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Designing the Concept and Design Elements of MSME X Room Deodorizer Packaging Using *Kansei Engineering* and *Fuzzy Logic* Methods

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ABSTRACT

Air fresheners are comfort-supporting products widely used for room freshness. The packaging used by MSME X for air freshener products is only plain plastic without product identity, and it still has shortcomings in terms of functionality such as product protection, ease of use, and ease of obtaining product information. The purpose of this research is to develop concepts and design elements for MSME X air freshener packaging by considering consumer needs. This study analyzed the design of MSME X air freshener packaging using the Kansei Engineering method to translate consumer perceptions of packaging design. The data obtained was processed using Principal Components Analysis (PCA) to analyze the Kansei words collected by questionnaire to derive design concepts. The Quantification Theory Type 1 (QTT-1) method was also used to measure the relationship between design elements and design concepts. An evaluation was then conducted using the fuzzy logic method to determine whether the design elements used aligned with the selected concepts. The PCA method in this study resulted in 1 selected Principal Component (PC) which was implemented as a concept, namely "Common and Efficient". Determination of design elements using the QTT1 method resulted in selected elements, namely X1.5 (ivory), X2.9 (oval), X3.9 (hanger + window), X4.1 (medium), X5.6 (sliding tray), X7.4 (directly printed on the packaging) for the Efficient concept and X1.2 (rigid plastic), X2.4 (standing pouch), X3.8 (air hole + hanger), X4.2 (small), X5.7 (flip top), X6.4 (fresh + matching aroma) and X7.5 (no design) for the Common concept.

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1. INTRODUCTION

MSMEs are one of the business sectors that are classified as independent and can grow and integrate into the national economy. There are many types of MSME works, but it requires creativity, innovation, and courage to compete with competitors. Increasing creativity and product quality is a form of business that can compete in the market. As reported by (Asri et al., 2020) Attractive and innovative MSME products can change consumer perceptions of a product, especially visual factors.

The packaging for MSME X air freshener products is currently only plain plastic, lacks a packaging label, has no features as it is just tied plastic, lacks an attractive shape, and material is easily torn plastic. These issues prevent buyers from recognizing the product, make it difficult to use, and reduce consumer interest in purchasing. Good packaging appearance gives a positive image to the product, so it is expected to attract consumer attention and convince buyers of product safety (Arini et al., 2023; Yung, 2023) In addition to packaging appearance, other packaging functions include physical ease - namely ease of packing, distribution, and use by consumers - as well as providing fast, easy and complete product information (Amelia & Oemar, 2017).

The development of MSME X air freshener packaging needs to be carried out to determine concepts and design elements that suit consumer preferences. A survey was conducted with respondents selected by purposive sampling who interacted with the product to strengthen the rationale for developing MSME X air freshener packaging (Lenaini, 2021). The concept is an important consideration in designing packaging (Fitriah, 2018). The concept that guides the creation of a product image produces important elements, especially on packaging which becomes verbal and non-verbal information to identify the product (Firmansyah, 2023).

Kansei Engineering is used in this study because of its ability to interpret consumer perceptions of the object to be developed, namely the MSME X air freshener. The term Kansei is a Japanese word that connotes affective, emotional, and sensitive meanings. This concept translates abstract customer psychological experiences into concrete Kansei terms, which are then measured quantitatively according to product features (Yanagisawa et al., 2016). Kansei Engineering was chosen because of its ability to interpret consumer perceptions of air freshener packaging designs. This method describes consumer impressions, feelings, and needs for a product or idea, which can later be developed and improved through the identification of method solutions and parameters (Nagamachi & Lokman, 2016).

This air freshener packaging redesign uses the Kansei Engineering method, with supporting methods namely Principal Component Analysis (PCA) and Quantification Theory Type 1 (QTT-1). In Kansei Engineering, PCA is used to manage Kansei words collected from survey results to be processed and produce extraction in the form of design concepts (Delfitriani et al., 2023; Isna et al., 2024). In addition to PCA, QTT-1 is also used to determine design elements because this method is considered able to measure the correlation between concepts and design elements (Habyba et al., 2018b). PCA and QTT-1 were chosen to process the Kansei words to formulate concepts and find out the correlation of concepts to the results of morphological analysis (Habyba et al., 2018a). To ensure and minimize uncertain data, an evaluation of the suitability of selected design elements and design concepts is carried out using the Fuzzy Logic method, utilizing morphological variable data with the support of Matlab software. Using fuzzy set theory, an object can be a member of various sets with different degrees of membership for each set (Jati et al., 2023).

The purpose of this study is to develop concepts and design elements for MSME X air freshener packaging by considering consumer needs. This research involves customer participation in determining the selected packaging design from a variety of alternatives generated through surveys, intending to match customer needs and preferences. This approach is strengthened by the involvement of parties directly related to the issue, to get more relevant input related to the problems faced (Sinulingga & Sihotang, 2023). It is hoped that this research will contribute to MSME players in the field of air fresheners in designing their packaging strategies so that they can compete effectively with other air freshener products. Sales of air freshener products are expected to increase, and the target market can be expanded through adding value to the packaging design of the resulting products.

2. METHOD

Research on the development of MSME X air freshener packaging was carried out *using the Kansei Engineering method with the support of PCA to process* the word *Kansei* obtained by distributing questionnaires to respondents who interacted with similar products into a design concept, then ensuring the correlation between concepts and design elements resulting from morphological analysis using the QTT-1 method. The stages of this research can be seen in the flowchart in Figure 1.

2.1. Identify the problem

The study began with collecting problems on packaging by conducting a survey to 83 respondents through questionnaires to determine the packaging that was prioritized for development.

2.2. Sample collection and kansei word collection

Sample collection is carried out after knowing the packaging that is a priority to be developed and making STP (Segmentation, Targeting, Positioning). The purpose of collecting samples is to obtain information about the design elements contained in the packaging. The collected samples will be redetermined in terms of physical, functional, and aesthetic design elements by expert panelists to determine which samples will be selected (Vilano & Budi, 2020).

The study continued with the collection of *Kansei* words according to the survey results which were distributed using questionnaires and direct interviews. Respondents were selected by means of purposive sampling to obtain more relevant results (Lenaini, 2021). Making questionnaires using *the Kansei Engineering method aims to get the word* Kansei in accordance with the opinions, inputs and criticisms that have been filled in by 30 respondents by involving stimuli in the form of video packaging problems faced by MSME X room fragrance products.

2.3. Collecting kansei word

The number of *Kansei* words collected generally

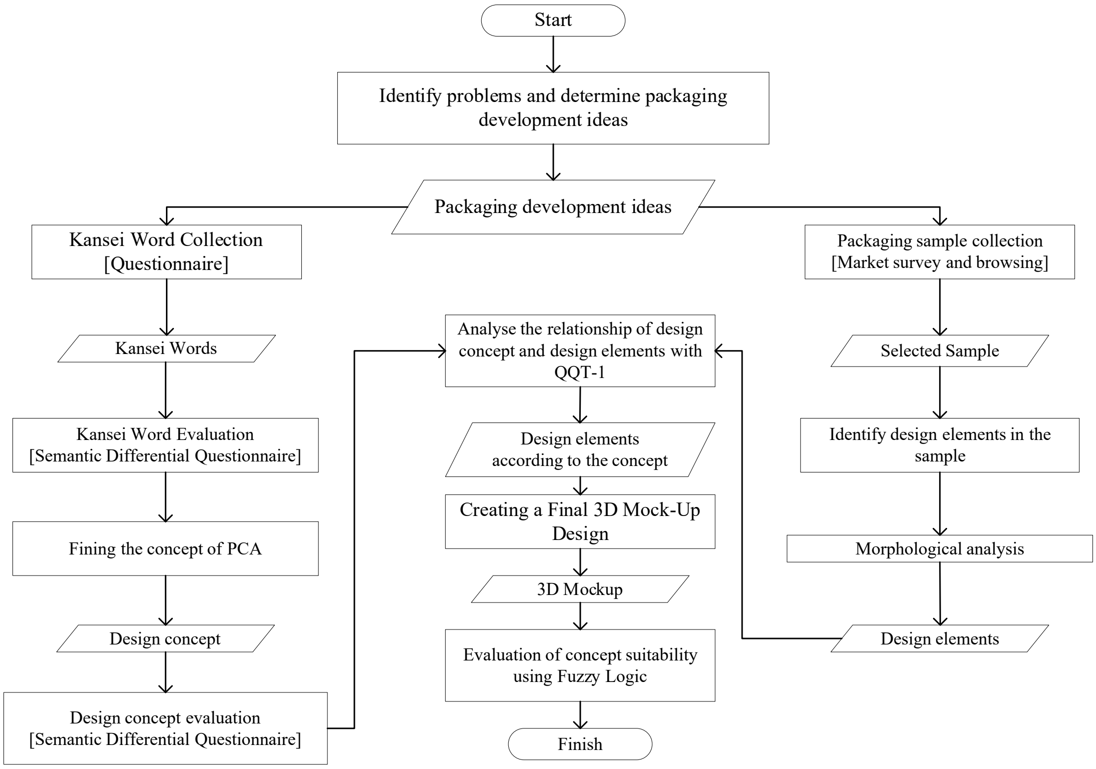


Figure 1. *Flowchart* of design process concept and packaging design elements

varies between 50-600 words (Naftasha et al., 2022) Evaluating *Kansei* Words with a Semantic Differential Questionnaire.

Semantic differential questionnaires were conducted to assess consumer sentiment toward products (Nagamachi & Lokman, 2016). The results of the Kansei word were obtained, and then an evaluation of the word Kansei was carried out with a packaging sample with a semantic differential in the form of a questionnaire using a 7-point scale (Naftasha et al., 2022). The 7 points are written like -3, -2, -1, 0, 1, 2, 3. Making a semantic differential questionnaire, the position of the *Kansei* word on the far right is the *Kansei* word which has a positive value, while the one on the left is the antonym of the *Kansei* word.

2.4. Fining the concept of PCA

Questionnaires that have been filled out by respondents are then processed into multivariate data. The existing data is then combined with artificial coding with the Principal Engineering Analysis (PCA) component so that it can be processed into R software. Running data in R software produces data in the form of standard deviation diagrams, proportion of variance, cumulative proportion, scree plot graphs, and distribution diagrams (Coghlan, 2014).

2.5. Morphological analysis

Morphological analysis is carried out by structuring each element of the design into a unity of the same factors with various types. The analysis process is carried out with expert panelists to determine the appropriate factors from each packaging sample (Sari et al., 2023).

2.6. Analyse the relationship of design concept and design elements with QQT-1

The concept obtained was evaluated by filling out a 7-scale Likert questionnaire by actively engaged respondents (Isna et al., 2024). The results of the questionnaire will later be processed using the QTT1 method to determine the relationship between concepts and design elements. Analysis of the relationship between concepts and design elements is carried out using the Quantification Theory Type 1 (QTT1) method with R software as a tool; the formula used as in Equation (1) (Hidayat & Wijayanti, 2021).

$$y_s = \sum_{i=1}^{E} \sum_{j=1}^{C_i} x_i \alpha_{ijs} + \varepsilon \quad (1)$$

Where:

s = Product sample
I = Product attribute index
E = Number of product attributes
j = Category index on the product's ith attribute
C_i = Number of categories in the product's ith attribute
ε = Stochastic variable with the value E (ε) = 0
α_{ijs} = Dummy variable coefficient

2.7. Creating a final 3D mock-up design

The results of QTT1 data processing are used to determine the final design through a process *of mind mapping*, brainstorming, *sketching,* expert *interviews and ending with making 2D designs* and 3D mockups *using the help of* Adobe Illustrator *and* Blender 3D *software.*

2.8. Evaluate the conformity of concepts using fuzzy logic

2.8.1. Fuzzification

It is a process to determine *fuzzy* variables, *fuzzy* sets, *fuzzy* curves, and membership degree values (Radhika & Parvathi, 2016; Auliana & Mansyuri, 2022). This research involves forming variables by combining a single variable with its linguistic aspects, and then the *fuzzy* set is processed using Matlab software. This process results in the classification of potentials, which can be either small potentials or large potentials (Mufid, 2023). The curve that interprets the membership function in this study is a triangular curve with the value of the members of the set divided into three parts, namely lower (L), medium (M), upper (U). Below is formula (2) to determine the set variable by the *fuzzyfication* process.

$$f(x) = \begin{cases} 0, & x \le a \cup x\, c \\ \frac{x-a}{b-a}, & a < x\, b \\ 1, & x = b \\ \frac{c-x}{c-b}, & b < x < c \end{cases} \quad (2)$$

2.8.2. Rule evaluation

After the variable is collected, the rules are evaluated to determine logic and unlogic variables using the If-Then command (Auliana & Mansyuri, 2022). The mapping between input and output is IF-THEN and the operator used to connect between two inputs is AND (AND) (Mufid, 2023).

If x ≤ a or x ≥ c then: $\mu(x) = 0$

If a < x ≤ b, then: $\mu(x) = \frac{x-a}{b-a}$

If b < x < c, then: $\mu(x) = \frac{c-x}{c-b}$

When it is made in a rule it will be like,

IF 1 *x* is A1 **AND** ... **AND** n *x* is an **THEN** Y is B.

2.8.3. Fuzzy Inference

This step is the step of determining the value of each rule by selecting the minimum value of each rule using the *fuzzy* min operator and then choosing the maximum value from the combined result of the value (Mufid, 2023).

2.8.4. Defuzzification

It is the final stage of *Fuzzy Logic* to determine the crisp value in the output which in this study becomes the value of evaluating the suitability of the design concept (Mohd Adnan et al., 2015). This research uses the help of Matlab software in conducting *defuzzyfication*.

3. RESULTS AND DISCUSSIONS

3.1. Identify problems and determine the object of study

The first thing to do was to collect some ideas for packaging problems, and 3 packages were selected, namely MSME X air freshener, spaghetti sanremo, and gold snack monde. 3 ideas were then disseminated to actively engaged respondents using *Google Forms*. Based on the three ideas submitted, the results obtained were the need to develop MSME X air freshener packaging. Because the product only uses simple plastic without product identity, branding, and features on the packaging.

3.2. Collecting packaging samples

Sample collection is carried out after identifying and determining the object of study. Sample collection is carried out based on STP that has previously been made and then sorted by expert panelists to determine the selected sample. The selected samples are at least 20-50 different samples (Naftasha et al., 2022). 46 selected samples were obtained from 58 samples. It can be seen in Figure 2, that the yellow sample is a selected sample that will later be used as a questionnaire with a stimulus in the form of a video to reach the emotional side of respondents to get the word *Kansei* that suits the respondent's perspective (Naftasha et al., 2022).

3.3. Identifying *kansei* word

Identifying *Kansei* words is the stage of collecting *Kansei* words that will be a reference to produce an overview of packaging design concepts. *Kansei* is obtained by means of surveys through questionnaires and direct interviews with respondents, respondents are selected by purposive sampling. The advantage of using non-probability sampling is to ensure that the sample will represent the population, especially for samples that are loyal to the product (Adeoye, 2023; Isna et al., 2024). The next step is to evaluate the word *Kansei* to be a simple adjective. Several *Kansei* words that have the same meaning will be made into 1 simple word. The selected *Kansei* word will be given a positive value (+) and given a negative antonym (-) from each *Kansei* word. 46 *Kansei* words were obtained out of 158 *Kansei* words. The selected Kansei word will then be given an antonym for each word as can be seen in Tables 1 and 2. The evaluation of *Kansei* word will be carried out by distributing a semantic differential questionnaire using a 7-point scale to assess consumer sentiment towards the product (Naftasha et al., 2022; Nagamachi & Lokman, 2016).

3.4. PCA concept analysis & data processing with R software

The results of the semantic differential questionnaire are used as input data in the *Kansei* word extraction process to determine the visual design concept of MSME X air freshener products. The completed questionnaire will be processed into multivariate data and then will be combined with artificial coding using PCA components so that it can be processed into R software. The running results are in the form of standard deviation diagrams, proportion of variance, cumulative proportion, scree plot graph, and distribution diagram (Kassambara, 2017). The data processing process that is successfully running will produce results in the form of a PC. PC is used to be a reference for packaging concepts, but the PC used is a PC that meets the standard, which has a cumulative

Figure 2. Selected samples

Table 1. *Kansei* said chosen

No	*Kansei* Word	Antonim	No	*Kansei Word*	Antonim
1	Hangable	Not hangable	19	*Colorful*	Neutral color
2	Informative	Not informative	20	Quality	No quality
3	Interesting	Boring	21	Branding	No branding
4	Practical	Complicated	22	Open and Close	Not resealable
5	Simple	Complicated	23	Contained	Not containerized
6	Not Excessive	Overkill	24	Windowed	Windowless
7	Not easy to tear	Easy to tear	25	Paper	Not paper
8	Airtight	Not airtight	26	Aesthetic	Not aesthetic
9	Mesh - net	Not mesh-net	27	*Fun* design	Design is not *fun*
10	Plastic	Not plastic	28	*Sealed*	Open
11	*Pouch*	Not *pouch*	29	Current model	Old model
12	Elegant	Simple	30	Unique	Ordinary
13	Strong	Easily damaged	31	Identity	Unrecognizable
14	Functional	Not functional	32	There is a patch feature	No patch feature
15	Laced	Not laced	33	Gradation	*Solid color* / Not graded
16	Eco-Friendly	Not eco-friendly	34	Protects the product	Does not protect the product
17	Combination	No combination	35	Makes the product durable	Makes the product not durable
18	Wood	Not wood	36	Reusable	Not reusable

Table 2. *Kansei* said chosen (Cont'd)

No	*Kansei* Word	Antonim	No	*Kansei Word*	Antonim
37	Not easy to leak	Easy to leak	43	*Flexible* in various places	Not *flexible* in various places
38	Design according to scent	The design does not match the scent	45	Easy to use	Not easy to use
39	Has air holes	Not perforated	46	Fresh design	Not fresh design
40	Medium size	Small size			

```
kelompok2.pca$sdev
 [1] 6.48685371  0.44322745  0.41509645  0.39424217  0.38150214  0.37888009
 [7] 0.35844593  0.35725979  0.34020129  0.33535919  0.32735835  0.32338481
[13] 0.31404597  0.31020737  0.29589455  0.29048944  0.28191779  0.26771146
[19] 0.26322882  0.25705419  0.25600736  0.24439059  0.23904185  0.23570713
```

Figure 3. Kaiser method PCA data

proportion value above 80% (Coghlan, 2014). The number of PCs obtained will be a reference for the packaging design development concept that has been discussed with expert panelists and will be changed into one simpler positive and negative word. 1 PC concept has been obtained that conforms to the standard, namely Common for negative and Efficient for positive. An analysis of the results of the PCA method was conducted. Here are the results of some PCA methods:

3.4.1. Kaiser method

Determination of concepts in PCA using the Kaiser method is done by maintaining data with variation values above 1 in the results of running Software R (Coghlan, 2014). The results of running PCA obtained can be seen in Figure 3, namely 1 PC.

3.4.2. Graphics plot screen

A scree plot is a graph that explains the percentage variation of the main component obtained by forming a graph between the eigenvalue and the value of the main component (Gour et al., 2017). In Figure 4 it can be seen that PC1 is the highest variable so it is maintained.

3.4.3. Standard deviation method

The standard deviation method in PCA is important to see the contrast value of data (Nugraha & Wiguna, 2020). In Figure 4 of the PCA running results, it can be seen that PC1 is the most contrasting data among other PCs with a value of 6.4869. Method Cumulation of Proportion. Determination of features in the PCA method can also be done by looking at the cumulative results of proportions using cumulative data variants that have 80% data variation. Figure 5 shows the results of running Software R with cumulative data of proportions above 80%, namely PC1 (93.51%), PC2 (93.51%), PC3 (94.32%), PC4.

3.4.4. Conclusion of design concept using PCA method

The distribution map is the result of running which shows the distribution of the word *Kansei* which will be a design concept based on its negative and positive axes. The determination of the selected group of words is seen by creating a diagonal line with a slope of 180^o that will form a paired PC (Coghlan, 2014).The number of lines drawn is an interpretation of the number of PCs selected by the PCA method that has been done previously with the results of 1 PC. The determination of words that fall into the PC group is done with expert assistance. In Figure 6 you can see that the negative axis includes the words Classic, Medium Size, Nets, According to Aroma, and Sealed while the positive axis includes the words Simple, Easy to Use, Open, and Informative. After discussing with experts, a concept that represents each axis was chosen, on the negative axis the concept of "Common" was chosen and on the positive axis the concept of "Efficient" was chosen.

3.5. Concept evaluation

Concept evaluation was carried out to assess each packaging sample conducted by means of a survey using a Likert scale questionnaire with the *Google Form* platform. The questionnaire was conducted on 30 respondents who were selected by purposive sampling using a Likert scale of 1-7 points. Likert scale is widely used in various surveys by choosing numbers that have answers in each corner (Hassine & Amyot, 2016). The evaluation results obtained are the average, minimum, maximum and standard deviation values of each product sample for each *Kansei* word used. The data is used as input data in analyzing into QTT1 using *R software*. The form of the questionnaire given to respondents can be seen in Figure 7.

3.6. Morphopogical analysis

Morphological analysis is performed based on the characteristics of each sample. The morphological analysis process is carried out by discussing with *expert panelists* to ascertain the types that match the characteristics of each sample. There are 7 design element factors, namely, (X1) material, (X2) Form, (X3) Feature,

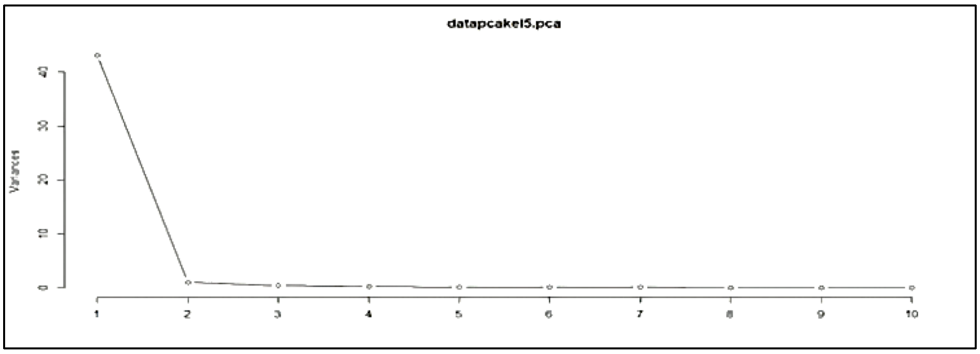


Figure 4. PCA data graph *plot screen*

	PC1	PC2	PC3	PC4
Standard deviation	6.4869	0.44323	0.41510	0.39424
Proportion of Variance	0.9351	0.00437	0.00383	0.00345
Cumulative Proportion	**0.9351**	0.93946	0.94329	0.94674

Figure 5. PCA data (*standard deviation* dan *cumulative of proportion*)

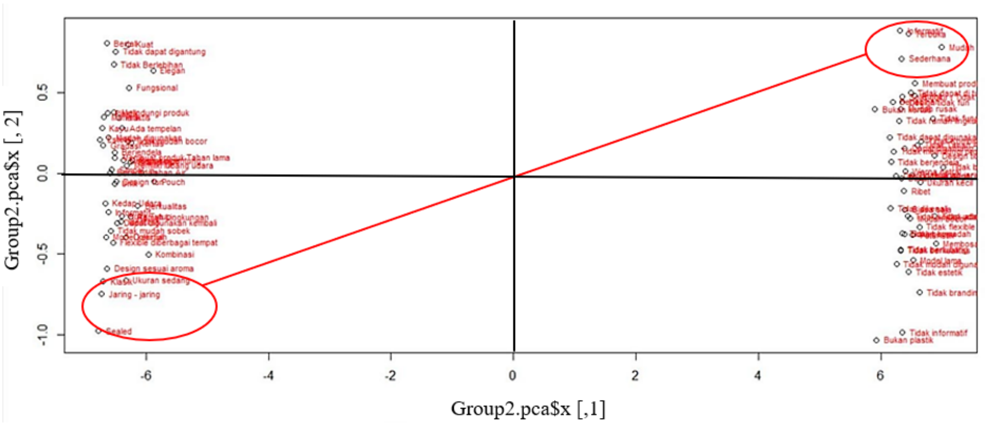


Figure 6. Map of *kansei word distribution* from *running software R results*

1 2 3 4 5 6 7

Common O O O O O O O Efisien

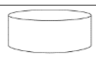
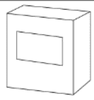
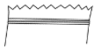
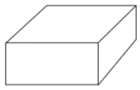
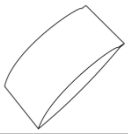
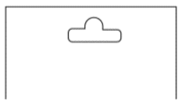
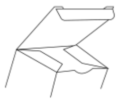
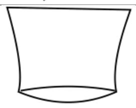
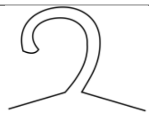
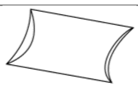
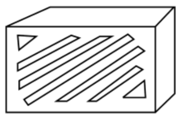
Figure 7. Likert questionnaire

(X4) Size, (X5) Cover Shape, (X6) design style, and (X7) Print Type. The results of the discussion with *the expert panelists* are addressed in Table 3 further.

3.7. Analysis of the relationship of concepts to design elements with QQT-1

The results of the morphological analysis will then be processed into the main design elements as a reference in making surface designs and 3D mockups using the QTT1 method. The running result will be a bar graph that has different lengths between types of factors against other types of factors. The R-value is the relationship coefficient that determines the match of observation data, while the R2 value is the coefficient that shows the match of data points with statistical models (Hidayat & Wijayanti, 2021). The R-value is described in the form of a bar, the longest bar being the chosen element to be used as an element of packaging development (Sari et al., 2023). As for the type of factor chosen, the left is for the common concept and the right is for the efficient concept. There are design elements with a common concept, namely X1.2 (Rigid Plastic), X2.4 (Standing Pouch), X3.8 (Air Hole + Hanging Straps), X4.2 (Small), X5.7

Table 3. Packaging morphology

TYPE	XI (Material)	X2 (Form)	X3 (Feature)	X4 (Size)	X5 (Lead Shape)	X6 (Design Style)	X7 (Print Type)
1	Plastic Flexible			Medium		Fun	Print on Stickers
2	Plastic Rigid			Small		Fun + Suitable to Aroma	Print on Paper
3	Craft Paper					Fresh	Print in Srinked Plastic
4	Crossed by Art Carton				Glued	Fresh + Suitable to aroma	Print directly on the packaging
5	Ivory Papers		Aroma Settings		Thread Cap	Poles	No Print
6	Parchment Papers		Open Close		Sliding Tray	Minimalist	
7	Duplex Papers	Follow the shape of the product			Flip top		
8	Ivory + Flexible Plastic	Unique Box	Air Hole + Hanger Strap		Two Pieces		
9	ART Carton + Rigid Plastic	Oval	Hanger Strap + Window		Wrap		
11	Wood		Hanger Hole + Hook				
12			Hanger Hole + Window				
13			Hanger Hole + Air Hole				
14			No Features				

(Flip Top), X6.4 (Fresh Design + According to Aroma), X7.5 (No Design) and efficient concepts, namely X1.5 (Ivory), X2.9 (Oval), X3.9 (Air Hole + Hanger Straps), X4.1 (Medium), X5.6 (Sliding Tray), X6.6 (Minimalist Design), X7.4 (Direct on packaging). The results of running QTT1 in the form of a graph are shown in Figure 8.

Seen in Figure 7, the efficient concept is in accordance with the selected design elements, namely the presence of air holes and hangers that make the packaging of MSME X air freshener easy to use, the sliding tray feature also makes the packaging easy to open and close.

3.8. Surface design and 3D mockup creation

Determination of design elements by running QTT1 will produce the main design elements according to the concept that has been obtained. The next step is to create a surface design according to the design elements that have been analyzed using Adobe Illustrator and will be developed again into a 3D mockup design so that the appearance of the packaging looks clearer. The suitability of the concept of selected design elements to consumer preferences can be seen from the results of questionnaires that have been distributed using the *Google Form*

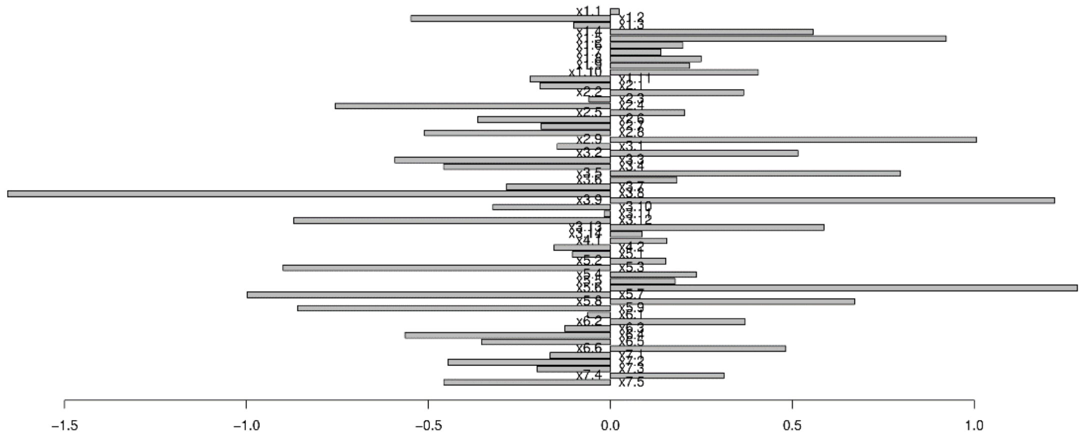


Figure 8. Graphics design elements "*Common"* and "Efficient" concepts

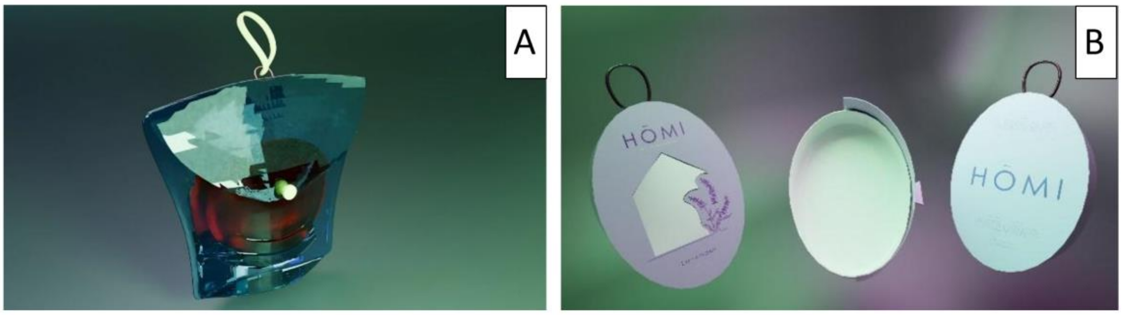


Figure 9. (A) General 3D concept mockup, (B) Efficient 3D concept mockup

Table 4. Morphological numerical data

Sample	Respondents							Common-Efficient			
	X1	X2	X3	X4	X5	X6	X7	Mean	Min	Max	Standard Deviation
A	1	4	4	1	1	4	4	2,4	1	5	1,191927
B	1	3	14	2	1	2	4	4,6	3	7	1,328728
...	...	...	...	...	...	...	...	...	...	...	...
SS	1	7	14	2	9	4	1	1,9	1	7	1,362891
TT	2	2	7	1	8	4	4	4,7	3	7	1,014833

platform. The result of the concept of the design element chosen by consumers is packaging B, amounting to 80%. Packaging B also represents the concept of design elements according to the *Kansei word* obtained, which is hangable, easy to use, has features, and can be opened and closed. In Figure 9 can be seen the results of a 3D mockup with a common and efficient concept.

3.9. Fuzzy logic process

3.9.1. Fuzzification

The process for producing output in making *fuzzy rules* requires the average value of the variable assessment after completing the QTT1 analysis. The mean, min, max, and standard deviation values are obtained from the results of the respondent questionnaire with Likert on the sample and sample morphology. The following numerical morphological data can be seen in Table 4.

The relationship between morphology and packaging samples can be seen in Table 4 above, for example, sample A falls into type 1 in factors X1, type 4 in factors X2 and X3, type 1 in factors X4 and X5, and type 4 in factors X6 and X7. The results of the QTT1 analysis obtained the *value of Partial Correlation Coefficient* (PCC) which is a priority for packaging development. The highest PCC value is the value of the most important design element in the "common-efficient" concept. The following table of selected design elements based on QTT1 can be seen in Table 5.

The concept of "common - efficient" obtained, namely Feature (X3) with a PCC value of 0.80944 is a priority in the development of MSME X Room Deodorizer packaging. Each set of variables will be evaluated in relation to elements from the other sets of variables. This allows the representation of the membership function of

Table 5. PCC value *common* concept – efficient

Material	Shape	Feature	Size	Lead Shape	Design Style	Print Type
0.62912	0.57104	0.80944	0.29012	0.79084	0.60541	0.51627

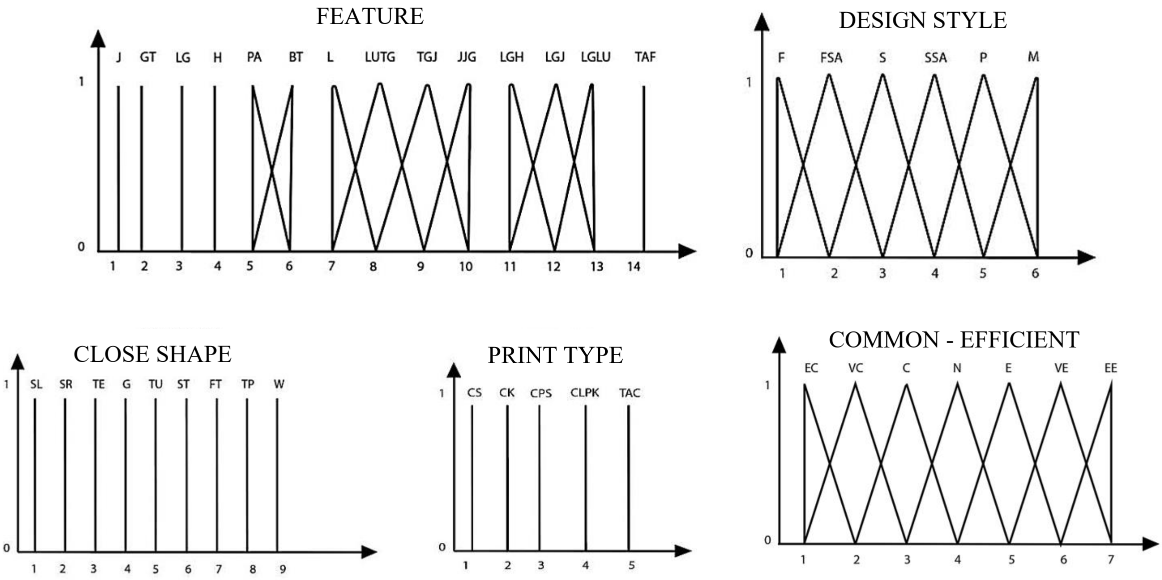


Figure 10. X1-X7 membership function representation and output value

Table 6. PCC *fuzzy* triangular C - E *value*

Linguistic term	EC	VC	C	N	E	VE	EE
Membership Function	1,1,2	1,2,3	2,3,4	3,4,5	4,5,6	5,6,7	6,7,7

that set in the form of a triangular curve covering a range of values between 0 and 1. The triangular curve diagram on X1 - X7 as input and C - E value as output can be seen in figures 10 and. The diagram in Figure 10 is obtained from the input of Table 4. Packaging Morphology.

There is a set that is given a single value to express a type that has no relationship with other types, while for C - E value is used as output data with a scale of 7 points. The *fuzzy* triangular C - E value can be seen in Table 6.

3.9.2. Fuzzy rule bases

The use of *the formula IF - THEN* is used for easy understanding. *Fuzzy* rulemaking has a major impact on system accuracy, where the decision-making process based on *rule base* design (Bahani et al., 2021). Rules are formed by combining variables of design elements, which then produce the packaging concept as *output. Fuzzy* rules can be seen in Table 7.

The DoS value is used as the output as shown in Table 6 above. For example, rows 1 and 2 are sample B which has input values X1 = PF (Plastic Flexible), X2 = SP (Standing Pouch), X3 = H (Hook), X4 = S (Medium), X5 = SD (Sliding Tray), X6 = SSA (Fresh According to Aroma), X7 = CLPK (Print Directly on Packaging) and output values with calculations in Figure 11. For example, the results of the DoS calculation in sample A have an average value of 4.6 and are included in member "E" (Efficient) with a membership level of 0.6 (= (1-0) x (4.6 – 1) / (5 – 1)), and become a membership of member "N" (Neutral) with a membership level of 0.4 (= (1-0) x (5 - 4.6) / (5 - 1)). The value of 0.6 is the upper bound of the highest DoS, while the value of 0.4 is the lower bound of the lowest DoS, that's why rows 1 and 2 have the same input with different output results because they produce 2 *fuzzy rules.* The value of 0.6 is the upper limit of the highest DoS, while the value of 0.4 is the lower limit of the lowest DoS, which is why rows 1 and 2 have the same input with different output results because they produce 2 *fuzzy* rules. 92 rules and DoS values were obtained from 46 selected samples. The application of *fuzzy* rules does not use absolute numbers (1,2,3, ...) in its processing. In this study, 4 absolute numbers were found so that only 88 rules were used to continue the defuzzification process. The following *fuzzy* rules can be seen in Figure 11.

3.9.3. Defuzzification

The final stage of the *Fuzzy logic method is defuzzyfication which is* used to test *fuzzy* rules and derive values from Common and Efficient (C-E) concepts. The data testing process is carried out using Matlab software as can be seen in Figure 12.

The data entered is a factor of design elements in the selected concept and gets the results of the output value of the Common–Efficient concept which is 4.5 with *a*

Table 7. Rules if-then design elements

Rules	IF (Antecedent)							THEN (Consequent)	
	X1	X2	X3	X4	X5	X6	X7	C-E (Y)	DoS
1	PF	SP	H	S	SD	SSA	CLPK	C	0.6
2	PF	SP	H	S	SD	SSA	CLPK	VE	0.4
…	…	…	…	…	…	…	…	…	…
91	PR	BK	L	S	TP	SSA	CLPK	E	0.27
92	PR	BK	L	S	TP	SSA	CLPK	N	0.73

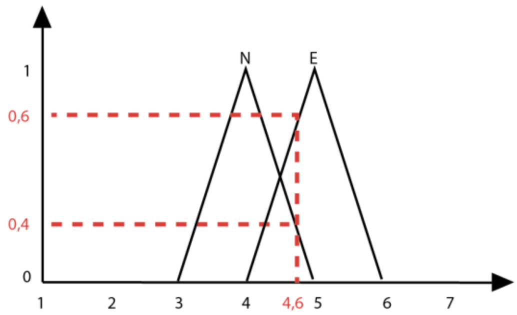


Figure 11. *Fuzzy rules concept common - efficient (C-E) air freshener packaging*

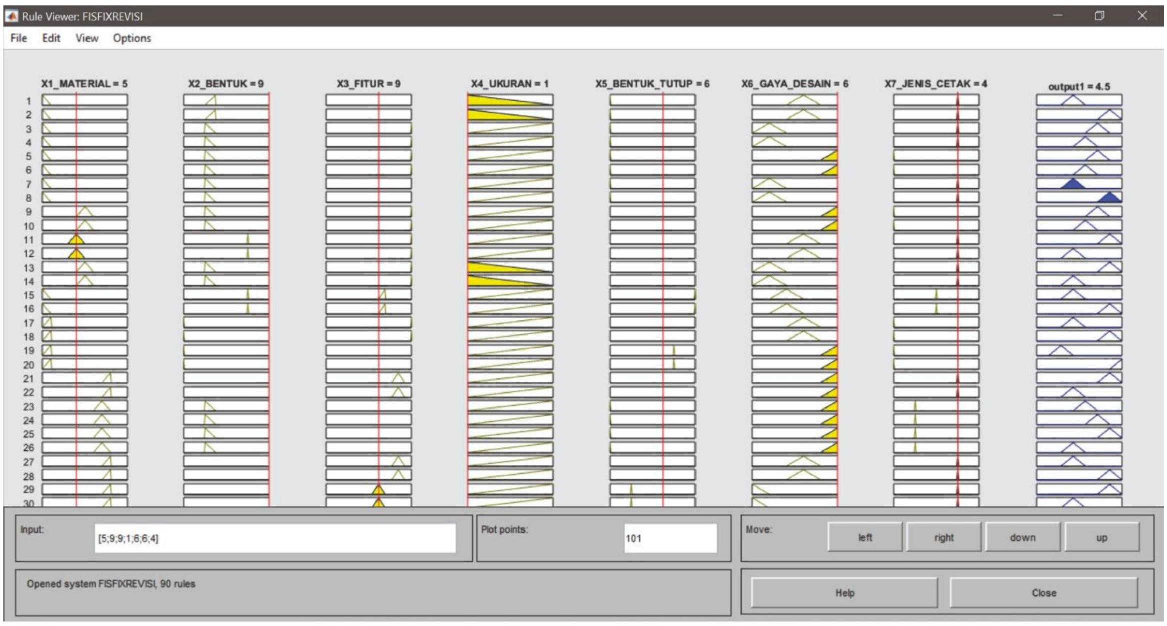


Figure 12. Defuzzification process in Matlab software

Table 8. Factors and types for selected concepts

Factor	X1 (Material)	X2 (Shape)	X3 (Feature)	X4 (Size)	X5 (Close Shape)	X6 (Design Style)	X7 (Print type)	
Type	X1.5	X2.9	X3.9	X4.1	X5.6	X6.5	X7.4	Y C - E value
Efficient Concept	Ivory	Oval	Hanger Strap + Window	Medium	*Sliding Tray*	Minimalist	Directly printed on packaging	4,5
	I	O	TGJ	S	ST	M	LDPK	

common value of 35.7% and an efficient value of 64.3%. The value of each factor is also obtained, in material factor (X1) = 5, Form factor (X2) = 9, Feature factor (X3) = 9, Size factor (X4) = 1, Cap Form factor (X5) = 6, Design Style factor (X6) = 6, Print Type factor (X7) = 4. In Table 8 it can be seen more clearly the factors and forms of the selected types according to the selected Efficient concept.

4. CONCLUSION

The design of the concept and design elements of MSME X room freshener packaging using the *Kansei Engineering* method with the main method, namely *Kansei Engineering* with the support of the *Principal Components Analysis* (PCA) method and the QTT-1 method, produced the concepts of *"common" and "efficient " and* obtained design elements, namely X1.5 (ivory), X2.9 (oval), X3.9 (hanger + window), X4.1 (medium), X5.6 (sliding tray), X6.5 (minimalist), X7.4 (directly printed on packaging) for Efficient concept and X1.2 (rigid plastic), X2.4 (standing pouch), X3.8 (air hole + hanger), X4.2 (small), X5.7 (flip top), X6.4 (fresh + according to aroma) and X7.5 (has no design) for *the Common* concept. The results were then made into a 3D *mockup and* analyzed for suitability to *Kansei Word* (KW) and consumer preferences. The suitability of the concept of selected design elements to consumer preferences is seen from the results of questionnaires that have been distributed using the *Google Form platform*. The results of the concept and design elements selected by consumers are mock-up packaging B, amounting to 80%. Mock-up B packaging also represents the concept of design elements according to the *Kansei Word* obtained, which is hangable, easy to use, has features, and can be opened and closed. Evaluation of the results of selected design elements using the *fuzzy logic* method can be concluded that the value obtained is 4.5 with a neutral category with a *common* value of 35.7% and an efficient value of 64.3%.

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