

Factors influencing customers' purchasing intentions for Electric two -Wheelers

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Abstract

India is targeting to become net carbon zero by 2070 for which using sustainable energy resources for transportation has to be now a necessity for the Indian population. one key point towards sustainability is that the Indian government is aiming to make India shift to use 100% e-vehicle by 2030. electric vehicles having very low dependency on fossil fuels which is the key to sustainable mobility. shifting to e-vehicle is still questionable in the minds of people because of so many factors which affect their buying intention to buy e-vehicle. our research aims to understand the different factors that affect the buying intentions of indian consumers with special respect to electric two wheelers in Indore, Madhya Pradesh. we have collected data from 150 respondents through an online survey method using non probabilistic random sampling methods. we have done a pilot survey before collecting the data to test the reliability of the questionnaire. cronbach alpha reliability test was applied which came out to be 0.977. we have used a structured questionnaire with 26 items to collect the data. an exploratory factor analysis method was used to identify the factors affecting buying intention. our study found that peb (perceived economic benefit), pa (product aesthetics), df (design fitness) and vfm (value for money) are major influencers towards bi (buying intentions) towards an e-vehicle. our research will help the manufacturers of e-vehicle to upgrade the e-vehicles accordingly. further the study can be done on other e-four wheelers over pan India.

key words: electric vehicles, sustainability, buying intention, sustainable mobility, two wheelers.

Introduction

The demand for electric vehicles (evs) has grown at a very large pace in recent years, although it represents only a small percentage of the total vehicles sold globally. electric vehicles (evs) are revolutionising the world, but it is at very early stage in India. after a decade of rapid growth, in 2020 the global electric car stock hit the 10 million mark, a 43% increase over 2019, and representing a 1% stock share. electric two/three-wheelers are projected to continue being the largest ev fleet among all transport modes. growth is mainly in asia where

two/three-wheelers are prevalent. the global stock of electric two/three-wheelers in the stated policies scenario increases from over 290 million in 2020 to more than 385 million in 2030, to account for a third of the total stock in 2030. sales of electric two/three-wheelers increase from almost 25 million in 2020 to 50 million in 2030, when they account for more than half of all sales. asia is the biggest market for electric two-wheelers due to developing economies such as india, china, and japan. globally, the electric car market has hit the 10 million mark and 18% of the new cars sold are electric, he said, adding that in china, 60% of the cars are electric and in europe, it is 15% and in the us, it is 10%. the indian government targets suggest that 30% of all vehicles sold in india by 2030 will be electric to reduce air pollution. according to siam, 15,119,387 two-wheelers were sold in the year 2020–2021 in india, and out of these, 143,837 units were electric two-wheelers. torch bearer of ev revolution in india, the electric two wheeler industry accounted for 55% of the total ev sales in fy2022 alone. the overall electric two wheeler (e2w) sales in india during the first half (h1) of fy2023 was about 4.56 lakh units which is double the sales of h1 of fy2022. during the same period, the sales of high-speed (hs) e2w was more than 65% of the overall e2w sales. The adoption of electric two-wheelers (e2w) is very low in India despite various government initiatives. the ev two-wheelers adoption rate in India is down due to high upfront costs, range anxiety, inadequate charging stations, and battery replacement costs.

India is ranked as the third most polluted country in the world and received 22 of the 30 most polluted cities. consumers are increasingly picking evs, understanding that the total cost of ownership (tco) is more favourable than their petrol counterparts, over 50 per cent for high

usage such as delivery. as of 2022, India's overall ev penetration, including 2w, is 3 per cent and although the electrification of mobility in india is still at a nascent stage, there is massive headroom for growth, the report mentioned. the mospi reports estimates that transportation sector contributes nearly 7.5% of the overall carbon dioxide emissions in india. in this context, the shift to electric mobility has become inevitable to reduce greenhouse gas (ghg) emissions as evs emit 50% fewer greenhouse gases than petrol or diesel. ev adoption is, therefore, the best solution to tackle the hazardous air pollution levels in choked cities in india. there are different categories of electric vehicles, including battery ev, hybrid ev, plug-in hybrid ev, extended-range ev, and fuel cell ev. electric two-wheelers mostly operate with the help of battery-run electric motors. the electric two-wheeler category comprises bicycles, mopeds, scooters, and motorcycles. electric bicycles are commonly called electric bikes or e-bikes. the maximum speed is below 20 mph. electric scooters and motorcycles are commonly used in india. electric two-wheelers use a lead-acid or lithium-ion battery. in 2021, hero electric and okinawa e2w continue to lead the indian market, accounting for over 50% of the total sales.

literature review

Mahal & patil 2021 studied people's perception towards buying electric vehicles and making india go green. they found that 28% of people are in favour of buying electric vehicles and 335 were still unsure. 70% of consumers demanded hybrid vehicles which can run on battery and fuel both. they found that ev startups and auto majors are caught between reducing ev costs and spending money to boost infrastructure. also, high price of electric vehicles and range anxiety among customers are major issues in adoption of e-vehicles in india.

kalita & hussain 2021 studied the opportunities and challenges of using e vehicles in india. the sales of ev vehicles are expected to grow at 24% in 2023. by 2030 sales of ev vehicles would reach 21.5 million. they concluded that not only the technological and economical factors must be given importance, the satisfaction of customers based on social importance must be given importance. the charging infrastructure is one of the main concerns of ev market expansion.

khurana et al 2019 studied different factors that affect ev adoption. the model in the research paper had perceived economic benefit, environmental concern, self-image and social influence as environmental concern as independent variables. the attitude acted as a mediating variable to test behavioural intention. the study found that attitude has a positive impact on behavioural intention to buy ev. they concluded that manufacturers and marketers of electric vehicles need to transform the attitude of people in a positive direction to increase its adoption. further they suggested that introduction of green licence plates on ev, priority parking space in public places, concessional toll rates may increase adoption of e-vehicles among the public.

marcello contestable, 2012 electric vehicles: a synthesis of the current literature with a focus on economic and environmental viability: marcello contestable, dr. gregory offer, dr. robin north, a research concludes that the longer-term uptake of evs will depend heavily on progress in battery technology, to bring down costs and increase energy density, and on the provision of a suitable recharging infrastructure.

dash p. k., 2013 says home charging should be encouraged. proper planning of place, population, traffic density, and safety should be considered before implementing the massive scale charging infrastructure. the integration of activities within the energy and transport fields is important. development goals through different innovative policies and programs, for instance, drivers of electrical cars are offered a financial consumer incentive, like tax credits, purchase subsidies, discounted tolls, free parking, and access to restricted highway lanes will help the market to grow.

philippe lebeau, 2015 opined that conventional, hybrid, or electric vehicles: which technology for an urban distribution centre?: by philippe lebeau, cedric de cauwer, joeri van mierlo, cathy macharis, freight transport has a major impact on urban movement. the researcher explored the possible integration of electric vehicles in

urban logistics operations. a fleet with different technologies has the opportunity of reducing the costs of the last mile. the researcher presented a fleet size and mix vehicle routing problem with time windows for evs. the main contribution of the authors was considering the variability of the range of evs. in the segments of small vans, evs are often the most competitive technology. in the segment of large vans, diesel has seen the most interesting solution from a financial point of view as electric vehicles would need to cover a longer distance to be cost-competitive. hybrid vehicles are chosen in the segment of trucks as their running costs and fixed costs are lower than a diesel truck

fanchao liao, 2017 says that however, this penetration of ev is comparatively low despite governments implementing strong promotion policies. they presented a comprehensive review of studies on consumer preferences for ev aiming to convey policy-makers and give direction to further research. they compared the economic and psychological approach towards consumer preference for electric vehicles. the impact of the financial and technical attributes of ev on its utility is generally found to be significant, including its purchase and operating cost, driving range, charging duration, vehicle performance, and brand diversity on the market. the density of charging stations also positively affects the utility and promotion of ev. the impact of incentive policies, tax reduction is quite effective.

(lingzhijin, 2017)international council on clean transportation: lingzhijin, peter slowik, the early market growth for electric vehicles continues, but several barriers prevent their widespread uptake. these barriers include the additional cost of the new technology, relative inconvenience of technology considering range and charge times, and consumer understanding about the availability and viability of the technology. this last point, typically referred to as —consumer awareness, is crucial.

mohamed m, 2018 study on electric vehicles in india opportunities and challenges: by mohamed m, g tamil arasan, and g sivakumar, the replacement of ice with electric engines will reduce pollution to a great extent and be profitable to consumers. many countries have implemented this technology and are contributing to the improvement of the environment. the researcher saw the opportunities and challenges faced in india over implementing evs. opportunities like government initiatives, batteries, industries, and environment have been considered. these challenges like the cost of evs, the efficiency of evs in india, and demand for evs were taken into consideration. the implementation of evs in india aims primarily to scale back greenhouse emissions and cut oil expenses. the govt. should make the foremost out of the opportunities available and find suitable ways to tackle the challenges.

pritam k. gujarathi, 2018 gujarathi, varsha a. shah, makarand m. lokhande, indian scenario is different because the current market share of ev/phev is around 0.1%. presently almost all vehicles consider fossil fuelbased transportation. these pollute the atmosphere by the emission of greenhouse gases & causes global warming. the gap between domestic petroleum production and consumption is widening. india imports around 70% of oil required per annum. hence there's an urgent need to investigate factors and challenges for sustainable and cleaner alternatives.

masurali. a, 2018 researched that india contributes around 18% in the transport sector alone in terms of compared to combustion-engine vehicle carbon emission. the electric vehicle (ev) is one of the foremost feasible alternative solutions to beat the crises. several automotive companies are introducing evs and are expanding their portfolio. promoting evs can help reduce fuel dependence and pollution and beneficial for both consumers and the nation. the education of people has a significantly higher influence over their awareness level on international journal of research publication and reviews vol (2) issue (7) (2021) page 661-668 663 evs. apart from manufacturers, government should strive hard to spread awareness and influence positive perceptions among potential customers

pretty bhalla, 2018 a study of consumer perception and purchase intention of electric vehicles: pretty bhalla, incas salamah ali, afroze nazneen, choice of cars depends upon environmental concern, cost, comfort, trust, technology, social acceptance, infrastructure availability. these arguments have been tested for both conventional cars and evs. they assume that these factors have a direct influence on individual choice of vehicle. they found that ev manufacturers and government have to invest more in social acceptance of the vehicle by creating more infrastructural facilities, putting more thrust on technology to create trust. the analysis depicts that the population is well aware of the environmental benefits. the responsibility lies on the shoulders of the government and manufacturers to invest in technology and of people's concerning the manufacturing of vehicles

mr. a. rakesh kumar, 2019 researched on electric vehicles for india: overview and challenges: by mr. a. rakesh kumar, dr. sanjeevikumar padmanaban, global pollution is on the rise and each effort made, is to cut back the co2 emissions and save the earth. one such effort is the introduction of evs. the transport sector is one of the largest emitter of co2 and hence it's important to reduce it. the government has come up with ambitious plans of introducing evs to the indian market and confine pace with the event of evs globally. the national electric mobility mission plan 2020 has included an in-depth report on evs. india encompasses a huge challenge in shifting the transportation sector from ice engines to evs. this needs lots of planning along with r&d. charging

infrastructure must be adequately build to deal with range anxiety. it's vital to form demand generation by making all government buses electric and offering tax exemptions for personal ev owners.

janardan prasad kesari, 2019 reviewed opportunities and scope for electric vehicles in india: by janardan prasad kesari, yash sharma, chahat goel, developing an aggressive strategy for the adoption of evs in india and ensuring a well-executed implementation is a challenge but vital for the government. the geography and diversity of india will present problems that require thoughtful solutions. public procurement is expected to be an important driver of the growth of evs, with the purchase of four-wheeled vehicles for government offices, three-wheeled vehicles, and buses for public transport. investments by fleet operators such as ola and uber, and operators of food distribution services, are also expected to boost the initial growth of two- and four-wheeled electric vehicles. however, private evs may take 5-6 years to gain popularity and acceptance.

objectives

1. to study demographics factors influencing buying intentions of customers for electric vehicles in indore city.
2. to study various product features influencing buying intentions of customers for electric vehicles in indore city.
3. to study various pricing factors influencing buying intentions of customers for electric vehicles in indore city.
4. to study various availability factors influencing buying intentions of customers for electric vehicles in indore city.
5. to study various technological factors influencing buying intentions of customers for electric vehicles in indore city.

Research methodology

Ev adoption is still a challenge. people still think about various factors before they actually buy an electric vehicle. we tried to ask about different factors that affect buying intention towards two wheeler e vehicles. the data was collected through an online questionnaire. the designed questionnaire has two parts. first part contained demographic information about the respondent. the second part has different questions related to technological, availability, pricing and product features about e-vehicles. these factors formed model variables of the study. the questionnaire had 29 items as different factors. these items measured the buying intention of people to buy electric vehicles. we applied confirmatory factor analysis to reduce these 29 factors.

sample size

simple random sampling method used to form the sample. target population was people of indore city. we target 250 respondents out of which we received responses from 150 respondents. there was no missing data as questions were closed ended and compulsory. all responses were found valid.

measurement

in the first part of the questionnaire we measured demographic variables as categorical data. in the second part we used a 5- point likert scale (1 as strongly disagree and 5 as strongly agree) to collect data from respondents. we used spss(software package for statistical tools) version 27 for analysis of data. we feeded all data collected using excel sheets in spss. we labelled all factors to understand proper names.

data analysis

as there were many factors under study we applied factor analysis to reduce the factors under study. the pilot was conducted on 25 respondents and cronbach alpha value was calculated for testing reliability of questionnaire which came out to be 0.977. hair, anderson, tatham, and black(1998) stated that the value greater than 0.6 is reliable. so, our questionnaire was reliable and we started collecting data. we started with 26 factors which described various product features, pricing factors and technological factors related to e-vehicle. after collecting data we cleaned the data and applied confirmatory factor analysis on data to reduce and obtain main factors. principal component analysis was applied to data.

following are the demographics of data collected:

Education	Count of Family Income
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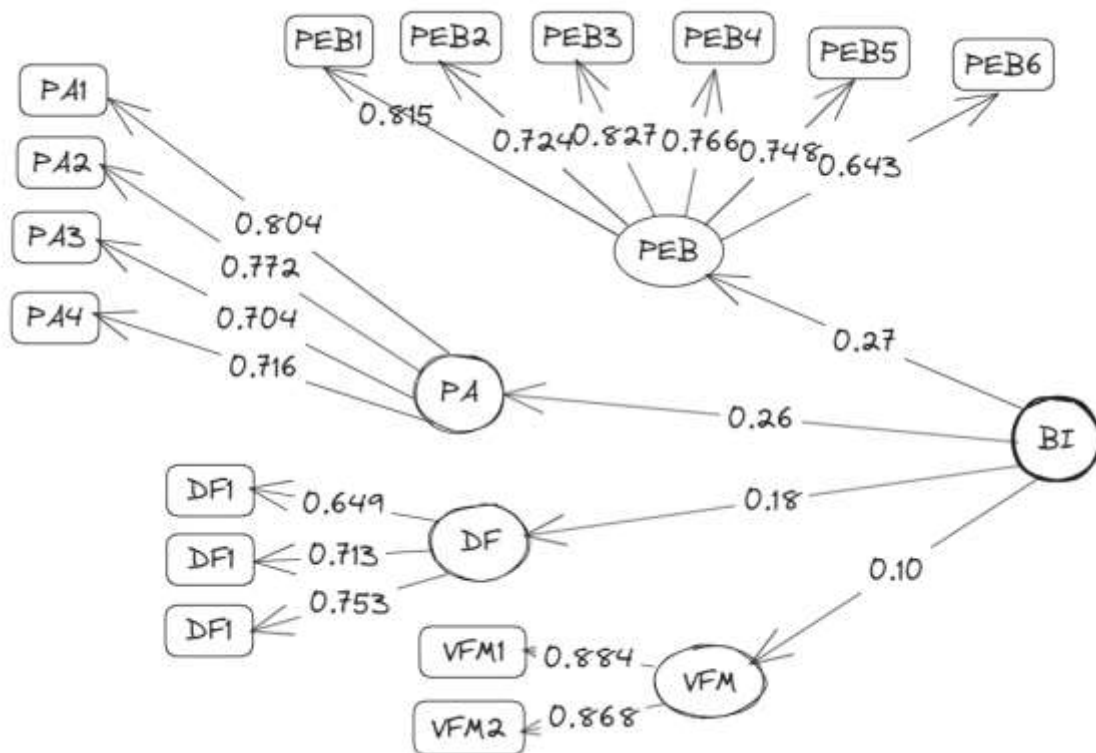
following table shows component and its constructs:

table 1

measured indicator	construct	factor loading
do you consider government subsidy while buying electric vehicle	peb1	0.815
what can be the exchange value ,when we will sell in future	peb2	0.724
is the product easily available ?	peb3	0.827
is an electric vehicle easily available nearby?	peb4	0.766
what distance does it cover once it is fully charged?	peb5	0.748

can electric vehicles be quickly charged?	peb6	0.643
does the size of the vehicle suit me?	pa1	0.804
can i handle the weight of the vehicle?	pa2	0.772
does appearance of the vehicle attractive?	pa3	0.704
does the colour of the vehicle appealing?	pa4	0.722
how innovative is product design?	df1	0.649
is the product environment friendly?	df2	0.713
can the product support my family size?	df3	0.753
how is the bluetooth connectivity feature ?	vfm1	0.884
is the product worth buying or cost effective?	vfm2	0.868

diagram showing factors influencing buying intention of consumers towards electric vehicle



source: author's own model

bi: buying intention, peb: perceived economic benefit, pa: product aesthetics, df: design fitness, vfm: value for money.

Results & interpretations

pca is a dimension reduction method which is used to reduce dimensions of large datasets, by transforming large sets of variables into smaller numbers that still contain maximum information in the large set. using pca our 23 dimensions were reduced to 4 factors. we named four factors as perceived economic benefit, product aesthetics, design fitness and value for money.

effect of perceived economic benefit (peb) on buying intentions for electric two wheelers is 27%, whereas product aesthetics (pa) are having an impact of 26%. the other two factor which impact the buying intentions of customer are design fitness (df) & value for money (vfm) which are having an influence of 18% and 10% respectively.

we collected data from respondents having different ages in which majors were from the age group 20-30 years, where a person is in need of having two wheeler most and thinking whether to buy an electric vehicle or not. respondents' gender does not impact on buying intention for electric vehicles. family income with 90,000 per month can afford e-vehicles. respondents from master's degree can understand the pros and cons of buying an electric vehicle.

Conclusion, limitations, and future scope of work

the automobile industry is focusing on e mobility, so its mandatory to address the lack of awareness of decision making factors for intentions to purchase e vehicles. as the study is limited to e vehicle adoption in indore city, the aim of this paper is to analyse the various factors affecting the buying intentions of electric two wheelers. based on the research study the four factors have been identified which are peb, pa, df & vam. this shows that if manufacturer focuses on identified factors then the buying intentions will increase towards e two wheelers.

the findings of this research can be used by manufacturers and suppliers of the automobile industry, the private and public institutions dealing with e-mobility, sustainability, or green business solutions as well as the governments. this could further help them to develop and provide strategies with the goal to overcome the adoption barriers currently existing. overcoming these barriers would then attract larger number of consumers to electric vehicles.

the study was restricted to one city in india i.e. indore which is an educational and business hub. the sample size was limited to only 150 respondents and mostly in the age group of 20–30 with salaried people. there is a need

to replicate the study in other cities to understand the influencing factors. further studies can focus on the influence of the factors identified in this study and also on acceptance of new technology when buying electric vehicle

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