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Consumer-driven product development and improvement combined with sensory analysis: A case-study for European filled chocolates

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ABSTRACT

Food producers are constantly searching for ways to improve existing products and to develop new products. Quality Function Deployment (QFD) methodology was designed to help incorporate the consumer's needs into the development and improvement of products. The House of Quality (HOQ) is the first matrix produced when QFD is applied. Although several adaptations to the HOQ have been made to make the method user-friendly for the food industry, very few industry applications can be found in the literature.

This paper presents the possibilities and limitations of the HOQ for the improvement of food products based on consumer preferences, processing parameters and sensory attributes. The method is illustrated by a case-study for filled chocolates. Although the results of the case-study provide insights concerning product improvement of filled chocolates, it also reveals limitations for the application and interpretation of HOQ within the food industry. To tackle these problems, the authors propose to include fuzzy set theory when completing the planning matrix, to incorporate chain information in the HOQ, and to establish good communication between departments. With precise and appropriate application of the HOQ, it is possible for a company to produce products with high consumer preference and, thus, a high success rate.

Introduction

Food companies are constantly searching for ways to innovate and to develop new or improved products to stay competitive (Craig & Hart, 1992). The difficulty within a company, when improvement or development of a process or product is necessary, is the communication between the involved departments. In order to develop new or improved products, collaboration between R&D, the sensory, and the marketing departments is necessary. However, these functional teams are traditionally situated in different parts of the company, often without any communication or coordination among them (Bech, Engelund, Juhl, Kristensen, & Poulsen, 1994). Therefore, the development of a methodological framework that includes the concerns of the R&D, marketing, processing and sensory department can be of use to collaborate and work more efficiently, thereby saving the company time and money (Craig & Hart, 1992). Theoretically, Quality Function Deployment (QFD) can meet this need when it is used as a structured approach for product improvement instead of in its traditional use for new product development. In order to use QFD for new product development, the amount of data that is required as input for the method is unlikely to be available for a product that is not on the market yet (Simeone & Marotta, 2010). Moreover, Simeone and Marotta (2010) state that it is challenging to obtain the voice of the consumer for non-existing products. However, QFD is considered to be the most complete and comprehensive method for integrating the goals of many processes and aligning them to the consumer's requirement (Holmen & Kristensen, 1998). On one hand it identifies problems that lower the acceptance of the consumer, while on the other hand it keeps in mind the process parameters and sensory characteristics of food products (Van Kleef, Van Trijp, & Luning, 2005). Kwong, Chen, Bai, and Chan (2007) state that when a company makes an effort towards meeting the customer requirements, development cycles are shortened, internal conflicts minimized and market penetration increases. Moreover, the quality of the product is improved, which results in higher customer satisfaction and higher revenues. Within a scientific context, QFD has been applied in the development of various food products, such as butter cookies, tomato ketchup, smoked eel, and chocolate cake mix (Bech, Kristensen, Juhl, & Poulsen, 1997; Bech et al., 1994; Hofmeister, 1991; Park, Ham, & Lee, 2012; Viaene & Januszewska, 1999). Although scientific studies clearly acknowledge that the use of QFD increases the chance of developing successful products, producing higher quality products and decreasing the cost of development time, the method is rarely

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used within the food industry (Garcia et al., 2007). This might be due to the fact that the implementation and interpretation is more complex than the current literature suggests (Benner, Linnemann, Jongen, & Folstar, 2003; Costa, Dekker, & Jongen, 2001). In the few cases in which the method is used, most of the relevant information is confidential and unavailable for the general public (Costa et al., 2001). Recent research has looked at adjusting the QFD method by making it more flexible and applicable for food companies (Bevilacqua, Ciarapica, & Marchetti, 2012). Sharma, Rawani, and Barahate (2008) indicated in their review that the post-2000 literature and publications helped in the adaptation of QFD to the maturity of user organizations and ever-evolving market conditions. Bevilacqua et al. (2012) presented an innovative fuzzy QFD-based methodology for characterizing customer ratings of food products.

Although QFD and specifically the House of Quality (HOQ), which is the first matrix in this method, are well known to many researchers, the authors believe that an overview of both concepts is needed. Therefore, this paper will first briefly review QFD and HOQ. Next the case of European filled chocolates will be used to illustrate how the HOQ can be developed based on consumer, sensory and instrumental data. In this case the problem of fat bloom is presented to demonstrate the specific use of the HOQ. Finally, the bottlenecks of the HOQ, and in a broader perspective QFD, are given and some recommendations are provided for an update or a simplification of the method.

Theoretical framework

House of Quality: first step in Quality Function Deployment

Quality Function Deployment (QFD) focuses and coordinates skills within an organization, first to design, then to manufacture and market goods that customers want to purchase and will continue to purchase (Hauser & Clausing, 1988). Chan and Wu (2002) defined QFD as 'an overall concept that provides a means of translating customer requirements into the appropriate technical requirements for each stage of product development and production'. Two main QFD implementation methods are defined in the literature (Cohen, 1995; Garcia et al., 2007; Hauser & Clausing, 1988). The first, the generic approach, is known as the 'Akao matrix of matrices' and is the most comprehensive QFD implementation model (Akao, 1990). It comprises a scheme of 30 matrices in which every matrix element is a part of the development process. The second approach, known as the 'Four-Phase model', is a technique in which the actual product can be described as several characteristics assembled together in the final product (Park et al., 2012). There are two types of activities involved in this QFD method, namely the product's quality deployment and the deployment of the quality function. The first consists of activities needed to convert customer-required quality into product-specific attributes, whereas the second type of activities are those needed to assure that the customer-required quality which is put into the product, are achieved (Costa et al., 2001). In order to define these activities, cascades of matrix-shaped charts are generated (Benner, Linnemann, et al., 2003). This matrix-generating process has been combined in a four-phase approach which consists of four matrices involving product planning, product design, process planning and process control planning phases. This first matrix is called the HOQ, in which customer requirements are translated into engineering targets (Benner, Linnemann, et al., 2003; Cohen, 1995; Urban & Hauser, 1993). Hauser and Clausing (1988) defined the HOQ as 'a kind of perceptual map that provides the means for interfunctional planning and communication' (Fig. 1). This research only focuses on this first matrix of QFD, the HOQ.

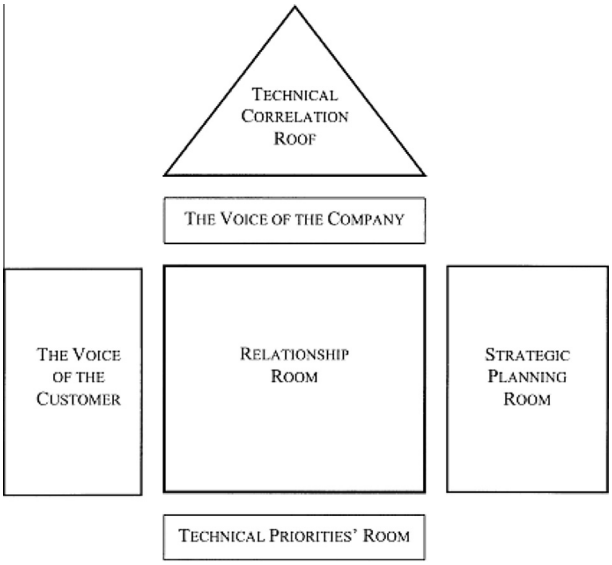

Fig. 1. The House of Quality (Costa et al., 2001).

House of Quality and application in the food industry

HOQ has been the main focus in QFD-related literature, because it contains the most critical information a company needs regarding its relationships with customers and its competitive position in the marketplace (Akao & Mazur, 2003). Input for the HOQ needs to be provided by marketing people and food technologists (Linnemann, Benner, Verkerk, & Van Boekel, 2006). Within the HOQ, the marketing part, known as 'voice of the customer,' tells us what to do, and the technology part, the room of the HOWs, tells us how to do it (Hauser & Clausing, 1988). The link between these departments is crucial to ensure that the company understands customer needs and translates them in an effective way (Gustafsson, 1997). The 'customer' in the QFD method can be a consumer, another manufacturer, a retailer, etc. (Costa et al., 2001).

The construction of the HOQ starts with the identification of *customer requirements*, which are called the customer attributes (CA's), as input for the *'voice of the customer'* (Hauser & Clausing, 1988). As this paper combines the QFD method with sensory analyses, the consumer is the customer here. Therefore, the consumer needs were determined, clarified, specified and used as CA's. These attributes can be derived through focus groups, qualitative interviews, or other possible sources of consumer data: market research data, sales data, consumer complaints, retailers, etc. As a wide variety of attributes can be gained from these techniques, the CA's are grouped into bundles. It is important that the bundles are named in the consumer's own words (Griffin & Hauser, 1993). When designers try to rephrase these attributes, it is possible that they no longer correspond to the consumer's actual views. This mistake can mislead the development teams and can result in the company tackling problems which a consumer considers as unimportant.

The next step is identifying what must be achieved to satisfy the consumers' wants. Whereas the marketing domain tells us what to do, the engineering domain tells us how to do it. In this step, the product is described in the words of the engineer. A list of *engineering characteristics (ECs)* is placed along the top of the HOQ. These attributes affect one or more of the CA's. It is important that these engineering characteristics describe the product in measurable terms and that they directly affect consumer perceptions (Govers, 1996).

As a following step, the *(strategic) planning matrix* is constructed on the right side of the HOQ. The main purpose of the planning