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Integration of the Kansei engineering method and quality function deployment in the design of a food dough mixer machine

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Abstract

The Apple Dodol home industry, located in Tegalwaru village, Dau, Batu City, is an apple Dodol home industry because the raw material for apples is relatively abundant in Batu city. This snack results from more efficient apples with higher economic value. The increase in the use value of apples is through processing various souvenir products, including apple cider, apple Dodol, and apple chips. The process of making Dodol is still using the manual method. The mixing of the ingredients is still using workers with manual equipment, causing the condition of workers to feel fatigued quickly because the mixing process takes 4-5 hours. Therefore, a proper machine is needed to help the Dodol mixing process.

The method used is Kansei Engineering Type I with the following stages: determining the Kansei Word, testing its validity and reliability, compiling the Semantic Differential (SD) Scale Structure, and compiling SD 1 Kansei Word. The scale used is a 5-point scale, as it is easier for respondents to understand. Illustrations of similar or uniform products to be designed are put together, and sorted items and categories are then applied to make technical specifications using the Quality Function Deployment method.

Based on the test results, the difference in the standard output of the two tools was 0.33 kg/hour, so an increase in the percentage of standard output was obtained by 49%. The use of this semi-automatic Dodol mixer is practical and convenient. The mixer can be removed, making it easier to clean the machine and easy to move as it has wheels on the tool frame.

Keywords: Kansei Engineering; QFD; Design; Mixing Machine

1. Introduction

The typical snack of Batu City is apple Dodol, such as that produced at the Apple Dodol Home Industry located in Tegalwaru Village, Dau Kota Batu. In general, stirring and cooking apple Dodol is traditionally done using a large frying pan and a wooden stirrer. Cooking Dodol by stirring takes 4-5 hours with a single stirring of 10 kg of Dodol dough. The duration of this process causes the condition of workers to feel tired quickly and, when done repeatedly, can cause muscle injuries or Musculoskeletal Disorders (MSDs). The working attitude of Dodol mixer workers using traditional Dodol mixers are standing body position and bending body posture, head down, both arms and hands pressing, and swinging while stirring. Hunched over when mixing is an unnatural body attitude, so workers are prone to experiencing musculoskeletal complaints and quickly feel tired. This happens because of unnatural work attitudes, repetitive movements, static work postures, monotonous work, and long working hours. [1]

In this condition, we need a machine that can help workers, especially in mixing Dodol. Thus, working conditions that are effective, comfortable, safe, healthy, and efficient (ENASE) will be created. It will be shown from the decrease in

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indicators such as musculoskeletal complaints and fatigue in traditional Dodol-making workers [1]. The design of an ergonomic product requires anthropometric data, a study related to the measurement of the human body. Anthropometry is widely used as ergonomic consideration in human interaction [2].

The Kansei Engineering method combined with the Quality Function Deployment method will be applied to the design of this Dodol mixer. Shifting customer requirements from a purely functional and financial perspective to hedonistic needs engagement requires a new set of thinking in product design. The Kansei Engineering (KE) and Quality Function Deployment (QFD) methodologies are simultaneously used to transform the customer's voice for both functional and emotional needs [3]. In translating the customer's emotional needs into product attribute parameters through engineering, KE is considered superior compared to other similar methods. So, to be able to meet the emotional needs of customers as well as meet customer needs and achieve customer satisfaction, the Quality Function Deployment (QFD) method is implemented [4]. As a product development methodology, Kansei Engineering is as a methodology for translating human psychological processes to an existing product or a new design concept. Human psychology can mean impressions, feelings, requests, and emotions related to products. Using the Kansei method, companies/factories can evaluate their products before launching them on the market [5].

Quality Function Deployment is a systematic planning process created to help companies organize all the elements needed to define, design and manufacture products or provide services that meet customer needs [6]. According to Namagachi, Kansei Engineering is a handy and practical technique from the outside when customer needs are very large and must be addressed, collected, and evaluated before the solution is deployed. There are six types of the Kansei Engineering method used in this study, namely the KE Type I Category Classification method, which is the reduction method of the target concept of a new product and is bound to Kansei subjectivity with the objective of design size [7]. Even if Kansei's needs and technical requirements are placed in a clear area, Quality Function Deployment is a powerful and profitable technology for product or service deployment. Kansei Engineering is practical and can be combined with Quality Function Deployment in identifying broad categories, implied, feeling, and affective needs and completes prior to VOC (Voice of Customer) analysis. Both approaches will be included in the House of Quality (HoQ) matrix in the Quality Function Deployment [8].

2. Material and methods

2.1. Kansei Engineering Stages

Using the Kansei Engineering method, the stages began with a preliminary survey of 15 owners and employees in the Dodol Buah Home industry. This survey aimed to determine the user's psychological and emotional needs and desires for the Dodol mixing machine so that later it will produce a Kansei Word, which will then be used to determine the technical specifications of the Dodol mixing machine. There are six types of methods that exist in Kansei Engineering to design a Dodol mixing machine using the Kansei Engineering type I method with the following stages:

- The initial stage of designing this fruit Dodol mixing machine is to conduct a preliminary survey with interviews with fruit Dodol business actors.
- Determine Kansei Word, which is then tested for validity and reliability using SPSS version 16.
- Compile a Semantic Differential (SD) Scale Structure. For Kansei Words, after conducting a Kansei investigation, a Kansei word selection is carried out that is related to the research. Then arrange SD 1 Kansei Word. The scale used is a 5-point scale as it is easy for respondents to understand.
- Collect product samples. Illustrations of similar products or uniforms that will be designed together.
- Sorting Items as well as categories. Items are all that are linked to the shape of the final design.
- Research assessment participants received directions, after which they assessed each type of Kansei word that had been compiled with an SD scale of 5 points. Analysis Using Statistical Methods Information that has been evaluated and analyzed using statistical methods.

2.2. Quality Function Deployment Stages

From the results of the voice of the customer obtained from the application of the Kansei Engineering method, the QFD method is used with the House of Quality (HOQ) by previously preparing the product's technical characteristics and comparing the values of existing products with those that are designed. From these alternative results, a prototype was made and then tested for its productivity, effectiveness, and efficiency [9].

- Determination of voice of costumer
- Brainstorming
- Validity and reliability testing
- Compile planning matrix
- Prepare the HOQ
- Information obtained from consumers is translated by product designers by implementing QFD through the stages of creating a House of Quality.
- After that, anthropometric data were collected from the respondents to be used on the dimensions of the dough mixer machine.

3. Results and discussion

3.1. Analysis Using Kansei Engineering

The results of the initial survey by observing 15 Dodol businesspeople directly through interviews with respondents to produce eight Kansei words, as shown in Table 1 below:

Table 1 Variables that influence Kansei Word

No	Variables that affect Kansei Word
1	Results of homogeneous dough mixing
2	Fast Mixing Process
3	Ergonomic machine design
4	Production Capacity
5	The heating is more even and consistent
6	Ease of maintenance
7	Machine durable
8	The machine is easy to move

The use of the Kansei Engineering method in the early stages is to perform factor analysis using the Kaiser Meyer Olkin (KMO) and Bartlett's tests with the help of SPSS 16.0 software. By doing so, it can be determined whether the data is feasible for further processing. The hypothesis of the test is as follows:

H0: The variable (sample) is not sufficient for further analysis.
Ha: The variable (sample) is sufficient for further analysis.

With the provision of decision making:
If the value of Sig. KMO > 0.5 then accept Ha, reject H0, and vice versa.
If the value of Sig. Bartlett's < 0.05 then accept Ha, reject H0, and vice versa

Table 2 KMO and Bartlet's test results

Kaiser-Meyer-Olkin of Sampling Adequacy		**0.589**
Bartlet's Test of Sphericity	Approx. Chi-Square of Sig.	87.071 15 0.000

From the factor analysis results, the Paired Wise Comparison test was carried out with the help of expert choice software to weigh each criterion and sub-criteria to produce a priority order of factors. Following are the recap results shown in Table 3 below:

Table 3 Global Weighting Recap Results

No	Attribute	Attribute Weight	Sub-Attribute	Sub-Attribute Weight
1	Production Factor	48 %	Production capacity	30%
			Faster mixing process	14%
			The heating is more even	27%
			The result of mixing the dough is homogeneous	29%
2	Flexibilities	39 %	Ease of use of the machine	34%
			Convenience when using the machine	35%
			Ease of maintenance	31%
3	Tool Variants	13 %	The machine is easy to move	31%
			Long lasting machine	69%

3.2. Result Analysis Using QFD

From the analysis using Kansei Engineering, the sub-attributes became the voice of the customer in making the House of Quality in the later stages of using the QFD method. From the Voice of Customer, the technical requirements of the machine to be designed can be determined. The designer makes technical requirements by connecting each attribute and sub-attribute. Technical response, commonly known as technical parameters, translates consumer desires into measurable technical language. The results of the technical requirements are shown in Table 5 below:

Table 4 Attributes and Importance of Customer and Technical Parameters of Dodol Dough Mixer Machine

No	Attribute	Importance of Customer Value	Technical Parameters
1	The result of mixing the dough is homogeneous	4.83	2 stirrers
2	Fast Mixing Process	4.71	The electric motor is equipped with a gear box
3	Ergonomic machine design	4.57	Machine dimensions according to the user's body size
			The stirrer is removable
			The container for the dough is removable
4	Production capacity	4.61	10-15 kg Capacity
5	The heating is more even and consistent	4.72	The material of the container can conduct heat
			LPG gas stove
6	Ease of maintenance	4.54	Machine Components are easy to buy
7	Long lasting machine	4.65	Sturdy machine frame
			Stainless steel material
8	The machine is easy to move	3.89	The bottom of the machine is given wheels

The fourth part of the HOQ links product attributes originating from the voice of the customer with technical parameters. A weak or strong relationship depends on the perspective of researchers in developing product designs on

the degree of closeness between product attributes and technical parameters [10]. The matrix between attributes and technical parameters can be seen as follows.

3.2.1. Relationship Matrices

After determining the technical response, the relationship between the technical response and the user's voice is determined.

Table 5 Relationship Matrics between the technical response and the user's voice

Technical response / User's voice	2 stirrers	Electric motor ½ HP (1400 rpm) equipped with a gear box. dimensions of the machine	Machine dimensions according to the user's body size	The stirrer is removable	The container for the dough is removable	10-15 kg capacity	The material of the container can conduct heat	LPG gas stove	Machine component is easy to buy	machine frame, steel	Stainless steel material	The bottom of the machine is given wheels
The result of mixing the dough is homogeneous	●	●										
Fast Mixing Process	●	●	○									
Ergonomic machine design			●	●								
Production Capacity						●						
The heating is more even and consistent							●	●				
Ease of maintenance		○							●	○		
Long lasting machine									○	●	●	
The machine is easy to move										○	○	●

description:

△ = there is relationship possibility
○ = Moderate relationship
● = Strong relationship

3.3. Anthropometric determination

The next step is to determine anthropometry as the basis for the dimensions of the Dodol dough mixer using anthropometric data from 15 respondents. The body dimensions taken include:

3.3.1. Reach forward

- Application: To determine the length of the dough mixer machine.
- P_{50} measurement results: 71.5 cm. (50th percentile)

3.3.2. Side Hand Reach

- Application: Used to determine the width of the dough mixer machine.
- P_{50} measurement results: 71.5 cm. (50th percentile)

3.3.3. Eye Standing Height

- Application: To determine the line-of-sight input of dough mixer machine material.

- P_{50} measurement results: 158.3 cm.

3.3.4. Stand Elbow Height

- Application: To determine the height of the on/off button of the dough mixer machine.
- P_5 measurement results: 92.4 cm.

3.3.5. Standing Knee High

- Application: To determine the height of the stove hole of the dough mixer machine.
- P_{50} measurement results: 49.5 cm

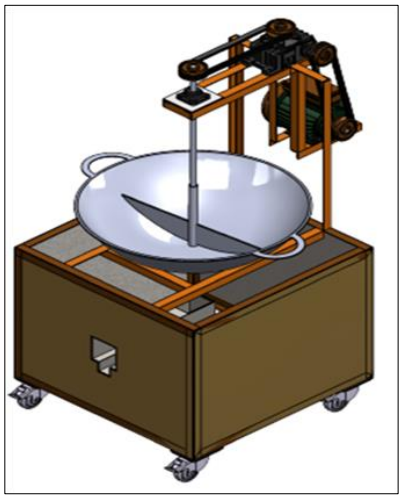

Figure 1 Dough Mixer Machine

3.4. The Dough Mixer Machine Specifications are as follows:

- Capacity : 10-15 kg
- Frame Material : Iron Plate
- Mixer Material : Stainless
- Frying Pan Material : Stainless
- Electric Motor : ½ HP (1400 rpm)
- Gearbox : Ratio 1 : 50
- Dimensions : 70 cm x 60 cm x 130 cm
- Overall Weight of the Tool : ± 65 Kg

4. Conclusion

From the results of the study by combining the Kansei engineering method and Quality Function Deployment, the dimensions of the Dodol mixing machine were obtained with a length of 70 cm, a width of 62 cm and a height of 130 cm. Working time testing using old equipment obtained a standard time of 1.5 hours/kg and working time testing using a new dough mixer obtained a standard time of 1 hour/kg. While the standard output using the old tool obtained a standard output of 0.67 kg/hour, and testing using a new tool obtained a standard output of 1 kg/hour. Based on the machine testing results, the standard output difference is 0.33 kg/hour, so an increase in the percentage of standard output is obtained by 49%. The semi-automatic Dodol mixing machine no longer needs an operator in the dough mixing process, so the operator does not experience work fatigue in the manufacturing process. The use of a semi-automatic Dodol mixer is practical and convenient. The stirrer can be removed, making it easier to clean the machine and easy to move because there are wheels on the machine frame.

Compliance with ethical standards

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Disclosure of conflict of interest

No conflict of interest. Informed consent was obtained from all individual participants included in the study.

References

[1] K. L. P. Dewi, N. Adiputra, I. M. Muliarta, K. Tirtayasa, I. P. G. Adiatmika, and I. W. B. Adnyana, "Pemberian Workplace Stretching Exercise Dan Modifikasi Kondisi Kerja Dapat Menurunkan Keluhan Muskuloskletal Dan Kelelahan Pada Pekerja Pembuat Dodol Tradisional Di Desa Tamblang – Kabupaten Buleleng," *J. Ergon. Indones. (The Indones. J. Ergon.*, vol. 4, no. 1, pp. 11–17, 2018, doi: 10.24843/jei.2018.v04.i01.p02.

[2] S. A. Muttalib, A. F. Hidayat, S. H. Abdillah, I. A. Widhiantari, R. Rozidi, and S. Burhan, "Pengembangan Desain Sprayer Buah Menggunakan Quality Function Deployment," *J. Tek. Pertan. Lampung (Journal Agric. Eng.*, vol. 9, no. 2, p. 149, 2020, doi: 10.23960/jtep-l.v9i2.149-156.

[3] R. Ginting and A. Y. Ali, "Improved Kansei Engineering with Quality Function Deployment Integration: A Comparative Case Study," *IOP Conf. Ser. Mater. Sci. Eng.*, vol. 505, no. 1, pp. 0–6, 2019, doi: 10.1088/1757-899X/505/1/012092.

[4] U. G. Mada, "Kansei Engineering dari Seminar Nasional UGM," pp. 104–110, 2020.

[5] M. Haryono and C. Bariyah, "Perancangan Konsep Produk Alas Kaki Dengan Menggunakan Integrasi Metode," *J. Ilm. Tek. Ind.*, vol. 13 No. 1, no. Juni, pp. 71–82, 2014.

[6] R. Prabowo, A. Agung, and J. T. Industri, "INTEGRASI METODE KANSEI ENGINEERING DAN QUALITY FUNCTION DEPLOYMENT," vol. 14, no. 02, pp. 60–67, 2019.

[7] M. Akmal and S. R. W. Ghani, "Perancangan Dan Pengembangan Produk Mesin Perontok Bulu Ayam Dengan Menggunakan Metode Kansei Engineering," *J. Penelit. Bid. Inov. Pengelolaan Ind.*, vol. 1, no. 2, pp. 49–60, 2022, doi: 10.33752/invantri.v1i2.2323.

[8] R. Santoso, R. Yusianto, and Jazuli, "Perancangan Alat Hybrid Penggiling Daging, Pengaduk Adonan Dan Pencetak Bakso Menggunakan Metode Kansei Engineering Dan Quality Function Deployment (Qfd)," *Tek. Ind.*, vol. 1, no. Perancangan alat penggiling daging, pengaduk adonan, dan pencetak baso, pp. 1–8, 2019.

[9] Sukardi, R. Setyaningrum, and D. N. Izzhari, "Perancangang Slicer Machine Crackers Dengan Menggunakan Metode Kansei Engineering Dan Quality Function Deployment (Qfd) Sebagai Upaya Meningkatkan Produktivitas Umkm Kerupuk Ikan."

[10] N. F. Utomo, P. Studi, T. Industri, F. Teknik, and U. M. Surakarta, "Perancangan Alat Bantu Pengaduk Adonan Kerupuk Rambak Dengan Metode Quality Function Deployment (Studi Kasus : Ukm Rambak Nur Sragen)," 2019.