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Research Article

The Impact of Mediating Role of Adoption Behavioural Constructs Between Stimulating Agents and Electric Vehicle Purchase Intention

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Abstract: Background: The launch of Electric Vehicles (EV) is essential to sustainable mobility and impact reduction for the environment. While past studies addressed impacts of technological and policy factors on the adoption of electric vehicles, there is lack of attention paid to the behavioural mechanisms through which stimulating variables affect the purchasing intentions of consumers. This study focusses on analysing mediating effect of adoption behaviour variables between stimulating factors i.e. environmental awareness, market readiness and environmental concern and consumer's intention to adopt EVs. **Methodology:** Cross sectional survey was carried out with combination of online and offline data collection methodology. Researcher has collected 1942 responses through structured questionnaire based on five-point Likert scale and out of which 212 were filtered out during the screening process resulting in the collection of 1730 legitimate respondents. The participants were picked from the customer and prospective buyers of the leading electric vehicle manufacturers in India. The reliability, validity, structural correlations and the mediating effects of the measurement model were performed with the help of PLS-SEM (Bootstrapping). **Results:** This study reveals that the effects of market readiness have the most important impact on adoption behaviour components followed by environmental awareness and environmental concern. All of the adoption behavioural constructs, i.e., green marketing, consumer trust, perceived usefulness, behavioural intention and technological innovation have a large and favourable effect on the purchase intention of EV. The behavioural intention was found to be the primary predictor of the purchase intention. Mediation study established is that adoption behavioural dimensions significantly mediate the associations between stimulating variables and purchase intention with green marketing and behavioural intention recognised as main mediators. **Conclusion:** The present findings show that the influence of stimulating and adoption constructs on EV purchase intention occur majorly through behavioural and technological process of change rather than the direct effects. This study enhances the theory of technology adoption by having environmental, market and behavioural dimensions to a coherent technology adoption framework, which can support specific behavioural, technological and policy interventions that can be utilized to support EV adoption by policy makers and industry stakeholders.

Keywords: Electric Vehicle, Environmental Awareness, Consumer Trust, Perceived Usefulness, Behavioural Intention and Purchasing Intention

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INTRODUCTION

The rapid growth in the global transportation demand has had the adverse effects of aggravating the environmental deterioration, energy security and greenhouse gas emissions, which makes the shift towards sustainable mobility system a global imperative. EVs have emerged as a practical technical solution to diminish carbon emissions and to break away from the dependence on fossil fuels and play an imperative role in climate mitigation policies and sustainable development goals. Governments, corporations and researchers around the world are trying hard to accelerate the growth of electric vehicles to reach their carbon neutrality goals and change the transportation industry [1]. Afroz *et al*. [2], focuses on the importance of EVs for short-term mitigation measures and carbon budgets meeting by developed and emerging economies [3].

Notwithstanding the advances in technology and regulation, the adoption of electric vehicles is uneven from one location to another, implicating that the purchasing intentions of customers are inclined by a number of technological, behavioural and market related factors. Previous studies have recognized legislative incentives, availability of charging infrastructure, technology configurations and market maturity as critical factors that affect the spread of electric vehicle markets [4,5]. Nonetheless, the availability of technology alone is not a guarantee for positive customer acceptance because behavioural and psychological factors have a great influence on the choice of adoption. Research suggests that the personal views, environmental values and perceived dangers have a significant influence on customer's readiness towards acceptance of the EVs [6].

Moreover, market readiness like infrastructure, policy frameworks and business models hold greater influence on the trend of adoption of electric vehicles. Prior researchers have found that governmental regulations and subsidies and infrastructure investments signify to a large extent the advancement of the propagation and sales growth of EVs [7,8]. Kley *et al*. [9], further highlight the necessity of an understanding of technological, policy and behavioural perspectives in order to have a proper understanding of the electric vehicle purchasing intentions [10]. Furthermore, the customer preferences in charging infrastructure, business models and service areas plays a pivotal role in adoption patterns and EV market development [9,11].

Environmental awareness & care have been accepting as key psychological levers in sustainable consumers behaviour. Consumers who are gaining more knowledge and fear for the environment degradation are more likely to purchase in to an environmental engineering and products like electric vehicles [12]. Previous empirical research has proposed environmental attitudes along with perceived ecological benefits have significant impacts on the PI of EVs and sustainable consumption behaviours [13]. Scientific studies confirm the rising academic attention to the behavioural and attitude-related aspects affecting the adoption of EVs, as an acknowledgement of the growing importance of the consumer-oriented approach in the research on sustainable mobility and the corresponding weight of consumer opinions [14].

In addition to environmental and market cues, environmental and market variables, conversion of external stimuli into purchasing decisions is mediated by the adoption behavioural variables such as green marketing, consumer trust, perceived usefulness, behavioural intention and technical innovation. Green marketing can be recognised as an effective tool in communicating the benefits of sustainability and influencing the pro-environmental consumption behaviour of consumers through effective communication and branding strategies [15]. Consumer confidence in the technology of electric vehicles, manufacturers and regulatory bodies reduce the perceived risk and uncertainty, making adoption of the technology more likely than not [16]. Perceived usefulness, going back to Technology Acceptance Model (TAM) and other theories like this, are still an important part in Making a technology adoption decision, especially related to emerging technologies such as EVs [17].

Behavioural intention has been identified as the most predictive factor of actual purchasing behaviour in the consumer adoption literature, which is consistent with the Theory of Planned Behaviour (TPB) [18,19] and the Unified Theory of Acceptance and Use of Technology (UTAUT) [20,21]. Prior researches have confirmed that behavioural intention moderates the impact of the attitudes, subjective norms and perceived behavioural control on the decision of EV adoption [2,22]. Perceptions of technical innovation such as vehicle reliability, energy efficiency, technological progress, etc., exert a huge influence on consumer trust on EV vehicles, which in turn influences their intention to purchase them [10,16].

While previous studies have focused on specific determinants of electric vehicles adoption, the scarcity of comprehensive models taking into consideration stimulating factors, such as environmental knowledge, environmental concern and market readiness as well as adoption behavioural characteristics as mediators, to explain the purchase intention. Current research tends to concentrate on the direct impact of policy, technology or attitudes without attention to the intermediate behavioural mechanisms that are involved in converting external cues into decision-making by consumers. Systematic evaluations highlight the need of integrated models, which bring together behavioural, technological and policy aspects at one platform which make it easy for others to understand consumers' behaviour towards the adoption of EVs [17,23].

Moreover, most of the empirical research has been done in industrialised economies and emerging and developing markets are largely unresearched. Variations in infrastructural availability, policy frameworks, technology preparedness and consumer knowledge may lead to variations in behavioural patterns in different situations. Comparative analyses across areas have shown that there exist variations in the factors of EV adoption, which in turn point to the need for context specific models [5,8]. Furthermore, business model innovation and service system design become more important factors to affect the spread and consumer acceptance of EVs [9,24].

This study aims at evaluating the role of mediating variables of adopting behavioral variables on a relationship between stimulating agents and an intent to buy EVs. This research considers in particular the impact of environmental

awareness, environmental concern and market preparation on EV purchase intention through green marketing, customer trust, perceived usefulness and behavioral intention and technological innovation. This study depends upon introduction of empirical information about direct and indirect relationships among these constructs so as to establish a comprehensive framework (behavioral-technological framework) for the study of electric vehicle adoption. This research brings about many theoretical and practical developments. Initially, it adds to the existing works on EV adoption by introducing the role of the motivating factors and behavioral mediators in a united conceptual framework by linking environmental psychology, technology acceptance and market readiness literatures. Secondly, it is the empirical analysis of different avenues of mediation, empowered by improved knowledge about the external cues that would affect the purchase intentions of customers. Third, it will give policy and managerial insights for policymakers, manufacturers and marketers in order to come up with effective strategies for promotion of adoption of electric vehicles through behavioural interventions and other technological interventions. In conclusion, understanding the mediating factors between the role of stimulating stimuli and the intent to purchase is crucial in moving sustainable transportation forward and the pervasiveness of EVs. This work contributes to the existing knowledge about how sustainable transportation and consumer behavior can be improved by presenting comprehensive theory based model and empirical findings about EV adoption dynamics.

Literature Review

Impact of Stimulating Factors on Adoption Behavioural Constructs

Environmental Awareness and Adoption Behavioural Constructs: Environmental Awareness (EA) is an indicator that shows consumers knowledge and understanding regarding the environmental problems and their awareness regarding the environmentally friendly technology such as EVs. Prior studies of research literature have found time and again that more eco-conscious consumers are generally more responsive to marketing techniques that focus more on sustainability [25,26]. Green marketing messages with environmental benefits and reduced emissions and sustainability credentials can be efficacious in translating awareness to favorable behavioral response [14,27]. Scientometric analyses further suggest that environmental awareness has become one of the key themes in the research pertaining to EV adoption, which points out its central role in influencing the response of consumers [28,29]. Environmental awareness is also expected to influence consumer trust of EV technologies, manufacturers and policy institutions. Informed consumers can be better placed to assess the environmental claims and technological attributes and helps to build more confidence in EV systems and return to drawing the board reducing the uncertainty [8]. Additionally, research conducted on both technological reliability and performance of electric vehicles have disclosed that awareness on technological standard and technological reliability helps to increase and enhance consumer trust and consumer confidence in EV adoption decision [22,30].

From a technology adoption perspective, the environmental awareness may increase the Perceived Usefulness (PU) by enabling consumers to be aware of the functional and environmental benefits of use of EVs (decreased fuel costs and decreased emissions) [12]. Prior researches find that environmental cognitions would strengthen utilitarian evaluations when consumers link environmental benefits with utilitarian value [28,31]. Furthermore, Behavioural Intention (BI) is highly affected by environmental attitudes and awareness as consciousness leads to positive attitudes and normative commitment to sustainable mobility [6]. Finally, environmental awareness may have an impact towards the perceptions of Technological Innovation (TI), as this environmental awareness for the sustainability issues lead people to become more open to the innovative clean technologies and advanced EV configurations. This is shown in studies regarding charging standard, safety and grid integration and the role of awareness in technological advancements to strengthen innovation perceptions and acceptance [10,32]. Therefore, the following hypotheses are put forwarded as:

- **H1:** EA has a significant impact on GM (H1a), CT (H1b), PU (H1c), BI (H1d) and TI (H1e)

Market Readiness and Adoption Behavioural Constructs

Market Readiness (MR) is perceived to be the availability of infrastructure, facilitating policies, charging infrastructure and business models that facilitate EV adoption. It is expected that the readiness of the market will be able to make the green marketing more successful since it will provide tangible proof of the EV feasibility, which will facilitate the sustainability communication messages. Responsiveness to consumer-related factors and market adoption of EVs were found to be influenced by the availability of infrastructures and policy incentives significantly [33]. It has already been mentioned that revised policy frameworks and infrastructure development can alter the consumer attitudes and perceptions regarding adoption of EV [8,25,26]. The studies of the use of charging infrastructure also demonstrate that geographic location and the availability of infrastructure influence the perceptions of reliability and trust to EV ecosystems significantly [25,26]. The business model innovations and the innovation in cost management are beneficial

in creating trust by elucidating the value propositions and reducing the perceived financial risks [34,35]. Market readiness also plays a very significant role in the consumer trust. An evident charging system, regular incentives and the service ecosystem reduce the perceived risk and uncertainty, which increases the trust in EV systems [36].

The market preparedness is closely connected with the perceived usefulness, in which positive infrastructure and policies raise the utilitarian usefulness and convenience of EVs. The studies of the design of the service region and optimization of charging networks indicate that the perception of accessibility and functional utility may be influenced by the design of the system [36]. In addition, policy boosts and subsidies contribute to the cost-benefit perception, which strengthens PU [32]. Market readiness is also a determinant of behavioural intention that decreases the hindrances to adoption and the perceived behavioural control [11]. Empirical evidence holds that consumer intention to use EVs is positively affected by the availability of infrastructure and government incentives, particularly in the emerging markets [12,27]. The use of EVs is also normalised through policy signalling and demonstration programs and helps to strengthen intention formation [7,38].

In addition, the market preparation will precondition the establishment of the vision of technological innovation, as the acceptance of the innovation will demand the backup of the standards and reliability, and, techno-economic feasibility [39,40]. The research on technology configuration shows that the qualities of innovation play an important role in EV sales and adoption decisions [10,22,41]. Smart pricing and smart charging would also help to create the image of smart and technological innovativeness of the system [42,43]. Therefore, the proposed hypotheses are put forwarded as:

- **H2:** MR has a significant impact on GM (H2a), CT (H2b), PU (H2c), BI (H2d) and TI (H2e)

Environmental Concern and Adoption Behavioural Constructs

The term Environmental Concern (EC) reveals an affective and value-based orientation towards environmental protection and environmental sustainability. Unlike awareness, which is a mental phenomenon, concern is an emotional and moral motivation that results in pro-environmental behaviour [6,31]. The sustainability of marketing communication messages that resonate with the values of consumers more interested in the environment are also better positioned to be responded to by them, which improves the effectiveness of such an approach [28,29]. One of the policies that affect the improved environmental quality is also consumer concern, creating sustainable technologies perceptions [8,29]. When the technologies are perceived as viable solutions to the environment concerns, the consumer confidence to EV systems is expected to be enhanced. Based on macro and micro adoption studies, the environmental motives interact with the policy and technological situations to characterize the purchase decisions and indicate that the concerned consumers may have more trust in the EV solutions [7]. Other areas that increase trust are also reliable and risk perception, which is related to environmental concern to develop trust [22,44].

The issue of environmental concern is another criterion that demonstrates perceived usefulness as usefulness is also applied to the environmental and social good [42]. Evidence-based research Adoption research findings showed that utilitarian and normative considerations are taken into account in EVs and the concept of total value is increased in the environmental concern [45]. The existing literature on subsidies also demonstrates that more environmentally conscious consumers experience more gains in terms of EV adoption [36]. The impact of environmental concern on behavioural intention is high since moral obligation and commitment towards sustainable behaviours is heightened. The literature review analyses carried out in the settings also demonstrate the strong impact of the environmental attitudes on EV purchase intention [12]. The results of long studies using UTAUT also show that motorists belong to the value-based formation of reinforcement intention [46,47].

Finally, the environmental concern aspect is also probable to influence the perceptions of technological innovation since at the scale of concern, the views on clean technologies and energy transition innovations will be more receptive. The works in the field of EV standards, reliability and technological advancement suggest that the sustainability-based considerations may promote the uptake of innovation [22,32]. The fact that smart cities and green power synergy are intertwined also indicates that consumer with environmental interests take into account the innovativeness features, as this feature helps them to adhere to sustainable mobility systems [30,39]. Therefore, the following hypotheses are put forwarded as:

- **H3:** EC has significant impact on GM (H3a), CT(H3b), PU(H3c), BI(H3d) and TI(H3e)

Green marketing behavioural constructs, consumer trust, perceived usefulness, behavioural intention and technological innovation are now established proximal predictors of consumer purchase intention of EVs user. Similar studies have found that the important medium of transmission through which the external stimuli is converted to actual adoption decision is the behavioural and psychological processes. The role of GM for shaping the development of pro-environmental purchasing behaviour is significant as it delivers the sustainability benefits, the environmental

performance and environmental-friendly value propositions. Empirical literature demonstrates that sustainability-oriented marketing messages can significantly impact the green purchase intention and produce a positive influence on the purchase of EVs or not [40,41]. Also, green marketing policies have the ability of equalizing the perception and enhancing the impact of environmental and technological attributes on the purchase intention that justifies GM as a primary behavioural concept [42]. These findings confirm the hypothesis that green marketing will positively affect the intention to acquire EVs.

Consumer trust (CT) is also another very critical determinant since trust lowers perceived risk and uncertainty of new technologies. The degree of trust in EV technology, the companies and the political systems is a vital element that influences the consuemr's willingness to use EVs [48-51]. Social influence and network effects are also encouragements of trusts in which consumers rely on individuals and social networks to make adoption choices [50]. Trust, consequently, is a fundamental process of affecting consumer adoption behaviour. The level that the consumers develop in regard to the opinion that EVs are useful in both functional and economic terms is PU and is founded on TAM Model. The perceived economic benefits, overall ownership cost and performance benefits are proven to have a strong impact on the PI [52] [53]. The knowledge of EV can also increase the willingness to adopt and the perceived utility and, consequently, purchase intention, which is also testified by other studies performed on experience [54].

TPB Theory and the UTAUT theories share the common belief that BI is the best predictor of actual PI. Empirically, behavioural intention has been demonstrated to mediate the correlation between the attitudes, social norms and the perceived control on EV adoption decisions [55]. Environments and social factors also contribute to the behavioural intention, so they are more key proximal antecedents of EV purchases [3756]. Technological Innovation (TI) perception is also relevant in motivating purchase intention since customers evaluated EVs on the grounds of technological advancement, vehicle to grid connectivity and business novelty. Technological innovation and alternative business models have been shown to generate the need to adopt and perceived value [51,57]. The innovations of the technologies as well as the innovations at the system level increase consumer confidence in EVs and their desire to purchase them [58]. Therefore, the following hypotheses are put forwarded as:

- **H4:** PI has been significantly impacted by GM (H4a), CT(H4b), PU(H4c), BI(H4d) and TI(H4e)

The Mediating Role of ABC

The mediating significance in the interpretation of the stimulating constructs that include environmental awareness (EA), market readiness (MR) and environmental concern (EC) into the purchase intention of EVs among the consumers include ABC constructs comprising of green marketing, consumer trust, perceived usefulness, behavioural intention and technological innovation [1,59]. The above-mentioned studies have proofs that the external stimuli are rarely having direct influence over the adoption process, rather, the process operates via mediating effect of behavioural and technological perceptions that influence the consumer decision making process. Environmental awareness and environmental concern have mediating behavioural and technological variables upon purchase intention of EVs [25,26]. Conscious consumer concerned about more sustainability issues, will be more likely to buy and use the EVs in the way that they will contribute to the intention to purchase it through the prism of behaviour and technological properties. The policy and energy transition literature states that the environmental factors should not be the sole reasons explaining that the necessity to decrease the consumption of fossil fuels should be supported by the perceptions of technological viability and behavioural acceptance. The empirical data also points out that usefulness, trust and innovation are also perceived by consumers in regards to the environment and the consumer adoption [60]. This brings out the mediating role of the behavioural constructs in transformation of environmental stimuli to adoption behaviour.

The behavioural factors and technological factors mediate the relationship between the MR and the EV PI. Government incentives promote the consumer perceptions of trust, usefulness and technological innovation, infrastructure development and conducive policies and impact on the purchase decision. Policy-implicative studies have demonstrated that reasons of consumer perceptions and decision-making to either adopt or not may be significant due to the presence of subsidies, EV charging Stations and the evaluation by regulation through behavioural processes [4] [61]. The mass deployment research also argues that infrastructure and market maturity determine adoption predominately by reducing uncertainty and increasing the perceived benefits [62]. Technological innovation and system level technological readiness, are also mediating effects on stimulating factors on purchase intention. EV technology, chargings, vehicle to grid and dual motor system are a few such innovations that encourage consumer reliability and innovation perceptions and act as stimulators to adoption choices [16,21]. It is indicated by the fact that the results of the techno-economic study of the electric and hybrid systems, the consumer acceptance depends indirectly on the feasibility of innovation and cost performance qualities, which are identified as result of the behavioural evaluation processes [63]. Such results indicate that perception of technological innovation is a mediating variable which gives an important contribution between external stimuli and purchase intention.

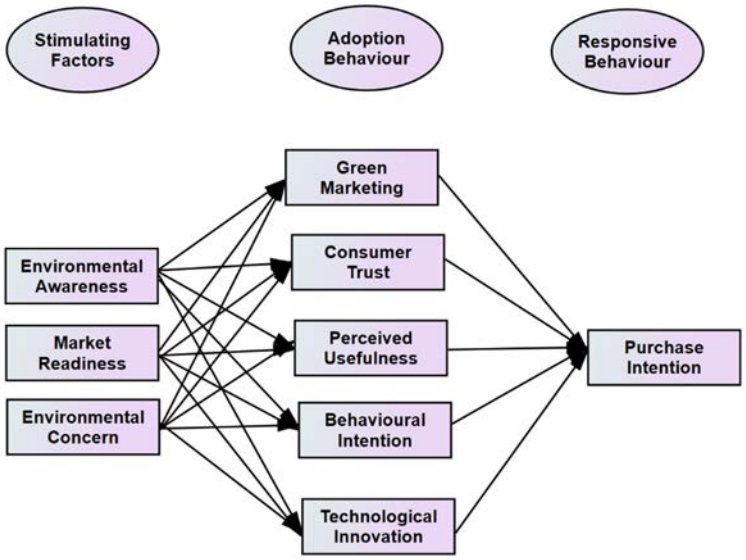


Figure 1: Conceptual Model of Purchase Intention of Consumers for EVs

Such other factors are the business model and cost structures as they influence the behavioural constructs which mediate the adoption decisions. The cost and value propositions of EVs have a significant effect on the perceived usefulness and trust, which will in its turn affect the consumer purchase intention [34]. The behavioural tests are crucial procedures in which the stimuli in the market and environment are converted into the real adoption decisions. Environmental awareness and concern and market readiness are the stimulating factors that have an effect in the EV purchase intention indirectly, mainly under the effect of behavioural and technological constructs. This supports the conceptualisation of ABC as an intermediary process in the EV adoption framework and the need to have incorporated behavioural-technological models in EV adoption research. Therefore, the following hypotheses are put forwarded as:

- **H5:** ABC constructs has significant mediating role in influencing the stimulating factors (EA (H5a), MR (H5b) and EC (H5c)) for the PI of EVs

The following is proposed conceptual model for current study, which is as Figure 1.

MATERIALS AND METHODS

Research Design and Data Collection

This research used quantitative research design of cross-sectional survey to study on the mediating role of the adoption behavioural constructs in relationship stimulating factors and EVs purchase intention. Data collection has been carried out from a structured questionnaire using offline and online survey data collection methods to achieve a better representation and without sampling bias. A total of (off-line) 796 (on-line) 1146 responses were first recorded, making up a total of 1 942 raw responses. After rigorous screening process targeting missing, incomplete, inconsistent and patterned responses, 212 responses were met with drop as a result of the screening process and subsequent analysis was performed on a final sample of 1,730 respondents. In order to ensure the relevance and contextual accuracy, the selection of the participants was based around their awareness regarding EVs and exposure to the Indian EV market and those who have experienced EVs. Respondents were recruited from users and potential buyers of the electric car products of the best-selling car companies in India (top 10) to ensure that they will be able to participate in the study with sufficient knowledge towards the EV products and brands. This sampling strategy added to the validity of the findings from outside as it reflected the perceptions of consumers that have been exposed to leading EV manufacturers and market offerings.

Data Analysis Procedure

The structured questionnaire is developed and consisted of two parts. The first section was a collection of demographic and background information and the second section was a measure of the latent constructs in the research model

proposed. The stimulating factors were Environmental Awareness (EA) [57], Market Readiness (MR) [38] and Environmental Concern (EC). Adoption behavioural constructs were Green Marketing (GM) Consumer Trust (CT), Perceived Usefulness (PU) [44], Behavioural Intention (BI) [19] and Technological Innovation (TI) [1], as well as the Purchase Intention (PI) [28], was defined as the dependent variable. Five-point Likert scale was used, which is very widely recommended for behavioural and technology adoption research. Researcher has conducted a pilot test with 135 respondents for clarity and reliability and content validity of questionnaire. The results indicate deletion of 9 items from the scale based on low correlation and issue of factor loading to their respective constructs.

Data analysis was performed through two-step approach recommended for PLS-SEM. First, the data screening, descriptive statistics, reliability measurement and Exploratory factor analysis was performed. Secondly, SmartPLS 3 was carried to test the measurement and structural model including the mediation analysis. The KMO value 0.854 were higher than the recommended level 0.60 and this value showed the adequacy of sampling and also significant Bartlett's test shows the appropriateness of the factor analysis. These results indicated that these data were satisfactory for multivariate analysis.

The Internal consistency reliability Cronbach Alpha (0.865) and Composite Reliability (0.887) where the value is 0.70 and above indicates acceptable values. The test of discriminant validity was assessed using Fornell-larcker criterion and inter-construct correlations with the view of ensuring that all the constructs were empirically orthogonal. These steps assisted in making sure the soundness of and legitimacy of the measurement model prior to assessing the structural connections. The stimulating and adoption behavior factors and purchase intention structural model was tested by performing PLS-SEM. Path coefficients, t-values and confidence interval estimates were estimated using bootstrapping, with a value of 5,000, resamples. The importance of the relations was identified with the assistance of t-statistics and p-values.

Mediation role of adoption behavioural constructs, the indirect effects have been studied by bootstrapping in order to get the confidence intervals as suggested by Hair *et al*. Both individual and multiple mediation effects were analysed in order to get overall knowledge about behavioural transmission mechanism from stimulating factors to purchase intention. Effect Sizes (f2) and Predictive Relevance (Q2) were also analyzed to be able to understand the explanation and the prediction ability of the model.

RESULTS

The demographics of the respondents indicate that the sample represents mostly economically active and technologically aware consumers that represent the principal target market for EVs. In terms of gender the respondents were also distributed with 60.30% and 39.70% being males and females respectively and this is a fairly even distribution in which males are slightly more represented than females. This pattern is typically experienced in studies relating to automobiles as males tend to be more involved with the purchase of the vehicles and research of the technical features with vehicles when purchasing. The age group reflects that the sample was dominated by younger and middle age consumers. The biggest proportion responded in the age group of 26 - 30 years (36.10%), 31 - 35 years (27.70%) and 18 - 25 years (15.70%) respectively. Respondents who were aged 36 + years had 14.00%, 5.60% were aged 46 - 55 years and 0.90% were above 55 years. This means that the study mostly reflected younger and working age people, who would be more likely to be at the forefront of innovative technologies such as EVs and accepting of environmental and technological innovations. In terms of education, the respondents were well educated with the largest number of them (55.30%) being at undergraduate education level and 24.50% junior college education. In addition, 11.90% had high school, 6.20% had postgraduate qualifications and the least proportions of such a group at 2.10% had middle school education or below. The high educational attainment level implies that the respondents had adequate knowledge and awareness to judge the technological and environmental information of EV and therefore made the responses more reliable.

Monthly income distribution shows that the sample has a high proportion of middle-income consumer as 39.20% earned between Rs 35,000 and Rs 55,000 and 31.00% earned between Rs 55,000 and Rs 75,000 whereas 12.00% earned less than Rs 35,000, 10.60% earned between Rs 75,000 and Rs 95,000 and 7.20% earned more than Rs 9 Regarding preference of price of cars, 32.36% preferred vehicles with price between Rs 8 -11 lakhs which was followed by the figure of 28.76% preferred for vehicles with price in the bracket of Rs 5-8 lakhs, 16.35% preferred vehicles priced between Rs 11-14 lakhs and 14.28% preferred vehicles priced above Rs 14 lakhs. Only 8.25% preferred vehicles above to Rs 5 lakhs. This suggests a strong preference for mid-range EVs, which could be an indication that affordability and value for money are important factors when deciding on purchase of EV.

Table 1 outlines the result of the measurement model with strong results for reliability and convergent validity of all constructs. The Standardized Factor Loading (SFL) implies that all the observed items are representatives of their latent constructs (value ranges between 0.781 to 0.964 which is above the recommended range of 0.70). The values of AVE are in range of 0.622 to 0.895 which are higher than 0.50 and thus meet convergent validity criteria, indicating that

all the constructs are capable of explaining for more than half variance in their indicators. Cronbach's Alpha (CA) (0.715 to 0.972) which ranges have higher values than acceptable 0.70 and show high interrelations among the measurement items. Similarly, CR values are well above the recommended value of 0.70 and furthermore affirms the robustness and reliability of the constructs. The constructs that had high SFL, AVE, CA and CR values, that is the measurement properties indicate that the constructs have high measurement properties and high construct stability. Overall, the results give support for adequacy of the measurement model of findings as they relate to the criteria for adequate evidence of a reliable and convergent measurement model for the purposes of subsequent structural model analysis and for hypothesis testing.

Table 2 presents the outputs of the discriminant validity and correlations analysis between the constructs and variables in the study. The square roots of values for AVE (diagonal elements) of all constructs ranging from 0.795 to 0.919 is greater than comparatively obtained inter construct correlations, which satisfies Fornell-Larcker criterion of discriminant validity. The correlations among stimulating factors (EA, MR and EC) are moderate and positive and indicate that the concept of environmental awareness, market readiness and environmental concern are related but conceptually separable constructs. Similarly, the adoption behavioural constructs (GM, CT, PU, BI and TI) measure exhibit moderate levels of inter-correlation implying theoretical coherence and at the same time ensure that there are no concerns of multicollinearity. Notably, Green Marketing and Consumer Trust have moderate associations with the stimulating factors which implies that the mechanisms of marketing and trust are affected by stimuli related to the environment and the market. Perceived Usefulness and Behavioural Intention are found to have relatively lower correlations with stimulating factors, which leads to the fact that the constructs are more positively directly influenced by behavioural and technological perceptions in comparison to environments stimuli (alone). Purchase Intention when correlated moderately with most constructs indicated its possible mediating and direct influence in the structural model, namely Green Marketing and Consumer Trust. Overall, the results support satisfactory discriminant validity which can be used to continue structural equation modelling and hypothesis testing since empirical evidence indicates that the constructs are empirically distinct.

Results of the structural model are shown to Table 3 that can be summarized in the following: The stimulating factors (EA, MR and EC) have different impact on the adoption behavioural constructs (GM, CT, PU, BI, TI) which in turn influence the purchase intention (PI). The results strongly support the proposed mediation framework and are consistent with the previous EVs adoption literature. Environmental awareness has significant relationship with green marketing ($\beta = 0.249$, $p<0.001$), behavioural intention ($\beta = 0.422$, $p<0.001$) and technological innovation ($\beta = 0.224$, $p<0.01$) which means that environment conscious consumers tend to be more open to green promotional strategies as well as innovative EV technologies. However, it has had no significant impact on consumer trust and perceived usefulness and illustrates that awareness alone is not necessarily translated into trust evaluations or functional. This result is supported by previous findings that environmental cognition is not always directly related to utilitarian perceptions [29,42].

Table 1: Measurement Model of all Constructs Model Results

Constructs	No. of Items	Cronbach's Alpha	Composite Reliability	Average Variance Extracted	Std. Factor Loadings
Environmental Awareness (EA)	4	0.814	0.885	0.638	0.802
Market Readiness (MR)	5	0.715	0.850	0.641	0.832
Environmental Concern (EC)	3	0.778	0.880	0.694	0.856
Green Marketing (GM)	4	0.814	0.885	0.638	0.798
Consumer Trust (CT)	5	0.799	0.877	0.622	0.781
Perceived Usefulness (PU)	4	0.972	0.984	0.895	0.964
Behavioral Intention (BI)	3	0.939	0.972	0.893	0.951
Technological Innovation (TI)	5	0.902	0.946	0.830	0.919
Purchase Intention (PI)	5	0.936	0.948	0.895	0.928

Source: Authors own calculation with SEM PLS

Table 2: Discriminant Validity and the Correlations

Constructs	EA	MR	EC	GM	CT	PU	BI	TI	PI
EA	0.805	-	-	-	-	-	-	-	-
MR	0.622	0.807	-	-	-	-	-	-	-
EC	0.584	0.596	0.84	-	-	-	-	-	-
GM	0.578	0.655	0.683	0.805	-	-	-	-	-
CT	0.569	0.549	0.618	0.632	0.795	-	-	-	-
PU	0.147	0.156	0.165	0.274	0.131	0.854	-	-	-
BI	0.137	0.146	0.147	0.212	0.124	0.282	0.853	-	-
TI	0.165	0.211	0.066	0.08	0.102	0.056	0.231	0.882	-
PI	0.312	0.318	0.385	0.403	0.429	0.085	0.033	0.293	0.919

Source: Authors own calculation with SEM PLS

Market readiness shows the greatest impact on a number of constructs, particularly, the concepts of GM (β = 0.488, p<0.001), CT behaviour (β = 0.274, p<0.01), PU (β = 0.173, p<0.001) and TI (β = 0.344, p<0.001). This indicates the important influence of infrastructure, policy incentives and market maturation on the perception of EV adoption which is producing similar results with studies emphasizing infrastructure readiness for driving EV adoption [25,26,32,36]. Environmental concern has a significant impact on GM, CT, PU and TI but not on BI. This indicates that emotional concern develops the attitudinal and trust-based evaluation and are less correlated with the technological assessment that also supports the idea that moral and affective motives are different from the technological cognition [37,40].

The purchase intention is considerably predicted in all the adoption behavioural constructs. Behavioural intention has the highest effect (β=.473, p<0.001) followed by PU (β=.255, p<0.001), GM (β=.233, p<0.01), CT (β=.181, p<0.05) and TI (β=.155, p<0.01). This provides validation to the behavioural intention as the first-order proximal determination of EV purchase which is also found to be the case in TAM and TPB based studies [27,35]. The picture comes of the huge impact of green marketing and trust is another sign of the importance of strategic communication and credibility to accelerate the diffusion of EVs. Overall, the current findings are able to validate the mediating role of the adoption behavioural constructs in the translation of the stimulating factors to the purchase intention and also demonstrates that the environmental and market stimulation factors indirectly affect the purchase intention for EVs through the behavioural and the technological perceptions. These results expand on the previous models for EV adoption by considering multi-dimensional behavioural mediators and have powerful theoretical and managerial implications for policy makers and marketers.

Table 4 demonstrates the mediating effects of some of the behavioural constructs related to adoption in the relationships between stimulating and purchase intention of stimulating factors using bootstrap confidence intervals. The results have sound evidence of the partial and multiple mediation mechanisms in confirming the theoretical proposition of the positive influence of stimulating factors on the EV purchase intention through the mediating effects of behavioural and technological constructs. For Environmental Awareness (EA) the indirect routes using the behavioural constructs of adoption are all significant as confidence intervals did not contain zero.

Table 3: Structural Model Results of Stimulating and ABC Constructs for PI and Effects Sizes (f2)

Criterion variable	Predictor variable	Path coefficient (β)	Std. Dev.	T	f^2	Hypothesis accepted or not
GM	EA	0.249***	0.069	6.510	0.057	H1a Accepted
	MR	0.488***	0.072	1.071	0.201	H2a Accepted
	EC	0.186**	0.077	4.604	0.033	H3a Accepted
CT	EA	0.029	0.063	.879	0.001	H1b Not Accepted
	MR	0.274**	0.066	6.734	0.026	H2b Accepted
	EC	0.161*	0.080	3.715	0.013	H3b Accepted
PU	EA	0.001	0.062	.042	0.000	H1c Not Accepted
	MR	0.173***	0.065	5.251	0.009	H2c Accepted
	EC	0.141*	0.076	3.506	0.006	H3c Accepted
BI	EA	0.422***	0.060	11.280	0.198	H3d Accepted
	MR	0.081	0.041	.051	0.000	H3d Not Accepted
	EC	0.319***	0.095	5.152	0.019	H3d Accepted
TI	EA	0.224**	0.081	4.690	0.039	H3e Accepted
	MR	0.344***	0.078	7.207	0.111	H3e Accepted
	EC	0.084	0.058	.115	0.000	H3e Not Accepted
PI	GM	0.233**	0.087	4.440	0.042	H4a Accepted
	CT	0.181*	0.090	3.627	0.025	H4b Accepted
	PU	0.255***	0.082	5.079	0.063	H4c Accepted
	BI	0.473***	0.074	9.590	0.201	H4d Accepted
	TI	0.155**	0.086	4.145	0.035	H4e Accepted

Source: Authors own calculation with SEM PLS

Table 4: Mediating Effect Analysis of ABC Constructs on PI

	EA→ABV→PI			MR→ABC→PI			EC→ABV→PI		
	95% Confidence Intervals								
Mediating effect	Effect	Lower	Upper	Effect	Lower	Upper	Effect	Lower	Upper
GM	0.358	0.251	0.481	0.296	0.179	0.427	0.358	0.251	0.481
CT	0.047	0.031	0.106	0.064	0.028	0.121	0.05	0.027	0.109
PU	0.053	0.023	0.113	0.081	0.034	0.147	0.06	0.021	0.121
BI	0.086	0.045	0.145	0.105	0.047	0.176	0.086	0.045	0.145
TI	0.088	0.047	0.148	0.102	0.055	0.17	0.088	0.047	0.148
Total effect	0.494	0.305	0.736	0.465	0.243	0.735	0.494	0.305	0.736

Source: Authors own calculation with SEM PLS

Green Marketing have the most (0.358) and Technological Innovation, (0.088), Behavioural Intention (0.086), Perceived Usefulness (0.053) and Consumer Trust (0.047) mediating effect. It can be seen environmental conscious consumers combine their environmental awareness status with purchase intention primarily manifested in their responsiveness to green marketing messages and their technological perceptions. These results are further supported by Nidal [48], who have indicated that knowledge of the environment is not enough if it is not supported by marketing communication and technological credibility [52].

For Market Readiness (MR) all mediating constructs have significant indirect effects where largest mediation is spotted for Green Marketing (borderline = 0.296) and Behavioural Intention (borderline = 0.105). This would appear to highlight the importance of infrastructure, policy incentives and market maturity in terms of behavioural and marketing based vectors in determining adoption of EVs. Previous researches have focused on expressing that policy frameworks, charging infrastructure and economic incentives have significant advantages to the consumer readiness and likelihood of adoption [53,61]. Similarly, Environmental Concern (EC) has significant indirect effect through all mediators with Green Marketing again showing the largest effect (beta: 0.358) followed by Technological Innovation and Behavioural Intention. This suggests that affective environmental concern is a part of making an effort to building a responsiveness towards sustainability-driven marketing and innovation attributes with follow-up research on environmental emotions as the determinant in pro-environmental buying [49,64].

The total indirect effects of EA (v = 0.494), MR (v = 0.465) and EC (v = 0.494) are significant and suggest that stimulating factors are mediated by adoption behavioural constructs to dominant extent by leading to EV purchase intention. These results are consistent with those from previous models of adoption, that mostly take into account behavioural, technological and trust-based mechanisms as proximal determinants of EV adoption [50,51,55]. Overall, results of the mediation analysis confirm a multi-layered transmission mechanism of behavioural responses, through which environmental and market stimuli influence intention to purchase an EV, though, primarily, the mediation of marketing, behavioural intention, technological innovation and perceived usefulness. This adds to the EV adoption theory, where some empirical evidence is gathered to support a comprehensive mediation model consisting of environmental, behavioural and technological constructs in a holistic structural model.

Table 5 indicates the mediating effects analysis between behavior constructs that are adoption regarding the passing of the stimulating factors, to EVs Purchase Intention (PI). Green Marketing (GM) has also realized most consistent mediating effect in terms of significantly higher indirect effects of GM as compared to the Consumer Trust (CT, Perceived Usefulness (PU), Behavioural Intention (BI) and Technological Innovation (TI). The positive contrast values and confidence intervals with no significant inclusion of the value of zero mean that marketing communication with focus on sustainability has a dominant like on translation of environmental and market stimulus on the consumer purchase decision. This finding is part of an increasingly large body of evidence that sustainability cues facilitated by marketing and policy communication plays an important role in the adoption behaviour of EVs [61].

The comparisons of measurements of the Consumer Trust and Perceived Usefulness (CT/PU) also a positive and significant difference to suggest that the perceived use in trust transaction could have rather important mediation than solely effect based perceptions. This is consistent with other research which has focussed on the importance of institutional trust and policy credibility and reducing risk in perception being an important factor in driving EV diffusion [60]. However, contrasts in CT, PU, BI and TI, are usually smaller and are often statistically insignificant suggesting these mediators have similar indirect effects and are complementary mechanisms rather dominant mechanisms. The difference between the PU/BI and the PU/TI are showing the moderate positive effects which implies the mediating role of perceived usefulness is stronger than behavior intention and technological innovation in some of the pathways.

Table 5: Comparison of Mediating Effects of ABC Constructs on PI

Comparison of Mediating effect	EA→ABC→PI		MR→ABC→PI		EC→ABC→PI	
	95% Confidence Intervals					
	Effect	(Lower, Upper)	Effect	(Lower, Upper)	Effect	(Lower, Upper)
GM/CT	0.311	(0.145, 0.450)	0.232	(0.058, 0.399)	0.308	(0.142, 0.454)
GM/PU	0.305	(0.138, 0.458)	0.215	(0.032, 0.393)	0.298	(0.130, 0.460)
GM/BI	0.272	(0.106, 0.436)	0.191	(0.003, 0.380)	0.259	(0.106, 0.436)
GM/TI	0.270	(0.103, 0.434)	0.194	(0.009, 0.372)	0.254	(0.103, 0.434)
CT/PU	0.312	(0.182, 0.379)	0.265	(0.049, 0.267)	0.300	(0.194, 0.388)
CT/BI	0.039	(0.114, 0.061)	0.041	(0.148, 0.074)	0.036	(0.118, 0.064)
CT/TI	0.041	(0.117, 0.059)	0.038	(0.142, 0.066)	0.038	(0.121, 0.062)
PU/BI	0.245	(0.122, 0.268)	0.186	(0.042, 0.250)	0.219	(0.124, 0.276)
PU/TI	0.331	(0.122, 0.268)	0.296	(0.006, 0.392)	0.328	(0.127, 0.374)
BI/TI	0.002	(0.103, 0.098)	0.003	(0.123, 0.121)	0.002	(0.103, 0.098)

Source: Authors own calculation with SEM PLS

This brings our attention to the importance which functional aspects of performance in terms of cost and saving, ease of charging, driving range, etc. have in the formation of adoption behavior [43]. On the other hand, the very close to zero differences between Behavioral Intention and Technological Innovation (BI/TI) leads to the impression that behavioral readiness and technological perceptions have equal but balanced role to play in the mediation process [62]. Overall, the research results imply the existence of a mediation hierarchical structure green marketing communication plays the most important transmission mechanism are followed by trust and positive perception of usefulness as mediating variables and behavior intention and technological innovation as supporting mediating variables. These results go beyond theory of EV adoption, by incorporating behavioral marketing mechanism and technology and policy driven determinants in coherence with recent policy and techno-economic research about the synergy of communication, infrastructure and innovation in driving EV diffusion [1,4,63].

DISCUSSION

This study focused on the mediating effect of adoption behavioural constructs (ABC) in the associations of stimulating factors, such as EA, EC, MR and PI of the consumers. The structural model results, measurement model validation and mediation analyses is good empirical evidence to the proposed conceptual framework.

Impact of Stimulating Factors on Adoption Behavioural Constructs

The results further show the significant effect of stimulating factors on the adoption behavioural constructs, but at a different degree and significance. Environmental awareness had a significant effect on green marketing, behavioural intention and technological innovation whereas, consumer trust and perceived usefulness had no significant effects. This brings us to the view that awareness may not really provide enough to build trust and/or functional evaluations which require reinforcement (both experientially and institutionally). This finding is supported by Lin & Shi [29], that environmental knowledge result in stronger provisions for attitudinal and behavioural receptivity but fails to in and of itself engender utility perceptions and trust without the supportive structure [6]. Market readiness stated a most prevailing stimulating factor, making a significant impact on green marketing, trust, perceived usefulness and technological innovation of the consumer. This validates the availability of infrastructure; supportive policies and the maturity of market have good behavioural and technological perceptual influences. Market readiness is also rested indirectly as a way of increasing perceived control and reduction of adoption barriers in order to increase behavioral intention to support behavioral designation towards explaining technology adoption and the theories of intention to use attitude and perception behavioral (UTAUT and TPB) in a support of behavior change [45,46].

These findings are similar to those from prior research that shows the important influence of policy incentives, charging infrastructure and regulatory frameworks on the perception of EV adoption [4,25,26,36]. Environmental concern ad had a high impact on green marketing, consumer trust, perceived usefulness and behavioural intention but not technological innovation. This suggests that affective environmental motivations are based on attitudinal and trust-based perceptions more than on technical evaluations based on technology. Previous studies also have found a stronger influences of moral and affective drivers to the adoption of the intentions and attitudes, although the technological cognition is more dependent on functional and infrastructural factors [12,37].

Impact of Adoption Behavioural Constructs on Purchase Intention

All the adoption behavioural constructs were found to be a significant predictor of the PI thus supporting H4a- H4e. Behavioural intention showed the biggest effect among the study variables on purchase intention indicating that it is the most proximal influencing reflection that determines its adoption behaviour in accordance with TPB and TAM [55] [56]. PU was also found to have a significant impact on the PI showing the importance of functional benefits (cost saving, performance, convenience) to driving the adoption of EVs [53,54]. GM had a significant impact in affecting the PI, therefore suggesting that communication and branding strategies that are sustainability-oriented are effective in stimulating EV adoption behaviour. Ouyang *et al*. [52], have produced similar results that green marketing and environmental message marketing improves green purchase intention and moderates the effect of the technological features [40]. Consumer trust also demonstrated an important prediction of purchase intention verifying the impact of institutional trust and technology trust on mitigating perceived risk and uncertainty on EV purchase [48-50]. Technological innovation had positive effect on the purchase intention which showing perception on advanced technology, innovation and system integration has effect on decision of consumer. This is consistent with other research work's finding of the influence of innovative business models, vehicle to grid systems and technological development on influencing the adoption behaviour towards EV vehicles [51,57,58].

Mediating Role of Adoption Behavioural Constructs

The results of the mediation analysis show powerful evidence of mediating relationships of stimulating factors on behavioral constructs of adoption and purchase intention and provide support to H5a-H5c. Green marketing was found

as the most mediating variable in all the stimulating pathways (in this order): behavioural intention, technological innovation, perceived usefulness and consumer trust. This hierarchical structure of mediation implies the environmental stimulus and market stimulus influences the purchase intention in the major extents through the marketing induced behavioural mechanism and the technological perception. These findings contribute to previous studies as it provides empirical evidence of such a circumstance where the stimulation factors do not directly relate to the adoption decision but are forwarded to the behavioural and technological constructs. Policy and infrastructure studies suggests in similar vein of indirect influence of external stimuli such as perceived usefulness, trust and feasibility of innovation on the adoption behaviour [42,43,44]. The important total indirect effects support centrality of behavioural mediation mechanisms in the EV adoption process which goes for behavioural and technological level frameworks integration in the sustainable mobility studies [17,45]. The pairwise mediation comparisons continues to demonstrate that green marketing is significantly better than the other mediators although behavioural intention and technological innovation have similar mediating powers. This implies that persuasive sustainability communication and technological perceptions provide a joint role in driving EV adoption behaviour whilst trust and usefulness are complementary mechanisms. Broadbent *et al*. [8], highlight the nature of communication strategies, policy messaging in conjunction with technological credibility towards helping to accelerate the diffusion of EVs [1,63].

Theoretical and Practical Implications

This research still adds some theoretical contributions as it extends the already well-established technology adoption frameworks (TAM, TPB and UTAUT) via this combination of stimulating factors (environmental awareness, environmental concern and market readiness) and adoption behavioural constructs as mediating mechanisms. The finding indicated the effect of EC and MR on the PI to have EVs via primary motivational route, behavioural and technological support the models of the adoption process in sustainability of mobility into a multi stage [45]. Furthermore, green marketing and behavioural intention as mediator dominance brings forward the diffusion and pro-environmental behaviour theories depicting the essential role of sustainability communication and psychological readiness in EV adoption [32,40]. Practically, the finds also have important implications to the policymaker's industry stakeholders. Policymakers ought to boost market readiness by increasing the charging infrastructure, financial incentives and supportive regulatory frameworks in order to increase consumers trust and the perceived usefulness [25,26,32,41]. In this case, it is important for EV manufacturers to invest in technological innovation and reliability so that they can increase the perceived technological value of EVs and reduce the uncertainty in adoption [52]. Marketers should have specific green marketing campaigns aimed at passing an effective message on environmental and economic rewards across, especially to youth and middle income, important potential adopters. On the whole, there exists a need for concerted policy, technological marketing strategies for the accelerated EV diffusion and sustainable transportation transition [1,61].

CONCLUSION

The interplay of stimulating factors, adoption behavioural constructs and intention to purchase provides important information about the EVs adoption behaviour from the consumers. This study was aimed at investigating the Impact of environmental awareness, market readiness and environmental concern through behavioural and technological mediators on the purchase intention of EVs. Using large scale survey data and PLS-SEM modelling some important findings were obtained. First, stimulating factors have significant impacts on adoption behavioural constructs although they had different impacts on constructs. Market readiness stated a most prevailing stimulating factor, making a significant impact on green marketing, trust, perceived usefulness and technological innovation of the consumer. Environmental awareness and environmental concern were found, also, to have significant impact on behavioural intention and also green marketing suggesting the presence of both cognitive and affective environmental drivers in shaping behavioural perceptions towards EVs. Second, all the adoption behavioural constructs, green marketing, consumer trust, perceived usefulness, behavioural intention and technological innovation, had a positive impact on PI which confirmed that behaviour and technological perceptions have a critical role in EV adoption decisions. TI was found to be the most powerful predictor of the PI followed by PU and GM.

Thirdly, the mediation analysis has confirmed that adoption behavioural constructs are important transmission mechanisms, which stimulate factors have on EV purchase intention. Green marketing, behavioural intention and technological innovations and perceived usefulness demonstrated the overriding mediating role followed by consumer trust the mediating role. These results highlighted the following such as external environmental and market stimuli are transposed in purchase decisions that are realised mostly through behavioural and technological evaluations instead of through direct effects. Overall, this study offers a comprehensive behavioural technological framework for understanding EV adoption and makes valuable insights for policy makers and industry players to establish specific strategies to drive the diffusion of EVs in emerging markets in the quickest possible pace.

Future Research Directions

Although this study has a relevant empirical information, some limitations ought to be overcome in future studies. First, data collection was only from India and therefore the generalisability of findings to other geographical contexts might be limited. Future studies are needed to perform some cross-country comparative studies in order to validate the suggested model on other different cultural, economic and political contexts. Second, present study was performed from cross sectional data which has limited the ability to understand dynamically the change in perception and the adoption behaviour of consumers over time. Future studies should be conducted working with longitudinal research design to examine the impact of ABC constructs and PI between mature EV markets and policies over time.

Third, the model was focused on certain stimulating factors and behavioural constructs. Future studies could contain other factors like perceived risk, charging anxiety, social influence, government trust and financial incentives to strengthen the power of the model along with other factors. Moreover, moderating influences of demographic variables and the market characteristics might be guided in order to identify the heterogeneous segments of consumers. Finally, this study was based on the measurement of purchase intention and not actual EV purchase behaviour. Future studies should look into the intention-behaviour gap by combining actual adoption data and usage behaviour and post-purchase satisfaction to gain a more comprehensive picture on the EV diffusion dynamics. In conclusion, future research to include the behavioural, technological and policy perspectives in time and space will enable more robust and generalizable understandings to promote the global shift to sustainable electric mobility faster.

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