Integration of Kano Model and Quality Function Deployment (QFD) to Improve Product Quality: A Literature Review

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Abstract. Companies must continue to improve service quality in order to face increasingly fierce competition. The design developed by the company must be a design that prioritizes the needs and wants of consumers. The purpose of this literature study is to make an analysis and synthesis of existing knowledge related to the topic to be studied in order to find gaps for the research to be carried out. In product design and development, there are many methods that can be used, one of which is using the Kano model and the Quality Function Deployment method. The kano model is widely applied as a useful tool for understanding customer needs and analyzing the effect of meeting customer needs on customer satisfaction levels. Meanwhile, Deployment Quality Function is used to translate the needs and desires of consumers which are then developed to meet product and service design requirements. This paper explains the extent to which the two methods are applied, namely the Kano model and the Quality Function Deployment method by analyzing several relevant journals. The author hopes that this paper can be used as a future reference for researchers in product design.

1. Introduction

Everyone agrees that industry competition is increasing. Meeting customer needs in terms of commonly used products to obtain market protection is not sufficient. Customer wants and needs must be met and this requires understanding from the customer which is constantly changing. Because customers do not always want or expect high commodity services, the expansion of quality affects customer satisfaction. The problem is what are the customer expectations of the commodity/service and how many commodities / services that meet expectations must be of high quality. Then quality can be defined as a property of a commodity / service which includes the ability to obtain relevant expressions of customer wants and needs [1].

Increasingly fierce competition forces companies to continue to innovate in order to support the quality that will be offered to customers. Excellence in competition is seen as important to attract customer attention. However, services with the usual attributes do not always maintain and increase competition in the market. So, the company needs to better understand what the requirements and wants of its customers are, and how those customers’ priorities are certain attributes of service provision [2].

Companies have their own way of defining quality that is not as natural as defect-free. In the view of Armand V. Feigenbaum, an expert in the field of quality, "Quality must start with identifying customer requirements and end with the product or service in the hands of a satisfied customer”. This
shows that whenever a company defines quality standards then they have to ensure that the requirements of the customer (user) are well met as one of the keys to staying in a competitive market.

This canoe model is widely used as a useful tool to meet and understand customer needs and analyze the effect of customer satisfaction on meeting their needs [3]. Meanwhile, Quality Function Deployment used a tool to link customer requirements in technical specifications, and is now applied in product and service design [2]. So it can be concluded that the relationship between the two methods is used to translate consumer needs and improve customer service attributes in order to improve product quality. Based on this method, the output of each matrix is used as input to the next matrix. So, through this procedure, the transfer of quality from the planning stage of a product or service to the production and assembly stage is carried out systematically [4].

On the off chance that the consequences of QC tests can’t satisfy the acknowledgment models, the aftereffects of examination of the entire arrangement of the estimations on that day must be eliminated or should be re-dissected, and an incomplete or full re-approval of the strategy considered [19].

The purpose of this literature study is to make an analysis and synthesis of existing knowledge related to the topic to be studied in order to find gaps for the research to be carried out.

2. Research Methodology

The method used in writing this article is literature review, which is a literature search both internationally and nationally using the Google Scholar website, the EBSCO database, and Science Direct. This paper describes several literatures works on the canoe model approach and the Quality Function Deployment method. The collected journals are journals that discuss the integration of the canoe model and the Quality Function Deployment method.

Literature review is not just an understanding of reading literature, but more in-depth understanding and evaluation of a topic in previous research. Literature review is said to be good if you have made new findings in a scientific paper by evaluating the quality of the findings.

In writing review literature there are several stages which are divided into five stages, namely:

- Define the topic to be reviewed
- Identify relevant and clear literature
- Conduct a literature review
- Write down the results of the review
- Apply the study to be carried out in the literature [5].

3. Results and Discussion

3.1. Kano Model

This model was first developed by Noriaki Kano and his team in 1984. This was done to identify and define a model by categorizing and prioritizing customer needs and providing a production container with guidelines for product design and development cycles in order to provide customer satisfaction that will continue to grow when return to a product with the same manufacturer [6].

The Kano model is one of the methods / techniques used to decide which attributes are most influential in order to meet customer (user) satisfaction when designing products and / or services [7]. The Kano method is used to find out the technical requirements of the customer. With this Kano method, one can clarify customer requirements more easily by classifying the attributes which are difficult to see into several groupings which can be shown graphically. The basis of this Kano method is that we know that customer satisfaction does not always lead to satisfaction for all product attributes or service requirements, nor is it always proportional to how functional the product is or higher quality [8].

On the Kano diagram the horizontal axis lines, show the physical adequacy of certain quality attributes, then on the vertical axis, indicates satisfaction with certain quality attributes [9]. There are six canoe models currently in effect, which can be seen in Figure 1:
• Must-be (M), a requirement that is not disclosed by the customer and this requirement does not lead to customer satisfaction. This type of requirement presents a certain minimum level of a product or service that must be achieved by the organization.

• One-dimensional (O), to show the increase in satisfaction linearly and usually expressly stated by the customer. This requirement is a standard type, meaning that before using a product or service the customer can define it.

• Attractive (A), Fulfillment of these requirements will lead to a very high increase in customer satisfaction. But if it is not fulfilled, it will not cause a decrease in the level of satisfaction. This requirement is neither expressly stated nor expected by the consumer.

• Indifferent (I), a requirement whereby customers are indifferent to product features, the presence or absence of these attributes does not make a difference in satisfaction reactions to the product. This is what should be avoided in doing because it is not very useful.

• Reverse (R), a requirement that the customer does not want, and if what the customer wants for the product is met, customer satisfaction is reduced. Maybe some of the functions / attributes of a product or service conflict with what customers want and expect.

• Questionable (Q), requirements that customers may not understand. For example, the interviewee misunderstood the question or crossed out the answers incorrectly. Most of the studies do not include this category of requirements, because it is feared that customers are misinformed [10].

The Kano model is basically a qualitative formulation, however quantitative formulations have been developed and used as a methodology that supports the decision-making process. According to the indications, some researchers interpreted that the product / service attribute was an important attribute used to determine the potential satisfaction of customers when conducting a survey. Furthermore, to generate satisfaction or avoid customer dissatisfaction in the absence of expected characteristics or performance. Then the number of must be, one dimensional and attractive must be higher. These two views as two distinct indices, viz. The coefficient of better (satisfaction level) and worse (level of dissatisfaction), which is calculated using the following formulas [11]:

![Figure 1. Kano model](image-url)
In the above equation, the symbols $A$, $O$, $M$, and $I$ show the customer response for each attribute assessed by the respondent regarding the quality attributes Attractive, One Dimensional, Must-be, and Indifferent. According to the dynamic Kano model, the term Better should apply first, then, with time and experience, the Worse index will become relevant.

### 3.2. Quality Function Deployment

Quality Function Deployment (QFD) is a method used to determine consumer demands or demands then translate these demands accurately into technical requirements, manufacturing systems, and precise production planning. In the late 1960s and early 1970s in Japan, developed by the Mitsubishi company at the Kobe Shipyard, and adopted by Toyota and continued by other companies, it quickly spread to the United States in the 1980s and later industrial industries in various countries, and a lot of literature on QFD reveals the very rapid development of QFD. To match the different needs of researchers and QFD practitioners, the literature needs to be categorized and reviewed [12].

The main part is the QFD house of quality, which is a graphical matrix which includes six major newcomers such as voice of the customer, technical response, relationship, benchmarks, correlations, and technical assessment. These submissions can broadly and clearly describe the relationships between various elements and identify comparisons with competitors who have similar core businesses. QFD is analyzed by cross-functional teams, because the horizontal concept extends across functional organizations. The QFD team must be intensively communicated with stakeholders where industry, customer and management representatives are required to obtain the required information[13].

![Figure 2. Basic house of quality](image-url)
The house of quality is the first stage in the development of Quality Function Deployment (QFD). The House of Quality forms like a house that shows the structural framework of the design and forms a cycle. The key in building HOQ is to focus on customer needs, so that the design and development process is more in line with what customers want than innovation technology. This is intended to obtain more important information from customers. This can lead to additional initial planning time in the development project, but the time to design or redesign to make the product or service market (time to market) will be reduced [13].

The relationship between technical information and customer desires is very important in order to determine the technical requirements set as targets. This is to ensure that the next product will truly be competitive so that it can satisfy customer wants and needs. In order to use the VOC, the technical requirements and selection of competitors will also determine the correct outcome. The results obtained in each section affect the results of other sections, and the correct selection of the parameters used is very important to get the best results [14]. In addition, to make a good product, QFD also evaluates the results and compare them with others to identify the purpose of the specific product will be increased. After all the requirements are identified, what is important is answering what product design must be done to meet the required requirements and assisting the trade-off decision to make a process [15].

Akao said that Quality Function Deployment is a method that aims to satisfy consumers by linking consumer wants and needs into design targets, the main points of quality are used as guarantees to develop quality during the production phase. Quality Function Deployment is a way to ensure design quality while the product is still in the design stage. As a very important side benefit, he points out that, when properly implemented, Quality Function Deployment has shown a reduction in development time by half to one-third. As for the 3 main objectives in implementing the Quality Function Deployment are:

- Prioritize customers' spoken and unspoken wants and needs.
- Translating requirements into technical characteristics and specifications.
- Build and provide quality products or services by focusing everyone on customer satisfaction [16].

The following models from Quality Function Deployment Phases 1 to 4 fit the criteria and conditions [17]:

![Figure 3. Model 4 phase in QFD](image)

Four different phases are explained below:

- Phase 1 (Product Planning), namely Building a quality house. At this stage led by the marketing department, this phase is usually called the House of Quality. Already various organizations have
gone through this phase of the QFD process. This phase documents a variety of data ranging from customer requirements, competitive opportunities, product measurement, competitive product sizes, warranty data, and the technical ability of an organization to meet every customer need. The success of this phase can be measured by how well the customer provides the required data.

- Phase 2 (Product Design), at this stage led by the engineering section in designing a product. A solid and compact team and creativity and innovative ideas are the keys to success at this stage.
- Phase 3 (Process Planning), at this stage led by the manufacturing engineering section. During process planning, all documentation of the manufacturing process is made with a flowchart used as a process parameter (or target value).
- Phase 4 (Process Control), is the last stage, at this stage production planning is carried out. This stage is carried out to review the performance made to monitor the production process, maintenance schedules, and skills training for operators. This stage is a scale that has been done to carry out the production process [18].

Figure 4. Flowchart of kano concept integration model in four phase QFD framework

3.3. Integration Of Kano Model and Quality Function Deployment
The four phases of the integration process of QFD and Kano are described in a flowchart in Figure 4, which describes the integration process carried out. QFD phase I uses the Kano method to classify design
requirements and customer requirements. The results of the Kano questionnaire will be calculated based on the value of the effect of customer satisfaction and dissatisfaction, while the QFD questionnaire is used to determine the attributes of the technical requirements that customers want. The following is the integration between the canoe model and the Quality Function Deployment method [19].

The following will show a list of journals that use the Kano model integration and the Quality Function Deployment method along with their application fields. There are several journal articles that have been selected, investigated and reviewed for further analysis.

**Table 1.** Some identified literature reviews about kano model integration and quality function deployment

| Authors                          | Title                                                                 | Approach                  | Results identified |
|---------------------------------|-----------------------------------------------------------------------|---------------------------|--------------------|
| Ismail Wilson, Taifa and Darshak A. Desai | Quality Function Deployment Integration with Kano Model for Ergonomic Product Improvement (Classroom Furniture) - A Review | QFD, Kano, dan Ergonomics Principles | This paper uses QFD and Kano integration. The integration of these techniques enhances customer-oriented classroom furniture design. The integration between the Kano Model, Quality Function Deployment, and Ergonomics Principles can help to understand user needs, satisfy students who spend six to eight hours per day and solve ergonomic design problems in long-term use of classroom furniture. |
| Hosna Pakizehkar, Mohammad Mirmohammadi sadrabadib, Rasool Zare Mehrjardic, and Amir Ehsan Eshaghiehd | The Application of Integration of Kano's Model, AHP Technique and QFD Matrix in Prioritizing The Bank's Substructions | Kano, AHP, and QFD         | This paper uses Kano, AHP, and QFD integration which is used to identify and prioritize customer needs through Kano, AHP, and QFD integration. The results showed that the most important technical requirements were to improve communication with clients. |
| Anjar Priyono and Andina Yulita | Integrating Kano Model and Quality Function Deployment For Designing Service in Hospital Front Office | Kano - QFD                | This paper uses the integration of QFD and the Kano Model for improvement. This study reveals that benchmarking against competitors can produce misleading results. The results differ when the analysis combines the QFD method and the Kano Model because it offers priority improvements in service attributes and technical requirements. |
| Mahmoud Afsar, Kamran Feizi and Amir Afsar | An Integrated Method of Quality Function Deployment, Kano's Model and Hierarchical Decision Making For Improving E-Service of Brokerage in Iran | QFD, Kano, and Hierarchical Decision Making | This paper uses the integration of QFD, canoe and Hierarchical Decision Making. Customer needs were collected through individual interviews with 20 customers, 10 needs were selected to be included in the housing quality planning matrix based on their frequency and then prioritized using AHP techniques. When the planning matrix was completed, each requirement was classified using the Kano questionnaire. Finally, the integration of these methods can help |
Adila Md Hashim, and Siti Zawiah Md Dawal

Kano Model and QFD integration approach for Ergonomic Design Improvement

Kano - QFD

This paper presents a combined method of the Kano Model and Quality Function Deployment to improve workstation design in terms of ergonomics and user requirements. A survey was conducted of 336 respondents to identify current workstation problems. The collected data was translated into Kano questionnaires and answered by 255 respondents. Then clarify and build a House of Quality matrix. The result is that both of these methods can be implemented into a new workstation that is designed ergonomically by prioritizing modification elements.

Customers needs and demands do not have a linear relationship with their satisfaction. So, the importance of each request and need can be reviewed with the help of the Kano model. Based on this model, customer needs are classified into three classes, they must be quality requirements, one-dimensional quality requirements, and attractive quality requirements. Since planning a home quality matrix is a prerequisite for prioritizing needs and determining their importance, using the integrated Kano model and quality planning table, the results will be priority needs regarding classification in the Kano model and this will reflect the nonlinear effects of some needs during their final priority determination.

4. Conclusion

Increasingly fierce competition forces companies to continue to innovate in order to support the quality that will be offered to customers. Excellence in competition is seen as important to attract customer attention. Understanding customer needs can thus be viewed as an important source of competitive advantage. The methods that can be used in this case are the canoe model and the Quality Function Deployment. The kano model is widely applied as a useful tool for understanding customer needs and analyzing the effect of meeting customer needs on customer satisfaction levels. Meanwhile, Deployment Quality Function is used to translate customer requirements into technical specifications, and is now applied in product and service design. So, it can be concluded that the relationship between the two methods is used to translate consumer needs and improve customer service attributes in order to improve product quality.

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