



REDESIGN ECO-FRIENDLY YOGURT PACKAGING USING KANSEI ENGINEERING METHOD

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ABSTRACT

This research is focused on the desire of companies to change their yogurt packaging from thin plastic pouches to stronger ones. The purpose of packaging redesign is not only to overcome the problem of packaging durability but also to make new packaging more attractive to consumers so that the selling value is higher. Thus, packaging that is technically feasible and represents the customer's preferences for the company's products is needed. In addition, companies must also consider the long-term environmental impact. Redesigning the packaging using the eco-design concept and the Kansei Engineering Method. Eco-design is used to determine the environmental impact of packaging, while Kansei Engineering is used as a product design tool. The eco-design assessment of the suggested packaging shows that the packaging is more environmentally friendly than the current packaging. Kansei Engineering's findings include cylinder-shaped yogurt packaging made from aseptic cardboard and full color with a packaging design that is fresh, cheap, beautiful, strong, environmentally friendly, ergonomic, complete with product information, a halal logo, and unique.

Keywords: Redesign, Packaging, Eco-Design, Kansei Engineering

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1. INTRODUCTION

This company collects pure cow's milk from independent breeders, then the milk is processed into pure milk products, yogurt, and pasteurized milk. The high level of public interest and awareness of yogurt consumption today has resulted in more and more yogurt SMEs in Bandung. To be able to survive and compete amid the rapid growth of the yogurt industry, companies must be able to improve product quality, improve marketing strategies, and continue to make continuous and comprehensive improvements starting from product aspects and other product quality aspects. Currently, the company wants to redesign the yogurt packaging, because both distributors and consumers give a negative assessment. One of the negative assessments is the occurrence of leakage in the packaging. Things like this will certainly harm distributors and reduce the company's image in the eyes of consumers.

The government's efforts to suppress plastic packaging waste as stipulated in PP NO.18 of 2012 article 12, namely producers are required to limit plastic waste accumulation by using packaging that is more environmentally friendly, biodegradable, and produces products with minimal waste. In addition, by increasing consumers' insight into the environment, environmental awareness is becoming an important issue today. So, both companies and distributors want a redesign of the packaging with an environmentally friendly concept. One approach to designing environmentally friendly products is to apply Eco-design. Based on ISO/TR 14062 eco-design is an approach that aims to reduce the impact of products on environmental sustainability (Lee and Park, 2005). The new product packaging is expected to increase sales of yogurt products in addition to cost considerations and environmentally friendly aspects.

The purpose of this study was to identify packaging designs with an eco-design approach, identify emotional factors and eco-friendly yogurt components that can fulfill consumer desires, and propose environmentally friendly packaging designs in accordance with the wishes of consumers.

2. METHODS

2.1. Eco-Design

Eco-design or eco-friendly design means the integration of environmental aspects into product design to improve environmental performance throughout its life cycle (Rasamoelina, Bouchard, and Aoussat, 2013). The international standards organization issued an eco-design standard called ISO/TR 14602. ISO/TR 14602 states that eco-design is the integration of environmental aspects with product design and development (Lee and Park, 2005). The aim of Eco-design is to minimize the impact of the product life cycle on the environment, energy consumption, carbon emissions, raw materials, packaging, transportation, and potential toxicity, recycling, and durability chemicals throughout the product life cycle. Eco-design is a product design process that follows a sustainable development approach. With Eco-design, it is hoped that a product design that is friendly to the environment will be obtained, in the sense that the product design will have the characteristics of a small negative impact on the environment.

Eco-design is an approach to developing a product that emphasizes considering the environmental impact of the product during its entire life cycle. Sustainability should consider the core concepts of packaging design and should be incorporated at the product development stage and at the early pie stages of packaging to minimize the impact on the environment, maximize cost savings, and avoid over-packaging, then align with consideration of the overall development and manufacturing strategy (Han, 2014 p.538). The eco-design methodology can be defined by the 3R principles (reduce, reuse, and recycle), the 4R principles (with added recovery), or the 5R principles (by adding renewable or degradable resources) which can be seen in Figure 1.

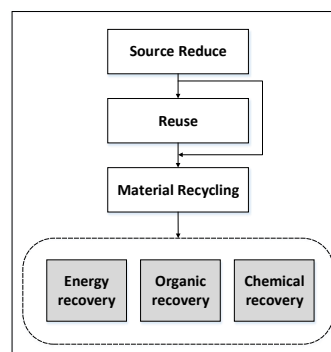


Figure 1. Hierarchy of packaging waste treatment

The strategy of implementing eco-design has consequences on the costs of products that are relevant for strategic business because some companies face social trends in society that are no longer supportive of industries that can pollute the earth freely. Environmental damage currently can be minimized by using product cost structures (taxes, emission licensing rights, technologies that support environmentally friendly, and other government regulations. This process may gradually become a threat to the company but, make it an opportunity. Having eco-cost A low value will contribute greatly in providing a competitive product in the future. However, in business there are product aspects (dimensions) that cannot be forgotten, such as: comparison of quality and cost or comparison of product value and cost. Value here is referred to as a value that is perceived by the consumer or receives a fair price Fair price is defined as the price that must be paid by the consumer Perceived value is defined as the use and impression expected by the buyer after the consumer buys the product Consumers' perceived value and market price must be the same as competitors' prices. Advantages Environmentally friendly systems are based on decisions in design. An environmentally friendly calculation scheme is shown in Figure 2.

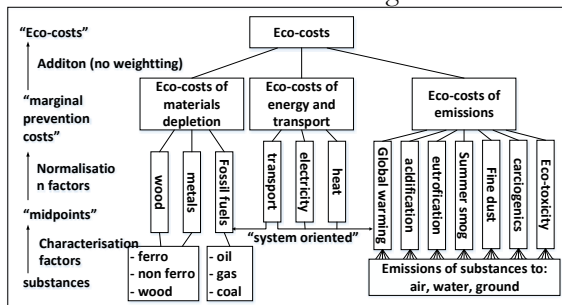


Figure 2. Calculation of the structure of the eco-cost (Wever dan Vogtlander, 2013)

2.2. Kansei Engineering

Kansei is a tool for product development aimed at meeting consumer satisfaction combined with technology and analysis of human emotions then poured into a product (Nagamachi and Lokman, 2011). Kansei Engineering has advantages compared to similar methods, the Kansei Engineering method has the ability to translate consumer intuition, emotions, and feelings into a real design parameter (Nagamachi & Imada,

1995). Kansei Engineering is a technology that combines Kansei or feelings based on engineering knowledge. One example of using Kansei to design packaging is batik clothes (Mulyati et al., 2020).

There are several important points from Kansei Engineering which can be seen in Figure 3 according to Nagamichi (2011), namely:

- How to accurately understand consumer desires.
- How to reflect and interpret Kansei in the form of design products.
- How to create a Kansei-oriented system and structure in the form of product design.

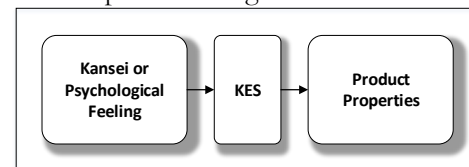


Figure 3. Kansei Engineering System (KES)

The steps in the research using Kansei Engineering:

1. Understand and listen to customers to understand customer strategy. In this way, Kansei Engineering knows what is the goal of the Kansei Engineering process to be carried out.
2. Collect various Kansei Words obtained from various references such as magazines, people, and newspapers that are involved with product sales.
3. Create a semantic differential (SD). SD is used to clarify the structure of the psychological language of product specifications.
4. Collection of samples in the form of collecting similar products that are similar to the product being worked on.
5. Items/categories relate to final product design specifications. Item is an aspect and category is the contents of an aspect of a specification. Examples of items include shape, color, etc., while examples of categories include round, flat, red, green, blue, yellow, etc.
6. Evaluate the product being worked on, using a semantic differential.
7. Perform analysis using statistical analysis.
8. Interpret the data that has been analyzed in accordance with the statistical analysis used.
9. Provide an explanation of the data that has been previously obtained regarding the specifications of the product being worked on to the designer.

Check the designs that have been done by the designer. Some of the designer's work results will be selected and

one of them will be used as the result of the Kansei Engineering Methodology, starting with determining the Kansei word. Hartono (2018) explains that the determination of Kansei Word (Kansei words) comes from consumer feelings or emotional feelings and their perceptions when receiving services or products. This stage is carried out using 5 Likert scales for each emotional need of the respondents.

3. RESULT AND DISCUSSION

3.1. Collect Kansei Word

The collection of Kansei words was obtained based on an open questionnaire and various sources, namely electronic news media and previous research, and obtained as many as 48 Kansei words which represent consumer preferences for the image of yogurt packaging. Then a Kansei word arrangement is carried out which aims to minimize the double meaning of the Kansei word and make it easier for respondents to evaluate the Kansei word. A total of 14 Kansei words were used as input in the semantic differential questionnaire I. The Kansei word assessment subjects were consumers of yogurt and consumers of other brands of yogurt. The semantic differential I questionnaire was distributed to 366 respondents from various professional backgrounds and ages. Table 1 shows the feelings of yogurt consumers towards packaged yogurt products.

Table 1. Kansei Word

No	Kansei Word
K-01	Cheap
K-02	Strong
K-03	Ergonomic
K-04	Environmentally Friendly
K-05	There is a halal logo
K-06	Complete Information
K-07	Unique
K-08	Beautiful
K-09	Full color
K-10	Bright
K-11	Fresh
K-12	Firm

3.2. Differential Semantic Questionnaire 1

The semantic 1st differential questionnaire aims to assess consumers' feelings about yogurt

packaging with the word Kansei. This questionnaire assessment uses a semantic differential scale. To the right means the respondent agrees with the Kansei word, while to the left means the respondent agrees with the opposite Kansei word. This questionnaire is closed so that respondents can only choose from a scale of 1 to 5. The semantic differential 1 questionnaire was distributed to 366 respondents whereas before the actual distribution of the questionnaire a pretest was carried out to 35 respondents. After being tested statistically and obtaining valid results, the actual questionnaire was distributed. The semantic differential 1 questionnaire aims to assess consumer feelings about yogurt packaging with Kansei words. This questionnaire assessment uses a semantic differential scale. To the right means the respondent agrees with the Kansei word, while to the left means the respondent agrees with the opposite Kansei word.

3.3. Validity and Reliability Test

Statistical questionnaire testing is by testing the validity and reliability of 12 Kansei words. Based on the calculation of the validity test, there are 3 Kansei words that are declared invalid, which means that Kansei words are not valid as a measuring tool. Kansei word results that do not meet the criteria will be removed. There are 9 Kansei words that meet the criteria and can be used for processing, which can be seen in Table 2.

Table 2. Recapitulation of Validity Test Results

No	Kansei Word	R _{count}	R _{table}	Result
K-1	Cheap	0,537	0.334	Valid
K-2	Strong	0,767	0.334	Valid
K-3	Ergonomic	0,765	0.334	Valid
K-4	Environmentally Friendly	0,700	0.334	Valid
K-5	There is a halal logo	0,732	0.334	Valid
K-6	Complete Information	0,692	0.334	Valid
K-7	Unique	0,630	0.334	Valid
K-8	Beautiful	0,709	0.334	Valid
K-9	Full color	0,310	0.334	Invalid
K-10	Bright	0,088	0.334	InValid
K-11	Fresh	0,726	0.334	Valid
K-12	Firm	0,051	0.334	Invalid

Based on the validity test, 9 valid Kansei words were obtained, then a reliability test was carried out using SPSS Ver 21 software. The results of the validity test can be seen in Table 3.

Table 3. Reliability Test Results

Cronbach's Alpha	N of Items
0.875	9

Then a reliability test was carried out and the Cronbach's Alpha value was 0.875 or greater than 0.6,

so it can be concluded that the Kansei word gives relatively the same or consistent results if the tests are carried out at different times.

3.4. Analysis Conjoint

Conjoint analysis is a statistical technique used in determining the level of relative importance based on consumer perceptions. The purpose of the conjoint analysis is to find out the relationship between the design elements and the Kansei word chosen. The result from the conjoint analysis can be seen in Table 4.

Table 4. Results From Conjoint Analysis

Item	Material			Shape			Color		
Category	Aseptic Carton	Plastic	Glass	Pyramid	Cube	Cylinder	Bright Color	Soft Color	Full Color
Cheap	-0,041	0,029	0,012	-0,048	-0,012	0,060	0,001	-0,036	0,350
Strong	0,045	-0,034	-0,011	-0,069	-0,022	0,091	-0,001	-0,055	0,056
Ergonomic	0,008	-0,043	0,035	-0,019	0,006	0,013	0,015	-0,007	-0,008
Environmentally Friendly	0,025	-0,001	-0,240	-0,016	-0,027	0,043	0,008	0,006	-0,014
There is a halal logo	0,067	-0,016	-0,051	-0,009	-0,021	0,003	0,029	0,025	-0,055
Complete Information	0,017	0,014	-0,031	0,002	-0,004	-0,160	-0,020	0,029	-0,009
Unique	0,041	-0,042	0,001	0,032	-0,007	-0,026	0,001	0,028	0,038
Beautiful	0,008	0,002	-0,010	-0,007	0,010	0,017	0,006	-0,025	0,018
Full color	0,017	-0,011	-0,005	-0,036	0,027	0,009	-0,011	0,003	0,007

Based on Table 4, it can be seen which category is selected for each item of each Kansei word. Items from each category are selected based on the greatest utility value, which means that the highest utility value will be used as a yogurt packaging element. For example, according to Kansei, for the cheap prices of paper, plastic, and

glass materials, the utility values are -0.041, 0.028, and 0.012 respectively, so that the largest utility value is a plastic material. The elements selected based on the calculation are consumer preferences in yogurt packaging designs. The results of the recapitulation of the selected design elements can be seen in Table 5.

Table 5. Recapitulation of conjoint analysis

KANSEI WORD	Design Elements		
	MATERIAL	SHAPE	COLOR
Cheap	Plastic	Cylinder	Full color
Strong	Aseptic carton	Cylinder	Full color
Ergonomic	Bottle	Cylinder	Bright color
Environmentally friendly	Plastic	Cylinder	Bright color
There is a halal logo	Aseptic carton	Cylinder	Bright color
Complete information	Aseptic carton	Pyramid	Soft color
Unique	Aseptic carton	Pyramid	Soft color
Beautiful	Aseptic carton	Cylinder	Full color
Full color	Aseptic carton	Cube	Bright color
Selected design elements	Aseptic carton	Cylinder	Full color

3.5. Packaging Design Result

The research design was carried out by factor analysis test, namely the MSA test. Kansei is said to be selected if the MSA value of 0.5 is obtained from 9 selected Kansei words, such as: fresh packaging design, cheap, beautiful, strong, environmentally friendly, ergonomic, complete product information, has a halal logo, and, unique. The selected Kansei word is a supporting item on the packaging. The main packaging specifications using the Kansei Engineering approach were obtained for each selected yogurt packaging design element, namely cartons, cylindrical shapes, and colorful labels. Interpretation of recommended yogurt packaging designs can be seen in Figure 3. If compared to the previous packaging design, there are differences in plastic packaging materials, so the current packaging shape is pillows, and the current packaging colors only use three color combinations, blue, and red, and the color is adjusted to taste.



Figure 3. Recommended yogurt packaging designs

3.6. Packaging Design Analysis With Cycle Impact Assessment Approach

The company currently uses yogurt packaging made from thin clear plastic from High Density Polyethylene (HDPE) which will reap in approximately 450 years and produce CO2 emissions of 825/Kg. The current packaging recommendation is to use aseptic cartons that are more environmentally friendly, namely the Tetra Evero packaging by PT. Tetra Pak Indonesia. The packaging materials are made of 52.2% cardboard, 44.5% plastic and 3.3% aluminum with a CO2 emission level of 55g CO2/pack (46g CO2/raw material packaging, 9g CO2/converted packaging) (www.tetrapak.com). When compared based on the CO2 emissions produced in the Ghenai study in Table 6, plastic packaging materials have greater emissions than cardboard packaging materials (Ghenai, 2012). In an effort to support environmental sustainability, appropriate materials are needed that have the least possible impact on long-term environmental sustainability.

Table 6. CO2 Footprint for Materials, Manufacturing, and Transportation

	Material Production	Manufacturing	Transport
Plastic	825	394	164
Aseptic carton	204	74	9

3.4. Consumer Responses to New Packaging

The packages that have been designed are then evaluated for the Company's consumers. Questionnaires were distributed to 53 consumers of the Company. Determining the amount of respondent data that can be statistically processed is a minimum of 30 data up to 500 data so that it can be concluded that the data can be processed statistically (Sugiyono, 2012:91). Packaging indicators evaluated according to materials, ergonomics, informative & packaging design. Based on the processing of quality evaluation data in new packaging, consumers assess a positive response to each evaluation criterion for each indicator of the new yogurt packaging evaluation criteria which are evaluated in terms of product safety, ergonomics, informativeness, and the packaging design can represent consumer preferences or aspirations. Assessment of quality and satisfaction of the package resulted in a positive response. A summary of the quality ratings of the new packaging is shown in Table 7.

**Table 7. Summary of Results
of Questionnaire Penilaian Quality and Satisfaction
Packaging New**

Question	Amount	Average	Information
Quality Assessment	Z1-01	217	4.1
	Z1-02	218	4.1
	Z1-03	214	4.0
	Z1-04	225	4.2
	Z1-05	226	4.3
	Z1-06	233	4.4
	Z1-07	230	4.3
	Z1-08	234	4.4
Satisfaction Assessment	Z2-01	221	4.2
	Z2-02	218	4.1
	Z2-03	216	4.1
	Z2-04	221	4.2
	Z2-05	224	4.2
	Z2-06	227	4.3
	Z2-07	231	4.4
	Z2-08	235	4.4

4. CONCLUSION

Yogurt packaging, according to consumer emotional factors, comes from Kansei which is collected from various sources, thirty-eight Kansei words are obtained. Furthermore, Kansei words are grouped into twelve words to reduce words that have the same meaning and statistical tests are carried out on the twelve Kansei words. Kansei words were chosen based on consumer emotions towards yogurt packaging, namely: beautiful, environmentally friendly, fresh, ergonomic, strong, has a halal logo, complete, unique, cheap, and complete information. Then pair the nine Kansei words with the selected design elements, namely, fresh packaging design, cheap, beautiful, strong, environmentally friendly, ergonomic, complete product information, there is a halal logo, and, unique. Eco-design when viewed based on the Life Cycle Impact Assessment on packaging made of High-Density Polyethylene (HDPE) plastic can produce greater CO₂ emissions when compared to cardboard packaging. As an effort to protect the environment, the selected packaging material that has a low impact on the environment is cardboard packaging material.

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