Unearthing the Factors Behind Adoption of Electric Cars : An Indian Perspective

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Abstract

Purpose : Electric cars have the potential to disrupt the existing automobile industry. Therefore, this study examined the factors influencing electric car adoption behavior among Indian car users.

Methodology : Both exploratory and descriptive approaches were used to accomplish the stated objectives. The study was conducted in two phases. In phase one, a sample including 200 prospective electric car buyers was approached to understand the critical factors leading to adoption. In phase two, conjoint analysis was used to decipher the utilities drawn by 300 consumers from nine combinations of price, recharge time, and driving range as attributes selected after reviewing literature and an unstructured interaction with potential electric car buyers.

Findings : The study indicated the three preferred combinations Indian consumers value the most when selecting an electric car.

Practical Implications : Results could offer crucial information to decision-makers and producers of electric vehicles so they could introduce this cutting-edge technology into the Indian economy. The findings of this study, particularly the conjoint analysis, could be used by manufacturers to determine the relative relevance of features that increase utility.

Originality : While the existing research was asymmetric and skewed toward understanding electric car adoption behavior in developed markets' contexts, this study could decipher consumer behavior in relatively less discussed developing markets like India.

Keywords : electric vehicles, environmental concerns, government aid, infrastructure, perception of economic benefit, performance, utility, driving range, recharge time, price, conjoint analysis, SDG 13

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With the increasing emphasis on global warming leading to climate change, it has become a global concern to reduce and eventually eliminate environmental hazards and achieve SDG 13 (climate action) (Curtale et al., 2021). In addition to numerous initiatives to address this problem, regulators have introduced and implemented policies to promote the production and adoption of electric vehicles (EVs) (Kore & Koul, 2022; Hu et al., 2021). Rising fuel prices and environmental degradation have concerned governments, automakers, and a substantial segment of consumers worldwide. The topic of alternative fuel-powered vehicles has been gaining traction recently, but the fact that they are still considered niche products necessitates further investigation. Therefore, it is crucial to pinpoint the elements and traits that can persuade a typical Indian buyer to consider a car using alternative fuel. Since numerous vehicles run on various fuels, the current study focuses solely on EVs (especially electric cars) powered exclusively by batteries.

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Growth in the Indian Automobile Industry : A Boon or a Bane?

The Indian auto industry is a critical economic driver. India is the fourth-largest automaker in the world due to its rapid growth (India Brand Equity Foundation, 2022). Rising middle-class income and a large youth population will boost auto demand in India. In January 2022, 1,860,809 passenger vehicles, three-wheelers, two-wheelers, and quadricycles were manufactured ("FY22 car sales up 13%," 2022).

With India's booming economy, more personal vehicles are spewing pollutants into the air, making it one of the world's most polluted countries (Nair, 2021). India has 13 of the world's 20 most polluted cities. India has the world's highest PM10 and PM2.5 levels (particles with diameters of 10 μm and 2.5 μm). Delhi's air with PM2.5 levels is six times higher than the WHO's "safe" limit of 25 μg. Unrestrained and unprecedented growth in traffic congestion is to blame for this terrible situation ("10 Indian cities with most," 2022). India has 1.3 billion people who are affected by air pollution. India's air pollution is responsible for 1.2 million deaths annually. According to medical experts in New Delhi, breathing is equivalent to smoking 10 cigarettes daily ("10 Indian cities with most," 2022). The rising number of cars in the country has increased air pollution and fuel import costs. In August 2017, the country's gross petroleum imports rose 12% to \$7.4 billion. In the first five months of 2017–2018, the gross petroleum import bill rose 16.55% to \$35.9 billion. Due to this, the nation's first-quarter current account deficit increased to \$14.3 billion, or 2.4% of the GDP (Phadke & Deorah, 2022).

India plans to cut pollution, fuel imports, and vehicle prices by having an entirely electric automobile fleet by 2030. A policy promoting e-production and adoption is being developed by the Ministry of Heavy Industries and NITI Aayog. Oil imports will cost \$60 billion less as a result. Over the following 13 years, this will limit infrastructure growth and reduce emissions by 37%. Developed countries have seen a slight increase in EVs due to affluent customers (Bhat & Verma, 2023), better infrastructure, and friendly government policies (Goel et al., 2023). Even in developed economies, EVs remain a niche (Bhat & Verma, 2023). In developing countries like India, EVs are new. The literature review shows that this field is primarily studied in developed economies while ignoring consumer perceptions of expected EV utilities. EV manufacturers and policymakers must be informed of Indian consumers' preferences and desired utility from EVs to improve India's electric vehicle ecosystem (Phadke & Deorah, 2022). This under-researched area requires a study to understand the factors influencing consumer preference and acceptance of EVs (Premi et al., 2021; Upadhyay & Kamble, 2023). Over the projection period (2022–2029), the market for EVs in India is expected to increase from \$3.21 billion in 2022 to \$113.99 billion in 2029, a CAGR of 66.52% (Fortune Business Insights, 2022). Now, more than ever, is the time to understand Indian consumers' perception of utilities from different combinations of EV features, a gap this research tries to bridge.

Review of Literature

The literature review discusses the factors that might affect consumers' electric car adoption behavior. The first part of the review is dedicated to understanding the factors influencing consumer acceptance of EVs (Curtale et al., 2021). The second part of the review focuses on the "product attributes," considered vital by consumers when purchasing an EV.

Factors Facilitating Adoption of Electric Cars

Environmental Concerns

Environmentalism and the need for energy security have driven global electric vehicle adoption (Hu et al., 2021). Studies suggested that eco-conscious consumers prefered hybrid or electric cars to oil-and-gas cars (Khandelwal et al., 2016). Studies in developed economies also indicated that consumers weigh electric cars' environmental benefits more than social and economic ones (Curtale et al., 2021; Ghose & Chandra, 2018; Laheri, 2020; Veena & D'Souza, 2017). Since EVs cause less environmental degradation and are eco-friendlier, pro-environmental consumer self-identity positively affects the perception and acceptance of EVs, which is a primary reason for their adoption (Nayum & Thøgersen, 2022). On the contrary, long-term environmental assessment of EVs was advised in many studies as they might increase energy and resource demand. Moreover, mining lithium, the key element of electric vehicle batteries, and discharging and recycling batteries might harm the environment, making it controversial (Xia & Li, 2022).

Government Support and Infrastructural Support

Regulators must create a framework for innovations to diffuse (Taalbi & Nielsen, 2021). According to the studies, government-supported tax incentives, subsidies, etc., influence consumers' alternative fuel vehicle purchases (Kumar et al., 2021). The government must mobilize research institutes, renewable energy suppliers, financial institutions, electric vehicle manufacturers, power companies, policymakers, and consumers to expand the electric vehicle market (Kore & Koul, 2022).

The government might provide EVs with a zero-down payment option so that people can pay the installments with savings on petroleum products. As per India's goods and services tax (GST), EVs are taxed at 12% (compared to 28%). India was considering zero import duties on EVs and lower electricity costs. State and local governments crafted electric car subsidies. Some states waived road tax and registration fees on electric cars to encourage adoption (Kore & Koul, 2022). Since India's charging infrastructure is not excellent, researchers also believe that the cities should have more charging stations (Zhou et al., 2022). Automakers will only invest in producing EVs with a sound charging system.

Developing an electricity infrastructure in India, where many areas still need more power and have frequent power cuts, can take time and effort. Unlike conventional vehicles, which must be refueled at gas stations, EVs may need home charging (LaMonaca & Ryan, 2022). As per research, electric car owners preferred home charging after a trial period due to its convenience. Regular use of EVs was found to be almost impossible due to a lack of charging facilities at home or work, which could be a concern for economies still struggling with a robust electricity infrastructure (Gönül et al., 2021).

Perceived Economic Factors

Since EVs cost consumers a premium (due to the high battery price, up to 50% of the purchase price of an EV), price is a significant consideration when buying an electric car. EVs' price and maintenance costs could influence the perceived economic benefits of adopting them. In many studies, the price affected EV utility negatively (Liang et al., 2022). When EVs were more expensive than traditional vehicles, price preferences varied (Zhang et al., 2022). High-income people were less price-sensitive, though some studies found this effect insignificant. However, price affected practical EV buyers less than design-focused buyers (Oryani et al., 2022). In almost every study, the operational cost was a critical factor in EV adoption (Archsmith et al., 2022). Some studies focused on maintenance costs alone or with energy costs as an operational cost attribute. These factors negatively affected the decision to buy a car, which gave EVs an advantage over traditional vehicles running on oil and gas since EVs had lower energy costs (Wicki et al., 2023). A study found that most respondents were unwilling to pay more for an EV. The cost of EVs also hinders sales (Ziegler & Abdelkafi, 2022). To make EVs cost-competitive, the industry or governments should subsidize a portion of the battery price, especially in developing economies (Haridev Singh & Phuntsho, 2014). A total of 36% of Austrian respondents overall rated price as extremely essential when making a purchase. In comparison, according to 35% of the respondents, EV adoption in Austria might increase if priced similarly to conventional cars, as the expense of battery lease (as opposed to one-time purchases) made it difficult for consumers to make judgments (Armenio et al., 2022).

Performance

Important Product Attributes While Adopting EVs

The small driving range compared to conventional vehicles is a barrier to EV adoption. In most studies, driving range positively impacted EV adoption. This effect was sometimes insignificant. According to a meta-analysis, consumer preference for the driving range may depend on charging station density and time (Wicki et al., 2023). The preference of consumers is for fast cars. The performance of EVs is determined by engine power, acceleration time, and top speed. Population dynamics meant that the acceleration time was insignificant. Compared to females, males favored more significant acceleration; also, shorter acceleration times were preferred by singles (Liang et al., 2022).

Battery Replacement Cost

Replacing an electric car's battery can cost as much as replacing the engine. Battery replacement costs may dominate vehicle operating costs (Green Car Congress, 2009). In 2010, the Technical University of Denmark paid $10,000 without rebates for a 25 kWh certified EV battery (or $400 per kWh). It was estimated that it would take 10–15 years for EV batteries to drop to 1/3 of their 2010 cost, making them affordable to a large consumer class (Zhang et al., 2022).

Cost-of-ownership calculations must include battery service life. Depth of discharge affects battery life (a recommended proportion of the total available energy storage for which the battery will achieve its rated cycles). Due to less regular maintenance, EVs may have lower battery replacement costs than traditional vehicles (Fayziyev et al., 2022). Higher-efficiency batteries could improve EV performance when they are due. EV batteries are expensive despite all the claims in their favor. EVs may become mainstream soon due to cheaper batteries. In the last five years, this research has dramatically lowered prices (Liang et al., 2022).

Driving Range

EV range anxiety is a common consumer concern. Range depends on battery quality and the number of batteries (Gao et al., 2022). Many factors affect driving range, such as weight and type of vehicle, terrain, weather, and driver performance, which may affect electric car adoption. Driving range parity is a buzzword when discussing electric car adoption challenges. This question asks if EVs have a range similar to an internal combustion engine (500 km/310 mi with 1+ kWh/kg batteries). A more extended driving range means fewer recharges. To be accepted and adopted, EVs must have a more extended range than gas-powered cars (Liang et al., 2022).

Recharge Time

Since discharged EV batteries must be recharged, recharge time is a key EV product attribute. Electric cars use power grids (at home or LIC charging stations). These power grids use coal, hydroelectricity, etc., to generate energy. Grid capacity limits charging time. Therefore, India's poor charging infrastructure and uncertain power supply may slow EV adoption.

In 1995, EV charging took almost an hour. AeroVironment's “PosiCharge” fast-charge system charged EVs in 6–15 minutes in 1997 (having lead-acid batteries). GM's “Magne Charge” recharged in 10 minutes. In 1998, this system had a 60–100 mile range. According to research, some respondents didn't prefer less recharge time because they had six to eight hours at work or overnight. Some workplaces have electric car charging stations (Asensio et al., 2021).

Objectives of the Study

The study aims at:

(1) Exploring the factors influencing the adoption of electric cars among Indian consumers.

(2) Identifying and investigating differential utility respondents might draw from a combination of select product attributes that can help EV manufacturers better address consumer preferences as the final offering.

Research Methodology

This study deploys exploratory as well as descriptive research design. A literature review was conducted to identify factors affecting consumer preferences for EVs. Factors were used to create a questionnaire (Chandel & Vij, 2019) that was administered to 250 car owners. A judgmental sampling was used for selecting the study's respondents, who agreed to express their opinion toward electric cars. A total of 15 incomplete questionnaires were found among the 217 returned for the study. Data cleaning resulted in 200 questionnaires for analysis. Exploratory factor analysis (EFA) was used to examine this measure's constructs and structure. Confirmatory factor analysis confirmed factor structure.

To achieve objective 2, product (EV) attributes affecting consumers' preferences and acceptance are studied (price, recharge time, driving range, etc.). This study considered EV adoption as a choice consumers had to make among a group of vehicle alternatives described by their "attributes." It was assumed that consumers would make purchase decisions by making a trade-off between various electric car attributes. Adopting an EV was considered as choosing a vehicle from the given set of attributes. Despite the possibility of multiple decision rules, consumers were assumed to maximize their utility. Conjoint analysis was used to find the most utilitarian electric car attribute combinations. The study was conducted in March – May 2022.

Questionnaire Design for Conjoint Analysis

For the development of the questionnaire, a total of 15 respondents (five respondents from each price range mentioned in Table 3) were interviewed in an unstructured manner and were asked to answer the undermentioned questions:

- How aware are you of electric cars? Rate your knowledge of EVs on a scale of 1–5, where 1 means *very low* and 5 means *very high*.
- India is trying to have a fleet of all-electric cars by 2030. As a potential car buyer, which factors would you consider while purchasing an EV? (open-ended question).

Respondents were stimulated to answer these questions as in an actual purchase situation. Attributes considered by respondents while purchasing an electric car are mentioned in Table 1. Recharge time and driving range are the three attributes with the highest repetition frequency among other attributes mentioned by the respondents. Therefore, price, recharge time, and driving range were selected to develop a questionnaire for conjoint analysis. These attributes are used to prepare different profiles of different levels (Table 2) of price,

Table 1. *Attributes Considered During Purchasing Electric Cars*

Attribute	Frequency of Repetition
Price*	12
Recharge time*	11
Design	2
Battery replacement cost	5
Driving range*	10
Brand	5

Table 2. *Different Levels of Attributes*

Price (in Hundreds of Thousands)	Recharge Time	Driving Range
1 – 11.99	Above 6 hours	Under 150 km
12 – 24.99	2 – 6 hours	150 – 250 km
25 lakhs and above	0 – 2 hours	Above 250 km

driving range, and recharge time for conjoint analysis. The levels of each attribute are based on a comprehensive review of literature consisting of research articles, industry reports, and newspaper articles.

The total number of combinations to conduct conjoint analysis is:

3 (Price) × 3 (Recharge time) × 3 (Driving range) = 27

A list of orthogonal attribute combinations was created. This was done because entering more than 25 or 30 responses was tedious and could lead to imprecise or uninvolved answers, affecting the procedure's validity (Nargundkar, 2008). The orthogonal design produced nine questionnaire combinations.

Three hundred respondents were chosen from three private universities and two shopping malls between April 15 and May 10, 2022. Given the nine-combination/profile questionnaire (generated by the software), respondents were contacted in parking lots. Respondents were selected based on the tentative price range of their own car, matching the three price levels selected as necessary in the Indian market. The details are mentioned in Table 3.

Table 3. *Distribution of Sample Respondents from Different Price Strata*

Price (in Hundreds of Thousands)	Area	Number of Respondents
1 – 11.99	University Campuses	50
	Curo High Street	25
	MBA Neopolis	25
12 – 24.99	University Campuses	30
	Curo High Street	30
	MBA Neopolis	40
25 lakhs and above	University Campuses	10
	Curo High Street	50
	MBA Neopolis	40

Analysis and Results

➯ **Objective 1 :** Exploring the factors influencing consumer perceptions and preferences toward electric car adoption.

Internal consistency was analyzed using reliability statistics. All items were submitted to an EFA with promax rotation and the maximum likelihood extraction approach, which condensed a huge collection of items into small factors to study consumer preferences and acceptance of electric cars. KMO (Kaiser–Meyer–Olkin) value of 0.911 verified the sample adequacy and that reducing variables to fewer factors was appropriate. Bartlett's test of sphericity was 0.000, indicating that data set correlations were relevant for EFA. Maximum likelihood factor analysis with a cut-off point of 0.40 and Kaiser's criteria of eigenvalues more significant than 1 yielded a four-factor solution accounting for 75.275% of the variance.

Environmental factors influencing consumer preference and acceptance of electric cars had a high factor loading. A new survey found that 87% of Indians would buy an electric car if it reduced air pollution (Patil & Majumdar, 2022). Increasing awareness of air pollution among Indians and massive investments by automakers have boosted the Indian electric vehicle market. Statements with high factor loadings on factor two corresponded to government aid and infrastructure-related factors. The Indian government is developing a cost-effective private and public charging station network. The Indian government is also working to create a comprehensive EV ecosystem. Statements with high factor loadings on factors three and four corresponded to the perception of economic benefits and electric car performance, respectively. The results of the factor analysis are shown in Table 4.

Table 4. ***Rotated Component Matrix***

	Components			
	1	2	3	4
I will shift to electric cars because they can help solve the pollution problem in India.	0.867			
I will switch to driving EVs because they use clean fuel.	0.864			
I believe the use of electric cars is a long-term step toward a sustainable future.	0.861			
I believe that using electric cars will help reduce the risk of respiratory diseases caused by harmful emissions by cars running on oil and gas.	0.858			
I believe electric cars will help reduce ozone layer depletion.	0.826			
If the Indian government supports promoting convenient buying choices (easy loans, lower interest rates, etc.), I will switch to EVs.		0.860		
I will shift to electric cars if the Indian government develops friendly policies.		0.855		
If the Indian government offers subsidies for using charging stations, I will switch to electric cars.		0.847		
I will shift to electric cars if the Government of India ensures enough availability of service stations.		0.821		
I will shift to electric cars if the Government of India works toward building infrastructure (roads, enough charging stations) facilitating the use of electric cars.		0.802		
Electric vehicles will aid in reducing the price of electricity.			0.829	
I will shift to electric cars if they are priced appropriately.			0.818	
I will shift to electric cars if the maintenance cost of such cars is low as compared to existing vehicles.			0.792	
If electric vehicles offer comparably less expensive private transportation, I will switch to them.			0.772	
I will shift to electric cars if the sales tax on the initial electric vehicle purchase can be waived.			0.765	

I will shift to electric cars if the speed is not compromised.				0.870
I will shift to electric cars if recharging such cars costs little time.				0.855
If electric automobiles have an efficiency greater than or at least equal to current vehicles, I will switch to them.				0.848
If the battery backup is performance-oriented, I will switch to electric vehicles.				0.837
I will shift to electric cars if the chances of engine breakdown are lowered.				0.816
Cronbach's alpha	0.918	0.909	0.901	0.936
Eigenvalues (percentage of variance)				75.275
KMO				0.911
Bartlett's test of sphericity				
Approx. χ^2				4317.741
Df				190
Significance				0.000

Note. [a.] Rotation converged in five iterations.

Assessing Reliability and Validity

Once the results of EFA reflect the four dimensions of building consumer preference and acceptance toward electric car adoption, confirmatory factor analysis (CFA) was deemed necessary to ascertain the validity of the measurement model/scale proposed. Campbell and Fiske (1959) proposed two aspects to assess construct validity; convergent validity and discriminant validity. In a CFA, convergent validity examines the extent to which measures of a latent variable share their variance. At the same time, discriminant validity examines how they are different from other constructs.

Convergent Validity

According to Table 5, values of composite reliability (CR) and average variance explained are found by the acceptable limits leading toward convergent validity.

Discriminant Validity

The factor correlation matrix in Table 6 summarizes the results of the discriminant validity of the constructs. Table 6 shows that each of these numbers is more than the correlation coefficients for the constructs. Consequently, the detected factors (items) fit the adoption pattern of electric cars.

Table 5. ***Composite Reliabilities (CR) and AVE Results***

Dimension	**CR**	**AVE**
Environmental Factors	0.909	0.666
Government Aid and Infrastructure	0.937	0.747
Perception of Economic Benefit	0.919	0.694
Performance	0.901	0.647

Table 6. ***Discriminant Validity of the Constructs (Square Root of the AVE and Correlations)***

Dimension	Environmental Factors	Government Aid and Infrastructure	Perception of Economic Benefit	Performance
Environmental Factors	**0.816**			
Government Aid and Infrastructure	–0.565	**0.864**		
Perception of Economic Benefit	0.53	–0.333	**0.833**	
Performance	0.052	0.058	0.078	**0.804**

Note. (a) The bold fonts in the leading diagonals are the square root of AVEs ; (b) off-diagonal elements are the correlations among the constructs.

Evaluating the Fitness of the Measurement Model

Several fitness indices used in CFA measure how well the model fits the data. Table 7 details the model fit category, their level of approval, and remarks. As mentioned in Table 7, the results are congruent with the prescribed model fit indices validating the CFA.

➯ **Objective 2 :** Identifying and investigating differential utility respondents might draw from a combination of select product attributes that can help EV manufacturers better address consumer preferences as the final offering.

The conjoint analysis creates customer-focused products. The conjoint analysis answers questions about what attributes consumers value more than others. Conjoint analysis asks respondents to trade features to maximize

Table 7. ***Fitness Indices***

Model Fit	Name of Index	Level of Acceptance	Observed Values
Absolute Fit	RMSEA	RMSEA,0.08	0.025
	GFI	GFI > 0.90	0.939
Incremental Fit	CFI	CFI > 0.90	0.992
Parsimonious Fit	χ^2/df	$\chi^2/df < 3.0$	1.194

Table 8. ***Electric Car Attributes' Profile***

Combination No	Price	Recharge Time	Driving Range	Rank
1	25 lakhs and above	0 – 2 hours	Below 150 km	–
2	1 – 11.99 lakhs	2 – 6 hours	Above 250 km	–
3	25 lakhs and above	Above 6 hours	Above 250 km	–
4	1 – 11.99 lakhs	0 – 2 hours	150–250 km	–
5	12 – 24.99 lakhs	0 – 2 hours	Above 250 km	–
6	25 lakhs and above	2 – 6 hours	150–250 km	–
7	12 – 24.99 lakhs	2 – 6 hours	Below 150 km	–
8	12 – 24.99 lakhs	Above 6 hours	150–250 km	–
9	1 – 11.99 lakhs	Above 6 hours	Below 150 km	–

utility. The full-profile approach was used, where respondents ranked various profiles according to their preferences. Individual profiles define a complete product by combining levels for all relevant factors (attributes).

↳ **Formulation of the Problem:** The attributes were chosen based on the literature review and client interactions. For the investigation, a subset of nine combinations was selected (Table 8).

↳ **Construct the Stimuli :** The fractional factorial designs were used to decrease the number of profiles from 27 to nine, which respondents had to rank as per their preference.

↳ **Decision on the Form of Input Data :** A metric form of rating was used to collect responses on a scale of one to nine (one as least preferred to nine as highly preferred).

The following formula represents the basic conjoint analysis model:

$$U(X) = \sum_{i=1}^{m} \sum_{j=1}^{Ki} \alpha_{ij} X_{ij}$$

where,

$U(X)$ = overall utility of an alternative.

α_{ij} = the part-worth contribution or utility associated with the jth level ($j, j = 1, 2, \ldots ki$) of an ith attribute ($i, i = 1, 2 \ldots m$).

X_{ij} = 1 if the j th level of an ith attribute is present.

= 0 otherwise.

ki = number of levels of attribute i.

m = number of attributes.

The importance of an attribute, I_i, is defined in terms of the range of the part-worth across the levels of that attribute:

The attribute's importance is normalized to ascertain its importance relative to other attributes.

$$W_i = I_i / \sum_{i=1}^{m} I_i$$

Source : Nargundkar (2008)

Table 9. ***Utilities***

Utilities			
		Utility Estimate	**Std. Error**
Price	1 – 11.99 hundred thousand	–0.162	0.105
	12 – 24.99 hundred thousand	0.295	0.105
	25 hundred thousand and above	–0.134	0.074
Recharge Time	Above 6 hours	–0.141	0.105
	2 – 6 hours	0.008	0.105
	0 – 2 hours	0.134	0.105
Driving Range	Below 150 km	–0.158	0.105
	150 – 250 km	0.029	0.105
	Above 250 km	0.129	0.105
	(Constant)	5	0.074

Table 10. ***Top Three Utility Combinations***

Utility Order	Price (in lakhs)	Recharge Time (in Hours)	Driving Range (in kms)
1	12 – 24.99	0 – 2	Above 250
2	25 lakhs and above	2 – 6	150 – 250
3	1 – 11.99	Above 6	Below 150

Table 11. ***Most Crucial Attribute***

Importance Values	
Price	44.857
Recharge Time	27.014
Driving Range	28.129
Averaged Importance Score	

Table 12. ***Correlation Table***

Correlations		
	Value	**Sig.**
Pearson's *R*	0.930	0.000
Kendall's tau	0.778	0.002

Note. [a.] Correlations between observed and estimated preferences.

The utility coefficients for each level of the property are shown in Table 9. The utility increases with the utility coefficient. The price range of 12–24,999 lakhs (utility coefficient: 295), followed by a price range of 25,999 lakhs and above (utility coefficient: –.134), and 1–11,999 lakhs (Utility coefficient: –.162), are shown to have the most utility for the respondents.

In the case of recharge time, respondents are found to derive maximum utility in the recharge time of 0–2 hours (utility coefficient: .134) followed by recharge time of 2–6 hours (utility coefficient: .008), and above 6 hours (utility coefficient: - .141).

In the case of driving range, respondents are found to derive maximum utility in the driving range of above 250 km (utility coefficient: .129) followed by a driving range of 150–250 km (utility coefficient: .029) and below 150 km (utility coefficient: - .158).

Hence, it could be concluded that respondents assign maximum utility to these three combinations (Table 10).

Table 11 shows the attributes that the respondents found to be the most useful. Driving range (28.129) and recharge time (27.014) are shown to be two of the three most crucial characteristics, with price (44.857) being the most crucial.

Table 12 shows whether the correlation between observed and estimated preferences is significant. As can be inferred from the analytics, the correlation between observed and estimated preferences is significant, indicating the appropriateness of the conjoint model for studying consumer preference toward EVs.

Conclusion and Managerial Implications

EVs have captured the attention of the global automobile industry. With the Government of India pushing for complete electrification as early as 2030, much is happening in the Indian electric car segment. Almost 40% of Indian car users want to pay less for an EV. Another 30% are willing to pay in parity for a conventional car. Only 15% of Indian car users are willing to pay more. An electric version of a car is priced at least 25% more than that of a similar petrol or diesel version. Relatively low awareness about EVs in India and the possible effects of unawareness may also be an obstacle that marketers must address (Chhikara et al., 2021). The findings of this research have multifaceted implications for a market as diverse as India. These findings will help automakers understand the factors behind electric vehicle adoption and offer electric cars as per customers' preferences. However, they will also help policymakers devise policies to ease the electric vehicle adoption process.

Since Indian consumers have shown a pro-environmental attitude toward electric car adoption, developing joint marketing campaigns highlighting the environmentally friendly aspects of electric cars by government agencies and automakers will be of use to help ease the electric car adoption process by creating needed awareness among the masses still stuck between the choices of electric and traditional vehicles. Since the perceived economic benefit is another factor in customers' decisions to buy electric cars, the stakeholders (government and automakers) must strategize their actions accordingly. Indian consumers were found to be skeptical regarding the price of EVs as per a myriad of surveys. Hence, the role of the government in subsidizing electric car adoption and the role of automakers in educating customers about EVs partially offset the cost of acquisition due to the relatively lesser need for regular maintenance over traditional vehicles must be strategized. Since performance is yet another factor playing an essential role in the adoption of electric cars; with the current status of government officials refusing to use electric cars made by home-grown carmakers – Mahindra and Mahindra and Tata Motors – due to poor performance and low mileage, automakers need to benchmark performance standards with global giants. Product development collaborations with global brands can also be an appropriate strategy.

The conjoint analysis results could be of particular use to product managers and product development teams in getting consumer insights about preferred electric vehicle choices. As per the study, the most preferred combination is electric cars with a price tag of ₹ 12–24.99 lakhs, a recharge time of 0–2 hours, and a driving range above 250 km on a single charge. Electric cars with a price tag of ₹ 25 lakhs and above, a 2–6 hours recharge, and a driving range of 150–250 km in a single charge are the second most preferred choice. The third preferred choice is an electric car with a price tag of ₹ 1–11.99 lakhs, a recharge time of above 6 hours, and the capability of traveling below 150 km distance in a single charge.

Limitations of the Study and Scope for Further Research

The study was conducted in the Punjab region of India only. The study might not be representative of India. Future studies must be conducted using a diverse set of populations from various states of India. Only three product attributes were used to study consumer utility: price, recharge time, and driving range. More attributes could be taken to create rich attribute profiles for electric cars and hence provide electric carmakers with a rich insight into the combination of critical attributes having maximum utility to Indian consumers. The study was cross-sectional in design. However, given this area's novelty and growing candor, electric car adoption behavior may undergo many robust changes. A longitudinal design may be advantageous to gauge consumers' preferences toward electric cars.

Author's Contribution

The study proposal was developed by Ajay Chandel, who was inspired by India's upbeat view of electrifying its entire car fleet by 2030. He also developed qualitative and quantitative designs to undertake this study. The author then verified the analytical methods. The manuscript was written and proofread by Ajay Chandel.

Conflict of Interest

The author certifies that he has no affiliations with or involvement in any organization or entity with any financial or non-financial interest in the subject matter or materials discussed in this manuscript.

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