Management Systems in Production Engineering

2012, No 4 (8), pp 3-7

# PROPOSAL OF THE IMPLEMENTATION OF THE QFD METHOD TO IMPROVE THE WELDING PROCESS IN THE CHOSEN, REALLY EXISTING COMPANY X

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**Abstract**:
The paper presents an analysis and evaluation of selected aspects of the enterprise X, there is shown the selection of the method of pro-quality, which is possible to apply and this method was carried out step by step to follow its course and find out whether the company will bring tangible benefits.

***Key words:*** *quality, irregularities, methods and techniques of quality management, QFD, the house of quality*

## INTRODUCTION

Some years ago the quality of the products was less important than the timeliness and implementation of production plans, because "bad quality of the products caused just criticism" [1], and it didn't manifest itself with any other consequences. Consumers just bought a variety of market news, if only the price was affordable, and nobody paid much attention as now on quality issues.

Everything has changed after satisfying the basic needs of people in highly developed countries, and therefore modern manufacturing company should take into special account the quality of the product produced by them, because this will be reflected in a noticeable market position of the company. Very often the level of quality is part of the competition between firms. It is worth noting that the quality of the product has its origin already in the design process. It is here that you need to plan it carefully, because mistakes made at this stage cannot be repaired in subsequent phases of production. Many defects observed during the manufacturing or using of the product can be clearly linked to negligence in the design [2]. At this point it should be mentioned about the life cycle of product quality [3], which can be presented as a closed circle which has three phases: planning, implementation and use (Fig. 1).

The quality of the final product is influenced by such elements as:

The quality of work, which includes the contractor's quality and working conditions (device and tool);

Materials which are on the input of the manufacturing process, raw materials and semi-finished products;

"Production quality which includes the structure of the deployment devices, storage, methods of cost planning, transport" [3].

Companies, where the quality policy is implemented, should have specified instruments, allowing you to perform tasks aimed at "shaping the quality of the products or processes at every stage of their existence" [1]. Typically, instruments are divided into: principles (rules), tools and methods. The rules are characterized by long-term effects, for instance the principle of "continuous improvement of processes". Tools are attributed by the short-lived impact, and their effects can be seen very quickly. An example might be the Ishikawa diagram. If the exposure time is concerned, the methods should be put between the principles and tools. The methods are: QFD, FMEA, etc.

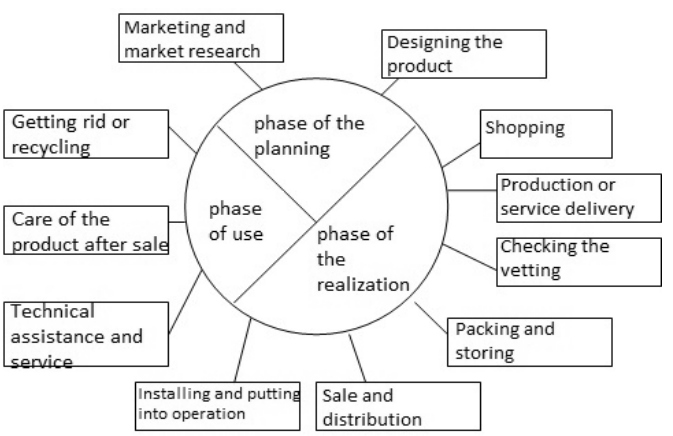


***Fig. 1. The life cycle of product quality [6]***

## RESEARCH AND ANALYSIS

The company adopted here to analyze produces a lot of steel constructions and is the firm that has existed in the market for over 60 years, so has some technology experience and during the period of political changes in Poland, it had relations with large companies from the industry area (construction equipment) from Western Europe. Currently, 95% customers of the company are from the foreign coun-

tries. Since 1996 the company has had a certificate of Quality System.

*Non-compliance- divergences between the product and the requirements*

The following graphs are a visualization of the number of reported non-compliance over the years from 1996 to 2010. Figure 2 refers to those reported at this time complaints from customers, and Figure 3 shows the faults in this period.

The author of the publication especially highlights this aspect of the enterprise' existing, because she expected a decrease in both the complaints and faults after the implementation of ISO 9001. But that did not happen.

*Quality costs*

After analysis the product's non- compliances the next area approaches- the quality costs Among them we can distinguish the costs that are incurred in order to remove non-compliances arising from errors and complaints, but the biggest item always is taken by the cost of the assessment. This data is presented below (Fig. 4). It is believed that "quality costs can consume 20-30% of incomes or turnover of the company" [4]. The potential opportunity reducing them exists, and would require from the company to make efforts to minimize the number of non-compliance. The experience of many companies shows that a large number of faults and complaints is the result of mistakes made during the design process. And the later the defects are observed, the more expensive will be removing them by the production company.

*Places of formation non- compliances*

From figures appearing on the next page you can read that most problems in the company functioning came into existence at assembly works. The second place belongs to welding, and the third- locksmith works. A large number of reported complaints relating to these listed above was due to the low detection rate of non-compliance at the company.

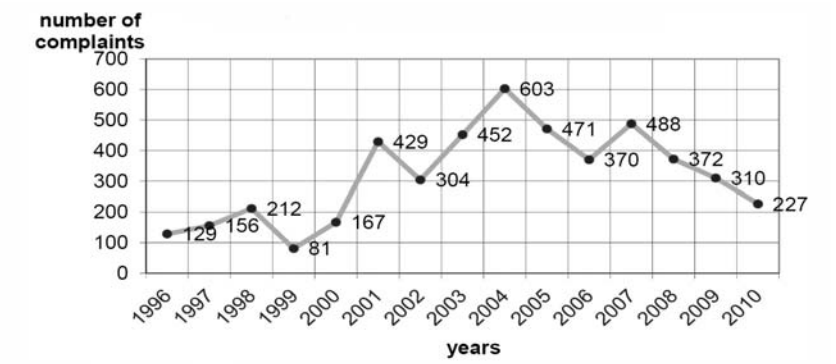


***Fig. 2. Summary of the number of complaints in the years after the implementation of ISO 9001***

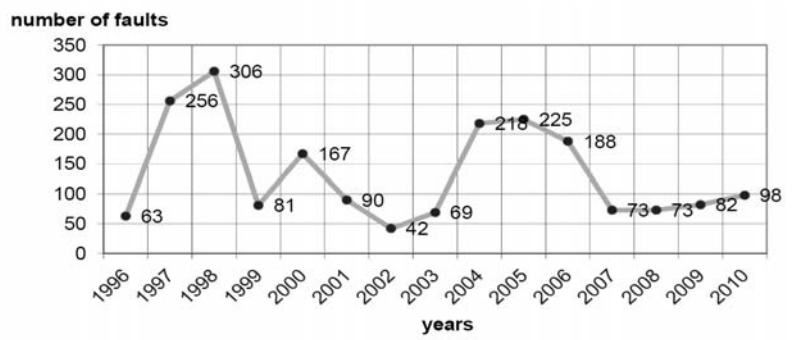


***Fig. 3. Summary of the number of faults in the years after the implementation of ISO 9001***

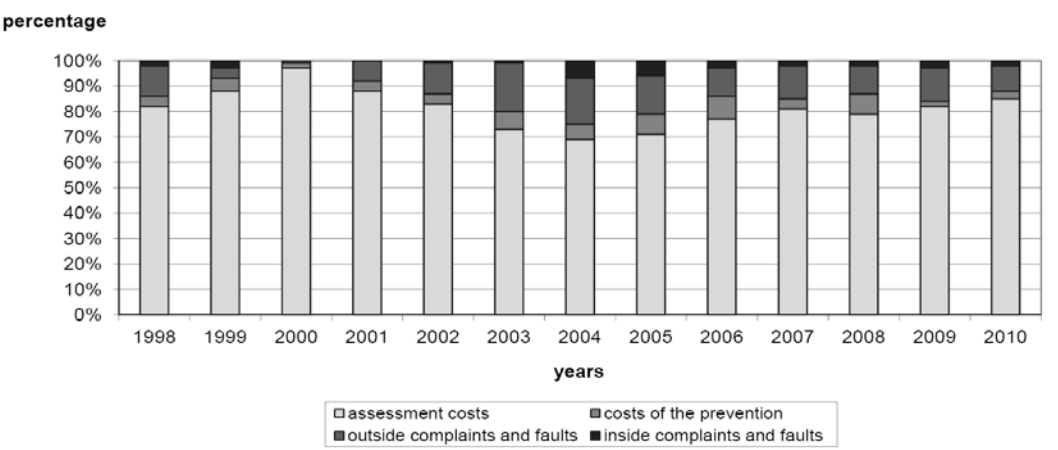


***Fig. 4. The structure of quality costs***

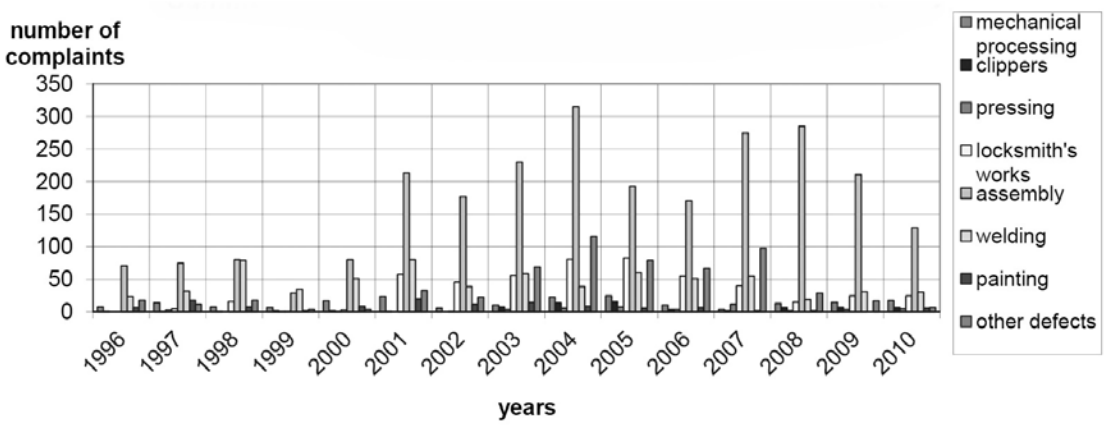


***Fig. 5. Summary of the number of complaints with reference to the operations and positions***

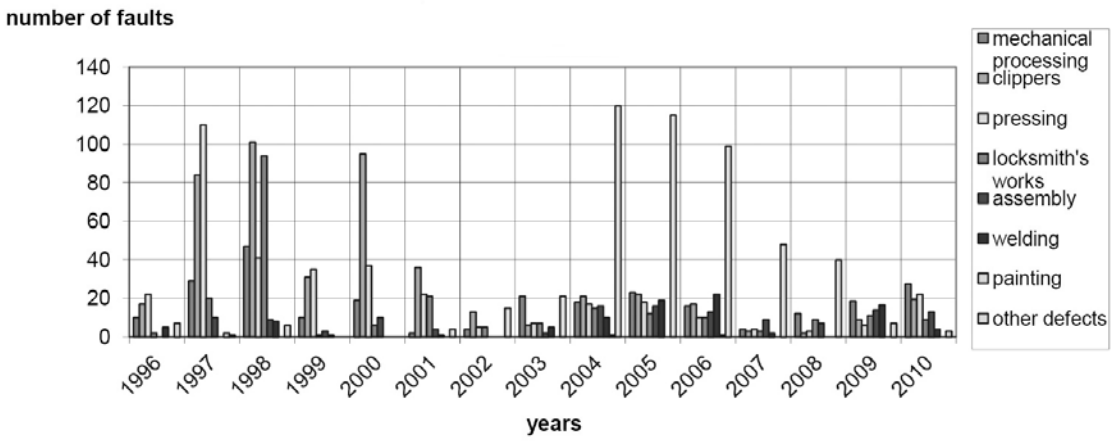


***Fig. 6. Summary of the number of faults with reference to the operations and positions***

*The proposal of the implementation of the method of pro-quality*

After analyzing the places of formation the non-compliances, the author took up improving of the welding process, because of it is the second most important determinant of complaints from customers.

Welding is a process widely used in industry. This process has influence on production costs and the quality of the final product. Therefore, it should be carried out efficiently and effectively. Welding is treated as “a special process”, as the tests of welds don’t confirm, whether the product quality (defined in standards) is achieved. Product quality is not achieved by the control - quality should be achieved in the production process. Even the most extensive and specialized non-destructive testing will not improve the weld quality" [5]. In order to avoid problems in the production and using it is necessary to supervise over all phases, which are in the area of business interactions. So if the welding process isn’t designed properly, this may causes the problems during installation or use. And, as it was noted earlier, the assembly problems in the company are quite often, so you can assume that some part of them is connected with the welding process.

The criterion of the selection a method

For further analysis the welding process was chosen the QFD method (Quality Function Deployment) due to its complexity, because "it takes into account all factors which influence on the quality of the designed products (processes)" [1]. Polish translation of QFD is the "development of the quality function". "QFD method was developed by Yoji Akao in Japan in 1966 of the last century" [1]. Its first application was in 1972. This was in the yard which belonged to Mitsubishi. 70’s the last century have given it a real boost and recognition of large companies in Japan and the USA.

QFD is a method which gives the possibility of solving problems coming from the limited contact between the firm and the client. It offers an opportunity to recognize consumer expectations, and you could say that the QFD method "translates" customer requirements "on the technical language used in the enterprise" [1].

The main tool of the chosen method is a diagram called "house of quality", which contains fields such as: customer requirements, their importance to consumers, technical parameters of the object (in this case- the welding process), the relation between these parameters, the relation between technical parameters and customer expectations, and "technical indicators of complexity" [1]. However, the final shape of the diagram and the number of fields are the results of the complexity of the analyzed problem. The examination also allows to assess the importance of the technical parameters, and the following formula is used for it:

$$T_j = \sum_{i=1}^{R} W_i Z_{ij} \tag{1}$$

where:
$T_j$ – importance of the technical parameter "j";
$W_i$ – importance of the requirement "i";
$Z_{ij}$ – the relation between the requirement "i" and the technical parameter "j";
R – number of the customer requirements.

Calculation of the coefficients $T_j$ allows an identification of technical problems.

Description of the procedure in the selected method

1. Select an object of analysis- the welding process in company X.
2. Prepare a list of clients' attributes: safety, conformity with the project, weld size, competence of the welder, cost, lead time of the order, durability, quality of materials and products, guarantee, renown of the company, lack of chips, customer service, aesthetic workmanship.
3. Divide these attributes into three categories:
   - Functional:
     - safety,
     - durability.
   - Associated with the appearance:
     - conformity with the project,
     - weld size,
     - aesthetic workmanship,
     - lack of chips.
   - Other:
     - cost,
     - guarantee,
     - quality of materials and products,
     - competence of the welder,
     - customer service,
     - lead time of the order,
     - renown of the company.
4. Evaluate the importance of these attributes.
5. Based on an interview with the company employee assigned weights to the attributes of the client (Table 1).
6. The technical attributes associated with the process of welding were appointed: complying with the requirements of norms, method of the welding, durability, resistance to extrinsic factors, linked materials, electrode or flux material, the amount and the concentration of the provided energy, geometry, project of the connection, stresses.
7. Specify the relations between the technical attributes and complete the "roof" of the diagram (Fig. 7).
8. Specify the relations between the technical attributes and the customer attributes (Fig. 7).
9. Calculate the importance of the technical attributes. For this purpose, use the formula (1). Results place in the diagram (Fig. 7).

***Table 1***

***Rate of the importance of the customer attributes***

| Customer Attributes | Weight |
|---|---|
| safety | 10 |
| durability | 7 |
| conformity with the project | 10 |
| weld size | 9 |
| aesthetic workmanship | 1 |
| lack of chips | 3 |
| cost | 8 |
| guarantee | 5 |
| the quality of materials and products | 6 |
| competence of the welder | 9 |
| customer service | 2 |
| lead time of the order | 8 |
| renown of the company | 4 |

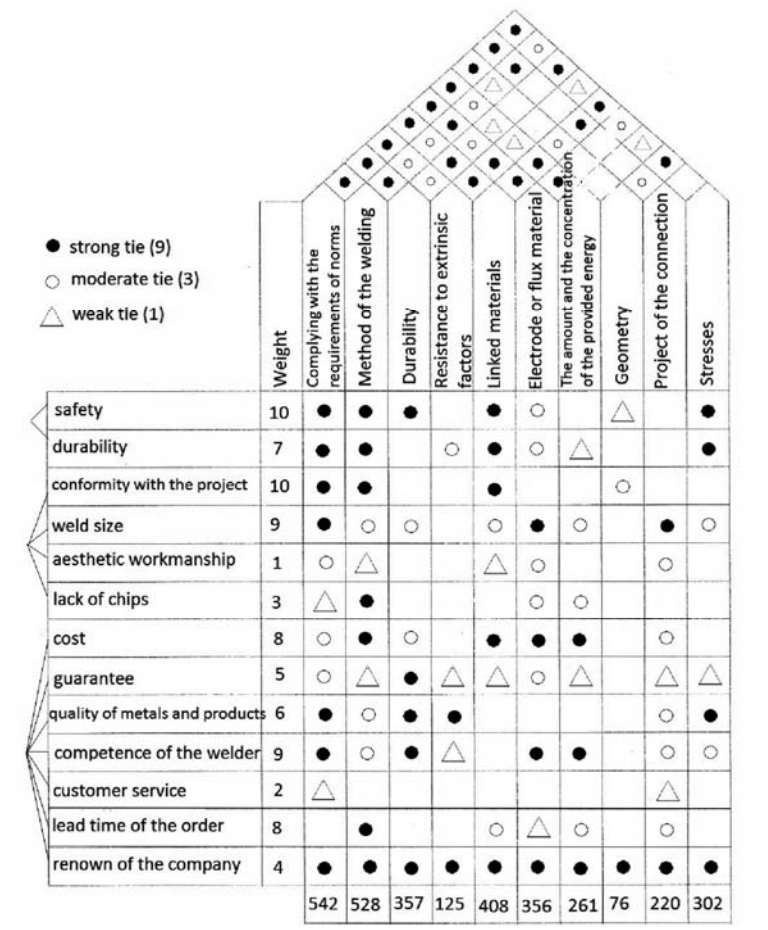


***Fig. 7. House of quality for the welding process***

**SUMMARY**

On the basis of assessment of the importance of attributes of the customer (Fig. 7) it is possible to state that peculiarly for recipients of products of the company X both a safety and a compliance with the delivered plan are relevant aspects for company at placing an order in relation to joints carried out. The least important are: an aesthetic workmanship and a customer service. The second conclusion from the diagram (Fig. 7) can be stating a strong tie between "complying with the requirements of norms" and the remaining technical attributes of the process of welding. Next the "renown of the company" from attributes of the customer is demonstrating the strong influence on all technical attributes of the welding process.

Based on the diagram "house of quality" the author states that the company should pay special attention to critical features, which are: complying with the requirements of norms, methods of welding and linked materials. There is a high probability that the issue of complaints regarding the welding process is the result of the listed attributes, and therefore the company should improve the process at the stage of design, when its course is determined.

An undoubted advantage of QFD seems to be understanding of customer requirements and the ability to account it for achieving complete success. At drawing up the "house of quality" the critical features of the welding process were found, which contains: complying with the requirements of norms and proper selection of materials to be joined and the proper method of welding. The conclusion based on the conducted analysis is that the company should put an emphasis on product quality and the processes at the very beginning during the design process, thus it may become possible to reduce the relatively high cost of quality.

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