Application of Quality Function Deployment (QFD) Method in Meeting Customer Satisfaction in the Bookshelf Industry

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Abstract. Business competition requires companies to be able to implement strategic plans to meet consumer needs in product development by increasing quality, performance, and reducing costs and production time. PT.X is a bookshelf manufacturing company that continues to strive to meet the needs of consumers with quality products. The problem that occurs in the company is the re-design of the bookcase product component design, causing a longer production time and high production costs. The purpose of this study is to understand the steps of Nigel Cross product design, identify the causes of waste of time and costs in the production process of bookshelves using the Quality Function Deployment (QFD) method. The QFD method is used to identify consumer needs associated with the technical characteristics of bookshelf products. The results of the approach with the QFD method show that in stages improving details consisting of the eliminate process and the reduce process show a decrease in the value of making products from prices IDR 145,325 be IDR 110,325.

1. Introduction

Business competition requires companies to be able to implement strategic plans to meet consumer needs in product development by increasing quality, performance, and reducing costs and production time. The current competitive environment makes this activity more difficult than ever before. Customers not only demand a higher level of quality in new products, but also demand the latest innovations. High quality products are the main prerequisite for competitive companies [1]. Something the company must first design the product to be designed. The design of the product itself consists of a series of sequential activities, therefore design is then referred to as the design process which includes all activities contained in the design. Activities in the design process are called phases. The phases in the design process differ from one another. Each phase consists of several activities called steps in phase [2].

QFD is a planning process that helps the organization's plans to effectively implement various technical support tools and complement each other to prioritize each problem. QFD is a way to improve the quality of goods or services by understanding the needs of consumers and then linking them with technical characteristics to produce a product or service at each stage of making the goods or services produced [3]. The main objective of QFD is to determine the priority design criteria which are the main focus in product design and development [4].

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 adjust them to the organization or
company that will design these design requirements [5]. The problem that arises in this industry is the presence of dissatisfaction with customers, therefore companies are required to meet customers [6]. In the manufacturing industry, quality is seen from the product itself, different from the service industry that prioritizes the quality of its services [7]. The main problem that arises most if the product technical specifications are not in accordance with customer desires, when not met then the consumer is not satisfied with the product enjoyed [8]. Quality in the product is the ability to meet customer needs [9]. The main goal is to make a product in accordance with the wishes of consumers [10].

2. **Theoretical Background**

   This research was conducted in the process of product planning and development as a method of analysis.

   Research - research related to product design is with the title Redesign Product Multi-Function Tissue Place Using the Quality Function Deployment Method. The object of research is Tissue Holder. Based on the results of the study, a redesigned multifunctional tissue holder is added to add value to the product in accordance with the wishes of the consumer, aimed at the needs of the family or household [14].

2.1. **Product design**

   Product design is a set of product development that becomes a process in the work of marketing and business vision, which includes improving the vision or objectives of the product into technical specifications, new development concepts, and the embodiment of new product engineering [11].

2.2. **Quality Function Deployment (QFD)**

   Quality Function Deployment (QFD) is a tool used to develop product designs towards the end user [12].

3. **Research Methodology**

   This type of research used in this research is descriptive research, where descriptive research is a type of research that aims to describe systematically, factually, and accurately about the facts and properties of a particular object. This research is also an action research to get a solution that will be applied to the company as a form of improvement of the original system [13]. The object of this research is the characteristics (attributes) of bookshelf products that are needed by consumers themselves. The steps involved in designing the product are as follows:

   - Brainstorming
   - Clarifying Objectives
   - Establishing Function
   - Arrangement of Requirements (Setting Requirements)
   - Determining the characteristics (Determining Characteristics)

4. **Result and Discussion**

4.1. **Specifications of Brainstorming Results**

   The specifications for the final bookshelf design brainstorm are shown in Table 1.
Table 1. Specifications for the final bookshelf design brainstorm

| No. | Product Specifications | Information |
|-----|------------------------|-------------|
| 1   | Form of Product        | Square      |
| 2   | Color                 | Purple      |
| 3   | Motif                 | Zig Zag     |
| 4   | Bulkhead Number       | 1           |
| 5   | Bulkhead Motifs       | Polka dot   |
| 6   | Solid Color           | Chocolate   |
| 7   | Product Decoration    | Name Tag    |
| 8   | Additional Functions  | Pencil case |
| 9   | Forms of Additional Function | Square |
| 10  | Color of Additional Functions | White |

The final design of the bookshelf product obtained based on the results of Brainstorming can be seen in Figure 1.

Figure 1. Bookshelf product design

4.2. Clarifying Objectives
Clarification of objectives is the first stage carried out in the design process. In this step, a goal tree will be created which is useful for classifying the goals and sub-objectives of the product to be made, where the relationship between the two is related by the 'how' question and the 'why' question.

The steps that must be taken in making the destination tree are as follows:

- Make a list of product design goals
  The list of design goals for office stationery shelves is as follows:
  - Form of Product bookshelf : Square
  - Color of Product bookshelf : Purple
  - Bookshelves product motif : Zig Zag
  - Number of bulkheads : 1
  - Motif on the bulkhead : Polka dot
  - Color on the bulkhead : Brown
  - Decoration of bookshelves : Name tag
• Additional functions : Pencil case
• Forms of Additional function : Square
• Color of Additional functions : White

Make a list of goals and sub-goals of design from the high level to the lower level. This step aims to find out what are the main objectives and additional objectives of product design and show the relationship between the two goals.

• Designs related to the physical design of bookshelves
• Functions related to the additional functions of the bookshelf product.
• Create a diagrammatic destination tree that shows the hierarchy of each goal and sub-objectives of the bookshelf product design.

![Diagram of bookshelf destination tree](image-url)

**Figure 2.** Destination tree diagram bookshelf
4.3. Establishing Function
Function determination is used to determine the required functions and system boundaries in product design, in this step the method of function analysis is used to describe the input output system of the Bookshelf product manufacturing process with the Black Box principle. The steps in assigning functions are as follows:

- Arrange the overall system function in the form of input-output transformation. This step is illustrated through an input-output transformation diagram (Black Box) which shows the process of adding value to an input into an output that can meet consumer needs.
- The division of functions into essential sub-functions
  - The book shelf product design function is divided into several sub-functions, namely:
    - Product manufacturing function sub. The making of the product is done as a place to store books and stationery.
    - The sub-function of making bulkhead. Screening is done as a barrier between bookshelves.
    - Sub product finishing function. Products that have been assembled, mashed and painted as desired and then combined the main functions with additional functions that have been made. After combined, add product decoration as desired.
- Block diagram showing interactions between sub-functions
- Design limiting system bookshelf
- Appropriate components for carrying out these sub-functions include:
  - The main function: wood, meter, saws, sand paper, ruler ballpoint pens, cutting machine
  - Additional functions: meter, sand paper, wood glue
  - Finishing: sand paper, spray paint, wood glue, name tag stickers

4.4. Arrangement of Requirements (Setting Requirements)
After the function is set, the next step is to determine the needs. This third step aims to create accurate manufacturing specifications that are necessary for the design / design. The method used is the Performance Specification Model.

The steps in preparing the requirements are as follows:

- Make different levels of generality of design solutions that can be applied.
- Determine the level of generality to operate
- Identify the performance of the product attributes required
- Determine the performance requirements for each attribute in full

4.5. Sub Solution
Determination of these characteristics aims to determine the desires and needs of consumers of the product organizer file that is being designed.

- Identifying consumer desires in the form of product attributes.
- Determine the relative importance of the product attributes.
- Evaluate competitor product attributes.
- Describe the matrix of resistance between product attributes and technical characteristics.
- Identify the relationship between product attributes and technical characteristics.
- Identify relevant interactions between engineering characteristics.
- Determine the level of difficulty, the degree of importance, estimated costs, and a description of the target to be achieved.
4.6. The Solution
Alternative generation aims to collect as many alternatives as possible that can be used to solve the problem, to then look for the best alternative. This is done using Morphological Charts with the following steps:

- Make a list of functions or goals that are important to the product
- Make ways to achieve essential functions
Identify a combination of design solutions that can be applied
Identify a combination of design solutions that can be applied
Identify the feasibility of a combination of sub-solutions

4.7. **Alternative Evaluation**

Alternative evaluation aims to compare the utility values of alternative product designs made or made on the basis of performance on the basis of weighting objectives, where the results of the alternative generation step are evaluated by examining the alternatives to be selected so that the best alternative is produced. The method used is the Weighted Objectives method. The steps in this alternative evaluation are:

- Make a List of Design Goals
- Ranking the objectives of designing a list of goals and sub-goals from the high level to the low level.
- Determine the relative weights of each goal.
- Establish implementation parameters / usability values for each purpose.
- Make calculations and compare the relative utility values of alternative designs.

![Bookshelf Gantt Chart](image)

**Figure 4.** Bookshelf gantt chart

From the calculation results obtained that the alternative Bookshelf has the largest value of 3.5980 which is the best solution followed by alternative 1 = 3.2376, alternative 2 = 2.8324 and alternative 3 = 2.7927. Therefore, alternative groups VI, and alternative 1 will be compared between the characteristics of one with the other by displaying the weight of their values and interests.

From the picture above, it can be seen that the greatest weight is found in W9, which is the form of an additional function, while the smallest weight is W10, which is an additional function. Both alternatives show a very large deviation from the weight of each alternative.

The alternative chosen was an alternative to group VI because the gantt chart showed that the alternative to group VI had a smaller gap than the gap from alternative I.
4.8. Design Development (Improving Details)
The final stage of the design process aims to increase the value of products for consumers and reduce costs incurred by producers, solutions that have been obtained from the alternatives that are then communicated to consumers through products with all the advantages of its attributes compared to competing products that have of a kind. This can be done using the Value Engineering Method.

4.9. Discussion
Based on the bookshelf production process it was found that there were difficulties with the length of wood cutting. This is because the wood has a hard structure. The rack is a little complicated so that the operator is less thorough in the wood cutting process.

5. Conclusion
Based on the above analysis, the conclusions that can be drawn are:

- Product design bookshelf using Nigel Cross’s 7 steps which produces a tree diagram with 3 different levels.
- The improving details stage which consists of the eliminate process and the reduce process shows a decrease in the value of making products from prices IDR 145,325 be IDR 110,325.

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