QFD not just a tool but a way of quality management

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Received 2 April 1998; accepted 6 April 2000

Abstract

Implementing QFD needs understanding of the “philosophy” behind the tool. Discrepancies in points of view and culture lead to different approaches of the methodology. Most attention in literature relates to the benefits of QFD or to the more or less “technical” aspects of the method. Mostly comments on implementation and use are mentioned quite summarily. QFD in fact is a method of continuous product improvement, emphasising the impact of organisational learning on innovation. It must not be seen as just an “ad hoc” tool for the development of a particular product neither will it lead to “perfect” products. QFD has to become part of a company’s culture. From that perspective it should belong to the management process. Because of that “cultural change” we will encounter quite specific implementation problems. Implementation problems can be categorised into three groups: methodological problems, organisational problems and problems concerning product policy. Besides the problem of information gathering, the biggest problems are of an organisational nature. Characteristics of western management can limit the effectiveness of the technique. Special attention must be paid to product policy and cross-functional project approach to make this tool a valuable technological and organisational aid for innovation projects. Based on document and case studies from the USA and the Netherlands we will reflect upon differences between the Japanese and “Western” practices and resulting implementation problems. © 2001 Elsevier Science B.V. All rights reserved.

Keywords: Process design; Quality function deployment; TQM

1. Introduction

Quality function deployment QFD is based on the concept of company wide quality control (CWQC). The CWQC philosophy is characterised by customer orientation, cross functional management and process rather than product orientation. It refers to quality of management and the quality of work being done (Japan Industrial Standard Z8101, 1981). From that point of view QFD becomes a management tool to model the dynamics of the design process.

The roots of Japanese CWQC are the same concepts of statistical quality control (SQC) and total quality control (TQC) as originated in the USA, but there are also fundamental differences. After World War II the quality concepts were brought over by Deming and Juran who found a keen audience among the Japanese captains of industry [1]. At that time, notably, they could communicate directly because of their knowledge of a foreign language. So the ideas of “Quality is fitness for
Use” and the statistical approach were put forward top down into the company. The cultural orientation of Japan on community and social harmony became a foundation for a strong market approach based on customer orientation and product quality. Horizontally and vertically customer desires were deployed by process development and product policy. The Japanese industry became more result-oriented and achieved competitive advantages in world markets by a strategy of continuous incremental improvements, called Kaizen [2].

In many “Western” companies the influence of scientific management is still fairly strong and sometimes the executive’s or engineer’s ideas in product development still predominate [3]. Because of that orientation the TQC concept is too often exclusively directed to the quality of product or service and usually limited to manufacturing and assembly activities. The (former!) TQC concept is strongly efficiency oriented. A lot of American and European companies still maintain a quite strong functional organisation structure and put great emphasis on problem solving and efficiency improvement during the implementation and production stage of new products. A functional organisation structure usually leads to classical transition problems from research and development to manufacturing [2,3].

The Japanese are strong with respect to a philosophical tendency, intuition, tacit knowledge and community spirit. In the West, people attach high importance to logic, codified knowledge and the contribution of the individual. These cultural dissimilarities also lead to differences in the application and appreciation of QFD.

2. QFD methodology

Customer’s requirements and their relationships with design characteristics are the driving forces of QFD methodology. For this moment, the methodology as such is assumed to be known. For details we refer to the literature like the “standard” works of Akao [4] and King [5] or an outline in a previous issue of the Journal of Production Economics [3].

The quality and reliability of a product are predominantly determined in the early phases of the development process. QFD enables an organisation to “build” quality into the product and to control the development process from concept to the commencement of manufacturing operations. In the “House of Quality” as it was named by Hauser and Clausing [6], the different steps of the planning phase for a new product are summarised. During this phase the customer requirements (WHAT) are translated into design characteristics (HOW) on the basis of market research and past experiences (the WHY scores). In Fig. 1 we depict the different steps of the product planning phase. Of all the steps in the total product development process, non deserves more (but often receives less) attention than the definition of the right product for the right customer. This means that management has to establish a clear product policy that should provide specific guides for intended product quality and market penetration. The quality to be worked out in the development phase is not just the quality of the product but also that of the after-sales services and even recycling or re-use. The product planning phase in the QFD sequence serves especially to identify the customer requirements. It is not sufficient to respond to the customer’s requests (expressed quality) but it is in fact necessary to study the whole area of so-called implicit quality (quality which is not asked for but is assumed to be there) and of attractive quality (quality which is not asked for because the customer does not even imagine that it can exist). This was explained by the Kano-model [3,5].

The wants and needs provided by the customer have to be translated into measurable scale units to be susceptible for market research. Because the statements of the customer are not always clear and comprehensible, they must be interpreted and explained. For that the QFD-approach provides a rare opportunity to work on cross-functional teams, employee involvement and participating management by discussing the meaning and importance of the “WHAT’s. These strategic issues already indicates that starting a QFD project needs all support and commitment of top management.

Principally, the product planning phase is meant to define the strategy for the new product to be
developed in the next 1–5 years (depending on the kind of product). QFD systematically takes the voice of the customer down to the operations level. The entire development process can be depicted in four charts (see Fig. 2) although in actual use as many levels of charts as desirable may be applied [5].

The operational activities involved in applying QFD to the product identified, is carried out both as group activity and individually. Team members have to bring in their specialised knowledge and the needed information. Team meetings are especially intended to discuss the outcomes of market research and technical benchmarking and to mutually argue the (mostly subjective) statements concerning targets and priorities.

Generally, in the literature, the benefits of QFD are well enlarged. A lot of attention is paid to different points of view related to more or less “technical” conditions like how to scale customer requirements and how to calculate priorities. Here we will concentrate on a more managerial and organisational background and on the “pitfalls” concerning the implementation and use of this method. To discuss possible improvements of development processes by QFD we need to understand the philosophy and concepts that are the roots of this method.

3. Organising a QFD project

A QFD approach must be supported by a certain “Quality Culture”. A company that still struggles with the quality performance at the aimed level, has to stress basic quality techniques first. Many times
there is an incredible amount of rework in introducing a new product because the steps to prevent problems are not taken. Quality does need to be first [2]. We need to understand what business functions are required to accomplish a new product introduction and how to accomplish them assuring that we have the processes under control [8]. To implement QFD successfully a company has to be able to control the production processes at a level which corresponds with that of obtaining an ISO certificate (process orientation). The culture has to move in the direction of Total Quality Management based on the concepts of, for example, the model of the Malcolm Baldridge award or the European Quality award. Roughly saying, these models are direct consequences of the Japanese CWQC philosophy. Two processes form the framework of the TQM concept (see Fig. 3, derived from [9]):

(1) Policy deployment: To get company goals realised, a top-down and bottom-up process has to align objectives through all levels of the organisation.

(2) Process management: To satisfy the customer, all objectives must be cross-functional aligned through the whole value chain from supplier to customer.

These two processes together create the transparency, focus and cohesion required to motivate concerted efforts and are a prerequisite to put QFD into a proper state for work. Akao has made a point to cover what he calls the narrow and the broad aspects of QFD [4]. The narrow sense of the term means “To deploy, in detail, the jobs or business tasks that are concerned with building up quality in an end–means system”. In the narrow sense QFD supports more process management as a tool. In the broad sense the attention is focused on quality deployment, providing a framework for delegation and participation and has all to do with policy deployment so it is more a management “style” [8]. Unless top management has declared an unshakeable policy of quality, everyone in the company will be sceptical. Therefore especially during the steps 1 and 2 of the product planning phase key persons involved in management must participate in the formulation of product and marketing policy. For starting QFD the scope of the project has to be established and should be communicated and agreed upon by management. Team members should reach agreement on issues as [3,5]:

- which product or product characteristic are we going to focus on;
- who do we consider as our customers;
- which competing products will be used as a reference for product evaluation and
- how does the QFD approach fit into process and production planning.

When the product strategy and the customer profiles are determined the team can start to built the House of Quality. Once a team is formed, there

![Fig. 3. The framework of TQM [9].](image-url)
should be a facilitated debate on the team rules. Each team is an unique temporary organisation [3] and some norms need to be established on issues as

- What are the rules for operating meetings? like:
  - start and stop times,
  - frequency,
  - need to follow the agenda,
  - developing next meeting’s agenda before terminating of the current meeting.
- What is the test for consensus?
- What rules govern the response to people who missed the last meeting and want to be updated or wish to re-open the discussion?

If time permits also some exercises are desirable to promote team feeling and to hone team skills. Team meetings are primarily used to determine and plan the actions required, and to discuss meaning and importance of data in the matrices. In most cases there will be assignments for members outside the meeting such as: generation of test results, research on complaints, and follow up on competitive assessments and test results. In essence QFD encompass same activities that people did before but it replaces erratic, intuitive decision making processes with a structural methodology establishing relevant (often “hidden”) information and experiences that are available throughout the organisation. It is an approach that serves as an “operational definition” of CWQC [10] and supports organisational learning. Generally it is advisable to have a facilitator working with the team throughout the whole process. This should be someone with a thorough understanding of the QFD methodology who can assist the team in its organisation, planning and actions. In most organisations there will be a champion or sponsor for most emerging methods, so look for people who have a positive attitude towards new approaches (“early innovators”). That means, however, that although quality professionals can play an important role to facilitate the QFD process, in the end the marketing, development and manufacturing professionals are responsible for the outcomes. Because teams will be composed of members from different departments, companies can make better key trade-offs between what the customer wants and what the company can afford to produce.

4. QFD practices

The literature speaks highly of the QFD benefits. On valuing these benefits it becomes clear that they all refer to the TQM concepts like: customer satisfaction, employee involvement, source utilisation and pro-active management. There is a growth of documented factual-based success stories and other experiences. Experiences in the Netherlands are quite recent. The first applications were communicated at a QFD conference on January 26, 1993 [11]. Recently, the background and some practical experiences were described in a book [12]. A (typical Dutch?) difficulty in acquiring information is the attitude of most companies to keep their QFD experiences only within the team. By doing so they hamper the possibilities for collective learning. What also strikes is that often attention is paid only to the first QFD chart. Although it is possible to achieve substantial benefits from QFD by implementing only the first chart, the greatest gains, however, will be realised when the “Voice of the Customer” get to be deployed to the most detailed level of manufacturing operations as illustrated before in Fig. 2. Conceivable explanations for this narrow-minded employment may be

- the position of the customer,
- the lack of KAIZEN and cross-functional co-operation,
- the prevailing experience with project management.

Differences between the Japanese and American approach concern the position of the customer and the way of deploying quality characteristics and marketing policy. To gain market share for the product or product-family concerned, most Japanese producers are on the lookout for new target groups by focusing more on implicit and attractive quality (Kano-model). The American approach is more passive or reactive. Here the “Voice of the customer” emphasising expressed quality, sets the direction of the deployment [12].

Also the KAIZEN philosophy has an influence on the way of deployment. Japanese deployment of the end-product is achieved by the deployment of parts. Because of collectivism, their way of dealing with the internal customer gives a more or less
“natural” sequence of the QFD phases as depicted in Fig. 2 and urges to search for continuous improvement in all stages. Initial familiarisation problems with cross-functional Co-operation are perhaps an explanation that western companies as yet find difficulty in proceeding from the first product planning phase to the others. This clarifies maybe also why they especially hold in admiration that QFD benefits the boosting of the communication.

Another explanation for the limited utilisation of the charts might be the opinion that the product planning process as such and the preparation of production are already well under control by the already long established practice of project management.

In the American Supplier Institute (ASI) approach [7] QFD is considered as one linked entity of procedures fashioned by the use of matrices. Uninterruptedly “The Voice of the Customer” will be translated from product planning to production planning. This approach follows more or less the original ideas of Akao.

When King introduced QFD in America, he did not pick up the KAIZEN philosophy as such but instead he added several known improvement techniques and combined these into the “matrix of matrices”. So in the American literature QFD became known as a “design tool”. Within that framework the Growth opportunity alliance of lawrence (GOAL) approach [5] considers QFD more or less as a composition of a number of methodological procedures which can be applied separately as well. Later on also Akao fitted these procedures into his concept.

5. Implementation problems

Akao [4], King [5] 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.

Mostly, these resistances can be diminished by good introductions. Sometimes organisations hold meetings to inform employees about company objectives and goals, or distribute meanings without a concrete follow up. However, teams that are not enough supported to establish the objectives and goals will be unable to select the organisation’s most critical processes. To solve this problem a QFD activity should be launched by management as part of an overall strategy to fulfil the organisation’s mission, directly followed by a case activity based on “learning by doing”. It will be better to train a team thoroughly at the start of a project (just in time training) than to give “general” introductions and await further initiatives.

Based on several QFD experiences performed in the framework of M.Sc. graduation projects I will categorise mistakes and common QFD failures into three groups:

- methodological problems,
- organisational problems, and
- problems concerning product policy.

5.1. Methodological problems

Generally difficulties arise because of

- Customer requirements are difficult to recognise.
- Interchanging customer requirements with engineering specifications.
- Assessment of the relationships and the correlation matrix.
- Focusing on metrics rather than processes; QFD charts are becoming too large.

The “cornerstones” of the house of quality are the customer requirements. These requirements must be stated in day-to-day parlance to avoid that known solutions are deliberated too obvious. Usually that is very difficult because it requires obtaining and expressing what the customer truly wants and not what we think he or she expects. It needs training and experience to change the frame of mind. Often it comes into sight that the method of approach for market research has to be adjusted also.

Because of their fondness for logic and quantitative approach engineers are inclined towards hard figures and the belief that everything is closely
interrelated. This can lead to a “mysticism of digits” and doubtful calculations. The completion of the House of Quality is important but may not become an end as such. It runs a risk to get lost between all conceivable relations. For this reason it is necessary never to forget that every decision must be taken with reference to the “vital few” concept (c.f. Pareto rule). To acquire experience it is advisable to start rather simple with the “re”-design of an ordered product. Often at the start of a QFD project it becomes visible that we do not have the information required to fill in the matrix. This applies especially to the “WHY” and “HOW MUCH” matrices because by virtue of this approach it becomes clear that benchmark information can be of high importance. In such cases it will be better to leave them out of consideration and to carry on with the core of the House of Quality than to use supposed or pseudo data. People have to keep an eye on the basic ideas instead of “filling in numbers” which will lead to “mysticism of digits”. By doing so the organisation can become a learning organisation and develop a better feeling for the QFD philosophy and market orientation.

5.2. Organisational problems

As a result of the long-established practice in Japan, the problems with the implementation in western companies differ from those in Japan. According to King [5] and the QFD handbook of ASI [7] in the USA one encounters problems which can be retracted to the following points:

- **Cross-functional Co-operation**: If cross-functional co-operation is not yet established communication problems will arise.
- **Staff group does the QFD project**: This stems from a functional orientation. Leaving the responsibility to “planning specialists” blocks the acceptance of the results so all people directly involved into the product creation process has to be committed.
- **Spontaneity**: Team members drafted to do QFD are less motivated to make every effort.
- **Failure to integrate**: QFD has to become a regular part of the product creation process, if not it will remain an isolated activity with questionable cost/benefit performance. Through lack of a (enthusiastic) facilitator it is often difficult to persist with concentration

Most of these problems result from a lack of management commitment. Management has to be in the lead to encourage cross – functional co-operation and to switch from a product oriented organisation to a customer driven organisation by forwarding customers’ desires between the several departments.

In a recent (small-scale!) student survey concerning “QFD in the Netherlands” [13] it came to the fore that management still distantly react on this kind of approaches. A lot of the respondents were in the first stages of the ISO approach of Quality Management and did not even know some of the basic techniques like the 7-Tools and/or 7 Management Tools which can be of practical benefit by applying QFD.

5.3. 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 (Kaizen). Notably during the first applications QFD will be quite time consuming, therefore one has to select the (first) projects very carefully. Getting QFD started on totally new products will cause problems to recognise customer requirements. Trying to start all innovation activities at the same time exposes an organisation to the risk of straining and the consequences of poorly worked out projects. To avoid these problems, top management has to establish a clear product policy by planning and appointment of priorities.

QFD is not a tool for fire-fighting product or production problems (short term) nor is it intended to develop “perfect” products as the denomination “design tool” may suggest. In the first place QFD supports the structuring and planning of the development process. A lack of policy gives rise to boundless discussions within the QFD team. Problems of defining the product concept and issues with respect to market segmentation can not be solved by a team on their own. In the Japanese
context the prognosis in the framework of product development is less problematic. In general, they depart from an existing product/market combination or try to broaden this, step by step (product evolution). Such experience is vital for successful implementation. Par excellence QFD will be suitable for development of product families.

The concepts of QFD are not restricted to the development of products or services. Sullivan [14] describes an approach for Policy Management in conceptual terms but he does not offer practical reference. Also in that field clear communication and customer orientation are fundamental for success. In an M.Sc graduation project his ideas were worked out for the development and management of an annual policy declaration for a production plant of an international IC-manufacturer [15]. Also with respect to policy management now some M.Sc. projects are in progress to try the QFD approach in the sector of health-services. Special attention will be concentrated on defining target groups and to make an inventory of their wants and needs and how to translate these into characteristics for treatment processes.

As far as I had contacts with Dutch QFD facilitators most of them reported improvements. Initial projects of QFD do not yield all expected benefits in one go. The problems encountered are analogous to those described in literature. Especially they had difficulties with acquiring and quantifying adequate market information. Early applications require more time and additional effort but results as knowledge transfer, better understanding of the customer expectations and better communication are directly exploitable. Much effort is required to integrate QFD into the regular product creation process. Often it is neglected to evaluate the projects thoroughly and to implicate the team dedication in personnel assessment. We also experienced that in a number of cases the QFD activities ceased after the facilitator had left the organisation. This will be a point for further research.

6. Conclusion

QFD is one of the improvement tools that should enable companies to achieve high quality. Tools alone however cannot provide results by themselves. They must be developed to reflect the companies’ culture and management vision. QFD is not a panacea for solving design problems nor for developing “perfect” products. It refers to “deploying” customers’ desires. It can be an excellent tool to plan and control the development process. Rather it is suited to improve process management and policy deployment by better communication and employee involvement. A problem, however, is how to get people in the company down to work to make all the pieces of QFD effective. Problems concerning the implementation can be categorised into three groups:

(1) methodological problems:
- the risk of going too much into details;
- the risk of “falling in love” with the method (is: “mysticism of digits”);
- interchanging customer and engineering requirements (change of mind);

(2) organisational problems:
- not enough management support (policy deployment, rewarding team dedication);
- lack on process orientation (reactive use and failure to integrate);
- weak cross-functional management/team building;

(3) product policy:
- choice of the right product (product evolution);
- definition of the customer (segmentation);
- market information (competitive and technical benchmarking).

To implement QFD successfully a company has to be able to control the production processes at a level of obtaining an ISO certificate (process orientation). Besides the problem of market information the biggest problems are of an organisational nature. Partly, these can be avoided by bringing into action an enthusiastic facilitator and by good project management.

Competition requires continuous quality improvements and innovation. In Western companies most improvements are still on project by project basis. Therefore, management has to take the
leadership in stimulating step by step approaches by formulation of a clear product policy. There is a need for sound evaluation and open-minded communication within the organisation to stimulate organisational learning. That make demands on a “culture change”. Because to a large extent the mentioned implementation problems call upon a ceaseless adaptation of the organisation, it can be said “QFD is not just a tool but has to become a way of Management!”

References