Tekmapro : Journal of Industrial Engineering and Management
Vol. 19, No. 1, Tahun 2024, Hal. 77-84
e-ISSN 2656-6109. URL: http://tekmapro.upnjatim.ac.id/index.php/tekmapro

Synergizing Customer Satisfaction and Sustainable Innovation: Leveraging the Kano Model for Eco-Design in Product Development

Komang Nickita Sari[1)], Maria Anityasari[2)] , Ni Ketut Sari[3)]
[1,2)]Departemen Teknik Sistem dan Industri, Fakultas Teknologi Industri dan Rekayasa Sistem, Institut Teknologi Sepuluh Nopember
[3)]Departemen Teknik Kimia, Fakultas Teknik, Universitas Pembangunan Nasional Veteran Jawa Timur
e-mail: komangnickita97@gmail.com[1)*)], maria@ie.its.ac.id[2)],
[c]sari_ketut@yahoo.co.id[3)]
*) Corresponding Author

ABSTRAK

Dalam konteks tuntutan konsumen masa kini dan kesadaran lingkungan yang semakin meningkat, desain kemasan barang konsumsi telah mendapatkan perhatian yang signifikan karena dampaknya terhadap kepuasan konsumen dan kelestarian lingkungan. Makalah ini berfokus pada pemanfaatan Model Kano sebagai metodologi yang kuat untuk membedakan atribut-atribut penting dalam desain kemasan minyak goreng berkelanjutan. Dengan memanfaatkan kerangka komprehensif Model Kano, penelitian ini berupaya mengidentifikasi fitur-fitur penting yang tidak hanya memenuhi harapan konsumen namun juga selaras dengan praktik yang bertanggung jawab terhadap lingkungan. Penelitian ini bertujuan untuk mengetahui dengan tepat atribut-atribut yang berkontribusi terhadap kepuasan konsumen dan pengurangan dampak buruk terhadap lingkungan. Dengan menekankan sinergi antara kepuasan konsumen dan kemasan berkelanjutan, makalah ini menggarisbawahi peran penting Model Kano dalam memandu proses desain menuju pembuatan kemasan minyak goreng yang tidak hanya memenuhi kebutuhan konsumen namun juga menunjukkan komitmen terhadap tanggung jawab ekologis. Wawasan yang diperoleh dari studi ini berfungsi sebagai panduan berharga bagi perusahaan yang ingin meningkatkan strategi desain kemasan mereka, menumbuhkan loyalitas konsumen sekaligus mempromosikan praktik berkelanjutan dalam industri minyak goreng.

***Kata Kunci**: atribut kemasan produk, desain ramah lingkungan, kansei engineering, kemasan minyak goreng, model kano.*

ABSTRACT

In the context of contemporary consumer demands and growing environmental consciousness, the packaging design of consumer goods has garnered significant attention for its impact on both consumer satisfaction and environmental sustainability. This paper focuses on the utilization of the Kano Model as a robust methodology for discerning pivotal attributes in sustainable cooking oil packaging design. By leveraging the comprehensive framework of the Kano Model, this research seeks to identify the essential features that not only fulfill consumer expectations but also align with environmentally responsible practices. Through a meticulous analysis of consumer preferences and environmental concerns associated with cooking oil packaging, this study aims to pinpoint the attributes that contribute to both consumer satisfaction and reduced environmental footprint. By emphasizing the synergy between consumer satisfaction and sustainable packaging, this paper underscores the vital role of the Kano Model in guiding the design process toward creating cooking oil packaging that not only meets consumer needs but also demonstrates a commitment to ecological responsibility. The insights derived from this study serve as a valuable guide for companies looking to enhance their packaging design strategies, fostering consumer loyalty while promoting sustainable practices in the cooking oil industry.

***Keywords**: cooking oil packaging, eco-design, kano model, kansei engineering, product packaging attribute.*

I. INTRODUCTION

In today's fiercely competitive business landscape, the design of a product plays a pivotal role in determining its success. Understanding and catering to customer preferences and expectations have become paramount for organizations striving to gain a competitive edge.

Simultaneously, the imperative to integrate sustainable practices into product development has led to the rise of eco-design as a crucial aspect of contemporary business strategies. Within this context, the Kano Model has emerged as an indispensable framework for product design, synergizing seamlessly with eco-design principles. By incorporating the Kano Model's customer-centric approach alongside eco-design principles, companies can systematically discern customer needs, prioritize features, and develop environmentally friendly products that not only meet but exceed user expectations. This paper aims to explore the symbiotic relationship between the Kano Model and eco-design, highlighting their combined potential to enhance customer satisfaction, drive sustainable innovation, and foster long-term business success.

Many researchers suggest that the Kano model is valuable in product design for several reasons. Narang highlights that the Kano model helps design and quality teams focus on important product features and differentiate themselves from competitors (Narang,2009). Hassan discusses how the Kano model can be used to improve product lifecycle by understanding customer requirements and integrating them into engineering design (Hassan, 2017). Kumar emphasizes the importance of using the Kano model in the product development process to achieve customer-centric evaluations and optimize the design process (Kumar, 2012). Lee explores the strategic integration of the Kano model with evolutionary grammar to refine product design strategies based on customer expectations (Lee, 2012). Overall, these papers demonstrate the usefulness of the Kano model in product design for understanding customer needs and making informed design decisions.

In an era marked by heightened environmental consciousness and evolving consumer preferences, the synergy between customer satisfaction and eco-sustainability has become paramount in product development strategies. The Kano Model, known for its ability to assess customer satisfaction, and Eco-design Analysis, renowned for its focus on minimizing environmental impacts, have emerged as two pivotal frameworks in their respective domains. The integration of these two approaches offers a novel pathway to achieve sustainable product development, catering to both consumer preferences and ecological concerns. This paper delves into the significance and implications of combining the Kano Model and Eco-design Analysis, highlighting the potential for enhancing product competitiveness, minimizing environmental footprints, and fostering a symbiotic relationship between consumer satisfaction and environmental sustainability.

II. LITERATURE REVIEW

A. ECO-DESIGN PRODUCT

Coelho, et al. say that good product packaging is packaging that can be recycled so that it reduces the use of virgin raw materials, and has high durability so that it has a longer service life. Apart from that, good packaging can also be refilled or in other words can be used repeatedly, thereby reducing the amount of waste going to final disposal. If the packaging is intended for packaging food, the packaging must be food-safe (Coelho, et al., 2020).

Zhong, et al. say that good packaging is not only easy to recycle, but must also have bio-degradability properties. Packaging that has bio-degradability properties is considered to have a smaller environmental impact or can be interpreted as meaning that the packaging is safe for the environment when the packaging is thrown away (Zhong, et al., 2019).

Gere and Czigany said that good packaging is packaging that can be recycled, thereby reducing the use of virgin materials during the production process. Apart from that, the packaging must also have high durability. If a packaging has high durability, the useful life of the packaging will be longer. Good packaging also has bio-degradability properties. By having bio-degradability properties, the packaging can be biologically recycled. If the packaging is intended as food packaging, then the packaging must also have food-grade properties (Gere & Czigany, 2019).

Niauonakis said that good packaging is packaging that can be recycled, is strong, can be refilled, and is safe for food if the packaging is intended for food (Niaounakis, 2020).

B. CURRENT COOKING OIL PACKAGING DESIGN

These papers provide insights into the current cooking oil packaging design in Indonesia. Utami focuses on the distribution of palm cooking oil in traditional markets in Jakarta

(Utami, 2017). They propose a system of distribution using fuzzy clustering, creating clusters of traditional markets with distribution centers. Hartini explores the circular economy designing of municipal waste cooking oil in Semarang City (Hartini, 2023). Abidin investigates consumer preferences for packaged cooking oil in Bandar Lampung City, finding that consumers prefer a price range of Rp 11,000-Rp 13,000 per liter, a packaging size of 2 liters, clear packaging, and bottled packaging (Abidin, 2022).

It can be concluded that in Indonesia the average cooking oil packaging design is in the form of pouches and bottles using plastic. Eco-design elements have not yet touched this market due to several factors. The frequency of use of cooking oil is very high because it is included in the nine necessities (sembako) in Indonesia.

C. COOKING OIL PACKAGING ATTRIBUTE

Sari uses Kansei engineering to capture the quality attributes of cooking oil packaging that consumers want. Sari divided quality attributes into 2 product semantics, namely packaging and labels. Quality attributes for packaging consist of quality attributes of protection, refillable, recyclable, biodegradability, food safety, additional function, attractiveness, conformity, ergonomic, and user friendly. Quality attributes for packaging labels include certain brand communications, communication of family product categories, main information, content declaration, instruction, opening, symbol, and eco-label (Sari,2023).

The author has analyzed that the quality attributes used by Sari (2023) fulfill the characteristics of eco-design. Therefore, the author uses these attributes to be tested and grouped based on their importance from a consumer perspective.

III. RESEARCH METHODOLOGY

The research methodology used is shown in the figure 1. Previous researchers identified the attributes of cooking oil packaging and obtained 18 attributes that can be used in this paper (Sari,2023). There are 18 attributes of palm cooking oil packaging which will be mapped according to their level of importance using the Kano model.

Using these attributes, a questionnaire will be created in the form of a pairwise questionnaire, containing functional and dysfunctional questions for each attribute. Examples of questions can be seen in Table 1. Respondents provide scores using a value range of 1 to 5 with information:

- 1: I like it that way/ strongly agree
- 2: It must be that way/ partially agree
- 3: I am neutral/ neutral attitude
- 4: I can live with it that way/ partially disagree
- 5: I dislike it that way/ strongly disagree

After the questionnaire has been created, a data adequacy test is carried out to ensure the sample can describe the population (the population used is the number of people from Java and Bali in 2020). The questionnaire validity test was carried out on 2 things, namely content validity and face validity. Reliability testing aims to ensure that the questionnaire can be trusted and relied upon as a tool for collecting research data.

The questionnaire data that has been successfully obtained will then be processed using descriptive analysis, Kano model categorization, and cross-tabulation using the chi-square statistical test to determine the existence of a correlation between the respondent's background and quality attributes.

Table 1. Example for pairwise question for protection attribute

Protection Attribute	
Functional Question	**Dysfunctional Questioner**
How do you feel if product packaging can protect your product?	How would you feel if product packaging was NOT able to protect your product?

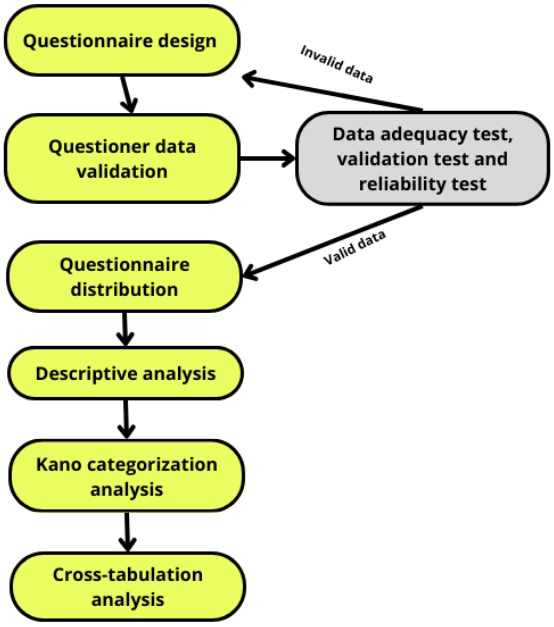

Figure 1. Research Methodology Flowchart

IV. RESULT AND DISCUSSION

A. QUESTIONNAIRE DESIGN

The questionnaire was created using pairwise questions for each quality attribute. The list of quality attributes used in the questionnaire can be seen in Table 2. Because the number of quality attributes used is 18, there will be 36 questions regarding quality attributes (18 functional questions and 18 dysfunctional questions).

Table 2. List of quality attributes used in the Kano model questionnaire.

No	Quality Attributes	Sign
1	Protection	Y1
2	Refillable	Y2
3	Recyclable	Y3
4	Biodegradability	Y4
5	Food Safety	Y5
6	Additional function	Y6
7	Attractive	Y7
8	Conformity	Y8
9	Ergonomic	Y9
10	User-friendly	Y10
11	Communicates certain brand	Y11
12	Communicates family product category	Y12
13	Main information	Y13
14	Content Declaration	Y14
15	Instruction	Y15
16	Open-dating	Y16
17	Symbol	Y17
18	Ecolabel	Y18

Before asking respondents about pairwise questions, a questionnaire was added regarding respondent demographics containing gender, marital status, age, and income.

B. DATA ADEQUACY TEST

The population (N) that will be used is the population of Java and Bali in 2020. The population of Java and Bali is 145.22 million people. The error tolerance limit is determined at 5% by Slovin's recommendations and also by the Krejcie-Morgan table (Krejcie-Morgan, 1970). After determining the population size and error tolerance, the sample size was found to be 400 respondents.

C. DATA VALIDATION TEST

Quantitative content validity test in the first round of 36 questions. Overall, the proportion of valid questionnaire items was 100%, 100%, and 100% from each validator (a total of 3 validators). So, the I-CVI value of the questionnaire is 1. The I-CVI value of the questionnaire is greater than ≥0.78 so that 36 questions in the questionnaire are declared quantitatively valid.

D. DATA RELIABILITY TEST

The results of Cronbach's Alpha calculations from functional question items in the Kano model questionnaire parts 1, 2, and 3 show that Cronbach's Alpha value is 0.796 for 18 questions. The results of the Cronbach's Alpha calculation from the dysfunctional question items in the Kano model questionnaire parts 1, 2, and 3 show that the Cronbach's Alpha value is 0.925 for 18 questions. So, the 18 functional and 18 dysfunctional questions in the Kano model questionnaire parts 1, 2, and 3 were declared reliable because the Cronbach's Alpha value was >0.6.

E. DESCRIPTIVE ANALYSIS

Female and male respondents had a proportion of 59.4% (240 respondents) and 40.6% (164 respondents) respectively. The age distribution of respondents was dominated by those aged 21-25 years with a percentage of 67.7% (273 respondents), 11.6% (47 respondents) aged 31-40 years, and 9.2% (37 respondents) aged 26-30 years. The remaining 6.7% and 4.7% are over 40 years old and between 17-20 years old respectively.

In terms of marital status, 76.4% (304 respondents) answered that they were not married and 23.6% (94 respondents) answered that they were married. Respondents with incomes below 2 million per month amounted to 38.7% (153 respondents) and those with incomes between 2 and 6 million amounted to 37.2% (147 respondents). There are 14.9% (59 respondents) earning between 6 and 10 million per month, 4.1% (16 respondents) earning between 10 and 15 million, and 5.1% (20 respondents) earning more than 15 million per month.

From this data, it can be concluded that male and female respondents have proportions that are not much different. The dominant age is 21 to 25 years which can be said to be teenagers (still studying). This resulted in the dominance of income being under 2 million because most of the respondents were students. In terms of marital status, unmarried status is also dominated by the same reason.

F. KANO CATEGORIZATION ANALYSIS

Kano categorization analysis was carried out using the CS-coefficient method as shown in Figure 2. The one-dimensional quadrant contains 5 attributes, namely attributes Y1, Y5, Y8, Y13, and Y16. This one-dimensional quadrant has a high satisfaction coefficient value (exceeds the average/is above the y-axis intersection point), namely 0.688 to 0.903, where the increase in consumer satisfaction reaches 68.8-90.3% if these attributes are in new packaging cooking oil. The one-dimensional category also has a high dissatisfaction coefficient value (exceeds the average/is to the left of the x-axis intersection point), namely (-0.565) to (-0.895) where consumer dissatisfaction will reach 56.5-89.5% if attributes in this category are not present in new cooking oil packaging.

The attractive attribute category can provide a high level of satisfaction to consumers. However, if consumers do not find this attribute on the cooking oil packaging, it will not cause consumer dissatisfaction. The attractive quadrant contains 4 attributes, namely attributes Y3, Y4, Y15, and Y18. The attractive category has a high satisfaction coefficient value, namely 0.69 to 0.771, where the increase in consumer satisfaction reaches 69-77.1% if these attributes are present on the cooking oil product packaging. The dissatisfaction coefficient value in this category is quite low, namely less than average or only ranges from (-0.378) to (-0.499) where consumer dissatisfaction will reach 37.8-49.9% if the attributes in this category are not present in the new packaging cooking oil.

In the must-be category, if the attribute is not met then the consumer will feel dissatisfied, however, if this attribute is met consumer satisfaction will not increase and the customer will be neutral. There are 2 attributes in this category, namely attributes Y9 and Y14. In the must-be quadrant, the satisfaction coefficient value is below average, namely

ranging from 0.656 to 0.675, where the increase in consumer satisfaction reaches 65.6-67.5% if these attributes are present on the cooking oil product packaging. The dissatisfaction coefficient value in this quadrant ranges from (-0.505) to (-0.539) where consumer dissatisfaction will reach 50.5-53.9% if these attributes are not present in the cooking oil product packaging.

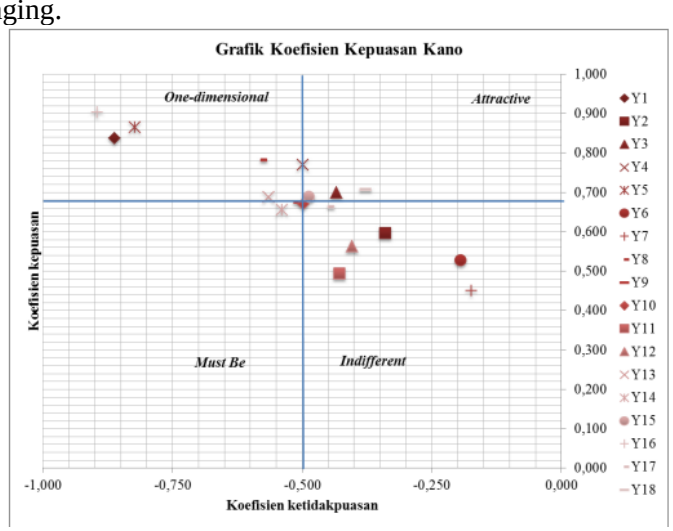

Figure 2. Kano Coefficient Satisfaction Graph

The indifferent category is a category that does not influence consumer satisfaction. There are 6 attributes in this quadrant, namely attributes Y2, Y6, Y7, Y10, Y11, Y12. In the indifferent quadrant, the satisfaction coefficient value is below average, namely only around 0.494 to 0.671, and the dissatisfaction coefficient value ranges from (-0.174) to (-0.497). Therefore, attributes in the indifferent category are considered unimportant/unnecessary because they have less influence on consumer satisfaction and dissatisfaction.

Of the four quality attribute categories, the author's focus is attractive. Referring to the results of the questionnaire, it was found that the quality attributes recyclable (Y3), biodegradability (Y4), and ecolabel (Y18) are attractive factors for consumers if these attributes are indeed present in cooking oil packaging. These results also support the hypothesis that now people will judge good packaging to be packaging with eco-design.

G. CROSS-TABULATION ANALYSIS

Based on the results of running SPSS software, there is a relationship between the respondent's gender and the respondent's assessment of the attributes recyclable, food safety, user-friendly, instruction, and open-dating. From these results, it was found that perhaps men need instructions on the palm oil cooking oil packaging label because they rarely cook so they need more guidance. Then women may pay more attention to food safety aspects for cooking oil packaging because it determines the quality of the oil.

In terms of respondent status, there is a relationship with packaging attributes such as recyclable, food safety, and attractiveness. In terms of labeling, there is a relationship with the quality attributes of communicating certain brands, instruction, open-dating, and ecolabel. Married respondents may tend to choose cooking oil packaging depending on the brand because married respondents usually have more concerns about brands than those who are not married. Then perhaps unmarried respondents prefer packaging with eco-label information because they are concerned about eco-friendly packaging.

There is a relationship between the respondent's age and the respondent's assessment of the attribute’s recyclable, biodegradability, food safety, additional function, and user-friendliness. Age may influence respondents in using cooking oil packaging, for example, older people need more user-friendly packaging for easy use. Likewise, for additional functions, parents may need additional functions such as a handle on the packaging so that it is easy to hold.

There is a relationship between the respondent's income and the respondent's assessment of the recyclable and communicates family product category attributes. Respondents with middle and upper incomes may be more sensitive to packaging that can be recycled because it is better for the environment even though it may be more expensive. On the other hand,

perhaps respondents with middle to lower income are very sensitive to the recyclable attribute because the packaging can be used again for subsequent products.

V. CONCLUSION

The criteria for sustainable cooking oil packaging are packaging that can be recycled, has a long shelf life (durability), can be reused/refilled (refillable/reusable), can be biodegraded by nature (biodegradability), and is safe for food. (food safety). After developing quality attributes based on eco-design for cooking oil packaging, the Kano model can be used to determine the influence of each quality attribute on customer satisfaction or dissatisfaction.

However, because quality attributes have previously been built based on eco-design, it can be ensured that these quality attributes not only meet consumer satisfaction but also know respondents' tendencies towards quality attributes that support eco-design. Through this integration, it is hoped that companies can develop designs not only in terms of consumer satisfaction but also in terms of environmental sustainability, one of which is eco-design.

ACKNOWLEDGEMENT

The author would like to thank Mrs. Assoc. Prof. Dr. Maria Anityasari ST, ME., Mr. Prof. Dr. Ir. Udisubakti Ciptomulyono, M.Eng.Sc., Mrs. Dyah Santhi Dewi, ST, M.Eng.Sc., Ph.D., and Mrs. Dewanti Anggrahini, ST, MT for the invaluable guidance, support, and expertise throughout the development of this research. Their insightful feedback and encouragement have been instrumental in shaping the direction and depth of this work, as well as the respondents who have been willing to take the time to fill out the research questionnaire.

REFERENCE

Narang, R.V. AC 2009-631: DEVELOPING PRODUCT DESIGN REQUIREMENTS USING KANO MODEL.

Senthil Kumar, P.S., Balasubramanian, S., & Suresh, R.K. (2012). Pairing of intelligent design concept method and Kano model for product development. *Australian Journal of Mechanical Engineering, 10*, 91 - 99.

Hassan, M.F., Rahman, M., Arifin, A.M., Ismail, A.E., Rasidi Ibrahim, M., Zulafif Rahim, M., & Ahmad, M.F. (2017). Preliminary Study on Kano Model in the Conceptual Design Activities for Product Lifecycle Improvement. *IOP Conference Series: Materials Science and Engineering, 226*.

Lee, H.C., Herawan, T., & Noraziah, A. (2012). Product Design Generation and Decision Making Through Strategic Integration of Evolutionary Grammars and Kano Model. *Int. J. Intell. Inf. Technol., 8*, 32-55.

Ginting, R., Hidayati, J., & Siregar, I. (2018). Integrating Kano's Model into Quality Function Deployment for Product Design: A Comprehensive Review. *IOP Conference Series: Materials Science and Engineering, 319*.

Yadav, H.C., Jain, R., Singh, A.R., & Mishra, P.K. (2017). Kano integrated robust design approach for aesthetical product design: a case study of a car profile. *Journal of Intelligent Manufacturing, 28*, 1709-1727.

Lee, H.C. (2011). Engineering Design Analysis Using Evolutionary Grammars with Kano's Model to Refine Product Design Strategies. *International Conference on Software Engineering and Computer Systems*.

Shahin, A., & Nourmohammadi, A.A. (2022). Selecting new products by the revised ideal ratio: a Kano model approach. *The TQM Journal*.

Utami, T.P., Maarif, S., Arkeman, Y., & Hartoto, L. (2015). Design of Grouping Packaging Palm Cooking Oil Distribution at Traditional Market in Jakarta with Fuzzy Clustering. *Public Policy and Administration Research, 5*, 4-13.

Hartini, S., Sari, D., Utami, A.M., Widharto, Y., & Ramadan, B.S. (2023). Circular Economy Designing of Municipal Waste Cooking Oil: A Case Study of Semarang City, Indonesia. *Polish Journal of Environmental Studies*.

Utami, T.P., Maarif, S., Arkeman, Y., & Hartoto, L. (2017). Designing Packed Palm Cooking Oil Distribution at Traditional Market in Jakarta Using Fuzzy Clustering.

Abidin, Z., Maharani, M.D., & Prasmatiwi, F.E. (2022). Consumer Preferences of Packaged Cooking

Oil in Bandar Lampung City. *Economics Development Analysis Journal*.

Sari, K. N., Anityasari, M., Sari, N. K., & Musthika, I. K. T. (2023). Application of Kansei Engineering to Capture Consumer Demand for Cooking Oil Product Packaging. *International Journal of Eco-Innovation in Science and Engineering (IJEISE)*, *4*(1). Retrieved from https://ijeise.upnjatim.ac.id/index.php/ijeise/article/view/113