Aromatherapy Pillow Design Using QFD Method to Cure Pinched Nerve

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Abstract. The therapeutic hot pillow is a blend of science and ancient health techniques concoction that are able to cure various ailments and maintain the body. Heat therapy can open blood vessels wider, thus increasing blood flow and supply of oxygen and nutrients to reduce pain in joints, muscles, and ligaments. Warm temperatures can also reduce the potential for muscle spasms. The specific purpose of this product design is to cure neck pain. The sub-issue of the Aromatherapy Pillow product / device specification will find a sub-solution with steps from Nigel Cross, Determining product characteristics with Quality Function Deployment (QFD). Evaluate alternatives by using Pairwise Comparison and AHP measurements to calculate the weights of each attribute and determine the ranking of each alternative. Value Engineering is the final step of the design process in order to increase the value of the product for the consumer and reduce the cost to be paid by the manufacturer. Value engineering steps are to list the product components and identify the function of each component, determine the value of the identified function, calculate the cost of each component, find ways to reduce costs without reducing value, and ultimately evaluate alternatives.

1. Introduction

The design of the product consists of a series of sequential activities, therefore the design later referred to as the design process which includes all activities contained in the design [1]. Special significance of the design of products described in product development, mold design, functional design, packaging design, and product research. Therefore, the product design is a process of some aspects of designing products along with research and development. One of the characteristics of the design activity always start late and finish early. This means that the focus of all activities is the design of the end point (the product description) [2].

Density of community activities around the university environment and most cities in Indonesia to be one of the background in the manufacturing of Aromatherapy Pillow. Most of the Indonesian people do not have enough time to just rest at home. They spend most of their time outdoors or on the go. Exposure to pollution, the body that rarely exercise, and mind fatigue due to a very solid activity allows their body becomes vulnerable to various diseases that can endanger his life [3].

Hot pillow therapy is a combination of science and engineering of ancient health potion that can cure many diseases and maintain the body, so that the best-selling modern medical equipment today [4]. Non-pharmacological pain management consists of pain management based on physical stimulation and cognitive behavior. Physical treatment includes skin stimulation, transcutaneous electrical nerve nerve stimulation (TENS), acupuncture, and includes skin stimulation techniques including massage, hot and
cold compresses. Aromatherapy is used as an alternative treatment for non-pharmacological pain [5]. Heat therapy can open wider blood vessels, thereby increasing blood flow and supply of oxygen and nutrients to reduce pain in the joints, muscles, ligaments, and reservoirs that injury [6]. Warm temperatures also able to reduce the potential for muscle spasms and increase range of motion. Therapy should be no longer than 20 minutes, unless there is a recommendation from a doctor or physical therapist. Ideal treatment was 5, 10, 15 minutes is sufficient because the skin is different from one another endurance heat reception.

1.1. Purpose
The purpose of this research is to design an Aromatherapy Pillow product that is a tool that can cure pinched nerves or fatigue in the neck. Aromatherapy Pillow itself is a hot pillow that can open blood vessels wider, thereby increasing blood flow and supply of oxygen and nutrients to reduce pain in the joints, muscles, ligaments, and reservoirs that are injured.

2. Research Methods
Research carried out by the author in March 2019 to June 2019. The study is used in the city of Medan. Materials and equipment used when doing research is a questionnaire and interview method. Then the authors make the steps of product design using the Nigel Cross method. The stages in the product design process with Nigel Cross are as follows:

- Classification of Purpose
- Determining Functions
- Determining Interests
- Determination of Characteristics
- Alternative Determination
- Alternative Evaluation
- Communication

The first step of product design is to brainstorm. Brainstorming is a form of discussion in order to gather ideas, opinions, information, knowledge, experiences from all participants to produce ideas and most ideas will be discarded to choose the best idea [7].

After that, the next step is to determine how many samples should be taken as samples. The sample collection method used is puropose sampling, which is a sampling technique by determining certain criteria [8]. The population that will be sampled in this study are orange farmers. After determining the number of samples, make a questionnaire, such as opened questionnaire, closed questionnaire, and AHP questionnaire. All types of questionnaires are to determine what customers want from the design of the tool. With all the answers from the questionnaire, then test the validity and reliability of their answers about the product design of the author, competitor 1, competitor 2, and competitor 3.

Then, classify the purpose and function of product determination. For sub-problems, determining needs, is a way to compare brainstorming results and attributes form a questionnaire recapitulation. Next is determining product characteristics using QFD based on a questionnaire containing customer needs or investigating customer satisfaction with products related to technical characteristics [9].

In order to find solutions to each problem from making a product, steps that produce alternatives, evaluate, and improve detail. From all the steps, it can be concluded that the product can be made with the right attributes and costs.

3. Results and Discussion
The results obtained from all stages of product design for aromatherapy pillow products are the determination of dimensions, product colors, handle colors, additional functions, additional function patterns, decorations, and energy sources of the products.
3.1. Purpose & Function Classification, Determining the Needs

Based on the previous problem, finding sub problems that will be the basis of the solution found from the problem design. To do that, there are 3 steps so that the problem will be divided into sub-problems, namely the classification of objectives, classification of functions, and determining needs:

The conclusion of 3 steps in the design of Aromatherapy Pillow product tools:

- Classification of Purpose
  A list of overall product design goals for Aromatherapy Pillow devices, among others: (i) Circular pillow shape, (ii) Pillowcases made from cotton, (iii) Aromatherapy pillow smells of green tea, (iv) Fill pillows using cotton, (v) The cable is on the back of the pillow, (vi) Aromatherapy is a liquid, (vii) The color used is green, (viii) There is a cable reel, (ix) The material used in the cable reel is cotton and (x) The color used for the cable coils is white.

The product design drawings can be seen in Figure 1.

![Figure 1. Aromatherapy Pillow products](image)

- Determining Function
  Determine functions to determine the functions needed and limit the system from new designs. These important functions are: (i) Pillow sub function, (ii) Aromatherapy sub function, (iii) Heater sub function and (iv) Sub function cable.

- Determining Interests
  Based on the results obtained from determined needs, Hope> Demand means product design in accordance with the wishes of the Aromatherapy Pillow tool on the market. So, the sub problems that result in these three steps are: (i) The product has a comfortable and ergonomic design, (ii) The product has a long lifetime, (iii) The product can issue aromatherapy and (iv) The product can deal with pinched nerves and some neck diseases.

Detailed information on the importance of each attribute is explained in Table 1.

3.2. Sub Problem

In this section, we will find a sub-solution of the product problem sub-problem of the Aromatherapy Pillow tool with the design steps from Nigel Cross, determining the product characteristics. The main planning tool used in QFD is the House of Quality. House of Quality translates customer voices into design requirements that meet certain value targets and match them with the organization or company that will design those design requirements [10].

House of Quality Aromatherapy Pillow products can be seen in Figure 3.
Figure 2. Purposive tree diagram

Table 1. Specifications of Aromatherapy Pillow devices

| No | Brainstorming Results               | D or W | Questionnaire Results               |
|----|-------------------------------------|--------|-------------------------------------|
| 1  | Circular pillow shape               | W      | Circular pillow shape               |
| 2  | Pillowcase made of t-shirts         | D      | Pillowcase made of cotton           |
| 3  | Green tea scented pillow            | W      | Green tea scented pillow            |
| 4  | Fill the pillow using cotton        | W      | Fill the pillow using cotton        |
| 5  | The cable is behind the pillow      | W      | The cable is behind the pillow      |
| 6  | Aromatherapy in the form of fluids  | W      | Aromatherapy in the form of fluids  |
| 7  | Green color used                    | W      | Green color used                    |
| 8  | There is a cable reel holder        | W      | There is a cable reel holder        |
| 9  | The material where the cable is a t-shirt | D  | The material where the cable is cotton |
| 10 | The color of the cable holder is green | D  | The color of the cable holder is white |
Relation’s Degree:

- V = Strong Positive Relationship : 4
- v = Moderate Positive Relationship : 3
- x = Moderate Negative Relationship : 2
- X = Strong Negative Relationship : 1

Customer’s Perception:

- 5 = Very Good
- 4 = Good
- 3 = Enough
- 2 = Bad
- 1 = Very Bad

Difficulties:

- 1 = Easy = 1 – 20%
- 2 = Normal = 21 – 40%
- 3 = Hard = 41 – 60%
- 4 = Very Hard = 61 – 80%
- 5 = Impossible = 81 – 100%

Cost Estimation:

- 1 – 15 = Cheap
- 16 – 30 = Expensive
- 31 – 45 = Very Expensive

Degree of Importance:

- 1 – 15 = Not Important
- 16 – 30 = Importance
- 31 – 45 = Very Important

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**Figure 3.** Quality function development Aromatherapy Pillow

- Comparison of the Aromatherapy Pillow tool with existing competitors related to the same attributes described in the table 2.
- Difficulty level: based on these technical characteristics, this product is relatively easy.
- Importance: All technical characteristics are quite important.
- Estimated Cost: Estimated cost of product design is relatively cheap.
Table 2. Attribute evaluation data of similar competitor products

| No. | Primary      | Secondary                | Tertiary | Competitor I | Competitor II | Competitor III |
|-----|--------------|--------------------------|----------|--------------|---------------|----------------|
| 1   | Design       | Pillow Shape             | Circular | 3            | 4             | 3              |
|     |              | Fill the Pillow          | Cotton   | 4            | 4             | 4              |
|     |              | Cable Location           | Back     | 4            | 3             | 4              |
|     |              | Aroma Properties         | Fluid    | 3            | 4             | 4              |
|     |              | Pillow Color             | Green    | 3            | 3             | 3              |
|     |              | Color Additional Function| White    | 4            | 4             | 3              |
|     |              | Pillowcase Material      | Cotton   | 3            | 3             | 5              |
|     |              | Kind of Scent            | Green Tea| 4            | 4             | 3              |
| 2   | Material     | Aroma Types              | Lavender | 3            | 3             | 4              |
|     |              | Cable Location           | Side     | 3            | 3             | 3              |
|     |              | Aroma Properties         | Gel      | 3            | 3             | 3              |
|     |              | Pillow Color             | Blue     | 3            | 3             | 3              |
|     |              | Color Additional Function| Grey     | 3            | 3             | 3              |
|     |              | Material Additional      | Place the cable reel | 3 | 3 | 3 |

3.3. Sub Solution

After finishing all the problems that occur, including in selecting attributes for the Aromatherapy Pillow, sub solutions can be done using the steps of Nigel Cross while maintaining the benefits and quality of improving the product.

There are 3 steps that will be used to make sub-solutions into solutions, such as generating alternatives, evaluating alternatives, and improving details. The conclusions of the three steps are:

- Produce Alternatives

In this step, the Morphological Chart of the Aromatherapy Pillow product is displayed in the form of a 10 x 3 matrix. Where, 10 is a function that must be achieved and 3 is an alternative that might be applied. Many combinations that can be done on how to achieve the function are:

$$\text{Many combinations} = 10C_3 = 120 \text{ pieces}$$

The Morphological Chart of the Aromatherapy Pillow can be seen in Table 3.

Table 3. Combination of product design solutions for Aromatherapy Pillow tools

| Function | How to Achieve Function |
|----------|-------------------------|
|          | 1     | 2     | 3     |
| Pillow Shape | Oval | Square | Rectangle |
| Pillow Case Material | Silk | Cotton | Shirt |
| Aroma Types | Lavender | Green Tea | Orange |
| Fill the Pillow | Kapok | Foam | Cotton |
| Cable Location | Side | Back | Front |
| Aroma Properties | Gel | Liquid | Powder |
| Pillow Color | Blue | Purple | Green |
| Additional Functions | Battery | Button | Place the cable reel |
| Additional Functions Material | Aluminum | Cotton | Plastic |
| Color Additional Functions | Blue | Grey | Black |
- Alternative Counting
  The evaluating alternative is to compare the utility value of an alternative product design or use it as a basis for performance or a basis for deliberate loading. This method is called Weighted Objectives. In order to do that, first make a list of product design requirements, then rank all alternatives with the Pair Wise Comparison and AHP scale. The results of the relative weight values of each of the other attributes can be seen in Figure 4.

![Diagram](attachment:image.png)

**Figure 4.** Relative weight value between attributes and other attributes

Next, determine the performance parameters of each attribute. Performance parameters can be seen in Table 4.
Table 4. Performance parameters for each attribute

| Characteristics       | Parameter | Score | 5 | 4 | 3 | 2 | 1 |
|-----------------------|-----------|-------|---|---|---|---|---|
| Pillow Shape          | Model     | Circular | Oval | Square | Triangle |
|                       |           | Oval   | 5 |   |   |   |   |
|                       |           | Model  | 4 |   |   |   |   |
|                       |           | Circular | 3 |   |   |   |   |
|                       |           | Square | 2 |   |   |   |   |
|                       |           | Triangle | 1 |   |   |   |   |
| Pillow Case Material  | Quality   | Very Good | Good | Pretty Good | Not Good | Not Good |
| Aroma Types           | Quality   | Very Good | Good | Pretty Good | Not Good | Not Good |
| Fill the Pillow       | Quality   | Very Good | Good | Pretty Good | Not Good | Not Good |
| Cable Layout          | Laying    | Back | Under | Front | Side | Top |
| Aroma Properties      | Quality   | Very Good | Good | Pretty Good | Not Good | Not Good |
|                       |           | Great | 5 |   |   |   |   |
|                       |           | Contrast | 4 |   |   |   |   |
|                       |           | Contrast | 3 |   |   |   |   |
|                       |           | Contrast | 2 |   |   |   |   |
|                       |           | Contrast | 1 |   |   |   |   |
| Additional Functions  | Capacity  | Very Large | Big | Moderate | Small | Very Small |
| Additional Functions  | Quality   | Very Good | Good | Pretty Good | Not Good | Not Good |
| Color Additional      | Quality   | Very Good | Good | Pretty Good | Not Good | Not Good |
| Functions             |           | Great | 5 |   |   |   |   |
|                       |           | Contrast | 4 |   |   |   |   |
|                       |           | Contrast | 3 |   |   |   |   |
|                       |           | Contrast | 2 |   |   |   |   |
|                       |           | Contrast | 1 |   |   |   |   |

Calculate and compare the relative importance of each attribute for each alternative. The value of alternative importance weights for each attribute for all alternatives can be seen in table 5.

Table 5. Alternative interest weight value of each attribute for all alternatives

| Evaluation Criteria | Parameter | Group V | Alternative 1 | Alternative 2 | Alternative 3 |
|---------------------|-----------|---------|---------------|---------------|---------------|
|                     |           | Exp. Score (v) | Wt. (v) | Exp. Score (v) | Wt. (v) | Exp. Score (v) | Wt. (v) | Exp. Score (v) | Wt. (v) |
| Pillow Shape        | Model     | Circula r | 5 | 0.1095 | 0.0876 | Square | 2 | 0.0438 | Rectangle | 3 | 0.0657 |
| Pillow Case Material| Quality   | Good | 4 | 0.0916 | 0.0687 | Pretty Good | 3 | 0.0687 | Very Good | 5 | 0.1145 |
| Aroma Types         | Quality   | Good | 2 | 0.0688 | 0.0688 | Pretty Good | 3 | 0.1032 | Pretty Good | 3 | 0.1032 |
| Fill the Pillow     | Quality   | Good | 4 | 0.4028 | 0.2014 | Not Good | 2 | 0.2014 | Good | 4 | 0.4028 |
| Cable Layout        | Laying    | Back | 5 | 0.271 | 0.2168 | Under | 4 | 0.1084 | Front | 3 | 0.1626 |
| Aroma Properties    | Quality   | Good | 4 | 0.2792 | 0.2094 | Pretty Good | 3 | 0.349 | Good | 4 | 0.2792 |
| Additional Functions| Capacity  | Moderate | 3 | 0.3405 | 0.3405 | Moderate | 3 | 0.454 | Small | 2 | 0.227 |
| Additional Functions| Quality   | Good | 4 | 0.4144 | 0.3108 | Pretty Good | 3 | 0.4144 | Pretty Good | 3 | 0.3108 |
| Color Additional    | Quality   | Good | 4 | 0.4144 | 0.3108 | Pretty Good | 3 | 0.4144 | Pretty Good | 3 | 0.3108 |
| Functions           | Quality   | Good | 4 | 0.4144 | 0.3108 | Pretty Good | 3 | 0.4144 | Pretty Good | 3 | 0.3108 |

Total : 1 | 35 | 3,689 | 31 | 2,727 | 34 | 3,625 | 31 | 3,207 |

The results for each weight for each alternative are:

Group V : 3.6891
Alternative 1 : 2.7274
Alternative 2 : 3.6246
Alternative 3 : 3.2067
Based on the results above, the biggest value is Group V at 3.6891. Because the closest value of Group V is alternative 2, Group V and Alternative 2 will be compared between the characteristics of one another by displaying the weight of their values and interests.

**Figure 5.** Relative weight value of each attribute to other attributes

From the calculation of the area of the gap between the group and alternative 2, it is concluded that the area of the group gap (0.0788) is smaller than the gap area of alternative 2 (0.5940) so that the selected product is a group product. From the Gantt chart it can be seen that the greatest weight is found in W10, namely the additional Color Function. While the smallest weight is W1, which is Pillow Shape.

### 3.4. Solution

Value Engineering was developed by Larry Miles during World War II to minimize. There are several types of values, namely, usability values, costs, prices, and exchange rates. Value Engineering is a method applied to reduce production costs by calculating the value of components, equipment, and procedures. There are several stages in value engineering, namely, the orientation phase, the information phase, the functional phase, the creative phase, the evaluation phase, the development phase, the presentation phase and the implementation phase. Value Engineering is the final step of the design process [11].

Next, the steps in the value engineering stage are:

- Make a list of product components and identify the functions of each component as shown in table 6.
- Determine the Value of The Function Identified
Based on the functions that have been identified, the values are determined based on consumer perception. The values of each function are assessed based on the suitability of the design to the desires of consumers. Can be seen in table 7.

### Table 6. Product components to be used in Aromatherapy Pillow

| Component        | Function                                      |
|------------------|-----------------------------------------------|
| Cotton Fabric    | Used for Aromatherapy Pillow pillowcases       |
| Green Tea        | Used as an Aromatherapy Pillow aroma          |
| Aluminum Foil    | Used to conduct heat                           |
| Cotton           | Used as a pillow filling                       |
| Cable            | Used to conduct electricity from the power source to the electricity user device |
| Choke Head       | Used to connect a cable to a socket            |
| Heating Element  | Used to generate heat when an electric current is applied |

### Table 7. Identified function value

| Function        | Value | Explanation                                                                 |
|-----------------|-------|-----------------------------------------------------------------------------|
| Main Design     | Good  | Aromatherapy Pillow has a simple main design for the shape adapted to the neck of the wearer, namely the elderly |
| Additional Functions | Good | Aromatherapy Pillow uses cotton as a material for pillowcases and a material for cable reels |

- Calculate the Cost of Each Component
  The price of each additional function has been estimated in advance to determine the selling price of the product produced. Can be seen in table 8.

### Table 8. Price of components to be used

| Component         | Component Prices (IDR) | Number of Components Required | Total Price (IDR) |
|-------------------|------------------------|-------------------------------|-------------------|
| Cotton Fabric     | IDR 25.000 / meter     | 1 meter                       | IDR 25.000        |
| Green Tea         | IDR 40.000 / pack      | 1 pack                        | IDR 40.000        |
| Aluminum Foil     | IDR 10.000 / roll      | 1 roll                        | IDR 10.000        |
| Cotton            | IDR 50.000 / kg        | 1/2 kg                        | IDR 25.000        |
| Cable             | IDR 7.000 / meter      | 1 meter                       | IDR 7.000         |
| Choke Head        | IDR8.000 / piece       | 1 piece                       | IDR8.000          |
| Heating Element   | IDR 25.000 / piece     | 1 piece                       | IDR 25.000        |
|                   | **Total**              |                               | **IDR 140.000**   |

Based on the value engineering step, it is found that from the available alternatives there is the best alternative with a total cost of IDR 140,000.00 which is lower than the previous cost of IDR 115,000.00. Using this tool can cure pinched nerves, reduce pain in the neck, and provide a relaxing effect.

### 4. Conclusions and Recommendations

The conclusions that can be drawn from the design of Aromatherapy Pillow products are the expected goals, aromatherapy pillow products with a characteristic were realized. As for the characteristics of Aromatherapy Pillow products obtained from the design purpose are circular shaped pillows, pillowcases made from cotton, aromatherapy scented green tea, the contents of the pillow using cotton, the cable is behind the pillow, aromatherapy in the form of liquid, the color used is green, there is a cable reel, place of cotton cable reel, and white cable reel place. Determination of Aromatherapy Pillow group V function is by transforming input and output with blackbox. Then the
function is divided into essential sub-functions. Block diagrams show interactions between sub-functions.

Suggestions that can be given are in carrying out brainstorming activities, students are expected to design products whose designs are not too complicated so that the product can be realized properly, and it is recommended that the selection of ingredients in the product is considered so that the price of the product can be reduced and each constituent material can be combined properly.

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