Developing an AHP-based model for the Problem-Solution Fit of Battery Electric Vehicles (BEV): A case of the most affordable BEV in Indonesian Market

ABSTRACT

The use of electric vehicles shows an increasing trend. However, the adoption rate of battery electric vehicle (BEV) is still relatively very low compared to the gasoline-powered cars. In the Indonesian market, BEVs are still not affordable for most people. Previous studies on EV have explored many factors that influence the level of adoption and people's purchase intention of electric vehicles. The purpose of this study is to analyze the problem-solution fit of a battery electric vehicle in the Indonesian market. The AHP decision model is adopted in the value proposition design (VPD) framework to see whether electric vehicles have the ability to answer people's pains and gains in performing customers' job to be done of commuting. The most affordable BEV currently introduced in the Indonesian market is chosen in this study. This study is expected to be able to explain the problem-solution fit of any BEV product offered to a certain target customer. In addition, this study can also explain the priorities of the customer pains and gains that gasoline powered car drivers want to resolve.

Keywords: problem-solution fit, battery electric vehicle, analytic hierarchy process

1. Introduction

In an effort to accelerate vehicle electrification, the government and electric vehicle manufacturers are trying to make it easier for people to own electric vehicles. In Indonesia, for example, the government has issued regulations to accelerate the development of the electric vehicle industry and its use. Major manufacturers have also introduced battery electric vehicles (BEV) to reach a wide range of target customers. However, the level of adoption of BEV is still very low. The BEVs, which are introduced for the first time in the Indonesian market, are still beyond the reach of car owners. Another barrier factor comes from the availability of public infrastructure for charging electric vehicle batteries which is still very limited. Previous studies on EV shows that high price and limited availability of battery charging station are the main barrier factors of EV adoption. (Dong et al., 2020).

To accelerate the adoption of electric vehicles, manufacturers have begun to introduce battery electric vehicles that are more affordable to the general public. From the government, several tax relief incentives and conveniences for electric motorists are also offered. Several manufacturers such as Hyundai and Nissan have also offered their BEV products to various customer segments. They offer BEVs in the Indonesian market with prices starting at IDR 700 million or USD 44,872 (on December 10, 2022). Meanwhile,

according to the Association of Indonesia Automotive Industries (Gaikindo), most car owners in Indonesia own vehicles with prices around Rp 300 million or USD 19,230 and below. It is not surprising that the adoption rate of BEVs Indonesia is still very low, considering that BEVs are still not affordable for most car users.

Realizing that BEVs are still too expensive for most vehicle owners, one foreign manufacturer offers a much more affordable BEV. BEV prices are offered in the range of IDR 240 - 300 million or USD 15,385 - 19,230. This is the price range of vehicles owned by most car owners in Indonesia. In contrast to previous studies on the adoption rate of electric vehicles which generally look for factors that influence the adoption or intention to buy electric vehicles, the purpose of this study is to determine the problem-solution fit of an electric vehicle in a particular customer segment. This study will also answer whether or not customers' jobs to be done (Christensen, 2016) in mobility have been performed satisfactorily; what are their customer pains and gains that are still unanswered by existing solutions.

2. Literature Review

Previous studies on electric vehicles have often referred to the theory of planned behavior/TPB (Ajzen, 1991) to explain the existence of purchase intention as a predictor of purchasing actions. With this theoretical framework, most of the studies explore the factors that influence the purchase intention of electric vehicles. Most of the respondents who were asked generally also did not have extensive knowledge about electric vehicles and also not all of them have the ability to pay electric vehicles. Ability to pay is important because it is a perceived behavioral control factor from TPB that influences purchase intention.

There are still few studies that link the specific attributes of certain electric vehicles to people's purchase intention (Rezvani et al., 2015). For the Indonesian market, a study using the analytic network process (Saaty, 1999) has shown a moderate preference of a certain target customer towards purchasing a certain battery electric vehicle (Febransyah, 2021). The BEV used in that study is still a BEV that is beyond the reach of vehicle owners in Indonesia. Therefore, further studies on electric vehicles that are right for the mass market need to be carried out.

3. Objectives

Different from numerous studies that focus on customers' purchase intention on BEV, the objective of this study is to analyze the problem-solution fit of a certain BEV whether or not the chosen BEV is able to relieve customer pains and create customer gains. Another objective is to find out whether target customers prioritize customer pains or gains in performing their mobility as jobs to be done. The most affordable BEV that is being currently introduced in Indonesian market will be used in this study.

4. Research Design/Methodology

The problem-solution fit analysis will be approached as a multi-criteria decision-making problem. Analytic hierarchy process (Saaty, 1980) will be used in this study by using 4 levels of decision hierarchy. Level 1 – the OBJECTIVE of this study to determine the problem-solution fit of electric vehicles offered in the market. In analyzing the problem-solution fit, the Value proposition design framework (Osterwalder et al., 2014) will be used. Based on pains and gains that customers experience from performing their jobs to be done (JTBD) with an existing solution, a new solution is proposed to help customers perform their JTBD more satisfactorily.

In this study, the presence of BEV is considered a new solution to the existing customers' JTBD performed with gasoline-powered cars. Therefore Level 2 of decision hierarchy consist of two entities: CUSTOMER PAINS and CUSTOMER GAINS. Level 3 will then divide customer pains into SUB-CUSTOMER GAINS and customer gains into SUB-CUSTOMER GAINS. Sub-customer pains will include all the painful experiences of gasoline-powered car owners, namely VOLATILITY of fuel cost, RESCTRICTED ROAD ACCESS, LONG QUEUE at the gas station, HIGH SERVICE & MAITENANCE COST, FREQUENT REPAIR, DRIVER FATIGUE. Sub-customer gains include all the benefits customer have or want to have from using their gasoline powered cars. These include HIGH MOBILITY, AFFORDABILITY, AVAILABILITY OF GAS STATION, COMFORT, PRESTIGE and FAMILY TOGETHERNESS. Finally, the last level, Level 4 contains Alternatives which contain the FIT and UNFIT of the BEV being analyzed.

5. Data/Model Analysis

A number of interviewees, namely commuters who use their own cars every day, will be invited to carry out pairwise comparisons. Commuters who drive their own vehicles are chosen because they are considered the early adopters of electric vehicles. In addition, another requirement to become interviewees in this study is that they have the ability to pay for the battery electric vehicle being assessed. The vehicles assessed are currently the most affordable BEV in the market with prices between USD 15,385 - 19,230.

The first pairwise comparison is performed at level 2: CUSTOMER PAINS AND GAINS. Here the interviewee is asked to answer questions such as the following: "In performing your jobs to be done of commuting, do you prioritize solving Customer pains or Customer gains? by how much on a ratio scale of 1-9?

At Level 3, interviewees were asked to rate the importance of each customer pain and gain. Based on customer pains at Level 2, an example of a pairwise comparison question is as follows: "Which is more painful, is the increase in fuel prices or the length of the queue at the gas station?" With respect to customer gains at level 2, the pairwise comparison questions are as follows: "Which do you prefer, is driving comfort or the availability of a gas station?"

Finally at Level 4, the pairwise comparison will be performed with respect to each customer pains and gains in Level 3. An example of pairwise comparison question is as follows: "with respect to the current increase in fuel prices, is BEV Fit or Unfit in reducing the cost burden?" By how much in a 1-9 ratio scale?

From the pairwise comparison that has been done, commuters who are more concerned with fulfilling customer gains (0.83) rather than pains (0.17), think that the most affordable BEV offered in the market is UNFIT (0.65) rather than Fit (0.35) in fulfilling the customer pains and gains.

From customer gains, it is found that Affordability is a benefit that has been obtained from the current use of gasoline-powered cars with local priority of 0.45. Followed by Comfort (0.18), High mobility (0.16), Prestige (0.14), Family togetherness (0.07) and Availability of gas stations (0.05). Meanwhile, from customer gains, it can be seen that the increase in fuel prices is the most burdensome pain with local priority of 0.40, followed by high Service and maintenance costs (0.23), Driver fatigue and Long queue at gas stations (0.13 each), Restricted road access (0.06) and Frequent repairs (0.05).

6. Limitations

The proposed model can help analyze the problem-solution fit of a BEV in the market. However, bearing in mind that the interviewees invited were limited to commuters with a certain ability to pay, the results of this study only explain the problem-solution fit of one particular target customer, not for all target customers.

7. Conclusions

A decision model based on AHP has been proposed to analyze the problem-solution fit of a BEV for a certain target customer. In addition to contributing to the provision of a decision model based on AHP related to EV adoption and purchase intention, this study also provides practical implications for BEV producers. They can understand what customers' pains and gains are when they perform their jobs to be done of commuting to work. Based on this understanding, they can prepare the right vehicle for the target customer they want to serve.

8. Key References

Ajzen, I. (1991). The theory of planned behavior. *Organ. Behav. Hum. Decis. Process*, 50, 179–211

Dong, X.; Zhang, B.; Wang, B.; Wang, Z. (2020). Urban households' purchase intentions for pure electric vehicles under subsidy context in China: Do cost factor matter? *Transp. Res. Part A*, 135, 183–197.

Febransyah, Ade. 2021. "Predicting Purchase Intention towards Battery Electric Vehicles: A Case of Indonesian Market" *World Electric Vehicle Journal* 12, 4: 240.

Osterwalder, A., Pigneur, Y., Bernarda, G., Smith, A. and Papadakos, T. (2014). Value proposition design: How to create products and Services customer want. Wiley, 1st edition.

Rezvani, Z.; Jansson, J.; Bodin, J. (2015). Advances in consumer electric vehicle adoption research: A review and research agenda. *Transp. Res. Part D*, 34, 122–136.

Saaty, T.L. (1980). The Analytic Hierarchy Process; McGraw-Hill: New York, NY, USA.

Saaty, T.L. (1999). Fundamentas of the analytic network process. *Proceedings of the ISAHP 1999*, Kobe, Japan, 12–14 August, 48–63.