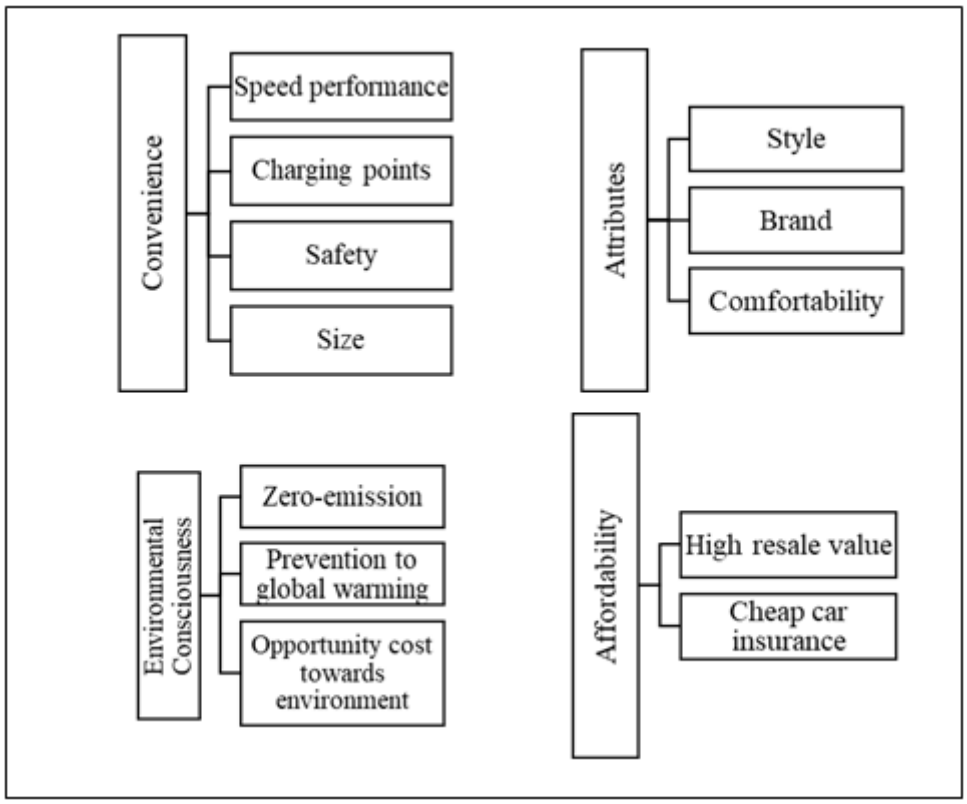

Figure 1. Factors influencing purchase decision of consumers towards electric vehicles.

Figure 1 displays the four factors extracted from the twelve through EFA. For all of these four factors, the eigen values are more than 1. The grouping is based on the rotated component matrix. These four factors can be named as convenience, attributes, environmental consciousness and affordability. All of these factors are associated with sustainability and ecological aspects of the organization which can be achieved with effective and systemized implementation of eco-friendly practices within the organization.

Multiple regression model

Next a multiple regression equation is developed with all four factors to measure the level of willingness of the respondents. This multiple regression model also shows how these four independent variables, viz., convenience (x_1), attributes (x_2), environmental consciousness (x_3) and affordability (x_4), are impacting the dependent variable, Y, the level of willingness of purchasing an electric vehicle.

$Y = 0.965 + 0.058x_1 + 0.020x_2 + 0.472x_3 + 0.254x_4$.

From the model it is clear that the influence of convenience is not significant, while the other three have significant effect on willingness to buy. This means more the convenience less customers will be inclined to purchase it. On the other hand, for the other three variables, price may work as a lurking variable, i.e., if the environment-friendly technology and other attributes cause price hike, very high proportion of the customers will be interested to purchase it, considering the Indian market. In the regression analysis, the R^2 that have been found out is 0.652 which is the co-efficient of determination, which is high, and R value is 0.808, which is co-efficient of correlation, which is also significantly high.

Table 5. Collinearity Statistics.

Model	VIF
Convenience	1.014
Attributes	1.011
Affordability	1.021
Environmental Consciousness	1.002

Table 5 of multicollinearity analysis shows that the variance inflation factors (VIF) for the independent variables are approximately 1, which implies the data set is less likely to be multicollinear with the dependent variable which is the level of willingness of the respondents.

6. CONCLUSION AND DISCUSSION

Over the last few years, the province of sustainable development in a corporation had been changed exorbitantly, there had been a conglomeration and inclusions of several multidimensional aspects, which had given the understanding of optimum utilization of sustainability aspects in an organization towards a new direction. From this work, it can be concluded that irrespective of gender, people are more or less aware of the growing concern of global warming and the importance of sustainability and also there had been certain factors that are considered for implementing sustainability aspects in the organization. It also has been found that the purchase decision varies with certain demographic factors. They have also understood the need of being socially aware and their contribution to the society. As sustainable development is now being treated as one of the cataclysmic social responsibilities of the organizations which are now adopting and implementing the viable and sustainable practices in almost all the areas of a company, not only to survive in the competitive age but also to stimulate the growing concern of environmental aspects in the society. Though the study has been done with a section of the respondents in the mega city of Kolkata, there is a

scope of doing similar study for various geo-demographic regions. Moreover, the industry perception is being explored in details, which will appear in a forthcoming research paper.

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