

Electric Vehicles and Factors That Influencing Their Adoption Moderating Effects of Driving Experience and Voluntariness of Use (Conceptual Framework)

Hamed Khazaei¹, Ali Khazaei²

¹*Malaysia – Japan International Institute of Technology, University Technology Malaysia*

²*Industrial Engineering Faculty, Yazd University, Iran*

Abstract: *Electric cars must deal with concerns like battery range or range anxiety, infrastructures, maintenance and spare parts. Also, any new technology, has a very low market share at its initial stage, it is important to study important factors influencing potential consumers of a new technology [1]. In other hand, with rising attention in saving our earth, and possibility of soaring gas and oil prices in next decades, numerous companies have produced electric and hybrid cars. These aspects have also attracted people to have intention of using electric cars. In countries having high contribution of renewable energies in electricity production, electric cars have direct effect on healthier environment [1]. In overall, low empirical researches have studied these factors in a single framework for electric cars. This research is going to fill these gaps by examining the association among social influence, perceived enjoyment, anxiety, facilitation condition, and intention to use, along with moderating effects of driving experience and voluntariness in the electric vehicle market in Malaysia.*

Keywords: *Electric Vehicles; Green Purchase; Green Technologies; Technology Acceptance Model.*

I. Introduction

Although electric cars are still in initial stage, automotive makers are producing more and more electric vehicles with more interesting designs. Many researches has been done, or ongoing about substitute fuels like bio diesels, hydrogen and others, with hope of possibility of widespread usage of them in society. Though, numerous of these unusual fuels will necessitate too many resources for the world's populace to entirely convert to within the close future [2].

It has been shown that inspiring the acceptance of environmentally responsive products by changing behavioral intention is a big challenge. In any product development, the most important consideration is customer needs; in initial stage of life cycle and product expansion. Detection of consumer needs is indispensable, in marketing. This is recognized that buyers have complex desires that determine the buying process [3]. Global warming and possibility of increasing energy prices in next decade made a transformed attention in expansion of electric cars. Current auto exhibitions feature more and newer electric vehicles; models are increasing and being more popular (like Nissan Leaf and Tesla S). Countries policies are also shifted to support usage of EVs: in many countries, governments give subsidies or offer tax inducements for buyers of electric vehicles. Augmented consideration of manufacturers and governments for EVs is comprehensible; though, widespread acceptance of EVs is expected to encounter tough challenges. Uncertain or limited battery range, long time charging, and insufficiency of charging stations, price, and maintenance, may be barriers for widespread EVs adoption. Moreover, expansion of substructure on behalf of charging EVs, which includes together construction charging stations and improvement of home facilities for charging of electric vehicles, might enforce extra problem on the electric network, possibly causing the need to upgrade the latter too, forming encounters for the electricity markets, besides leading to enlarged environmental damage in countries where oil is used to produce electricity [4]. Usually, economists and market examiners have been attentive in recognizing the aspects that affect the buyer's intention to predict market share, and for that reason, they have introduced number of models for car type choice [2]. As the introduction of electric vehicles is relatively new in Malaysia, this study is going to determine the factors that influence intention to use of electric cars in Malaysia. Base on background of study and research problem, there seems to be a coming up need and opportunity to realize how EVs can attract the consumers and how they influence the development of the new technology. The main objectives of study proposed by this research are examining effects of social influence, facilitating condition, perceived enjoyment, environmental concern and anxiety of use, and will they affect intention of use of electric cars in Malaysia? This study, also will test the moderating effects of driving experience and voluntariness on correlations.

II. Literature Review

In order to develop conceptual framework and study the relevant variables related literature was reviewed. This section consist of literature that which are centered the study variables:

2.1 Social Influence

Social influence represents the degree of what a person believes that other people who their idea are important for him or her, think the same way about a new technology [5]. The construct called subjective norm, in the Theory of Reasoned Action model. In extension of technology acceptance model or TAM2 and unified theory of acceptance and use of technology, social influence characterized as subjective norm, or social factors in some other models Thompson et al. [6] used the term social norms in defining their theory, and recognized its correspondence to subjective norm within Theory of Reasoned Action model. Although they have dissimilar tags, each of these concepts comprises the obvious or implied concept that the person's behavior is influencing by the way which they believe that society will view them as a result of using the technology [7].

Accepting from (UTAUT 2 model) or Unified theory of acceptance and use of technology, following hypothesis is proposed:

H1. There is a positive significant relationship between social influence and intention of use of EVs.

2.2 Facilitating Conditions

Facilitating condition is someone's perception about infrastructures or technical support existed for using a technology or system [8]. About the electric vehicles, it can be interpreted as availability of batteries, learning tools or maintenances, charging infrastructures in home and roads, or after sale services. This relationship adopted from extension of unified theory of acceptance and use of technology theory [8].

H2. There is a positive significant relationship between facilitating condition and intention of use of EVs.

2.3 Anxiety

Anxiety in the car industry is a degree of how a person responds to a situation with uneasiness or arousal [9]. Anxiety is an important factor in behavioral intention in social cognitive theory [10]. Range anxiety in using EVs is about fear that EV has insufficient battery range to reach to a destination [11]. Considering that EV technology comprises of innovative technology and comes up with extreme changes comparing with combustion engine cars, consumer anxiety about using EVs may be higher than anxiety about other cars. Consumers may also perceive risks when there is batteries with limited ranges and lack of technology infrastructures like charging stations. This anxiety may be also increase when consumers are sensitive to spare parts or EVs repair. So, these anxieties may hinder potential consumers accepting the product and may have direct negative effect on EV approval. Sundaravej, T found a significant negative effect of anxiety on the intention of use [12]. Thus:

H3. There is a negative significant relationship between anxiety and intention of use of EVs.

2.4 Perceived Enjoyment

It embodies the enjoyment deriving and ownership of an EV. Since EVs are very smooth and have high acceleration comparing with cars with combustion engines, might have an enormous effect on the enjoyment of the passengers and driver [5].

Liao et al. and Venkatesh et al., view perceived enjoyment as a fundamental source of motivation [13,8]. This factor has effect on both attitude and intention of use of a system. A system perceived to be easy to use, considered to have further fun to use, foremost to a sturdier association between perceived fun and attitude toward using, and consumers' behavioral intention. [13]. Based on above discussion following hypothesis was proposed:

H4. There is a positive significant relationship between perceived enjoyment and intention to use of EVs.

2.5 Environmental Concern

By increasing global issues, environmental concerns become more significant for purchasing decisions. Public argument on global warming regarding to Co2 emissions, produced by cars, is impacting purchasing decisions of car consumers [14]. Using or driving a "green car" lets people to adopt a responsible rule in the social order. Based on an empirical investigation in Malaysia by Razak et al. [14], there was a significant relationship between environmental concern and intention to use of a hybrid car Thus:

H5. There is a positive significant relationship between environmental concern and intention of use of EVs

2.6 Intention to use

Davis [15], Bagozzi [16], and Warshaw [17], 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. This study assumed

that determine the consumers positive or negative feelings towards using 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.

2.7 Moderating Effects of Voluntariness of Use

Voluntariness is a degree of which use of technology is perceived as voluntary, or of self-determination [18]. Though voluntariness was not a part of innovation model proposed by Rogers [1] in diffusion of innovation model or Davis [15] in TAM, but Venkatesh et al. [18] have proposed voluntariness as a moderator in the relationship between social influence and intention behavior. Based on this call, this research proposes the following hypothesis:

H6. Voluntariness of use of EVs, effectively moderates the relationship between social influence and intention of use of EVs.

2.8 Moderating Effects Driving Experience

More experience of using technology will lead to more awareness and better knowledge of structure of system, therefore decreasing user dependency on outward support [11].

Customers’ driving experience is operationally defined as their driving experiences with EVs. Customers who drive an EV for one or more are identified as experience, which are distinguished from non-experienced customers with no driving experience. In model UTAUT 2, Venkatesh et al. [8] showed that the experience of system can have moderating effect on relationship between, social influence and behavioral intention. Thus:

H7. Driving experience of EVs, effectively moderates relationship between social influence and intention of use of EVs. Experience can moderate the relationship between facilitating conditions and behavioral intention [8].

H8. Driving experience of EVs, effectively moderates the relationship between facilitating condition and intention of use of EVs. Rauh et al. [19] investigated the relationship between driving experience and range anxiety toward EVs acceptance. The study showed that experienced drivers had less range anxiety on the cognitive and emotional level than inexperienced drivers. Base on above discussion, this study generate this hypothesis:

H9. Driving experience of EVs, effectively moderates the relationship between anxiety and intention of use of EVs.

2.10 Conceptual Framework of study

The conceptual framework shown in figure 1, describes variables and relationships between them base on empirical studies discussed in literature review. The framework has two main features, first, it explores the links among social influence, perceived enjoyment, facilitating condition, anxiety of use, environmental concern, and intention to use. Second, the framework explores the moderating effect of voluntariness of use and driving experience as moderator on formation of switching intention.

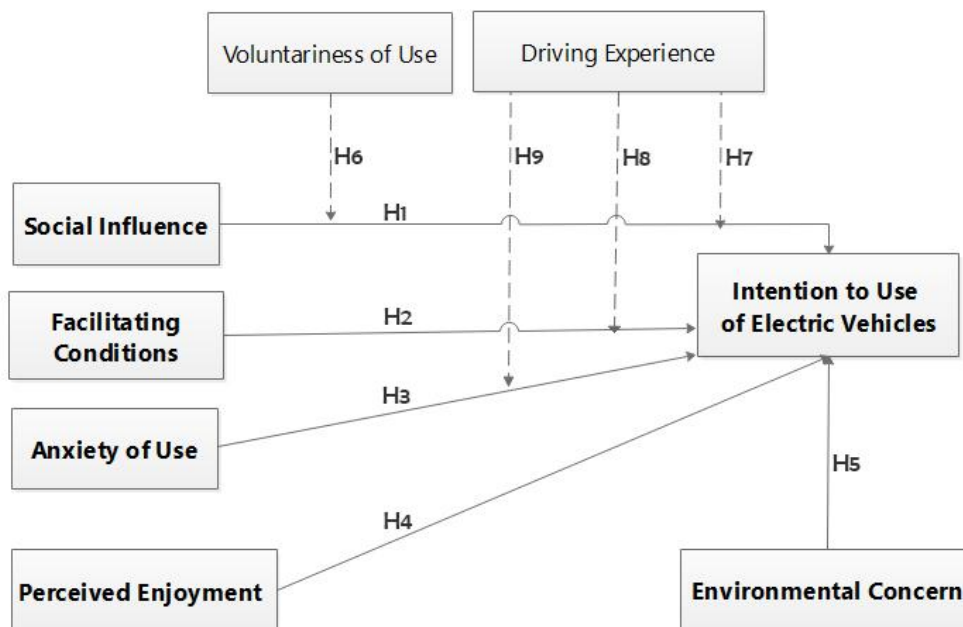


Figure 1 Conceptual Framework of Study

III. Methodology

This study is going to utilize quantitative method to design questionnaires, and sampling. Data will be collected by distributing and collecting questionnaires. Purpose of this study is to examine relationships between social influence, perceived enjoyment, anxiety, facilitation condition, and intention to use, along with moderating effects of driving experience and voluntariness in the electric vehicle market in Malaysia.

Variables and Measures

The research framework consists of eight variables among which five are independent variables, and one dependent variable and two moderator variables. Dependent variable is intention to use, and Independent variables are social influence, perceived enjoyment, facilitating condition, anxiety to use, and environmental concern.

Dependent Variable

Intention to Use

The dependent variable “Intention to Use” adopted from Alain [21] is determined by means of four items. Seven point Likert scales will be used for measuring from: 1= highly disagree to 7=highly agree. Table 3-1 shows measures for intention of use of EVs.

Items	Source
If I had an EV available, I would favor driving it rather than a traditional vehicle.	Alain, [20]
If I were to purchase a vehicle within the next 5 years, I would purchase an EV.	
I would recommend others to purchase an EV.	
There is a high probability that my next vehicle will be an EV.	

Table 3.1 Items of Intention to Use

Independent Variables

Social Influence

The construct Social Influence or “Social Norms” adopted from Alain [21], is determined by means of six items. Seven point Likert scales will be used for measuring from: 1= highly disagree to 7=highly agree. Table 3-2 shows measures for social influence. Table 3-2 shows measures for social influence.

Items	Source
EVs have a positive image in society.	Alain, [20]
People react positively when they see an EV on the road.	
People whose opinions are important to me find EVs good.	
Driving a vehicle that attracts others’ attention is important to me.	
An EV would reflect my personality.	
An EV would be a status symbol for me.	

Table 3.2: Measurement items of Social Influence

Facilitating Condition

Facilitating condition was determined by means of four items (Table 3-3). Items are adopted from UTAUT2 model by Venkatesh et al. [7]. Seven point Likert scale was used which measured from 1 = “Strongly disagree” to 7 = “Strongly agree”. Table 3-3 shows measures for facilitating condition.

Items	Source
The resources necessary to use EVs are existed.	Venkatesh et al. [7]
I have the knowledge necessary to use EVs.	
EV is compatible with other technologies I use.	
I can get help from others when I have difficulties using EV.	

Table 3.3: Items for Facilitating Condition

Anxiety

Anxiety will be measured by five items adopted from Osswald et al. [9]. Seven point Likert scale was used which measured from 1 = “Strongly disagree” to 7 = “Strongly agree”. (Table 3.4 shows measures of anxiety of use of EVs).

Items	Source
I have concerns about using the EVs.	Osswald et al. [9]
I think I could have an accident because of using the EVs.	
The lack of enough infrastructure somewhat frightening to me.	
I fear that I do not reach my destination because of the EVs.	
I am afraid that I do not learn using EVs.	

Table 3.4: Items of Anxiety

Environmental Concern

Environmental Concern will be measured by 5 items adopted from Razak et al.[14] Five point Likert scale was used which measured from 1 = “Strongly disagree” to 7= “Strongly agree”. Table 3-5 shows measures for environmental concern.

Items	Source
I want to preserve the environment.	Razak et al. [14]
I love to see green environment.	
I want to buy electric car because of air pollution crisis.	
Electric car contributes to saving environment for the next Generation	
Electric cars cause less pollution.	

Table 3.5: Items of Environmental Concern

Hedonic Motivation (Perceived Enjoyment)

Hedonic motivation (Perceived Enjoyment) will be measured by 3 items adopted from UTAUT2 model presented by Venkatesh et al., (2012). Three point Likert scale was used which measured from 1 = “Strongly disagree” to 7 = “Strongly agree”. Table 3-6 shows measures for perceived enjoyment.

Items	Source
Driving an EV is fun.	Venkatesh et al. [7]
Driving an EV is enjoyable.	
Because of smoothness and high acceleration, driving an EV is very entertaining.	

Table 3.6 Items for Perceived Enjoyment

Moderator Variables

Driving Experience

According to UTAUT 2 model, facilitating condition and social influence are theorized to influence behavioral intention to use a technology, while behavioral intention and facilitating conditions determine technology use. Also, individual difference variables, namely experience, are theorized to moderate above relationships. (Venkatesh et al., 2012). Driving experience was measured by a statement in demographic section with using following statement: Have you drove an EV before?

Voluntariness of Use

Venkatesh & Davis,(2000) and Venkatesh et al. (2003) have looked at voluntariness as a moderator in the relationship between social influence and intention behavior. For measuring voluntariness of use, 3 items were adopted from UTAUT model by Venkatesh et al. (2003). Table 3.7 shows Items for voluntariness.

Items	Source
My use of the system is voluntary.	Venkatesh et al. [19]
My supervisor does not require me to use the system.	
Although it might be helpful, using the system is certainly not compulsory in my job.	

Table 3.7 Items for voluntariness

IV. Conclusion

One of the major encounters is adoption of electric cars as new technology that needs new aspects of consumers. According to this, this research describes and defines electric car acceptance factors and proposes a new conceptual framework. The framework synthesizes different technology acceptance models such as UTAUT and UTAUT2 model's to clarify and predict electric vehicles adoption. This study introduced range anxiety and environmental concern as relevant additional factors in the proposed model for future study.

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