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"Assessing Consumers' Interest in Quantum-Powered Electric Vehicles: A Study Using UTAUT 2 and Brand Image"

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Abstract

This research explores the intricate landscape of consumer adoption intentions towards Quantum-Powered Electric Vehicles (QPEVs) within the context of the dynamic Indian automotive market. Leveraging an integrated model that combines the Extended Unified Theory of Acceptance and Use of Technology (UTAUT2) framework with brand image mediation, the study investigates the factors influencing consumers' attitudes and intentions towards this emerging technology. The analysis is based on a substantial sample size of 449 respondents, employing Partial Least Squares Structural Equation Modeling (PLS-SEM) for a rigorous examination of the relationships among variables. The study identifies and critically analyzes the perceived importance and challenges associated with QPEVs in the minds of Indian consumers, offering valuable insights into the unique considerations surrounding sustainable transportation solutions. Results indicate the substantial impact of facilitating conditions, hedonic motivation, and price value on QPEV adoption, while also highlighting the mediating role of brand image. This research contributes to the expanding discourse on electric vehicle adoption and provides a comprehensive understanding of the factors shaping the acceptance of quantum-powered electric vehicles in the Indian market

Keywords: Quantum powered, electric vehicle, brand image, adoption intention, UTAUT2

Introduction

The automotive industry is currently undergoing through a significant transformation with the rising prominence of electric vehicles, marking a pivotal shift towards an environmentally conscious, clean, renewable, and sustainable mode of transportation (J. Zhang et al., 2022)This transition aligns with the global commitment of nations to actively low down carbon emissions and collaboratively create a more environmentally favorable atmosphere. Notably, electric vehicles are gaining prominence as a preferred alternative to traditional internal combustion engine cars (H. Singh et al., 2023) The imperative for adopting electric vehicles becomes clear when considering the critical need to resolve the existing imbalance between fuel supply and demand, as well as to mitigate the adverse impact of exhaust gas emissions on air quality. This recognition is clearly mentioned by the findings of(Thuy Tien Ho1, Nguyen Mau Ba Dang1, 2024) (Q. Li et al., 2022), emphasizing the urgency to address these environmental challenges. As the automotive landscape continues to evolve, the adoption of electric vehicles emerges as a crucial strategy to not only meets the growing demand but also for sustainable and eco-friendly transportation. It also contributes significantly to global efforts aimed at enhancing air quality and fostering a more environmentally sustainable future.

In the swiftly advancing nation of India, grappling with a high population rate and rapid industrialization, the transportation sector encounters a range of complex challenges. These include concerns related to energy security, energy utilization, energy for coming future and a notable surge in greenhouse gas emissions. The escalating energy consumption and growing demand have led India to rely increasingly on foreign oil, reaching 80% in 2016, and projections indicate a further increase to 90% by 2025, as highlighted (Singh et al., 2021). These fact and figures

emphasize the critical need to urgently identify the alternative and sustainable transportation solutions, aiming to curtail oil and fuel consumption and mitigate the adverse environmental impact caused by pollution (J. Li et al., 2022).

In response to the prevailing challenges, the Indian government has implemented precise measures to promote the widespread adoption of electric vehicles. This has entailed to provide a supportive environment for manufacturers, retailers, and consumers of electric vehicles (EVs), as outlined by (Singh et al., 2020). These initiatives encompass subsidies, complimentary green parking, incentives, and official backing. Electric vehicle manufacturers, propelled by renewable electricity sources, play a pivotal role in delivering a mode of mobility that is both socially and environmentally responsible. This concerted effort aligns seamlessly with the nation's overarching objective of minimizing fossil fuel consumption. The multifaceted approach adopted by the Indian government not only encourages the adoption of electric vehicles but also reflects a comprehensive strategy aimed at fostering sustainable and eco-friendly practices across the entire spectrum of the electric vehicle ecosystem. (Hasan & Simsekoglu, 2020).

While there have been positive developments in the adoption of electric vehicles (EVs), the widespread acceptance of EVs faces various obstacles. Challenges such as extended charging durations and the availability of charging infrastructure have emerged as significant deterrents to consumer interest in EVs, despite their numerous benefits (Róycki et al., 2023). Additionally, apprehensions regarding the safety and reliability of EV batteries have become a crucial element influencing consumer confidence. (Rabinowitz et al., 2023).

Confronted with these challenges, the introduction of quantum computing in the automotive sector, particularly in the realm of electric vehicles, has emerged as a revolutionary and potentially groundbreaking approach to address current barriers impeding the widespread adoption of electric vehicles (Dalyac et al., 2021). Quantum computing, grounded in the principles of quantum mechanics, holds the promise of unparalleled computational power, surpassing the capabilities of classical computers(Qammar et al., 2024). The integration of quantum computing into electric vehicles has the potential to transform various facets of the automotive industry, including enhancing battery efficiency, optimizing range, enabling autonomous driving, and facilitating intelligent traffic management (McKinsey, 2021). In the last two years, Mercedes-Benz, in collaboration with its research partner Google, has successfully leveraged the potential of quantum computing for chemical simulations(Correa-jullian et al., 2022). This achievement not only expedites the development of advanced battery materials and systems for upcoming electric vehicles but also aligns with the considerable potential of quantum computing in reshaping the automotive sector (Dalyac et al., 2021).

In light of the potential benefits of quantum computing in transforming electric vehicles and overcoming existing barriers to EV adoption, a more comprehensive examination of consumers' attitudes and intentions toward quantum-powered electric vehicles in India is necessary. While these vehicles have garnered recognition in business markets and the automotive industry, their actual acceptance among users in emerging countries like India necessitates further exploration (Ahn et al., 2022). The Indian automotive market, known for its volatility in pricing, brand value, and specifications, presents a suitable focus for this investigation(Dogra & Kaushal, 2021).

This study primarily aims to understand the perceptions and adoption intentions of Indian consumers concerning quantum-powered electric vehicles and identify the barriers to their usage intentions. To uncover these concepts, the researcher also considers elements such as perceived safety, risk, and cost(Chakraborty & Biswal, 2020). Consequently, there exists a gap in comprehending how Indian consumers perceive and are willing to embrace this emerging technology, like quantum technology, in the automotive sector. While research on electric vehicle adoption, behavioral intentions, and recommendations for EV use has been conducted broadly and documented in various studies, the specific nuances related to quantum-powered electric vehicles in the Indian context remain largely unexplored (Khurana et al., 2020; Gunawan et al., 2022; Sanguesa et al., 2021).

Numerous previous researchers have independently examined the intentions to adopt electric vehicles (EVADINT), identifying the factors that influence adoption behavior (Hasan & Simsekoglu, 2020). Additionally, these components of adoption intention have been explored and documented in various contexts in India and other countries (Lakshika & Hemamali, 2020). Emphasis has been placed on influential factors, including demographic, situational, contextual, and psychological factors (V. Singh et al., 2020). Furthermore, these elements are predominantly derived from self-regarding models such as the social cognitive theory, the planned behavior theory, the theory of reasoned action, the innovation

diffusion theory, the TAM model (Mensah et al., 2020), and the UTAUT (Bellet & Banet, 2023). Researchers consistently underscore the significance of analyzing technology adoption behavior and the influential factors of EVADINT. This comprehensive examination has provided valuable insights into the emerging technologies that drive behavioral intent.(Lee et al., 2020).

This study will concentrate on the well-established model, the Extended Unified Theory of Acceptance and Use of Technology (UTAUT2), to assess consumers' intentions to adopt quantum-powered electric vehicles (QPEVs). Simultaneously, the UTAUT2 model primarily serves to comprehend consumers' attitudes toward innovative technologies and their functionality (Venkatesh et al., 2015) (Hilal & Varela-Neira, 2022). However, its specific application in the context of quantum-powered electric vehicles in India remains an area that requires further investigation. Through an exploration of variables such as performance expectancy, effort expectancy, facilitating conditions, social influence, hedonic motivation, and price value, this research aims to delve deeper into the determinants influencing consumers' adoption intentions (Ryu & Kim, 2024). This approach seeks to provide a more profound understanding of the acceptance of this emerging technology in the minds of consumers.

During the initial phase of introducing electric vehicles in India, sellers encountered various challenges, including inadequate charging infrastructure, limited driving range, and high upfront costs, contributing to hesitancy among potential users. Despite the Indian government's efforts to promote electric mobility through regulations and policies, there were constraints in effectively implementing these measures (Rabinowitz et al., 2023). Additionally, a lack of awareness about electric vehicles and their environmental significance, along with a limited variety of available models, posed obstacles to widespread adoption. Customers also sought guidance on the resale value of electric vehicles, further complicating matters for sellers. Consequently, a thorough analysis is underway to ascertain whether similar challenges will be encountered with Quantum-Powered Electric Vehicles (QPEVs) and whether they will be accepted during the initial stage or require an extended timeframe for market acceptance. This assessment will serve as the foundation for strategic planning among branded companies as they navigate and address these challenges (Chakraborty & Biswal, 2020). The study also elucidates the influence of brand image as a mediator, enriching the investigation and offering comprehensive insights into the potential drivers of quantum-powered EV adoption.

This research concentrated more on these three main objectives: (1) to identify consumers' adoption intentions towards quantum-powered electric vehicles in the context of India; (2) to examine and test a collaborative model that integrates the extended Unified Theory of Acceptance and Use of Technology (UTAUT2) framework and the brand image as a mediator to understand better consumers' adoption intentions of quantum-powered electric vehicles (3) to analyze the role of the mediating factor (brand image) in influencing consumers' adoption intentions towards electric vehicles in India. Moreover, this study finds different contributions to the field. First, in the context of EVADINT, this study examined and critically analyzed the most popular constructs, theories, and models from the previous three years. Second, the study considers the perceived importance and challenges of quantum-powered electric vehicles in the minds of consumers. Third, the outcome reveals that facilitating conditions, hedonic motivation, and price value substantially impact the uptake of quantum-powered electric vehicles. Fourth, performance expectancy, effort expectancy, and social influence have no substantial impact on adopting quantum-powered vehicles.

The rest of the paper is in the following sequence: (2) a review of research on EVADINT that presents the theoretical context, hypothesis, and general quantum approaches (3) an outline of the methodology—sampling procedures, scale measurements, and chosen statistical analyses (SEM). (4) summarizes the findings of the empirical analysis. (5) discussions of the findings and implications (6) contains a conclusion and suggestions for future directions.

2. Review of Research

Consumers' acceptance and utilization of information technology are among the most well-developed areas within the research field of information systems(Ryu & Kim, 2024) . Only when consumers embrace a technology do they begin to feel at ease with it, and this comfort level acts as a catalyst, driving them to adopt it through various products (Venkatesh et al., 2015)(Hilal & Varela-Neira, 2022). The UTAUT model's foundation lies in synthesizing eight theories focused on behavioral intention, providing a comprehensive framework to elucidate organizations' willingness to adopt new technologies(Hasan & Simsekoglu, 2020). UTAUT mainly concentrated on four essential factors. 1st one is performance

expectancy, then effort expectancy, social influence, and facilitating conditions to clarify organizations' intentions to use technology in their product and their subsequent utilization behavior from a manufacturer perspective (Zefreh et al., 2023) (Venkatesh et al., 2003). Beyond the four essential factors of UTAUT, the expanded Unified Theory of Acceptance and Use of Technology (UTAUT2) introduces three additional variables to convert it into a consumer's perspective: hedonic motivation, price value, and habit. It is introduced to make a clear picture focusing on understanding the context in which consumers utilize technology (Venkatesh et al., 2012). The UTAUT2 model is a proven model that has gained widespread recognition and applicability across various domains, such as uptake of QR code e-wallet services (Hamzah et al., 2023), intention towards private autonomous vehicles (Zefreh et al., 2023), and intention of customers to use e-commerce (Higueras-Castillo et al., 2023). Consequently, this study could utilize the UTAUT2 model to investigate consumers' perceptions of embracing quantum-powered electric vehicles. This paper omits the variable called habit with the guidance provided by (Tamilmani et al., 2019), which advocates for omitting the 'habit' variable when studying early technology adopters, thereby enhancing the effectiveness of the proposed model (Hamzah et al., 2023).

2.1 Performance expectancy

Performance expectancy refers to an individual's confidence in the system's ability to benefit their activities and make them perform well in all aspects (Zefreh et al., 2023). It denotes the perception that using a system will lead to cost-effective outcomes and an easily attainable destination without struggles (Gunawan et al., 2022). Studies conducted beforehand (Hamzah et al., 2023)(Higueras-Castillo et al., 2023)(Hilal & Varela-Neira, 2022) suggested that performance expectancy is all about the performance the system gives and it plays a statistically significant role in the adoption of electric vehicles. Furthermore, empirical findings substantiate that performance expectancy is crucial in predicting brand image regarding technology adoption.(Hamzah et al., 2023). In link with the previous pieces of literature, the stated hypothesis was formulated:

Hypothesis H1. Performance expectancy positively influences the intention to adopt quantum-powered electric vehicles.

Hypothesis H2. Brand image mediates the relationship between performance expectancy and the intention to adopt quantum-powered electric vehicles.

2.2 Effort Expectancy

Effort expectancy explains the degree of convenience and user-friendliness individuals perceive while utilizing a particular information system(Venkatesh et al., 2015). Several studies on AV (Autonomous Vehicle) technology acceptance have reported a direct positive impact of effort expectancy on adoption intention (Zhou et al., 2021)(Thilina & Gunawardane, 2019). Previous studies have also indicated that when it comes to adoption, effort expectancy plays a statistically significant role as a predictor alongside brand image ((Hamzah et al., 2023). Consequently, an electric vehicle's perceived ease of use will enhance its adoption process. Thus, the subsequent research hypothesis was proposed:

Hypothesis H3. Effort expectancy positively influences the intention to adopt quantum-powered electric vehicles.

Hypothesis H4. Brand image mediates the relationship between effort expectancy and the intention to adopt quantum-powered electric vehicles

2.3 Social Influence

Social influence refers to the degree to which someone thinks that influential individuals think they should adopt the new system(Si et al., 2024). It comprises other people's perspectives on the importance of using EVs, including those of society, friends, family, and coworkers(Phung et al., 2020). Being the most recent technology in the field of road transport, EVs provide a sense of identity, and possessing one is seen as a sign of social standing. Additionally, prior research clearly mentioned that brand image and social influence are statistically significant adoption predictors (Hamzah et al., 2023). Thus, the subsequent research hypothesis was proposed:

Hypothesis H5. Social influence positively influences the intention to adopt quantum-powered electric vehicles.

Hypothesis H6. Brand image mediates the relationship between social influence and the intention to adopt an electric vehicle.

2.4 Facilitating conditions

Facilitating conditions directs to the degree to which a person thinks that a technological and organizational infrastructure is in place to assist the use of the system(Cabellos et al., 2024). Numerous AV technology acceptance studies have indicated the effect of facilitating conditions on adoption intention (Nordhoff et al., 2020). Furthermore, other studies have demonstrated that facilitating conditions and brand image are both statistically significant predictors of adoption ((Nilashi et al., 2023) (Hamzah et al., 2023). Thus, the subsequent research hypothesis was proposed:

Hypothesis H7. Facilitating conditions positively influence the intention to adopt quantum-powered electric vehicles.

Hypothesis H8. Brand image mediates the relationship between facilitating conditions and the intention to adopt quantum-powered electric vehicles.

2.5 Hedonic motivation

HM mainly talks about customer enjoyment of a product or service. Regarding the acceptance of new technologies, hedonic motivation represents the user's fun element using services provided by technology(Dogra & Kaushal, 2021). Hedonic motivation refers to customers' bliss for EVs due to their innovative technology, pleasurable driving dynamics, and differentiation from typical automobiles (Venkatesh et al., 2015). Previous literature stated that hedonic motivation considerations significantly influence the buyers of EVs to adopt (Gunawan et al., 2022). Additionally, previous research has shown that brand image and hedonic motivation are statistically significant adoption determinants (Nilashi et al., 2023). The following research hypothesis was put forth:

Hypothesis H9. Hedonic motivation positively influences the intention to adopt quantum-powered electric vehicles.

Hypothesis H10. Brand image mediates the relationship between hedonic motivation and the intention to adopt quantum-powered electric vehicles.

2.6 Price value

Price value refers to the cost over benefit received or the total evaluation of a product's pricing at what customers believe it is worth. Worthiness feels like spending money when using an electric vehicle, and value at present pricing and purchase price in the case of EVs are considered (Zhou et al., 2021). Additionally, earlier research (Asadi et al., 2021) (Kim et al., 2018) pointed out that PV significantly affected adoption intention. Other studies in different domains have also shown that price value and brand image are statistically significant factors influencing adoption (Nilasha et al., 2023). It proposed the following research hypothesis:

Hypothesis H11. Price value positively influences the intention to adopt quantum-powered electric vehicles.

Hypothesis H12. Brand image mediates the relationship between price value and the intention to adopt quantum-powered electric vehicles.

2.7 Mediating Effect of Brand Image

Brand image as a mediator is investigated in many studies, and the influence of brand image on usage intention was found. For instance, one study investigated how consumers view corporate social responsibility (CSR) programs and the extent to which the branded companies perceive (Khan & Fatma, 2023) (Thong Tien Nguyen1*, Nhi Phuong Doan2, 2024) (Ploypailin Kijkasiwat1*, Anwar Hussain2, Uzma Nisar3, 2024), developing a sustainable brand image with a mediating role explicitly tailored for the hospitality industry (Bashir et al., 2020). Nevertheless, detailed research is required to investigate the mediating role of brand image, particularly the applications within the realm of quantum-powered electric vehicles. Brand image is customers' trust and loyalty to a product or service (Watson et al., 2023). Brand image is a tactical necessity that helps organizations deliver more value to customers and create a more sustainable

competitive advantage(Chakraborty & Biswal, 2020). Customers may be more likely to trust a brand with a strong reputation. According to earlier research, the organization's reputation is protected by brand image (Khan & Fatma, 2023). Following a prior investigation, a connection exists between brand perceptions and image and the intention to adopt (Bashir et al., 2020). In light of the preceding discussion, the following analysis investigates the mediating effect of brand image on the customer's intention to adopt. It proposed the following research hypothesis:

Hypothesis H13. Brand image significantly predicts the consumers' intention to adopt quantum-powered electric vehicles.

The proposed conceptual model is shown in Fig. 1

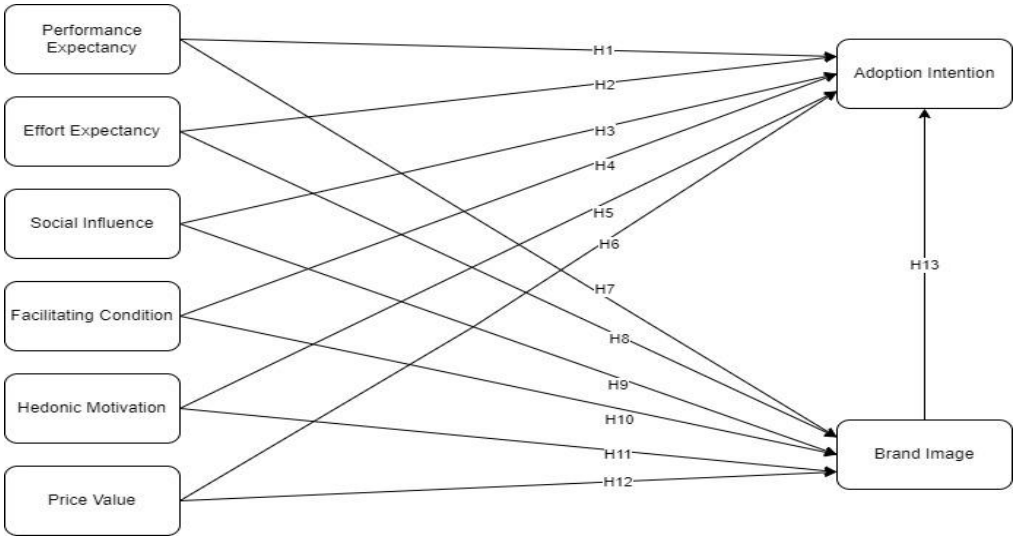

Figure 1. Research Model

3. Research methodology

3.1 Questionnaire and data gathering

The research employed a survey methodology to collect pertinent data. The survey questionnaire comprised two sections. The initial part encompassed demographic details of the involvement, including their years of age, gender, level of education, and electric vehicle driving experience. At the same time, the second section went in-depth on the constructs that this study is investigating. All scale questions for the questionnaire were collected from past investigations, primarily the study by (Venkatesh et al., 2015), (Singh et al., 2023),(Hamzah et al., 2023), (Higueras-Castillo et al., 2023),(Bashir et al., 2020),(Hilal & Varela-Neira, 2022), (Nilashi et al., 2023),(Gunawan et al., 2022) and (Mensah et al., 2020) and revised in the context of the adoption of quantum powered electric vehicle (QPEV) showed in Appendix A. In responding to the survey questions, a five-point Likert scale from “strongly disagree” (1) to “strongly agree” (5) was used.

From January 2023 to August 2023, the study was carried out in the Indian state of Kerala. Snow ball sampling was used to improve the accuracy of the research (Singh et al., 2018). Only those respondents with valid driving licenses and prior knowledge of electric vehicles were allowed to participate in the poll. Following the removal of invalid responses, a total of 449 responses were gathered. 24% of the interviewees were female, while 76% were men. The age range of 67% of interviewees was 18 to 35. Of those interviewed, 33% are above 35. 27% of interviewees had educational backgrounds other than engineering, making up about 73%. Undoubtedly, 81% of them will continue to use EVs in the foreseeable future.

3.2 Methods for analyzing data

The analysis used Structural Equation Modelling (SEM) techniques with SPSS and Smart PLS. The validity and reliability metrics of the data generated were thoroughly examined. The study used the Smart PLS software (version 4.0.9.6). It is recognized as a non-parametric data analysis approach, investigating intricate models with multiple constructs that quantify linear regressions between the constructs (structural model) and correlations between the variables and observed items (measurement model).

4. Results

4.1 Measurement model

The measurement model's findings, which were utilized to evaluate the reliability and validity of the survey instruments, are displayed in Table 1. The validity and reliability of the measurement model of our constructs were evaluated using the indicators average variance extracted (AVE), composite reliability, Cronbach's alpha, and factor loadings. The analysis of average variance extracted and factor loadings was used to perform the convergence validity test. The AVE values of each item should be more significant than 0.50 (Si et al., 2024), and the factor loadings should be greater than 0.60 (W. Zhang et al., 2022) to confirm convergent validity. To clarify, in addition to reliability and validity, a discriminate validity (DV) analysis was also done. For this, the criteria of Fornell-Larcker were also used. The criteria say DV that the correlation between the variables should be lesser when compared with the square roots of expected average variance (AVE). The Heterotrait-–Monotrait (HTMT) proportion of correlations procedure was additionally used to verify the DV, and all of the results remained beneath 0.85, supporting the value of the DV (Sukhov et al., 2023). So, in this study, discriminative validity is also confirmed, as shown in Table 2.

Table 1: Measurement Model Analysis

Construct	Items	Average variance extracted (AVE)	Composite reliability (rho c)	Cronbach's alpha	Loadings
Performance Expectancy (PE)	PE1	0.644	0.878	0.816	0.802
	PE2				0.823
	PE3				0.813
	PE4				0.769
Effort expectancy (EE)	EE1	0.688	0.868	0.773	0.749
	EE2				0.867
	EE3				0.867
Social Conditions (SC)	SC1	0.645	0.844	0.737	0.719
	SC2				0.827
	SC3				0.856
Facilitating conditions (FC)	FC1	0.658	0.906	0.87	0.830
	FC2				0.779
	FC3				0.809
	FC4				0.808
	FC5				0.828
Hedonic motivation (HM)	HM1	0.683	0.895	0.843	0.698
	HM2				0.816
	HM3				0.901
	HM4				0.876
Price Value (PV)	PV1	0.824	0.949	0.929	0.903
	PV2				0.921

	PV3				0.918
	PV4				0.89
Brand Image (BI)	BI1	0.817	0.931	0.888	0.894
	BI2				0.894
	BI3				0.923
Adoption Intention (AI)	AI1	0.835	0.938	0.901	0.917
	AI2				0.926
	AI3				0.898

Table 2. Discriminant Validity

Items	AI	BI	EE	FC	HM	PE	PV	SC
AI	**0.914**							
BI	0.812	**0.904**						
EE	0.446	0.433	**0.828**					
FC	0.500	0.457	0.270	**0.811**				
HM	0.572	0.558	0.596	0.355	**0.823**			
PE	0.534	0.486	0.339	0.698	0.404	**0.802**		
PV	0.582	0.578	0.507	0.321	0.524	0.589	**0.908**	
SC	0.068	0.078	0.071	0.087	0.049	0.077	0.134	**0.801**

4.2 Structural model

Table 3 displays the results of the structural framework. The framework is used for the secondary analysis carried out in SEM after the validity and reliability of the indicators have been confirmed. The data shows that performance expectancy (β =0.049, p >.05), effort expectancy (β =0.063, p >.05), and social influence (β = -0.022, p >.05) did not significantly alter the brand image. As a result, H2, H4, and H6 lost support. Furthermore, it was found that adoption intention was not significantly affected by the performance expectation (β =0.058, p >.05), effort expectation (β =0.026, p >.05), or social influence (β =-0.003, p >.05). This led to the loss of support for H1, H3, and H5. It was discovered, therefore, that the facilitating conditions had a significant role in predicting the adoption intention (β =0.122, p <.05) as well as the brand image (β =0.199, p <.05). As a result, H7 and H8 were accepted. Furthermore, price value is significant in predicting adoption intention (β =0.129, p <.05) and brand image (β =0.306, p <.05). As a result, H11 and H12 were approved. Additionally, brand image and intention to use were positively and significantly impacted by hedonic motivation (β =0.233, p <.05), (β =0.126, p <.05). H9 and H10 were therefore also supported. Ultimately, consumers' intention to adopt electric vehicles with quantum power is substantially predicted by the brand image (β =0.516, p <.05). As a result, H13 is also approved. Figure 2 shows a graphic representation of the verified structural model.

Table 3. Result of Structural Model (Hypotheses)

Hypotheses	Path	β	T Value	P values	Supported
H1	PE -> AI	0.058	1.227	0.220	No
H2	PE -> BI-> AI	0.049	1.041	0.298	No
H3	EE -> AI	0.026	0.553	0.580	No
H4	EE -> BI-> AI	0.063	1.528	0.126	No
H5	SC -> AI	-0.003	0.005	0.996	No
H6	SC -> BI-> AI	-0.022	0.377	0.706	No
H7	FC -> AI	0.122	2.490	0.013	Yes

H8	FC -> BI-> AI	0.199	4.065	0.000	Yes
H9	HM -> AI	0.126	2.280	0.023	Yes
H10	HM -> BI-> AI	0.233	4.925	0.000	Yes
H11	PV -> AI	0.129	2.703	0.007	Yes
H12	PV -> BI-> AI	0.306	5.591	0.000	Yes
H13	BI -> AI	0.516	9.671	0.000	Yes

The Validated research model is shown in Fig 2

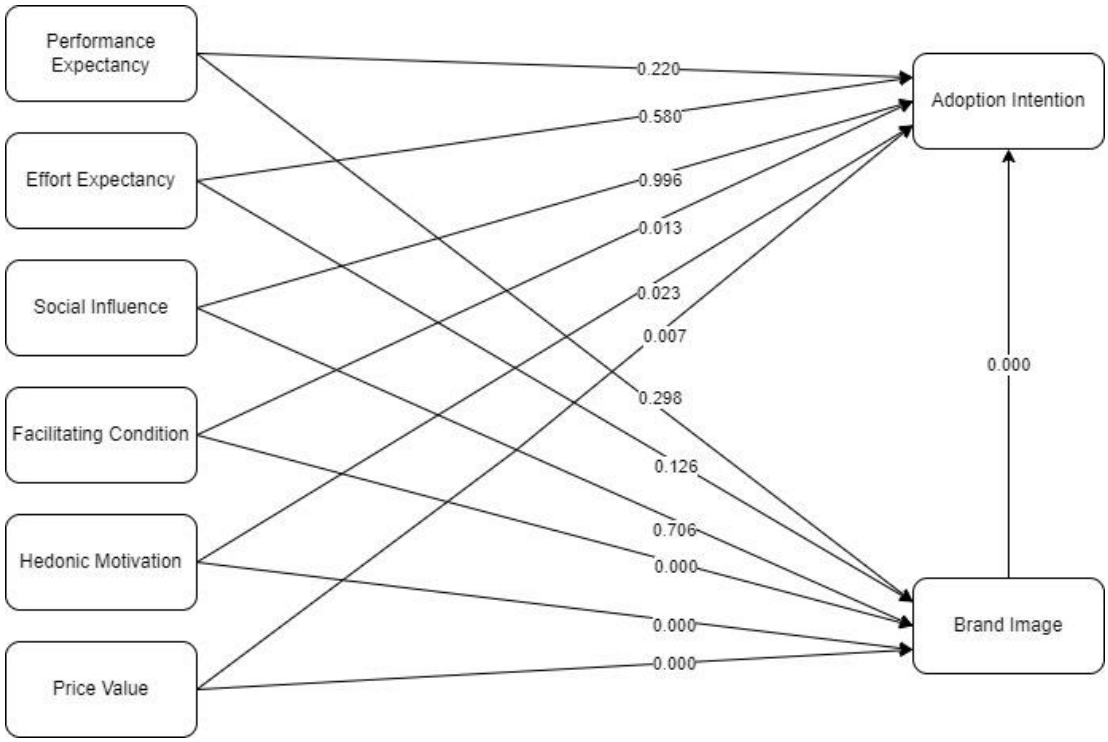

Figure 2. Validated research model

5. Discussions of the findings and implications

In light of concerns over prolonged charging times and the need for charging infrastructure, India has embarked on several initiatives to address these issues and promote energy conservation in the road transport sector. The focus is curbing carbon emissions and contributing to a more environmentally friendly setting. Electric vehicles (EVs), aligning with the global goal of achieving zero-emission mobility, emerge as a critical alternative. Transitioning to quantum computing, India is actively participating in public funding endeavors in this cutting-edge field. While China and Europe take the lead, India is making substantial contributions. However, amidst these global strides, it is crucial to consider how customers perceive and react to quantum-powered EVs. Their responses play a pivotal role in widespread adoption. This aspect is integral to the ongoing efforts to enhance and ensure the overall success of EVs. The extended UTAUT2 model was utilized in this study in order to clarify the association between factors and adoption intention. In order to fill the research gap on consumer behavior in the adoption of electric vehicles powered by quantum technology, the suggested study also looked into the mediating effect of brand image on adoption. The combined model effectively identified the variables impacting EVADINT (Electric Vehicle Adoption Intentions) and, as a result, how adoption intentions may be reinforced. Out of the 13 routes in the integrated model, 7 were significant.

5.1 Elements Impacting Quantum-Powered EVADINT

Performance expectancy and adoption intention have been found to be strongly linked in the literature; however, this study found no significant correlation between performance expectancy and consumer intention. No substantial correlation was observed ($\beta = 0.049$, $p > 0.05$) between Performance Expectancy (PE) and quantum-powered Electric Vehicle adoption intentions (EVADINT). As a result, there is no backing for hypothesis H1. Studies conducted in various environments by (Mensah et al., 2020), (Utomo et al., 2021), and ((Abbasi et al., 2021) were consistent with these findings. This suggests that improved performance and reduced running costs are exclusive to conventional vehicles, which do not have these qualities. The results contradict prior research (Singh et al., 2023) and (Alalwan et al., 2017), indicating that performance expectancy has a significant role in the adoption of EVs. The impact of performance expectations on the brand image was statistically insignificant ($\beta = 0.049$, $p > 0.05$). Hence, hypothesis H2 is not substantiated. Interestingly, our study diverges from (Hamzah et al., 2023) findings, suggesting that the behavior of our consumer demographic may differ, potentially accounting for this unexpected result.

Hypotheses H3 and H4 are unsupported since EE was not found (to significantly correlate with adoption intention ($\beta =0.026$, $p >.05$) or brand image ($\beta =0.063$, $p >.05$). The study by (K. Bhaskar et al., 2021) similarly did not provide evidence in support of EVs. Studies conducted in various environments by (Si et al., 2024)and (Nordhoff et al., 2020) were consistent with these findings. This suggests that EE's influence over customers who are unfamiliar with electric vehicles (EVs) and have trouble understanding, learning, using, and becoming proficient with EVs is hampered by interaction limitations(Guo, 2010). This result, however, runs counter to the findings of EVADINT by (Abbasi et al., 2021) and (Hamzah et al., 2023), who demonstrate that EVs are simple to operate and that customers' interactions with them are clear and intelligible. It was determined that effort Expectancy had no statistically significant effect on the brand image ($\beta =0.063$, $p >.05$). Therefore, hypothesis H4 is unsupported. Furthermore, this aligns with the research conducted by (Hamzah et al., 2023) regarding the adoption of QR code e-wallets.

A substantial correlation was not observed between SI towards adoption intention ($\beta = -0.003$, $p >.05$) and brand image ($\beta = -0.022$, $p >.05$). This suggests that prospective EV buyers appear less interested in the opinions of those closest to them, their loved ones, and society at large. In the narrative of Indian perceptions, the notion that quantum-powered electric vehicles (EVs) are still considered a novel or unproven technology serves as another rationale for this unvalidated hypothesis(Arteaga Sánchez et al., 2017). Additionally, even well-established companies struggle to dispel this apprehension. It is akin to a narrative where the unfamiliarity with quantum-powered EVs and the inability of branded companies to alleviate this concern contributes to the lack of support for hypothesis H6. (Hamzah et al., 2023) conducted studies in various settings that support these findings.

The variables FC and adoption intention towards quantum-powered electric vehicles (QPEV) demonstrated a noteworthy positive influence ($\beta =0.122$, $p <.05$) The outcomes are consistent with earlier research results (H. Singh et al., 2023), (Mensah et al., 2020),(Zhou et al., 2021), and (Bhat et al., 2022) when considering the contextualization of electric vehicles. The factors affecting adoption intention in India include charging infrastructure, knowledge about electric vehicles, adaptability of EVs, availability of EV facilities, and accessible resources. Charging stations in India are on the rise, with increasing government support(Koronios et al., 2016). The promotion of EV charging station installations is evident through capital subsidies offered under the FAME India Programme Phase II and supportive measures at the state level. In simpler terms, prospective consumers are more inclined to embrace quantum-powered electric vehicles (QPEV) when they perceive sufficient government resources, services, and facilities supporting the use of EVs(Nath et al., 2014). Recognizing the importance of FC and brand image, our hypothesis has validated a meaningful causal relationship; the mediating role of brand image in connecting facilitating conditions with intention is proved ($\beta =0.199$, $p <.05$).

(There was a notable and statistically significant relationship between HM towards adoption intention ($\beta =0.233$, $p <.05$)), and. The results align with the findings in the existing literature by (Hamzah et al., 2023),(Singh et al., 2023),(Gunawan et al. (2022) in the context of EV. These findings demonstrate that people's perceptions of fascinating emerging technologies and the enjoyment they get from driving quantum-powered EVs are stronger when they receive more favorable feedback. Brand image plays a mediating role between hedonic motivation (HM) and the adoption process ($\beta =0.126$, $p <.05$).

There was support for both H11 and H12 ($\beta =0.129$, $p <.05$) and H3 ($\beta =0.306$, $p <.05$). The results imply that PV has a significant role in predicting prospective consumer decisions to switch to quantum-powered EVs. These findings

correspond to earlier studies by Gunawan et al. (2022), H. Singh et al. (2023), and Hamzah et al. (2023). The companies working on quantum-powered electric vehicles have plans to implement different features and add-values to increase their PV, so the same is what customers expect for quantum-powered electric vehicles, which is in line with the findings of Asadi et al. (2021) identified as likely to motivate potential customers to acquire quantum powered EVs in the future. Customers give more value to branded companies; a positive brand image can enhance the price value of a product or service, making consumers more willing to pay a premium.

There is statistical significance in the relationship between brand image and adoption intention(β =0.516, p <.05).The results are consistent with the research conducted by (Bashir et al. (2020) and Khan & Fatma (2023). Once more, it was found that brand image predicts the intention to adopt, consistent with the findings of (Hamzah et al., 2023) study, which found that BI predicts adoption intention. Thus, consumers in India think it makes sense to drive or use a branded, quantum-powered electric vehicle.

5.2 Implications for theory

This study is among the few that have used the UTAUT2 model. The proven and accepted UTAUT2 model was created by Venkatesh et al. (2012), and it has been used in this study to examine customers' intentions to embrace quantum-powered electric vehicles (QPEVs). In addition to UTAUT2, brand image was linked as a mediator with the model to investigate the intention to adopt QPEV and is a notable contribution to the literature. Apart from the UTAUT2 constructs, the brand image also plays a crucial influence on adoption(Koronios et al., 2016). This addition helps to build a more thorough framework for comprehending the adoption intention predictors in the particular context of India. In the context of quantum-powered EV acceptability, this study critically evaluates and examines the most prevalent hypotheses and constructions. Notably, the intention to adopt QPEVs is significantly influenced by price value (PV), brand image, hedonic motivation (HM), and facilitating conditions (FC). On the other hand, it has been discovered that in the context of QPEV adoption intention, performance expectancy (PE), effort expectancy (EE), and social influence (SC) are not significant determinants. has been

5.3 Implications for Practice

This paper unveils compelling insights with significant implications for electric vehicle manufacturers seeking to sway potential customers. The study's findings distinctly highlight the significance of HM, FC, and PV. The design of an electric vehicle (EV) plays a pivotal role, and consumers are inclined to embrace an EV that boasts excellent design, comfort, and an enjoyable user experience(Dogra & Kaushal, 2021). Consequently, in the mindset of consumers, quantum-powered electric vehicles (QPEVs) are expected to be perceived as more advanced(Ryu & Kim, 2024). Successfully persuading customers about the appealing features of QPEVs can effectively sway potential buyers towards adopting this QPEV. Our research indicates that prospective consumers place high value on the comfort aspects of vehicles, particularly emphasizing attributes such as serenity and adaptable systems. This suggests that QPEV manufacturers or brands should initiate consumer education campaigns, prioritizing millennials. Since a larger sample of this generation is included in our study, more people from this generation will be aware of the benefits of choosing QPEVs over traditional cars. Secondly, devote more attention to the implementation of government policies. In the case of normal EVs, it took a long time for people to adapt and accept the technology; however, this should not occur in the case of QPEVs, so from the government's perspective, policy implementation should happen more quickly, enabling consumers to adopt in a short amount of time. The policies refer to all the facilities that people can access through the government or policymakers. Many previous research has highlighted the significance of social situations, but this study does the exact opposite. As a result, most of our sample, primarily between the ages of 18 and 37, show relatively little interest from the perspectives of their friends, family, coworkers, and society. However, their primary emphasis remains on the price value concerning the price or the advantages derived from the product's cost. Finally, our study showed that brands directly impact adoption intentions. When reputable companies produce electric vehicles powered by quantum technology, people are eager to use and consume them.

6. Conclusion and Future Studies

Future EV-to-QPEV conversions must be implemented in India as part of the growth of the automotive industry. This study investigated the driving forces behind Indian consumers' adoption of emerging technologies such as QPEVs. The

SEM technique aims to provide a comprehensive framework of information about the factors influencing QPEV adoption. This research also offers a fresh viewpoint combining a brand image with UTAUT2. The findings indicate that while PE, EE, and SI have a non-significant impact on QPEV adoption, the other constructs for QPEV adoption, such as FC, HM, PV, and BI, can help predict interest in adopting QPEVs in India. This study has various limitations, underscoring the necessity for future research. Foremost among these limitations is the absence of actual implementation of quantum-powered electric vehicles; the study is purely observational at this stage. In this study, the potential QPEV buyers were examined. Although actual adoption behavior can be analyzed using real-life adoption intention, actual adoption behavior could be analyzed by gathering information from QPEV owners. Next, while some of the characteristics from these models were considered, this study mainly used the factors from UTAUT2 to explain QPEV adoption. Thus, factors like habit and trust—may be considered in future research, along with additional mediating variables. The study was carried out in the Indian state of Kerala, which is a developing nation that takes too long to adopt new technologies. Consequently, the outcomes may vary compared to other nations, particularly developing ones.

Author Contributions

[Author 1, Pushpam T Davis]: Conceptualization, Methodology, Data Curation, Formal Analysis, Writing – Original Draft, Writing – Review & Editing, Project Administration.

[Author 2, T Chandrasekar]: Conceptualization, Methodology, Writing – Review & Editing, Supervision.

Both authors contributed significantly to the research and preparation of this article. They have reviewed and agreed upon the final version of the manuscript, and both authors take responsibility for the content and integrity of the work.

Disclosure statement

The authors reported no potential conflict of interest. During the preparation of this work, we, the authors, used Chat GPT to refine the language. After using this tool, the authors reviewed and edited the content as needed and took full responsibility for the publication's content.

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