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RESEARCH ARTICLE

Empowering Indian consumers to embrace electric vehicles through the unified theory of acceptance and use of technology

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Abstract

The Indian transport sector accounts for the highest share of greenhouse gas emissions. Traditional vehicles replacing with electric ones are India's only viable solution to reduce greenhouse gases. "Electric Vehicles (EVs)" might significantly lessen the negative effects of the transportation sector on the environment. In this research, we use a unified theory of acceptance and use of technology (UTAUT) model to assess consumer intent to embrace EVs as a means of transportation. "Data from 200 Indian respondents were collected using a purposive sampling strategy, and the results were analyzed using the Amos structural equation modeling technique". According to the findings, there is a considerable impact of "Performance Expectancy,""Effort Expectancy", "Social Influence", "Facilitating Conditions", and "Price Value" on consumer adoption intentions for "electric vehicles". The findings of this study will provide valuable insights for policymakers and manufacturers in developing effective marketing tactics that enhance "Customer Motivation, Awareness, and Value Generation" for "electric vehicles for sustainable development.

Keywords: Electric vehicle, UTAUT model, Consumer intention, EVs adoption intention, Sustainable, Greenhouse gases.

Introduction

Population growth and emerging economies (such as "China, Russia, India, etc.") expand, and the demand for fossil fuels has increased dramatically (Khazaei, 2019). "Oil, coal, and natural gas" can be the sole sources of energy in the future, but they still meet a large fraction of global demand (Farooqi *et al*., 2021). When fossil fuels are utilized for transportation and industry, they also increase emissions of pollutants and greenhouse gases (GHG) (Global EV Outlook 2019 – Analysis, n.d.). To address the problem of carbon emissions, businesses have implemented measures to reduce environmental pollution from the point of view of their customers by adopting ecologically friendly products (Amran *et al*., 2016). Given Earth's current bleak environmental situation, lowering emissions of greenhouse gases should be a primary priority.

It is important to keep in mind that road vehicles are the biggest contributors to GHG emissions and other pollutants when thinking about the environmental impact of transportation options; they are responsible for about 75% of global CO_2 emissions from the transportation sector and about three-quarters of urban air pollution (Lefevre & Enriquez, 2014; World Energy Outlook 2020 – Analysis - IEA, n.d.). This has resulted in a major rise in vehicular carbon emissions, which has prompted the Government of India (GoI) to investigate several options for addressing the issue. The widespread availability of electric vehicle (EV) mobility is a crucial policy (Singh *et al*., 2023).

The rising cost of crude oil because of the crisis in Russia and Ukraine, as well as other international tensions, has prompted India to rapidly transition to EV as its primary mode of transportation (Deb *et al*., 2021). In addition, the demand for "electric vehicles" in India has seen a revolution because of the country's strict emission rules, trash policy, and environmental consciousness (Singh *et al*., 2022; Dixit & Singh, 2022). The Indian government's support of EVs in terms of tax policy and incentives has led to a shift in

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consumer preference. Furthermore, by 2021 estimates, India will have the world's fourth-largest vehicle sector (Das & Bhat, 2022). As can be seen in Figure 1, most Indian customers choose battery electric vehicles (BEVs) over plug-in hybrid electric vehicles (PHEVs), and the demand for them is expected to grow to 75% by 2030 (Hema & Venkatarangan, 2022).

The technology acceptance model (TAM) and the unified theory of acceptance and use of technology (UTAUT) model are only two of the many theories that have been used to examine the processes that lead to widespread technology implementation (Madigan *et al*., 2016, 2017). An enhanced TAM was used to predict the possibility that people in India would embrace EVs by considering ethical issues, legal difficulties, and trust (Ramjan & Sangkaew, 2022). They validated the importance of ethical considerations, regulatory concerns, and confidence in technology in India's adoption of EV choices. The researchers also observed that societal factors, specifically those related to the implementation of artificial intelligence technology, play a substantial influence in influencing the pace of technological adoption. It has been shown via studies that socially relevant elements, as well as technical effort and benefit perceptions, can have an impact on consumers' opinions. The phrase "perceived values" is used to explain how consumers' valuations of a product's monetary, ecological, utilitarian, and affective merits influence their final purchase choices (Tian & Wang, 2022). To learn more about the conceptual obstacles that prevent customers from buying "electric vehicles", the UTAUT model is continually being updated.

"The primary aim of this research is to examine the suitability of the UTAUT framework in comprehending the determinants that impact the acceptance and utilization of EVs among consumers in India. The primary objective of this research is to identify the key characteristics that significantly influence the adoption of EVs among customers in India". These factors include "expected performance, expected effort, social impact, and enabling circumstances." The study aims to help policymakers, manufacturers, and other stakeholders in India develop sustainable transportation and reduce environmental impact by promoting EV adoption by examining factors like driving range, charging infrastructure availability, perceived effort in charging and affordability, social norms, and government policies.

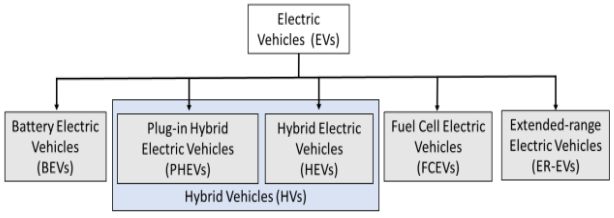

Figure 1: Electric vehicles classification (Makeen *et al*., 2022; Sanguesa *et al*., 2021)

Electric Vehicles and Their Types

Vehicles that are propelled by electric or traction motors are referred to as EVs. The level of electrification varies from vehicle to vehicle. In general, it is classified into five categories (see Figure 2):

Battery electric vehicle – All-electric vehicle

The all-electric vehicle (AEV) or battery electric vehicle (BEV) is propelled by an electric motor and high-capacity batteries (Figure 3). It has no fuel cell, gasoline tank, or internal combustion engine, instead relying only on its battery pack for propulsion. Plugging the vehicle into a charging point is the sole option for maintaining its battery life (He *et al*., 2012; Iversen *et al*., 2014).

Hybrid electric vehicles

The majority of EVs on the road now are hybrid electric vehicles (HEVs). HEVs include a small rechargeable battery that is charged not by plugging it in but by an internal combustion electric motor and/or the braking system. The HEV is a multi-energy system because its batteries can produce and store electricity, unlike the batteries of conventional vehicles, which can only create power. HEVs will continue to grow in popularity because these vehicles are capable of satisfying consumers' requirements (Shen *et al*., 2011). Figure 4 indicates the architecture of HEV.

Plug-in hybrid electric vehicles

Compared to BEVs, plug-in hybrid electric vehicles (PHEVs) (PHEVs) have smaller battery packs. For short commutes

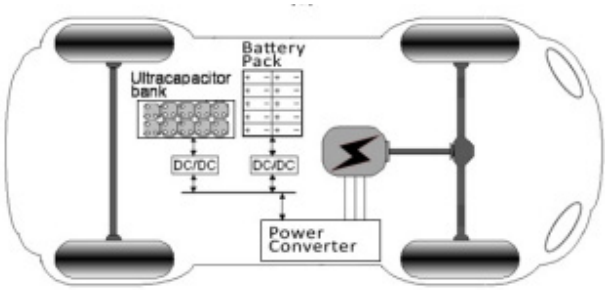

Figure 2: Architectural diagram of BEV (Mahmoudi *et al*., 2014)

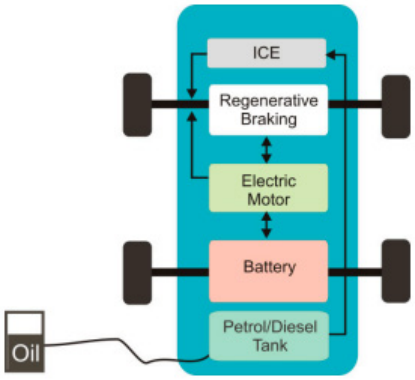

Figure 3: Architectural diagram of HEV (Alosaimi *et al*., 2021)

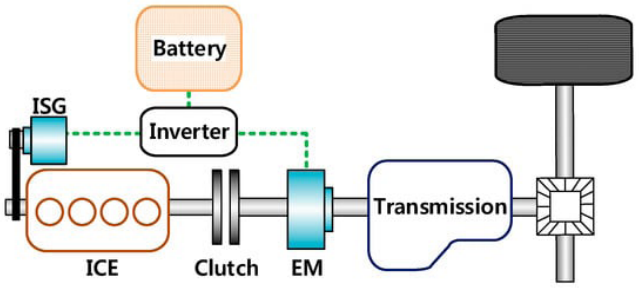

Figure 4: Architectural diagram PHEV (Sim *et al*., 2017)

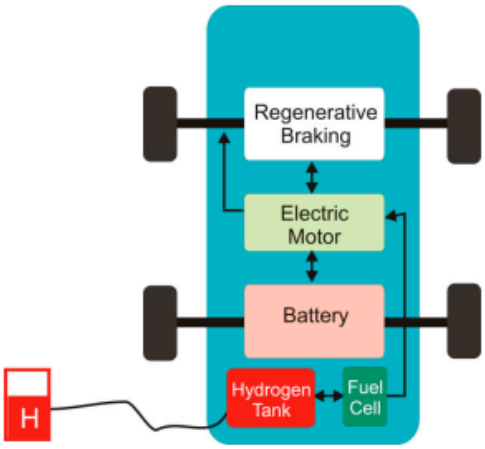

Figure 5: Architectural diagram of FCEV (Alosaimi *et al*.,2021)

and around town, plug-in hybrids are ideal. Plug-in hybrid electric vehicles are now widely available. PHEVs can be charged either by connecting to an electrical outlet or by utilizing the vehicle's onboard generator. Plug-in hybrids provide valuable fuel flexibility. Compared to HEVs, PHEVs have a bigger battery and a more powerful motor, but the selection is still restricted. The system includes an internal combustion engine (ICE), an electromagnetic (EM), an inertial guidance (IG) system, a clutch, a transmission, and a final reduction gear (Kim *et al*., 2014). Figure 5 indicates the architecture of PHEV.

Fuel-cell electric vehicles

Fuel-cell electric vehicles (FCEVs) are distinct from other types of EV. FCE is fuelled by a hydrogen fuel cell and emits only water vapor and warm air. The fuel cell in FCEVs converts chemical power into electrical power, but the hydrogen fuel is stored in a tank. Therefore, there is less of a concern for energy density and range (Offer *et al*., 2010). Figure 6 indicates the architecture of FCEV.

Extended-range EVs

These vehicles are very comparable to battery EV. However, if the batteries ever run low, the extended-range EVs include a backup internal combustion engine to charge batteries. In contrast to the engines present in PHEVs and HEVs, this particular type of engine is just employed to charge and does not possess any connection to the propulsion of the vehicle. Table 1 indicates the advantages and disadvantages of EV types.

In this study, the application of the UTAUT for EV adoption among Indian consumers is proposed. This study

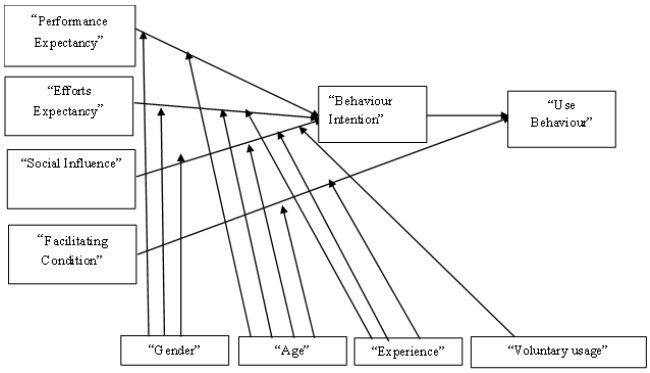

Figure 6: The UTAUT (Ayaz & Yanartaş, 2020; Shore *et al*., 2018)

Table 1: Comparing major available EVs: Advantages & disadvantages

Technology	*Advantages*	*Disadvantages*
HEV	Reduced fuel use and pollutants; potential energy recovery through regenerative braking.	Two power trains increase the complexity of the build and increase the potential for energy loss during transmission (raising the original cost).
PHEV	The potential for grid connection is high; fuel consumption and emissions are decreased; performance is maximized; energy is recovered while braking; The capacity to emit no pollutants at all.	Higher initial cost; construction complexity combining two power trains (Transmission Power loss); component availability; high expenses of batteries and battery renewal; Consider adding weight.
BEV	Reduced operating expenses due to the use of cleaner electric energy; Zero-emission Vehicles; overnight battery charge; energy recovery through regenerative braking; and Low noise production.	Range limitations: Still developing battery technology and deficient public charging infrastructure.
FCEV	There are no harmful byproducts released into the atmosphere (other than water and heat), and the vehicle uses far less energy than a traditional internal combustion engine (ICE).	Hydrogen generation and onboard storage security issues; Higher upfront cost Hydrogen refuelling stations should be easily accessible and reasonably priced (infrastructure needs improvement); In-progress normative work; Capability of mass production.

is defined as follows: Section 2 provides a literature study of relevant prior work; Section 3 provides a UTAUT model and hypotheses. Section 4 defines the methodology. In Section 5, the result and comparison analysis has been done. In section 6 conclusion and future have been explained.

Review of Literature

This section provides a summary of research published on the topic of using the UTAUT to promote the adoption of EV among Indian customers. Comparison between the reviewed literature as shown in Table 2. According to the objectives, the review of the literature has been divided into three areas, which are outlined below:

- "Adoption of electric vehicles in India"
- Unified theory of acceptance and use of technology (UTAUT)
- "Impact of UTAUT in adoption of electric vehicles in India"

Adoption of Electric Vehicles in India

Numerous solutions have been proposed to address the worldwide issue of environmental deterioration, including increased usage of renewable energy sources and other measures that minimize greenhouse gas emissions. Because transportation is the primary source of GHG emissions, EVs can be utilized as an alternative. EVs have significant advantages and can be utilized in a variety of applications, there are numerous hurdles in their widespread adoption (Kumar & Padmanaban, 2019). The implementation of EVs represents a significant effort to mitigate CO2 emissions and address global environmental challenges (Aswani *et al*., 2018). The Indian government has expressed its ambitious aspirations to introduce EVs into the Indian market, aligning with the global trend. The promotion of EV is being actively pursued worldwide as a means to counteract the adverse impacts of fossil fuel emissions and address environmental concerns. In this regard, the Indian government has set a target for the complete adoption of EVs on Indian roads by the year 2030. Numerous aspects influence a consumer's acceptance of an EV; nevertheless, attitude (ATT) emerged as a powerful mediator, impacting the adoption of EVs (Khurana *et al*., 2020). Perceived Environmental benefits and financial incentives had been identified as important motivators for EV adoption (Verma *et al*., 2020). EVs were promoted as a clean and green technology that may help usher in a smoother transition to a transportation system with less greenhouse gas emissions and less strain on our planet's finite natural resources (Tarei *et al*., 2021). The rate of EV uptake was calculated using factors including driving ability and dependence. "Electric vehicle (EV)" adoption is hindered by several factors, including poor performance and range, high total cost of ownership, a dearth of public charging stations, and a general lack of knowledge about EV technology.

Unified Theory of Acceptance and Use of Technology

A decade ago, (Venkatesh *et al*., 2003) constructed and developed UTAUT based on eight competing models of technology acceptance to unite the field of technology acceptance research. Among these are "the PC utilization model, the innovation diffusion theory (IDT), the social cognitive theory (SCT), and a model combining the technology acceptance model and the theory of planned behavior (C-TAM-TPB)". Contrary to expectations based on SCT, neither self-efficacy nor anxiety appear to be direct predictors of intention to use (Yang & Yoo, 2004). UTAUT does not believe that self-efficacy and anxiety significantly affect ITU because they are not direct predictors of ITU.

Table 2: Comparison between the reviewed literature

Author's name	*Techniques*	*Outcomes*
(Chaveesuk *et al*., 2023)	Quantitative method	"The research found that factors including performance expectations, effort expectations, favourable conditions, environmental benefits, and financial incentives all play a role in the likelihood of Thai customers adopting autonomous vehicles."
(Gunawan *et al*., 2022)	SEM	"The findings of the study indicate that the model offers a precise assessment of the research variables."
(Abbasi *et al*., 2021)	PLS-SEM	"The results indicated that there is a substantial association between Effort Expectancy, Social Influence, Technophilia, Perceived Environmental Knowledge, and Purchase Intention towards electric vehicles, but not Performance Expectancy."
(Ashraf Javid *et al*., 2021)	PLS-SEM	"According to the findings of this study, "Awareness Of Consequences (AC), Ascription of Responsibility (AR), and Social and Economic Values (SEV)" are Significant Predictors of "Personal Norm (PN), while Personal Norm (PN) and Personal Preferences (PP)" are also positive predictors of travellers' willingness to buy and use."
(Jain *et al*., 2022)	PLS-SEM	"Based on the findings of this study, it has been observed that the factors of «Performance Expectancy and Facilitating Conditions» have a favourable impact on the intention to adopt electric vehicles (EVs). Conversely, the perception of risk has a negative influence on the desire to adopt EVs. The study found that government support has a role in moderating the link between Perceived Risk and Adoption Intention, hence mitigating the negative relationship between Perceived Risk and Adoption Intention."

Attitude toward technology, unlike self-efficacy and anxiety, is a complex (multi-dimensional) construct involving many different factors.

Impact of UTAUT in Adoption of Electric Vehicles

GHG emissions have been steadily rising over the past several decades, and the transportation sector is largely blamed. EVs provide the possibility of facilitating a transition from traditional petroleum vehicles to electric mobility in road transport, which is of interest in the context of analyzing the environmental implications of transportation. Even though EVs potentially have significant positive effects on the environment, they have yet to achieve widespread market adoption. Developing nations are particularly affected by this. The low rate of EV adoption is largely attributable to consumers' lack of curiosity about and familiarity with EVs' advantages. Consumer interest in EVs and environmental consciousness using a UTAUT model that included incorporated "Perceived Environmental Consciousness and Technophilia" (Abbasi *et al*., 2021). While "Performance Expectancy" was not shown to be related to any of the other variables, a strong correlation between "Effort Expectancy," "Social-Influence," "Technophilia," "Perceived Environmental Knowledge," and "Purchase Intention" toward "Electric Vehicles" was discovered. While "Perceived Risk" does negatively impact "EV Adoption Intention," the relationship between "Perceived Risk" and "Adoption Intention" is moderated by government assistance, lessening the inverse association between "Perceived Risk" and "Adoption Intention" (Jain *et al*., 2022). "Performance Expectancy," "Effort Expectancy," "Facilitating Conditions," "Environmental Benefits," and "Purchase Subsidy" are significant drivers of consumer adoption of autonomous vehicles in Thailand (Chaveesuk *et al*., 2023). Stakeholders should focus on strengthening several factors, including "Ease of Use, Flexibility, Clarity, Understanding, and Social Status", to boost customers' propensity to embrace autonomous vehicles. "Attitude Toward Usage (ATU)", "Subjective Norm (SBN)," and "Perceived Behavior Control (PBC)" from the "Theory of Planned Behavior (TPB)" all have a role in how people feel about EVs (Gunawan *et al*., 2022). At the same time, "performance and effort expectations," "hedonic motivation," "price value," and "functional, financial, and social risks" all affect ATU. Situations that facilitate change also affect PBC. The greatest influence on the adoption of EVs comes from the ATU factor. "Awareness of consequences (AC)", "attribution of responsibility (AR)", and "social and economic values (SEV)" are all significant predictors of "Personal Norm (PN)", and "Personal Norm (PN)" and "Personal Preferences (PP)" are both positive predictors of travelers' readiness to buy and utilize (Ashraf Javid *et al*., 2021).

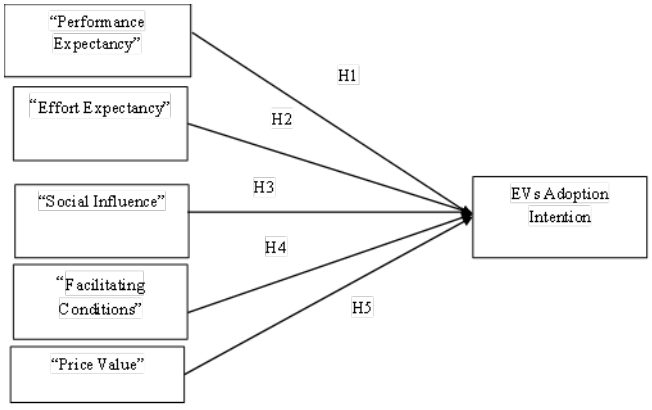

Figure 7: Research model

UTAUT Model and Hypotheses Development

The eight hypotheses of technology adoption under examination by venkatesh and his research team in 2003 were as follows: "TAM, the combination of TAM and TPB (C-TAM-TPB), model of PC utilization (MPCU), innovation diffusion theory (IDT), motivational model (MM), TPB, and the SCT" (Momani, 2020). They concluded that a new theory was needed, and so they suggested the UTAUT include the best features of the previously described theories and models. Figure 7 summarizes the historical development of the hypotheses into a single timeline to better explain the steps that led to the creation of the UTAUT (Ayaz & Yanartaş, 2020). Five factors were used to produce UTAUT in this study:

"Social influence, performance expectation, effort expectation, price value, and facilitating conditions" (Al Mansoori, 2017; Thomas *et al*., 2013).

It also considers four additional factors known to regulate users' acceptance of an IS: gender, age, experience, and voluntary usage. In addition, researchers have paid close attention to UTAUT to experimentally verify the model, and it has been tested effectively in the context of EV adoption (Alharbi & Drew, 2014). Figure 8 indicates the hypothesis based on UTAUT.

Performance expectancy

Positive Expectations (PE) are achieved when people voluntarily adopt novel technologies as a result of being exposed to them through this approach. Perceived utility, as defined in TRA and TAM, has been the driving force behind this construction. The belief system's PE represents student confidence in their ability to improve their knowledge through m-learning. The impression of "Performance Expectancy" is the first factor that is thought to have an impact on people's attitudes regarding driving EV. The attitudes that support people's liking or disliking of something are based on assessments of the object's performance. This implies that a person's favorable preference would increase in proportion to an object's performance (Ajzen, 1991, 2005). The usage of a product is encouraged by people who have the positive attitudes

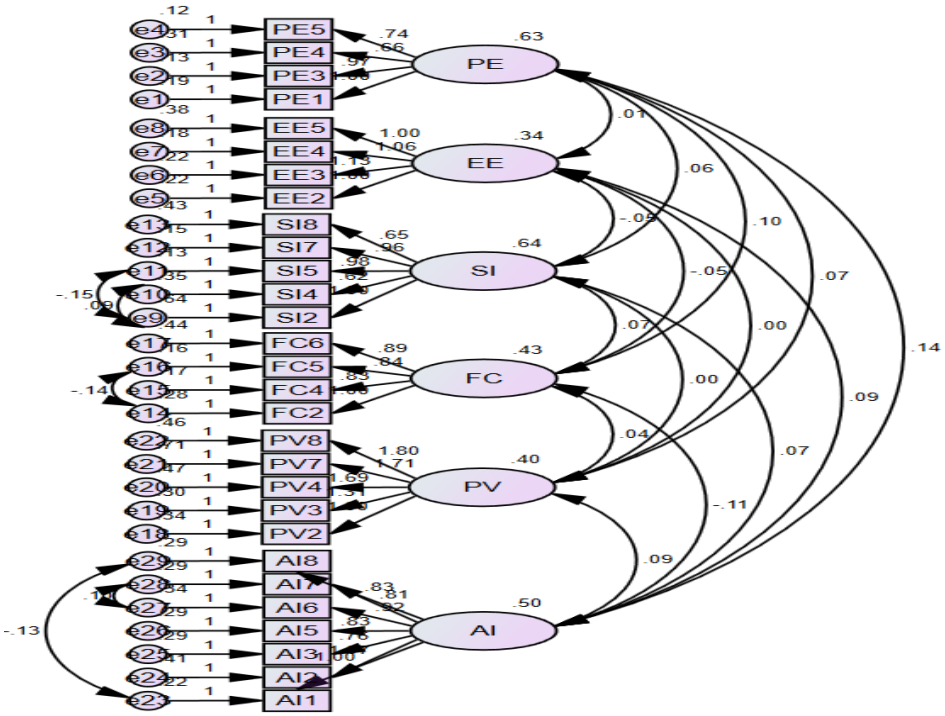

Figure 8: Measurement model

that come from believing that technical advancements are beneficial to their lives (Yuen *et al*., 2020). Based on this, a first hypothesis was developed:

H1. "PE positively influences the adoption intention of EVs in India".

Effort expectancy

Technology adoption can be predicted with the help of EE, which is introduced in UTAUT. "Efforts Expectancy (EE)" refers to how familiar and simple it seems to use a new piece of technology. The second gauge of the effort expectation theory examines the time and energy it takes to learn a technological skill. This approach is analogous to Davis' (1989) concept of perceived ease of use, which analyses how individuals feel about the amount of effort required to utilize various technologies. The UTAUT2 hypothesis, however, was derived from TAM. Technology is simple to use, which promotes a positive outlook, simplicity, and emotions of comfort and enjoyment. Based on this, a second hypothesis was developed:

H2. "EE positively influences the adoption intention of EV in India".

Social influence

"Social influence (SI)" measures how seriously people take the opinions of others when it comes to adopting and using cutting-edge technology. A person's sense of SI is a measure of how strongly they believe that other people share their views about emerging technologies (Miao *et al*., 2014). According to the "Theory of Reasoned Action paradigm", there is a concept called subjective norm. Many models, like the "Theory of Reasoned Action (TAM/TAM2)", the "UTAUT", and others, have utilized the phrase "social norms" to identify their theories and acknowledge their similarities to the SBN found in the "Theory of Reasoned Action model"(Thompson *et al*., 1991) . Each of these topics has its label, but they all share the idea that a person's behavior is affected by their perception of how others would view their use of technology (Venkatesh *et al*., 2012a). Based on (UTAUT 2 model), a third hypothesis was developed:

H3. "SI positively influences the adoption intention of EV in India".

Facilitating conditions

The availability of facilities that assist the respondents' use of TV streaming is referred to as "Facilitating Conditions." The fourth measurement, a facilitating circumstance, is someone's view of infrastructural or technical assistance available for employing a technology or system (Venkatesh *et al*., 2012a). Regarding "EVs", it could be regarded as the availability of batteries, educational materials or maintenance services, home and public charging infrastructures, or post-purchase services. This development of the "unified theory of technology usage" and adoption can be attributed to the making of this connection (Khazaei & Khazaei, 2016). This led to the formulation of the fourth hypothesis:

H4. "FC positively influence the adoption intention of electric vehicles in India."

Price value

The fifth metric is the consumer pricing value of ATU of "EV." While adopting technology, the expenses spent and the apparent advantages are evaluated. With the assumption that technological gains are substantial. Under the assumption that the technology is really useful. If it exceeds the customer's expectations, the product's value will rise, and the customer's degree of satisfaction will change accordingly (Venkatesh *et al*., 2012b). Individual distrust and poor interest in using a product are caused by negative views about the price of the product (Jaafar, 2013). Individuals who believe the product has a pricing advantage, on the other hand, have a favorable outlook. Based on this, a fifth hypothesis was developed:

H5. "Price value (PV) positively influences the adoption intention of EV in India."

Research Methodology

A technique outlines how a researcher conducts their study to offer authentic, trustworthy evidence that meets their objectives. The methodology is a collection of procedures that operate together to generate data and insights relevant to the study topic and the researcher's goals. The relationship between the IDVs and DVs, as established by the study's theoretical model and hypothesis, is depicted in Figure 8. According to the study's theoretical framework, there are five IDVs, including PE, EE, SI, FC, and PV, and one DV, EVs Adoption Intention. These IDVs prompted consumers' motivation to increase their intention to adopt EV.

Measurement of Constructs

This research aimed to identify which aspects of a technology model have the most impact on people's propensity to embrace EVs. The selection of questionnaire measurement items, along with a clear articulation of the research objective, was communicated to the participants through email. Out of the total sample size of 382 respondents, only 200 were deemed genuine for this study. In this study, the "PE" scale comprised six items, the "EE" scale comprised five items, the "SI" scale comprised eight items, the "FC" scale comprised five items, the "PV" scale comprised eight items, and the "AI" scale comprised eight items, all of which were established by Venkatesh (Venkatesh *et al*., 2012b). The questionnaire furthermore encompasses significant demographic data, including age, gender, occupation, educational attainment, and marital status. Several indicators were removed from the analysis because they were found to have "inadequate reliability, convergent validity, extracted average variance, or discriminant validity".

Data Collection and Sample Size

"The primary data for this study was obtained via online surveys aimed at evaluating the factors that influence the purchase of EVs in India". The primary data collection technique used in the study is a questionnaire with closed-ended questions on a 5-point scale. For this investigation, the non-probability sampling method (Purposive Sampling) was applied. To collect data, a questionnaire was circulated through Google Forms in English to people in India who own automobiles. "The questionnaire was partitioned into two sections. Section A encompassed demographic data, including age, gender, educational attainment, occupational position, and marital status. Section B encompasses five essential measures for evaluating EV construction, namely, PE, EE, system integration (SI), functional cost (FC), and performance validation (PV)". A total of 382 responses were obtained via the implementation of Google Forms, out of which 200 were deemed legitimate.

Data Analysis Method

This study employs a structural equation model to examine the validity and reliability of the measurement model, as well as to demonstrate a causal relationship between independent and dependent variables. Examining these variables offers a comprehension study of consumer behavior in relation to the acquisition of EV.

Analysis and Results

Demographic Profile of Respondents

Table 3 displays "the demographic characteristics of the respondents" in terms of their "gender, age group, education, marital status, and occupation". According to

Table 3: Demographic profile of respondents

S. No.	*Demographic Characteristics*	*Category*	*N*	*%*
1.	Gender	Male	126	63.0
		Female	68	34.0
		Others	6	3.0
2.	Age group	18-23 Years	5	2.5
		24-35 years	98	49.0
		36-41 years	71	35.5
		Above 41 years	26	13.0
3.	Educational Background	UG	3	1.5
		Graduate	73	36.5
		Postgraduate	87	43.5
		Ph.D.	37	18.5
4.	Marital Status	Single	24	12.0
		Married	165	82.5
		Others	11	5.5
5.	Occupation	Student	4	2.0
		Employed	151	75.5
		Self-employed	46	23.0
		Unemployed	3	1.5

Table 3, 63.00% of the 200 respondents are men, 34.00% are women, and 3.00% are others. The majority of responders (98) are between the ages of 24 to 35, accounting for 49.00% of the total. Postgraduates account for the majority of responders (87), or 43.50%. The following table reveals that the majority of respondents (151) are employed (75.50%), and the majority of respondents (165) are married (82.50%).

Assessment of the Measurement Model

The AMOS 23.0 software is used for both measurement and analysis. The paper gives a through examination of the four forms of validity and reliability evaluations: "internal consistency reliability, indicator reliability, convergent validity, and discriminant validity". The subsequent findings presented above depict the outcomes of each study conducted to evaluate the soundness and reliability of the measuring model.

Construct reliability and validity

There are three separate ways to determine validity and reliability (Hair *et al*., 2014). Firstly, "average variance extracted (AVE)" was calculated, then calculated "Cronbach's alpha" for each indicator, and then the factor loadings. "Cronbach's Alpha" has been used by scientists and researchers for quite some time to assess the precision of a measuring device. A construct with a high "Cronbach's Alpha" rating indicated that its constituent pieces had a consistent meaning and range (Cronbach, 1947). The construct's validity and reliability are shown in Table 4. "Cronbach's alpha" for all variables was above 0.7, with the individual item "Cronbach's alpha" values between 0.82 and 0.90 and the "composite reliability" of all items falling in the 0.81 to 0.91 range. The build dependability has been proven, and the reliability statistics are more than 0.70 (Hair *et al*., 2011). The "AVE" for each research variable

Table 4: Construct reliability and validity

Constructs	*Items*	*Standardized loadings*	*Cronbach's alpha*	*Composite reliability (CR)*	*Average variance extracted (AVE)*
Performance expectancy	PE1	0.832	0.89	0.89	0.82
	PE3	0.844			
	PE4	0.632			
	PE5	0.958			
Effort expectancy	EE2	0.792	0.85	0.86	0.77
	EE3	0.786			
	EE4	0.849			
	EE5	0.661			
Social interaction	SI2	0.636	0.85	0.86	0.74
	SI4	0.655			
	SI5	0.894			
	SI7	0.882			
	SI8	0.626			
Facilitating conditions	FC2	0.791	0.82	0.85	0.76
	FC4	0.794			
	FC5	0.812			
	FC6	0.662			
Price value	PV2	0.738	0.89	0.91	0.81
	PV3	0.824			
	PV4	0.839			
	PV7	0.789			
	PV8	0.856			
Adoption intention	AI1	0.835	0.90	0.90	0.75
	AI2	0.764			
	AI3	0.704			
	AI5	0.734			
	AI6	0.746			
	AI7	0.727			
	AI8	0.740			

is displayed in Table 4; the AVE value should be greater than 0.5, as suggested by Hair (Hair *et al*., 2010). However, as the convergent validity of the concept is considered to be satisfactory if the AVE is less than 0.5 and the "composite reliability" is better than 0.6, a value of 0.4 is acceptable.

Factor loadings

Table 5 of the factor loading shows that there are 6 constructs and 34 items, with 11 items deleted because the factor loading value is less than 0.5. Because the remaining 23 factor values are greater than 0.5, they are considered in further testing. The "KMO value" is 0.785, and "Bartlett's test value" is significant. That data is appropriate for factor analysis. The elements in the matrix, according to Comrey and Lee, (Lee, 1992), represent the factor loadings for each observed variable on each rotational factor. A high factor loading indicates a significant association between the observed variable and the corresponding factor. The results of the indicator and item loadings demonstrate that the factor loadings of all items are stronger on the underlying construct to which they belong than on the other construct.

Table 5: Factor loadings

	AI	*PV*	*SI*	*PE*	*EE*	*FC*
PE1				.855		
PE3				.889		
PE4				.687		
PE5				.844		
EE2					.747	
EE3					.824	
EE4					.804	
EE5					.680	
SI2			.680			
SI4			.699			
SI5			.831			
SI7			.899			
SI8			.630			
FC2						.669
FC4						.859
FC5						.686
FC6						.695
PV2		.727				
PV3		.831				
PV4		.833				
PV7		.795				
PV8		.848				
AI1	.750					
AI2	.751					
AI3	.688					
AI5	.732					
AI6	.790					
AI7	.750					
AI8	.680					

"Extraction Method: Principal Axis Factoring."
"Rotation Method: Varimax with Kaiser Normalization."
a. "Rotation converged in 6 iterations."

Discriminate validity

"Discriminant validity" is defined by Fornell and Larcker, (Fornell & Larcker, 1981) as the ratio of an idea's AVE square root to its correlation with all other ideas being larger than 0.5. Table 6 presents the outcomes of the "Discriminant Validity" assessment, specifically focusing on the use of Fornell and Larcker's criterion (FL) to evaluate the indicators. "The table demonstrates that the square root of the AVE for a particular construct surpasses its correlation with other constructs". Consequently, it provides additional evidence in favor of the concept of Discriminant Validity.

Assessment of Structural Model

Goodness model fit

"In AMOS SEM analysis, the goodness-of-fit indices are used to determine how well the defined model matches the observed data". AMOS has a number of fit indices that can be used to evaluate model fit (Figure 9). Table 7 shows the goodness of model fit, which includes the "CMIN/DF statistic", which is used to compare the "chi-square statistic" to the "degrees of freedom". A CMIN/DF ratio less than 5 suggests a good match (Hair *et al*.,2009), but the result CMIN/DF value is 2.755, indicating a good and better match. The RMSEA statistic quantifies the discrepancy between the assumed model and the covariance matrix of the population. A value of 0.08 or lower is considered indicative of a satisfactory fit (MacCallum *et al*., 1996), and the RMSEA result of 0.063 suggests that the model fits well. The goodness of fit index (GFI) is a statistical metric that spans a range of 0 to 1. Higher values on this index are indicative of a more optimal fit of the model (Hair *et al*.,2009). In this study, the GFI value was found to be 0.830, indicating strong patterns of variance and covariance in the data. Additionally, an adjusted goodness of fit index (AGFI) score above 0.80 is commonly regarded as indicative of a good fit (Hair *et al*.,2009). Therefore, the AGFI score of 0.796 obtained in this study suggests a good model fit.

Table 6: Discriminant validity

	PE	*EE*	*SI*	*FC*	*PV*	*AI*
PE	0.91					
EE	0.025	0.88				
SI	0.059	-0.123	0.86			
FC	0.183	-0.142	0.13	0.87		
PV	0.136	-0.013	-0.012	0.092	0.90	
AI	0.243	0.23	0.103	-0.226	0.197	0.87

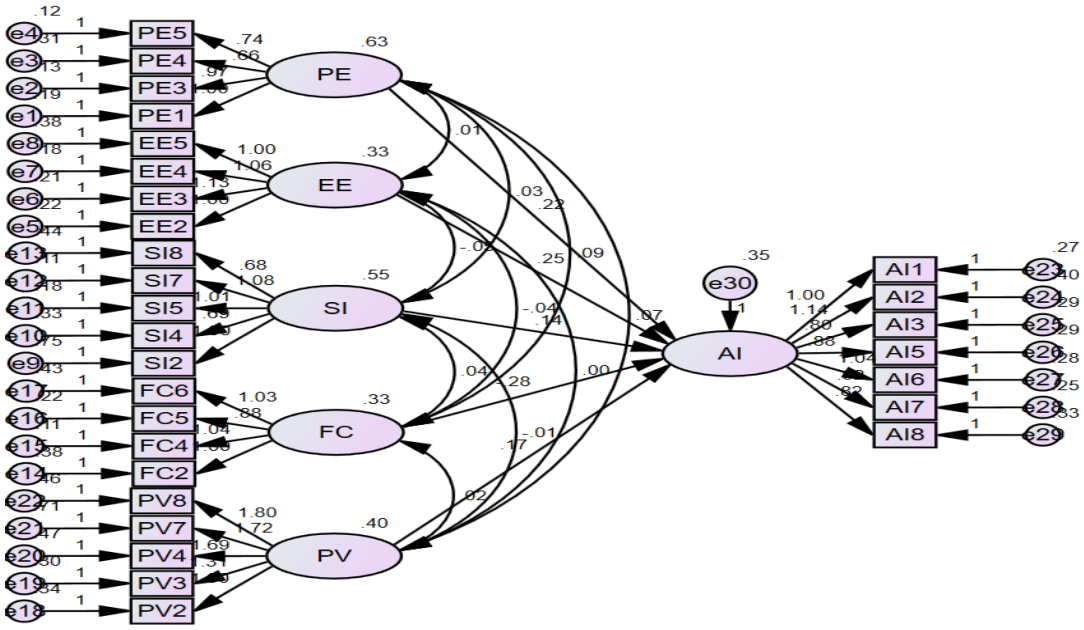

Figure 9: Structural model

Table 7: Goodness model fit

The goodness of model fitness index	*CMIN/Df*	*GFI*	*AGFI*	*RMSEA*
Calculated value	1.784	0.830	0.796	0.063
Required value	Less than 5	More than 0.8	More than 0.80	Less than 0.08

Table 8: Hypothesis testing

S. No.	*Hypothesis testing*	*Standardized estimates*	*t-value*	*p-value*	*Results*
H1	Performance expectancy ---> EV adoption intention	0.218	3.439	.000	Supported
H2	Effort expectancy ---> EV adoption intention	0.249	2.817	.005	Supported
H3	Social influence ---> EV adoption intention	0.136	2.049	.040	Supported
H4	Facilitating condition ---> EV adoption intention	0.279	3.007	.003	Supported
H5	Price value ---> EV adoption intention	0.175	2.243	.025	Supported

Hypothesis testing

The study looked at the influence of PE, EE, SI, FC, and PV on consumers' EV, AI. The impact of PE, EE, SI, FC, and PV on consumers' AI regarding EV was significant (b= 0.218, 0.249, 0.136, 0.279, & 0.175 t = 3.439, 2.817, 2.049, 3.007, & 2.243, p 0.05), supporting all five hypotheses, and the alternative hypothesis is accepted (Table 8).

Conclusion and Policy Implications

The results of the study demonstrate that consumer motivation can be useful in elevating the likelihood that individuals will adopt EVs. This research established links between five factors—anticipated performance, anticipated effort, SI, a conducive environment, and perceived value—that affect consumers' propensity to embrace EVs. In addition, the results of the surveys showed that these factors are sufficient to convince people to purchase EVs. Despite its importance in the literature, this study indicated that none of the characteristics studied–"PE, EE, social influence, enabling circumstance, or price value"—were significant in influencing consumers' inclinations toward a particular technology. The infrastructure for selling "EV" exists, but sales need to be increased. As a relatively new technology, "electric vehicles (EVs)" need widespread adoption to significantly cut transportation-related carbon emissions. Customers' awareness and familiarity with these cars can be

improved, however, by the inclusion of motivating factors. Businesses and governments should fund and spread EV education to increase sales. Encouraging enthusiasm and cultivating a sense of comfort among individuals with respect to these cars will aid the government's efforts to reduce carbon emissions, as outlined in the "Green Tech Master Plan 2030" and the "Sustainable Development Goals." The increasing prevalence of environmental awareness is expected to positively impact consumers' attitudes and willingness to use environmentally friendly vehicles.

As far as the managerial implication is concerned, this research paper it thoroughly studied the application of the adapted extended theory of UTAUT to study the organizational environment and customer environment to predict the EV adoption intention of Indian consumers and after analyzing these factors, it is found to have some important practical implication such as enabling conditions affect EV adoption intentions, the government and organizations should concentrate on increasing the availability of charging infrastructure. To achieve this, it might be necessary to develop a system for collaborating between private sector businesses, state and local government organizations, and businesses from a range of industries, including transportation, energy, oil and gas, and automobiles, to fasten the adoption intention of EVs in the Indian market. Other policy tools, such as reducing cost of building EVs and batteries giving preference to EVs for parking, could be utilized to achieve these goals in addition to the typical policy instruments of subsidies and taxes.

Discussion

There was a total of five hypotheses formed, and this section looked into the one concerned with consumer intent to buy. The literature suggests that consumers' "PE" influences their adoption intention when it comes to purchasing EVs; however, the study findings indicate that there is a substantial impact of "Performance Expectancy" on consumers' adoption intention in relation to the purchase of EVs (T = 3.439, p = 0.000). Therefore, the obtained results provide support for hypothesis 1. Similar to the findings of (Chaveesuk *et al*., 2023), found that the PE outcome had a significant, positive, and statistically significant effect on AI. The results of this study supported the hypothesized relationship, and they are consistent with previous studies on the topic of technology adoption by researchers (Abbasi *et al*., 2021) .

A favorable and statistically significant (T = 2.817, p = 0.005) relationship was found between customer anticipation of effort and EV purchase adoption intent, lending support to hypothesis 2. The results are in line with previous research by Venkatesh (Abbasi *et al*., 2021; Venkatesh *et al*., 2012b). Consumers are more likely to buy "electric vehicles" as interest in them grows. Consumers hope that using EVs will be less of a hassle, will save them time and money, and will be better for the environment. This leads to its users becoming incredibly proficient with it. The study provides evidence supporting hypothesis 3, which suggests that "Social Influence has a significant and substantial impact on customers' intention to adopt and acquire an EV". In line with the research conducted by Venkatesh (Abbasi *et al*., 2021; Venkatesh *et al*., 2012b), it was observed that there was a positive impact. The results of the present study align with the hypothesized proposition, yet they deviate from the outcomes reported by other scholars who have investigated the subject of technology adoption, such as (Chaveesuk *et al*., 2023).

These results are consistent with hypothesis 4, which claimed that FC would have a positive and statistically significant effect on customers' adoption intentions for EV purchases (T = 3.007, p = 0.003). The results coincide with previous research by Venkatesh (Chaveesuk *et al*., 2023; Venkatesh *et al*., 2012a). Positive and significant (T = 2.243, p = 0.025) effects of "Price Value" on customers' adoption intentions for purchasing EVs provide support for H3. The findings of this study suggest that providing consumers with information regarding the advantages of electric cars (EVs) could potentially enhance their inclination towards these types of vehicles. The findings of this research corroborate those of (Venkatesh *et al*., 2012b), who argue that UTAUT can encourage and persuade consumers to purchase EVs. According to the results, the model has important implications for understanding EV motivation.

Incorporating environmental perceptions into the UTAUT model within the context of driving factors, this study fills a gap in the existing literature. Previous work on the UTAUT model has been conducted by Chaveesuk (Abbasi *et al*., 2021; Chaveesuk *et al*., 2023; Venkatesh *et al*., 2012b). The UTAUT paradigm is effective in various studies for facilitating the adoption and utilization of cutting-edge technologies. This research improved the UTAUT model by highlighting the importance of EV quality and cost in fostering EV adoption. The findings of this study yielded statistically significant results, indicating that all other factors examined exhibited a positive influence on customers' preferences for EVs.

Conclusion

The results of the study demonstrate that consumer motivation can be useful in elevating the likelihood that individuals will adopt EVs. This research established links between five factors—anticipated performance, anticipated effort, "Social Influence", a conducive environment, and perceived value—that affect consumers' propensity to embrace EVs. In addition, the results of the surveys showed that these factors are sufficient to convince people to purchase EVs. Despite its importance in the literature, this study indicated that none of the characteristics studied—"performance expectation, effort expectation, social

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