

Analysis of new energy user satisfaction and research on prospective customer mining in Jiangsu province——based on IPA model and potential customer value model

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Abstract. With the increasingly prominent environmental pollution and energy crisis, the slogan "Green water and green mountains are golden mountains and silver mountains" has become increasingly loud. New energy vehicles, as a new means of transportation, are highly praised by most environmentalists because of the particularity of their power. This survey takes new energy vehicle users in Jiangsu Province of China as the research object. Based on the results of the questionnaire, an IPA model is established to analyze new energy vehicle user satisfaction, and a potential customer value model is established to mine potential users. It provides some useful theoretical thinking for the development and popularization of new energy vehicles.

Keywords: New Energy Vehicle; Questionnaire Investigation; Satisfaction; IPA Model; Potential Customer Value

1. Introduction

As the main pillar industry of the current national economy, China's new car production and sales have ranked first in the world for 12 consecutive years. Effective control of the total carbon emissions of the automobile industry is particularly important for China to reach the peak of carbon emissions as soon as possible. Vehicle pollution is an important cause of smog and photochemical smog pollution. Facing the dual pressure of environmental problems and energy shortage, the development of new energy vehicles is the general trend. [1] With the social and economic progress in China, people's living standards are constantly improving, and the demand for new energy vehicles is also rising. Some professionals said that by 2030, the proportion of new energy vehicles in the Chinese market is expected to reach 70%. [2] The following figure 1 shows the monthly sales volume and year-on-year growth trend of new energy vehicles since June 2019. The left axis shows the monthly sales volume of new energy vehicles (10000 vehicles), and the right axis shows the year-on-year growth rate (%):

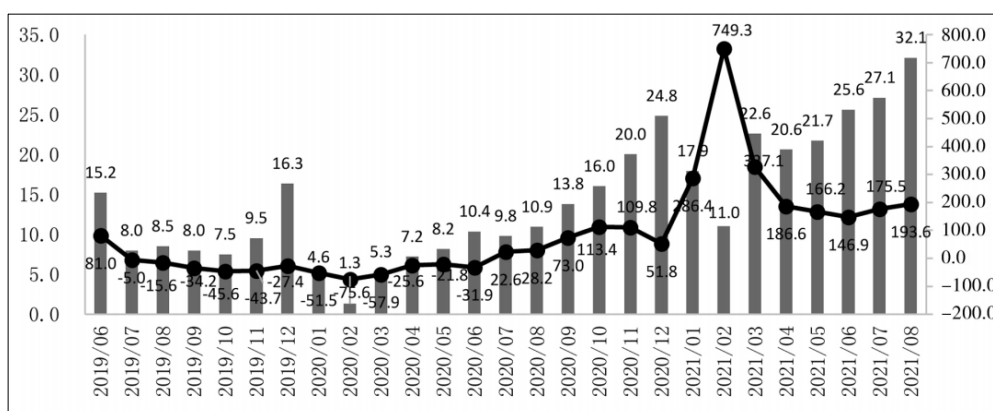


Figure 1. Monthly sales and year-on-year growth of new energy vehicles since June 2019

Based on this, this paper starts from the actual situation in China, combined with the latest development of new energy vehicles, uses the text data mining method to analyze the user comments

on new energy vehicles in well-known automobile websites, so as to extract the influencing factor indicators of new energy vehicle user satisfaction required for research, and carry out questionnaire design. Based on space design, this paper does not show the process of data mining and survey design. First of all, literature review is conducted to understand the research status of new energy vehicles; Secondly, the variable with more repetitions in the word cloud graph based on text data mining is used as an indicator to analyze the influencing factors of new energy vehicle user satisfaction, and the new energy vehicle user satisfaction is further analyzed through IPA model; Thirdly, we use the potential customer value model RFM to analyze the potential users of the new energy vehicle market in Jiangsu Province, and finally obtain the basic information of the potential users of new energy vehicles at different levels, so as to dig out the potential users of the new energy vehicle market. Finally, draw conclusions and prospects.

2. Literature review

Xiong Yongqing, Wang Junfeng and Qin Shufeng (2022) [3] used the panel data of China's new energy vehicle listed companies from 2009 to 2018 to analyze the differences in the impact of government procurement on the scale expansion and innovation and development of new energy vehicle enterprises, as well as the impact of political relevance, marketization level and other factors. The results show that the government procurement policy can promote the scale expansion and innovation development of different new energy vehicle enterprises, and the promotion of innovation development is higher than the scale expansion. Fang Xianhui (2022) [4] believes that users' environmental awareness can help them subconsciously form a sense of social responsibility and achieve energy conservation and environmental protection for the environment. At the same time, this sense of social responsibility also encourages users to green consumption and increases their desire to buy new energy vehicles. Zhang Changling (2021) [5] believes that passenger cars dominate. In recent three years, the trend of new energy passenger vehicles leading the new energy vehicle market in China has become increasingly obvious. Zhang Chunyan, He Hongjing and Hu Huiying (2020) [6] built a new energy vehicle user satisfaction and repurchase intention impact model according to the SOR model. Xie Ruyu and An Liren (2020) [7] believe that the market diffusion of new energy vehicles is still in the early stage of innovation diffusion. How to subdivide and screen target groups and target innovative users is an important means of market diffusion of new energy vehicles. Gu Hongjian and Hu Huiying (2020) [8] believed that after the subsidy was cancelled, the first four factors that users concerned about when purchasing new energy vehicles were endurance, configuration, intelligence and charging time. Therefore, how to effectively control costs, reduce prices and provide users with the most attractive products will become the focus of enterprises in the future.

At this stage, the academia has accumulated valuable research results in the field of new energy vehicles, but there are still some outstanding problems to be solved and explored. The contributions of this paper are as follows: First, based on the latest information provided to manufacturers and sellers from the perspective of users, this research selects "new energy vehicles" as the topic of this survey report to help new energy vehicle manufacturers and sellers understand market trends and explore potential users of the new energy vehicle market. Secondly, in this user satisfaction analysis, the program is written in python language to conduct word frequency statistical analysis, and 16 factors most concerned by users are selected as the influencing factor indicators of new energy vehicle user satisfaction for IPA model analysis.

3. Satisfaction Analysis of New Energy Vehicles in Jiangsu Province

3.1 Model construction

In this study, the variables with many repetitions in the word cloud map extracted from text data mining are analyzed as the influencing factors of user satisfaction of new energy vehicles, and the

IPA scale is constructed from the aspects of new energy vehicle body, brand, service and policy. In this study, 16 influencing factor indicators of new energy vehicles are numbered A1 to A16.

The reliability analysis of the questionnaire items using SPSSPRO shows that the Cronbach coefficients of the importance and satisfaction of new energy vehicles influencing purchase factors are 0.924 and 0.938, respectively, which indicates that the reliability of the questionnaire is very good. Then, the data obtained from the scale are analyzed and processed. The scale of importance and performance performance adopts the 5-point scoring method. The higher the score, the higher the importance of the new energy vehicle user influencing factor indicators and the higher the performance, the more important/satisfied the performance.

From the mean value and standard deviation of importance (I) and performance (P), it can be seen that the mean value of importance and performance are both in the general and important range, indicating that new energy vehicle users have high expectations and satisfaction with various influencing factor indicators of new energy vehicles. Under the premise that the performance of new energy vehicles is important, their users pay more attention to the after-sales service of vehicles. As a product of technological development, new energy vehicles adapt to the principle of environmental protection and energy conservation. Users also agree with their energy-saving performance. Table.1 shows the importance and performance of influencing factors for new energy vehicle users.

Table 1. importance and performance of new energy vehicle user influencing factor indicators

Indicators of influencing factors	Importance(I)		Importance(P)	
	mean	S. D	mean	S. D
A1 Price advantage	4.27	0.831	4.09	0.906
A2 Environmental advantages	4.20	0.860	4.24	0.830
A3 Energy saving advantages	4.30	0.798	4.25	0.837
A4 Appearance design	4.09	0.900	4.03	0.906
A5 Spacious	4.15	0.832	4.01	0.936
A6 Excellent seismic resistance	4.11	0.888	4.08	0.902
A7 Excellent endurance	4.28	0.863	3.97	0.946
A8 Complete interior configuration	4.18	0.852	4.09	0.883
A9Excellent power performance	4.20	0.882	4.08	0.882
A10 Fast charging	4.28	0.840	4.07	0.957
A11Excellent battery safety	4.33	0.862	4.09	0.906
A12Popularization of charging pile	4.30	0.906	3.87	1.070
A13Brand awareness advantage	3.93	0.948	3.88	0.968
A14Brand reputation advantage	4.06	0.913	3.90	0.931
A15Car purchase service	4.15	0.837	4.07	0.829
A16after-sale service	4.35	0.835	4.05	0.919

The IPA model architecture generally lists the importance evaluation of each attribute of the product as the horizontal axis, and the performance (satisfaction) evaluation as the vertical axis. Finally, the weighted arithmetic average of the customer's evaluation on the importance and performance of each attribute of the product is used as the space division point of the X-Y-axis of the whole space, and the whole space is divided into four quadrants.

3.2 Analysis of model results

According to the mean value and standard deviation of importance (I) and performance (P), a scatter plot is made, and the mean value of the horizontal and vertical coordinates is taken as the basis for quadrant division, so as to make the quadrant graph required by the IPA model. Sixteen user satisfaction influencing factor indicators are located in four quadrants, as shown in Figure 2:

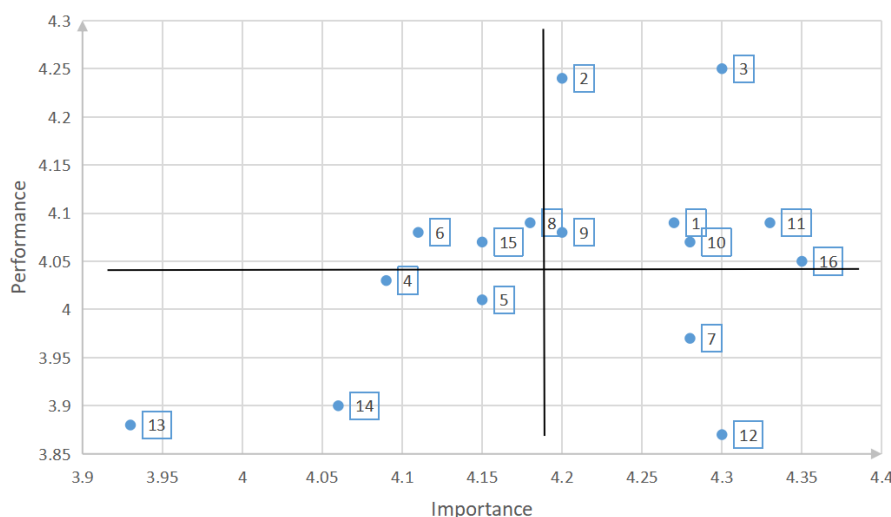


Figure 2. IPA analysis on user satisfaction of new energy vehicles

1.The first quadrant (Main)

This area is a continuous maintenance area. The influencing factor indicators located in the first quadrant include price advantage, environmental protection advantage, energy saving advantage, excellent power performance, fast charging and other indicators. It shows that users of new energy vehicles are satisfied with most of their own performance, and they also believe that these performances are important for new energy vehicles, which will continue to maintain these indicators and play a positive role in the development of new energy vehicle industry.

2.The second quadrant (Over supply)

This area is a supply transition area. The influencing factors in the second quadrant include excellent seismic resistance, perfect interior configuration and car purchasing service. It shows that in the supply transition zone, new energy vehicle users do not attach much importance to these indicators, but their performance is very high. In these three indicators, production input can be appropriately reduced, and more resources can be invested in the required indicator production to solve the problem of excessive supply.

3.The third quadrant (No priority)

This area is a low priority area. The influencing factors in the third quadrant include appearance design, spacious space, brand awareness and reputation advantages. It shows that in the low priority area, new energy vehicle users do not attach importance to these indicators and are not satisfied with these indicators, indicating that the brand awareness and reputation of businesses need to be further improved.

4.The fourth quadrant (Improve)

This area is a key area for strengthening improvement. The influencing factors in the fourth quadrant include excellent endurance and popularity of charging piles. It shows that although users attach great importance to the endurance of new energy vehicles and the popularity of charging piles, this part of work has not been done well, which has not satisfied users. The two indicators need to be improved.

4. Mining potential users of new energy vehicles

4.1 Model establishment

Through the analysis of the questionnaire survey, we found that some of the respondents have already possessed the characteristics of the new energy vehicle users, but they did not buy new energy vehicles in the end. We regard this part of the population as the most likely potential user group to be discovered at present. In the customer relationship management (CRM) model, RFM model is widely used. The traditional RFM model is an important tool and means to measure customer value and customer profitability. [9] This model can dynamically display the profile of a customer, which provides a basis for personalized communication and service. At the same time, if the customer has been dealing with for a long enough time, it can also accurately judge the long-term value (even the lifetime value) of the customer. By improving the status of indicators, it can provide support for more marketing decisions. [10] It mainly describes the customer's value status through three indicators: the customer's recent purchase behavior (Recency), the overall frequency of purchase (Frequency), and the amount spent (Monetary). However, in terms of the analysis of potential users of new energy vehicles, the indicators here are not applicable. It is necessary to derive a similar model from the RMF model to adapt to this investigation project. [11]

By studying the data of potential customers, we analyze the common behavior patterns of potential users in terms of motivation to purchase new energy vehicles. Using the survey items in the questionnaire, select five related items, quantify the survey results, and take the five quantitative items as indicators to study the potential customer value of new energy vehicles.

4.2 Model application and analysis

4.2.1 Selection of clustering factors

Select the questions in the questionnaire for non new energy vehicle users, and use the questionnaire to screen potential users. Those who choose "No" in "Have you ever bought a car" are directly defined as potential customers, totaling 136. Users who choose "Yes" are screened for the second time, using the question "Is the car you bought a new energy car?", and those who choose "No" are defined as potential users, totaling 114. The total number of potential users is 250. As shown in Figure 3:

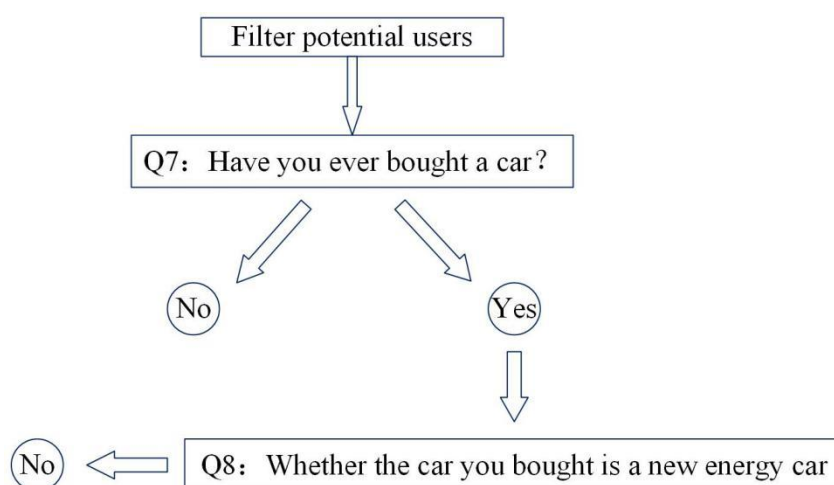


Figure 3. Diagram of potential users screening

Before clustering, we extract that there are four variables (gender, age, education, annual income) in the user characteristics that are more relevant to becoming a potential customer. Question 17 in the questionnaire is a scale of the importance of the influencing factors of new energy vehicles. Under various factor levels, it is very important, important, indifferent (uncertain), unimportant, and very unimportant to set up four options. Each answer is given a score. The favorable items from very

important to very unimportant are respectively 5, 4, 3, 2, and 1 points. As long as the score under this factor is greater than 3 points, It is recorded that users are willing to buy at this factor level. The score of this question is obtained by summing up the scores under all factor levels. We assume that the respondents with higher scores are more willing to buy new energy vehicles due to different factors of new energy vehicles, and the probability of becoming potential customers is greater.

We finally determined that the indicators for cluster analysis are: Q1, Q2, Q4, Q5, Q6 and Q17, and the corresponding factors are: age, gender, education background, occupation, annual income and purchase intention (what characteristics will you buy a smart bracelet because of). These six indicators are represented by A, S, E, J, I and P respectively as indicators to identify customer value (see Table2), which are recorded as the ASEJIP model.

Table 2. Index Meaning of Potential Customers of New Energy Vehicles

index	A	S	E	J	I	P
meaning	age	sexual distinction	education	occupation	annual income	Purchase intention (What factors will lead to the purchase of new energy vehicles)

4.2.2 Establishment of potential customer value model

The model is mainly composed of two parts. In the first part, customers are clustered according to the data of the above six indicators; The second part analyzes the characteristics of different customer categories, compares the customer value of different types of customers and sorts them.

1. Clustering of potential customers

Cluster analysis is conducted on the data, and customers are divided into five groups. The results of R software analysis are shown in Table 3.

Table 3. Customer Type Cluster Center of New Energy Vehicle

potential customer s	I	II	III	IV	V
(A)	41-65	26-40	20-25	20-25	26-40
(S)	male	male	male	female	female
(E)	Junior high school senior high school junior college	Junior college or above	undergraduate college	undergraduate college	postgraduate or above
(J)	middle class	Working-class	Student/working class	Working-class	Working-class
(I)/yuan	200000~400000	100000~200000	50000-200000	50000-200000	100000~200000
(P)	8 categories	10 categories	11 categories	13 categories	15 categories

2.Potential customer value analysis

Analyze the characteristics of the clustering results, as shown in the figure. Analyze the situation of each attribute of the five customer groups, and summarize the characteristics of each group. The results are shown in Figure 4 below:

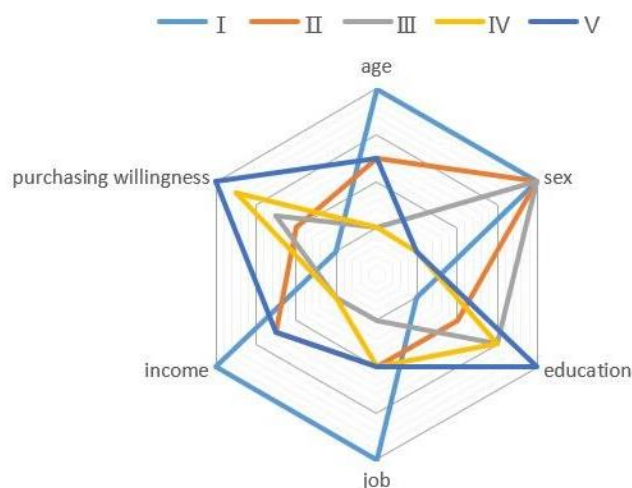


Figure 4. Radar Chart of User Characteristics Distribution of New Energy Vehicles

According to the potential customer type cluster center table and feature analysis diagram, each customer group has significantly different performance characteristics. Based on this feature description, we divide potential users into five categories: important potential customers, important development customers, secondary potential customers, general and low value potential customers. The characteristics of each potential customer category are as follows:

(1) Important potential customers: These customers are Class V potential customers (represented by black lines). They have higher acceptance of new things, are more interested in new technologies, and are most willing to buy new energy vehicles. For married families, the parent-child test drive meeting can be held specially for the characteristics of having a family and picking up children. For unmarried women, it is mainly about convenience. Therefore, improving the charging convenience should be the first priority, and the formation of electric vehicle charging infrastructure system should be accelerated.

(2) Important development customers: These customers are potential customers of category IV (indicated by red lines) and are interested in new energy vehicles. It also confirms our questionnaire analysis results: the group buying new energy vehicles is getting younger and younger. For this group, we need to focus on the product cost performance. On this basis, increase research and development, and launch economic models for this population. Secondly, the way for such users to learn about new energy vehicles is mainly through advertisements or recommendations from people around them. Therefore, they also need to plan targeted marketing programs, such as placing physical advertisements in places with large traffic such as subway entrances to guide such people to buy new energy vehicles.

(3) Secondary potential customers: These customers are the third category (indicated by light blue lines). They have a good acceptance of new things and are environmentally friendly. These people have a certain willingness to buy new energy vehicles. Secondly, new energy vehicles are far ahead of traditional fuel vehicles in terms of intelligent network connectivity, which is also an important reason for them to choose new energy vehicles. The data shows that such men's acceptance of new energy is slightly lower than that of women, and they are more worried about technology, but on the whole, they are optimistic and positive about the prospects of new energy vehicles. Therefore, when trying to catch up with these customers, we should focus on promoting the technology, intelligence and environmental protection of the car.

(4) General potential customers: This type of customer is the second type (indicated by the green line), who is usually cautious and suspicious of the battery technology, charging technology, new energy charging pile and other infrastructure construction of new energy vehicles. For such people, automobile enterprises should adhere to the research and development of various technologies, constantly improve product technology and quality, and increase social recognition. Secondly, more test drive activities can be carried out to let customers personally participate in the driving scene of

new energy vehicles, so that they can personally realize that the new energy vehicles under today's technology can completely meet people's daily commuting and business trip.

(5) Low value potential customers: These customers are the first category of potential customers (indicated by the dark blue line). These groups do not pay as much attention to economic and price factors as those in the previous sections. However, these groups have relatively high requirements for vehicle quality, comfort, power, safety technology and other performance. They have deep doubts about new energy and are less able to accept new things than young people, Therefore, the purchase intention is the lowest.

5. Conclusions and suggestions

Through analysis, we propose development strategies from three dimensions of consumption demand, consumption development trend and national policy: first, new energy vehicle users believe that new energy vehicles have certain advantages in terms of price, environmental protection, energy conservation, interior configuration and power performance, but lack in popularity of charging piles and endurance. Therefore, attention should be paid to the research and development of new energy vehicles, especially the research and development of battery safety and endurance, and high-end technology should be introduced to ensure the safety and endurance of new energy vehicles. Second, new energy vehicle users believe that the endurance of new energy vehicles needs to meet their travel needs, and female users have higher willingness to purchase new energy vehicles than male users. Therefore, from the aspect of service marketing, we should improve services and innovate marketing plans, strengthen after-sales services, tap high-end markets, pay attention to women's needs, implement industrial cluster marketing, and expand diversified marketing channels. Third, users of new energy vehicles have medium understanding of national policies, and national preferential policies are of great significance to stimulate the consumption of new energy vehicles. We should improve national policies, focus on the infrastructure construction of new energy vehicles, including the popularization of charging piles, get rid of the "subsidy dependency", adopt the "right of way priority" and "charging guarantee" policies, and stimulate and induce the consumption and use of new energy vehicles.

References

- [1] Wang Xiujie, Chen Yisong, Xu Jianquan. Research on Problems and Countermeasures of Industrialization Development of New Energy Vehicles in China [J]. Science and Technology Management Research, 2012,32 (11): 29-35.
- [2] Li Guobin. Research on the development status and future prospects of new energy vehicles [J]. Internal combustion engine and accessories, 2019, (14): 221-222.
- [3] Xiong Yongqing, Wang Junfeng, Qin Shufeng. Effect analysis of government procurement policy for new energy vehicles [J]. China Science and Technology Forum, 2022, (1): 9.
- [4] Fang Xianhui. Research on influencing factors and guiding policies of new energy vehicle consumers' purchase intention [J]. Modern Commerce and Trade Industry, 2019, 40 (21): 168-169.
- [5] Zhang Changling. China's new energy vehicle market mechanism analysis and development trend outlook [J]. China Economic Review, 2021, (11): 8.
- [6] Zhang Chunyan, He Hongjing, Hu Huiying. Research on satisfaction model of new energy vehicles based on SOR model [J]. Practical automotive technology, 2020, (13): 3.
- [7] Xie Ruyu, An Liren. The impact mechanism of innovation characteristics on the adoption willingness of new energy vehicle consumers: the regulatory role of individual innovation [J]. Contemporary economic science, 2020, 42(5): 9.
- [8] Gu Hongjian, Hu Huiying. Research on Consumer Satisfaction and Demand of China's New Energy Vehicles in 2019 [J]. China Auto, 2020, (1): 7.

- [9] Zhao Min. Research on the Application of Cluster Analysis and Naive Bayesian Classification in Customer Value Prediction [D]. Hefei University of Technology, 2010.
- [10] Lian Qi, Su Yi. Research on customer segmentation based on SOM and PSO clustering combination algorithm [J]. East China Economic Management, 2011, (1): 4.
- [11] Tang Chuncheng. Research on Hengyang Mobile Precision Marketing Strategy Based on Data Mining [D]. Nanhua University, 2011.