

# Application of Quality Function Deployment (QFD) In Aluminium Pot Manufacturing Industry with TPM Pillars

Edwin Joy Pulikkottil

PG Scholar, Dept. of Mechanical Engineering, ECET Coimbatore, India

\*\*\*

**Abstract** - Maintenance is an important strategy used by the industries to thrive in the global market. Total productive maintenance (TPM) is an approach for improving the productivity of a firm. But it has some paucity in considering the customer voice in improving the productivity. QFD is a structural approach for integrating customer needs with the technical realities. QFD methodology works on the House of Quality (HoQ) a graphical representation of relationship between the customer needs and the associated product characteristics. The study is conducted in a Pot manufacturing industry.

**Key Words:** QFD (Quality Function Deployment), TPM (Total productive Maintenance), HoQ (House of Quality), Action plan, TQM (Total Quality Management), HoQ Matrix, Anodisation, Heat treatment apparatus.

## 1. INTRODUCTION

The customer became the king of the market in the 20<sup>th</sup> century. In order to thrive in the competitive global market, the industries were forced to innovate better methodologies and models and equipment. Many strategies were tested and applied to make success in the market. Some of the strategies were replaced by other strategies. The industries understood the value of the quality. In order to get the maximum quality, the machines should work in better condition. Replacing a damaged machine by a new one was not an economical way in some circumstances. Thus they found an important strategy, i.e. maintenance. The maintenance strategy became an inevitable strategy in the industries. But the method of maintenance strategy had a lot of change. The maintenance strategy used in 20<sup>th</sup> century had many difference from the strategy that we use today. Many different approaches were linked with the maintenance. Industries developed different strategies that suit their need. One such methodology is TQM (Total Quality Management). The TQM is integrated with the TPM (Total Preventive Maintenance) structure. QFD (Quality Function Deployment) is an important tool in the TQM.

QFD is used to find out the voice of customer (VOC). This (VOC) is related with the technical parameters in QFD. In the case of TPM it doesn't have provision to find VOC. Thus the QFD and TPM could be integrated for preparing an improved strategy. QFD is a structural approach which integrates the customer's expectations and the technical realities of the competitive industry in to a unique product specification. The QFD method works on the House of Quality, a graphical representation of the interrelationship between the voice of customers and its associated product characteristics. QFD approach is suitable for product improvements. It cannot be used for an innovative product. The QFD approach ensures that the improvement of the product is according to the needs and expectations of the target customer group. Pot (idly purpose pana) is a flat bottomed cooking utensil which is used for making idly's in steam. There are many varieties of Pots. Some does not have coating. Pots are made in variety of materials. Nowadays Pot (idly purpose pana) find a large demand in the property due to south Indian people also uses commonly the breakfast as idly. So a quality maintenance study in a Pot (idly purpose pana) will be important. It was found that there was MQFD implementation in the cooking ware manufacturing industry and it was found that no work was done in the case of a Pot (idly purpose pana). So a study about the quality assessment in the Pot (idly purpose pana) manufacturing industry is found necessary.

### 1.1 Quality Function Deployment (QFD)

QFD is a structured approach which was developed to transform the voice of customer in to the engineering characteristics of a product. It was developed in Japan in 1966 by Yoji Akao. And in 1978 the first book on QFD was published in Japanese. According to Yoji Akao QFD is a "method to transform qualitative user demands into quantitative parameters, to deploy the functions forming quality, and to deploy methods for achieving the design quality into subsystems and component parts, and ultimately to specific elements of the manufacturing process." QFD is a structural approach which integrates the customer's expectations and the technical realities of the competitive industry in to a unique product specification. QFD is a tool used to convert customer's vague language in to technical languages. QFD helps in linking the expectation of customer with design, development, engineering, manufacturing, and service functions. The implementation of the QFD needs preparation of a composite matrix HOQ (House of Quality). HOQ is a combination of matrix consisting of six sub matrices namely customer requirement, technical language, relationship matrix, ranking of customer language, ranking of technical language and correlation matrix. The QFD approach uses HOQ as a medium to convert customer language in to technical parameters. A major

part of the development of a QFD is the preparation of HOQ. The primary functions of QFD have been developed from – product development, Quality management, Product design and costing, Decision-making, Performance measurement, evaluating company’s current status. In fact, QFD is a methodology for measuring and analyzing evaluation indicators by their relationship matrix. For achieving strong competencies, modern organizations have to attain high quality accompanied by adoption of innovative strategies. IQFD (Innovative Quality Function Deployment) is a powerful technique used in this field. IQFD is a blend of both QFD and IM( Innovation Management).

**1.2 Total Productive Maintenance (TPM)**

The aim of TPM is to produce a perfect working condition for all the equipment. It focuses on zero breakdowns and no delays in the manufacturing process. The TPM works on the eight pillars of TPM. V.R Pramod et al (2011) made a study on synergizing TPM and QFD. TPM focuses on improving the operational efficiency of the equipment. TPM also aims to have a safer working environment. The basic requirement of the idea of TPM emerged due to the high need of a process that can coordinate all the production process for achieving a common goal. The gradual modification in the Preventive maintenance, maintenance prevention and maintainability improvement resulted in the evolution of the idea of TPM. TPM is a productive maintenance carried out by all employees through team activities. There are many similarities between TPM and TQM. But they are viewed as two distinct approaches in most of the publications. Both TQM and TPM result in an increase in quality. But they differ in the way of achieving the high quality. One of the important aims of TPM is to increase the productivity of the equipment and the plant by investing in maintenance. TQM aims in improving the quality of the product and services and increase the customer satisfaction by raising the awareness about quality concerns across the organization. The TPM is based on product, process, organization, leadership, commitment to the excellence throughout the organization. V.R. Pramod et al (2008) conducted a receptivity analysis of MQFD in an Indian electronic switches manufacturing company. In this literature it clearly provides the difference and similarities between TQM and TPM.

**2. QFD AND HOUSE OF QUALITY**

QFD is a method for structured product planning and development that enables a development team to specify clearly the customer’s wants and needs, and then to evaluate each proposed product or service capability systematically in terms of its impact on meeting those needs. The methodology comprises building one or more matrices known as ‘quality tables’. The House of Quality (HoQ), the first matrix used in the process, displays the voice of the customer (VoC) or the customer needs against the technical responses to meet them.

The development of HOQ needs a good knowledge about the product and its characteristics. Initially some important customer languages were identified by having a discussion with the production manager. A questionnaire has to be prepared to determine the importance of each customer language in the product. The questionnaire response was collected from 30 end users. The questions were structured in a scale varying from 1 to 10, where 1 stands for worst and 10 stands for the best. Through proper discussion with the quality manager the customer vague language is converted into appropriate technical language. The relationship between the customer voice and the technical parameters is made and weightages are assigned in order to quantify the strength of relationship between them. In HoQ table the weightages are depicted by symbols.

Relation	Symbol	Score
Strong	■	9
Moderate	▲	3
Weak	●	1

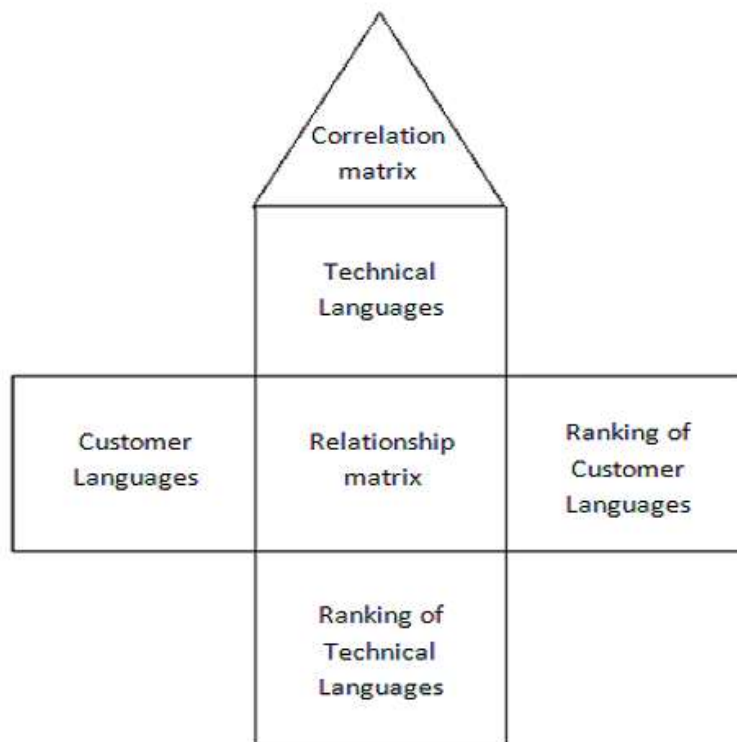
**Fig - 1:** Symbols used in QFD matrix

Quality Function Deployment (QFD) is a structured approach to defining customer needs or requirements and translating them into specific plans to produce products to meet those needs. The “voice of the customer” is the term to describe these stated and unstated customer needs or requirements. The voice of the customer is captured in a variety of ways: direct discussion or interviews, surveys, focus groups, customer specifications, observation, warranty data, field reports, etc. This understanding of

the customer needs is then summarized in a product planning matrix or “house of quality”. These matrices are used to translate higher level “what’s” or needs into lower level “how’s” – product requirements or technical characteristics to satisfy these needs.

**Table -1:** Customer And Technical Parameters

Customer parameters	Technical parameters
Scratch resistance	Anodisation
Corrosion resistance	Heat treatment
Ease of cleaning	Thickness of the oxide coating
Weight of the pan	Shape of the pan
Durability	Thickness of sheet
Handle strength	Painting
Attractive look	weight of the handle
Uniform heating	Handle material
Easiness of handling	Grip pattern in the handle
Stability	Riveting
Cost	Price tolerance



**Fig -2:** HOQ Matrices

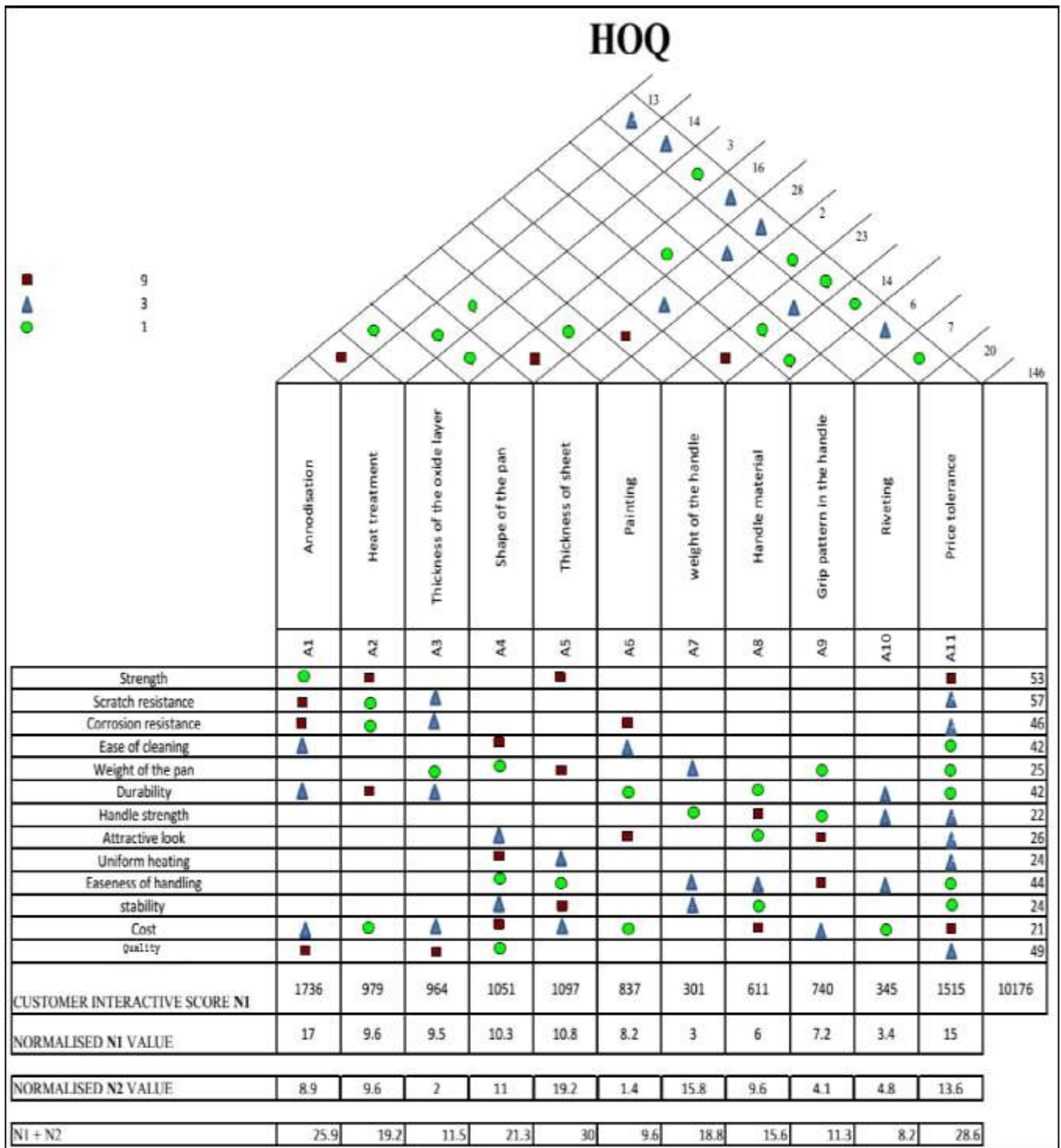


Fig -3: HOQ Implementation

### 3. TPM PILLARS AND ACTION PLAN

The outputs of the QFD matrix have been analysed. TPM focuses on improving the operational efficiency of the equipment. TPM also aims to have a safer working environment. The basic requirement of the idea of TPM emerged due to the high need of a process that can coordinate all the production process for achieving a common goal. The gradual modification in the Preventive maintenance, maintenance prevention and maintainability improvement resulted in the evolution of the idea of TPM. TPM is a productive maintenance carried out by all employees through team activities.

**Table -2:** Action plans in Anodisation with TPM Pillars

Anodisation	Action plan
Autonomous maintenance	Worker should be well known to check the electric circuit and rectify electrical failure.
Individual improvement	The worker should have knowledge about the electrical parameters.
Quality maintenance	The worker should ensure that proper anodisation is produced and the thickness of the coating should not be less than 20µm as per Indian standard. The worker should do pretreatment like polishing before the anodizing the pot.

**Table -3:** Action plans in Heat treatment with TPM Pillars

Heat treatment	Action plan
Autonomous maintenance	The heat treatment machine should be clean and maintained properly.
Individual improvement	The employees should be aware of the time duration for which the component should be kept in the heating chamber. He should have a good idea and knowledge about the cooling time required. The temperature of heat treatment should be 420°C.
Education and Training	A proper training should be given to the employees about the importance of the heating temperature and the cooling time. He should be taught about the purpose of the heat treatment process.
Planned maintenance	Planned inspection should be done to provide proper passage of hot air through the chamber. Cooling system should have a scheduled inspection. Cleaning should be done in a routine basis. The air circulating fan should be maintained if needed.
Safety	The operator should know to inspect the sonnet valves and non-returning valves.

**Table -4:** Action plans in Riveting with TPM Pillars

Riveting	Action plan
Autonomous maintenance	The worker should himself know the maintenance in the riveting machine. He should drain the water in the compressor daily before the work.
Individual improvement	The worker should have proper logic in the selection of the good rivets. He should avoid those defects. The worker should improve himself in producing less waste of rivets. He should be careful in operating the rivet machine without rivet between the punch. This will damage the punch of the machine

#### 4. CONCLUSION

The quality and efficiency of the TPM method could be improved to a larger extent, by integrating with HoQ matrix of QFD. In QFD the customer parameters were changed to technical terms. Customer interactive score were found out for each process in the manufacturing process of pot. The result from the HoQ tells that industry should give importance to three technical parameters. They are Thickness of the sheet, Price tolerance and anodisation. The technical parameter “thickness of the sheet” got the highest percentage normalized value of 30. The second highest is for “price tolerance” with a normalized score of 28.6. Third important parameter is “anodisation” with a normalized score of 25.9.

**REFERENCES**

- [1] R.A. Sankaran, V. Senthil, S.R. Devadasan, V.R. Pramod (2008) Design and development of Innovative Quality Function Deployment Model, International journal of Business Innovation and Research, 203-222
- [2] V.R.Pramod and S.R.Devadasan (2011), Synergising TPM and QFD: A Case Of Electronic Switch Manufacturing, International Journal of Quality and Innovation, 314-323.
- [3] V.R. Pramod, S.R. Devadasan, S. Muthu, V.P. Jagathyraj, G.Dhakshina Moorthy (2006) Integrating TPM and QFD for improving quality in maintenance engineering, Journal of Quality in Maintenance Engineering, 158-162
- [4] V.R. Pramod, S.R. Devadasan, V.P. Jagathy Raj (2006) "Customer Voice Adoption For Maintenance Quality Improvement Through MQFD And Its Receptivity Analysis". International Journal Of Management Practice, 87-89

**BIOGRAPHY**

Edwin Joy Pulikkottil completed B.Tech in Mechanical Engineering under Calicut University at Jyothi Engineering College. He had 1 year of experience in industry and 2 years of experience in teaching. He is doing Masters in Manufacturing Engineering.