

Quality function deployment in India: A Review

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Abstract

The term Quality Function Deployment (QFD) plays a very crucial and important role in the manufacturing sector not only from theoretical perspective but also from managerial perspective. QFD is a system for designing a product or service based on customer demands that involves all members of the producer or supplier organization. In the present scenario, automobiles are the most effective medium of transportation. QFD is a four phase model, which includes the house of quality (HOQ), parts deployment,, process planning and production planning. Among the various stages, the HOQ is most commonly used stage and its aim is to reflect customer desires (E.I.). For this, the organization conducts surveys, the research, trend research; Planning of the product also involves study of different territorial and climatic condition and other such factors. Through this, the organization will get an idea about the views and choices of their customers, opinions about the various components of the product, common complaints, etc. It is through these set of activities that the organization is able to identify specific product quality features. Apart from these error identifying techniques, a method known as Failure Mode and Effects Analysis (FMEA) is developed for preventing both part and process type failures. This research work shows how Quality Function Deployment is helpful in improving the development process with a special focus on needs of customer i.e. what features are needed by customer while using and expectations.

1. Introduction

The term Quality Function Deployment (QFD) plays a very crucial and important role in the manufacturing sector not only from theoretical perspective but also from managerial perspective. Manufacturing budgets and expenses as well as quality related issues are increasing year by year in terms of quality management program proposals, its implementation, project making, etc., keeping in view the future competition in the market and subsistence. Large sums of money are spent on training of personal, quality control of products, providing warranties, etc., QFD is central to these quality improvement programs concerning with the current market trends.

QFD is a system for designing a product or service based on customer demands that involves all members of the producer or supplier organization. In Japanese, 'deployment' refers to an extension or broadening of activities and hence 'Quality Function Deployment' means the responsibilities for producing a quality item is assigned to all parts of a corporation. It is sometimes referred as the most advanced form of Total Quality Control, in Japanese style.

In the present scenario, automobiles are the most effective medium of transportation. We have evolved so much from their past discovery to till date, in the contemporary time,

it is the best machine created for mankind. Today, India's passenger car and commercial vehicle manufacturing industry is the sixth largest in the world. In metropolitan cities, roads are filled with cars and yet there is an increasing demand for more vehicles. And not only the demand is increasing but there is also increase in the desires of the customers that are related to the design and features of automobiles they drive for their comfort. Today the consumer wants safety, style as well as maximum features at minimum price. The present case study deals with a particular part of a car, namely the dashboard and tries to make it more useful and user friendly.

While focusing on defenses vehicle scenario of the country, it is clear that the battle zone has been shifted from the declared war at border to border incursion, terrorism and naxalites. In order to give quick response to attack effectively and successfully, the demand of vehicles of different role is most highlighted the design requirement for military vehicles, too much concerned with survivability at different territorial and extreme climatic conditions. The product design specification based on voiced of army personnel by way of Q.F.D. matrix, can fulfill their requirements through Q.F.D. approach, the requisite technical characteristics and other factor is taken into account while designing to satisfy the need of army of multipurpose like combat activities, patrolling, transportation, ambulance, kitchen container, water browser, anti mine and light recovery vehicle.

QFD is a methodology to translate the voice of the customer to design characteristics of a product. Its aim is

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to ensure that customer requirements are integrated in the design and production of the information system Kane, Sereku, Takhons on T suzi (1984) developed a model which has been used by other to categorize the attributes of the product or service based on how well they are able to satisfy customer requirement (Scroll direct).

Q.F.D. is a four phase model, which includes the house of quality (HOQ), parts deployment,, process planning and production planning. Among the various stages, the HOQ is most commonly used stage and its aim is to reflect customer desires (E.I.).

2. Literature Review

In the light of the above, this study deals on the topic- Applying the QFD model in the Indian Automotive Industry. Following are the collective objectives of the presented study:

- Improving the design of automobiles as per the customer's requirement.
- Enhancing more menovarability, survivability,& safety of the user.
- Enhancing the comfort, security and reliability.
- Achieving the above objectives while keeping the design characteristic to use vehicle at different territorial and extreme climatic condition.

Our study is aimed at finding out the technology and features which are available in the international market and possibilities of making it available to masses of this country, if can be made available to them in their budget. All our focus is on the improvement of quality of vehicles by utilizing the QFD model in the Indian Automobile Industry.

2.1 Historical Development

QFD was developed in the year 1960, in Japan, by two learned professors- Shigeru Mizuno and Yoji Akao. It was the time when the statistical quality control, which was specifically introduced after the World War II, and had taken deep roots in the manufacturing industry of Japan. Activities viz.-a-viz. quality activities were being integrated with the teachings and methodologies which were emphasized thereby giving importance in making of quality control an integral part of the concept of business management, which broadly came to be popularly known as Total Quality Management i.e. the TQM. The main motive behind the efforts resulting into an important invention of Professors Mizuno and Akao was to develop a method of quality assurance, resulting into designing products, to the entire satisfaction of the customers.

Previously, the method of quality control were aimed specially and primarily at fixing/sorting out a problem during the process of manufacturing or thereafter. Large scale application of the same was presented in the year 1966 by Mr. Kiyotaka Oshiurni of the organization M/s. Bridgestone Tyres of Japan, using a process assurance items termed as "Fishbone Diagram" to identify and notify requirement of each and every customer viz.-a-viz. its effect thereby identifying the design substitute quality characteristics factor and process factors i.e. causes of it which needed to control and measure the same. It was during the year 1972, with the help of application of QFD for the purposes of designing of an oil tanker at the Shipyard at Kobe of Mitsubishi Heavy Industries, where the fishbone diagrams become burdensome. As the effects

in it had multiple causes and fishbone could be started afresh thereby providing desired effects of customer satisfaction resulting into controlling and measurable causes. It was at that time only that one Mr. Katsuyoshi Ishihara introduced and propounded the concept of Value Engineering principles which used was to be used to describe how a product and its components work in which he elaborated this to describe important business functions which were very necessary to assure quality of the design process in itself. It was a result of combined effect of these new ideas that the concept of QFD eventually became the comprehensive quality design tool or system for both for the segments of product and business processes. It was in the year 1983 that the concept of QFD was introduced first time to United States of America and Europe when the American Society for Quality Control published Akao's work in Quality Progress and Cambridge Research which is known as Kaizen Institute presently, invited Akao to give a QFD seminar in the Chicago. After this several lectures were organized on QFD for American audiences which were sponsored by Bob King of Boston. The concept of QFD had lots of flexibility and comprehensiveness in it that, the U.S., in particular its methodology was eagerly accepted and embraced by the businesses especially by those which were facing tough Japanese competition. New, innovative and technological applications of QFD were experimented by business houses and productive industries which were not reached or experimented before. In today's world, the concept of QFD continues to inculcate and inspire strong interest the world over thereby resulting into generation of ever new applications by the competent practitioners and researchers from time to time. The countries which have held International QFD Symposium include the U.S., Japan, Sweden & Germany amongst others.

3. QFD Process

QFD process cycle includes the below mentioned steps;

1. Planning of the product
2. Mechanism deployment
3. Process Development and Quality control Planning.
4. Production operation Planning
5. Inspection

3.1 Planning of the Product

Since, QFD is based on the customer's needs and demands; therefore it is very basic for the development of the product that the company is well aware of the features that will the maximum satisfaction to the customers. For this, the organization conducts surveys, the research, trend research, Planning of the product also involves study of different territorial and climatic condition and other such factors. Through this, the organization will get an idea about the views and choices of their customers, opinions about the various components of the product, common complaints, etc. It is through these set of activities that the organization is able to identify specific product quality features.

3.2 Mechanism Deployment

Mechanism deployment involves converting the final product quality characteristics into material parts and their functions. It includes, calculating reliability and quality of these components. In such a study, some components may be more critical than others in satisfying the

customer requirements. These components are called 'critical'. Critical components along with their characteristics are carefully defined in a hardware deployment plan.

3.3 Process Development and Quality Control Planning

In this stage the relationship between the component parts is identified and their respective process operations are developed. Once such relationships are identified, quality control activity is undertaken in which control as well as check points are identified. Control points are critical product component parameters (such as radius, viscosity, etc.) that are created or are directly affected in a given process. On the other hand, check point are critical process parameters that must be monitored strictly to assure that the component parameters are achieved. Apart from these error identifying techniques, a method known as Failure Mode and Effects Analysis (FMEA) is developed for preventing both part and process type failures.

3.4 Production Operation Planning

The quality control plan achieved in the previous stage is analyzed in order to identify three major production requirements, namely, equipment and manpower plans, control items and check methods. Decisions about what equipment to use are taken on the basis of the quality desired along with the process specifications for each component part. Further, time study is performed to set the standard operating time required for each process to ensure delivery in time. This standard is documented and used later for training the manpower. After this, control items and check methods are employed. These include the appropriate sampling size and sampling frequency for each item.

3.5 Incoming Inspection

To avoid the outflow of defected products, inspection procedures are engraved within the production process at various stages to minimize defects as per the principles of Six Sigma.

4. Kano Model of Customer Satisfaction

The Kano Model 11 is a useful tool in understanding customer needs are given in figure 1 derstanding Customer Needs The Understanding Customer Needs The Kano model categorizes customer needs into three groups" basic, performance, and excitement. This model must be applied to a specific market segment; for example, customer expectations for a commodity masking product are significantly different from those for a high temperature automotive masking product. Basic needs are those that get a company in the market; they are not spoken unless violated.

Sources of basic needs include complaints, industry standards, what your competitors are doing, and your own product expertise. Performance needs are known as those that keep a company in the market. They are spoken by the customer and considered when purchasing decisions are made. Performance needs make the customer happy or unhappy, and the customer's happiness is proportional to how well the performance needs are met. For a pressure sensitive product, it is a basic expectation that it will stick to a surface

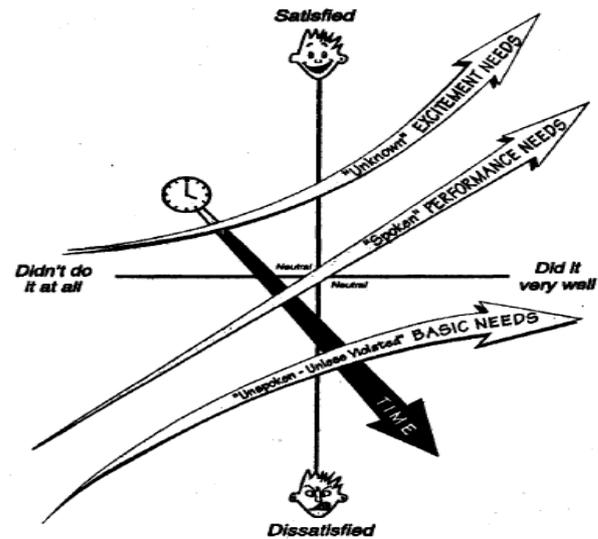


Fig. 1 Kano Model

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The last categories of needs per the Kano model are those that afford the greatest opportunity in terms of becoming a market leader or innovator. These needs are known as excitement needs. Like basic needs, excitement needs are unspoken. However, unlike basic needs, which are expected and known, excitement needs are beyond customer expectations. For this reason, they are generally unknown and difficult to uncover. Some of the techniques used to uncover these needs include looking upstream and downstream in a customer's process, evaluating how a product has evolved with time, looking for unconventional uses of the product, and involving people from outside the industry. Excitement needs are pleasant surprises, leap improvements, "bells and whistles", and sources of customer delight. As such, if an excitement need is not fulfilled, it does not impact customer satisfaction. If an excitement need is fulfilled in any way, there is movement on the curve towards increased customer satisfaction. "Me too" companies do not address excitement needs; these needs are handled by innovative companies that are looking for the next generation product or service.

There are many examples of this in the auto industry where automatic transmission, cup holders, visors with clips, automatic windows, and airbags were once considered excitement needs and are now expected in a new vehicle.

5. Fuzzy QFD

The concept of Fuzzy logics revolves around 'what if' analysis in a situation. Since the customer, in general, is usually confused about their wants, the concept of fuzzy logics is brought into picture by the company to arrive at a decision. The following are some of the studies that have

been undertaken so far, which combines QFD and Fuzzy logics.

Fung proposed a non-linear fuzzy model to offer a more practical and effective means of incorporating the resource factors in QFD planning. Solutions to non-linear fuzzy models can be obtained using a parametric optimization method or a hybrid generic algorithm.

Bai and Kwong presented a fuzzy optimization model for the determination of target values for engineering requirements in QFD. An inexact generic algorithm approach was introduced to solve the model that takes the mutation along the weighted gradient direction as a generic operator. Through an interactive approach, a design team can determine a combination of preferred solution sets from which a set of preferred target values of engineering requirements can be based on specific design scenario could be obtained.

In a study by Verma modified and extended the QFD conceptual phase initially proposed by Pugh by applying concepts from fuzzy concepts theory. The extended approach presented by the author provides a rigorous mechanism for dealing with imprecise requirements and priorities. It developed a set of correlations as prerequisites to concept selection. The paper presented an expert system based extension of the fuzzy QFD methodology. An expert system was embedded in the fuzzy QFD tool to facilitate strategic product planning, early design decision making, and parameter target setting.

Vanegus and Labib proposed a novel method for determining optimum target in QFD. Fuzzy numbers are used to represent the imprecise nature of the judgments, and α defines more appropriately the relationship between EC's and customers attributes. Constraints such as cost, technical difficulty and market position are considered.

5.1 House of Quality

QFD utilizes a series of matrices, referred to as the House of Quality (HOQ), to translate the demands of the customers through product design and manufacture. There are four phases of the project-

- Phase 1- Product planning
- Phase 2- Design deployment
- Phase 3- Process planning
- Phase 4- Production control

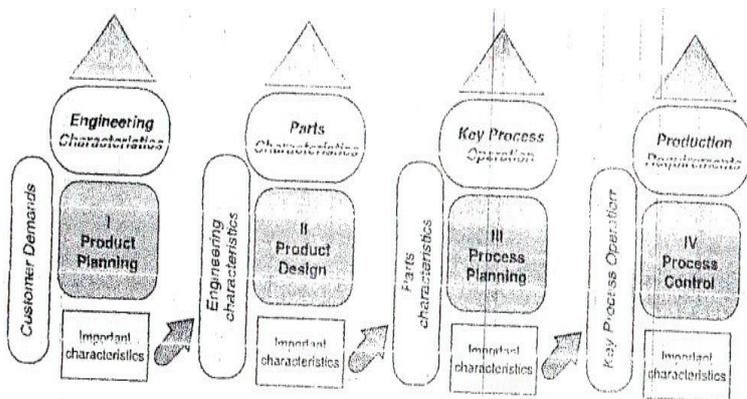


Fig. 2 House of Quality

The four important elements of HOQ are- what (customer needs), how (customer measure), relationship (between what and how), and how much (target value).

The first chart is normally known as the "house of quality" owing to its shape (Figure 2a). Figure 2b shows an example of the house of quality for manufacturing process. The QFD charts help the team to set targets on issues, which are most important to the customer and how these can be achieved technically. The ranking of the competitors' products can also be performed by technical and customer benchmarking.

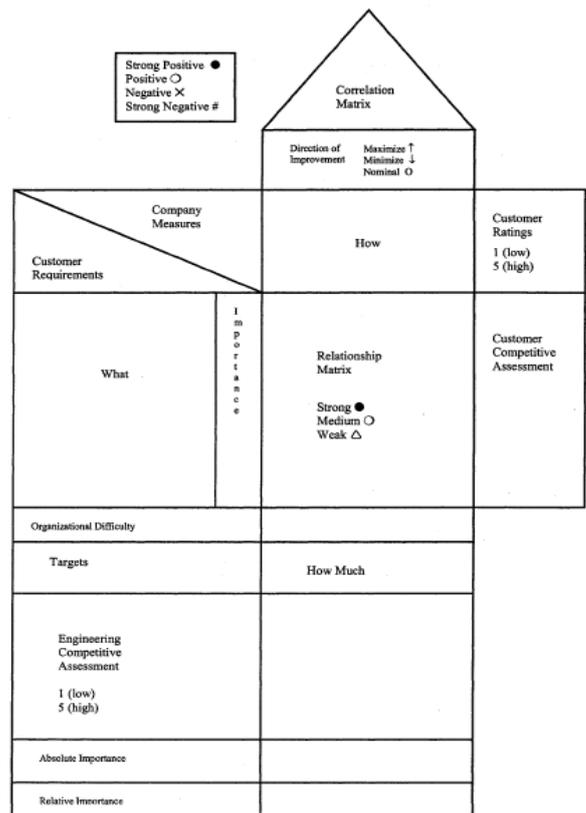


Fig.3 House of Quality

The QFD chart is a multifunctional tool that can be used throughout the generation. For engineers, it is a way to summaries basic data in a usable form. For marketing, it represents the customer's voice and general managers use it to discover new opportunities (causing and Pugh, 1991).

5.2 Identifying the Customer's Needs

Since the whole concept of QFD is laid down on the foundation of customer demand, therefore, in order to commence with this we will have to identify the need of the customer. The results of a number of surveys conducted show that the customers desire the following features:

- Forced exhaust system
- Multipurpose container for different attachments like cups, bottles, etc..
- Good ergonomics
- User friendly
- Automatic operating system

- Cost effective

The above features should not affect the existing features of the dashboard.

5.2.1 Need of the Study

In today's world having global scenario that too with highly competitive and demanding market, it is very much necessary and essential for the survival of any of the manufacturer(s) who want to be in market, to be proactive, responsive, adaptive to the changes of that too when he/they has/have capability to provide high quality goods according to the latest changes and trends happening in the market as per customer expectations. One has to keep in mind that without taking into consideration requirements of the customers, no one can even imagine to survive in the market. The success of new products, especially in the automobile sector depends largely on how well they meet customer needs and requirements, keeping in view the car in today's world have become a product of daily need and are not a luxury. Keeping in view these important aspects, QFD i.e. Quality Function Deployment provides a structured methodology for translating the Voice of Customers' into design requirements by guiding the product development process thereby improving the success rate for new products to be launched in the market. This research work shows how Quality Function Deployment is helpful in improving the car dashboard development process with a special focus on needs of customer i.e. what features are needed by customer while using dash board and expectations. Two important researches and developments in the car dashboard, the forced exhaust system and the multipurpose cup holder are tried to be made according to the customer's needs and expectations.

6. Conclusions

For identifying the customer needs to selected from the following walks of life and different strata of societies who have been using cars for a decade or more amongst others using cars for the last few years. A survey and the production site were visited as the workshop of Honda Motors, Tata Motors Authorized repair and service centre as well as workshop of Audi Motors in Gurgaon. In this attempt, an effort was made to study the functions of the car dash board and what further improvement can be done in it. The results of which was Forced exhaust system and multipurpose cup holder in it. Second point of survey was undertaken and conducted to know the requirements of the customers what to say "Voice of Customer" (VOC) viz.-a-viz. forced exhaust system and multipurpose cup holder which was obtained as result of my first survey. For this purpose data which was collected was strictly interpreted in terms of consumers' needs which were organized as per their relative importance. Utmost importance was given to needs and requirements of customers allocating it on a scale of 1 to 5 thereby allocating 5 to most important and allocating 1 to least important.

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