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Establishment of Quality Parameters in Steel Rolling Industry Using Quality Function Deployment

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Abstract: - This work presents a proposal for a conceptual model of QFD application aiming to establish the quality parameters in steel rolling industry. To develop this model, the following stages were carried out: literature review to identify information about QFD use, analysis of data collected in a field research and review of data from previous interviews with QFD users. Quality function deployment is a useful customer oriented product development process that uses a series of structured management processes to translate the customer needs into various stages of product planning, design, engineering, and manufacturing. The proposed method is aimed at expanding the current research scope from the product planning phase to the part deployment phase to provide product developers with more valuable information. Both customer requirements and the company's production demands will be used as the inputs for the QFD process to enhance the completeness and accuracy of the QFD analysis results. The purpose of this paper is to show practitioners and researchers how this process can be used as a planning process to link customer needs and product quality characteristics with attributes, production characteristics and measurable controls, that can reveal and trace the level of satisfaction of customer needs in the steel rolling industry. A case study is presented to illustrate the application of the proposed method**.**

Keywords: - Quality Function Deployment, Product Design, Quality Control, Steel Rolling, House of Quality

I. INTRODUCTION

Quality function deployment is an important product development method, dedicated to translating client requirements into activities to develop products. It works by linking together customer needs, product and parts design requirements, process planning, and manufacturing specifications during product development. Basically, it is based on the use of sequentially connected cross matrix tables in which customer needs are transformed to product characteristics and product and process engineering parameters. The QFD starts and ends with the customer.

Yoji Akao introduced the concept of QFD in Japon in 1966. According to Akao QFD is a method for developing a design quality aimed at satisfying the consumer and then translating the consumer's demand into design targets and major quality assurance points to be used throughout the production phase (Edwin).

The Voice of Customer (Griffin & Hauser, 1993) is the main driver and will be propagated through all subsequent downstream processes, and as a result, greater customer satisfaction is created in the end product/service. According to a study by Griffin (1992), the two most critical factors that determine the QFD's successful use in providing definite strategic product development benefits are the high commitment of all team members in all functional areas.

The advantages that would be realized through the use of QFD include a reduction in the time required for product design as well as a reduction is those costs associated with the process. This is possible because the design alternatives are realized much earlier in the process thus reducing the number of corrections and design errors. Also, a higher level of clarity for decision making is gained through the use of this tool. Some of benefits of QFD are summarized below (Bossert, 1991).

1. Customer Driven:
- Focus on customer requirements
- Uses competitive information effectively
- Prioritizes resources
- Identifies items that can be acted upon
- Structures resident experience/information

2. Reduces Implementation Time:
- Decreases midstream design changes

- Limits post-introduction problems
- Avoids future development redundancies
- Identifies future application opportunities
- Surfaces missing assumptions

3. Promotes Teamwork:
- Consensus based
- Creates communication at interfaces
- Identifies actions at interfaces
- Creates global view out of details

II. METHODOLOGY

The success of a product or service largely depends on how they meet the customers' needs and expectations. Consequently, more effort is involved in getting the information necessary for determining what the customer truly wants. The organization's task is to form the strategies of the definitions of the customer's priorities and the measurement of their satisfaction based on the quality criterion. This form of activity is connected with designing and manufacturing of product, which marks corresponding optimum level of quality determined by customers.

The House of Quality is the first of many matrices in the QFD process of translating customer needs into product requirements and system specifications. The number of matrices corresponds to the number of phases in the development process. For example, the American Supplier Institute (ASI) follows a four-phase approach, in which a QFD team deploys customer requirements into product characteristics, product characteristics into part characteristics, part characteristics into process characteristics, and finally process characteristics into production characteristics. Other approaches may include more phases, from customer requirements to design requirements, engineering design, product characteristics, manufacturing/ purchasing operations, and finally production/ quality controls.

The QFD matrix presents these issues in an outline form, which permits the organization to examine the information in a multidimensional manner. This will serve as a basis for developing an understanding of the QFD process in steel rolling industry other manufacturing industries.

The most-used QFD methodology beyond the HoQ is the conventional manufacturing-based QFD, which is deployed through a four-phased sequence (Sullivan 1986). The four phases are:

• Phase I: Product planning (HoQ)
• Phase II: Design deployment (part deployment)
• Phase III: Manufacturing planning (process planning)
• Phase IV: Production planning (production operations planning)

Proponents of this design process generally build a house of quality in step to understand the interrelation ship between the customer req. and design parameter. The overall process of QFD is based on its core matrix framework, called the HoQ. The components of this house are:
- Understanding and identifying the target customers
- Identifying customer requirements (WHATs)
- Establishing relative importance of customer requirements
- Analyzing the customer requirements (WHATs)
- Performing a customer competitive evaluation and analysis
- Identifying service characteristics (HOWs)
- Establishing relationships between the WHATs and HOWs
- Prioritizing service characteristics and technical weightings
- Establishing the correlations matrix
- Performing a technical competitive assessment
- Setting desired target values to achieve customer satisfaction

III. QFD IMPLEMENTATION

A. Customer Voices

In the collection of customer voice we have taken interviews of customers and retailers. As the consumers are well known and familiar with the product so it was better to do the survey among end users. Supporting techniques in developing a Core QFD matrix included brainstorming, focus group discussions, questionnaires, and interviews. These methods allowed developing and organizing information through a structured process and providing visualization of relationships at various detail levels. The customer voices are;

- Edge of product is not good
- Shape is not uniform
- Surface quality is not better
- Corrosion problem
- Acceptance of Product

B. Translation of Customer Voices into Technical Parameters

In the voice collection it is apparent that customers' voices follow no order. Customers do not deliver their comments in an organized manner. The first comment concerns the quality of edge, the second concerns the geometry of shape, and the next states the quality of surface, fourth voice concerns weather protection, the fifth voice concerns preferences of product.

Table I: Translation of Customer voices

1	Edge of product is not good	Quality of Edge
2	Shape is not uniform	Geometry Shape
3	Surface quality is not better	Quality of Surface
4	Corrosion problem	Weather Condition Protection
5	Customer Acceptance	Acceptance of Product

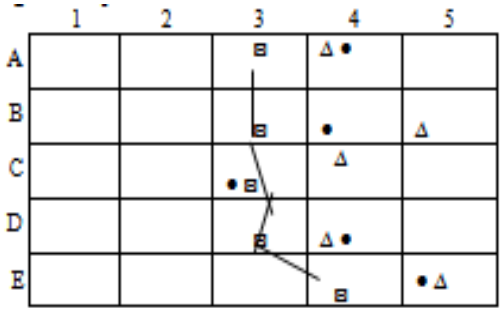
The beginning of technical portion of the matrix is the translation of the customer's voices into technical requirements. The voices must be translated into the type of language that the company uses to describe its products for design, processing, and manufactures at the same time.

Table II: Translation of Customer voices into Engineering Characteristics

1	Quality of Edge	Cutting
2	Geometry Shape	Control of charge
3	Quality of Surface	Heat treatment
4	Weather Condition Protection	Roll levelling
5	Acceptance of Product	Corrosion protection

C. Customer Competitive Analysis

The customer evaluation of the performance of the competitors' products of the surveying company was determined using a scale of 1 to 5. In this case two competitors were examined for comparing and benchmarking process. The customer competitive analysis shows that where the consumer product is today, and what the competitors are doing with respect to the customer demands



A. Quality of Edge
B. Geometry Shape
C. Quality of Surface
D. Weather Condition Protection
E. Acceptance of Product

Scale 1-5
1 - Very Bad
2- Bad
3 - Normal
4 - Good
5 - Very good

◙: Own Company
Δ: Competitor 1
●: Competitor 2

Fig.1. Customer competitive analysis

D. QFD Metrix

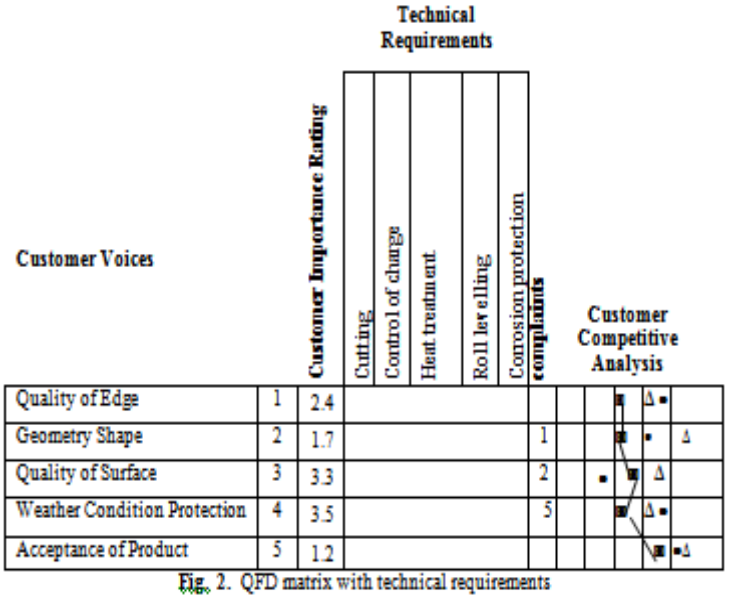


Fig. 2. QFD matrix with technical requirements

It is helpful to record decisions about each technical requirement to show the direction that customers prefer. For every technical requirement, there is a direction that is most favourable for customers, one that will maximize their satisfaction. This information can be helpful to team when they are examining the co-relationship between technical requirements and when they are establishing targets. The symbols showing direction of customer improvement are usually placed in the matrix above the technical requirements. They have their greatest value when examining the co relationships between technical requirements. When they are placed across the top of the matrix, they are conveniently located during co-relationship determination

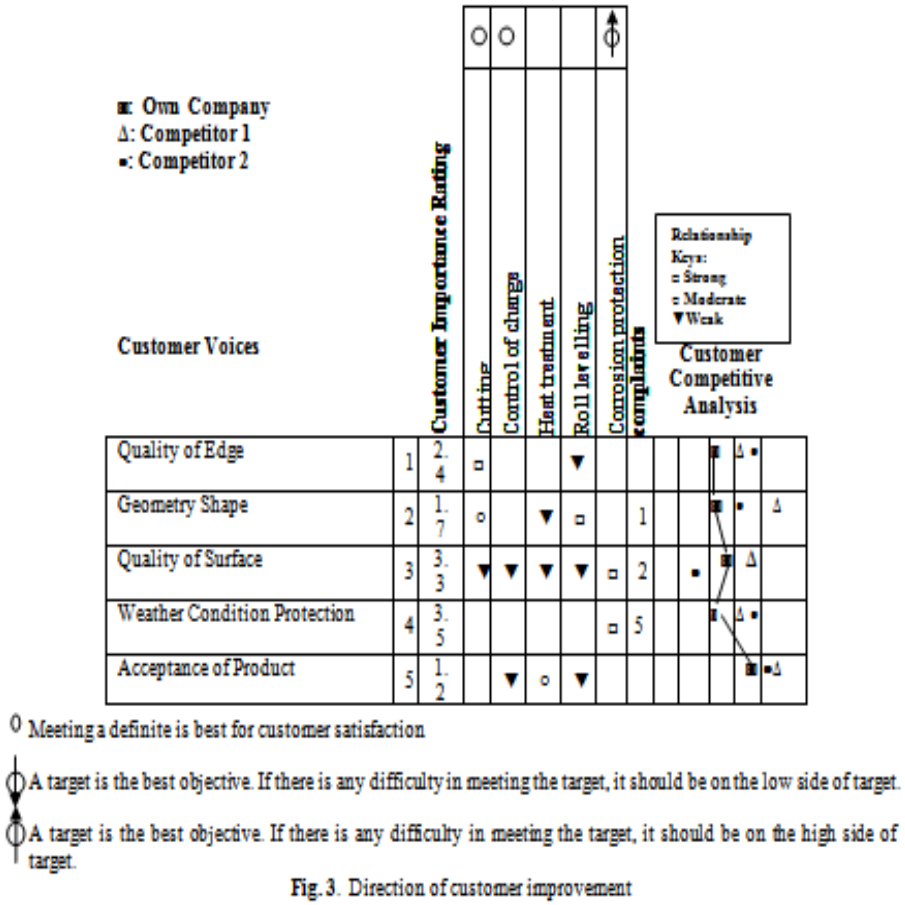


Fig. 3. Direction of customer improvement

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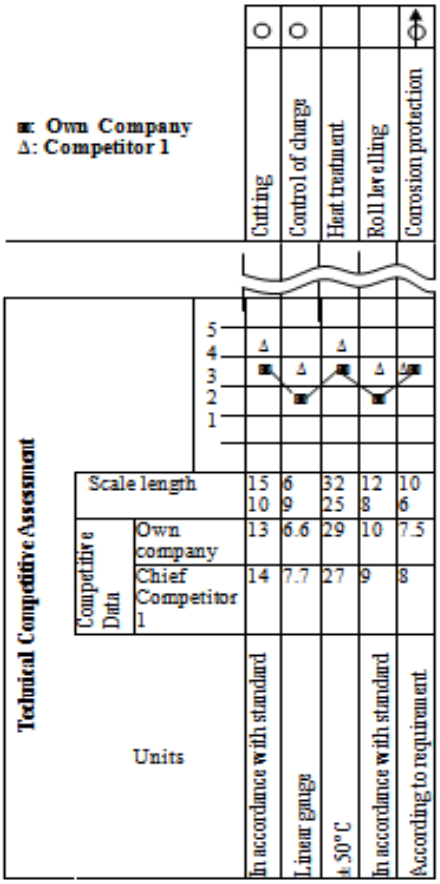

Fig. 4. Technical competitive assessment

The customer's evaluation of poor performance of all companies is strong signal that a competitive opportunity exists. Any other companies doing similar customer research will see this same situation and the obvious opportunity. Our chief competitors are at higher positions, so we have to improve our product to best satisfy our customers The portion of the QFD planning matrix reserved for the results for competitive technical testing can be used in a variety of ways depending upon a team's determination. The competitive assessment data shown in diagram can be transferred to the matrix as a series of numerical data. An alternative is to portray the data graphically another approach is to show both the data and the graphic portrayal. Observation indicates that most people find the graphic representation easiest to use when analysing the completed matrix to establish priorities and competitive targets.

C. Establishing targets

If the team combines its discussion of target values and graphic plots, the concern for how to plot the data will normally resolve itself. The next figures will help illustrate this process each represents a selected piece of the QFD product planning matrix. Each shows the customer voice, importance, complaints, and competitive evaluation along with the technical competitive assessment data and the strength of relationship. Each uses the technical requirement different customer competitive evaluations and different competitive test assessment data are used in each figure to help illustrate the team decision process [4].

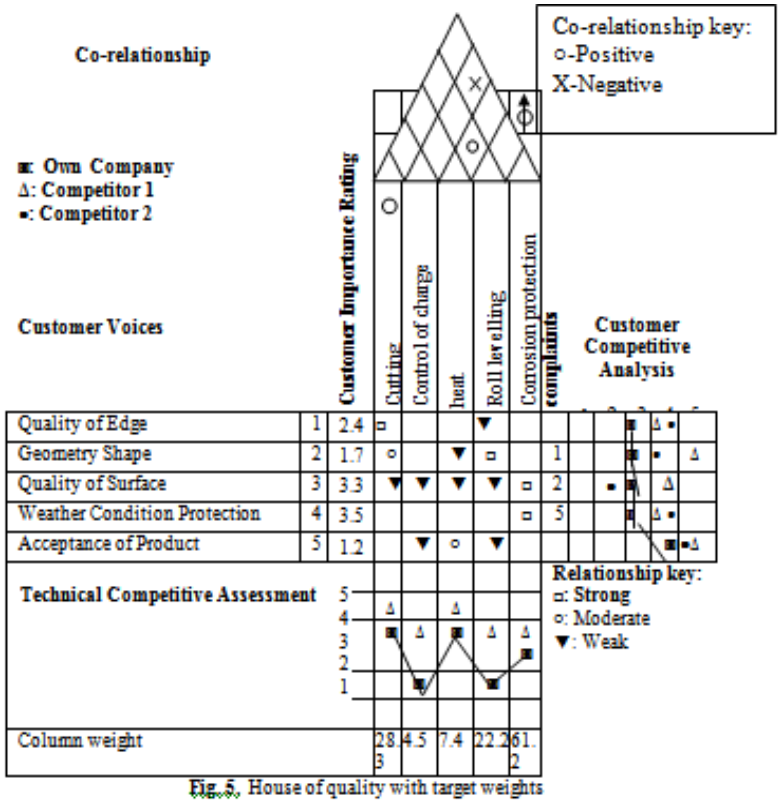

Fig. 5. House of quality with target weights

D. Analysis

House of Quality for hot rolled steel has been presented (Figure 3).

The building of The House of Quality covered the following phases:

Phase I: The demands and desires of customer have been established.

Phase II: The importance of demands of customer has been classified. And also the priorities of the individual customer requirements have been established.

Phase III: The scale of the importance of own activity at customer with his requirements has been compared.

Phase IV: Fulfilled demands of customer have been assigned to corresponding parameters of product. Answers to question have been established – What does customer expect? And how will it be realized by product?

Phase V to VII: Measurable (standard) values of parameters, the possibilities of achieving the aim, difficulties in technical realization have been defined.

Phase VIII: The dependence field between phase I and phase II.

Phase IX: Comparison between company's product and competition products – based on customer's estimation.

Phase X: The analysis of estimation achieved by customer.

Phase XI: Comparison between company's product and competition products – based on technical parameters.

Phase XII: The mutual dependence field between technical parameters of hot rolled steel.

Phase XIII :The critical points of sales.

Fig. 5 shows that customer voice "Quality of edge" is at 2.5 and the chief competitor is at 3.5 and the importance of this voice is 2.4, there are no complaints for this voice.

For the customer voice "Geometry shape", the importance rating for this voice is 1.7 and on 1-5 scales our company is at 2 and the chief competitor is at 5. There is one complaint regarding this voice.

For the customer voice "Quality of surface", the importance rating for this voice is 3.3 and on 1-5 scales our company is at 2.5 and the chief competitor is at 4. There are 2 complaints regarding this voice.

For the customer voice "Acceptance of product", the importance rating for this voice is 1.2 and on 1-5 scales our company is at 4 and the chief competitor is at 5. There is no complaint regarding this voice.

The weight can be calculated for each column that represents a combination of both customers' level of importance the strength of the relationships. This is accomplished using the product of the relationship strength and the importance. Thus, in column 1, row 1 in figure 5 the customer importance level is 3.6 and the weight for the strong relationship symbol is 9; the column weight is 28.3.

Similarly, figure 5 shows column weight for column 2 is 4.5, for column 3 is 7.4, for column 4 is 22.2, for column 5 is 61.2. These are recorded across the bottom of the matrix.

IV. CONCLUSION

To the analysis of Customers' Requirements related to hot rolled steel the Quality Function Deployment method has been used. Product - the hot rolling steel: breadth 1000-2500mm, length 2000-12000mm, thickness 5-32 mm with grade of steel : 20 MF according to standard the relations between the customer's requirements and relations at the top of HOQ are numerically calculated and have impact on internal and external factors of the organization.

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