A STUDY ON THE MARKETABILITY OF THE NEXT GENERATION COMMUNITY VEHICLE

Pi-Ju TSAI*, Satoshi Kawae* and Shin'ya NAGASAWA**

*Graduate School of Business Administration, Ritsumeikan University, Nishi-higashi, Shiga 525-8577, Japan  **Graduate School of Asia Pacific Studies, Waseda University, Nishi-waseda, Shinjuku-ku, Tokyo 169-0051, Japan

Abstract: This study deals with the marketability of Class 1 environmentally friendly automobiles, or NCV21 (the next generation community vehicle), using the "Seven Tools for New Product Planning". The evaluation of consumer acceptance of Class I was clarified by conducting interview survey, questionnaire survey and positioning analysis. The most preferred Class 1 concept was obtained using the conceptualization method, idea screening method and conjoint analysis. As a result, it is understood that the Class 1 concept of "Price of 400,000 yen", "Electrically driven", "Installation of a character display system", "4WD transmission", "Design offering 50 color choices" could be accepted by half of the consumers. And this combination is attractive for half of consumers depend on the result of segmentation.

Keywords: Next generation community, Environmentally friendly automobiles, Class 1, Seven tools for new product planning.

1. INTRODUCTION

In 1988, IPCC (Intergovernmental Panel on Climate Change) pointed out the reason of global warming was because of greenhouse gas, and also pointed out to the greenhouse gas that the contribution degree of carbon dioxide was the highest. To combat a further deterioration in the impact of global warming, restrictions on greenhouse gas emissions in Japan, the U.S.A, Europe, and other countries have become stricter, and the environmental problems caused by automobiles are receiving more and more attention. In order to solve these problems, automobiles must be improved in some way and it's thought that the introduction of the electric car is one of the solutions. Therefore, this study deals with the marketability of the electric car. One kind of the electric car, Class 1, which is one category of environmentally friendly automobiles, or NCV21, is selected to be the study subject. Using the "Seven Tools for New Product Planning", advocated by Kanda and Nagasawa etc, to make the research plan. Following the order of "Interview Survey", "Questionnaire Survey", "Positioning Analysis", "Generation of Ideas by Conceptualization", "Idea Screening Method", and "Conjoint Analysis".

2. THE DEMAND OF NCV21

Although the automobile is now an indispensable part of everyday life and its convenience and utility are beyond comparison, many problems remain to be solved such as those concerning exhaust gas emissions, noise and fuel efficiency. In addition, consumers still tend to prefer and seek large-vehicles, resulting in greater numbers of recreational, and wagon-type vehicles on the road. Consequently, large-vehicles are commonly used within cities even for daily routine journeys. However, it is extremely irrational to use large, fuel-inefficient vehicles in cities for traveling short distances, dropping off and picking up family commuters and children to and from nearby schools or railway stations, shopping, and so forth, carrying a small number of passengers over short-distances. If ultra-small cars powered by electricity that can travel along narrow streets with ease were to be used for such purposes, exhaust gas emissions and noise could be eliminated and energy consumption reduced. It is believed that electric cars are the most suitable vehicles to preserve the environment of residential areas and to reduce energy consumption. Therefore, the NCV21, which is an ultra-small vehicle representing the next generation of vehicles, with outstanding performance in terms of fuel efficiency and control of exhaust gas emissions, is proposed as suitable for urban transportation in the 21st century.[1] Experiments on the use of NCV21 are already under way. Such like "ICVS" of HONDA, "Crayon" of TOYOTA in Japan, "City Car" in Europe, and "BART Station Car" and "Intelli Share" in American, etc. However, the real marketing promotion is just beginning, and the preference of consumer about NCV21 will be an important subject for tapping markets.
Therefore, one kind of NCV21, "Class 1" is selected to be the study subject, the needs of "Class 1" will be found out, and the concept of "Class 1" will be optimized by using "Seven Tools for New Product Planning" [2].

3. ASSESSMENT OF THE DEMAND FOR NCV21 BY INTERVIEW SURVEY

In order to assess the demand for NCV21, two types of NCV21 were prepared for test-driving (Figure 1 and Figure 2). Besides, photographs and explanation of "Class 2", bicycle, motorcycle, mini-car, etc., were prepared to compare with NCV21. 21 university students were divided into three groups, and Group Interviews were conducted three times at Ritsumeikan University BKC campus, in May 2001. The opinions got from Group Interviews were arranged and the KJ Figure was made to lead the hypothesis for vehicles. These hypothesize for the vehicle were as follows:

- Vehicle that people would be proud to drive.
- Safe vehicle.
- Practicable vehicle.
- Pleasant vehicle to ride in with air conditioner, stereo,
- reclining seat, etc.
- Low priced vehicle.
- Vehicle with excellent practical functions such as charging time, parking space, etc.
- Vehicle that requires special support from society (special roads and special licensing)

4. VERIFICATION OF THE HYPOTHESIS BY QUESTIONNAIRE SURVEY

Because these hypothesize that had been obtained through the group interviews were just depend on 21 persons, it was necessary to verify these hypothesize for a number of people, so a questionnaire survey was conducted. Preparation of 11 types of vehicle and 12 evaluation items provided the basis of a questionnaire using an attitude rating scale. A selection of university students provided the sample and the survey was carried out during the special subject class "Environment theory" at the School of Business Administration, Ritsumeikan University, on June 4, 2001.
Figure 4: Snake plot of the evaluation items

(a) Factor 1 (Stability) — Factor 2 (Environmental-friendly)

(y = 0.215 x)

(b) Factor 1 (Stability) — Factor 3 (Youthful)

(y = -2.041 x)

Figure 5: Perception map
There were 168 valid answers in total. Figure 4 shows the snake plot of each evaluation item for the 11 evaluation objects (types of car). Based on Figure 4, ultra-small cars and hybrid cars had a high average value in the question item "I want this product", and also had a high average value in the question items, "design" and "safety". Thus, it can be said that the hypothesis obtained through the group interviews was verified.

5. POSITIONING ANALYSIS

To clarify the competitive position of Class 1 and other vehicles, and to find out the direction of consumer preference, factor analysis was carried out using the data obtained from the questionnaire survey. As the result, 12 evaluation items were into 3 factors, stability factor, environmental-friendly factor and youthful factor. A market map based on the 3 factors of the 11 evaluation vehicles was made. Preference regression was performed using "I want this product" as the outcome variable to clarify the direction of the preference. Figure 5 shows these results.

5.1. The Analysis of All Data

Figure 5 is a three-dimensional space composed of three different character axes. According to Figure 5 (a), "single passenger electric vehicle" is considered high level on environmental-friendly but low level on stability. About figure (b), the axe of youthful was turned for easily explaining, "compact" is considered good on "stability" and "youthful". According to the direction of the ideal vector, consumers prefer a vehicle that is stable, environmentally friendly, and youthful. However, according to figure 2 (b), the evaluation of Class 1 (Single Passenger Electric Vehicle) as regards stability and youthfulness is the lowest, and NCV21 is at the pole position regarding the ideal vector. On the other hand, the evaluation of Class 1 is high regarding the environment as shown in figure 2 (b). This means that to recommend Class 1, it is necessary to improve its stability and youthfulness.

5.2. The Analysis of Personal Data

According to the result of stratified analysis, the difference between man and woman was found out. Figure 6 and Figure 7 show the perception map of man and woman.
As the result of the comparison of Figure 6 and Figure 7, it has been understood that man is disregard for environment but woman make a thing of it. Moreover, compare with the angle of the ideal vector and Class 1 (Single Passenger Electric Vehicle) of Figure 6 and Figure 7, the angle of Figure 7 is smaller than Figure 6, so it can be said that woman is the better target for selling Class 1.

5.3. The Analysis of Segmentation

Because it has been understood that Class 1 is attractive for woman that think environment is very important, so a layer that value environment might exist. To clarify this question, the Cluster Analysis was conducted by using the data of “I want this product” item, and 2 clusters were obtained. The answers of cluster 1 are 69 and cluster 2 are 97. According to the result of executing the Positioning Analysis of each cluster, cluster 1 could be named "The layer that value environment" and cluster 2 could be named "The layer that value youthfulness". Figure 8 and Figure 9 show the Perception Map of these 2 clusters.

According to Figure 8 of “Factor 1 Stability” and “Factor 2 Environmental-friendly”, the “Hybrid Car” is on the position that the ideal vector tends to. Moreover, the angle of the ideal vector and Class 1 (Single Passenger Electric Vehicle) is small, so it can be said that the layer is promising for selling Class 1.

On the other hand, it is difficult to sell Class 1 to the Layer that Value Youthfulness because the angle of the ideal vector and Class 1 (Single Passenger Electric Vehicle) is very large.

5.4. Conclusion of Positioning Analysis

According to the result of Positioning Analysis, it is understood that the need of vehicle with stability and youthfulness is strong. Because the evaluation of Class 1 is high regarding the environment, this means that to close the ideal vector, it is necessary to improve its stability and youthfulness.

Depend on the result of stratification and segmentation, it is found out that woman is more promising than man for selling Class 1. It is also found out that cluster 1 which value environment is promising layer.
6. GENERATION OF IDEAS BY CONCEPTUALIZATION

In order to propose an improvement plan for Class 1, original and special idea is necessary. Therefore, the Analogy Conceptualization was used. The Analogy Conceptualization method developed by Konno and Kanda, referring to a reverse-set method, the system, and analogy, form the idea pattern by deconstructing the current state of the product and creating commonsense to epoch-making ideas. Conceptualization should follow the results of the positioning analysis. The processes and part of the results of the analogy conceptualization are shown in the Table 1.

Take Idea No.6 as example, get commonsense of vehicle firstly, such like “Vehicle is stability also on bad roads”, then get the opposition secondly, and “Unstable on bad road” is gotten. The problem of the opposition is “Vibrates is dangerous”. To solve this problem, think about a solution from other field, and this is the mean of “analogy”, for example, “Safari”, and then writes down the keyword of the “analogy”, “No problem on bad road”. Finally, the idea “Four-wheeled drive car with large tire” is obtained. 533 ideas are obtained by this way.

7. SELECTING IDEAS USING THE IDEA SCREENING METHOD

Although many ideas are generated at the conceptualization stage, the number of attributes that can be taken into consideration in the conjoint analysis is limited, only 6 ideas are allowed. Therefore, a screening or selection method should be used.

To extract ideas that are closer to the direction of the preference, a weighted average method was used. The evaluation item for the weighted-average method should be decided according to the results of the Positioning Analysis. Therefore “Stable” and “Youthful” were used. The weight of the evaluation item should follow the ideal vector, so the weight of “Stable” is 5 point, and the weight of “Youthful” is 10 point. Next, it is necessary to decide the point of each idea. “3” means “agree greatly”, “2” means “agree”, and “1” means “agree difficulty”. Take Idea No. 6 as example again, it gets 3 points on “Stability” and 2 points on “Youthful”, so its Composite Score is 35 points (3 × 5 + 2 × 10 = 35). Rate the Composite Scores for each idea 5 times by 5 research workers, then count the average of composite score of each idea. Rank these average composite scores and select the higher ones. Finally seven ideas were

<table>
<thead>
<tr>
<th>No.</th>
<th>Commonsense</th>
<th>Opposition</th>
<th>Problem</th>
<th>Keyword</th>
<th>Analogy</th>
<th>Idea</th>
</tr>
</thead>
<tbody>
<tr>
<td>6</td>
<td>Stability also on bad roads</td>
<td>Unstable on bad road</td>
<td>Vibrates is dangerous</td>
<td>No problem on bad road</td>
<td>Safari</td>
<td>Four-wheeled drive car with large tire</td>
</tr>
<tr>
<td>34</td>
<td>Good color</td>
<td>Bad color</td>
<td>Ugly stand out</td>
<td>50 colors</td>
<td>UNIQUL</td>
<td>Increasing the color variation</td>
</tr>
<tr>
<td>35</td>
<td>Good color</td>
<td>Bad color</td>
<td>Vulgar hobby</td>
<td>Good sense</td>
<td>Model-designer</td>
<td>Designed by a celebrity or a famous designer</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>No.</th>
<th>Idea</th>
<th>Research worker A</th>
<th>Research worker E</th>
<th>The average of Composite Score</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Stability (5 point)</td>
<td>Youthful (10 point)</td>
<td>Composite Score</td>
<td>Stability (5 point)</td>
</tr>
<tr>
<td>6</td>
<td>Four-wheel drive car with large tires</td>
<td>3</td>
<td>2</td>
<td>35</td>
</tr>
<tr>
<td>444</td>
<td>The color transform in different time</td>
<td>2</td>
<td>3</td>
<td>40</td>
</tr>
<tr>
<td>34</td>
<td>Increasing the color variation</td>
<td>1</td>
<td>3</td>
<td>35</td>
</tr>
<tr>
<td>35</td>
<td>Designed by a celebrity or a famous designer</td>
<td>1</td>
<td>3</td>
<td>35</td>
</tr>
<tr>
<td>527</td>
<td>Made of denim</td>
<td>1</td>
<td>3</td>
<td>35</td>
</tr>
<tr>
<td>337</td>
<td>Words display system</td>
<td>3</td>
<td>2</td>
<td>35</td>
</tr>
<tr>
<td>485</td>
<td>Three kinds of bodies</td>
<td>2</td>
<td>2</td>
<td>30</td>
</tr>
</tbody>
</table>
chosen. Some of the results of the weighting method are shown in Table 2.

8. OPTIMIZATION OF CONCEPTS THROUGH CONJOINT ANALYSIS

To convert the ideas to form a concrete product concept, and to optimize the product concept, Conjoint Analysis was conducted.

8.1. Preparation and Presentation Of The Questions

The attributes and levels of the conjoint analysis were set up based on the results of the idea screening method. They are shown in Table 3.

When there is one attribute with four levels and four attributes with two levels, it is necessary to prepare $4^1 \times 2^4 = 64$ attribute profile cards. It is awkward for respondents to arrange as many as 64 cards (or products) in their order of preference. A table of $L_8$ orthogonal arrays was therefore used. The orthogonal array is designed to have each level of each attribute appear the same number of times for examination. By using the orthogonal array, there will be only 8 profiles required. Moreover, in order to verify the reliability of data, 2 holdout cards are also prepared. These 10 profile cards are shown in Table 4. The research of Conjoint Analysis was executed for the university student, during the special subject class "Environment theory" at the School of Business Administration, Ritsumeikan University, on July 16, 2001. There were 162 valid answers in total.

8.2. Analysis of Survey Results

The reliability of data can be verified by comparing average order and calculate order as show in Table 5. Because the values of average order and calculate order are very close, it can be said that the obtained data is reliable.

<table>
<thead>
<tr>
<th>Attribute</th>
<th>Notation</th>
<th>Level of attribute</th>
</tr>
</thead>
<tbody>
<tr>
<td>Design</td>
<td>A_1</td>
<td>Denim</td>
</tr>
<tr>
<td></td>
<td>A_2</td>
<td>Famous designer</td>
</tr>
<tr>
<td></td>
<td>A_3</td>
<td>Color variation</td>
</tr>
<tr>
<td></td>
<td>A_4</td>
<td>Color transform in different time</td>
</tr>
<tr>
<td>Driving method</td>
<td>B_1</td>
<td>4WD</td>
</tr>
<tr>
<td></td>
<td>B_2</td>
<td>2WD</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Attribute</th>
<th>Notation</th>
<th>Level of attribute</th>
</tr>
</thead>
<tbody>
<tr>
<td>Words display system</td>
<td>C_1</td>
<td>Installed</td>
</tr>
<tr>
<td></td>
<td>C_2</td>
<td>None</td>
</tr>
<tr>
<td>Power source</td>
<td>D_1</td>
<td>Electricity</td>
</tr>
<tr>
<td></td>
<td>D_2</td>
<td>Gasoline</td>
</tr>
<tr>
<td>Price</td>
<td>E_1</td>
<td>¥400,000</td>
</tr>
<tr>
<td></td>
<td>E_2</td>
<td>¥500,000</td>
</tr>
</tbody>
</table>

Table 3: Calculation results of Conjoint Analysis

Table 4: Profile Cards and Holdout Cards

Table 5: Holdout Table
The results of the Conjoint Analysis are shown in Figure 10. Figure 10-a shows which level is preferred and what kind of combination is optimal. Plus utility value means preferred and minus utility value means unfavorable, the higher utility value the bigger preference. Figure 10-b shows which attribute has more influence over choosing products. According to the proportional contribution in Figure 10-b, it was determined that "design" represented 74.2% of the influence over the ranking of the product preference order. Next, it is the order of "Power source" and "Price". And "Driving method" and "Words display system" have no influence over choosing products. When seen from the utility value of Figure 10-a, it is suggested that "50 colors" and "Design by a celebrity or a famous designer" are preferred ideas. Moreover, the attributes that can cover the decrease of utility because improve the price from ¥400,000 to ¥500,000 are "Design" and "Power source", "Driving method" and "Words display system" have no value of 100,000 yen. Therefore, the combination of "Color variation" of design + "4WD" of Driving method + "Installed" of words display system + "Electricity" of power source + "¥400,000" of price is the best. It can be said that Class 1 is promising if its design is improved.

The analysis of stratify depended on personal data is also carried out. However, certainly different group is not found.

9. SEGMENTATION BY CLUSTER ANALYSIS

Table 6 is the best table of Conjoint Analysis, shows the preference order of 8 profile cards. It is understood that profile no.4 is the best choose by consumers. However, average order of profile no.4 is 3.5, it means that the preference order of answers are not consensus. Therefore, to examine whether different layers existed together, segmentation was carried out by using Cluster Analysis, with the preference order data indicating the degree of preference in the Conjoint Analysis.

Figure 11 shows the dendrogram obtained from Cluster Analysis. All respondents could be divided into four segments clearly depend on Figure 11. The conjoint analysis of each segment was then conducted by summing up all data in each segment. The characteristics and considerations of each segment concerning Class 1 are as follows.
(1) Segment 1: 51 persons (31.9%) belong to this segment. Figure 12-a and Figure 12-b show the results of conjoint analysis. Because the proportional contribution to design is 96.7%, this segment consists of significant advocates of design. The design with "All 50 colors" available was the most liked. The quality of the design is directly connected to the purchase because considerable importance is attached to the design. Therefore, maybe it is necessary to sell electric car as an attractive vehicle.

(2) Segment 2: 33 persons (20.6%) belong to this segment. Figure 13-a and Figure 13-b show the results of conjoint analysis. This segment represents design-valuing advocates, with a preference for the level of "Designed by a celebrity or a famous designer". The use of gasoline as fuel was supported. It is thought that it is difficult to sell electric cars even if the design is improved because this layer likes gasoline-powered vehicles.

(3) Segment 3: 47 persons (29.4%) belong to this segment. Figure 14-a and Figure 14-b show the results of conjoint analysis. The proportional contribution of design, price, and the power source are high, and all of these attributes are important. In other words, a well-balanced sales promotion of design, power source, and price is necessary for this layer. The sale of electrical cars to this layer is promising.

(4) Segment 4: 29 persons (18.1%) belong to this segment. Figure 15-a and Figure 15-b show the results of conjoint analysis. Because the proportional contribution of the power source is 92.8%, this segment is an advocate of environment protection. It is a layer where friendliness to the environment is the most likely to lead to a purchase. It is a promising layer as a target, although the share of the total is not very high.
According to the result of segmentation, it is understood that all answers could be divided into 2 layers, the layer that value design and the layer that value environment. Moreover, the layer that value environment include segment 3 that value design and segment 4 that value price and power source. It can be said that for selling electric vehicle, segment 3 and segment 4 are promising layer as a target.

10. CONCLUSION

This study examined the marketability of Class 1 using the "Seven Tools for New Product Planning". By using an interview survey and questionnaire survey, the requirements for Class 1 were found and verified. Positioning Analysis clarified that Class 1 lacks appeal in terms of "stability" and "youthfulness", and found that this was a direction that had to be improved. By using conceptualization and evaluation and selection analysis, creative ideas for Class 1 were suggested. Based on these ideas, a Conjoint Analysis was conducted, and it was understood that "design" is the most important attribute for choosing products. Segmentation was carried out to examine whether different layers existed together. As the result, it can be said that the concept combining a "Price of 400,000 yen", "Electrically driven", "Installed with a character display system", "4WD transmission", "Design with a choice of 50 colors" is promising for half of the respondents.

REFERENCES