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RESEARCH ARTICLE

Intention to Purchase Electric Passenger Vehicles Among Drivers in Thailand: A Structural Equation Modeling Analysis

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Abstract: Electric passenger vehicles are still in the early stage of research and development in Thailand, but domestic researchers are already keen to know about the variety of factors that would have a potential to influence the intention of Thai drivers to buy the said vehicles. Using structural equation modeling analysis, this study examined the direct and indirect effects of attitude, external environment, marketing mix, subjective norms, and customer perception on purchase intention. Data were obtained from a sample of 650 Thai licensed drivers who were randomly selected and interviewed at 367 car service centers located across Bangkok. Results reveal that 52.3% of the purchase intention of Thai drivers are explained by the five-factor model. However, of the five factors, the most significant is subjective norms, followed by the marketing mix and attitude. Attitude, which lies at the heart of purchase intention, is predicted most significantly by the external environment. The findings suggest that Thailand's concerted efforts on electric passenger vehicles would have to be carefully designed such that the relevant external environment, subjective norms, marketing mix, and attitude would all be directed to influence the purchase intention of local drivers positively. The model needs further validation among a broader sample of Thai drivers.

Keywords: electric passenger vehicles, purchase intention, structural equation modeling, Thai drivers

As a highly innovative country, Thailand has been adopting cutting-edge green technologies with a mass-based impact, the latest of which is the electric passenger vehicle (EPV). The rising fuel prices, as well as the worsening environmental pollution caused by the tens of millions of gas-based vehicles plying the roads each day—not to mention the pressure stemming from global and regional competition for innovation in the transport system (Victor, 2018)—are making EPV a probable option for Thailand (Warr & Kohpaiboon, 2017).

The government, specifically the Ministry of Energy, has a standing policy on EPV under its Energy Efficiency Development Plan (2011–2030). Broadly, the Plan seeks to stave off the phenomenal energy consumption levels throughout the country, by conserving 15,000 kilotons of oil equivalent and thereby reducing its carbon footprint by 53 million

tons by 2030 (Ministry of Energy, 2011). The use of EPV constitutes one explicit measure geared towards achieving the milestones under the Plan (Ministry of Energy, 2011), including those in related policies (Victor, 2018).

To date, Thailand has yet to roll out the EPV in the domestic, commercial market, albeit some companies have already begun using them in a few off-road applications. The government is usually prudent when making decisions on newer technologies because the latter commonly have attendant birthing and development challenges. Like other technologies, the EPV has numerous challenges of its own revolving around, for instance, their off- and on-road use, such as those related to the driving range, speed, safety, reliability, charging facilities, pricing, and post-purchase service. The preceding challenges, as well as others—for example whether this vehicular technology will indeed solve the country's existing environmental and energy problems (Selvakkumaran, Winyuchakrit, Limmeechokchai, & Ahlgren, 2018)—are thus compelling Thailand to carry out further intensive research and development on EPV before the product's commercial launch. There also lies the question if the Thai drivers would be responsive to the said product—in particular, if they would consider and intend to purchase such a vehicle in the future. Although much is known about the technical and environmental aspects of the EPV in Thailand, there is generally a dearth of local knowledge about the purchasing intent of potential consumers of this new technology, although some parallel findings are available (see Thananusak, Rakthin, Tavewatanaphan, & Punnakitikashem, 2017). Using structural equation modeling, this study examines the intention of Thai drivers to purchase EPV in the context of attitude, external environment, marketing mix, subjective norms, and consumer perception. Data have potential promotion and marketing implications for this emerging product.

Framework and Hypotheses

Figure 1 shows the variables included in the model, namely, purchase intention of EPV among Thai drivers in the context of attitude, external environment, marketing mix, subjective norm, and consumer perception. The presumed relationships between and among these variables are also indicated in the figure and discussed in the following sections.

Purchase intention refers to consumers' plan, consideration, or preference to buy the product (Younus, Rashed, & Zia, 2015). Research indicates that purchase intention does not occur in a vacuum but is intricately interwoven with a host of factors with which consumers evaluate of whether or not to purchase the product (Zeng, 2008). Across a number of studies, purchase intention has been examined for its relationships with a multitude of factors, among of which are attitude, external environment, marketing mix, subjective norms, and consumer perception.

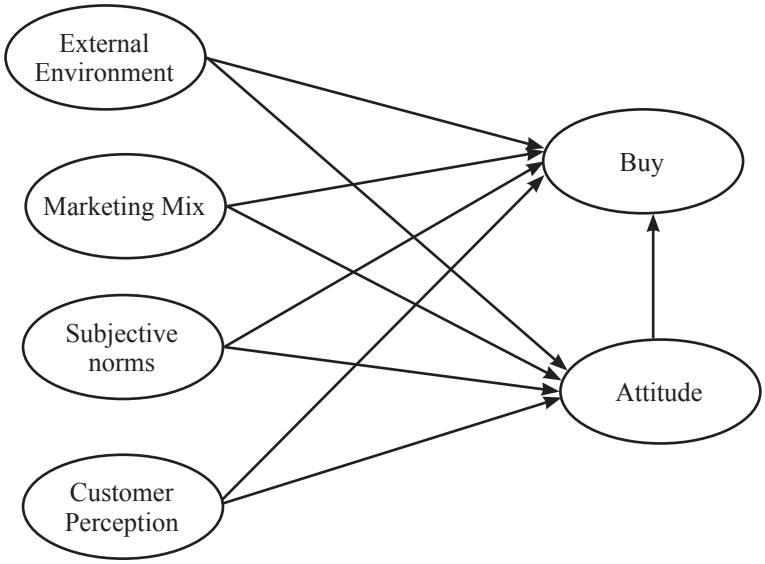

Figure 1. Study variables

Attitude is the proximate determinant of purchase intention in the model. Attitude is an overall disposition of being in favor or not in favor of something. As a subjective foundation, attitude thus serves as a springboard towards making a decision, such as having the intention to purchase EPV. The linkage between attitude and purchase intention has ample support theoretically and conceptually (Ajzen, 1991) and in the empirical literature (Heyvaert, Coosemans, Mierlo, & Macharis, 2015; Afroz, Rahman, Masud, Akhtar, & Duasa, 2015). One's attitude is therefore hypothesized as being directly related to one's purchase intention of EPV among Thai drivers (**Hypothesis 1**).

The external environment comprises macro-level political, economic, sociocultural, and technological factors (Voiculet, Belu, Parpandel, & Rizea, 2010). Political factors involve laws and legal regulations, and policy framework; economic factors involve credit access, interest rates, inflation, and price fluctuations; sociocultural factors involve the general ways of life of the people; and technological factors involve a country's technological innovation and sophistication, as well as the actual and potential benefits it has derived from using technologies in general. Laws and funds are enabling factors, whereas sociocultural norms and technological benefits are either push or pull factors, all of which are nonetheless powerful to affect one's intention to purchase EPV positively. Conversely, in the absence of these factors, such as legal and financial support, the industry would be hard-pressed to entice drivers to purchase the electric version because prospective consumers would be bereft of any structural security that the product is tenable. Consistent with empirical evidence (Thananusak et al., 2017; Bhalla, Ali, & Nazneen, 2018), external environment is hypothesized as directly related to the purchase intention of EPV among Thai drivers (**Hypothesis 2a**).

In addition to its direct influence, external environment carries further prospect of affecting one's purchase intention indirectly, such as via one's attitude towards the product. With its spectrum of broad-based frameworks and structures, which are essentially life-altering conditions, the external environment could help develop one's subjective or attitudinal predisposition to favor or to not favor EPV, based on one's general evaluation of the vehicles (for example, as an energy-saving, environmentally-friendly, and economically and socially beneficial technology). Overall, the external environment exerts a social force strong enough to form an attitudinal precursor to purchase intention (Ajzen, 1991). We, therefore, hypothesize that external environment indirectly affects one's purchase intention among Thai drivers via one's attitude towards EPV (**Hypothesis 2b)**.

Marketing mix refers to the multiple processes involved in promoting and selling, as well as augmenting and sustaining the presence of a product. As a tool (Kotler & Keller, 2006), marketing mix—or 4Ps marketing—involves the product itself, price, place (i.e., how the product will be distributed), and promotion (i.e., marketing communication strategies). The overarching aim of marketing is to effectively communicate a coherent set of messages in varied ways to establish the product, which in this case are EPV, as an asset and a need. The successful marketing of the product as an essential good should lead many consumers to want to purchase it assuming that other factors are also considered (Garling, 2000). In this respect, marketing mix is hypothesized for its direct relationship to one's purchase intention of EPV among Thai drivers (**Hypothesis 3a**), which is a proposition akin to that implied by other authors (not necessarily among Thai drivers; Garling & Thogersen, 2001).

On the other hand, rather than having direct effects, marketing mix is posited for its indirect effects on one's purchase intention among Thai drivers, but these indirect effects are channeled via one's attitude. The wide range of focal information communicated to consumers, dwelling on the advantages of EPV, is usually intense and persuasive that consumers are more likely than not to develop a favorable attitude towards the product. As known, a favorable attitude is a pathway to purchase intention, and eventually, to actual purchase. In this regard, the marketing mix is hypothesized to be indirectly related to one's purchase intention among Thai drivers through one's attitude towards EPV (**Hypothesis 3b**).

Beyond the macro level-based external environment and marketing mix, there lies at the social level subjective norms, which refers to one's perceived social pressure to perform or to not perform the behavior in question (Ajzen, 1991). The published literature has ample evidence underscoring the relationship between social pressure and behavioral performance, but it further indicates that such pressure intensifies if the sources of such pressure are one's family, an expert, and a famous person, which are in themselves key

reference groups in Thailand as elsewhere. As a new technology, EPV should be a source of tremendous pressure for consumers to purchase the product given its promise for a novel level of comfort (for the benefit of one's family), technical ease and sophistication (as articulated by an expert), and high social status (as endorsed by a celebrity). Recommendations from these reference groups alone, because these serve as social and interpersonal forces, are sufficient for consumers to develop an intent to purchase. Hence, in this case, subjective norms are directly related to one's purchase intention of EPV among Thai drivers (**Hypothesis 4a**).

Alternatively, instead of having direct effects, subjective norms would only be indirectly affecting one's purchase intention but occurring through one's attitude towards EPV. One's family expressing wanting an EPV, an expert endorsing the technology, and a famous person invoking vehicle ownership as a symbol of social mobility and status are powerful reasons for one to develop a favorable attitude towards the product. Through this attitude, subjective norms would then manifest their indirect influence on purchase intention. Thus, we propose that subjective norms are indirectly related to one's purchase intention among Thai drivers via one's attitude towards EPV (**Hypothesis 4b**).

Although purchase intention is influenced by macro- and social-level factors, it is likewise affected by individual- or consumer-based perception, which essentially pertains to the interpretation of consumers about the product and the fitting in of such interpretation into one's frame of reference (Walters, Bergiel, & Sheth, 1989). One's interpretation could have developed as a result of marketing information and other broad-based factors, but other informal, interpersonal, and everyday sources could have marked influences on the outcome as well. Perception or interpretation—for instance, that electric vehicles are easy to use, useful, affordable, and of quality—is expected to lead consumers to develop an intent to purchase the product. The published empirical literature affirms the positive relationship between customer perception and purchase intention; for instance, in tandem with personality type, perception explains 57.1% of the variance in purchase intention of electric vehicles (He, Zhan, & Hu, 2018). Consumer perception is, therefore, hypothesized to be directly related to the purchase intention of EPV among Thai drivers (**Hypothesis 5a**).

Instead of its direct effect, however, customer perception influences purchase intention only indirectly via one's attitude. The literature has established the connection between perception and attitude, as they either independently or collectively impact on decision-making process (Birke, Kunert, Link, & Ortuzar, 2015). Their bivariate relationship is concordant, or in agreement with each other, which means that if customers perceive the product in a positive light, their attitude would also tilt towards favoring the product. In this regard, customer perception is posited for its indirect effect on one's purchase intention among Thai drivers through one's attitude towards EPV (**Hypothesis 5b**).

Methods

A survey employing a self-administered questionnaire was carried out among 650 Thai licensed drivers. These drivers, who were residents of Bangkok and nearby suburbs, were randomly selected and interviewed at 367 car service centers located across the metropolis (Table 1). A little over a third of these drivers (35.78%) were sourced from Toyota showrooms, and between 12.3% and 15.2% were from Nissan, Honda, and Mitsubishi showrooms. Smaller numbers of participants (<8.0%) were from showrooms of other car brands.

Table 1

Number of Study Participants by Car Brands and Showrooms

Car Brands	Number of Showrooms	Number of Participants	%
Toyota	131	229	35.2
Nissan	57	99	15.2
Honda	56	98	15.1
Mitsubishi	46	80	12.3
Suzuki	28	49	7.5
Mazda	22	38	5.9
Mercedes-Benz	16	28	4.3
BMW	8	19	3.0
Porsche	3	10	1.5
Total	**367**	**650**	**100**

The variables included in this study were measured using a set of Likert statements which were found, upon examination, with a high level of internal consistency based on the reliability test conducted. Purchase intention was based on four statements (Cronbach's alpha coefficient: 0.89); attitude on three statements (0.81); external environment on four statements (0.84); marketing mix on four statements (0.97); subjective norms on three statements (0.89); and customer perception on four statements (0.94). The SPSS 22.0 and LISREL 9.2 were used for confirmatory, causal, and structural equation analyses.

Results

Of the 650 respondents, 63.7% were males, and 36.3% were females. Respondents were of varying ages (range: 21–50) and were either single or married. About half (46.0%) had a bachelor's degree, whereas others had no college degree or had a post-graduate degree. At the time of the interview, respondents were engaged in a business of their own or employed in a company or an organization. On average, about a third of respondents were earning a monthly income of 20,000-40,000 baht (32.2%) and another third a monthly income of 40,001-60,000 baht (32.2%), but about 40% were earning more. Two-thirds of respondents were homeowners (64.0%) and 55.7% owned at least one car that they reportedly used for 10–50 kilometers per day for personal and family activities.

Table 2 shows the results of the correlation analysis of the variables included in the model. Findings suggest that the variables are all statistically and significantly correlated with each other. Specifically, attitude, external environment, marketing mix, subjective norms, and customer perception are each linearly related to purchase intention in varying strengths (from r=0.30 to r=0.84). Furthermore, external environment, marketing mix, subjective norms, and customer perception are also significantly related to attitude, where the correlation coefficients ranged from r=0.21 to r=0.87.

Table 3 reveals the results of the consistency check of the overall model of the structural equation. The values based on the fit indices are all statistically significant (X^2/df, =2.273, p=0.001, GFI=0.97, AGFI=0.98, IFI=0.97, TLI=0.96, CFI=0.98, RMR=0.006, RMSEA=0.044), which means that the model is consistent with empirical data.

Results of the structural equation modeling analyses are presented in Table 4 as well as illustrated in Figure 2. The hypothesized positive effects of attitude on purchase intention (**Hypothesis 1**) and of external environment (**Hypothesis 2a** and **Hypothesis 2b**), marketing mix (**Hypothesis 3a** and **Hypothesis 3b**), subjective norms (**Hypothesis 4a** and **Hypothesis 4b**), and consumer perception (**Hypothesis 5a** and **Hypothesis 5b**) on purchase intention are all confirmed as statistically significant. For instance, attitude is directly predictive of purchase intention (coefficient=0.590, p<0.05) as well as customer perception is both directly (coefficient=0.300, p<0.05) and indirectly predictive (coefficient=0.260, p<0.05) of purchase intention.

Table 2

Correlations of Variables Included in the Model

Variables	1	2	3	4	5	6
External environment	1	0.47**	0.45*	0.53*	0.48**	0.47*
Marketing mix		1	0.48*	0.57**	0.83*	0.63*
Subjective norms			1	0.42*	0.87**	0.84*
Customer perception				1	0.21*	0.30*
Attitude					1	0.59**
Buy						1

*p<0.05, **p<0.01

Table 3

Fit Indices for the Proposed Model

Indices	Value	Acceptable range	Acceptability
X^2/df (X^2=259.14, df=114, p=0.001)	**2.273**	**<5.0**	+
Goodness of Fit Index	**0.97**	**>0.9**	+
Adjusted Goodness of Fit Index	**0.98**	**>0.9**	+
Incremental Fit Index	**0.97**	**>0.9**	+
Tucker Lewis Index	**0.96**	**>0.9**	+
Comparative Fit Index	0.98	>0.9	+
Root Mean Square Residual	0.006	<0.05	+
Root Mean Square Error of Approximation	0.044	<0.05	+

Table 4

SEM Standard Coefficients of Influence

Variables	Purchase Intention (BUY)			Attitude (ATTITUDE)		
	Total effects	**Direct effects**	**Indirect effects**	**Total effects**	**Direct effects**	**Indirect effects**
External environment	**0.**950**	**0.**470*	**0.4**80*	**0.**480*	**0.**480*	–
Marketing mix	**0.**860*	**0.**630*	**0.**230*	**0.230***	**0.**230*	-
Subjective norms	**0.**890*	**0.**845*	**0.**045*	**0.**045*	**0.**045*	–
Customer perception	**0.**560*	0.300*	0.260*	0.260*	0.260*	–
Attitude	**0.**590*					
Structural Equation		BUY			ATTITUDE	
R^2 (Coefficient of determination)		0.523			0.643	

*p<0.05, **p<0.01

A closer examination of the results reveals that, although the direct and indirect effects of the external environment (0.470 versus 0.480, p<0.05) and of customer perception (0.300 versus 0.260, p<0.05) are comparable, the parallel direct and indirect effects of marketing mix and subjective norms are much more skewed. That is, the effects of the latter variables on purchase intention are much more markedly direct than indirect (marketing mix: 0.630 versus 0.230, p<0.05; subjective norms: 0.845 versus 0.045, p<0.05). Overall, 52.3% of the intention to buy EPV among Thai drivers is predicted by the model. Based on this model, subjective norms are the most significant for their primarily direct effects on purchase intention, followed by marketing mix and attitude. External environment and customer perception are similarly significant predictors of purchase intention, but they are closely intertwining with attitude. Moreover, the model is strongly predictive of Thai drivers' attitude (64.3%) towards EPV, but much of this attitude has to do chiefly with the external environment, and secondarily with customer perception and marketing mix.

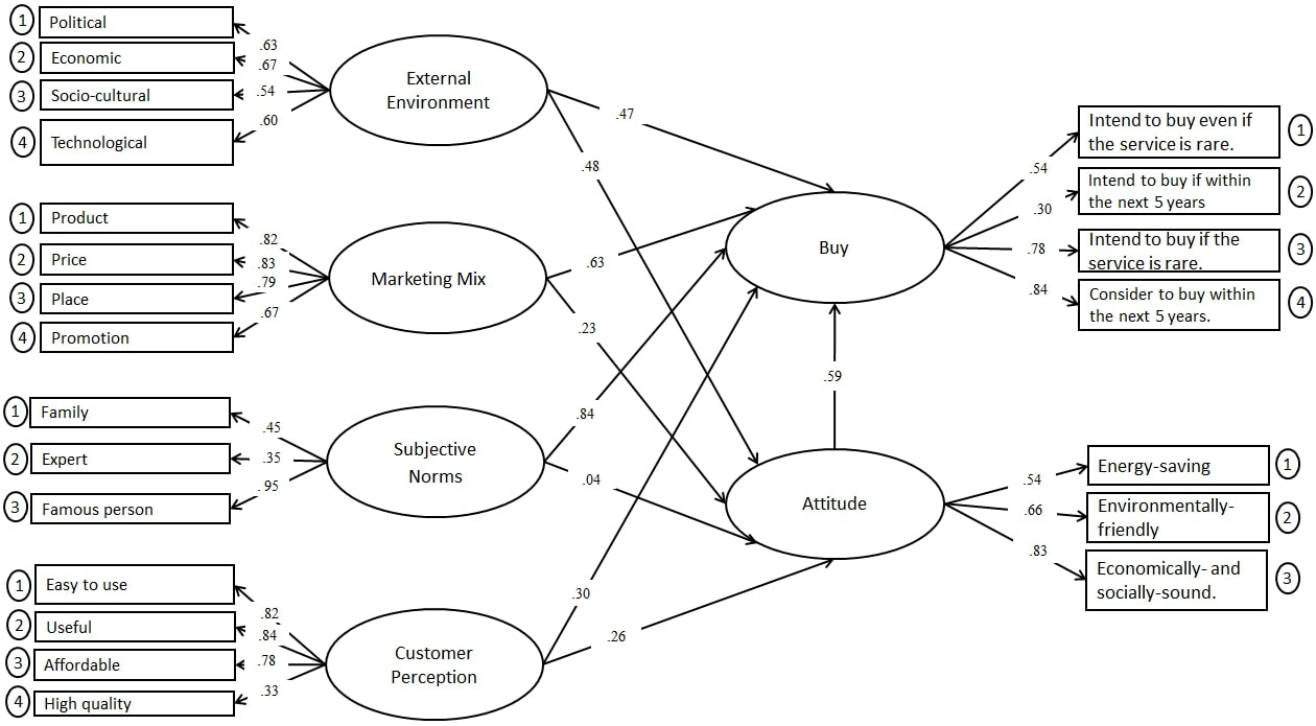

Figure 2. The structural equation modeling of factors influencing the purchase intention of electric vehicles among Thai drivers

Discussion

Using structural equation modeling analysis, this study examined the Thai drivers' intention to purchase EPV in relation to five factors, namely, attitude, external environment, marketing mix, subjective norms, and customer perception. Systematic evidence is needed to determine the factors that could potentially influence the successful introduction, sales as well as the long-term prospects of the EPV in Thailand. Along with prior findings (e.g., Thananusak et al., 2017), the present set of evidence would help build the pool of local knowledge on the problem on which the focus and substance of prospective studies, discourses, and decisions on EPV in Thailand can be based on. The future of overarching and life-changing technologies, such as EPV, should be well-anchored on nuanced scientific information. Human behavior, especially when it is as complex as seeking to buy a new and a yet-to-be-proven technology, would be better directed if the said behavior is thoroughly understood.

The present study shows that its five-factor structural equation model explains 52.3% of the intention among Thai drivers to buy EPV. In other words, in one of every two instances, the model can be used to predict the said purchase intention among this group of drivers. Much of the model's predictive power, however, rests mainly on three largely independent factors—subjective norms, marketing mix, and attitude, in that order. Studies elsewhere have also reported on the statistically significant relationships of subjective norms (Hamilton & Terblanche-Smit, 2018), marketing mix (Garling & Thogersen, 2001), and attitude (Hamilton & Terblanche-Smit, 2018) vis-à-vis purchase intention. Anchored on a powerful combination of social pressure and key reference groups (Ajzen, 1991), which somehow also underlie crucial social elements, such as modeling and interpersonal and collective trust, subjective norms should understandably play a big role in buying intention. With its set of focally-creative strategies aimed at promoting and selling a product like the EPV, marketing mix is also expected to exert a robust influence, such that a person who has been targeted by the array of marketing and promotion activities, would seek to purchase one (Garling, 2000). Additionally, as a subjective predisposition where a person states his or her position of being in favor or not in favor towards a product, attitude (especially in

the context of highly-specific attributes of EPV) should be an expected precursor of one's buying intention (Heyvaert et al., 2015).

In this study, attitude has been examined not only as a predictor but also an outcome variable, where the findings have clearly indicated that attitude is likewise robustly predicted and explained by the model. The evidence particularly suggests that 64.3% of the Thai drivers' attitude is due to the combined effects of the external environment, marketing mix, subjective norms, and customer perception. Various investigations have also reported on the empirical linkages between these variables—for example, external environment and consumer perception (Coffman, Bernstein, & Wee, 2015)—and attitude. However, additional present study findings revealed that, among the four predictors of attitude, the external environment is the most significant. Certainly, the political, economic, sociocultural, and technological conditions existing and operating at the macro level (Voiculet et al., 2010), because these are indicative of the overall level of conduciveness of the larger society to roll out the EPV and sustain its long-term viability, could induce the formation of relevant attitudes among Thai drivers.

The preceding key findings suggest that, if the local drivers were to be positively influenced to buy the EPV, Thailand would need to organize and implement systematic efforts to improve the EPV-related subjective norms, marketing mix, and attitude. Furthermore, to positively affect attitude, which is at the heart of purchase intention, Thailand should as well carry out parallel efforts to improve the external environment on EPV. Among others, these efforts would call for Thailand to utilize the most credible endorsers of EPV, to design and roll out a coherent and a focal set of messages on and attributes about EPV, to develop and implement the most effective marketing and promotion activities on EPV, and to institute societal and institution-wide laws, policies, and structures that are supportive of EPV. These recommendations, which are consistent with those offered in other studies (see Coffman et al., 2015), are expected to affect purchase intention based on current evidence.

The findings of the present study need further validation among other samples of Thai drivers, such as those residing in other parts of Thailand (not just in Bangkok) and from higher-income groups. To ensure an accurate representation of these overlooked categories of Thai drivers in the sample, future studies should adopt a stratified, rather than a simple random sampling scheme. Overall, prospective research must further explore the scientific and empirical soundness of the model covering the current set or even an expanded set of variables.

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Declaration of ownership

This report is our original work.

Conflict of interest

None.

Ethical clearance

The study was approved by the institution.

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