Overview of Qfd – a Concept and Implementation

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ABSTRACT
In this paper the capability of a customer focused quality engineering technique called "Quality Function Deployment (QFD)" have been reviewed. A comprehensive perspective of QFD and its potential areas for improvement have been studied, which could serve as an opportunity for further investigations. It is revealed that, QFD is the most applicable technique for quality design and to analyze customer satisfaction and hence accepted all over the world. The efforts are made here to review various research papers to outline the methodology adopted and benefits availed using QFD .

Key Words: Quality function deployment (QFD), Product development; Customer needs, Quality Management.

1. INTRODUCTION

In this paper, QFD is reviewed in order to understand how it works, to highlight its strengths and weaknesses and to discuss its practical applications. The first part of the paper will present an overview of QFD and explain the methodology. Various case studied of implementation of QFD is studied and problems faced during implementation are revealed. It is observed that QFD has helped designers to solve problems in many different areas, from manufacturing to services, and even in education.[1]

The best method remains ineffective unless it is implemented. Quality Function Deployment is a systematic approach to design based on a close awareness of customer desires, coupled with the integration of corporate functional groups. Quality Function Deployment (QFD) is a quality tool that helps to translate the Voice of the Customer (VoC) into new products that truly satisfy their needs.

Quality Function Deployment (QFD) was conceived in Japan in the late 1960s, during an era when Japanese industries broke from their post-World War II mode of product development through imitation and copying and moved to product development based on originality. QFD was born in this environment as a method or concept for new product development under the umbrella of Total Quality Control. The subtitle "An Approach to Total Quality Control" added to Quality Function Deployment [3]. People started to recognize the importance of design quality, but how it could be done was not found in any books available in those days. Companies were already using QC process charts, but the charts were produced at the manufacturing site after the new products were being churned out of the line.QFD changed the approach to design, process quality monitoring and control.

2. Historical aspect of QFD

In 1975, the Computer Research Committee was appointed by the Japanese Society for Quality Control (JSQC). In 1987, it published a final survey report on the status of QFD application among 80 Japanese companies. [4] The companies surveyed listed the following as the purpose of using QFD: setting design quality and planned quality, bench-marking competitive products, new product development that sets the company apart from competitors, analyzing and accumulating market quality information, communicating quality related information to later processes, deploying design intent into manufacturing, identifying control points for the gemba, reducing initial quality problems, reducing design changes, cutting development time, reducing development costs, and expanding market share.

The first QFD seminar (a 2-day seminar) in Japan was organized in 1983 by Japan Productivity Center, and was followed by many others. Today QFD classes are available through the Japan Standards Association (a 2-day seminar), Central Japan Quality Control Organization (a 3-day seminar), and Union of

Japanese Scientists and Engineers (a 4-day seminar).

The Japanese side selected 400 Japanese companies for the survey who were involved with the QFD Research Committee of JUSE or attended introductory QFD seminars. The U.S. side selected 400 U.S. companies with a similar background. An identical survey form was sent to these companies. 146 of the Japanese companies (37%) and 147 U.S. companies (37.6%) responded. According to the survey results, 31.5% of Japanese companies used QFD in their development process, while 68.5% of American companies did the same. [3]

For the information source for creating a quality chart, American companies used 'personal interviews with customers,' 'customer surveys specifically designed for QFD implementation and 'focus group interviews.' Japanese companies listed 'experiences of the product design team' and 'customer claims information.' American companies in the survey reported that they had corporate support in QFD implementation in the form of 'sufficient budget for QFD implementation,' 'sufficient resources,' and 'adequate time for QFD implementation'.

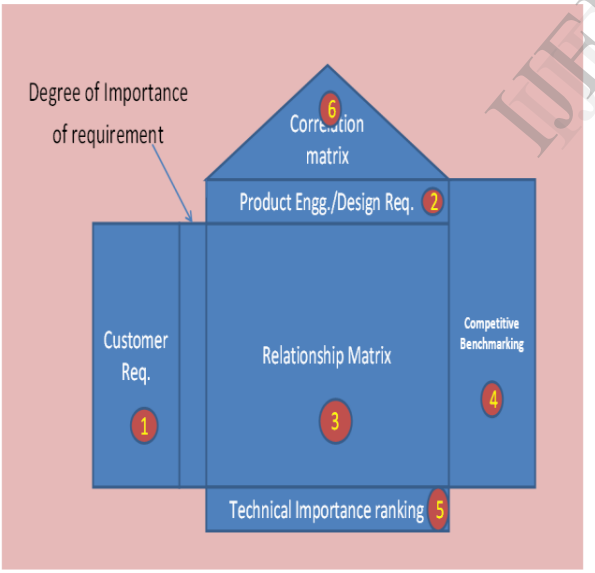
3. QFD Methodology

In order to build a quality product, customers' requirements (CR) have to be considered and addressed. From the designer's perspective, customer needs could seem to be vague, qualitative, incomplete and sometimes inconsistent. Customers only express what they want. Most likely these what's do not imply any "what exactly" in terms that make sense to designers, e.g. easy to use. Designers need to figure out how these what's can be satisfied by a product/service. Designers need detailed, technical-oriented requirements (how's) for design. There is an obvious gap between what's and how's. Customers "what's" are usually expressed in customers' own language without any implication of technology and implementations. These customers what's need to be translated into designers how's, which are quantitative, measurable and actionable technical specifications, so that they can be used by designers for design. Hows are designers understanding in technical terms of customers what's. Quality Function Deployment (QFD) is one of the techniques that can bridge the gap and help translate customers whats to designers hows.[2]

The general purpose of QFD model includes the components addressed in Figure 1. Customers requirements (CR) - Also known as "Voice of Customer" or VoC, they are the "whats" the customers want from the product to be developed. They contain customers' wishes, expectations and requirements for the product. Customer importance ratings - Once these "whats" are in place, the customer needs to provide numerical ratings to these "whats" items in terms of their importance to the customer. A numerical rating of 1 to 5 is often used, in which the number 5 represents the most important and1 the least. Customer market competitive evaluations - In this block, a comparison is made between a company's product/service and similar competitive products/services on the market by the customer. The comparison results will help the developer position the product on the market as well as find out how the customer is satisfied now. For each product, the customer gives 1 to 5 ratings against each CR, 5 being best satisfied and 1 the worst. Technical specifications - They are the technical specifications that are to be built into a product with the intention to satisfy the CR. They are sometimes referred as "hows" because they are the answers to CR: how can the requirements be addressed or satisfied. They are the engineers' understanding in technical terms what customers really want. The technical specifications must be quantifiable or measurable so that they can be used for design. Relationship matrix - Relationship matrix is used to maintain the relationship between CR and design requirements. In other words, the matrix corresponds to the "whats" vs. "hows". It is the center part of HoQ and must be completed by technical team. A weight of 1-3-9 or 1-3-5 is often used for internal representation of relationship, 1 being the weak and the biggest number being the strong relationship. Correlation matrix - It is the triangular part in the HoQ (the "roof"). The correlation matrix is used to identify which "hows" items support one another and which are in conflict. Positive correlation help identify "hows" items that are closely related and avoid duplication of efforts. Negative correlation represents conditions that will probably require trade-offs. The positive and negative ratings are usually quantified using 2, 1, -1, and -2 ratings, with 2 being the two "hows" items are strongly supportive to each other and -2 being the conflicting. Sometimes only 1 and -1 are used. Target goals - Completed by technical team, these are the "how muchs" of the technical "hows" items. They provide designers with

specific technical guidance for what have to be achieved as well as objectively measuring the progress. The goals have to be quantified in order to be specific and measurable. Technical difficulty assessment - Technical team conducts the assessment. It helps to establish the feasibility and realizability of each "hows" item. A 1 to 5 ratings are used to quantify technical difficulty with 5 being the most difficult and 1 being the easiest. Technical competitive evaluation - It is used for comparing the new product with competitor's products to find out if these technical requirements are better or worse than competitors. Again, 1 to 5 ratings are used with 5 being the fully realized each particular "hows" item and 1 being the worst realized. Overall importance ratings - This is the final step of finishing HoQ for phase 1. For each column, sum all the row numbers each of which is equal to the production of relationship rating and customer's important rating. The results help identify critical product requirements and assist in the trade-off decision making process.

Fig.1 Main Component of House Of Quality



4. QFD Practical Application

QFD's popularity is becoming worldwide, in fact according to Chan and Wu (2002b) there are reported applications and studies in countries such as Australia, Belgium, Brazil, Denmark, Finland, Germany, Hong Kong, India, Ireland, Israel, Italy, Korea, Malaysia, Netherlands, Scotland, Singapore, Slovenia, Sweden, Taiwan, Turkey, the UK and the United States (US). There may be more countries, but sometimes companies are very loath to publish their results because of the confidentiality associated with them and because the results can be of strategic value to the company (Govers, 1996).[5] As can be seen in literature, variety of industries implemented the QFD. Design improvement of School Furniture [6], A Ceramic Washbasin [7],Shoes industries[10],Semiconductor industry [8],Software industry, service industry, improving sales for product, Hotel industries, Automotive company, manufacturing company etc. are major sectors to publish their cases.

Following two points has the significance of QFD in industry.

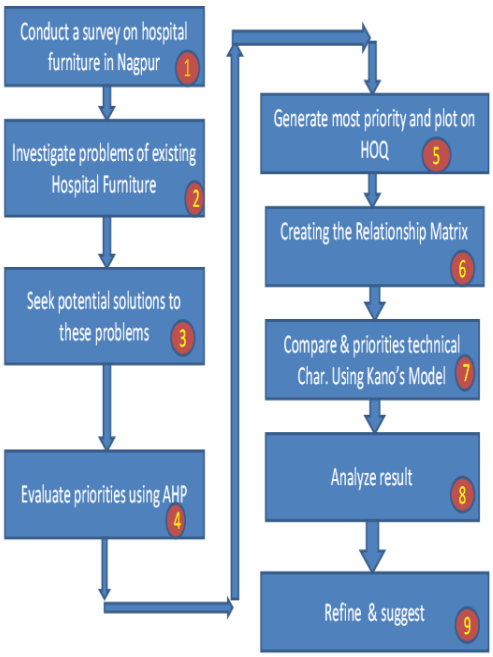
1. QFD has changed what we have known as quality control in manufacturing processes, and established quality control for development and design. In other words, QFD has established quality management in product development and design. QFD has played a significant role when the focus of TQC shifted from process-oriented QA to design-oriented QA and creation of a new product development system.
2. QFD has provided a communication tool to designers. Engineers, positioned midway between the market and production, need to lead new product development. QFD renders a powerful arm to engineers as they build a system for product development.

The 3 main goals in implementing QFD are:

1. Prioritize spoken and unspoken customer wants and needs.
2. Translate these needs into technical characteristics and specifications.
3. Build and deliver a quality product or service by focusing everybody toward customer satisfaction. Since its introduction, Quality Function Deployment has helped to transform the way many companies:

• Plan new products
• Design product requirements
• Determine process characteristics
• Control the manufacturing process
•Document already existing product specifications

Fig 2.QFD Project Methodology



QFD uses some principles from Concurrent Engineering in that cross-functional teams are involved in all phases of product development. Each of the four phases in a QFD process uses a matrix to translate customer requirements from initial planning stages through production control Each phase, or matrix, represents a more specific aspect of the product's requirements. Relationships between elements are evaluated for each phase. Only the most important aspects from each phase are deployed into the next matrix.

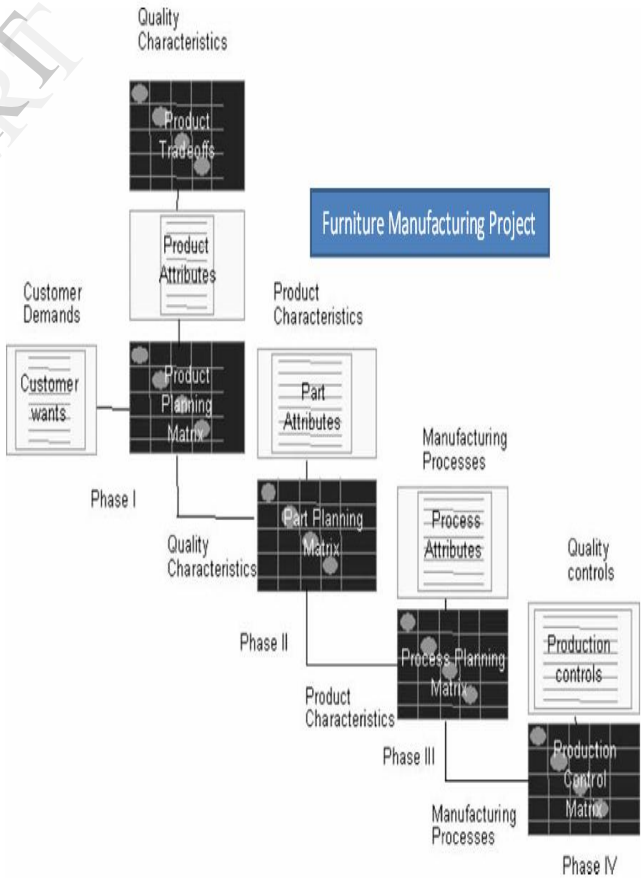
Phase 1, Product Planning: Building the House of Quality. Led by the marketing department, Phase 1, or product planning, is also called The House of Quality. Many organizations only get through this phase of a QFD process. Phase 1 documents customer requirements, warranty data, competitive opportunities, product measurements, competing product measures, and the technical ability of the organization to meet each customer requirement. Getting good data from the customer in Phase 1 is critical to the success of the entire QFD process.

Phase 2, Product Design: This phase 2 is led by the engineering department. Product design requires creativity and innovative team ideas. Product concepts are created during this phase and part specifications are documented. Parts that are determined to be most important to meeting customer needs are then deployed into process planning, or Phase 3.

Phase 3, Process Planning: Process planning comes next and is led by manufacturing engineering. During process planning, manufacturing processes are flowcharted and process parameters (or target values) are documented.

Phase 4, Process Control: And finally, in production planning, performance indicators are created to monitor the production process, maintenance schedules, and skills training for operators. Also, in this phase decisions are made as to which process poses the most risk and controls are put in place to prevent failures. The quality assurance department in concert with manufacturing leads Phase 4.

Fig. 3 Roadmap of the QFD Project



5. QFD BENEFITS

In the product development process it is important to match the human needs with the product characteristics, which can be achieved by using the QFD method It is possible to design not only a product that satisfies and exceeds customer expectations but a product that considers the limitations of the production process. In order to quantify the design criteria and evaluate the priority vector for the design alternatives, the AHP method should be combined with QFD. QFD can be an excellent tool for planning and controlling the development process. QFD enables an organization to `build a quality into the product and to control the development process from concept to the commencement of manufacturing operations.

6. IMPLEMENTATION PROBLEMS

Akao , King and others describe some resistances to implement a QFD approach which are more or less of the type of `general resistances to changes like

- Lack of time.
- Short-term thinking.
- Stuck on tradition.
- What is in it for me.
- Lack of support, etc.

common QFD failures into three groups:
1.methodological problems,
2. organizational problems, and
3.problems concerning product policy.

Methodological problems

Generally difficulties arise because of

- Customer requirements are difficult to recognize.
- Interchanging customer requirements with engineering specifications.
- Assessment of the relationships and the correlation matrix.
- Focusing on metrics rather than processes

Organizational problems

1. Cross-functional Co-operation: If cross-functional co-operation is not yet established communication problems will arise.
2. Differing group does the QFD project: This stems from a functional orientation.
3. Leaving the responsibility to `planning specialists blocks the acceptation of the results so all people directly involved into the product creation process has to be committed.
4. Spontaneity: Team members drafted to do QFD are less motivated to make every effort.
5. Failure to integrate.

Product Policy

Close attention must be paid to product policy. Western companies have high esteem for technological breakthroughs (technology push) while the Japanese keep an eye more on the gradual improvement.

7. CONCLUSION

Analyzes the Customer requirement for intended product. Uses to find possible improvement in product and processes. Thus, investigate possible improvement in Quality The inclusion of QFD in the product process will bring positive results to the design and production process as well as advantages in market development and sales. Better scheduling and planning of production can minimize lead time to delivery. It minimizes frequent changes in design, process. QFD provides perfect approach to implement quality check at each level of product development. Thus, provide new approach to measure customer requirement and providing them a product with required characteristics. Reduces the total cost of design, manufacturing and post production processes. It can be an excellent tool to plan and control the development process in advance of operation.

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