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Determining Behavioral Intention of Logistic and Distribution Firms to Use Electric Vehicles in Thailand

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Abstract

Purpose: Electric vehicle (EV) technology started in 2015 in Thailand. The Thai Government has indicated that 30% of all cars produced in Thailand by 2025 will be EVs. Using EVs in Thailand will reduce road pollution and increase energy efficiency, especially in major cities. Hence, the adoption of EVs in the country has been promoted. This study pointed out that social influence, facilitating conditions, perceived enjoyment, environmental concern, attitude, and perceived behavioral control are key factors affecting the behavioral intention to adopt EVs among logistic and distribution firms in Thailand. **Research design, data, and methodology:** 500 top management, middle management and purchasing managers of logistic and distribution firms in Thailand are surveyed. The study employed judgmental, convenience, and snowball sampling. Confirmatory Factor Analysis (CFA) and Structural Equation Model (SEM) are the main statistical tools for data analysis. **Results:** The results show that all determinants impact customers' willingness to adopt EVs, except perceived enjoyment and environmental control. **Conclusions:** The study proposes to promote the incentives by decreasing electricity prices and endorsing EVs purchase to accelerate the adoption of EVs in Thailand. Therefore, future policies should focus on behavioral intention toward EVs amongst logistic and distribution firms for enhancing the future of mobility in Thailand.

Keywords : Logistics, Distribution, Supply Chain Managment, Behavioral Intention, Electric Vehicle

JEL Classification Code : M10, M31, L61, L62, O30.

1. Introduction

Emissions from private vehicles contribute approximately 12 percent to global greenhouse gas (GHG) emissions worldwide, and combined with other vehicle types, the transportation sector, on the whole, contributes approximately 22 percent (Sierzchula et al., 2014). Therefore, the global political agenda has been elevated to reducing emissions from private and other vehicles or discouraging their use altogether (Klöckner et al., 2013). Accordingly, many countries address significant efforts to shift to sustainable transportation behavior (Mahmoud & Hine, 2016). Various benefits of EVs depend on end users' adoption. A better understanding of the factors that influence EV diffusion can contribute to achieving policy goals related to reducing transportation-related GHGs. Three domains of electric vehicle development are governmental support, technological advancement, and consumer acceptance (Mohamed et al., 2016).

In Thailand, key challenges of road transport in Thailand include the rapid growth of vehicles, which increases energy

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demand, thereby contributing to GHG emissions and air pollution as particulate matter or PM2.5 (Kongklaew et al., 2021). In 2015, the Thai government launched policies to promote EVs, which launched EV policy in Thailand. However, EV adoption is quite low, at 0.32% of the total registered vehicles (Kester et al., 2018). The Energy Efficiency Plan (EEP2015) provides the roadmap for EV adoption aiming for 1.2 million EVs by 2036 (Thananusak et al., 2021). The National Science and Technology Development Agency (NSTDA) announced a plan for Thailand to be an ASEAN BEV hub, including the capacity to produce 1000 electric buses a year and develop prototype-modified EVs, along with the Board of Investment of Thailand granted EV investments by creating tax incentives for investors, customs deductions for imported EVs, and EV parts and equipment. Accordingly, it is more attentive to the country for EV adoption, which helps to develop innovative policy incentives for the country (Kongklaew et al., 2021).

Due to any new technology initially having a very low market share and users' adoption rate at the beginning, it is important to study influential factors influencing potential consumers of new technology (Rogers, 2003). Even though electric vehicles are still in the initial stage, automotive makers are producing more and more such vehicles. Following this trend, many studies have been conducted about the substitute fuels like bio diesels, hydrogen, and others as they have been widely used in society. Furthermore, numerous unusual fuels will soon seize higher adoption among the world's populace. In light of this, with the increasing attention to environmental concerns, renewable energy, and the possibility of soaring gas and oil prices in the next decades, numerous companies have produced electric and hybrid cars (Khazaei & Khazaei, 2016).

Recently, a greener supply chain has been promoted among logistic and distribution firms in Thailand. Big C Supercenter as the leading grocery retailer in Thailand, and DHL Supply Chain Thailand, the global market leader in contract logistics, have announced the deployment of electric trucks for product distribution. Another obvious example is that CEVA Logistics served as Decathlon products distribution has expanded fleet of electric vehicles, aiming to reduce annual CO2 emissions by more than 100,000 kilograms. The problem statement is that the adoption has been risen but still limited in Thailand. The research gap is that there is insufficient research on the behavioral intention to adopt EVs among logistic and distribution firms in Thailand. As a distribution business is a lifeblood of most countries' economy, the value of this research highlights behavioral intention toward EVs amongst logistic and distribution firms could the future of mobility as environment-friendly, cost-saving and sustainability. Therefore, this research aims to fill the gap in studying key factors affecting the behavioral intention of logistic and distribution firms to adopt EVs in a developing country like Thailand.

2. Literature Review

2.1. Social Influence

Social influence is "the degree to which a person believes that other people whose ideas are important to him or her think the same way about a new technology" (Khazaei & Khazaei, 2016). Social influence is also termed a "subjective norm" in the Theory of Reasoned Action model. Later, the construct was extended to the technology acceptance model or TAM2 and the unified theory of acceptance and use of technology or UTAUT (Venkatesh et al., 2003). Social influence is conceptualized as "the person's behavior is influenced by the way which they believe that society will view them as a result of using the technology" (Venkatesh et al., 2012). Khazaei and Khazaei (2016) posited that the purchase decision of EVs is not purely on an individual level but is also heavily influenced by businesses, especially logistic and distribution firms. Besides, the adoption may be ignited by external social pressure. Ozaki and Sevastyanova (2011) acknowledged that social influence is the normative beliefs generated from the compliance of personal behavior with a reference group in society. It can govern personal judgment to express behavioral intention to adopt new technology. Thus, the below hypothesis is proposed:

H1: Social influence has a significant impact on behavioral intention to adopt EVs.

2.2. Facilitating Conditions

Facilitating conditions explain "an individual's perception about infrastructures or technical support existed for using a technology or system" (Venkatesh et al., 2012). The adoption of electric vehicles can be signified by the "availability of batteries, learning tools or maintenance, charging infrastructures in home and roads, or after-sale services" (Khazaei & Khazaei, 2016). UTAUT is the foundation theory that affirms the significant relationship between facilitating conditions and the intention to use EVs (Venkatesh et al., 2003). Tran et al. (2019) investigated the predictors of behavioral intention to use the electric carsharing system. However, several studies found little effect of facilitating conditions on behavioral intention (Casey & Wilson-Evered, 2012; Fleury et al., 2017; Madigan et al., 2017). Xie et al. (2022) found no significant relationship between facilitating conditions and behavioral

intention to use new technology. Nevertheless, the study of Venkatesh et al. (2003) distinguished the influence of facilitating conditions on behavioral intention in the various context of technology. Therefore, the following hypothesis is indicated:

H2: Facilitating conditions have a significant impact on behavioral intention to adopt EVs.

2.3. Perceived Enjoyment

Liao et al. (2008) indicated that perceived enjoyment is a fundamental motivation to perform a behavior or adopt new information technology. Perceived enjoyment embodies the pleasure of deriving ownership or experience of using an EV. Although EVs are new automobile technology that highlights smooth driving and offers high acceleration compared with combustion engine cars, the enjoyment of the drivers and passengers of EVs is obtained (Khazaei & Khazaei, 2016). Perceived enjoyment is a significant effect on the intention to use a system. When a system is perceived as easy and fun to use, it associates with consumers' behavioral intention (Venkatesh et al., 2012). Khazaei and Khazaei (2016) emphasized the significant relationship between perceived enjoyment and intention to use EVs. Based on the above assumption, the following hypothesis is stated:

H3: Perceived enjoyment has a significant impact on behavioral intention to adopt EVs.

2.4. Environmental Concern

Environmental concern can be emphasized as the perception that the environment is deteriorating. Environmental concern is "the degree to which people are aware of environmental problems and support efforts to solve this problem and indicate a willingness to contribute personally to the solution" (Dunlap & Jones, 2003). Environmental concerns become critical to the consumers' decision-making. In transportation, global warming, regarding Co2 emissions produced by cars, is gaining more and more concerns among consumers (Razak et al., 2014). Green products and "green cars" have been debated to establish a significant relationship between environmental concern and behavioral intention (Khazaei & Khazaei, 2016). Ajzen (1991) theorized the theory of planned behavior or TPB to address attitude and perceived behavior control as predictors of intentional behavior. Attitude denotes "the consequential beliefs resulting from the perceived impacts of performing specific behavior" (Anable, 2005). Lai et al. (2015) added that environmental concern is a psychological factor that should impact user's attitudes towards the acceptance of EVs. In addition, perceived behavioral control is governed by personal judgment/control (Ozaki & Sevastyanova, 2011). Mohamed et al. (2016) identified that environmental concern significantly impacts intention, attitude, and perceived behavioral control of adopting EVs as constructed hypotheses:

H4: Environmental concern has a significant impact on behavioral intention to adopt EVs.
H5: Environmental concern has a significant impact on attitude towards adopting EVs.
H6: Environmental concern has a significant impact on perceived behavioral control.

2.5. Attitude Towards Adopting EVs

Attitude represents "one's beliefs, thoughts, and opinions in a response with an individual to a product, brand, or service" (Eagly & Chaiken, 2007). Attitude determines the tendency of consumers to purchase a product or service in the future (Khurana et al., 2020). In this context, business customers believe that EVs are environmentally friendly and contribute to the self-green image. Attitude can direct the acceptance/rejection of EVs (Ajzen, 1991). The attitude is "the cognitive resonance of belief regarding whether the EV is good or bad" (Ali & Naushad, 2022). Attitude is the most significant factor of behavioral intention to embrace or reject something. Many scholars determine attitude's effect on the EV adoption decision (Ali & Naushad, 2022; Khurana et al., 2020; Mohamed et al., 2016; Wang et al., 2017). Dash (2021) determined whether attitude impacts other variables in purchasing electric vehicles. Khurana et al. (2020) indicate the positive effect of attitude on the notion of behavioral intentions. Therefore, the proposed hypothesis is presented:

H7: Attitude has a significant impact on behavioral intention to adopt EVs.

2.6. Perceived Behavioral Control

Perceived behavior control is "the influence of pressures and facilitators around individuals as they decide about a certain behavior" (Yegin & Ikram, 2022). Accordingly, it is "the individual's perception of the difficulty of performing a certain behavior" (Kraft et al., 2005). Wang and Yan (2015) observed the impact of perceived behavior control on consumers' purchase decisions for EVs. Yadav and Pathak (2016) supported that perceived behavior control is the most influential predictor of consumers' pro-environmental behavior. Yan et al. (2019) posited that perceived behavior control can be stronger when consumers have access to resources and opportunities. In EVs, potential consumers

consider sufficient economic capacities such as charging resources and other related maintenance services. Nguyen et al. (2022) presented that the greater the perceived behavioral control, the stronger the intention to perform that behavior. Ajzen (1991) identified that perceived behavior control predicts behavior intention. Wang et al. (2014) highlighted that perceived behavioral control contributes significantly to the intention to adopt EVs. Subsequently, the following hypothesis is derived based on the above discussions:

H8: Perceived behavioral control has a significant impact on behavioral intention to adopt EVs.

2.7. Behavioral Intention to Adopt EVs

According to Alomari et al. (2020), the theory of planned behavior (TPB) is the widely accepted theory stating that key variables drive behavioral intention: attitudes, subjective norms, and perceived behavioral control. Davis et al. (1989) defined the behavioral intention to use technology as "a degree that an individual has considered conscious plans to act or not to act certain behavior in future." Lai et al. (2015) studied factors influencing the adoption intention of EVs. Khazaei and Khazaei (2016) highlighted the effect of social influence, perceived enjoyment, facilitating conditions, and environmental concern on the intention to use EVs. Furthermore, Mohamed et al. (2016) pointed out the significant impact of attitude and perceived behavioral control on the intention to adopt EVs. Thus, this study determines the significant factors impacting consumers' intention to adopt EVs. The intention of potential customers toward the use of EV technology, along with the associations with independent variables of the research, are the key interests of this specific research.

3. Research Methods and Materials

3.1. Research Framework and Hypotheses

Based on the above literature review, the research model and hypotheses are proposed to investigate key factors affecting the behavioral intention to adopt EVs among logistic and distribution firms (Figure 1). Dependent variables are social influence, facilitating conditions, perceived enjoyment, environmental concern, attitude, and perceived behavioral control. Behavioral intention to adopt EVs is an independent variable.

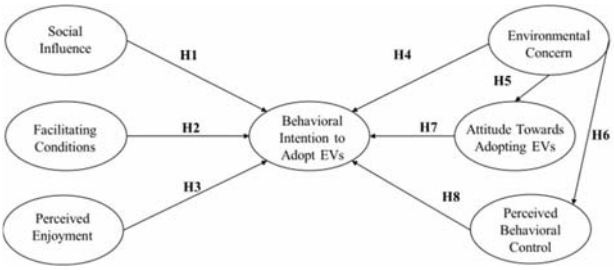


Figure 1: Conceptual Framework

H1: Social influence has a significant impact on behavioral intention to adopt EVs.
H2: Facilitating conditions have a significant impact on behavioral intention to adopt EVs.
H3: Perceived enjoyment has a significant impact on behavioral intention to adopt EVs.
H4: Environmental concern has a significant impact on behavioral intention to adopt EVs.
H5: Environmental concern has a significant impact on attitude towards adopting EVs.
H6: Environmental concern has a significant impact on perceived behavioral control.
H7: Attitude has a significant impact on behavioral intention to adopt EVs.
H8: Perceived behavioral control has a significant impact on behavioral intention to adopt EVs.

3.2. Methodology

The study applied a quantitative method to collect the data from the survey distribution. A questionnaire contains three parts which are screening questions, the five-point Likert scale questions, which ranged from "1=strongly disagree" to "5=strongly agree", and demographic information, including gender, age, income, and educational level. The questionnaire was distributed to over 1,000 top management, middle management and purchasing managers of logistic and distribution firms in Thailand. Before the data collection, the Item–Objective Congruence (IOC) index was applied to invite three experts, resulting in all 26 items being reserved at a score of 0.5. The pilot test of 50 participants was used to verify construct reliability, resulting in all constructs being approved at a Cronbach's Alpha coefficient value of 0.7 (Nunnally & Bernstein, 1994). After the data collection, Confirmatory Factor Analysis (CFA) and Structural Equation Model (SEM) were used to analyze and confirm the model's goodness-of-fit and hypothesis testing, using SPSS AMOS statistical software.

Table 1: Scale Items

Variables	Source of Questionnaire	Scale Items
Social Influence (SI)	Khazaei and Khazaei (2016)	SI1: EVs have a positive image in society. SI2: People react positively when they see an EV on the road. SI3: People whose opinions are important to me find EVs good. SI4: Driving a vehicle that attracts others' attention is important to my company. SI5: An EV would reflect my company. SI6: An EV would be a status symbol for my company.
Facilitating Conditions (FC)	Khazaei and Khazaei (2016)	FC1: The resources necessary to use EVs are existed. FC2: My company has the knowledge necessary to use EVs. FC3: EV is compatible with other technologies. FC4: My company can get help from others when it has difficulties using EV.
Perceived Enjoyment (PE)	Khazaei and Khazaei (2016)	PE1: Driving an EV is fun. PE2: Driving an EV is enjoyable. PE3: Because of smoothness and high acceleration, driving an EV is very entertaining.
Environmental Concern (EC)	Mohamed et al. (2016)	EC1: I think my company should change its behavior to reduce climate change and protect the environment. EC2: My company is very concerned about human behavior and its influence on climate change and the environment. EC3: I think my company awares climate change is a threat to society.
Attitude Towards Adopting EVs (ATT)	Mohamed et al. (2016)	ATT1: In the long-term, I think buying an EV is more cost effective than owning a conventional vehicle. ATT2: Buying an electric vehicle (EVs) will reduce climate change. ATT3: I think buying an EV is a good decision.
Perceived Behavioral Control (PBC)	Mohamed et al. (2016)	PBC1: With an excellent battery warranty, I would not worry about buying an EV. PBC2: I am confident that it is easy to maintain and operate an EV. PBC3: EV will accommodate the travel needs even with the limited battery range.
Behavioral Intention (BI)	Mohamed et al. (2016)	BI1: My company is willing to buy an EV in the near future BI2: My company is willing to spend more money to buy an EV BI3: My company would modify my travel patterns somewhat to own an EV BI4: My company is willing to tolerate some periodic battery charging inconvenience for the benefits of driving an EV.

3.3. Population and Sample Size

The target population is top management, middle management and purchasing managers of logistic and distribution firms in Thailand who have involved or influenced on buying decisions of electric vehicles for their companies. According to Kline (2011), 200 is recommended as the minimum sample size. The online questionnaires were distributed to over 1,000 participants. The responded rate and qualified respondents were obtained to be 500 for the data analysis.

3.4. Sampling Technique

The study employed judgmental, convenience, and snowball sampling. First, judgmental sampling was to target top management, middle management and purchasing managers of logistic and distribution firms in Thailand who have involved or influenced on buying decisions of electric vehicles for their companies. Second, the researcher used convenience sampling to distribute online questionnaires via email, chat application, and social media from August to December 2022 to the expected participants. Last, snowball sampling was a referral mechanism to recruit potential participants from qualified respondents.

4. Results and Discussion

4.1. Demographic Profile

The demographic results of 500 respondents are summarized in Table 2. Most respondents were males at 59 percent (295), and 41 percent (205) were females. The respondents' age mainly ranged between 41 to 49 years old at 39.6 percent, followed by above 50 years old and over at 26 percent, 31 to 39 years old at 21.4 percent, and 18 to 30 years old at 13 percent. The largest group for monthly income was THB 60,001-90,000 per month, of 37.8 percent. For educational level, most respondents were a bachelor's degree with 61 percent.

Table 2: Demographic Profile

Demographic Data (N=500)		Frequency	Percentage
Gender	Male	295	59.0%
	Female	205	41.0%
Age	18-30 years old	65	13.0%
	31 to 40 years old	107	21.4%
	41 to 49 years old	198	39.6%
	50 years old and over	130	26.0%
Income per Month	Below THB 30,000	37	7.4%
	THB 30,001-60,000	105	21.0%
	THB 60,001-90,000	189	37.8%
	THB 90,001-120,000	98	19.6%
	Above THB 120,000	71	14.2%
Educational Level	Below Bachelor's	18	3.6%
	Bachelor's	305	61.0%
	Master's	136	27.2%
	Doctorate	41	8.2%

4.2. Confirmatory Factor Analysis (CFA)

CFA was used to measure the degree of the significant relationship between variables before the analysis measurement model with the structural equation model (SEM). In Table 3, the results show that no constructs were less than the cut-off point of factor loading at 0.50, and the p-value is lower than 0.05. Nunnally and Bernstein (1994) recommended that Cronbach's Alpha be accepted at 0.70 or higher. According to Hair et al. (2017), composite reliability or CR value is acceptable at 0.7 and above. Furthermore, each construct's average variance extracted (AVE) value is approved at 0.4 or above.

Table 3: Confirmatory Factor Analysis Result, Composite Reliability (CR) and Average Variance Extracted (AVE)

Variables	Source of Questionnaire	No. of Items	Cronbach's Alpha	Factors Loading	CR	AVE
Social Influence (SI)	Khazaei and Khazaei (2016)	6	0.676-0.737	0.854	0.855	0.496
Facilitating Conditions (FC)	Khazaei and Khazaei (2016)	4	0.640-0.712	0.767	0.769	0.455
Perceived Enjoyment (PE)	Khazaei and Khazaei (2016)	3	0.826-0.892	0.886	0.885	0.721
Environmental Concern (EC)	Mohamed et al. (2016)	3	0.820-0.875	0.883	0.882	0.715
Attitude Towards Adopting EVs (ATT)	Mohamed et al. (2016)	3	0.641-0.763	0.743	0.745	0.494
Perceived Behavioral Control (PBC)	Mohamed et al. (2016)	3	0.689-0.722	0.752	0.754	0.505
Behavioral Intention (BI)	Mohamed et al. (2016)	4	0.636-0.804	0.814	0.815	0.526

Note: CR = Composite Reliability, AVE = Average Variance Extracted

The results in Table 4 show that the square root of AVEs is larger than all inter-construct/factor correlations. Therefore, the discriminant validity is supportive (Fornell & Larcker, 1981). Additionally, the factor correlations did not surpass 0.80. Consequently, the problem of multicollinearity is not issued (Studenmund, 1992).

Table 4: Discriminant Validity

	EC	SI	PE	FC	BI	PBC	ATT
EC	**0.845**						
SI	0.540	**0.704**					
PE	0.658	0.539	**0.849**				
FC	0.641	0.522	0.655	**0.674**			
BI	0.449	0.527	0.511	0.550	**0.725**		
PBC	0.382	0.182	0.335	0.508	0.378	**0.711**	
ATT	0.511	0.543	0.596	0.587	0.609	0.340	**0.703**

Note: The diagonally listed value is the AVE square roots of the variables

According to Table 5, the measurement model can be verified with the CFA method. This study's goodness of fit indices includes CMIN/DF, GFI, AGFI, NFI, CFI, TLI, RMSEA, and RMR. All values were in acceptable fit criterion and can confirm convergent and discriminant validity.

Table 5: Goodness of Fit of Measurement Model

Index	Acceptable Values	Measurement Model
		Statistical Values
CMIN/DF	≤ 3.00 (Kline, 1998)	384.827/278 = 1.384
GFI	≥ 0.90 (Kline, 2005)	0.946
AGFI	≥ 0.90 (Tabachnick & Fidell, 2007)	0.931
NFI	≥ 0.90 (West et al., 2012)	0.939
CFI	≥ 0.90 (West et al., 2012)	0.982
TLI	≥ 0.90 (West et al., 2012)	0.979
RMSEA	≤ 0.05 (MacCallum et al., 1996)	0.028
RMR	≤ 0.05 (Steiger, 2007)	0.012
Model summary		**Acceptable Model Fit**

Remark: CMIN/DF = Ratio of the chi-square value to degree of freedom, GFI = goodness-of-fit index, AGFI = adjusted goodness-of-fit index, NFI = normalized fit index, TLI = Tucker-Lewis index, CFI = comparative fit index, RMSEA = root mean square error of approximation, and RMR = root mean square residual

4.3. Structural Equation Model (SEM)

The structural model can be computed in the SEM method, as shown in Table 6. The initial model was an unacceptable fit. Therefore, an adjustment is required. After the model adjustment, the acceptable fit values are demonstrated, including CMIN/DF = 2.017, GFI = 0.921,

AGFI = 0.902, NFI = 0.908, CFI = 0.951, TLI = 0.944, RMSEA = 0.045, and RMR = 0.045, respectively.

Table 6: Goodness of Fit of Structural Model

Index	Acceptable Values	Structural Model	
		Statistical Values Before Adjustment	Statistical Values After Adjustment
CMIN/DF	≤ 3.00 (Kline, 1998)	1323.369/291 = 4.548	574.865/285 = 2.017
GFI	≥ 0.90 (Kline, 2005)	0.826	0.921
AGFI	≥ 0.90 (Tabachnick & Fidell, 2007)	0.790	0.902
NFI	≥ 0.90 (West et al., 2012)	0.789	0.908
CFI	≥ 0.90 (West et al., 2012)	0.826	0.951
TLI	≥ 0.90 (West et al., 2012)	0.806	0.944
RMSEA	≤ 0.05 (MacCallum et al., 1996)	0.084	0.045
RMR	≤ 0.05 (Steiger, 2007)	0.094	0.045
Model summary		**Unacceptable Model Fit**	**Acceptable Model Fit**

Remark: CMIN/DF = Ratio of the chi-square value to degree of freedom, GFI = goodness-of-fit index, AGFI = adjusted goodness-of-fit index, NFI = normalized fit index, TLI = Tucker-Lewis index, CFI = comparative fit index, RMSEA = root mean square error of approximation, and RMR = root mean square residual

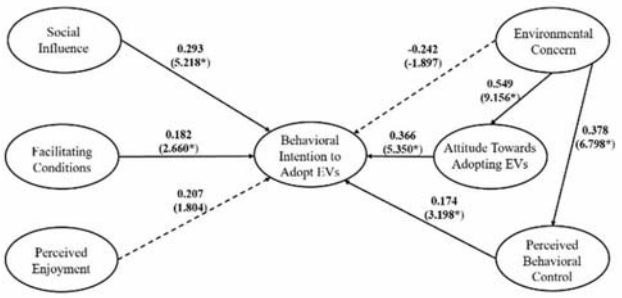
4.4. Research Hypothesis Testing Result

According to Table 7 and Figure 2, the results of hypotheses testing are measured by the standardized regression weights and t-value. A significance is evaluated at p = 0.05. In summary, H1, H2, H5, H6, H7 and H8 are supported, whereas H3 and H4 are not.

Table 7: Hypothesis Result of the Structural Model

H	Paths	(β)	S.E.	t-Value	Tests Result
H1	BI <--- SI	0.293	0.058	5.218*	Supported
H2	BI <--- FC	0.182	0.081	2.660*	Supported
H3	BI <--- PE	0.207	0.106	1.804	Not Supported
H4	BI <--- EC	-0.242	0.121	-1.897	Not Supported
H5	ATT <--- EC	0.549	0.048	9.156*	Supported
H6	PBC <--- EC	0.378	0.051	6.798*	Supported
H7	BI <--- ATT	0.366	0.080	5.350*	Supported
H8	BI <--- PBC	0.174	0.056	3.198*	Supported

Note: *p<0.05



Remark: Dashed lines, not significant; solid lines, significant. *p<0.05

Figure 2: The Results of Structural Model

The results of this study can be discussed in the following;

H1 stated the support relationship between social and behavioral intention to adopt EVs with the standardized path coefficient value (β) of 0.293 (t-value=5.218*). Khazaei and Khazaei (2016) supported the previous study that the adoption of EVs is not purely on an individual level but is influenced by social pressure or a reference group in society.

H2 approves the significant relationship between the facilitating conditions and behavioral intention to adopt EVs, resulting in the standardized path coefficient value (β) of 0.182 (t-value=2.660*). The adoption of electric vehicles can be signified by the facilitating conditions such as batteries, parts, charging infrastructures in homes and roads, or after-sale services (Casey & Wilson-Evered, 2012; Fleury et al., 2017; Khazaei & Khazaei, 2016; Madigan et al., 2017; Tran et al., 2019).

H3 shows that perceived enjoyment has no significant impact on behavioral intention to adopt EVs as a standardized path coefficient value (β) of 0.207 (t-value=1.804). The results contradict previous empirical studies that perceived enjoyment is a fundamental motivation to adopt EVs (Khazaei & Khazaei, 2016; Liao et al., 2008).

H4 disapproves of the support relationship between environmental concern and behavioral intention to adopt EVs, with a standardized path coefficient value (β) of -0.242 (t-value=-1.897). The results oppose many scholars that environmental concerns drive the behavioral intention to adopt EVs among logistic and distribution firms (Khazaei & Khazaei, 2016; Liao et al., 2008; Ozaki & Sevastyanova, 2011).

H5 supports the relationship between environmental concern and attitude towards adopting EVs, representing a standardized path coefficient value (β) of 0.549 (t-value=-1.897). Hence, the results align with the previous claims that environmental concern is a psychological factor that should impact user's attitudes toward the acceptance of EVs

(Khazaei & Khazaei, 2016; Liao et al., 2008; Ozaki & Sevastyanova, 2011).

H6 proves that environmental concern has a significant impact on perceived behavioral control. The analysis results present the standardized path coefficient value (β) of 0.378 (t-value=6.798*). Ozaki and Sevastyanova (2011) stated that perceived behavioral control is governed by personal judgment/control, which significantly impacts the intention of adopting EVs.

H7 reflects that attitude significantly impacts behavioral intention to adopt EVs, with the standardized path coefficient value β) of 0.366 (t-value=5.350*). As supported by many studies, attitude can direct the acceptance/rejection of EVs regarding whether the EV is good or bad (Ali & Naushad, 2022; Khurana et al., 2020; Mohamed et al., 2016; Wang et al., 2017).

Finally, H8 is significant as a standardized path coefficient value (β) of 0.174 (t-value=-3.198*). Therefore, perceived behavioral control significantly impacts behavioral intention to adopt EVs. Wang and Yan (2015) addressed the impact of perceived behavior control on consumers' adoption of EVs.

4.5. Discussion

The results can be explicated that social influence determines the belief of employees of the EVs benefits, where they source ideas and views from other important persons such as friends and family (Khazaei & Khazaei, 2016). Ozaki and Sevastyanova (2011) acknowledged that social influence is a subjective norm that governs consumers' judgment to adopt EVs. Facilitating conditions such as participants' perception of infrastructures or technical support existing for using an EV is mandatory (Venkatesh et al., 2012). Khazaei and Khazaei (2016) stated that the adoption of electric vehicles can be signified by the availability of batteries, maintenance, charging infrastructures, or after-sale services".

Perceived enjoyment has no significant impact on behavioral intention to adopt EVs. The results differ from the previous investigation that perceived enjoyment embodies the pleasure of deriving ownership or experience of using an EV (Khazaei & Khazaei, 2016; Liao et al., 2008). The demographic results show that most respondents are between 41 and 49 years old and monthly earned THB 60,001-90,000. It signifies that enjoyment is not a key factor affecting EV adoption among this group, where they would seek safety and affordability more than fun driving. Based on the results that may not be consistent with previous research, future study needs to further investigate in the qualitative approach for a clearer interpretation.

This study does not find a supportive relationship between environmental concerns and behavioral intention to adopt EVs. The study was conducted in a developing country where the environmental concern of the citizen is not high. The results indicated that environmental concern partly influences EV adoption but is insignificant. Therefore, the outcome contradicted earlier scholars (Dunlap & Jones, 2003; Razak et al., 2014). It aspires to provide further exploration of the research findings.

The relationship between environmental concern and attitude towards adopting EVs is supported. EVs are a consumer alternative for the future of mobility. Despite the Thai government launching policies to promote EVs in 2015, the country is gearing towards more adoption of EVs (Thananusak et al., 2021). Mohamed et al. (2016) also supported that environmental concern significantly impacts attitudes toward adopting EVs. As the environmental concern is proven to have a significant impact on perceived behavioral control, it can be denoted that perceived behavior control as predictors of intentional behavior as personal judgment/control can determine whether or not a consumer would adopt an EV (Mohamed et al., 2016; Ozaki & Sevastyanova, 2011).

Consumers' beliefs, thoughts, and opinions can determine behavioral intention to adopt EVs (Eagly & Chaiken, 2007). It can dictate the tendency of consumers to purchase an EV in the future (Khurana et al., 2020). Attitude is the baseline of technology adoption, the most influential factor of behavioral intention to embrace or reject the adoption (Ali & Naushad, 2022). Wang and Yan (2015) added that perceived behavior control predicts consumers' adoption of EVs. This research also determines that sufficient economic capacities, such as charging resources and related maintenance services, contribute significantly to the consumers' intention to adopt EVs.

5. Conclusion, Recommendation and Limitation

5.1. Conclusion

The research objectives have been met to identify key factors affecting the behavioral intention to adopt EVs in Thailand. From the perspective of 500 top management, middle management and purchasing managers of logistic and distribution firms in Thailand who have involved or influenced on buying decisions of electric vehicles for their companies, the data were quantitatively analyzed using CFA and SEM. The findings are that social influence, facilitating conditions, attitude, and perceived behavioral control are key factors affecting the behavioral intention to adopt EVs. Nonetheless, neither perceived enjoyment nor environmental concern significantly impacts behavioral intention. This study can contribute to the new knowledge of EV adoption for government agencies and car producers

to promote the EVs adoption to logistic and distribution firms as a future of mobility in Thailand.

5.2. Recommendation

The outcomes of this study offer crucial implications for policymakers and carmakers to strategize solutions for EV adoption. Due to this research establishes a link between several theories as an intent to make a theoretical contribution, including TAM, TAM2, and UTAUT, it is preferable if the findings of this study can be linked to these two theories to compare the research findings obtained with these two theories. Initially, it is important to focus on the key predictors that significantly impact behavioral intention to adopt EVs, including social influence, facilitating conditions, attitude, and perceived behavioral control. This is to address the socioeconomic and demographic factors of the adopters in this study. The motives of the adoption decision come from the social pressure where personal beliefs can be influenced by other persons who are important to them. In this case, policymakers and carmakers can build a national campaign to promote the benefits of EVs and how this future of mobility can improve people's lives through reliable celebrities or other influencers. Without facilitating conditions, encouraging EV adoption among consumers would not be easy. Behavioral intention can be driven by the adequate supply of batteries, maintenance, charging infrastructures, or after-sale services.

Moreover, future policies can facilitate a shift in behavioral intention toward EVs amongst a larger proportion of the businesses like logistic and distribution firms where their business is transportation, such as monetary incentives. The attitude of people towards EVs can be considered. Value propositions such as ease of use and usefulness of EVs can be emphasized to motivate positive attitudes among potential adopters/ business customers. Behavioral intention also links to an individual's control in deciding between EV adoption. Next, perceived enjoyment and environmental concern have no significant impact on behavioral intention. Both factors still partly predict behavioral intention, which cannot be ignored. To encourage the adoption of EVs, policymakers and carmakers should gear towards the product attributes in the awareness level of the enjoyment of driving. Additionally, Thailand, Bangkok, and other main cities have faced a big problem with air pollution as particulate matter or PM2.5. This issue has to be raised on how EVs can be a part of the solution regarding Co2 emissions produced by gasoline cars. Individual beliefs on EVs are not only scaped in a great deal of information and marketing of EVs, but also the dimensions of environmental problems which is needed to be solved.

5.3. Limitation and Further Study

This study presents several limitations. Firstly, the objectives focus on adopting EVs but still need to determine the willingness to pay for vehicle attributes. Secondly, the research concentrates on a developing country's market in the adoption motivation. The introduction of EVs in Thailand has been made for several years. The EVs infrastructure cannot cover the larger population, and the adoption has been rising but not yet booming. To some extent, global limitations should be considered for future EV research studies in other countries.

Next, further research is required to identify the level of innovativeness of the sample group, including innovators, early adopters, early majority, late majority, and laggards, to gain a deeper understanding of the behavioral intention of each group. Lastly, future research should consider the qualitative methodology for more insights into how and why some factors are insignificant. In summary, these findings mean in both theoretical and practical terms that future researchers could extend the study in the regional and global level when there is higher adoption rate on EVs among businesses. In practice, government and policy makers should consider to monitor the impact of EVs usage in logistic and distribution industries as it could elevate country's competitiveness and economy development.

References

Ajzen, I. (1991). The theory of planned behavior. *Organizational Behavior and Human Decision Processes, 50*(2), 179-211. https://doi.org/10.1016/0749-5978(91)90020-T

Ali, I., & Naushad, M. (2022). Insights on electric vehicle adoption: Does attitude play a mediating role*?*. *Innovative Marketing, 18*(1), 104-116. https://doi.org/10.21511/im.18(1).2022.09

Alomari, M. M., El-Kanj, H., & Topal, A. (2020). Analysis of Energy Conservation Behavior at the Kuwaiti Academic Buildings. *International Journal of Energy Economics and Policy*, *11*(1), 219-232. https://doi.org/10.32479/ijeep.10407

Anable, J. (2005). Complacent Car Addicts or Aspiring Environmentalists? Identifying travel behaviour segments using attitude theory. *Transport Policy, 12*(1), 65-78. https://doi.org/10.1016/j.tranpol.2004.11.004

Casey, T., & Wilson-Evered, E. (2012). Predicting uptake of technology innovations in online family dispute resolution services: An application and extension of the UTAUT. *Computers in Human Behavior, 28*(6), 2034-2045. https://doi.org/10.1016/j.chb.2012.05.022

Dash, A. (2021). Determinants of EVs adoption: A study on green behavior of consumers. *Smart and Sustainable Built Environment, 10*(1), 125-137. https://doi.org/10.1108/SASBE-02-2019-0015

Davis, F. D., Bagozzi, R. P., & Warshaw, P. R. (1989). User acceptance of computer technology: A comparison of two

theoretical models. *Management Science, 35*(8), 982-1003. http://dx.doi.org/10.1287/mnsc.35.8.982

Dunlap, R. E., & Jones, R. E. (2003). Environmental attitudes and values. In R. Fernández-Ballesteros (Ed.), *Encyclopedia of Psychological Assessment* (pp. 364-369). Sage. https://doi.org/10.1177/0022022105275962

Eagly, A. H., & Chaiken, S. (2007). The advantages of an inclusive definition of attitude. *Social Cognition, 25*(5), 582-602. https://doi.org/10.1521/soco.2007.25.5.582

Fleury, S., Tom, A., Jamet, E., & Colas-Maheux, E. (2017). What drives corporate carsharing acceptance? A French case study. *Transportation Research Part F: Traffic Psychology and Behaviour, 45,* 218-227. https://doi.org/10.1016/j.trf.2016.12.004

Fornell, C., & Larcker, D. F. (1981). Evaluating structural equation models with unobservable variables and measurement error. *Journal of Marketing Research, 18*(1), 39-50. https://doi.org/10.2307/3151312

Hair, J. F., Hult, G. T. M., Ringle, C. M., & Sarstedt, M. (2017). A *Primer on Partial Least Squares Structural Equation Modeling* (PLS-SEM) (2nd ed.). Sage Publications Inc. https://doi.org/10.1007/978-3-030-80519-7

Kester, J., Noel, L., de Rubens, G. Z., & Sovacool, B. K. (2018). Policy mechanisms to accelerate electric vehicle adoption: A qualitative review from the Nordic region. *Renewable and Sustainable Energy Reviews, 94,* 719-731. https://doi.org/10.1016/j.rser.2018.05.067

Khazaei, H., & Khazaei, A. (2016). Electric Vehicles and Factors That Influencing Their Adoption Moderating Effects of Driving Experience and Voluntariness of Use (Conceptual Framework). *IOSR Journal of Business and Management (IOSR-JBM), 18*(12), 60-65. https://doi.org/10.9790/487X-1812036065

Khurana, A., Kumar, V. R., & Sidhpuria, M. (2020). A Study on the Adoption of Electric Vehicles in India: The Mediating Role of Attitude. *Vision, 24*(1), 23-34. https://doi.org/10.1177/0972262919875548

Kline, R. B. (1998). *Principles and practice of structural equation modeling.* Guilford Press.

Kline, R. B. (2005). *Principles and practice of structural equation modeling* (2nd ed.). Guilford Press.

Kline, R. B. (2011). *Principles and practices of structural equation modeling* (3rd ed.). The Guilford Press.

Klöckner, C. A., Nayum, A., & Mehmetoglu, M. (2013). Positive and negative spillover effects from electric car purchase to car use. *Transportation Research Part D: Transport and Environment, 21*, 32-38. https://doi.org/10.1016/j.trd.2013.02.007

Kongklaew, C., Phoungthong, K., Prabpayak, C., Chowdhury, M., Khan, I., Yuangyai, N., Yuangyai, C., & Techato, K. (2021). Barriers to Electric Vehicle Adoption in Thailand. *Sustainability, 13,* 1-14. https://doi.org/10.3390/su132212839

Kraft, P., Rise, J., Sutton, S., & Røysamb, E. (2005). Perceived Difficulty in the Theory of Planned Behaviour: Perceived Behavioural Control or Affective Attitude? *British Journal of Social Psychology, 44*(3), 479-496. https://doi.org/10.1348/014466604X17533

Lai, I., Liu, Y., Sun, X., Zhang, H., & Xu, W. (2015). Factors Influencing the Behavioural Intention towards Full Electric Vehicles: An Empirical Study in Macau. *Sustainability, 7*(9), 12564-12585. https://doi.org/10.3390/su70912564

Liao, C.-H., Tsou, C.-W., & Shu, Y. (2008). The roles of perceived enjoyment and price perception in determining acceptance of multimedia-on-demand. *International Journal of Business and Information, 3*(1), 27-52. https://doi.org/10.6702/ijbi.2008.3.1.2

MacCallum, R. C., Browne, M. W., & Sugawara, H. M. (1996). Power Analysis and Determination of Sample Size for Covariance Structure Modeling. *Psychological Methods, 1*(2), 130-149. https://doi.org/10.1037/1082-989X.1.2.130

Madigan, R., Louw, T., Wilbrink, M., Schieben, A., & Merat, N. (2017). What influences the decision to use automated public transport? Using UTAUT to understand public acceptance of automated road transport systems. *Transportation Research Part F: Traffic Psychology and Behaviour, 50,* 55-64. https://doi.org/10.1016/j.trf.2017.07.007

Mahmoud, M., & Hine, J. (2016). Measuring the influence of bus service quality on the perception of users. *Transport Plan Technology, 39*(3), 284-299. https://doi.org/10.1080/03081060.2016.1142224

Mohamed, M., Higgins, C., Ferguson, M., & Kanaroglou, P. (2016). Identifying and characterizing potential electric vehicle adopters in Canada: A two-stage modelling approach. *Transport Policy, 52,* 100-112. https://doi.org/10.1016/j.tranpol.2016.07.006

Nguyen, Q. N., Hoang, T. H. L., & Mai, V. N. (2022). Applying the Theory of Planned Behavior to Analyze Household Energy-Saving Behavior. *International Journal of Energy Economics and Policy*, *12*(5), 287-293. https://doi.org/10.32479/ijeep.13396

Nunnally, J. C., & Bernstein, I. H. (1994). The Assessment of Reliability. *Psychometric Theory, 3,* 248-292.

Ozaki, R., & Sevastyanova, K. (2011). Going hybrid: An analysis of consumer purchase motivations. *Energy Policy, 39*(5), 2217-2227. https://doi.org/10.1016/j.enpol.2010.04.024

Razak, M. I. M., Yusof, A. M., Mashahadi, F., Alias, Z., & Othman, M. Z. (2014). Intention to Purchase Hybrid Cars in Malaysia: An overview. *International Journal of Economics, Commerce and Management, 2*(10), 1-13.

Rogers, E. M. (2003). *Diffusion of Innovations Theory* (5th ed.). Free Press.

Sierzchula, W., Bakker, S., Maat, K., & van Wee, B. (2014). The influence of financial incentives and other socio-economic factors on electric vehicle adoption. *Energy Policy, 68,* 183-194. https://doi.org/10.1016/j.enpol.2014.01.043

Steiger, J. H. (2007). Understanding the limitations of global fit assessment in structural equation modeling. *Personality and Individual Differences, 42*(5), 893-898. https://doi.org/10.1016/j.paid.2006.09.017

Studenmund, A. H. (1992). *Using Econometrics: A Practical Guide.* Harper Collins.

Tabachnick, B. G., & Fidell, L. S. (2007). *Using Multivariate Statistics* (5th ed.). Allyn and Bacon. https://doi.org/10.4236/ojm.2013.33016

Thananusak, T., Punnakitikashem, P., Tanthasith, S., & Kongarchapatara, B. (2021). The development of electric vehicle charging stations in Thailand: Policies, players, and key

issues (2015–2020). *World Electric Vehicle Journal, 12*(1), 2-30. https://doi.org/10.3390/wevj12010002

Tran, V., Zhao, S., Diop, E. B., & Song, W. (2019). Travelers' Acceptance of Electric Carsharing Systems in Developing Countries: The Case of China. *Sustainability, 11*(19), 1-22. https://doi.org/10.3390/su11195348

Venkatesh, V., Morris, M. G., Davis, G. B., & Davis, F. D. (2003). User Acceptance of Information Technology: Toward a Unified View. *MIS Quarterly, 27*(3), 425-478. https://doi.org/10.2307/30036540

Venkatesh, V., Thong, J. Y. L., & Xu, X. (2012). Consumer Acceptance and Use of Information Technology: Extending the Unified Theory of Acceptance and Use of Technology. *MIS Quarterly, 36*(1), 157–178. https://doi.org/10.2307/41410412

Wang, N., & Yan, R. (2015). Research on Consumers' Use Willingness and Opinions of Electric Vehicle Sharing: An Empirical Study in Shanghai. *Sustainability, 8*(1), 1-18. https://doi.org/10.3390/su8010007

Wang, S., Fan, J., Zhao, D., Yang, S., & Fu, Y. (2014). Predicting consumers' intention to adopt hybrid electric vehicles: using an extended version of the theory of planned behavior model. *Transportation, 43*(1), 123-143. https://doi.org/10.1007/s11116-014-9567-9

Wang, S., Li, J., & Zhao, D. (2017). The impact of policy measures on consumer intention to adopt electric vehicles: Evidence from China. *Transportation Research Part A: Policy and Practice, 105,* 14-26. https://doi.org/10.1016/j. tra.2017.08.013

West, R. F., Meserve, R. J., & Stanovich, K. E. (2012). Cognitive sophistication does not attenuate the bias blind spot. *Journal of Personality and Social Psychology, 103*(3), 506-519. https://doi.org/10.1037/a0028857

Xie, H., Kitcharoen, K., Leelakasemsant, C., & Varghese, M. M. (2022). The Effect of Behavioral Intention to Use Hybrid Education: A Case of Chinese Undergraduate Students. *AU-GSB E-JOURNAL*, *15*(2), 159-168. https://doi.org/10.14456/augsbejr.2022.81

Yadav, R., & Pathak, G. S. (2016). Young Consumers' Intention towards Buying Green Products in a Developing Nation: Extending the Theory of Planned Behavior. *Journal of Cleaner Production, 135,* 732-739. https://doi.org/10.1016/j.jclepro.2016.06.120

Yan, Q., Qin, G., Zhang, M., & Xiao, B. (2019). Research on Real Purchasing Behavior Analysis of Electric Cars in Beijing Based on Structural Equation Modeling and Multinomial Logit Model. *Sustainability, 11*(20), 5870. https://doi.org/10.3390/su11205870

Yegin, T., & Ikram, M. (2022). Analysis of Consumers' Electric Vehicle Purchase Intentions: An Expansion of the Theory of Planned Behavior. *Sustainability, 14,* 12091. https://doi.org/10.3390/ su141912091