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DESIGN QUALITY IN MECHANICAL ENGINEERING APPLICATION

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Abstract: *There is a close relationship between material chose and quality in mechanical engineering application like there is in all the other engineering applications. If this relation is balanced then engineering success increases. Material chose comes to fore in the design process most of the time. The two most important responsibilities of the design engineer in here is to chose suitable material and to know the production processes about design. The chose of material of a design that will fulfill the needs all through its life has great importance. It is needed to limit the material applicants by choosing the most suitable ones among variable material. Choosing materials that were examined before and whose behavior is well known provides the designer to feel confident. However since using highly successful materials would increase the competitive power of the designs; designers should follow the developments in materials and know the features of new materials. The description of these features can be interpreted within quality. Quality from the point of engineer is the total fulfillment of expectations.Engineer today are faced with very important problems such as fast technological innovations, a dynamic socio-economical environment, global rivalry. One of the life buoys they stick while trying to solve these problems is total method of quality control. Total Quality model which can provide higher competitive power compared to classical management model brings success only when applied with its whole components. "Approach toward prevention" and"measurement and statistics" have an important place among these elements. The first step of the approach toward prevention composes of design quality and Quality Function Deployment (QFD), or in other words The House of Quality method that will provide this. In this paper; considering the quality function deployment, how the chose of material are done in mechanical engineering applications will be explained.*

Keywords: *quality, house, mechanical ,engineering*

1. INTRODUCTION

Today's companies face several important problems such as rapid technological innovations, a dynamic socioeconomic environment and globalizing competition. One of the lifesavers that companies tightly hold onto in order to find a solution to these problems is a quality control method. Total Quality model, which enables a higher competitive power when compared to classic management model, can lead to success only when it is applied by adapting all its components. Among these components "preventive approach" and "measurement and statistics" play important role. The first step of the "preventive approach" is the design quality and the Quality Function Deployment (QFD), which enables that approach, in other words the Quality House.QFD is a systematic approach that consists of planning and communication processes and provides necessary coordination by concentrating on the capabilities of the organization to realize the materials, service design, production and marketing of what the consumer wishes to purchase.
QFD is a customer oriented; team work demanding quality methodology which basically transforms customer demands into measurable performance alterations, and supports the acquisition of an optimized process and well organized delivery/sales canal. Studies show that the application of QDF in a process reduces the problems by half, shortens the development period and increases profitability. Today, many industrial corporations apply this method.QFD is not a tool but a planning process which assists a company in the efficient use of technical tools in a way that these tools support and complement each other, and in putting forward the issues of first priority. Customer oriented QFD helps companies in gaining a customer focus. In this study, the design of a QFD and how it is carried out regarding the selection of materials are explained step by step.

2. QFD OR DESIGN OF HOUSE OF QUALITY

There is not any mysterious component in the QFD or design of the house of quality. This illustration and

naming is neither a difficult nor a complicated task, however, it may take some time to get used to the methods applied. In time, problems can be defined by looking at the graphical tables named as the house of quality as if looking at a map. The main components of the house of quality are illustrated in the Figure 1.

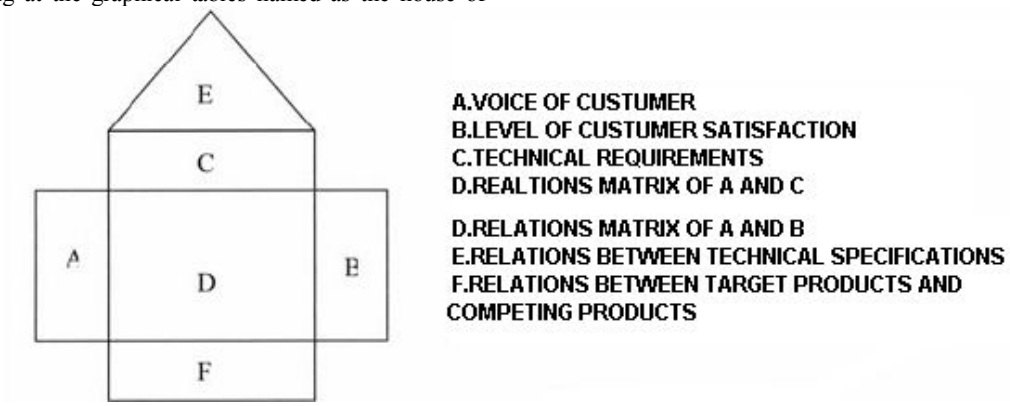


Figure 1:The main components of the quality house

8 stages are needed in order to build the house of quality. These are:

1. STAGE: Determining the Characteristics of the Target Consumer and the Products of Rivals

Material demands and needs of the customers are determined by carrying out surveys for that purpose. It is essential to determine the targets for whom the survey is going to be carried out. It is necessary to determine where the material, which is to be released, can be sold at, who the rivals producing the same material are; their market share and the characteristics of the rival materials.

2. STAGE: Determining the Customer Needs

Customer expectations are the customer's demands regarding the characteristics of the material and it is important that those needs are expressed in the words of the customers. The reason is that, the works to be done later on are going to be directed by the components determined at this stage.

While determining the material needs of the customer, costs and prices should not be taken into consideration at this stage. The language of the customer should be applied and care must be taken so that the QFD team can correctly understand all the needs. Determined customer needs are placed in the related part of the house of quality (A) as shown in the Figure 2.

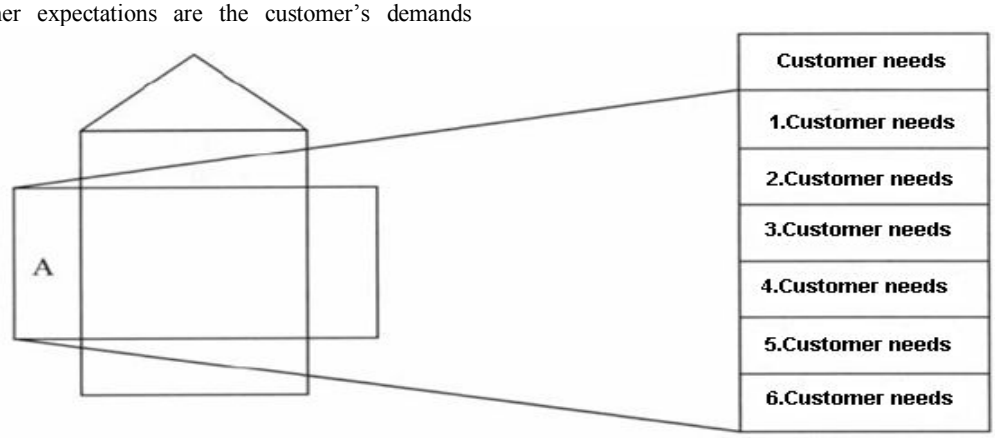


Figure 2.Customer needs

3. STAGE: Classification of Customer Needs

At this stage, customers' views on the degree of importance of their material needs are acquired through surveys and through one to one interviews conducted with customers. In the quality matrix, right next to the column of customer material needs placed the column of importance degree which includes the average of customer importance degrees (Figure 3).

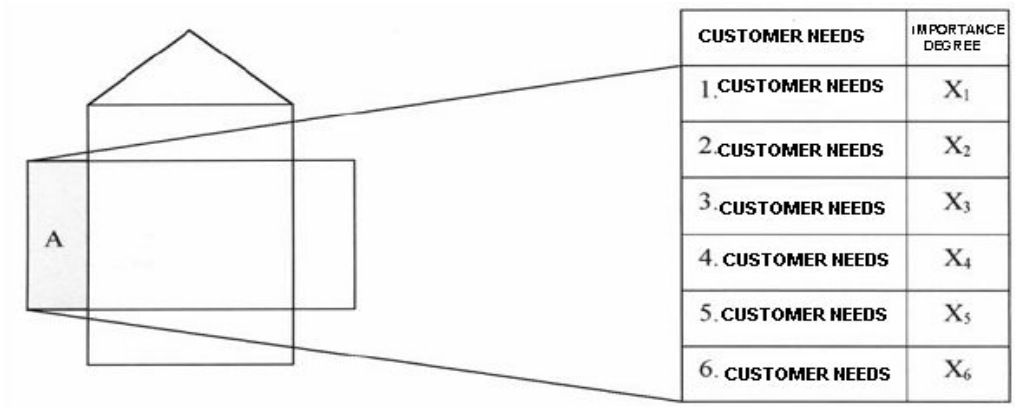


Figure 3. Classification of Customer Needs

4. STAGE: Consumer Satisfaction Level Analysis – Customer Perception Analysis

Customers are addressed questions about the material and asked to make comparison with that of the rival products. Thus, weak and strong sides of the rivals are tried to define. Customers place the firm which has the research carried out and the rivals in ranking according to their own views. After that these ranking is transformed into marking and conveyed to the house of quality (Figure 4).

	Xij	Rij	Aij	Bij	Pij	Yij	Zij	MAij
	IMPORTANT DEGREE	COMPANY SATISFACTION	A FIRM SATISFACTION	B FIRM SATISFACTION	QUALITY PLANNING	RATE IMPROVEMENT	SALES OF ADVANTAGE	ABSOLUTE WEIGHT
1.CUSTOMER NEEDS	**X11**	**R12**	**A13**	**B14**	**P15**	**Y16**	**1**	**MA18**
2.CUSTOMER NEEDS	**X21**	**R22**	**A23**	**B24**	**P25**	**Y26**	**1,2**	**MA28**
3.CUSTOMER NEEDS	**X31**	**R32**	**A33**	**B34**	**P35**	**Y36**	**1.2**	**MA 38**
4.CUSTOMER NEEDS	**X41**	**R42**	**A43**	**B44**	**P45**	**Y46**	**1,5**	**MA48**
5.CUSTOMER NEEDS	**X51**	**R52**	**A53**	**B54**	**P55**	**Y56**	**1**	**MA58**
6.CUSTOMER NEEDS	**X61**	**R62**	**A63**	**B64**	**P65**	**Y66**	**1**	**MA68**

Figure 4. Customer Perception Analysis

5. STAGE: Determining Technical Specifications

The first stage to start the technical part of the matrix is transformation of customer opinions into technical needs (Figure 5).

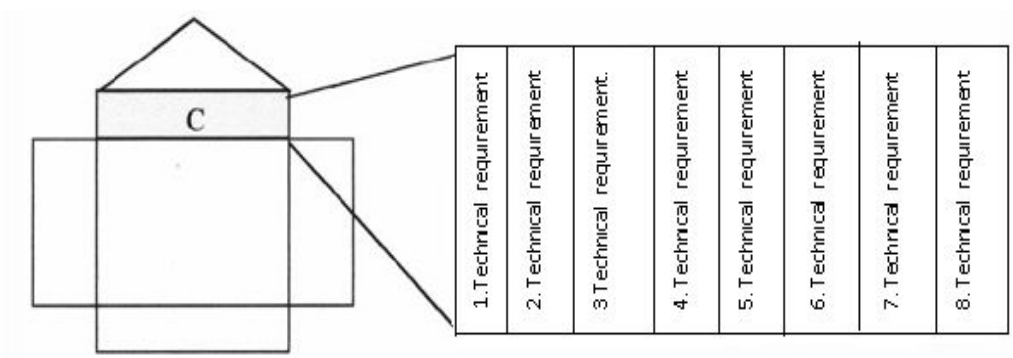


Figure 5.Technical requirements

6. STAGE: Determining the Relationships

This process starts with the question of how each cell of the matrix affects what – and in what way while the relationships between the customer material needs and technical specifications are defined. If the answer is no, the cell is left blank, namely there is no relationship. If the answer is yes, the degree of relationship is defined as weak, medium or strong (Figure 6).

7. STAGE: Calculation of Absolute and Relative Importance Values of Technical Needs

Absolute and relative importance degree of each technical need regarding the meeting of customer expectations is calculated with formulas. Absolute weight value is taken from the customer perception analysis matrix and placed into Figure 7.

	Technical Requirements							
	O	**O**	▲	▼	▲	▲	**0**	**0**
	1. Technical Requirements	**2. Technical Requirements**	**3. Technical Requirements**	**4 Technical Requirements.**	**5 Technical Requirements**	**6 Technical Requirements.**	**7. Technical Requirements**	**8. Technical Requirements**
1.CUSTOMER NEEDS	**I11**	**I12**	**I13**				**I17**	
2.CUSTOMER NEEDS		**I22**		**I24**	**I25**		**I27**	
3.CUSTOMER NEEDS		**I32**	**I33**				**I37**	
4.CUSTOMER NEEDS			**I43**			**I46**	**I47**	
5.CUSTOMER NEEDS		**I52**				**I56**	**I57**	**I58**
6.CUSTOMER NEEDS		**I62**				**I66**		**I68**

Figure 6. Correlation Matrix

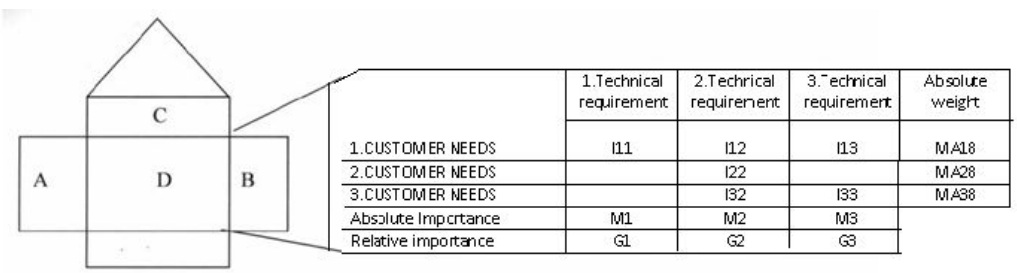


Figure 7. Customer perception analysis matrix

8. STAGE: Determining the Relationship Between Technical Specifications or the Correlations

Several technical needs may be in relation with other technical needs. Any work conducted to develop one of those technical needs can help the related need and a positive or useful effect may come out as a result. On the other hand, any work conducted to develop a need may affect the related need negatively. Relationships between the technical needs are determined and placed into the roof of the house of quality (Figure 8).

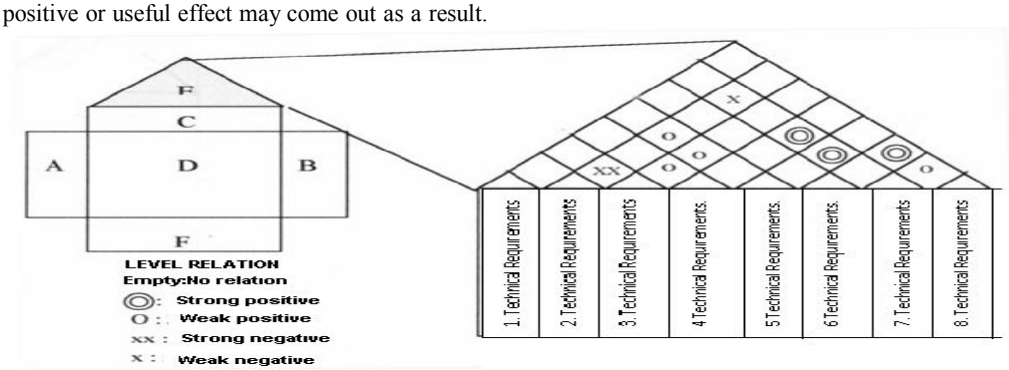
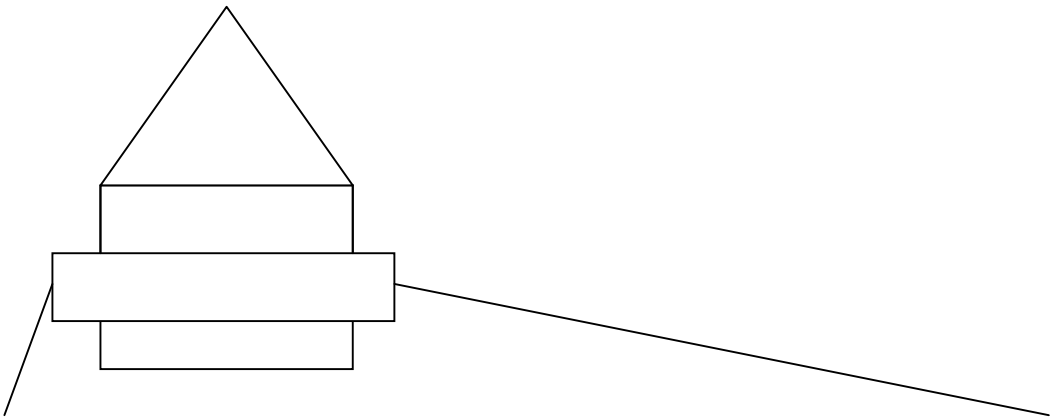


Figure 8.

After those processes, theoretical building of the house of quality is completed (Figure 9).



Factor Survay firm □ Opponent A ○ Opponent B △			Level importance	1.Technical Requirement	Customer rating 1 2 3 4 5
1.Customer requirement			4	◎	△□○
Competitive technical	Development direction			↑	
	Competitive data	Survey Fırm		Rrj	
		Opponent A		Raj	
		Opponent B		Rbj	
Target values				Hj	

Figure 9. Last stage of quality house

3. CONCLUSION

Today, QFD can form a method that can successfully be applied in the selection of material. Continual increase in the customer needs along with decreasing costs due to increasing competition conditions and also material development periods requires a systematic material development process. The use of QFD in the development process enables the development of product in accordance with the customer demands and significant decrease in engineering alteration, material development period, costs of material, maintenance and repair problems.

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