Total Quality Function Deployment A Case Study

Pramod George
Department of Mechanical Engineering
Caarmel Engineering College
Ranni, Kerala, India

Pradeep George
Department of Mechanical Engineering
Caarmel Engineering College
Ranni, Kerala, India

Abstract: In order to distinguish ourselves from competitive pack , its becoming increasing important to seek a deeper understanding of value driving customer needs during early stages of product process development. QFD techniques and its many advanced versions can be used for it. This article aims to appraise the feasibility of Total Quality Function Deployment (TQFD) by conducting a case study in a traditional Tiller manufacturing company. Some repeatedly reported complaints about the tiller are considered for the case study. TQFD documents are successfully prepared during the case study and it indicates the possibility of TQFD in tiller manufacturing companies. The findings may considerably represent the traditional Tiller manufacturing environment.

Key words: Quality function deployment, innovative Quality function deployment, Total quality management, Tiller, Total quality.

I. INTRODUCTION

For firms to compete successfully on quality, the Total Quality Management (TQM) philosophy must be integrated into all aspects of the organization. The main objective of TQM is to fulfill the needs of the customer completely. But achieving this goal is a Herculean task. The main reason is that the languages of the customer are normally vague and it may not be completely understood by the authorities. For the effective translation of customer language techniques like QFD are used. QFD provides a systematic process for integrating TQM into new product development activities. It combines various design engineering and management tools to create a customer oriented approach to developing new products. Since QFD technique is little complicated many advanced versions are developed. viz Innovative QFD, Total quality function deployment(TQFD),Dynamic QFD etc. by researchers. In this case study an improved version of QFD technique called Total Quality Function Deployment (TQFD) has been considered and its feasibility in real time environment has been examined. For this purpose, a case study involving tiller manufacturing company has been carried out. Finally, the inferences were drawn based upon the experiences during the case study.

A. Benefits and limitations of QFD

Quality function deployment (QFD) is a 'system' for designing a product or service, based on customer demands by translating customer requirements into appropriate technical requirements for each stage. The main component of QFD are House of quality matrix(HOQ).Along with that QFD utilizes seven management and planning tools which includes affinity diagrams, relations diagrams, hierarchy trees, matrices etc However, recent researches have started to report the limitations of QFD and suggest improved version of it. Some of the major limitations of QFD cited by researchers are listed below.

a) QFD is a complicated process, which requires the expertise of qualified professionals to develop a House of Quality (Ref. [6])

b) There is no provision to incorporate the opinions and the preferences of all levels of employees in conventional QFD process (Ref.[6])

c) There is a problem in decomposing tables separately from the HOQ. (Ref.[7])

In addition to the above limitations, a study of QFD and its operational features enabled us to identify the following drawbacks. Since QFD requires the contribution experts, it is often sidelined by a group of personnel possessing theoretical expertise. This prevents the involvement of educationally less qualified personnel possessing practical knowledge from taking part in QFD process. There is every danger that this phenomenon

would retard TQM implementation since TQM envisages the involvement of all personnel towards achieving continuous quality improvement.

1. As the House Of Quality cannot be decomposed into tables, the completion process takes considerably long time. “Ref.[1]
2. Special symbols used in QFD makes it difficult to understand “Ref.[1]”.
3. To get results from QFD again expertise is required. “Ref.[1]”

As mentioned earlier, QFD restricts its scope towards product quality improvement. Its contribution towards humanization in the form of enhanced motivation, enthusiasm, work culture etc. among the employees of all levels is not given adequate thrust.

. The deficiency of QFD is that it directs the technical output only to design and production. Very often customers views are related to other functions namely sales, service, finance, materials management etc. These supporting functions are ignored in the existing QFD features.

II. OVERVIEW ON TQFD

A. Need for TQFD

QFD is comparatively a complicated process. More over it biased towards design improvement .By implementing QFD only the quality improvement in product design is prone to improve. The other functions namely production process, procurement, Research and development, service and so on, may not get the benefit of applying QFD in the company. some defects are prone to occur in other non manufacturing areas like packaging, transportation, procurement etc.Hence many advanced versions of QFD are developed by researchers. An improved model called Total Quality Function Deployment is designed to overcome these difficulties ((Devadasan S.R, Kathiravan N andThirunavakkarasu, (2006)). The term ‘total’ assumes special importance in the title ’TQFD’. Unlike conventional QFD, in TQFD process, reactions will have to be received from both internal and external customers from all possible nodes and channels of the company.. The term ‘node’ refers to source, which may include employees of all levels and all the external customers. ’Channel’ refers to the wide range of communication media like manual messengers, telephonic conversation, and internet supported feedback entries. The TQFD technique should facilitate the involvement of all levels of concerned personnel from all the concerned departments.. For this purpose, instead of developing ‘House Of Quality’ in TQFD, the matrices are decomposed and simple languages are recommended for usage. The TQFD development process has to progress by developing five matrices in stages and has to end by releasing the work instructions. the complete utilization of the data, information and knowledge generated during the TQFD development process

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B. Structure of TQFD team

A TQFD team involves the members of management who set the policies, the sales manager who contact to sell products of a certain quality and obtain customers’ feedback regarding quality, the design engineer who set the product specifications. The materials manager who purchase raw materials of right quality and the manufacturing personnel who are responsible for making the product according to prescribed specifications. In all persons co-operation of the organizations the quality of the products and program can be maintained. The structure of TQFD model is shown in fig.1

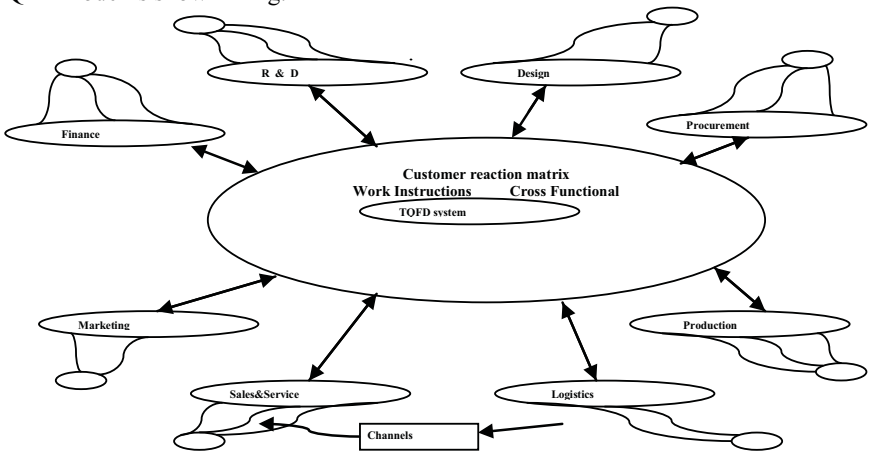


Fig1. Conceptual features of TQFD technique. “Ref.[1]”

C. Development of TQFD

The aim of the TQFD is to built quality into the product right from he conceptual stage and continues during various stages of product development. Conventional QFD involves the development of planning matrix, deployment matrix, process plan and quality control charts, operating instructions.

TQFD involves the development of the following matrices:

1. Customer requirement matrix.
2. Cross functional matrix.
3. Product development matrix.
4. Component deployment matrix.
5. Process plan and quality control charts.
6. Work instructions.

D. Likert scale

Likert is a bipolar scaling method, measuring either positive or negative response to a statement. Sometimes Likert scales are used in forced choice method where the middle option of "Neither agree nor disagree" is not available.

After the questionnaire is completed, each item may be analyzed separately or item responses may be summed to create a score for a group of items. Hence Likert scales are often called summative scales.

III. Implementation Programme

The steps to be followed during implementation are enumerated below.

- Study the existing the TQM system and identify improvement opportunities.
- If the QFD efforts are already on, identify the strengths and pit falls of the conventional QFD and introduce TQFD to the management .If QFD efforts are partially on, review the present QFD efforts and introduce the importance of TQFD to the management. If unsuccessful attempt on QFD was exerted, the causes of failures to be identified and the effect of TQFD is appraised to the management.
- Obtain management commitment and support for implementing TQFD.
- Suggest changes in organizational structure for effective implementation of TQFD.
- Introduce the concept of TQFD in stages to all levels of employees.
- Identify nodes and channels for obtaining customers' reactions in each function.
- Identify the customer languages from various nodes and channels of the company.
- Apply the TQFD documents and develop/modify the documents.
- Distribute and authorize these developed/modified TQFD documents at various levels.
- Appoint a TQFD coordinator from the middle level managerial category and implement the TQFD programme.
- Asses the customers' satisfaction towards the company's product and services after implementing TQFD programme

Depending upon the customers' satisfaction, modify and refine TQFD program.

A. Benefits of TQFD

The effective implementation of TQFD would result in the following advantages.

1) TQFD facilitates in spontaneous networking of functions and personnel for effective translation of customers' languages into technical languages.
2) Simpler procedures for developing the documents, which facilitate the participation of all employees and managerial personnel.
3) Possibility of using documents developed during all stages by different kinds of users.(Ref[1])
4) Employee Involvement:
5) Employee motivation:
6) Employee Enthusiasm:
7) Employee work culture:
8) Employee communication ability:

9) Employee positive attitude.

IV. CASE STUDY

The case study was carried out in a traditional Tiller manufacturing company in Kerala. Some repeated complaints from the customers are considered for the case study. Case study was started by preparing the customer requirement matrix based on the complaints received from the customers through various nodes and channels.

A. Specifications of tiller engine

Engine : ER90, Single cylinder, 4 stroke
Horse Power (max): 12
.
Tiller 1
Governor ball guide is broken and oil leakage in engine block is noticed.

Tiller 2
Leakage in Pipe Bolt area is also noticed. and leakage in MBC covering is also noticed.
The main components which can cause above problems are G.B guide, Pipe Bolt, Main bearing case cover, cylinder frame, side cover.
A copy of the customer reaction matrix is put upon the notice boards Tiller Assembly shops E1 and E2 painting section and Testing. For creating awareness among staff members and all employees about customer reactions and their requirements. Suggestions from the employees and staff are collected to meet customer requirements. When the 2 engines were inspected following problems were inspected. Following problems were identified.

B. Customer requirement matrix

With the available data, the customer requirement matrix formed as shown in table 1

TABLE 1
CUSTOMER REQUIREMENT MATRIX

TQFD No.	Customer requirement, complaint	Nodes	Channel	Rating	Remarks.
1	Tiller is not working properly	Dealer (kollam)	Land line	10	Startig Troube.
1	Tiller is not working properly	T.N.Agrosales Coimbatore.	e-mail	10	Oil leak in engine block

Tiller – Persons from these departments form
Team - to discuss about customers problems. After conducting a number of sessions Cross-functional matrix is formed. The important ratings are made on the bare of likert's scale. about customers problems. After conducting a number f From the table different Problems and the responsibility and importance of each departments can be easily identified.

C. Cross functional Matrix

The department heads like Production and Purchasing, Assembly, Design, Inspection and QC, Painting, Marketing are associated with the manufacturing

TABLE 2
CROSS FUNCTIONAL MATRIX

Customer Complaint.	Importance rating	. Functions/Department.					
		P	D	I	A	PA	M
Tiller is not working properly	10	7	8	9	8	4	3

Customer Complaint : Tiller is not working Properly.

P- Production and purchase
D- Design
I- Inspection and QA
A- Assembly
PA- Painting
M - Marketing& servicing

A copy of the Cross-Functional matrix may be put up on the notice boards of all departments adjacent to the Customer reaction matrix. A copy is circulated to all the participating members of the team also.

D. Product development matrix

Followed with the creation of Cross-Functional Matrix, formation of Product development matrix of individual function was carried out. Members of each department participate in the discussion and bring out the product development matrix. Using Likert's scale the importance ratings are indicated. Since degree of responsibility will differ depending upon the nature of the customer's requirement under each function a Likert's scale in the range of one to ten is used. A number of discussions with team members, experienced employees and staff is carried out for this.

TABLE 3

SECTION PRODUCT DEVELOPMENT FOR DESIGN

Function	Final Product Characteristics		Component
	G.B guide don't break	No leakage in Pipe bolt	G.B guide, Pipe Bolt
Design	8	6	

Since the Governing Ball guide breakage is a repeated problem it is considered seriously. The problem is discussed with the members of design department. It is found that the existing material can't withstand the rpm and it is decided to change the material to En8.The finishing of pipe bolt is changed to prevent the leakage.. The Product development/modification matrix of design department is published on the notice board of respective departments and is circulated among the team members.

TABLE 4
PRODUCT DEVELOPMENT FOR INSPECTION DEPT.

Function	Final Product Characteristics			Components
	Cylinder frame and Side cover sent for assembly should be	Smooth surface finish for pipe bolt & MBC cover	GB guide should not have any material defect	
Inspection	9	7	8	Cylinder. frame, Pipe

Usually batch inspection is done for cylinder frame, side cover etc. The problems of cracks in these components are repeatedly occur. These factors are discussed with the persons in Inspection and QA section. If crack is found in cylinder frame of a sold tiller, it should be dismantled and new cylinder frame is to be assembled .Lot of time and money wastage occur So it is decided to give more importance in the inspection of cylinder frame, side cover etc.

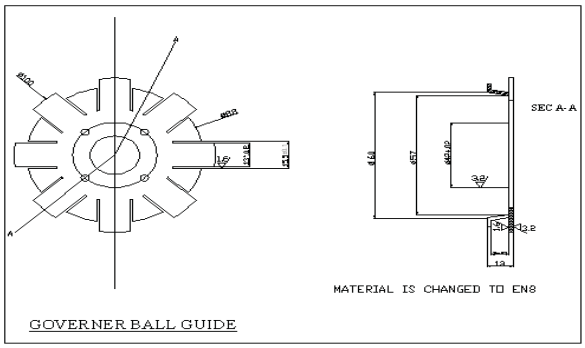


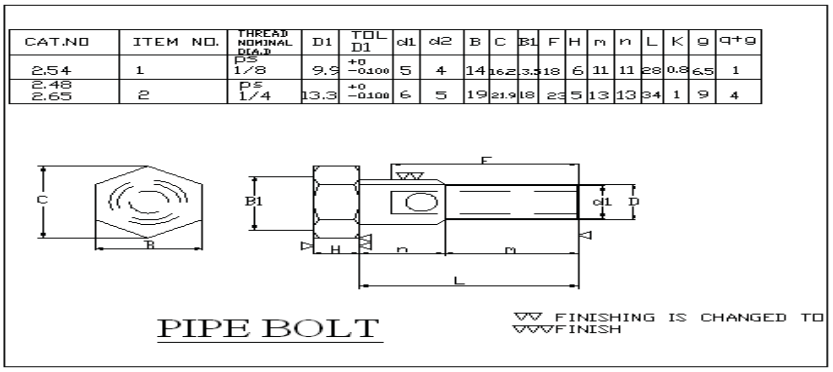
Fig.2

E. *Planning and control chart*

In this matrix, the planning and control strategies required for each components with the target functions are prepared and is shown below The planning and control chart represent the transition from development to the execution of production phase.. In order to attain planned results control efforts are required to be exercised .The matrix is published in the notice board of all the departments. It is circulated among the team members also.

TABLE 7
PLANNING AND CONTROL CHART

Components	Finished Component Characteristics	Design changes/ Modifications.	Target functions
G.B guide.	Material should not break	Material. is changed to EN8	Design Production Assembly.
Pipe bolt	The surface finish should be high	Surface finish is. improved	Design Inspection Assembly
Cylinder frame, side. cover	Material should not have crack in it.		Production Inspection. Assembly



CAT.NO	ITEM NO.	THREAD NOMINAL DIA D	D1	TOL D1	d1	d2	B	C	B1	F	H	m	n	L	K	g	g+g
2.54	1	PS 1/8	9.9	+0 −0.100	5	4	14	16.2	3.5	18	6	11	11	28	0.8	6.5	1
2.48 2.65	2	PS 1/4	13.3	+0 −0.100	6	5	19	21.9	18	23	5	13	13	34	1	9	4

Fig 3

V: RESULT-WORK INSTRUCTIONS

The implementation steps as a result of the formulation of Planning and control strategies are translated into simple technical language. This is due to the fact that the employees who undertake 'Transaction processing' will not find it convenient to refer to planning and control strategies. Hence the document 'work instructions' is designed for each department. The problems are rectified.

TABLE. 7
WORK INSTRUCTION FOR DESIGN DEPARTMENT

Department/Function : Design TQFD document number : 1 Target user: Drafts man. Work Instructions : Circular to drafts man with instructions that dimensions of the following parts changed and accordingly revised drawing to be prepared. a) G.B guide material is changed to En8. b) Surface finish of pipe bolt is. Changed from finish to. Finish. Revised Drawings of G.B guide, pipe bolt, . TQFD Team members : Supporting documents :
Signature of authority :

VI. CONCLUSION

Reaching the highest degree of excellence in manufacturing or fulfilling the customer needs completely is the main objective of TQM. But achieving this goal is not an easy one. In most of the cases the customer language is vague and is not easily understandable to the practitioners normally the application of TQM becomes ineffective due to this phenomenon. For the effective translation of customer languages QFD technique is used for the past three decades. QFD is a complicated process. Many advanced QFD models are developed during the past few years viz. advanced QFD, Dynamic QFD, Total QFD etc. by various researchers. This article deals with a case study to appraise the feasibility of Total quality Function Deployment in a traditional Tiller manufacturing company. Since, the project was curiosity driven one, the management don't show much interest in it. I got help from experienced employees in each section than the top level management .Thus the case study had to be conducted with certain practical difficulties. Yet it was possible to develop the TQFD materials involving all connected functions. Case study was conducted for 2 tillers and the complaints are analyzed. The following documents are prepared.

a) Customer requirement matrix.
b) Cross-functional matrix.
c) Product development matrix
d) Component deployment matrix.
e) Planning and control chart.

f) Work instructions.

So TQFD method is applied to solve the complaints and there by achieving customer satisfaction. The documents can be used by many departments for future purposes. The TQFD team analyze the complaints, Prepare the tables and give work instructions for solving the complaints. During the monitoring session The D.G.M appreciate my effort. The experience of conducting this case study indicated that management support and commitment are vital for the successful implementation of TQFD programme. In a nut shell ,the experiences during case study, and on the basis of previous works about TQFD indicate the practical feasibility of TQFD not only in Tiller manufacturing company but also in any organization.

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