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Conceptualize the Drivers' Intention Towards Electric 3-Wheelers for Delivery Services

Dr. N. V. Ramachandran[1],

Assistant Professor, Department of MBA, SRM Arts and Science College, Kattankulathur

Dr. S. S. Anugragha[2]

Assistant Professor,DOMS, Crescent School of Business, BSAR Crescent Institute of Science and Technology,Chennai

ABSTRACT

The intention of this research is to know the factors that influence the selection of an Electric vehicle for the mobility of goods (i.e) deliveries among driver's community of a selected e-commerce groceries provider. To make sure the data is generalizable the respondents were chosen from three major cities of the company operation. Since the respondent's details are known random sampling was the method adopted in the research. Data was collected through a structured questionnaire from 214 drivers. Five constructs were identified based on factor analysis and backed up by reviews they were named as perceived utility, perceived ease of use, Economic benefits, Comfort and design changes. Had if a choice was provided to driver to choose an electric vehicle or internal combustion engine was the binary logistic question used. Results showed that perceived utility, perceived ease of use, Economic benefits, and design changes influence the selection between electric vehicles or Internal combustion engine vehicles.

Keywords: Electric vehicle, Delivery, Perceived utility, Perceived ease of use, Economic benefits

INTRODUCTION

Battery electric vehicles (BEVs) have attracted interest as a potential remedy for environmental problems in the transportation industry, which is primarily dependent on fossil fuels, over the past 10 years. As a result, many nations have pushed BEVs and eventually replaced internal combustion engine vehicles with them (ICEVs). Consequently, the quantity of BEVs registered has climbed from 16.42,000 in 2010 to 1208,92,000 in 2016, or 1.1% of the global automotive market (Global EV Outlook 2017, IEA). The proliferation of charging stations and the declining cost of BEV technologies have both recently made this growth more pronounced. (Liu et al., 2017).

More drivers have had exposure to electric vehicles technologies as more battery vehicles have been sold. These experienced drivers' attitudes can assist us in diagnosing the existing state of BEV operation and, as a result, in developing practical and successful tactics for BEV promotion. Evaluating user happiness and its interaction with numerous influencing factors is a direct way to comprehend user attitudes. Because pleasure is inextricably linked to the acquisition and consumption of a product, consumer satisfaction surveys are frequently utilised for post-choice evaluation of particular products (Oliver, 2014)

To better serve ICEV consumers, numerous consumer satisfaction studies have previously been carried out in the traditional vehicle business (Jahanshahi et al., 2011; Jajaee and Ahmad, 2012). In these research, satisfaction has been measured across a number of aspects, including vehicle performance, operational environment, and attributes associated to purchases. However, because BEVs differ from ICEVs in practical and technological factors including source of propulsion, fuel type, and charging/refueling, the findings of ICEV satisfaction studies cannot be applied to BEVs (Brennan and Barder, 2016).

Although extensive research has been done to understand potential consumer perceptions of BEVs because BEVs have just recently become available, only a small number of studies have used data gathered from actual BEV users (Figenbaum and Kolbenstvedt, 2016; Helveston et al., 2015). Recent studies (Mersky et al., 2016, Lee et al., 2019, Hardman and Tal, 2016) have mostly concentrated on examining actual consumer purchasing behaviour or on finding factors that influence the adoption of BEVs. Additionally, research is gradually being done on the usage patterns of BEV consumers, including charging (Flammini et al., 2019) and travel habits (Han et al., 2016). Understanding the behaviour of persons who buy and use BEVs has advanced significantly thanks to these studies.

Studies on customer perceptions of and levels of satisfaction with BEVs, however, are still scarce and other behavioural shifts need to be identified. This is merely a result of a lack of BEV users with at least six months of BEV experience necessary to assess post-purchase behaviour (Igbaria et al., 1996). Instead than analysing and enhancing the operational environment for BEVs, the majority of earlier studies concentrated on methods to encourage the wide use of BEVs.

To shed light on this, we performed face-to-face surveys and questionnaire mode among actual electric vehicle drivers to evaluate their choice of selection between electric or internal combustion engines if they are provided choice to choose and factors influencing the use of electric 3 wheelers. In the remainder of this paper, Section 2 provides an in-depth literature review and builds hypotheses among the attributes of electric vehicle usage. Analysis was done using SPSS and the tool chosen was Binary Logistic Regression since the driver choice is Binary (Dichotomous question) and all other variables are continuous.

REVIEW OF LITERATURE

The various attempts in the literature to gauge household EV user acceptance (Rezvani et al., 2015) range from comprehensive theoretical models based on socio-economic and socio-technical approaches (Moons and Pelsmacker, 2012; Sovacool, 2017) to behavioural and experimental economics using discrete choice experiments (Hackbarth and Madlener, 2013). In addition, TAM-based surveys, the DoI Theory, psychological assessments, or short-term EV field trials have all been incorporated (Fazel, 2014).

EV implementation in business applications is crucial for a continued dissemination of EVs and charging infrastructure (Globisch et al., 2018b). Determining the obstacles preventing the commercial deployment of EVs (such as those Figenbaum, 2018 in craft and service enterprises, for example), particularly in the CEP sector, is vital. Numerous studies therefore focus on fleet managers or investment decision makers and how they view EVs in their particular application areas; however, such studies ignore the end-user, i.e. the EV driver (Steinhilber et al., 2013; Burs and Roemer, 2015; Globisch et al., 2018b; Globisch et al., 2018a). Kaplan et al. have created a fairly thorough model of EV procurement choices (2016).

The procurement managers are questioned to determine the operational ease of EV use, which may or may not match the drivers' perceived operational ease of use. The disregard of a critical component of acceptance, namely the acceptance by the end-user, namely the driver, is further demonstrated by an analysis by Jonuschat et al. (2012) of all e-mobility users' acceptance studies conducted in Germany until 2012. This is partially due to the fact that EVs have not been used as work equipment long enough to determine their precise levels of adoption in commercial applications.

As a result, those who make the decisions on whether or not to electrify the company fleet have primarily been picked as interview subjects or survey respondents. Globisch et al., 2018b; Burs and Roemer, 2015).

As a result, nothing is known about how commercial EV drivers adjust to a shift in driving technology. An EV acceptance study in a commercial context implies a higher degree of complexity than a study in a private usage context would, as highlighted by Morton et al. (2011) i.e., the impact of psychological and sociological workplace influences on user acceptance should not be underestimated. Only a few research employ quantitative approaches, while several qualitative studies explore the user acceptance of commercial EV drivers (e.g. Globisch et al., 2018a for passenger EVs in business fleets).

The few quantitative investigations use simulations, including: Perboli and Rosano (2019) ignore the drivers' professional judgement while analysing efficiency increases in terms of parcels delivered per hour when comparing traditional and green delivery service business models (i.e., employing EVs and bicycles). Marmaras et al(2017) simulation of genuine driver behaviour in two stages of vehicle adoption follows a similar pattern.

Field tests of EVs used in goods traffic have been used for socioeconomic study; one of these field tests took place at a delivery base of Deutsche Post in collaboration with Volkswagen (VW), utilising the VW E-Caddy (BMU, 2011a, 2011b). Guided interviews with the drivers were a part of the research, and the qualitative findings are used to improve our own model, the UTAM. It is not obvious how much the drivers rely on EVs to perform their duties, according to Axsen et al. (2013), who look into the impact of social influences and drivers' preferences for EVs in the workplace.

Similar to this, several studies examine how well-suited employees are to using EVs for business travel (Deffner et al., 2012). However, utilising an EV for a business trip is considerably different than using it for delivery services for a few hours each day. The backdrop of a genuine business environment in the supply of services is thus left out of earlier studies. Peters and Hoffmann (2011) is a study that is pertinent to our situation because it examined the benefits and drawbacks of electric vehicles (EVs), as well as the concepts and business models of EV fleets, through focus groups of potential commercial EV users in Germany in 2010.

Hacker et al. give a recent overview of EV attitudes across all of Germany (2015). In Sweden, a nation with a significant commercial EV deployment, Wikström et al. (2014) give a socio-technical approach on EV adoption in business fleets. Regrettably, the study does not reveal measurement items utilised for examining customers' viewpoints. As a result, we rely on German studies like Ehrler and Hebes (2012), which is closely related to the subject of our investigation. The authors examine how some of the drivers who worked for Deutsche Post in Berlin between 2010 and 2011 responded to EV adoption by drivers in the courier, express, and parcel (CEP) industry. In the CEP industry, particularly at Deutsche Post, their study is used as a reference for drivers' initial perceptions and anticipated uses of EVs.

User expectations of the BEV's future worth can have an impact on user satisfaction. The overall worth of a BEV indicates not only its current technological state but also its potential for technological advancement, market expansion, and good social influence in the future (Koller et al., 2011). Hassenzahl (2003) asserts that consumer contentment is significantly impacted by a product's future prospects. Consumers typically believe that a product's value will improve with favourable future predictions or evaluations linked with it. In this context, we develop two hypotheses about user satisfaction with BEVs.

Future-expectations of BEVs refer to consumer expectations for BEV use that will be more convenient in the future as a result of the development of the BEV market and technology. It's widely believed that the BEV segment of the automotive market will stagnate. The positive viewpoint, however, predicts that a significant portion of ICEVs will be replaced by BEVs, allowing both markets to survive (Al-Alawi and Bradley, 2013). BEV users should anticipate good outcomes from the BEV industry as the market for BEVs grows and technology advances (such as faster charging, shorter wait times at charging stations, and higher resale value of old BEVs) (Brown et al., 2010). The future value of a product with a favourable expectation of BEV in the future will thus be higher than the current value because people frequently develop their expectations during their encounter with the product (Kim, 2012). (Moliner et al., 2007). As a result, this will have an impact on user happiness.

RESEARCH METHOD

Sample method: Sample of Respondents belong to Drivers of delivery vehicles operated by Grocery e-commerce company in their delivery process. 214 responses were used to arrive at generalization of the research outcome. Random sampling was the method adopted and the geographical component of the respondents is scattered in three major cities of Chennai, Bangalore and Hyderabad.

Questionnaire construction: 24 Likert scale questions were used in the questionnaire which had questions related to Perceived utility, Perceived ease of use, Economic benefits, Comfort and Design changes. After factor analysis and the initial screening based on Cronbach Alpha, items which had lesser weightage were removed and finally 16 questions were used to do the analysis. Apart for the likert scale demographic variables were also part of the questionnaire.

One important question that was used to test the relationship was “Had if a choice I provided to drivers on the choice of vehicle for their delivery services, what would they prefer?” An Electric vehicle or Internal Combustion Vehicle. Since it categorical and all other independent variables are continuous Binary logistic regression model was used.

Hypothesis development:

Dependent variable is binary and all the independent variables are continuous.

H1: Choice of preference between Electric vehicle and Internal Combustion Engines by the drivers had if the option is given may be influenced by Perceived Utility.

H2: Choice of preference between Electric vehicle and Internal Combustion Engines by the drivers had if the option is given may be influenced by Perceived Ease of use.

H3: Choice of preference between Electric vehicle and Internal Combustion Engines by the drivers had if the option is given may be influenced by Economic benefits

H4: Choice of preference between Electric vehicle and Internal Combustion Engines by the drivers had if the option is given may be influenced by Comfort.

H5: Choice of preference between Electric vehicle and Internal Combustion Engines by the drivers had if the option is given may be influenced by Design Changes expected.

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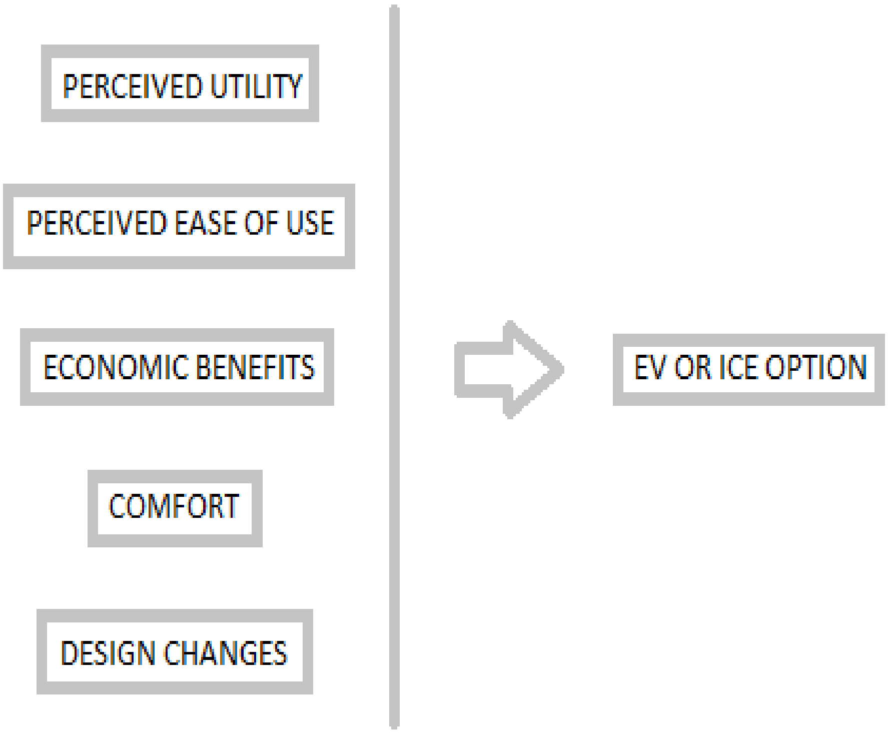
Model developed:

Fig 1: Model of the research



ANALYSIS AND DISCUSSION

Table 1: RESEARCH VARIABLES

		Frequency	Percent	Mean	Std.Dev
Age	Below 26	102	47.7	1.67	.750
	26-35	84	39.3		
	36-45	24	11.2		
	46-55	4	1.9		
Education	Upto SSLC	42	19.6	2.67	1.097
	HSC	46	21.5		
	Diploma	68	31.8		
	Under Graduate	56	26.2		
	Post Graduate	2	.9		
Driving Experience	<3	106	49.5	1.89	1.160
	3-6	62	29.0		
	6-9	24	11.2		
	9-12	8	3.7		
	>12	14	6.5		
Monthly Income	upto 15000	6	2.8	3.00	.880

	15001-20000	60	28.0		
	20001-25000	80	37.4		
	25001-30000	64	29.9		
	Above 30000	4	1.9		
Do you have any previous experience of driving E-Vehicles other than Bigbasket?	Yes	38	17.8	1.82	.384
	No	176	82.2		
How many years you are driving LMV E-Autos at Bigbasket ?	<1yr	150	70.1	1.45	.838
	1-2yr	46	21.5		
	2-3yr	6	2.8		
	3-4yr	10	4.7		
	>4yrs	2	.9		
How many orders you are assigned per day by the company?	Upto 15	4	1.9	2.33	.579
	16-30	144	67.3		
	31-45	58	27.1		
	46-55	8	3.7		
What is the average speed you drive in E-Auto?	30-40	78	36.4	1.77	.667
	41-50	108	50.5		
	51-60	28	13.1		

Maximum driver employed in Big basket fall in the Age category of less than 26. Maximum of the driver were diploma holders. Driving experience of most of the driver's is less than 3. Monthly income of the driver's maximum falls in the range of 20001 to 25000. Maximum of the drivers have experience in driving the Electric vehicle even before joining delivery section of the current organization. In the current company most of the drivers were using the electric vehicles less than a year. On a day 16 to 3o orders were assigned per day to the drivers. Most of the time the speed driven by drivers is 41 to 50 in a e-Auto.

Table 2: FACTOR ANALYSIS

Rotated Component Matrix[a]					
	Component				
	1	2	3	4	5
Maintenance is so easy	.521				
Range of battery is satisfactory	.713				
Power consumption reduces though regenerative braking	.571				
Greener options provided with government incentives	.672				
Maintenance is so easy	.593				
Battery charging is so easy		.562			
Manoeuvring in traffic is so easy		.780			
Suspension is so good		.774			
Driver cabin is comfortable			.821		

Comfortable to drive without any transmission			.796		
Storage facility is adequate for this kind of business				.690	
So useful for short distance deliveries				.768	
I am happy to be part of saving the environment				.641	
GPS tracking device would help locate the delivery place					.457
ABS should be a default option					.506
Hazard indicator can be helpful					.770

Extraction Method: Principal Component Analysis.
Rotation Method: Varimax with Kaiser Normalization.

a. Rotation converged in 9 iterations.

Factor analysis was done to know the how the constructs align and arrived at 5 constructs. Based on the reviews the constructs were named as Perceived utility, Perceived ease of use, Economic benefits, Comfort and Design changes

A question to know which vehicle would the driver choose had if a choice is provided between Electric vehicle and Internal Combustion Engines is used as the dependent variable in in this Binary Logistics Regression model with other variables like Perceived utility, Perceived ease of use, Economic benefits, Comfort and Design changes as the independent variables.

Table 3: Reliability test

Latent Variables	**Cronbach Alpha**	**Measured items**
Perceived Utility	0.876	Storage facility is adequate for this kind of business
		So useful for short distance deliveries
		I am happy to be part of saving the environment
Perceived Ease of Use	0.763	Battery charging is so easy
		Manoeuvring in traffic is so easy
		Suspension is so good
Economic benefits	0.796	Maintenance is so easy
		Range of battery is satisfactory
		Power consumption reduces though regenerative braking
		Greener options provided with government incentives
		Reduction in operational expense
Comfort	0.714	Driver cabin is comfortable
		Comfortable to drive without any transmission
Design Changes	0.824	GPS tracking device would help locate the delivery place
		ABS should be a default option
		Hazard indicator can be helpful

Table 4: MODEL SUMMARY

Omnibus test of model co-efficient proves that the model is significant and its sows a good fit. There is significant improvement in fit compared to null model. Model is describing the data very well. Hosmer and Lemeshow test is also a test of goodness of fit. Being insignificant this too support that model is a good it.

Step	-2 Log likelihood	Cox & Snell R Square	Nagelkerke R Square
1	84.921[a]	.284	.418
a. Estimation terminated at iteration number 6 because parameter estimates changed by less than .001.			

Nagelkerke R is a Psuedo R-Square, 41.8% change in the criterion variable can be accounted to the predictor variables in the model.

Table 5: Classification table

Observed			Predicted		
			Preference		Percentage Correct
			ICEV	EV	
Step 1	State your overall satisfaction level of using Electric Auto.	ICEV	26	28	48.1
		EV	12	146	92.4
	Overall Percentage				81.1

The model correctly classified 81.1% of cases overall. This is the rate of correct classification if we always predict that a driver would choose Electric vehicle.

Specificity (Negative rates) Those who will not select Electric vehicle falls in this group (i.e) Predicted not to select a Electric vehicle when a choice is provided between selecting Electric vehicle or Internal combustion vehicle. 48% will not choose Electric vehicles. Sensitivity of the model is 92.4%.

Table 6: Variables in equation

		B	S.E.	Wald	Sig.	Exp(B)	95% C.I.for EXP(B)	
							Lower	Upper
Step 1[a]	Perceived Utility	.713	.346	4.260	.039	2.041	1.037	4.018
	Perceived Ease of Use	.851	.372	5.241	.022	2.343	1.130	4.856
	Economic Benefits	.462	.228	4.105	.043	1.588	1.015	2.484
	Comfort	-.468	.336	1.937	.164	.626	.324	1.211
	Design Changes	.952	.315	9.134	.003	2.591	1.397	4.804

	Constant	-9.195	2.476	13.793	.000	.000		

Binary Logistic regression model revealed that the Perceived Utility, Perceived Ease of Use, Economic Benefits and Design changes needed were the significant factors in deciding whether Electric Vehicle of Internal combustion engine is chosen by driver's when they were provided the choice of selection.

Odd ratio of Perceived utility, perceived ease of use, Economic benefits and Design changes is more than 1, which implies that probability of choosing a Electric vehicle is more than the probability of choosing the Internal combustion Engines when the drivers are provided a choice between the same. Perceived utility being 2.041 lead to choose an Electric vehicle for delivery. Perceived Ease of Use being 2.343 lead to choose an Electric vehicle for delivery. Economic benefit being 1.588 lead to choose an Electric vehicle for delivery. Design changes being 2.591 lead to choose an Electric vehicle for delivery.

The Odds of a driver choosing Electric vehicle when design changes are considered are 2.591 times higher than those of Internal Combustion Engines.

CONCLUSION

Intention of knowing the driver's choice among the vehicles was tested using Binary Logistic model which revealed that Perceived Utility, Perceived Ease of Use, Economic Benefits and Design changes needed were the significant factors in deciding whether Electric Vehicle of Internal combustion engine is chosen by driver's when they were provided the choice of selection. The predictor variable (choice of vehicle) was influenced by the Criterion variables by 41.8%. Based on the probability of the choice it is concluded that the choice of using Electric vehicle is favored by the driver's community.

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