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Mediating the Drive: How Brand Image Shapes the Adoption of Technology and Innovation in Bangkok's Electric Vehicle Market

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Abstract

Background and Aim: The electric vehicle (EV) market in Bangkok has evolved driven by environmental concerns, urban congestion, government incentives, charging infrastructure development, and consumer preferences, making it a promising contributor to a cleaner and sustainable urban mobility landscape. This research explores the dynamics of technological acceptance, innovation, brand image, and decision-making in the context of electric vehicle (EV) adoption. Therefore, this research can be used as a guideline for policymakers, marketers, and industry stakeholders aiming to promote sustainable and technologically advanced transportation solutions.

Materials and Methods: The study employs a quantitative approach, utilizing a questionnaire-based survey method, and targets a sample of 200 participants residing in Bangkok with prior knowledge of electric vehicles. Following the principles outlined by Gorsuch (1983), simple random sampling was applied. The index of item-objective congruence (IOC) was between 0.67-1.00. The Cronbach's alpha coefficient was between 0.835 - 0.919. Statistical analysis techniques encompassing percentages, averages, standard deviations, and structural equation modeling (SEM) were employed.

Results: The findings of this research reveal that individuals possessing knowledge about electric cars exhibit a significantly high level of acceptance regarding technology, innovation, brand image, and decision-making. Also, they all have high scores in every aspect with a mean of 3.97, 3.81, 3.87, and 3.98, as well as standard deviations of 0.792, 0.764, 0.690, and 0.652, respectively. Furthermore, the study elucidates the factors influencing decision-making (DM) regarding electric vehicle purchases, with technology acceptance (TA) and innovation (IN) emerging as critical determinants. Both TA and IN exert direct effects on DM with values equal to 0.122 and 0.241. Additionally, these factors indirectly impact DM with values equal to 0.159 and 0.495, respectively, which underscore their multifaceted roles in shaping consumer choices. Importantly, TA and IN also have a direct effect of 0.270 and 0.840 on brand image. Notably, brand image has a direct effect on DM with values of 0.589.

Conclusion: The findings underscore the significance of informed consumer knowledge and positive brand image in fostering the adoption of electric vehicles, aligning with the broader societal goal of sustainable and environmentally conscious mobility solutions.

Keywords: Innovation; Brand Image; Decision Making; Electric Vehicle (EV) Market

Introduction

Nowadays, the automotive sector is recognized as an important driver of the economy. According to a survey by Transport Statistics Group (2022), the number of cars (of all types) registered with the Department of Land Transport increased by one million over the previous year (Thansettakij, 2023). This rise in the number of cars registered was evidence of Thailand's economy recovering and giving its citizens more purchasing power. According to the results of the 39th Motor Expo, or Motor Expo 2022, which took place on 12th December 2022, the total number of car bookings at the event was 36,679, an increase of 16.1 percent from 2021. From the estimated total value of 50,000 million baht, it consisted of reservations for 5,800 electric cars. The research conducted by Transport Statistics Group (2022) found that there are 326,918 electric cars in Thailand. This included 255,733 Hybrid Electric Vehicle (HEV), 41,743 Plug-In Hybrid Electric Vehicle (PHEV), and 29,402 Battery Electric Vehicle (BEV).

Through the above data, the Thai government sees the potential in the EV industry in terms of the growth and development of electric cars. Therefore, the Thai government plans to produce electric cars to account for 30% of all cars produced in 2030. Looking at the Thai electric car market in 2022, it was found that the newly registered EVs accounted for 1.5 thousand vehicles, which would generate an added value to the gross domestic product (GDP) of no less than 200,000 million and create a labor demand in the production of automobiles (Public Relations Department, 2023).

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Currently, EV cars have been introduced in Thailand by many car brands such as Tesla, BYD, Neta, and MG or luxury car groups such as Benz, BMW, and Volvo. The key features of EVs include lower noise levels and more efficiency (saving fuel energy) compared to gasoline-powered cars. For instance, automobile owners or drivers can conserve fuel by simply charging a car's battery at home or a certain place, like a public battery charger (Setiawan et al., 2017).

Additionally, brands should concentrate on their brand images because they pertain to attitudes, feelings, understanding, and awareness of the brand. This will help potential buyers remember the name or logo of the business. To ensure their names or existence are in the minds of their target customers, manufacturers or car importers must understand the significance of brand images. For example, when considering electric vehicles with minimalistic design, Tesla is often the brand that comes to mind. When considering BYD, it is commonly associated with an electric vehicle that offers a maximum range of 480 km per charge. Similarly, Volvo is often associated with the luxurious experience that accompanies its seamless driving performance.

It is regarded as being very difficult to develop a strong brand image that gives the target market acceptance in the technology of a new generation of automotive innovations because technology acceptance happens only after an individual has experimented with and experienced it until it finally occurs.

Rogers & Singhal (2003) studied the factors which influence consumer's decision-making for electric cars in Don Mueang, Bangkok. His study found that the consumer's acceptance of technology has to come from the design such that the product has to be interesting, easy, and uncomplicated. This will trigger consumer purchasing decision-making processes. In addition, David (1989), stated that acceptance of technology will lead to the decision to purchase an electric car. Therefore, manufacturers and distributors must design the product to make it user-friendly, well-designed with modern technology, and easy to navigate.

Additionally, in response to how people behave in the present period, manufacturers have created an electric car invention that helps minimize pollution while saving money on the price of oil, which is continually rising. Besides, a proactive government policy that encourages and supports the use of alternative energy sources is also present, and this sends a positive message to the Thai market for electric vehicles. However, technology acceptance in customers is a challenge for many EV business owners because a lot of people still prefer normal cars over EVs because the majority of charging stations are only available and cover the main roads usually in the big cities. As a result, switching to electric vehicles is still up for debate among residents who do not live in big cities.

All the above reasons, lead to the interest of this study to investigate the acceptance of technology amongst customers, brand image and innovation of EV, and customer purchase decision-making. The findings of this study can serve as a roadmap for marketing the EV business and as a springboard for future customer behavior response initiatives. With the acceptance of technology and the availability of charging stations that mostly cover only major roads within the city or in Bangkok, therefore, deciding to choose an electric car with alternative energy for people in the provinces is still a matter of serious thought. For these reasons, it affects the interest in studying. Consumer acceptance of technology EV innovation through brand image affects the decision to buy an electric car. Therefore, research on "Brand image as an interstitial variable linking adoption of technology and innovation to the decision to purchase electric passenger cars. (EV) of the population in Bangkok" is proposed to use the research results to develop the improve various strategies to respond to consumer behavior in the future.

Objectives

1. To investigate the level of opinion about brand image, technology acceptance, innovation, and customers' decision-making to purchase electric vehicles (EVs).

2. To examine the role of brand image in mediating the relationship between technology acceptability, innovation, and customers' decision-making about the purchase of electric cars (EVs).

Literature Review

1) Theories and concepts related to technology acceptance

The concept of technology acceptance was invented by Davis (1989) and is widely used for users' acceptance and usage of technology (Venkatesh, 2000). He invented the Technology Acceptance Model (TAM) to explain how users come to accept and employ technology. The model was developed from the

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Theory of Reasoned Action (TRA) which studied factors that can affect users in terms of technology acceptance and innovation. According to Rogers & Singhal (2003), innovations that enable people to create, accept, and use technology consist of 1) the perception of benefits, 2) the ease of use, 3) the risk perception, and 4) the attitude toward use 5) the social influence.

2) Theories and concepts related to innovation

Innovation is the use of knowledge and creativity to step up the development of new products or services with existing ones or rebuilds to replace old systems or products. The innovation might develop during the product analysis through the interaction of ideas between the provider (producer) and customers (Ehls, 2022). According to Chen et al. (2018), there are three elements of innovation. Firstly, product innovation is the introduction of technology to functional development, including inventions that can be applied to create a competitive advantage. Secondly, process innovation is the introduction of technology into practice to generate knowledge, experience, and techniques to make the process more efficient. Also, working processes require continuously changing work patterns to adapt to change. Lastly, management innovation is the introduction of managerial skills to improve a different operating pattern so that operations are faster. This leads to other corporate innovations.

3) Theories and concepts related to brand image

Brand image is the value and specificity of a certain type of product. It is the customer's perception of the brand. Brand image creation can be a result of good marketing activities aimed at consumer acceptance and a good attitude towards the product or the brand. Boulding (1975) said that brand image can be divided into four components: 1) perceptual component 2) cognitive components 3) affective component and 4) active component. These components can help determine consumer behavior. For instance, purchasing behavior will eventually emerge if consumers perceive and have a positive attitude toward a product or business.

4) Theories and concepts related to decision-making to purchase

Decision-making is an emotional process in which customers try to meet their needs by gathering information and selecting the products or services they want. Regarding Adugu & Broome (2018), by maintaining a good relationship with the consumers can give consumers a positive attitude toward the product or brand. Consumers' satisfaction-generating and networking involvement allows consumers to choose to buy goods and use services. Therefore, businesses need to find a way to motivate consumers to make purchasing decisions by understanding customer needs and paying attention to the purchase decision-making process. According to Downey et al. (2012) and Lamb et al. (2012), decision-making can be divided into five stages as follows: 1) awareness of the problem 2) search for information 3) evaluation of alternatives. 4) buying decisions and 5) after-purchase behaviour. In simpler terms, consumers will assess whether the product is capable of meeting their needs or not.

Conceptual Framework

From the review of the related literature above. The researchers have developed a conceptual framework for the research study from various concepts, theories, and research related to "The brand image mediates the adoption of technology and innovation to the decision to buy a passenger electric vehicle (EV) of the population in the Bangkok area." We have summarised and created a conceptual framework for this research as shown in figure 1.

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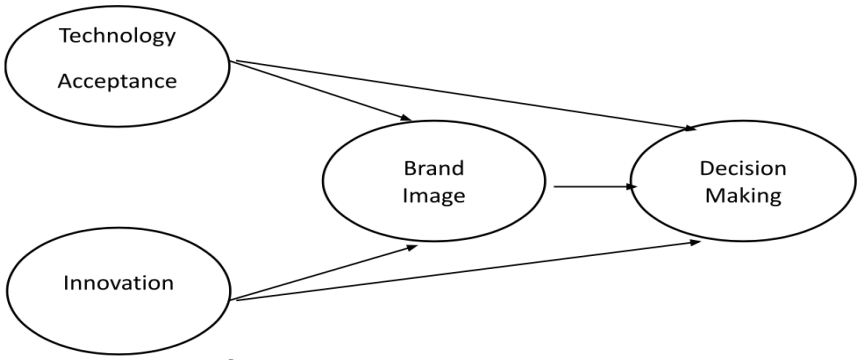

Figure 1 The Conceptual Framework Model

Hypothesis:

H1: Acceptance of technology has an impact on brand image.
H2: Innovation has an impact on brand image.
H3: Acceptance of technology has an impact on customers' decision-making in purchasing electric cars (EVs).
H4: Innovation has an impact on customers' decision-making to purchase electric cars (EVs).
H5: Brand image has an impact on customers' decision-making to purchase electric cars (EVs).
H6: Brand image mediates the relationship between technology acceptance and decision-making to purchase electric vehicles (EVs).
H7: Brand image mediates the relationship between innovation and decision-making to purchase electric vehicles (EVs).

Methodology

In this research, "Brand image as an interstitial variable linking adoption of technology and innovation to the decision to purchase electric passenger cars. (EV) of the population in Bangkok" is presented. According to the quantitative research and the survey research, the population is the general public who is familiar with personal electric cars in Bangkok. The sample size was determined according to the formula of Gorsuch (1983), and a simple random sampling method was used. The tools used to collect data were questionnaires. The researcher has checked the quality of the tools by testing the validity by taking the developed questionnaire to three experts to check the quality of content validity to find the IOC value. The researcher also selected only questions that meet the criteria are IOC $\geq$ .50 along with a confidence test (reliability) with an Alpha coefficient that has characteristics similar to a sample of 30 cases, with a confidence value of α of 0.70 and above, considering that the question has confidence (Vanichbuncha, 2017).

The first section of the questionnaire consists of checklist questions asking about the participants' demographic information which includes gender, age, education level, employment status, and monthly income.

Sections two to five are interested in technology acceptance, innovation, brand image, and decision-making to purchase electric cars (EVs). All measures used a 5-point Likert Scale (Likert, 1932).

Regarding data collection, we collected data between March and August 2023, and then we put data into codes and used statistical tools to analyze the data.

In terms of data analysis, we processed and analyzed data obtained from the questionnaire using a statistical package as follows:

1. For participants' personal information, we used frequency and percentage distribution to describe personal characteristics.

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2. To analyze data for technology acceptance, innovation, brand image, and decision-making to purchase, we used mean and standard deviation to translate the meaning of various data to summarise and describe the characteristics of variables by averages based on the concept of Best (1981: 182).

3. To test our hypotheses, we used inferential statistics which is a statistical method to find relationships among factors influencing the decision-making to purchase electric cars (EV) of the population in Bangkok. We used the Smart PLS 3 package (Hair et al., 2019) to analyze both direct and indirect with structural equation modeling (SEM).

Results

Based on the survey of the population of 200 people in the Bangkok area, it was found that men made up the majority of respondents (56.4%), had higher education (72.5%), earned an average monthly income of between 30,001 and 40,000 baht (45%), and 37.75% own a business or work as a freelance.
The results of the analysis of technology acceptance, innovation, brand image, and decision-making to purchase are shown in Table 1.

From Table 1, the results of a sample group of general people who are familiar with personal electric cars in Bangkok show that there is an opinion that factors in technology adoption, innovation, brand image and overall purchasing decisions are at a high average level with $\bar{x}$ of 3.97, 3.81, 3.87 and 3.98, respectively; the SD value of .792, .764, 690 and .652, respectively; the CV value of 0.20, 0.16, 0.18, and 0.14, respectively, which are lower than the minimum threshold for the CV at the 0.25 level. This shows that the information has low variation and within the criteria of the general public who is familiar with personal electric cars in Bangkok, respondents to the questionnaire with similar opinions.

Table 1. Mean, Standard Deviation, and Coefficient of variation (CV) for Technology Acceptance, Innovation, Brand Image, and Decision-Making to Purchase

	$\bar{X}$	SD	CV	Result
Technology Acceptance	3.97	.792	0.20	High
Innovation	3.81	.764	0.16	High
Brand Image	3.87	.690	0.18	High
Decision-Making to Purchase	3.98	.652	0.14	High

Note: $\bar{X}$ = mean; SD = standard deviation

The overall analysis can be shown through the use of structural equation models to analyze the factors influencing the purchasing decision for electric cars (EV) of the people in Bangkok to test our hypotheses. The analysis results are shown in Figure 2.

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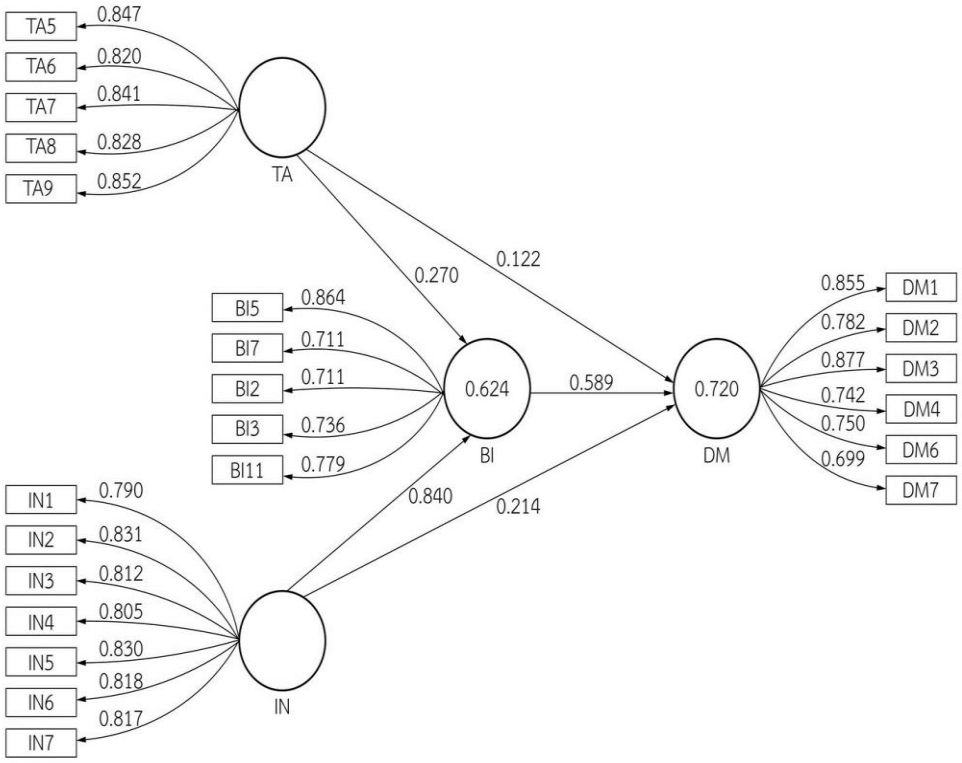

Figure 2. Relationship Paths of Structural Equation Models

Figure 2 shows the relationship path of the structural equation model that studies the relationship between variables. The results of the structural equation model analysis can be explained as follows:

1) Factors that affect purchasing decision

It found that technology acceptance (TA) and innovation (IN) have a direct effect on decision-making (DM) to purchase with values equal to 0.122 and 0.241. Technology acceptance (TA) and innovation (IN) also have an indirect effect on decision-making (DM) to purchase with values of 0.159, and 0.495, respectively.

2) Factors that affect brand image

It found that technology acceptance (TA) and innovation (IN) have a direct effect on brand image (BI) with values equal to 0.270 and 0.840, respectively. Brand image (BI) also has a direct effect on decision-making (DM) to purchase with values of 0.589.

We have summarized the results of the relationship between the effects of all variables on decision-making to purchase (DM) as shown in Table 2.

Table 2. Relationship between the effect of variables on decision-making to purchase

Variables	(R^2)	Effect	TA	IN	BI
Decision-Making	0.720	DE	0.122	0.214	0.589
		IE	0.159	0.495	0.000
		TE	0.281	0.709	0.589
Brand Image	0.624	DE	0.270	0.840	0.000
		IE	0.000	0.000	0.000
		TE	0.270	0.840	0.000

Note: DE=Direct Effect, IE=Indirect Effect, TE=Total Effect, N/A=Not Applicable

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From the results of the structural equation model analysis of factors affecting the decision-making to purchase electric cars (EV), the summary of all hypothesis testing is in Table 3.

Table 3. The Summary of All Hypothesis Testing

Hypothesis	Coefficient	T-Test	Result
H1: Acceptance of technology has an impact on the brand image.	0.270***	3.095	Support
H2: Innovation has an impact on the brand image.	0.840***	13.799	Support
H3: Acceptance of technology has an impact on customers' decision-making to purchase electric cars (EVs).	0.122**	2.354	Support
H4: Innovation has an impact on customers' decision-making to purchase electric cars (EVs).	0.241**	2.493	Support
H5: Brand image has an impact on customers' decision-making to purchase electric cars (EVs).	0.589***	7.798	Support

*Note: * $p < .05$ or $t \geq 1.65$, ** $p < .01$ or $t \geq 1.96$, *** $p < .001$ or $t \geq 2.58$*

Table 3, shows that technology acceptance has an influence on brand image and decision-making to purchase electric cars (EVs), with t-test values of 3.095 and 2.354. Moreover, innovation influences the brand image and decision-making to purchase electric cars (EVs), with t-test values of 13.799 and 2.354. Brand image influences the decision to purchase electric cars (EVs) with a t-test value of 7.798.

The results of analysis of the effect of mediation variables. which is a variable that changes the relationship between the independent variable and the dependent variable where the mediation variable explains the indirect effect. The results are shown in Table 4.

Table 4. Results of the Mediation Effect

Hypothesis	Effect	Boot SE	Boot LLCI	Boot ULCI
H6: Brand image mediates the relationship between technology acceptance and decision-making to purchase electric vehicles (EVs).	0.4927	0.0603	0.3796	0.6140
H7: Brand image mediates the relationship between innovation and decision-making to purchase electric vehicles (EVs).	0.3982	0.0561	0.3373	0.4756

From Table 4, the results of the mediation effect found that brand image mediates the relationship between technology acceptance and decision-making to purchase electric vehicles (EV) of the population in Bangkok (Effect = 0.49, SE = 0.06, 95% CI = [0.38, 0.61]). Moreover, the brand image also mediates the relationship between innovation and decision-making to purchase electric vehicles (EV) of the population in Bangkok (Effect = 0.40, SE = 0.06, 95% CI = [0.34, 0.48]).

Discussion

As mentioned in the result section, it was found that the overall acceptance of technology was at a high level. This is because electric cars are easy to learn how to use. Not only is it suitable to use in this era since it can help reduce carbon emissions, but it also helps with user's emotional benefits as they may feel

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like they are helping the world. This matches with the study from Artamevia (2021) which studied the impact of brand image and technology acceptance on Gojek's online transportation on customers' purchase decisions. The research found that brand image including how customers perceive the product's benefit and ease of use can influence decision-making to purchase.

In addition, the results of the innovation level analysis found that overall, it is at a high level. Innovation in electric cars is the design of the car in a functional form to make it suitable for urban people. By using production innovation, it makes the cars engineless, has technology that can inspect the car system, and uses raw materials in production that can reduce fuel energy.

This result is in line with the research from Wahyuni (2019), which studied how innovation, brand image, and physical characteristics influence Starbucks's customers purchasing decisions in Jakarta. The result found that product innovation influences the design of the product in the eyes of consumers, and it has a direct effect on the brand image with statistical significance at the .01 ($p \leq .01$). Also, product innovation has an indirect effect through the brand image to purchase decisions (through word of mouth) which is statistically significant at the .05 level ($P \leq 0.05$).

Furthermore, our result found that brand image influences purchasing decisions, that is, the decision to purchase an electric vehicle is based on the brand reputation. Before making the purchase, customers will take value for use into consideration, as well as compare various brands. This is similar to the research from Setiawan et al., (2017) that found that brand image is the perception about a brand and a well-known brand image will result in a more positive attitude towards the brand.

Additionally, we found that decision-making to purchase is high, especially the level of information-based decision-making which was at its highest because there are many types of electric cars. Therefore, customers must search for information about respective models of electric cars and compare to get the electric car that best meets their needs. As a result, before making a purchase decision, information must be gathered and then comparisons are made to choose the one that consumers receive the most benefit from. This is in line with Manktelow's (2021) concept, which states that consumers will select products or services based on product information received under limited circumstances before they decide to purchase.

Overall, what we can learn from this research is to bring technology and innovation to develop the decision-making process for purchasing electric cars (EVs). In today's era, electric cars play an important role in replacing cars driven by energy sources that burn fuel which causes various pollution. The car's brand image can also help stimulate them to best resonate with the target group. If the brand reaches the target group that is interested in the product, it will have an increased impact on purchasing decisions.

Conclusion

In conclusion, this research has provided valuable insights into the factors influencing the decision-making process to purchase electric cars (EVs) in the Bangkok area, with a specific focus on the interplay between technology acceptance, innovation, brand image, and ultimate purchasing decisions. The result found that technology acceptance and innovation have both direct and indirect effects on purchasing decisions to buy electric cars. Moreover, technology acceptance and innovation also have a direct effect on brand image. Finally, brand image has a direct effect on decision-making to purchase electric cars. This research not only contributes to our understanding of the factors influencing the adoption of electric cars but also provides practical guidance for stakeholders in Thailand who aim to promote sustainable and innovative transportation solutions. This is because electric cars are suitable for today's society. After all, they are more environmentally friendly. By leveraging the insights from this study, it is possible to foster a greater acceptance of electric vehicles, thus contributing to a greener and more environmentally conscious future for the Bangkok area and the wider society.

Recommendation

In terms of practical applications of this research, we found that information on technology acceptance consists of 1) perceived benefits 2) ease of use 3) perceived risks 4) attitude towards use, and 5) social influence. Therefore, automobile companies must adapt to the new change since in today's society, the world is transitioning to a new era of using alternative or clean energy. This turning point is a challenge in Thailand's automotive business. Nowadays, driving electric cars can lead to a good image in society as well as help reflect the identity of people who want to save the world from global warming. As a result,

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electric car businesses should build trust and make people accept technology to increase the market opportunities available in the Thai electric car industry.

Moreover, in terms of innovation, we found that it consists of 3 components: product innovation, process innovation, and management innovation. For example, product innovation that brings technology to develop work including various inventions that can be used to create a competitive advantage. Besides, process innovation is the use of technology to assist the working process to create knowledge, techniques, and experiences to develop the working process and make it more efficient. It also requires constant development and adjustment. Therefore, car companies should design cars in a functional form suitable for urban people by adopting innovations in production. They should also offer a 'test drive' service so that people can try their cars before purchasing. There should be an electric car service center that should provide systematic service as well as a car inspection service using new technology.

Furthermore, in terms of brand image, it can be divided into 3 aspects: perception aspect, knowledge aspect, and emotional aspect.

According to research findings, when consumers wish to purchase a car, they initially consider electric car brands. The next step is for the customer to know the brand and see if it is a well-known brand. Then, usually, customers learn about the brands from motor shows which can make them feel satisfied and confident in the quality of the electric cars (EVs).

In the case of the purchasing decision-making process, we can divide them into five stages: 1) problem awareness, 2) information seeking, 3) alternative evaluation, 4) purchasing decision, and 5) post-purchase behavior. From the results, it is found that the decision to purchase an electric car is based on the brand's reputation. Next is the usability features by searching for information before deciding to buy an electric car, which customers might consider the worthiness of its function and they may also ask other people for their opinion. If they are satisfied with the car or brand, they might recommend the car to their friends or family.

For future application, since this research only focused on the Bangkok area, hence future research could investigate further into a larger area so that it can be more generalized and apply to other provinces of Thailand. Besides, this research only has 4 factors including brand image, innovation, technology acceptance, and decision-making to purchase electric cars. As a result, future research could study other factors that might affect purchasing decisions for electric cars.

1) This research is a study of "Brand image as an interstitial variable linking the acceptance of technology and innovation to the decision to purchase electric passenger cars (EVs) of the population in Bangkok". In the next research Integrated research should be conducted. (Mixed-Methods Research) both quantitative research and qualitative research with an in-depth interview (In-Depth Interview).

2) This research is a study of only the population in the Bangkok area of personnel. The next research can be further developed to conduct studies with samples in other provinces to obtain different data for greater completeness.

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