What are the Best Practices of QFD?

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Abstract

What are the Best Practices of QFD? This was the driving question approx. a dozen experienced users of Quality Function Deployment (QFD) wanted to answer during various two-day workshops. The QFD Institute Germany e.V. (QFD-ID) had invited to come up for discussion on the Best Practices of QFD. The QFD-ID exists for almost 10 years now, but the origins of QFD and its successful application worldwide are already more than 30 years old. The time was ripe to carry together and present the approved QFD Practices in Germany as Best Practices. This paper presents the results of the workshops.

Keywords: Best Practices, research results, deployment framework

1. Introduction

What are the Best Practices of QFD? This was the driving question approx. a dozen experienced users of Quality Function Deployment (QFD) from research and practice wanted to answer during various two-day workshops. The main goal was to identify approved and established practices of QFD in Germany. The QFD Institute Germany e.V. (QFD-ID) had invited to come up for discussion on these Best Practices of QFD. The QFD-Institut Deutschland (QFD-ID) is a German association of people who are interested in or who are actively using the QFD methodology. The QFD-ID is dedicated in a non-profit way to improve knowledge, application, methodology and use of QFD in all areas of academics and industry. With its approx. 140 members from research and practice in Germany the QFD-ID has devoted itself to the support, distribution and further development of QFD. The QFD-ID exists for almost 10 years now, but the origins of QFD and its successful application worldwide are already more than 30 years old [1]. The time was ripe to carry together and present the approved QFD Practices in Germany as Best Practices. This paper presents the results of the workshops.

2. Preparation

The QFD method itself was divided up into five modules plus a constitutional module zero representing the overlapping aspects of different QFD projects. Framed by Module 1 (the prerequisites of and preparations for the use of QFD in a concrete project) and Module 5 (the documentation and software assistance of QFD), the following main stages of each QFD application in practice took center stage during the discussions:

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- Module 2: the elicitation of customer needs and customer requirements and its assessments.
- Module 3: the elicitation of solution features and the construction of the House of Quality (HoQ).
- Module 4: the Deployment of the voice of the customer (VoC) during the complete development process.
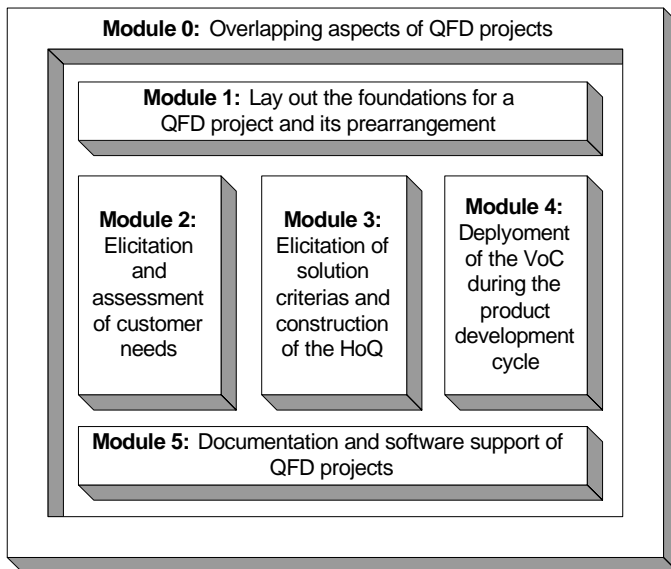
Module 0: Overlapping aspects of QFD projects

Module 1: Lay out the foundations for a QFD project and its prearrangement

Module 2: Elicitation and assessment of customer needs

Module 3: Elicitation of solution criterias and construction of the HoQ

Module 4: Deplyoment of the VoC during the product development cycle

Module 5: Documentation and software support of QFD projects

Figure 1: Identified working modules of QFD

2.1. Module 0: Overlapping aspects of QFD projects

Module 0 represents the aspects of QFD which are independent of a concrete development project. So in the workshops the main aim of the discussion concerning these overlapping aspects of QFD projects was to establish a common understanding or – more formal – a definition of QFD. The participants reached consensus on seeing QFD as one method in the "toolbox" of product development and as a flexible and for the connection to other methods open framework. This corresponds to the view of QFD as the backbone of Design for Six Sigma [e.g. 2]. Concerning relevant QFD terms the participants agreed to rely on existing standards like e.g. [3].

2.2. Module 1: Prerequisites of and preparations for the use of QFD in a concrete project

The initial position of the discussion about the best practices of module 1 was the demand to plan and develop a product, i. e. the existence of a concrete development project. Central question was "what can the application of QFD in concrete development project accomplish, and what not?" The participants came up with rather normal project management tasks which are of course also relevant to a QFD project:

- To get to know the tasks and goals of the complete project and the problem to be solved respectively
- Define, what QFD is able to achieve in the project and what not

- Define the goals of the QFD-Process

Face-to-face communication with the project manager as well as with central team members and winnowing relevant documents to form an opinion about the actual dates were accounted as most important measures. Moreover four indispensable key success factors for a QFD-Project were identified which are essential parts of checking the product's aptness/suitability for QFD:

- As the central input to QFD the needs and requirements of the customer are well-known or are able to be determined.
- The solution must not finally be defined and fixed because without effective degrees of freedom in the fulfillment of customer needs i. e. the solution finding there is no design possible.
- QFD has to be moderated neutral by a QFD-Expert to mediate between the different views on the product development process of external customers, marketing, sales, development, quality management, service etc.
- For commitment and necessary support key persons of the customer's as well as the developers' side are appointed for the QFD project and are available.

2.3. Module 2: Elicitation and assessment of customer needs

Module 2 can be divided into four basic subtasks:
2.1 Collect and get to know the Voice of the Customer (VoC)
2.2 Preprocess the VoC and understand the customer needs
2.3 Prioritize the needs for each customer segment
2.4 Analysis of the prioritized customer needs

Concerning subtask 2.1 the following best practices were identified:

- Get the information unfiltered from the customer: "real Voice of the Customer"!
- Query additional sources of information, esp. different internal departments, especially the marketing: Completeness of information dominates at this stage the detailedness.
- Analysis of the business processes at the customer side ("go to the gemba") is necessary for understanding, especially if the process, which is going to be supported, is very complex and can't be easily monitored or observed.
- Conflicts between the requirements should not be ignored or neglected but identified and inserted into the QFD-Process.
- Controlled but personal contact of the customer/customer representative and the QFD-Team preferred.

Concerning subtask 2.2 the following best practices were identified:

- Structuring (e.g. relating and clustering) of the information should be done by an application expert.
- Categorization of the information in a project specific Voice of Customer Table [4]
- "Why" and "what for"-Questions are central for identifying true customer benefits.
- Possible solutions specified by the customer will be transformed to requirements during the QFD-Process. The solution will be deleted from the requirements list (but it still remains a potential solution).
- Use a project specific 5W1H-table ([4] supplemented by the Kano classification [5] and Maslows needs hierarchy [6]).

- Provide a requirements hierarchy tree for detailing the customer needs.

Within subtask 2.3 customer requirements must be prioritized separately for the individual different customer segments. It is not sufficient to use only one single valuation criterion ("importance"), because a purchase decision is always depending on several criteria and to that effect customers rate requirements very differently. The classic planning matrix [e. g. 7, pp. 4-5 and 4-6] calculating importance values, improvement factor and sales points suffers from the inherent risk of the sales points (also called "voice of marketing") to be used manipulative and not in the sense of the customers' preferences. The participants presumed that the sales points represent only a rough aggregation of the classification according to Kano [5], differentiating base, performance and exciting requirements, and the classification of Maslow [6] being physiological, safety, affiliation, self-respect and self-realization needs as well as the rating of monetary utility of a requirement. So the last-mentioned assessments should substitute the vague and manipulative sales points. But the assessment concerning these "soft" factors should be separated from the rating of the "hard" factors like the importance as well as the current and targeted performance degrees (customer satisfaction) including the competitive comparison. The way of uniting all these valuations and creating a ranking order to be taken over by the HoQ or for the transaction of the prioritizing calculation is product dependent and carried out context specific.

Concerning subtask 2.4 the following best practices were identified:

- Review the plausibility of the assessments (could of course be risky to question the customers' judgments)
- Evaluation with the help of portfolios (e.g. monetary value of benefit to hard/soft criteria)
- Situation-specific, product-dependant use of the weighting criteria (e.g. different analysis of soft and hard criteria, differentiated to customer segments) and their combination into a weighting value for transfer into the matrix.
- Make the requirements understandable and acceptable for the QFD-Team (e.g. with the help of a comprehensible presentation of the results; regarded very important because the customer needs represent the essential input of the further QFD process)
- If there is the situation that the customer needs are not usable for the QFD-Process (even after thorough elicitation) than it is better to delay the QFD until the data is of adequate quality.

2.4. Module 3: Elicitation of solution features and construction of the HoQ

As for module 2 also for module there were four subtasks identified:

- Collect, get to know, pre-process, understand the Voice of the Engineer (VoC) i. e. the solution features.
- Clarify the relations between the solution features and the customer requirements
- Prioritization of the solution features within the HoQ
- Clarify the interdependencies of solution features within the roof of the HoQ

Regarding these subtasks few problems were identified and so great unity existed between the participants. The first subtask was viewed similar to the elicitation of the VoC in module 2, although obviously closer connected with other methods like TRIZ. Concerning the remaining three subtasks no surprises and new insights were brought up to light because the technical armamentarium of building a House of Quality is obviously well understood.

2.5. Module 4: Deployment of the VoC during the product development cycle

Deployment in QFD was interpreted by the participants as the systematic interconnection and implementation of the customer orientated criteria in all phases of the product development cycle. The overall best practice for module 4 is that for all applicable deployment frameworks project-, product- and process-specific adaptation and extension (e.g. with additional matrices and method pointers, depending on the application case) have to take place in advance. The extensive deployment based on Akao [8] was referred as historical grown and respected realizable only in principle, as well as the famous four phase model of the American Supplier Institute (ASI) [9], which is usable at best as a marketing instrument for QFD (e. g. lacks the ASI model product functions). The deployment landscape i.e. the type, number and combination of the HoQ matrices, tables and lists has to be adjusted to the respective problem and to be developed by a QFD moderator in coordination with the project manager.
Nevertheless the workshop came up with a minimum framework of useful matrixes arranged in a basic deployment (see fig. 3). The framework was derived at first from general reasons for the execution of a deployment as requirements on the deployment process which were contrasted with potential features of deployment frameworks (see fig. 2).

Requirements on deployments (Why a Deployment?)	Features of deployments									
	Matrix (e.g. part attributes vs. process attributes)	Link-up from output to input	Weighting of the factors	Identification of critical factors	Structure and visualization of the deployment	Analysis of the dependancies between links of output and input	Hand-Over of the customer prioritization	Flexibility of the deployment	Documentation of the decisions	Support for interfaces to other methods
Process planning	X									
Product development		X								X
Projectplanning/ Projectcontrolling			X	X	X	X				
Customer Orientation along the Value Chain (transport customer's benefit downstream)		X	X	X			X			X
Better, more customer oriented products and process in shorter			X	X		X	X			
Focus on pruduct (time and ressources)			X	X		X	X	X		
Systematic focus for the most important aspects		X	X		X		X			
Patency		X				X	X			
Comprehensibility		X				X	X		X	
Weight scenarios			X			X	X	X		
consense between marketing, quality management, and development			X	X	X		X		X	X
Make it measurable and weightable (define weightable sizes for evaluation and use)			X				X			
Process visualization					X				X	
Identification of conflicts			X	X		X				X

Fig. 2: Requirements vs. features of deployments

Simple support relations were identified as e.g. the "link-up from output to input" contributes to "customer orientation along the Value Chain (transport customer's benefit downstream)". Such relations were marked with a "X" in figure 2.

Secondly potential information as input for the matrices were identified: market, business goals, business processes, use cases, customer requirements, quality characteristics, functions, concepts, design elements / function carrier, supplier, technologies, risks, test cases, process planning etc. From the great amount of possible combinations of potential matrices nine matrices (plus two lists) were selected and arranged in a deployment framework (see fig. 3).
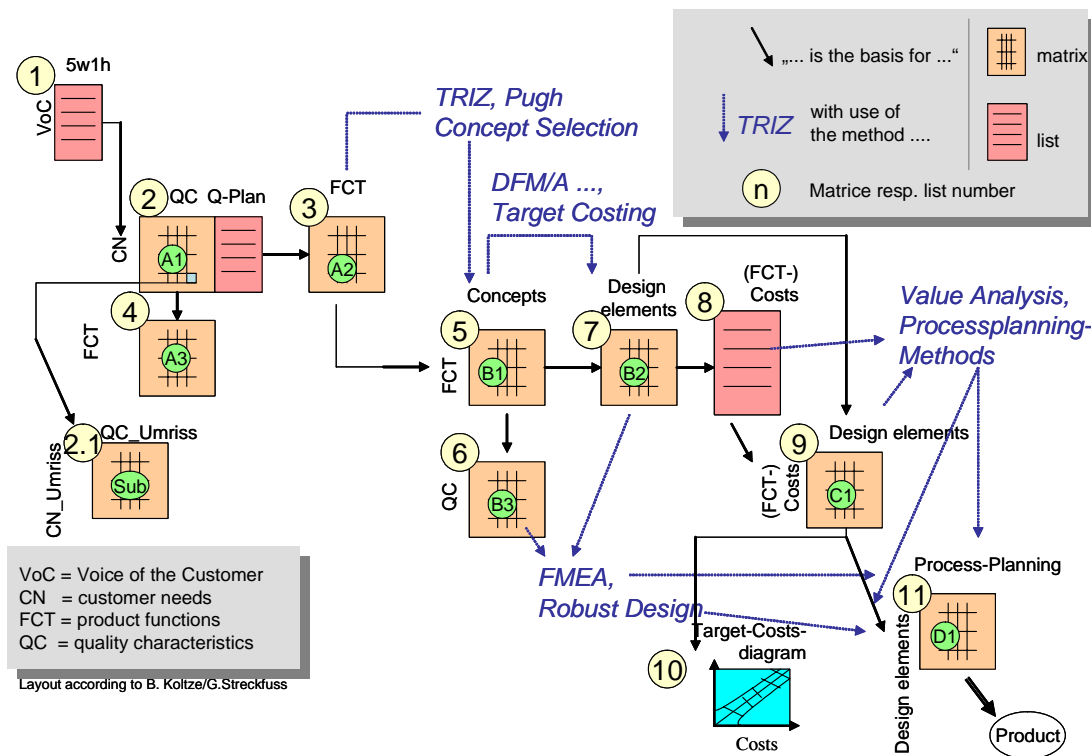
Figure 3: Deployment framework (layout according to [10, p. 46])

Potentially first components are the three basic matrices of Akao (no. 2 to 4), the confrontations of customer requirements, quality characteristics and product functions. A reasonable addition represents early starting cost considerations in form of a cost deployment/target costing (no. 8 to 10) as well as the examination on the design elements level (no. 7 and 9). Concept selection for the most on a technical level with the quality characteristics and the product functions was added as well (no. 5 and 6). The interfaces to other development-/quality methods like TRIZ, FMEA etc. have to be considered as well and such possible connections of QFD to other methods are also shown in fig. 3.

But despite the high importance of the deployment it has to be pointed out that greatest care is necessary for the construction of the first HoQ. If this first HoQ is not coherent, the matrices building on it will be erroneous to an even bigger extent. In all cases the prioritization values at advanced stages of the QFD process have to be analyzed with great care. And no mixture but a clear separation and categorization of the link elements is indispensable, starting of course with the indispensable separation of requirements and solutions.

2.6. Module 5: Documentation and software support of QFD

The aim of this module is to document the QFD findings and to make them comprehensible to all persons involved. The "old" conflict between the use of an individual software solution based on widespread spreadsheet software like e. g. Microsoft Excel and specialized standard software packages like QFD Capture or Qualica QFD appeared [see e. g. 11].

3. Conclusion

The results of the workshops show that the greatest agreement met at module 3, especially concerning the technical construction of the HoQ. Fewest surprises were brought to light here. Obviously particularly the technical needs for building a HoQ are understood well. There were larger differences and partly intense discussions, however, at the best practices of the modules 2 and 4. Table 1 gives a final summarized overview of the results.

Table 1: Overview of the best practices

Modul	Description	Results and best practices
0	Overlapping aspects of QFD projects	QFD is an open and flexible method in the „toolbox"; standards for terms exist
1	Prerequisites of a QFD project	Customer needs are ascertainable, solutions creatable, QFD moderator and key persons available
2a	Collect the Voice of the Customer	Query customers unfiltered; Completeness dominates Detailedness; personal contact between team and customers
2b	Understand customer needs	Structure design/Requirements hierarchy; VoCT; „Why/What for"-Questions, project specific 5W1H-Table
2c	Prioritize the customer needs	Differentiation in hard (importance, actual and future value), soft (Kano, Maslow) and monetary factors
2d	Analyze the weighted needs	Check plausibility; Portfolios; situation-specific product-dependant handling of criteria
3	Solution Features and HoQ	Handcraft of building a HoQ well known; few problems
4	Deployment	Specific adaptation always necessary; Deployment-framework with 9 Matrices (instead of ASI 4-Phase-Model)
5	Documentation and Software	Interpret QFD findings comprehensible; Spreadsheet software or special QFD-Software?

References

[1] *Akao, Y.:* "Development History of Quality Function Deployment"; In: Shigero Mizuno, Yoji Akao (Editors): "QFD, the customer-driven approach to quality planning and development"; Tokio 1994, pp. 339-351.

[2] *Magnusson, K.; Kroslid, D.; Bergman, B.:* "Six SIGMA the Pragmatic Approach"; Studentlitteratur AB, 2004.

[3] *Deutsche Gesellschaft Qualität (DGQ):* "QFD – Quality Function Deployment" (in german); Beuth Verlag 2001.

[4] *Mazur, G.:* "Voice of Customer Table: A Tutorial"; In: QFD-Insitute (Editor): Transactions from the Fourth Symposium on Quality Function Deployment; Novi, Michigan 1992, pp. 105-111.

[5] *Kano, N.; Seraku, S.: Takahashi, F. and Tsuji, S.:* "Attractive Quality and Must-Be Quality"; In: Hinshitsu (Quality) (in japanese); No. 2, 1984, pp. 39-48.

[6] *Maslow, A.:* "A Theory of Human Motivation"; In: Psychological Review; 1943, pp. 370-396.

[7] *King, B.:* "Better Designs in Half the Time"; Methuen, Massachusetts 1987.

[8] *Akao, Y.:* "Quality Function Deployment: Integrating Customer Requirements into Product Design"; Translated by G. Mazur; Cambridge, Massachusetts 1990.

[9] *ASI (American Supplier Institute):* "Quality Function Deployment – Excerpts from the Implementation Manual for Three Day QFD Workshop. Version 2.4"; In: QFD-Institute (Editor): "Transactions from the Second Symposium on Quality Function Deployment"; Novi, Michigan 1990, pp. 21-85.

[10] *QFD-Insitut Deutschland (QFD-ID):* "Was ist QFD?" (in german); QFD-Forum Sonderausgabe 4.th Edition, July 2005, editorial responsible G. Streckfuss, can be ordered via www.qfd-id.de.

[11] *Herzwurm, G.; Schockert, S.; Mellis, W.*: "Joint Requirements Engineering - QFD for Rapid Customer-Focused Software and Internet-Development"; Vieweg, Wiesbaden, 2000

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