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QFD Integrated in New Product Development - Biometric Identification System Case Study

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Abstract

The paper attempts to integrate the Quality Function Deployment (QFD) method in the New Product Development (NPD) cycle. We propose a methodology to evaluate the voice of the customers in designing innovative products. The results presented after applying the methodology focus on the first stage of requirements capture for both the design phase and for the development of the actual product phase. There was considered as case study an innovative, newly patented product, a biometric identification system for emergency cases. The research methodology is inter, multi, trans- disciplinary approach for the development of innovative products. In the context of our study NPD was the pathway for the research steps to follow, and QFD the logic glue among the specialists from different fields, like quality management, electronics, computer programming and medicine. The methodology follows the general steps of the QFD formalism and consists in developing a mathematical model that quantifies by an overall index, that we call offset, the level of customer requirements achievement by the technical characteristics of the designed or developed innovative product.

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Keywords: innovation; quality; NPD; fingerprint;

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1. Introduction

In the world of business competition, subject to the fast development of new technologies and continuous changes in customer needs, the companies have to adopt according to Graessel and Zeidler, (1993), new approaches in new product development (NPD).

For this, let us look at past successful innovation stories. Steve Jobs, cofounder and CEO of Apple, is widely regarded as one of the most successful innovators in history. From his innovation secrets revealed by Gallo (2010), results that customers cannot say for sure which product they want.

During the development of Apple this approach worked, because, only the large companies had access to innovative technologies and innovative techniques. Currently, customers also have access to these and are able to decide what innovative products they want. In Steve Jobs' approach certainly mattered customers, but more in the sense of familiarizing them with the innovative technologies. In other words, there was created a basis on which customers can build their own ideas. Now, innovative ideas cannot exist without taking into account the customers' needs. It is the merit of Steve Jobs for getting here.

The innovative product life cycle is the main subject of the new product development (NPD) framework. In this context, the QFD methodology can be used in order to avoid the development of a new product that will not be a success on market and to minimize the costs of development. This represents a tool that can help companies to successfully develop new products or to improve the existing ones through a series of innovation related steps, starting from the process of idea generation and ending at the launch of the product into the market.

We chose the QFD method, stated by Chan and Wu (2002), as the method that transforms the "customers' voice" into "product technical characteristics" to be integrated into the NPD, because the most important requirement for a successful NPD is defined as: "Meet the needs of potential customers." Putting customers first, and really understanding them, gives companies a "higher power" that can shake them loose of their stuck-in-the-mud ways. In fact, around 50% of new products fail in the marketplace. And the biggest reason for failure is that the products don't fill the needs of customers.

The study presents the use of QFD method in NPD applied on a biometric identification system for emergency cases. The paper attempts to reconsider the QFD method by proposing a methodology in order to support the NPD as previously applied by Shiu, Jiang and Tu (2007). The biometric identification system for emergency cases uses a method of storing relevant medical information based on biometric identification, generating medical records that allow the emergency medical personal to track the patient medical history and identify problems or patterns that may help determine the course of health care. The innovative product eliminates the classical methods insufficiencies by optimizing the time response, facilitating access and by ensuring an increased security regarding the primary medical information for emergency situations and represents a new storage approach of the primary healthcare information based on biometric identification by means of fingerprint sensor.

2. Research Method

Our research methodology was oriented on inter, multi, trans- disciplinary team work in order to develop an innovative product. The NPD was the pathway for the research steps to follow, and the QFD was the logic glue among the specialists from different fields, like quality management, electronics, computer programming and medicine. The methodology used in our research to perform the QFD analysis consists in developing a mathematical model that quantifies by an overall index, that we call offset, the level of customer requirements achievement by the technical characteristics of the designed or developed innovative product.

The methodology follows the general steps of the QFD formalism according to Akao (1997), but in order to quantify the entire system by the proposed offset, we introduced: the use of different distribution functions for the characterisation of the different difficulty degrees of the quality characteristics; the generalisation of the correlation matrix with the asymmetrical form due to the different dependencies between the quality characteristics; the measurement of the achievement level of each quality characteristic; the use of the influence matrix between the customers' requirements and the quality characteristics; the influence matrix together with the achievement matrix determines the relationship matrix and, thus, the relationship matrix contains exact values resulted from measurements instead of generally used estimations {0, 1, 3, 9}.

Now, we present some key elements that prove the applicability of the QFD method in the context of NPD. The application of QFD to NPD as Graessel, and Zeidler (1993) stated, requires that the voice of customers is integrated in every stage of product planning to ensure customer satisfaction. The first step towards understanding customers' needs according to Lai, Ho and Chang (1998) is to identify attributes and customer consequences, which are a result of using attributes. The interviews and questionnaires generate the customers' requirements matrix CR_n consisting of all the identified requirements grouped in priority classes (figure 1) according to Shen, Tan, and Xie (2000). The design team establishes the main quality characteristics of the innovative product that meet the users' expectations. As a result the quality characteristics matrix QC_m is created and also contains the achievement difficulty level for each characteristic. Each characteristic is related to technical implementations and has well defined purpose. The influences matrix $ICQ_{n\ x\ m}$ contains the way of distributing the users' requirements on quality characteristics, and the correlation matrix $TQC_{m\ x\ m}$ the interdependencies between the characteristics. The technical team implements the characteristics of the product, and the testing team, after applying different methods of evaluation and validation, determines the achievement level of each characteristic and thus the achievement matrix AQ_m. The achievement matrix and the influences matrix determine the relationship matrix $RCQ_{n\ x\ m}$. This matrix shows the accomplishment level of the customers' requirements by the implemented quality characteristics. Based on all these matrices we can compute the offset.

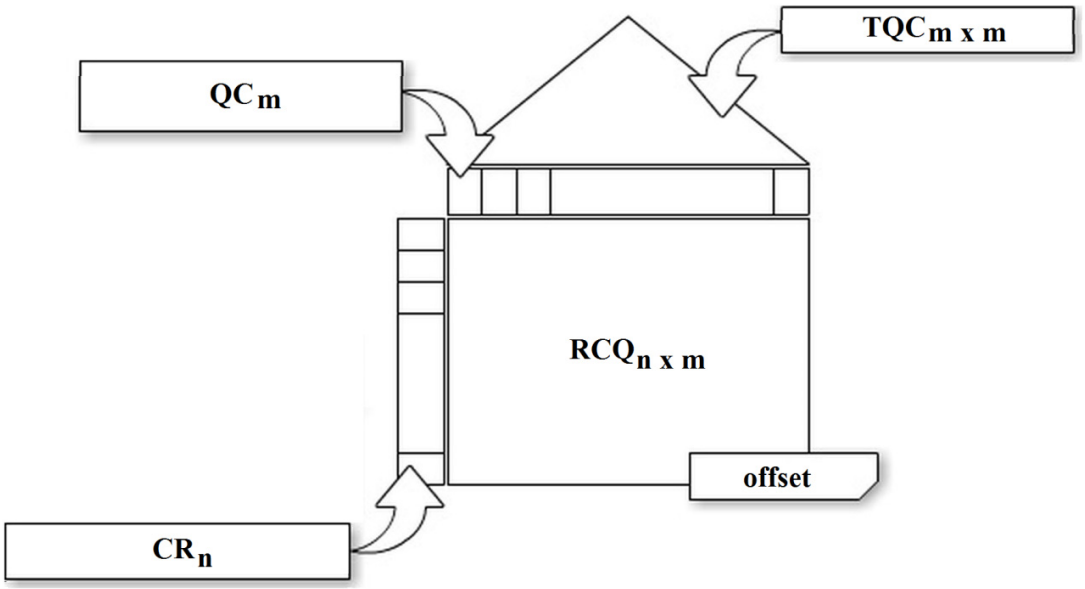


Figure 1. QFD methodology

3. Findings and Results

We will present next, the application of QFD method in NPD for our innovative product, the biometric identification system for emergency cases. The focus will be on the phase of customers' requirements capture.

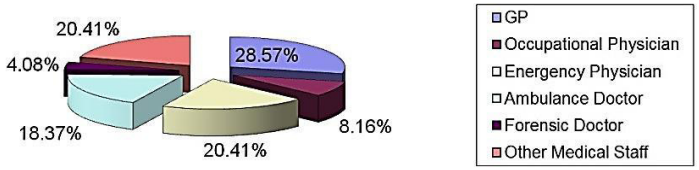


Figure 2. Customers' categories

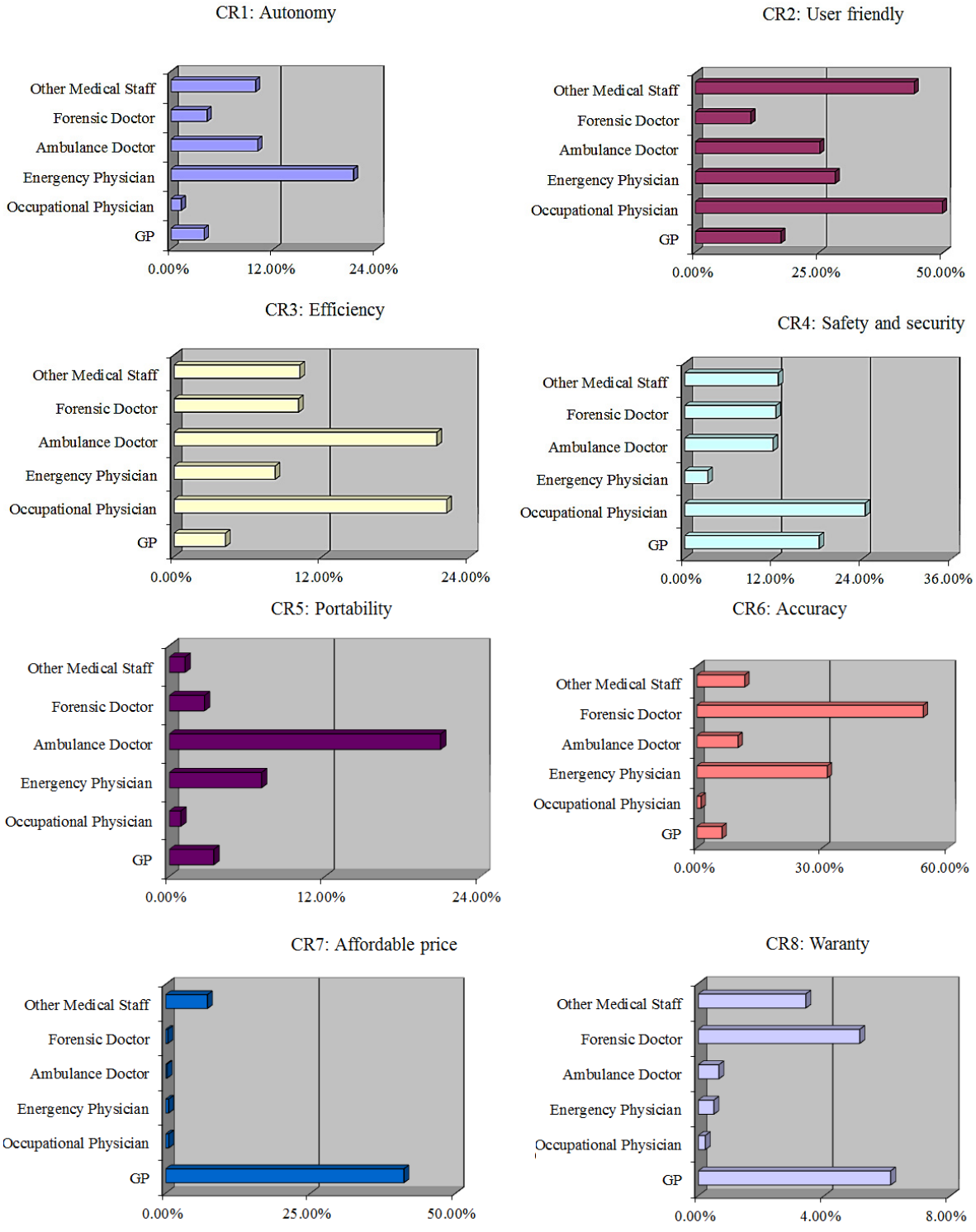


Figure 3. Customers' requirements prioritization

Thus, we identified the customers' requirements, as follows:

CR1: autonomy;
CR2: efficiency;
CR3: safety and security;
CR4: portability;
CR5: accuracy;
CR6: affordable price;
CR7: warranty insurance, service and updates.

The customers' group used for requirements capture phase consisted in several categories, as presented in figure 2. These requirements were prioritized at each customer category level and then was determined the global importance of each requirement, as presented in figure 3.

The current state of the product development consists in the prototype design and validation. From this stage resulted a total of 19 quality characteristics (QC) of our innovative product related to the CRs. The strategy adopted was to determine from each CR the corresponding QCs and then establish the further interdependencies of each QC to the other CRs for the entire accomplishment of all CRs by the QCs. For example, for the CR1 (Autonomy), resulted four QCs, as follows:

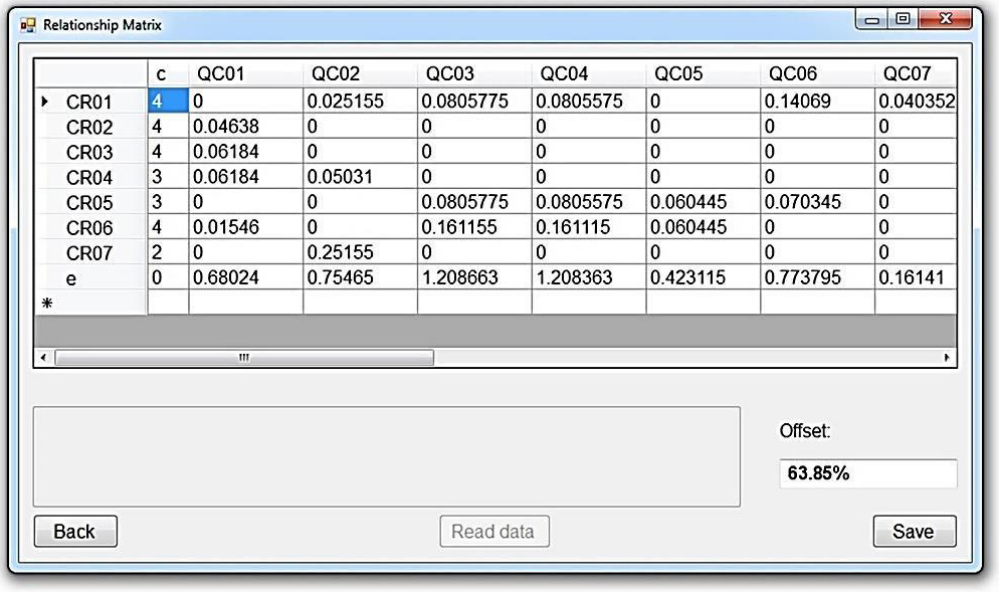
QC1: Ability to start / stop the device
QC2: Automatic power saving mode
QC3: Signal low energy
QC4: Possibility to use both battery and accumulator

We apply the methodology to calculate an index value at the current moment of our innovative product development, which will provide a basis of comparison for the next stages of NPD.

The value obtained by applying the methodology in the design phase, which consisted in developing a prototype for our innovative product, is 63.85% (figure 4). This value we considered viable for a successful product, which led us to patent the product by Leba, Dobra and Ionica (2014).

In the next stage, together with the producers, we will apply the same methodology for the development and implementation phases.

The methodology developed by us will determine which customer requirement is the least accomplished by the characteristics of the product and from what category of customers it comes from. Depending on the category identified, there will be resumed the requirements capture phase using other interview techniques and increasing the number of subjects from the category.



	c	QC01	QC02	QC03	QC04	QC05	QC06	QC07
CR01	4	0	0.025155	0.0805775	0.0805575	0	0.14069	0.040352
CR02	4	0.04638	0	0	0	0	0	0
CR03	4	0.06184	0	0	0	0	0	0
CR04	3	0.06184	0.05031	0	0	0	0	0
CR05	3	0	0	0.0805775	0.0805575	0.060445	0.070345	0
CR06	4	0.01546	0	0.161155	0.161115	0.060445	0	0
CR07	2	0	0.25155	0	0	0	0	0
e	0	0.68024	0.75465	1.208663	1.208363	0.423115	0.773795	0.16141

Figure 4. The offset for the design phase

4. Conclusions and Recommendations

The paper presents how the QFD method can be implemented in a NPD approach. The biometric identification system is an innovative product that requires the cooperation of specialists from very different fields. The use of QFD integrated in NPD methodology, as presented in the paper, can be considered a viable approach for innovative interdisciplinary products development.

The QFD based methodology for NPD offers the possibility to continuously estimate the current state of product development by means of an offset, that is an overall index computed based on the mathematical model embedded in our methodology. The offset represents the level of customer requirements achievement by the quality characteristics of the new product.

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