

Key Factors to Analyze the Customer Adoption of Electric Two-Wheelers in India

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Abstract

Global warming has emerged as a pressing issue on a global scale. Nations are actively exploring various strategies to promote environmental sustainability. Given the accelerating depletion of fossil fuels and the consequent surge in prices, there is a pressing necessity to identify alternative energy sources to power transportation systems. Electric Vehicles stand out as prominent energy consumers, necessitating India to either curtail its energy demands or seek out alternative energy reservoirs. The aspiration for a pollution-free world is universal among individuals. Nonetheless, there continues to be a steady rise in the number of vehicle registrations. This escalating usage of automobiles poses a detrimental threat to the environment. Consequently, the imperative lies in transforming our transportation modalities to ones that are both eco-conscious and enduring. The advent of Electric vehicles emerges as a viable solution to this quandary. By diminishing a nation's reliance on gasoline, Electric vehicles offer a promising avenue towards environmental conservation. Despite constituting a mere fraction of the total vehicles vended in India, Electric vehicles are poised for an upsurge in adoption rates in the forthcoming years. Numerous automotive manufacturers have commenced the production of Electric vehicles, with projections indicating the sale of approximately 9 million units in India by the fiscal year 2026-27. This research endeavor seeks to discern the pivotal factors influencing the Customer Adoption of electric two-wheelers in India. Primary data was meticulously gathered through a structured questionnaire administered to 300 respondents, and subsequently subjected to rigorous analysis utilizing data analysis software.

Keywords: EV Adoption, Sustainability, Customer Perception, Environment Friendly, Carbon Credits.

Introduction

The burgeoning demand for electric vehicles (EVs), representing a small fraction of the overall new vehicle market globally, has exhibited a remarkable surge in recent years. Despite being in its nascent stages in India, electric vehicles (EVs) are revolutionizing the realm of road transportation according to Bjerkan et al. (2016). The worldwide sales of electric cars hit the 10 million mark in 2020, constituting merely 1% of total sales. The year 2020 witnessed a staggering 25 million electric two-wheelers (E2W) being sold, largely attributed to the escalating demand in Asian countries as noted by Carley et al. (2013). Due to the expanding economies of countries like India, China, and Japan, Asia stands as the primary market for electric two-wheelers. The dominance of two-wheelers in India's automotive sector is evident as they account for over 80% of car sales, delineating the landscape of the country's automobile industry as highlighted by Chéron & Zins (1997).

In an endeavor to combat air pollution, the Indian government has set forth a target stipulating that 30% of all vehicles sold in India by 2030 must be electric as underscored by Coffman (2017). The years 2020-2021 saw a total of 15,119,387 two-wheelers being sold in India, with a mere 143,837 of them being electric two-wheelers, representing less than 1% of all two-wheeler sales in 2021. Despite numerous governmental initiatives, the uptake of electric two-wheelers (E2W) in India remains relatively low according to Jaiswal et al. (2021).

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The adoption of electric two-wheelers in India is facing a decline primarily due to factors such as exorbitant initial costs, range anxiety, inadequate charging infrastructure, and costly battery replacements. With twenty-two of the thirty most polluted cities globally, India emerges as the third most polluted nation, elucidating the severe air pollution crisis as noted by Eccarius & Lu (2020). As the primary emitter of carbon dioxide globally, India's transportation sector plays a significant role in exacerbating air pollution levels. Based on MOSPI data, the transportation industry contributes to nearly 7.5% of India's total carbon dioxide emissions according to Egbue & Long (2012).

Given that electric vehicles (EVs) produce half the amount of greenhouse gases compared to traditional gasoline or diesel vehicles, the transition to electric mobility has become imperative to curtail greenhouse gas (GHG) emissions. Embracing EVs stands as the most effective approach to combat the hazardous levels of air pollution prevalent in India's congested urban centers as suggested by Almansour (2022). Electric vehicles encompass various categories including battery EVs, hybrid EVs, plug-in hybrid EVs, extended-range EVs, and fuel cell EVs. Electric two-wheelers predominantly utilize electric motors powered by batteries, encompassing bicycles, mopeds, scooters, and motorcycles within this category. Electric bicycles, commonly known as e-bikes, are characterized by a maximum speed of less than 20 mph according to Feng et al. (2018). Electric motorcycles and scooters are extensively utilized in India, with these vehicles typically employing lithium-ion or lead-acid batteries as highlighted by Naveen et al. (2014). Leading the Indian market in 2021, Hero Electric and Okinawa E2W accounted for over 50% of all sales as documented by Hidrue et al. (2011). Owing to the convenience of utilizing portable batteries, electric two-wheelers are deemed more suitable for developing nations like India, allowing for charging at home or workplaces using standard wall sockets as indicated by Higgins et al. (2017).

Electric vehicles have gained increasing popularity as a viable environmentally friendly option compared to gasoline-powered cars due to their zero carbon emissions (Kar et al., 2021). In contrast, electric two-wheelers have been noted to possess superior environmental attributes, lower noise levels, and higher efficiency in comparison to their gasoline counterparts (Khurana et al., 2020). Despite these advantages, the utilization of electric motorcycles is still in its nascent stages, necessitating further investigation to determine consumer acceptance. Challenges faced by electric cars include expensive batteries, limited driving range due to insufficient charging infrastructure, and lengthy recharge times. While extensive research exists on the consumer acceptance of electric and hybrid vehicles, there is a noticeable dearth of studies on electric two-wheelers. Previous scholarly works primarily concentrated on electric vehicle adoption, with minimal attention given to electric two-wheelers (Konstantinou & Gkritza, 2023). Variations in electric vehicle acceptance have been observed across diverse geographical and economic settings. The primary objective of this research was to develop a model for understanding the adoption of electric two-wheelers (Lal, 2015). Through a comprehensive review of existing literature, this study identified factors influencing individuals' decisions to purchase electric two-wheelers. By employing this proposed framework, policymakers can formulate effective strategies to expedite the uptake of electric two-wheelers (Lane & Potter, 2007). Manufacturers of electric two-wheelers can leverage the recommendations outlined in the model. Government initiatives aimed at promoting electric vehicle adoption are expected to reduce pollution levels and decrease dependence on foreign oil sources (Li et al., 2017).

Literature Review

The utilization of electric vehicles (EVs) is presently an extensively researched area, with numerous studies dedicated to this subject. Research has shown that potential buyers of electric vehicles often consider factors such as price, driving range, and the longer charging time as disadvantages compared to traditional automobiles (Lin & Wu, 2018). Various prior studies have highlighted that factors like

Price, Charging Infrastructure, Environmental awareness, Social Reinforcement, and Perceived Economic Benefits play a significant role in influencing consumer adoption of EVs.

Price

The consideration of price is pivotal in the decision-making process when selecting an electric vehicle. Consumers are typically constrained by their budget when making purchasing choices. Lower-priced products allow consumers to save money and generally attract a larger customer base. Customers facing financial constraints may choose not to purchase an electric vehicle due to the high cost involved. The expensive nature of electric vehicles can be attributed to the cost of batteries and the lack of economies of scale. Manufacturers can achieve economies of scale if their production volume is substantial. Unlike traditional goods that enjoy consistent high demand leading to price reductions, the demand for electric vehicles remains relatively low and unstable (Liu et al., 2019). Additionally, the initial cost is a crucial factor to consider in the purchase of an electric vehicle (Falvo et al., 2014). Financial aspects hold utmost importance for customers contemplating the acquisition of an electric vehicle.

Charging Infrastructure

The presence of adequate charging infrastructure is vital for electric vehicle owners. The availability of charging stations instills confidence in customers considering the purchase of an electric vehicle (Prakash et al., 2014). Establishing personal charging infrastructure at home is unfeasible for most consumers, underscoring the necessity to enhance public charging infrastructure, especially in major urban centers like Delhi, Mumbai, Bangalore, and Hyderabad. These cities, characterized by high land costs and large populations, require robust charging infrastructure (Rezvani et al., 2015). The development of charging infrastructure demands substantial government investment, and governments can incentivize private sector involvement in charging infrastructure development (Tarei et al., 2021). Customers evaluate factors such as charging infrastructure availability, charge point compatibility, and station accessibility in their decision-making process regarding electric vehicle purchase. Publicly accessible charging stations located in convenient areas such as public spaces, residential areas, and workplaces are preferred by customers (Verma et al., 2020). The positive correlation between electric vehicle adoption and the availability of charging facilities underscores the critical importance of efficient charging infrastructure for the success of electric vehicles (Nilesh, 2020).

A person's environmental awareness of problems and concerns is often referred to as environmental concern (Wang et al., 2016). The level of environmental concern can also be observed in an individual's willingness to address environmental issues. In the present day, governments, consumers, and international organizations place a strong emphasis on environmental matters. Research indicates that customers' decisions to purchase electric vehicles are influenced by their environmental concerns (Xue et al., 2012). The increasing rate of environmental concerns has led consumers to show eagerness in adopting electric cars. Customers who prioritize environmental protection and seek to reduce gasoline costs are more likely to opt for electric vehicles. The preference for electric vehicles is often associated with customers who are environmentally conscious. Global customer surveys have highlighted that environmental considerations play a significant role in the decision-making process of purchasing electric vehicles. The utilization of electric vehicles is expected to address various environmental issues and result in substantial energy savings. Electric vehicles are considered environmentally safe and contribute to reducing environmental risks. For electric vehicle manufacturers, prioritizing environmental protection over energy efficiency is crucial.

The term 'Social reinforcement' denotes the impact of friends, family, and neighbors on a consumer's purchase decision. Customers typically seek validation from their social circle before making a purchase. Historically, customers relied on the opinions and preferences of their acquaintances when

making buying decisions. Consumers tend to choose products that align with the favorable views of their social network and are socially endorsed. Consequently, the actions of others play a significant role in determining whether a customer makes a purchase or not (Yong & Park, 2017). Social reinforcement is a critical factor in the decision-making process regarding the adoption of electric vehicles. Customer behavior and intentions related to purchases are heavily influenced by social reinforcement, making it essential for the acceptance of electric cars among consumers.

The perceived economic benefits play a crucial role in the decision-making process of selecting an electric vehicle. Customers assess the benefits derived from a product against its cost before making a purchase. When the advantages of a product outweigh the costs, customers are more likely to make a purchase. This principle holds particularly true when comparing the costs of electric vehicles to traditional vehicles.

In conclusion, the adoption of electric vehicles is influenced by various factors. The factors highlighted in the preceding sections that contribute to the adoption of electric vehicles are summarized in Figure 1 below.

Research Methodology

A study was conducted on the adoption of electric two-wheelers through a quantitative analysis. Google forms served as the platform to initiate the experiment. A questionnaire was designed focusing on various factors influencing the adoption of electric two-wheelers, such as Price, Perceived Economic Benefits, Social Influence, Charging Infrastructure, and Environment Friendly.

Demographic information including gender, age, income, and education level was also collected through the form. Out of 300 responses received, 75 percent belonged to the age group of 21-30 years. Graduates and post-graduates constituted 48.8 percent and 46.9 percent, respectively. The respondents consisted of 58 percent males, 41 percent females, and 1 percent who chose not to disclose their gender. The highest participation was from students (41 percent) compared to other professions.

The data collected from the forms was analyzed using SPSS software. SPSS Statistics, developed by IBM, is a comprehensive statistical software suite utilized for various analytical purposes. Factor analysis was employed to investigate the impact of factors like Price, Perceived Economic Benefits, Social Influence, Charging Infrastructure, and Environment Friendly on the consumer adoption of electric two-wheelers in the Indian market.

Upon conducting factor analysis using SPSS, the team obtained significant results. The Kaiser-Meyer-Olkin (KMO) statistic was above 0.50, indicating the adequacy of the sample size (255) for the analysis. The Bartlett's test revealed a statistically significant correlation matrix ($p=0.000$).

The extraction method employed was Principal Component Analysis with a standard cut-off of 0.4. All factors analyzed, including Price, Charging Infrastructure, Perceived Economic Benefits, Environmentally Friendly, and Social Influence, were found to be statistically significant. The sum of squared loadings identified four key factors with a cumulative percentage exceeding 60%, further confirming the significance of the factor analysis results.

From the rotated sum squared loading, the cumulative percentage cut-off in our research is 61.938%, slightly higher than the standard 60%. The six factors observed remain statistically significant. The methodology employed for extraction was Principal Component Analysis, with a Varimax Rotation Method using Kaiser Normalization. A cut-off value of 0.5 (50%) was utilized. The first factor identified, named Environmentally Friendly, encompasses aspects such as Reduced Carbon Impact

(0.856), Future Generations (0.854), Environment Friendly (0.838), and No Fuel (0.715), all exhibiting values exceeding the threshold of 0.5. The second factor pertains to Price and Charging Infrastructure, while the third focuses on Social Influence, and the fourth on Perceived Economic Benefits.

Based on the aforementioned data, it can be deduced that various factors influence customers when deciding to switch to electric vehicles (EVs), particularly in the context of two-wheeler vehicles. The primary factors driving this decision include environmental friendliness, with sub-factors like Reduced Carbon Footprints, Environment Friendly, and No Fuel playing crucial roles. Additionally, pricing, cost-effectiveness, and infrastructure support are significant influencers. Social circles, including family and friends, also play a role in shaping individuals' decisions. Moreover, economic considerations pertaining to owning an electric two-wheeler are integral to customer perceptions.

The research findings have important managerial implications. The adoption of electric vehicles (EVs) could address pressing issues like environmental pollution and oil dependence. Despite substantial government efforts to promote EVs, market penetration remains limited. As EVs gain traction globally, companies are introducing diverse models to attract customers. This study serves as a valuable resource for marketers, policymakers, manufacturers, and researchers interested in EVs, particularly Two Wheelers, which are pivotal in emerging economies

Scope for Future Study

The present research investigation concentrated solely on two-wheelers, neglecting to consider four-wheelers and commercial vehicles falling within the scope of Electric vehicles. Future research endeavors should delve deeper into the factors influencing the adoption of EVs across all categories. The study was conducted in India, a country engaged in continuous discourse on electric vehicles for the past decade, witnessing the introduction of various makes and models over time. This environment has enabled consumers to articulate their preferences through the available products, thereby establishing a robust research framework for these issues. Nevertheless, conducting studies in different empirical settings using EVs or other eco-innovations would enhance the findings. It would be beneficial to explore whether traits like the big five personality dimensions are associated with early EV adoption, thus advancing the comprehension of eco-innovation adoption overall, especially concerning interpersonal influence.

Conclusion

Since the inception of Electric Vehicles (EVs) in the consumer market, a crucial question has been how to encourage individuals to embrace this innovation. This poses a significant challenge for both the industry and governments, given the transformative nature of the product. The gradual global increase in adoption rates signifies a positive trend. Prior research has elucidated how consumers manifest a willingness to purchase EVs, primarily considering instrumental attributes (the perceived functional aspects of EVs) and environmental values. Revisiting the core research inquiry of this study, what motivates EV purchase intention, is essential. While existing studies have explored the link between environmental values, instrumental attributes, and EV purchase intention, further investigation integrating additional behavioral constructs is warranted. Factors such as environmental impact and reduced reliance on fossil fuels should be included in future research efforts.

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