Quality improvement of the primary cable of the handbrake lever: a QFD approach

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Abstract. Quality function deployment is one of the most used tools for the quality improvement of products or services. According to the literature, manufacturing is one of the industries that has benefited most from its employment. Therefore, the purpose of this paper is to illustrate the usability of the quality function deployment in improving the quality of the primary cable of the handbrake lever. In this way, the technical priorities of this product were established by comparison with those of the main competitors in the market and the target values of each technical characteristic of the product were determined. In addition, the attention of the manufacturer of the primary cable of the handbrake lever can be also focused on the fulfillment of the customer expectations.

1. Introduction

Firms are competing today in a demanding economy, where quality is seen as one of the most important factors in addressing organizational success. To satisfy customers, firms have to improve their products to deliver greater quality characteristics than their competitors [1]. One of the main tools for achieving this goal is Quality Function Deployment (QFD), which has been the subject of much literature [2, 3]. Since its introduction in Japanese firms, it has been successfully employed around the world [4, 5]. This is also the case of a Romanian firm, code for confidentiality reasons as Our Company, which aims to improve the quality of its products using a QFD approach.

2. The Quality Function Deployment

A detailed literature review on QFD, based on different functional areas of its employment and considering both industrial and service applications, is shown in [3]. A comprehensive review of the application of QFD in different areas and industries/services was also presented in [6, 7].

According to existing studies, manufacturing is one of the industries that can benefit most from the employment of QFD. Our Company is a firm involved in manufacturing and has a wide range of products for the automotive industry. Among such products, the primary cable of the handbrake lever is one of the most manufactured products (figure 1). At the same time, the company aims to continuously improve its products, and QFD can be a solution to achieve this goal. Through the use of QFD, the customer needs can be translated into activities related to the development of the Our Company products [2].

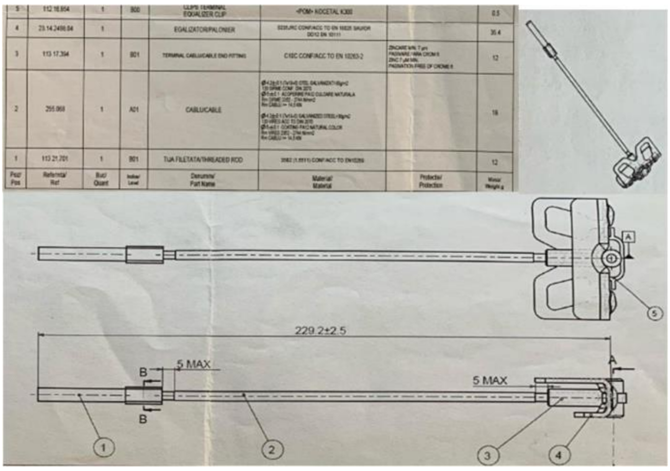


Figure 1. The primary cable of the handbrake lever

In conformity with [1, p.25], QFD involved a four-stage approach. Considering its importance to QFD this study addresses only the first stage-product planning, while the other three stages (part, process, and production planning) are somewhat similar to this first one. The main element of product planning is the House of Quality (HOQ), through which the customer requirements are correlated with the technical characteristics of the product to be developed. The framework of the HOQ and its elements are described in detail in [1, 8, 9].

3. The case study

The employment of the QFD through the HOQ in the case of the primary cable of the handbrake lever is presented below, considering the steps presented in [1, 9]. For confidentiality reasons, the product manufactured by Our Company was codified as Our Product, while the products of the main competitors in the Romanian market were codified as product Competitor A and product Competitor B, respectively.

Step 1) The identification of the customer needs (WHAT's List)

The customer needs have been identified by discussions and feedback from the clients. As a result, the following customer needs were established**:**

- conformity;
- warranty;
- price;
- quality of the packaging.

Step 2) The identification of the technical specifications (HOW's List)

The product improvement team has identified the following technical requirements:

- tensile strength (N);
- deviation from the length (mm);
- maximum deviation between axes (^{0});
- traceability.

Step 3) The planning matrix

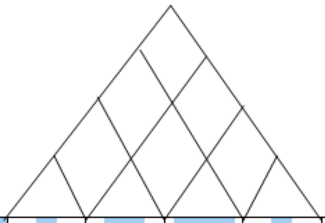
The planning matrix includes the evaluation of Our Product compared with the product Competitor A and product Competitor B, based on the performance of the products in responding to the customer needs. For this purpose, the following steps have been completed (figure 2):

- the establishment of the degree of importance of each client need, using a five-point scale;
- the competitive evaluation against the main competitors, using a five-point scale;
- the establishment of the planned coefficient of each customer need;
- the computation of the improvement factor using the following relation [8, p.315]:

  Improvement factor = {(Planned coefficient - Coefficient of Our Product }*0.2}+1 (1)

- the establishment of the market leverage points (1.5, 1.2, 1), which correspond to (strong, moderate, no market points) [10].
- the computation of the global importance of each customer need using the relation [8, p.316]:

Overall importance=Importance of WHAT's* Improvement factor* Market leverage points (2)

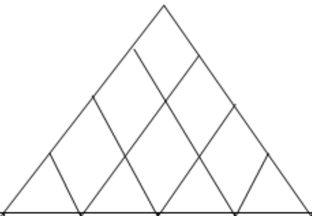


Technical characteristics (HOW's) / Requirements of customers (WHAT's)		Tensile strength	Deviation from the length	Maximum deviation between axes	Traceability	Imortance of WHAT's	Competitive analysis			Planned coefficient	Improvement factor	Market leverage point	Overall importance
							Our product	Competitor A	Competitor B				
Conformity						5	4	5	5	5	1.2	1.2	7.2
Warranty						4	3	4	4	4	1.2	1.2	5.76
Price						4	4	3	4	4	1	1.2	4.8
Quality of the packaging						4	3	4	5	5	1.4	1	5.6
Importance of HOW's													
Percent importance of HOW's (%)													
Competitive benchmarking	Our product												
	Competitor A												
	Competitor B												
	Target values for our product												

Figure 2. The WHAT's List, HOW's List and the planning matrix

Step 4) The relationship matrix

In order to establish the relationship between each customer need and each technical requirement (relationship WHATxHOW), a (9,3,1,0) scale was employed. The (9,3,1,0) scale corresponds to (strong, moderate, weak, no relationship) levels [1]. Figure 3 depicts the relationship matrix.



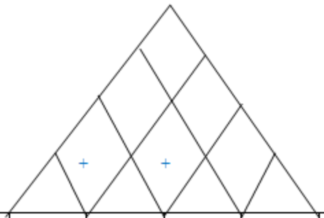
Technical characteristics (HOW's) / Requirements of customers (WHAT's)		Tensile strength	Deviation from the length	Maximum deviation between axes	Traceability	Imortance of WHAT's	Competitive analysis			Planned coefficient	Improvement factor	Market leverage point	Overall importance
							Our product	Competitor A	Competitor B				
Conformity		9	9	9	3	5	4	5	5	5	1.2	1.2	7.2
Warranty		9	3	9	0	4	3	4	4	4	1.2	1.2	5.76
Price		3	1	1	1	4	4	3	4	4	1	1.2	4.8
Quality of the packaging		0	0	0	9	4	3	4	5	5	1.4	1	5.6
Importance of HOW's													
Percent importance of HOW's (%)													
Competitive benchmarking	Our product												
	Competitor A												
	Competitor B												
	Target values for our product												

Legend
Relationship scale: 0=no relationship, 1=weak relationship, 3= moderate relationship, 9=strong relationship.

Figure 3. The relationship matrix

Step 5) The correlation matrix

The correlation matrix is used to assess the correlation between each two HOW's (+ represents a positive correlation, while – a negative one). Figure 4 depicts the correlation matrix.



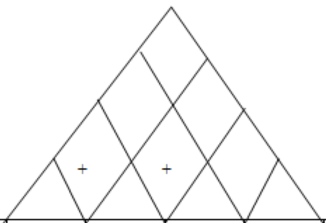
Technical characteristics (HOW's) / Requirements of customers (WHAT's)	Tensile strength	Deviation from the length	Maximum deviation between axes	Traceability	Imortance of WHAT's	Competitive analysis: Our product	Competitor A	Competitor B	Planned coefficient	Improvement factor	Market leverage point	Overall importance
Conformity	9	9	9	3	5	4	5	5	5	1.2	1.2	7.2
Warranty	9	3	9	0	4	3	4	4	4	1.2	1.2	5.76
Price	3	1	1	1	4	4	3	4	4	1	1.2	4.8
Quality of the packaging	0	0	0	9	4	3	4	5	5	1.4	1	5.6
Importance of HOW's												
Percent importance of HOW's (%)												
Competitive benchmarking: Our product												
Competitive benchmarking: Competitor A												
Competitive benchmarking: Competitor B												
Competitive benchmarking: Target values for our product												

Legend
Relationship scale: 0=no relationship, 1=weak relationship, 3= moderate relationship, 9=strong relationship.
The correlation between the technical characteristics: +positive impact, -negative impact.

Figure 4. The correlation matrix

Step 6) The technical matrix

The last step in developing the HOQ is the technical matrix (figure 5).



Technical characteristics (HOW's) / Requirements of customers (WHAT's)	Tensile strength	Deviation from the length	Maximum deviation between axes	Traceability	Imortance of WHAT's	Competitive analysis: Our product	Competitor A	Competitor B	Planned coefficient	Improvement factor	Market leverage point	Overall importance
Conformity	9	9	9	3	5	4	5	5	5	1.2	1.2	7.2
Warranty	9	3	9	0	4	3	4	4	4	1.2	1.2	5.76
Price	3	1	1	1	4	4	3	4	4	1	1.2	4.8
Quality of the packaging	0	0	0	9	4	3	4	5	5	1.4	1	5.6
Importance of HOW's	131.04	86.88	121.44	76.8								
Percent importance of HOW's (%)	31.49%	20.88%	29.18%	18.45%								
Competitive benchmarking: Our product	4500	±2	20	-								
Competitive benchmarking: Competitor A	5000	±2.1	20	Eticheta identif.								
Competitive benchmarking: Competitor B	4500	±2.1	20	Eticheta identif.								
Competitive benchmarking: Target values for our product	5000	±2	20	Eticheta identif.								

Legend
Relationship scale: 0=no relationship, 1=weak relationship, 3= moderate relationship, 9=strong relationship.
The correlation between the technical characteristics: +positive impact, -negative impact.

Figure 5. The technical matrix

The importance of each HOW was computing using the following relation [1, p.31]:

$$\text{Importance of } HOW_i = \sum_{j=1}^{4} \left(\text{Relationship } WHAT_j \; xHOW_i\right) * \left(\text{Overall importance of } WHAT_j\right) \quad (3)$$

$$i = \overline{1...4}$$

The competitive benchmarking was conducted by comparing the value of each HOW of Our Product with the corresponding values of product Competitor A and product Competitor B, respectively.

4. Conclusions

A QFD approach was used to correlate the client requirements with the technical possibilities of Our Company to achieve these requirements in the case of the primary cable of the handbrake lever. For this purpose, a HOQ has been developed based on the steps described in the literature. The advantage of this approach is the establishment of the technical priorities of the primary cable of the handbrake lever, by comparing each technical characteristic of the own product with those of the main competitors in the market.

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