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Determinants of Consumer Behavior in Electric Vehicle Adoption: Insights from Indonesia

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Abstract

In Indonesia, electric vehicles are considered a strategic solution to reduce dependence on fossil fuels and air pollution. Although the use of electric vehicles is essential for a sustainable transportation system, individual acceptance must be considered to accelerate the adoption of electric vehicles. This study aims to assess individual acceptance of electric vehicles using the UTAUT3 model. The factors causing individual behavioral intention and use behavior used in this study are performance expectancy, effort expectancy, social influence, facilitating conditions, hedonic motivation, price value, habit, and personal innovativeness. Two hundred thirty respondents participated in an online survey through social media and messaging. The requirements to be a respondent are to own and use an ICE (Internal Combustion Engine) car, have a driving license, know electric vehicles, and come from the Surabaya and Jabodetabek areas (Jakarta, Bogor, Depok, Tangerang, and Bekasi). This study shows that behavioral intention strongly determines electric vehicle use behavior. Based on this study, the factors strongly influencing the intention to adopt electric vehicles are effort expectancy, habit, hedonic motivation, performance expectancy, and personal innovativeness. The behavioral intention of electric vehicle adoption is not influenced by price value, facilitating conditions, and social influence factors. Understanding the complex aspects of Indonesian society's view of electric vehicles can provide information on the reasons that drive the use of electric vehicles and provide guidance for more effective implementation strategies.

Keywords
Electric vehicle, behavioral intention, use behavior, Indonesia

1. Introduction
The global transition toward electric vehicles (EVs) aims to reduce carbon emissions and foster sustainable mobility systems. In Indonesia, EVs are viewed as a strategic initiative to decrease dependency on fossil fuels and address urban air pollution. However, EV adoption in Indonesia remains suboptimal, as evidenced by the disparity between the current adoption rates and government targets. For instance 2023, only 17,147 EV units were sold, far below the government's 2030 target of 2 million units (Biro Komunikasi dan Informasi Publik, 2022). Furthermore, Indonesia's EV adoption rate lags behind that of developed countries, highlighting the critical need for interventions.

While adopting EVs is vital for advancing clean energy and sustainable transportation systems, individual acceptance is a key determinant of success. The effectiveness of EV implementation largely depends on consumer adoption, which is influenced by behavioral intentions and actual usage. Factors shaping individual decisions, such as technological, social, economic, and psychological considerations, must be thoroughly understood.

Previous studies have investigated various factors influencing EV adoption, including energy efficiency, reliability, ease of use, price, supporting infrastructure and others. Researchers have also used various theories of human behavior to study individuals' acceptance of technology. The most frequently used approaches by researchers in modeling the acceptance of electric vehicles include TPB, TAM, UTAUT, and UTAUT2 (Manutworakit and Choocharukul, 2022; Shanmugavel et al. 2022; Singh et al. 2022). TPB was developed to explain human behavior in general, while TAM and UTAUT were explicitly designed to describe technology acceptance. These theories propose several factors that influence the acceptance of a technology, with behavioral intention and use behavior as measures of acceptance. Many researchers also develop models by adding other factors as needed.

The UTAUT3 model is a development of UTAUT (Unified Theory of Acceptance and Use of Technology), which considers additional factors, namely hedonic motivation, price value, habit, and personal innovativeness. UTAUT3 has been proven relevant to understanding the adoption of new technologies in the individual context. Independent variables of the UTAUT3 model, such as performance expectancy, effort expectancy, social influence, hedonic motivation, price value, habit, facilitating conditions, and personal innovativeness, explain the intention to adopt the technology. The intention to adopt, facilitating conditions, habit, and personal innovativeness affect the actual use behavior.

1.1 Objectives
This study aims to model individual acceptance of electric vehicles using the UTAUT3 framework, particularly in Indonesia. While behavioral models for EV acceptance exist, the application of UTAUT3 in this context is limited. This study evaluates factors influencing behavioral intention and usage behavior in EV adoption, offering insights into consumer perceptions. These findings will aid policymakers and manufacturers in designing effective strategies to promote EV adoption and accelerate Indonesia's transition to sustainable transportation.

2. Literature Review
The UTAUT model is widely recognized for its effectiveness in predicting intentions and behaviors related to transportation technology adoption. It has been applied in various studies, including investigations into factors influencing the acceptance of automated road transportation systems in Europe (Madigan et al. 2016), driver condition monitoring technology (Smyth et al. 2020), cargo transportation platforms (Lee et al. 2021), public transportation systems (Pak et al. 2023), electric motorcycles in Indonesia (Yuniaristanto et al. 2024), and AI-based transportation applications (Lal et al. 2024). The popularity of UTAUT stems from its flexibility in analyzing complex factors driving technology adoption and its ability to guide effective implementation strategies. As a comprehensive framework, the UTAUT model integrates elements from eight foundational theories, including the Theory of Reasoned Action (TRA), the Technology Acceptance Model (TAM), and the Diffusion of Innovation Theory (DOI) (Venkatesh et al. 2003). It focuses on four primary constructs influencing human actions: performance expectancy, effort expectancy, social influence, and facilitating conditions.

Over time, UTAUT has evolved with the inclusion of additional constructs as long as these new variables contribute significantly to explaining individual behavior. This adaptability has allowed researchers to apply the model to diverse

contexts and refine it to address specific challenges in understanding individual reactions to technology adoption (Faiers et al. 2007). The development of extended models such as UTAUT2 and UTAUT3 highlights the model's progression and relevance. UTAUT3 builds upon its predecessors by incorporating a new construct, personal innovativeness, further enhancing its explanatory power (Farooq et al. 2017). In UTAUT3, personal innovativeness reflects individual tendencies to adopt new technologies earlier than others. This characteristic is often linked to personality traits and behaviors in technology adoption processes. Individuals with high personal innovativeness are typically more comfortable and eager to explore new technologies, even if these require additional effort to learn or utilize. This construct strengthens the relationship between behavioral intention and actual technology use.

Including personal innovativeness has proven valuable in various studies examining technology adoption. For example, studies on the intention to adopt drone delivery services in Thailand (Chen et al. 2019) and electric vehicles in India (Shanmugavel et al. 2019) found that personal innovativeness strongly influences behavioral intentions. Similarly, this construct has been integrated with other frameworks to study electric vehicle adoption in Malaysia (Khazaei et al. 2019) and Indonesia (Hasudungan et al. 2024). These studies consistently highlight the positive relationship between personal innovativeness and the intention to adopt electric vehicles. However, previous studies have not utilized the UTAUT3 model framework, which comprehensively considers the factors of performance expectancy (PE), effort expectancy (EE), social influence (SI), facilitating conditions (FC), hedonic motivation (HM), price value (PV), habit (H), and personal innovativeness (PI) to determine electric vehicle adoption behavior.

The findings of this research contribute to the growing body of knowledge on technology adoption and its practical implications. By analyzing the interplay of diverse constructs within the UTAUT3 framework, this study offers insights into how personal and contextual factors shape the intention and behavior of Indonesian consumers in adopting electric vehicles. These insights can inform policymakers and industry stakeholders in designing strategies to promote electric vehicle adoption effectively.

3. Methods

A quantitative survey was conducted to understand the Indonesian population's intentions and behaviors regarding electric vehicle usage. Two hundred thirty-two participants completed the online survey distributed via social media and messaging platforms. Out of this number, two respondents were disqualified for failing to meet the eligibility criteria, leaving 230 valid samples. This sample size was deemed sufficient for multifactor analysis. According to previous research, the sample size should exceed ten to fifteen times the number of variables included in a multifactor analysis, or the sample should be more than 200 (Golob, 2003; Preacher et al. 2012).

The criteria for respondents included owning and using a car, holding a valid driver's license, being familiar with electric vehicles, and residing in one of the following areas: Jabodetabek (Jakarta, Bogor, Depok, Tangerang, or Bekasi) and Surabaya. Jabodetabek is Indonesia's largest metropolitan region, characterized by a high level of urbanization, dense traffic, and more developed infrastructure. Meanwhile, Surabaya, the largest city in eastern Indonesia, represents an urban area with vehicle usage patterns that differ from those in Jabodetabek. Combining data from these two regions offers valuable insights into public behavior in urban and suburban areas, which are key targets for electric vehicle adoption. Both cities also have relatively well-developed supporting infrastructure for electric vehicles, such as charging stations and government incentives. The collected data can serve as an initial representation of major cities in Indonesia and highlight opportunities for further development. Respondents were asked to indicate their residence to ensure the sample was representative of the specified regions. The questionnaire distribution began in May 2024 and continued until September 2024.

The questionnaire consisted of two main sections. The first section gathered respondents' demographic profiles, while the second assessed the constructs within the tested model. The questionnaire was written in Indonesian using simple and accessible terms for respondents to comprehend quickly. All constructs were adapted from previously validated literature and refined through a pilot study. Feedback from the pilot study contributed to improving the questionnaire. Construct evaluations employed a Likert scale, ranging from 1 (strongly disagree) to 5 (strongly agree).

The research data was analyzed using Partial Least Squares Structural Equation Modeling (PLS-SEM). The PLS-SEM procedure involved evaluating validity and testing hypotheses. First, the variable model was assessed to ensure it met the requirements for factor loadings, reliability, composite reliability, average variance extracted (AVE), and discriminant validity. Factor loadings for each variable statement had to exceed 0.7. Both composite reliability and

Cronbach's alpha values were required to be greater than 0.7. The AVE value had to be above 0.5, and discriminant validity was evaluated using the heterotrait-monotrait (HTMT) ratio. HTMT values for each construct needed to be below 0.9. Second, to determine the acceptance of the hypotheses, the analysis examined path coefficients, f2, t-values, and p-values using bootstrapping techniques. This study tested a total of twelve hypotheses. The flow of this research is depicted in Figure 1.

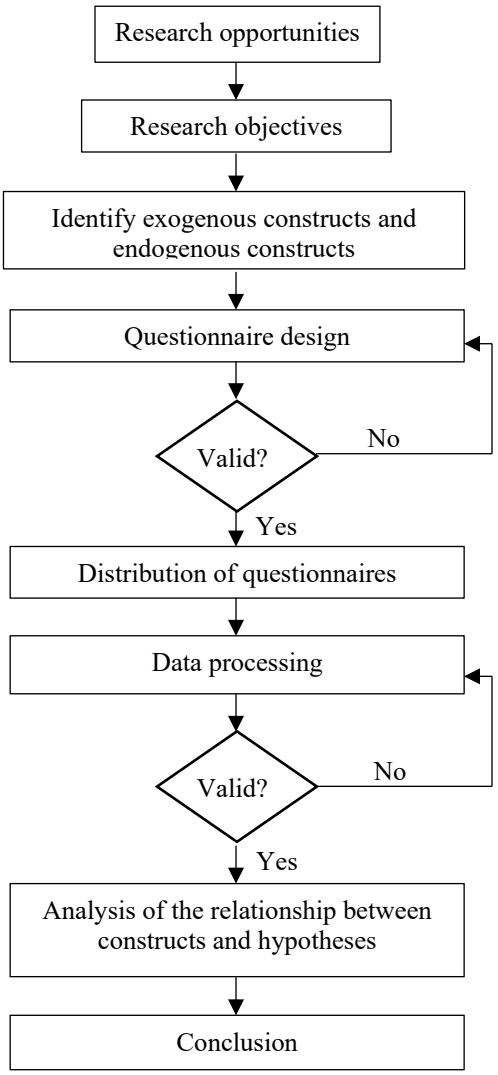

Figure 1. Research flow

4. Data Collection

4.1 Respondents' profile

Demographic details of the valid sample are summarized in Table 1. The total respondents were 230, consisting of 172 men (74.78%) and 58 women (25.22%). Most respondents (N = 129, 56.09%) had a bachelor's degree. The respondents ranged from 17 to over 50 years, with the majority being aged 30-39 (N = 77, 33.5%). Most respondents (N = 183, 79.57%) were married. Respondents reported that their monthly expenses were less than or equal to 10 million rupiah. Most respondents (N = 156, 67.53%) owned one car. Respondents (N = 143, 62.17%) wanted to buy an electric vehicle someday.

Table 1. Respondent characteristics.

Description		Total
Gender	Male	172
	Female	58
Marital status	Married	183
	Not married	47
Age	17-29	43
	30-39	77
	40-49	44
	>=50	66
Education	<=High school	19
	Bachelor's degree	129
	Master's degree	68
	Doctoral	15
Expenditure/month	<=10 million	111
	10.1-20 million	78
	20.1-30 million	21
	30.1-40 million	7
	>40 million	13
Number of cars	1	156
	2	58
	3	13
	>3	3

4.2 Assessment of reliability and validity

The structural model of this research is depicted in Figure 2. Effort expectancy, performance expectancy, social influence, hedonic motivation, price value, facilitating conditions, habit, and personal innovativeness account for 70.4% of the variance in the behavioural intention variable. On the other hand, behavioural intention, facilitating conditions, habit, and personal innovativeness contribute to 60.7% of the variance in the use behaviour variable for electric vehicles.

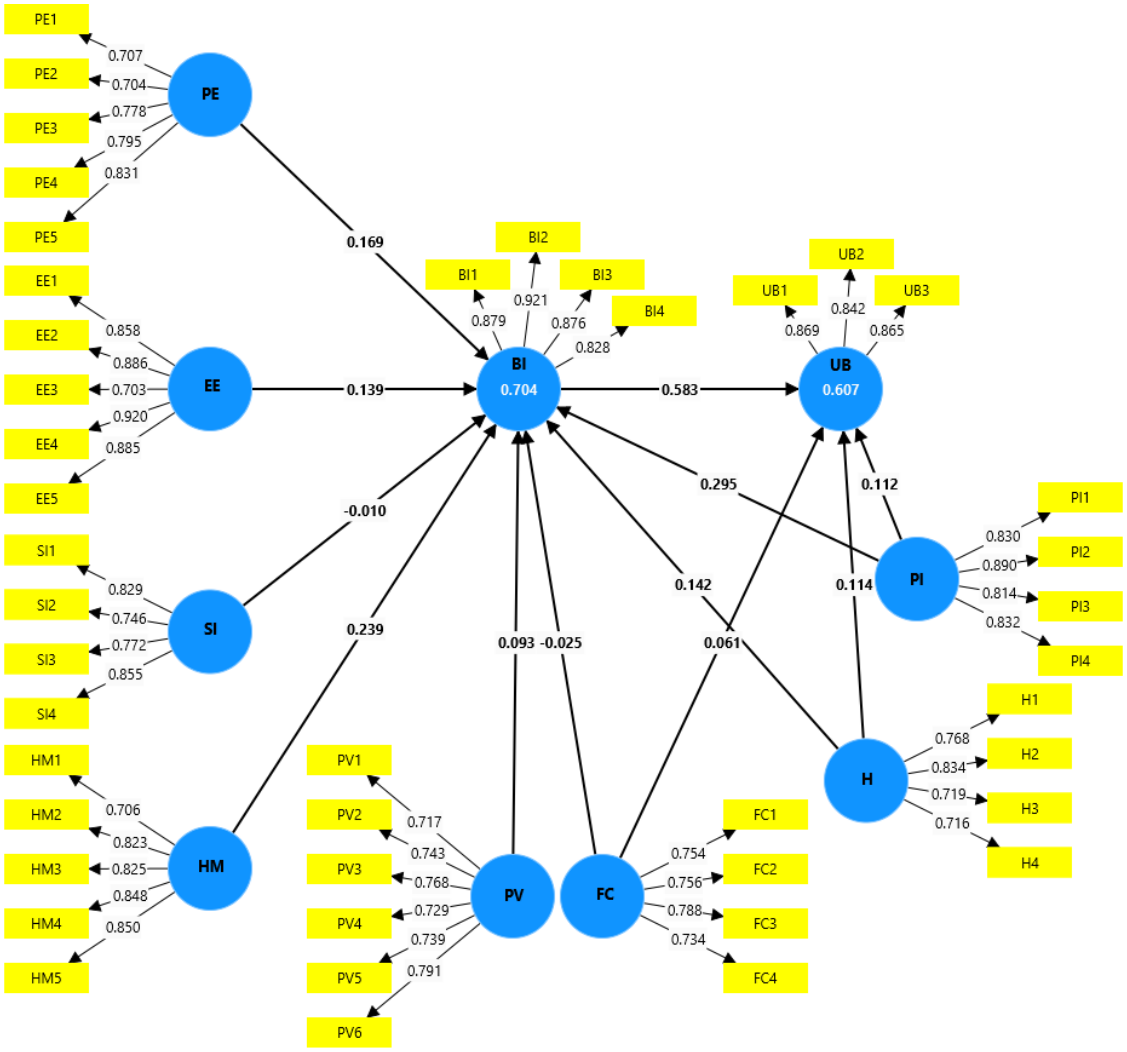

Figure 2. The structural model of this research

According to Table 2, the factor loading values for all statement items exceed the threshold of 0.7. Furthermore, the composite reliability values range from 0.844 to 0.930, while Cronbach's alpha values fall between 0.770 and 0.905, exceeding the recommended minimum of 0.70. These results indicate that the constructs are reliably measured. The average variance extracted (AVE) scores for all constructs range from 0.560 to 0.768, surpassing the minimum threshold of 0.50 (Henseler, 2017). This confirms the convergent validity of the constructs, demonstrating that the measurement model aligns well with the collected data. Additionally, the AVE values for each construct are higher along the matrix's diagonal than the off-diagonal values, confirming satisfactory discriminant validity.

Table 2. Reliability and Construct Validity Values

Construct	Items	Factor loading	Cronbach-α	Composite Reliability	AVE
Behavioural Intention	BI1	0.879	0.899	0.930	0.768
	BI2	0.921			
	BI3	0.876			
	BI4	0.828			
Effort Expectancy	EE1	0.858	0.905	0.930	0.729
	EE2	0.886			
	EE3	0.703			
	EE4	0.920			
	EE5	0.885			
Facilitating Conditions	FC1	0.754	0.755	0.844	0.575
	FC2	0.756			
	FC3	0.788			
	FC4	0.734			
Habit	H1	0.768	0.770	0.846	0.579
	H2	0.834			
	H3	0.719			
	H4	0.716			
Hedonic Motivation	HM1	0.706	0.875	0.906	0.660
	HM2	0.823			
	HM3	0.825			
	HM4	0.848			
	HM5	0.850			
Performance Expectancy	PE1	0.707	0.822	0.875	0.585
	PE2	0.704			
	PE3	0.778			
	PE4	0.795			
	PE5	0.831			
Personal Innovativeness	PI1	0.830	0.863	0.907	0.709
	PI2	0.890			
	PI3	0.814			
	PI4	0.832			
Price Value	PV1	0.717	0.844	0.884	0.560
	PV2	0.743			
	PV3	0.768			
	PV4	0.729			
	PV5	0.739			
	PV6	0.791			
Social Influence	SI1	0.829	0.816	0.878	0.642
	SI2	0.746			
	SI3	0.772			
	SI4	0.855			
Use Behavior	UB1	0.869	0.822	0.894	0.737
	UB2	0.842			
	UB3	0.865			

This study also employed the heterotrait-monotrait ratio (HTMT) of correlations, as Henseler et al (2015) recommended. As shown in Table 3, the HTMT values for all constructs are below the threshold of 0.9, further confirming adequate discriminant validity.

Table 3. Discriminant validity heterotrait-monotrait (HTMT) ratio

	BI	EE	FC	H	HM	PE	PI	PV	SI	UB
BI										
EE	0.662									
FC	0.644	0.539								
H	0.684	0.435	0.650							
HM	0.761	0.515	0.651	0.624						
PE	0.782	0.729	0.708	0.556	0.698					
PI	0.786	0.514	0.579	0.575	0.656	0.622				
PV	0.724	0.615	0.748	0.699	0.618	0.791	0.600			
SI	0.490	0.304	0.492	0.586	0.610	0.495	0.470	0.446		
UB	0.887	0.568	0.612	0.642	0.638	0.822	0.718	0.718	0.551	

4.3 Hypothesis testing

Hypothesis assessment begins by assessing the consistency of multicollinearity through the Variance Internal Factor (VIF) value. The results presented in Table 4 indicate no lateral collinearity problem in this study because the VIF values of all variables are less than 3.3 (Diamantopoulos et al. 2006). The most critical evaluation parameter for the structural model is the coefficient of determination (R2), representing the amount of construct variance explained by the model. The recommended R2 value must be greater than 0.25. The result is that the R2 value for behavioral intention and use behavior meets the minimum value limit of 0.704 and 0.607. So, because the recommended minimum value has been exceeded, most of the model variance can be explained by the factor. The f2 measure is used to determine the relative effect of the predictor construct on the endogenous structure. The f2 value is considered satisfactory when more than 0.02.

To determine the acceptance of the hypothesis, it is necessary to analyze the path coefficient, t-value, and p-value values through the bootstrapping technique with 5000 resamples. Table 4 shows the significance of the 12 hypothesis paths, six hypotheses are accepted, and six hypotheses are rejected. Factors have a significant effect when p-values <0.05 and t-value> t-table. Behavioral intention significantly affects electric vehicle adoption behavior, while facilitating conditions, habits, and personal innovativeness do not considerably affect use behavior. Effort expectancy, habit, hedonic motivation, performance expectancy, and personal innovativeness significantly affect electric vehicle adoption intentions. While facilitating conditions, price value and social influence do not considerably affect electric vehicle adoption intentions.

Table 4. Hypothesis testing

Hypothesis	Relationship	Coefficient	t-value	f2	VIF	P-value	Supported
H1	BI → UB	0.583	7.557	0.352	2.461	0.000	Yes
H2	EE → BI	0.139	2.681	0.036	1.812	0.007	Yes
H3	FC → BI	-0.025	0.495	0.001	1.913	0.620	No
H4	FC → UB	0.061	1.093	0.006	1.580	0.275	No
H5	H → BI	0.142	2.699	0.034	2.015	0.007	Yes
H6	H → UB	0.114	1.953	0.019	1.753	0.051	No
H7	HM → BI	0.239	3.958	0.080	2.412	0.000	Yes
H8	PE → BI	0.169	2.741	0.037	2.585	0.006	Yes
H9	PI → BI	0.295	5.526	0.161	1.821	0.000	Yes
H10	PI → UB	0.112	1.759	0.016	2.048	0.079	No
H11	PV → BI	0.093	1.715	0.011	2.579	0.086	No
H12	SI → BI	-0.010	0.203	0.000	1.508	0.839	No

5. Results and Discussion

This study employs the UTAUT3 model to investigate the factors influencing the intention and behavior associated with electric vehicle (EV) adoption in Indonesia. The findings reveal that behavioral intention strongly determines actual EV usage behavior, consistent with previous research. The significance value of each construct's influence on

the endogenous variable, as presented in Table 4, can be used to evaluate both the strength and importance of the relationship. Behavioral intention has a coefficient value of 0.583 ($p < 0.05$), indicating a strong and significant relationship with EV purchasing decisions. Fundamentally, an individual's intention to act is the primary predictor of behavior, as established by various technology acceptance theories (Venkatesh et al. 2003). Similar to prior studies, behavioral intention remains the strongest predictor of EV usage, often influenced by social factors and facilitating conditions (Wang et al. 2023). However, in this study, the primary determinants of behavioral intention include effort expectancy, habit, hedonic motivation, performance expectancy, and personal innovativeness.

Effort expectancy significantly impacts the intention to adopt EVs, as consumers prioritize the perceived ease of use and maintenance when considering new technologies. Effort expectancy has a coefficient value of 0.139 ($p < 0.05$), indicating a weak and significant relationship with the intention to buy an EV. In this study, effort expectancy encompasses ease of operation, understanding features, maintenance, and learning to use EVs proficiently. These findings align with prior research in China, which highlighted that ease of charging, driving experience, and related applications enhance consumer intentions to purchase electric vehicles (Wang et al. 2023).

Habit, a psychological construct reflecting behaviors ingrained through previous experiences, weakly influences behavioral intention. Habit has a coefficient value of 0.142 ($p < 0.05$), indicating a weak and significant relationship with intention to buy an EV. Habit acts as a reinforcing factor, where actions performed habitually become more straightforward to repeat. This study indicates that respondents intend to adopt EVs because they are accustomed to staying updated on vehicle developments, enjoy collecting specific vehicle types, are drawn to new products, and believe using EVs can become habitual. The role of habit is particularly significant as users adapt to innovations and the growing EV market ecosystem (Nguyen et al. 2019).

Hedonic motivation, derived from pleasure, satisfaction, or positive emotional experiences, also plays a critical role in shaping intentions. Hedonic motivation has a coefficient value of 0.239 ($p < 0.05$), indicating a weak and significant relationship with the intention to buy an EV. This study identifies several factors driving hedonic motivation, including the enjoyment and excitement of using EVs and their ability to convey social status, evoke pride, and reflect personal identity. Hedonic motivation has significantly influenced intention, particularly among younger consumers seeking novel, enjoyable, and pride-inducing experiences (Moons et al. 2012; Zhou et al. 2021);

Performance expectancy directly affects EV adoption intentions, as consumers favor technologies that substantially benefit efficiency, reliability, and performance (Venkatesh et al. 2003; Zhou et al. 2021). This research shows that performance expectancy has a coefficient value of 0.169 ($p < 0.05$), indicating a weak and significant relationship with intention to buy an EV. Respondents in Indonesia recognize that EVs can meet daily transportation needs, offer environmental benefits, are comfortable, serve as viable alternatives to internal combustion engine (ICE) vehicles, and enhance productivity. These factors collectively drive their intention to adopt EVs.

Personal innovativeness, reflecting an individual's openness to new technologies and willingness to embrace innovations, further strengthens the relationship between perceived EV benefits and adoption intentions. Innovative individuals tend to be more receptive to the benefits and risks associated with new technologies (Moons et al. 2012). In this study, personal innovativeness is particularly relevant for respondents eager to experiment with new technologies, explore advanced features, and compare EVs with existing alternatives. Personal innovativeness has a coefficient value of 0.295 ($p < 0.05$), indicating a weak and significant relationship with intention to buy an EV.

This study finds that behavioral intention to adopt electric vehicles is not influenced by price value, facilitating conditions, and social influence. Price value has a coefficient value of 0.093 ($p > 0.05$), indicating a very weak and insignificant relationship with intention to buy an EV. Although price value is commonly identified as a determinant of new and expensive technology adoption, it does not significantly influence behavioral intention in this context. This condition may stem from the high initial cost of EVs, which overshadows their long-term financial benefits, such as lower operating costs. Additionally, respondents might focus more on emotional and financial factors rather than practical considerations. Uncertainty regarding long-term economic advantages, coupled with varying income levels and consumer preferences, could further dilute the importance of price value. A lack of awareness about available incentives or subsidies may also prevent respondents from fully appreciating the economic benefits of EV adoption (Rezvani et al. 2015). The strategy to address the perceived high cost of electric vehicles (EVs) includes educating consumers about the total cost of ownership and government incentives such as tax discounts (Pemerintah Indonesia, 2023).

Meanwhile, facilitating conditions and social influence have coefficient values of -0.025 and -0.010 ($p > 0.05$), indicating a negative and insignificant relationship with the intention to buy an EV. If facilitating conditions have a negative and insignificant relationship with behavioral intention, it indicates that the availability of supporting facilities does not enhance users' behavioral intention and may even act as a barrier. Users may feel that the available supporting facilities are irrelevant or do not meet their needs. A lack of public awareness about the infrastructure supporting electric vehicles can reduce the influence of facilitating conditions on behavioral intention. If the general public does not fully understand how electric vehicles or new technologies work, they may not prioritize facilitating conditions because they fail to see their relevance. Furthermore, uneven infrastructure distribution makes respondents perceive this factor as less significant (Axsen et al. 2012). Facilitating conditions may be more relevant when individuals are in the use behavior stage rather than when they are still considering adopting the technology. The strategy to address public perceptions of facilitating conditions is to provide education on electric vehicles, as well as their supporting facilities and systems. By ensuring that these facilities are available, easily accessible, and well understood, the public will become more familiar with electric vehicles and their associated infrastructure.

Social influence has a negative and insignificant relationship with the behavioral intention to use electric vehicles. This condition suggests that social pressure or influence from others is not enough to encourage individuals to intend to use electric vehicles. In fact, this social influence may even have the opposite effect. Negative information or experiences from others about electric vehicles can affect an individual's perception. The influence of social factors decreases when individuals have greater autonomy in decision-making (Venkatesh et al. 2003). When the adoption of electric vehicles is still low in a society, individuals may not feel the need to follow social trends. For consumers with limited understanding of technology, practical factors become more important than social influence. A lack of adequate information about new technologies can diminish the impact of social factors. If respondents do not see promotions or support from influential figures, social influence becomes minimal, especially for new technologies (Wang et al. 2021). Addressing public perceptions of social influence requires an approach that focuses on the influence of individuals, communities, and institutions. Educational campaigns should be conducted to raise public awareness of the benefits of electric vehicles, and periodic surveys should be carried out to understand the public's perceptions of electric vehicles and social influence.

A limitation of this study is the inclusion of respondents who are not EV users. These respondents rely solely on perceptions shaped by information from the media or others, struggle to evaluate technical aspects, and often exhibit a more conservative viewpoint.

6. Conclusion

This study confirms that behavioral intention strongly determines electric vehicle usage behavior. While facilitating conditions, personal innovativeness, and habit are expected to have a direct relationship with EV usage, the results indicate these factors do not significantly influence this context. Instead, the most decisive factors influencing the intention to adopt electric vehicles are effort expectancy, habit, hedonic motivation, performance expectancy, and personal innovativeness. The findings also reveal that price value, facilitating conditions, or social influence do not significantly affect behavioral intention. Understanding the complex factors driving the Indonesian public's attitude toward electric vehicles provides valuable insights into the motivations behind EV adoption. These insights can inform strategies for more effective implementation, addressing the practical and emotional drivers influencing consumer decisions.

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