Integration of Kansei Engineering and Quality Function Deployment (QFD) for Product Development: A Literature Review

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Abstract. Kansei is a Japanese word that means consumers' feelings and psychological imagery about new products. Kansei Engineering aims to produce new products based on the feelings and demands of consumers. Quality Function Deployment can be defined as a mechanism or process for determining customer requirements which are further translated into technical characteristics, so that every level of organization and functional area are able to understand and make improvements to achieve the objectives of consumer product selection that now seems irrational. However, price, quality assurance and functionality are no longer the choice's main criteria, but what attracts and invites the five senses has become the choice. Spoiling customers is now critical issues to long-term business success. Through Kansei Engineering can help translate customer feelings into design specifications, while QFD can help companies to determine customer desires. This paper provides a combined analysis of method reviews from Kansei Engineering with Quality Function Deployment. Several international journal articles published in 2010-2019. Thorough analysis has been carried out and focused on this paper on practical use.

1. Introduction
Kansei is a Japanese word that means consumers' feelings and psychological imagery about new products. When the consumers want to buy something, they have the image of the product as "luxurious, vibrant and strong". Kansei Engineering technology allows its image with feelings to be used in the new products. Kansei Engineering is explained as "the technology of translating consumer feelings (Kansei in Japanese) from product to design elements [1].

Kansei Engineering has a goal to produce new products based on feelings with demands of consumers. There are four points related to the technology:

- How to understand consumer (Kansei) feelings about products in terms of economic and psychological estimation,
- How to identify the product design characteristics of Kansei consumers,
- How to build Kansei Engineering as an ergonomic technology,
- How to adjust product design with changes in current society or trends in community preferences [2].
Kansei Engineering, collected words of customer feelings or Kansei from stores that sell and from magazines’ industry. Our first step was to collect 600 to 800 Kansei words and then select around the 100 most relevant words [3].

QFD can be defined as a mechanism or process to determine customer requirements translated into technical characteristics, so that each organizational level and functional area are able to understand and make improvements to achieve goals [4]. Quality Function Deployment is a technique utilizing to guarantee the quality in each creating items stages, beginning by the plan quality itself [22].

Shifting customer needs from purely functional and financial perspectives to hedonistic needs involvement requires the new set of thoughts in design’s product. It is proposed that the Kansei engineering methodology with the QFD are simultaneously used to modify the customer's voice to both emotional and functional needs. QFD offers several different tools. Kansei Engineering offers the opportunity to gather customer attitudes about the importance of different product variations [5].

The purpose of this literature study is to review the use of the integration of Kansei Engineering with QFD based on its application field and the advantages of using the Kansei Engineering with QFD method.

2. Theoretical Background

2.1. Kansei Engineering

Kansei Engineering was introduced by Prof. Mitsuo Nagamachi in 1970. Kansei engineering is a technology that combines Kansei (emotions and feelings) with engineering disciplines (engineering). KE is used in product development to obtain customer satisfaction, namely by analyzing human feelings and emotions and connecting those emotions and feelings into design’s product. Kansei Engineering have a goal to develop products based on the innermost feelings of consumers [6].

The consumer's need for a product is not only in terms of functionality or utility but begins to emphasize emotional needs (Kansei). Consumer choice for a product that now seems irrational. Quality assurance, price, and function are no longer the main criteria of choice, but what attracts and invites the five senses is an option. Spoiling customers is now critical issues to long-term business success [7].

Kansei Engineering as a type of product development methodology, can be defined as a methodology for translating human psychological processes to an existing product or new design concepts [8].

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2.2. Quality Function Deployment (QFD)

The main focus of QFD is to involve customers in the product development process as early as possible, where their wants and needs serve as the starting point of the process of QFD. Therefore, QFD is referred to as the voice of the customer. QFD is defined as a structured mechanism or process to define customer requirements and translate them into relevant technical requirements, where each functional area of the organization can understand and act. In other words, QFD translates what customers need into what the organization produces [10, 24–30]. The QFD approach may likewise be extremely useful for scholastics intending to approve recuperation viability in the administration business [23].

The QFD application methodology in the service or product design process begins with the formation of the service or product planning matrix or called the HOQ.
Figure 1. House of quality

Part A: Room in the first of HOQ is the needs or customers’ desires. This phase uses the diagram of affinity process and then is arranged in a hierarchy with the lowest level of need to the highest level. Most development teams collect customer votes by interview and then arrange in a hierarchy.

Part B: The second part of HOQ (The Planning Matrix) and referred to as a place to determine product goals or objectives, based on the market research team’s interpretation. Goal setting is carried out with a combination of priority customer needs.

Part C: The part when HOQ is a technical response, describe products or services for development. Usually the pictures come from customer needs in the HOQ’s first section.

Part D: The HOQ’s fourth part is relationships, the biggest part in the matrix and the work. In the phase uses the priority matrix method.

Part E: The fifth part of HOQ is technical correlations, matrices that look like roofs. Used to help the QFD team find out which designs are experiencing bottlenecks and determine the key communication between the designers.

Part F: This section consists of three types of data namely:

- Priorities of Technical response, ranking order of importance (ranking) technical requirements.
- Competitive technical benchmark, inform the results of ratio of the technical requirements’ performance products produced by the company against the product performance of competitors.
3. Research Methodology

The method used in this paper is the literature review study. This paper presents several works of literature on Kansei Engineering with QFD method. The collected journals are journals that discuss the integration of Kansei Engineering with QFD. The journals are collected through the Google Scholar and Science Direct websites.

4. Result

4.1. Integrating Method

Rony dan Achmad [12] make and store the design of a precise cement gauge and is convenient to use. To support this goal, in this study using the Kansei Engineering and Quality Function Deployment (QFD) methods. A calculation results show there are 15 attributes (customer needs) and 10 technical parameters (technical responses) that are implemented in an anthropometric measuring device design.

Naufal [13] integrated KE and QFD to design electric guitar bags. From this research, 111 Kansei words were identified which were then reduced to 12 Kansei groups which were used for semantic differentials assessment of 17 product samples. The data from the assessment is then used for the factor analysis process which results in four need factors. The four needs factors are the factor of having the ability to protect the guitar from various external factors, the factor of having the ability to load various tools needed by the user, the practical and comfortable factor when carried, and the factor of having an appearance that suits its class. These four factors are the input of designing the product concept using the House of Quality matrix.

Leman dan Gülser [14] expanded and integrated QFD and KE to support the process of setting CR and TR targets in product planning by paying special attention to products with a sensory characteristic. Developed analysis methods and data collection, than applied to pure yogurt to solve related difficulties determining the direction and target of improvement for CR and TR by also applying sensory studies in the literature.

In industrial design, as summarized by Brotchner and Mazur [15], Kansei engineering brings "reason" and analysis into the process. This process requires a metaphor; it examines user experience by the feelings generated by the product and the sense differences that are touched by it. In the industrial design process, specifically in product development and design, an integral part of the process lies in the design of Kansei and QFD.

Alancari and Tolooei's research [16] aims to investigate the emotional connection of users and product properties; thus this shows that there is a direct relationship or connection between the user's emotional factors and the properties of the product. In addition, customer-focused designs are needed to realize success in international markets, but situational knowledge about competition is also needed in the right market segments. Comparison of products from various products in the same segment can be provided by QFD - a comparison in terms of the level of fulfillment of certain consumer needs. By comparing the EC studies results made for different competitor products, the comparison profile is able to established and included in HoQ. The HoQ-KE combination allows the creation of Kansei specific profiles that are expressed by the product.

According to Schütte, Kruis and Eklund [17], KE and QFD have a role in product development. They emphasize that consumer needs can be explicitly integrated in the product development process, which then leads to innovative solutions. Affective data is more abstract than QFD input data based on objective consumer needs - such as functionality, durability, and ergonomics.

Thompson [18] noted that the needs and desires of consumers are related to technical responses (in the relationship matrix). The relationship strength is bended by the guesses of more or less qualified experts who distinguish between weak, medium, and strong relationships. Refinements to scale further complicate decision making process and consequently increase evaluation time. For some cases, more
comprehensive informations are needed. KE is able to calculate these connections by developing Kansei's mathematical model from consumers. Statistics allow the examination of different groups of consumers who have different opinions, turn leads for alternative product development. At QFD, consumer needs are collected using methods such as focus group interviews or activity analysis.

Fransiska [19] integrated Kansei Engineering with QFD to design quality bottles and seasoning bottles. In this study, using KE and QFD for the purpose of packaging and products that are attractive, ergonomic, and simple. The Nineprototype packaging design was offered to the focus group discussion respondents, using the Kansei word, Design 2 was the best design. To fulfill "end client" desires for a good taste, fire, reusable bundle and solid surface, we use the QFD technique. As a result, spice size of particle is less than 250 microns, increasing the spicy composition ingredients, the design of the thin bottle with the size of 0.05 cm, lots of tiny holes on the cap for sparkling.

Wassanai and Tanitta [20] Product development for GABA rice snack that was selected in this study based on the target group of healthy snacks. The Quality Function Implementation Technique (QFD) is applied to develop GABA snack products that are suitable for paying attention to consumer preferences. Subsequently, Kansei engineering technology was implemented to provide advice on the appropriate snack package form for each particular group.

Ernanda, et, al [21] made improvements to the design of the garbage cart by knowing the wishes of the garbage cart operator and the owner of the garbage cart facility, namely the Surabaya City Sanitation and Landscaping Office. The method used is to use the Kansei Engineering method and the Quality Function Deployment method. The design of the garbage cart uses a propulsion tool in the form of a bicycle that is combined with the garbage cart using a slot lock so that it can be removed and installed. The use of a combination of front: rear gear on a bicycle of 9:19 makes the paddle load light, thus minimizing the chance of injury arising.

5. Conclusion
Kansei engineering is used in product development to obtain customer satisfaction, namely by analyzing human feelings and emotions and connecting those feelings and emotions into product design. Kansei engineering aims to develop products based on the innermost feelings of consumers. The main focus of QFD is to involve the customer in the product development process as early as possible, where the wants and needs of each customer serve as the starting point of the QFD process. The integration between Kansei Engineering and Quality Function Deployment is widely used for product design and improvement in accordance with the feelings and emotions of consumers.

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