Determining the Success of a QFD-Project –
exemplified by a pilot scheme carried out in cooperation with the
German software company SAP AG

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Table of Contents
1 Problem ................................ ................................ ................................ ................................ ... 2
2 Basic Possibilities of Determining QFD Success ................................ ................................ ... 2
  2.1 Simultaneous Development of a Product with and without using QFD ......................... 2
  2.2 Comparing a QFD-based Product to a Reference Yield.................................................. 2
  2.3 Assessing both Approaches ......................................................................................... 3
3 Determining QFD Pilot Scheme Success at SAP AG......................................................... 3
  3.1 The QFD Pilot Scheme “R/3 Diary” ............................................................................. 3
  3.2 Preparations for and the Enforcement of Success Determination ................................. 5
    3.2.1 Establishing the Aims of the Pilot Scheme ......................................................... 5
    3.2.2 The Attitude towards Individuals and towards QFD as an important
          Factor for QFD-Success ......................................................................................... 6
    3.2.3 Personal Criteria of Success relevant for QFD-Assessment ................................. 9
    3.2.4 QFD-Success Determination as Judgment of Customer Satisfaction .................... 9
    3.2.5 Comparing the Planning Results with and without Using QFD ......................... 12
  3.3 Results of Success Determination ............................................................................. 13
4 Conclusion ................................ ................................ ................................ ............................. 15

Abstract

Most concepts about the introduction of QFD recommend pilot schemes as a means of method
evaluation. Quite often, however, a standard for the evaluation of a QFD pilot scheme success
is lacking. A problem that occurs while trying to make such an evaluation is that at the end of
a pilot project the product dealt with is planned but production is not completed. Therefore a
comparison on this basis of “development with QFD” and “development without QFD” is not
always convincing. In practice, without a valid evaluation standard, these difficulties have the
effect that decisions pro or contra QFD are not made on the basis of facts but rather instinc-
tively or even arbitrarily.

Within the framework of a QFD pilot scheme carried out in cooperation with the SAP AG,
the largest German software company, a methodological standard for QFD success assessment
has been developed. This article describes the function of this model and its results concerning
the SAP pilot scheme.
1 Problem

A sound decision about introducing a concept like QFD[1] can only be made after one or more pilot schemes have been carried out. To impartially judge the accomplishment of QFD at the end of a project, one must have objective criteria. Basically there are two possible ways to determine these criteria: the simultaneous development of the same product with and without the use of QFD, or the comparison of a QFD-based development with a reference product.

2 Basic Possibilities of Determining QFD Success

2.1 Simultaneous Development of a Product with and without using QFD

The safest way to judge the success of a QFD-based project is to simultaneously develop a product with and without QFD and compare the results. The advantage of this method is that objective criteria can be determined and on the basis of this the success of QFD can be proved (or disproved), e.g.:

- shorter periods of development or improved productivity
  (e.g. measured in function points per working day)
- little reworking
  (e.g. measured in time needed for revision)
- increased customer satisfaction
  (e.g. measured on the number of complaints or a customer satisfaction index, determined by a customer survey, in relation to the money, time and energy needed.

This method, however, has three substantial disadvantages.

1. There is no concept to make sure that possible differences between the two products are not caused by other factors than the usage of QFD. In the case of two different teams developing the products, differences in productivity or quality could be caused by unlike qualifications of the team-members rather than the advantages or disadvantages of QFD. If only one team is responsible for both products, the second method has advantages over the first one because of certain learning effects (e.g. customer requirements that became known and familiar in the meantime) that might influence the team.

2. Using such a complex method as QFD a certain amount of learning, which is difficult to measure, has to be mastered. This learning process spoils the meaningfulness of the determined results, especially if time is one of the quantities to be considered.

3. Finally, this method of determining success is very costly and, having economy in mind, hardly justifiable. This is even more valid because the determination would have to be made repeatedly to achieving reliable results, which means that several products would have to be developed at the same time.

2.2 Comparing a QFD-based Product to a Reference Yield

A considerable reduction of expenditure would result from comparing a planned QFD-based product to an existing equivalent, instead of applying the method described above. The problem is that such products can only rarely be found in practice. In addition, the difficulties concerning the isolation of other influential factors mentioned before are valid again.
2.3 Assessing both Approaches

Both described methods have the same problem, characteristic for a QFD pilot scheme: The product to be judged is planned but not completed. Therefore the above mentioned objective determination criteria such as productivity, perfect production or customer satisfaction only work under certain conditions. In addition, a couple of other factors, which are not covered by these criteria, play a role for the success of a method. Some of these other factors would be, for example, developer motivation or the improvement of work climate between developers and customers or marketing etc. Such “soft factors” are of fundamental importance for the success of quality management concepts.[2]

3 Determining QFD Pilot Scheme Success at SAP AG

Within the framework of a QFD pilot scheme the University of Cologne carried out in cooperation with the German developer of standard software SAP AG, a methodical concept for success determination has been elaborated. Besides using objective criteria, this concept also tries to take subjective standards into account. Essentially it is based on the enforcement and analysis of structured interviews before and after the carrying out of a QFD pilot scheme.

3.1 The QFD Pilot Scheme “R/3 Diary”

Before the elaborated concept and the achieved results are described, the QFD-project should be outlined to show project conditions.

The pilot project was carried out to determine the suitability of QFD for its use at SAP. As the software package used in this pilot scheme the R/3-Diary, Version 3.0b was chosen. This piece of software enables several persons to view and maintain each others appointments from different locations at the same time.

A QFD-team of seven people, consisting of three customer representatives (adviser, developer and offices) two persons from the development team, one responsible for the product and one for QFD, was put together. This team worked together on a concept for success determination. The meetings were prepared, assessed and presented by two people from Cologne University staff.

Two aims concerning the use of QFD in the pilot scheme were pursued especially for the Diary: Reviewing the old Diary and concentrating developmental resources on the essential parts.

As noted in the aims of the project (comp. 3.2.1) the emphasis of QFD-evaluation was put on the early stages of QFD, particularly the House of Quality. Special importance was attached to the analysis of customer needs and satisfaction. The usual aids like the Voice of the Customer Table (VoCT), affinity- and tree-diagrams, comparisons in pairs, importance-satisfaction- portfolios, Pareto-analyses, etc. have been used.
Calculating the importance of product features, not only the weightiness of customer requirements but also that of customer satisfaction were used to process a code. In the case of a further development of a product, as in this case, customer satisfaction is substantial. But taking only the weighted satisfaction (weightiness * customer satisfaction) as a basis for decisions, one would certainly draw the wrong conclusions: When multiplying weightiness and customer satisfaction the importance of customer requirements would increase if the customer is particularly satisfied. This would mean that a lot of time, energy, and money would be invested in parts of the product that the customer is already satisfied with. Other requirements would still not be met. In the SAP-Project a code for the importance of customer requirements was used, in which the weightiness was divided by the index for customer satisfaction. This code marks the significance of customer requirement for the further development of the product in view of the factors of weightiness and satisfaction.

The following diagram displays a small part of a comparison of customer requirements and product features of the diary:

### Fig. 3-1  Examples of the practiced aids in the SAP QFD-Project

<table>
<thead>
<tr>
<th>cust. statement</th>
<th>customer request</th>
<th>product features</th>
<th>product functions</th>
<th>features of quality</th>
<th>comment</th>
</tr>
</thead>
<tbody>
<tr>
<td>status plan with reproduction</td>
<td>no forgetting of planned appointments</td>
<td>deleting of a planned appointment after fixing it</td>
<td>e.g. by redisplaying</td>
<td>free adjustability of every part of the screen display</td>
<td></td>
</tr>
</tbody>
</table>

| adjustability of the interface | free adjustment of the blocks | | |

| customer-group A | customer-group B | customer-group C |

Legend: customer-group A, customer-group B, customer-group C.
3.2 Preparations for and the Enforcement of Success Determination

To assess the effects of using QFD it is important to

- ask everybody involved in the project about his or her opinion, because success or failure of the project might be seen very differently from the various points of view (customer, developer, quality management, marketing, etc.),

- carry out the questions before and after the enforcement of the pilot scheme, because not only absolute opinions and facts, but especially changes and developments caused by QFD are decisive for QFD success determination.

3.2.1 Establishing the Aims of the Pilot Scheme

Without establishing any aims for a pilot scheme it seems very unlikely that agreement will be reached on if and to what extent the aims were fulfilled at the end of such a project. This is what Gilb formulated in his “principle of fuzzy targets”: “Projects without clear goals will not
Concerning the use of QFD in the Diary project two major goals were pursued: Reviewing the old Diary and concentrating developmental resources on the essential parts. To fix the pursued aims as precisely as possible, concrete expected results of the project (e.g. “the in relationship to customer requirements most important implementation-independent product features as guide and main focus of further development”) were taken into consideration. In addition several secondary aims (e.g. “stating differences from ‘conventional’ approaches and problems so

All persons involved agreed on the aims to be followed. Remarkable team-work was the reason for this unanimous decision.

3.2.2 The Attitude towards Individuals and towards QFD as an important Factor for QFD-Success

Attitude towards Individuals

Based on the experiences with the QFD project up to this point one starting thesis for success determination at SAP was that QFD success depends on certain attitudes and prejudices against colleagues or customers and developers.

| thesis: | QFD improves the communicational exchange between the persons involved in the project and leads to a better understanding of each other’s needs and problems. |
| query: | How do you assess the composition of the project team and its cooperation in the pilot scheme? |

Within the framework of success determination those involved were questioned on the attitudes and prejudices against colleagues or customers and developers before starting the pilot scheme. It was examined afterwards, if QFD caused a change in these attitudes. Such questions were: “What contribution is to be expected from each member of the team regarding the practice of his or her function for the project?”, or “Which members of the team will possibly cause problems?” (not as an individual, but in pursuance of their role/function).

It turned out, that some customers had prejudices against certain developers because these had not fulfilled a special customer requirement for quite a long time. Instead of complying with this requirement these developers would have been much more interested in object-oriented software development and other “playing abouts”. On closer examination it turned out that the required software feature simple could not be realized under the given developmental circumstances and that the developers saw object-oriented programming as a means of becoming able to realize customer requirements otherwise not to be fulfilled. This communicative problem could easily be rectified in a QFD session. One problem concerning the composition of the team that could not be predicted beforehand, was the high number of developers in the team, which afterwards was sensed as unfavorable, especially by the customers.

Attitude towards QFD

Experience in other areas of software development like the CASE-introduction shows that quite often projects are assessed as failures not because their methods were inadequate but because the expectations were much too high.[4] Another aspect of this are unfounded fears regarding the innovations that come with the introduction of a certain method.
The persons involved in the project do have wrong ideas about the possibilities and limitations of QFD. Usually this evokes expectations and fears which are carried too far.

**Query:** How do you assess the QFD-approach to product planning?

For this reason the members of the QFD project were questioned about positive or negative presuppositions they might have about QFD (comp. 3.3) and about the problems or improvements they expect after the introduction of QFD.

### Interview Instructions to Determine Criteria of Success

**Part 1: Personal Views**

<table>
<thead>
<tr>
<th>1. Attitude towards QFD</th>
<th>Degree of Assent</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>a. How do you assess the QFD approach to product planning / customer requirement analysis?</strong></td>
<td></td>
</tr>
<tr>
<td>Following, you will find a couple of statements about Quality Function Deployment.</td>
<td></td>
</tr>
<tr>
<td>1. Suitable as a method for structuring teamwork</td>
<td>Total assent</td>
</tr>
<tr>
<td>2. Improves communication between the persons involved in a project</td>
<td>Total assent</td>
</tr>
<tr>
<td>3. Chances are high, that customer requirements are ascertained correctly and completely</td>
<td>Partial assent</td>
</tr>
<tr>
<td>4. Chances are high, that the most important customer requirements can be complied with</td>
<td>Partial assent</td>
</tr>
<tr>
<td>5. Structured representation of many influences on product planning</td>
<td>Partial assent</td>
</tr>
<tr>
<td>(customer requirements, competition analysis etc.) in just one diagram</td>
<td></td>
</tr>
<tr>
<td>6. Facilitates the comparison of one’s products with the competitors’</td>
<td></td>
</tr>
<tr>
<td>7. Formulation of, from a customers point of view, well-founded suggestions for development (e.g. in the form of product features)</td>
<td></td>
</tr>
<tr>
<td>8. Facilitates an assessment of the product for everybody involved</td>
<td></td>
</tr>
<tr>
<td>9. Opens up a potential for shorter development cycles</td>
<td></td>
</tr>
<tr>
<td>10. Will decrease the need for a reworking of the product</td>
<td></td>
</tr>
<tr>
<td>11. Opens up a potential for software of higher quality and, because of that, for increased customer satisfaction</td>
<td></td>
</tr>
<tr>
<td>12. A long and costly approach</td>
<td></td>
</tr>
<tr>
<td>13. Most likely no fundamental difference concerning the result in comparison with a conventional approach</td>
<td></td>
</tr>
<tr>
<td>14. Doubtful simplification of product planning in a diagram, implementing a few figures</td>
<td></td>
</tr>
<tr>
<td>15. Success is too dependant on the selected customers</td>
<td></td>
</tr>
<tr>
<td>16. Possibility of just a seeming involvement of customers in the process of development</td>
<td></td>
</tr>
<tr>
<td>17. Odd putting together of very different groups of persons makes the quality and the acceptance of the results questionable</td>
<td></td>
</tr>
<tr>
<td>18. Applicability to the field of software development is uncertain</td>
<td></td>
</tr>
</tbody>
</table>

Please mark with a cross, to what extent you agree or do not agree with the statements below.

**Fig. 3-3:** Questionnaire about attitudes towards QFD
The results of the survey showed that either the attitudes at SAP were surprisingly realistic or that this pilot scheme was exceptionally successful: No positive attitude concerning QFD was assessed less positive after the end of the project; most aspects were judged even more positive afterwards (the absolute values can be found in 3.3).

![Graph showing changes in attitude after the QFD-project](image)

**Fig. 3-4: Changing in attitude after the QFD-project**

The easiest possibility to determine the factors of success is to take these from existing publications.[5] The query about attitudes is just one example of this.

Empirical surveys, though, show that the success of certain measures very often is dependent on factors which are only indirectly connected with these measures. Software companies, for example, were more successful after the introduction of a quality management system according to ISO 9000, although almost all requirements demanded to fulfill this standard were met even before the official introduction. The success of the ISO 9000 standard was largely based on factors such as better communication and higher motivation on the part of the employees; for example the ISO certificate as a common goal worked as an incentive, created a team spirit and in the end caused better results. To fully judge the success of a measure one has to systematically and individually find out about the factors of success valid for every body involved.
3.2.3 Personal Criteria of Success relevant for QFD-Assessment

**thesis:** The persons involved in the project have very individual needs, which have an effect on the demands one makes on a method like QFD. These needs can only be determined with the help of a direct survey.

**query:** How do you, personally, decide if the use of QFD in the pilot scheme has been worthwhile or not?

We have asked everybody involved in the QFD-project at SAP the following question: “How would you decide if the use of QFD in the pilot scheme has been worthwhile or not?” Many of the answers differed quite considerably from the aspects of use usually connected with QFD in the literature. The initiator of the QFD-project, a member of the quality management, defined the pilot scheme as successful if the development team states that QFD has been helpful and the person responsible for the product approves the use of QFD to the board of directors. To the mind of another employee working for quality management the personal input of the persons involved is a critical factor: Persons coming too late to the meetings or leaving them before the official end are, in that employees view, signs for the failure of QFD. Rather diverse answers showed very clearly that the personal opinions concerning the question, what the criteria for success are, differ enormously. Subsequent to the pilot scheme the same persons were consulted again on the question of if their personal criteria for success were met by the QFD-project.

For most of them the personal criteria were fulfilled; some others, before feeling able to give their opinion, wanted to analyze the QFD-results in detail.

3.2.4 QFD-Success Determination as Judgment of Customer Satisfaction

**thesis:** QFD can be viewed as a supplier for certain (intermediate) products for every person involved in the process of development (= “QFD-customers”). Consequently a determination of success according to a special group of persons is similar to a query about customer satisfaction and can therefore be carried out with analogous methods.

**query:** How satisfied are you with the development of the Diary with or without QFD?

In the sense of TQM, QFD can be seen as an internal customer-supplier-relationship. QFD works as a supplier for different customers. Customers in this sense could be the developers of the software, the quality management, the person responsible for the project or the product, and even the person that buys software planned and developed with the help of QFD. Taking this for granted, the determination of QFD success is similar to the determination of customer satisfaction.

Depending on the group of persons under observation, QFD success has to be defined quite differently: For the person responsible for the whole project the keeping of given schedules and budgets might be most important. A developer might find the aspects of a possible better understanding of customer requirements and a clearer view of the developments to be made most promising. Customers might value QFD for the direct contact to the development-team, which enables them to try and convince the team of their requirements and problems.

Experience shows that if one asks developers or customers directly about valid criteria for QFD-assessment, these people find that very difficult. Therefore another method, namely the
Critical Incident Technique (CIT) [6] which was established in the field of sociology, seems to be much more applicable. On the one hand CIT facilitates checking the suitability of assessment criteria discussed in the relevant literature; on the other hand CIT is even a tool to find criteria which have not been thought of before.

The basis of CIT is the assumption that the judgment of a “QFD-customer” originates in the process of assimilating and storing some concrete incidents taking place during the development of the software (e.g. the negative experience of a customer when one of the requirements he/she expressed was dismissed on the part of the developers as nonsensical, or a developer’s positive experience when one of the customers calls to thank him/her for a very easily accessible user-interface). CIT, being a qualitative method, aims at the registration of customer experiences during the process of software development. Experiences of that kind display very clearly which aspects of software development are important to a customer, and by that indicates possible criteria for the assessment of methods like QFD. The experiences have to be categorized as regards content and then be given a heading. These headings, then, resemble the criteria sought after. That way CIT facilitates a development of assessment criteria which is quantitatively and qualitatively controlled by customers and serves as a basis for the determination of QFD-success.

Every person involved in the project was asked to list five positive and negative experiences each that they encountered during the development of the Diary. The results were categorized separately for customers and developers; both categories were then summarized to have ten criteria of assessment each (following the ten customers’ criteria):

- functionality in our definition
  Set of features that the Diary has and which might lead to improvements in our working process.
- new functionality
  New, surprising, useful features of the Diary, one would not have thought of oneself.
- Usability
  Simple operation and the need for just a short training period.
- technical innovation
  A diary that represents the state-of-the-art.
- waiting period for the next release
  Fast realization of customer requirements.
- objective assessment of our requirements
  Well-founded acceptance or denial of customer requirements.
- realization of our requirements
  Making sure that customer requirements are not only accepted but realized.
- early involvement in the process of development
  Early and continuous participation in the development of the Diary.
- personal contact to the development-team
  Exchange between customers and developers.
- understanding each other
  Achieving knowledge about the developers’ and customers’ needs and worries.

Fig. 3-5: Criteria to judge the diary
After that the assessment criteria should be applied to the present Diary and its process of development and the Diary planned with QFD. The latter, as stated above, caused problems because the new Diary has not been realized to this point in time and therefore some judgments (e.g. about usability) were almost impossible.

Some patterns for assessment are judged as more important than others by either customers or developers. Because of this a query was done on the level of importance of every criterion. Naturally, as a result of this query there are specific criteria that are important for developers (e.g. technical innovation) and criteria especially relevant for customers (i.e. complying with their requirements).

![Importance of performance criteria for the development of the Diary](image)

**Fig. 3-6:** Importance of performance criteria for the development of the Diary

One can observe that besides pure product requirements (e.g. functionality and usability of the Diary) factors of the developmental process (e.g. early involvement in this process) are sometimes equally important for satisfaction.

With the help of the opinions given about the criteria stated above, it was possible to determine an index of the degree of satisfaction with every single criterion and for the Diary on the whole (= index of customer satisfaction as mean of the evaluated assessment factors). The results show a fairly high degree of satisfaction with the Diary. Comparing the “Diary with QFD” and the “Diary without QFD”, however, shows that even this rather high level of satisfaction can still be increased by QFD. This is true for each and every criterion as well as for the Diary on the whole (without QFD 3.86; with QFD 4.43).
3.2.5 Comparing the Planning Results with and without Using QFD

**thesis:** The only way to justify the use of QFD is the achievement of different i.e. better results concerning effectively and efficiency.

**query:** What are the main differences concerning product planning in the amount of time, energy and money needed and the results achieved with the “old approach” and the use of QFD?

In principle, an overall improvement caused by QFD is possible in two ways: On the one hand QFD can lead to a more effective way of software development, i.e. the product realized with the use of QFD, for example, leads to a higher degree of customer satisfaction than a product planned and completed without QFD; on the other hand the developmental process can be more efficient, i.e. lower need for resources through the avoidance of wastefulness (realization of features that are not required by the customers), less need for reworking (because the first version already meets the requirements) and through the avoidance of problems caused by lack of clarity about further developments.

In the case of the SAP project a conventional planning of the next release of the Diary had taken place before starting the QFD scheme. According to the developers QFD essentially confirmed the results of the conventional approach. Nevertheless (or maybe even because of that) the developers considered QFD to have a positive effect. For them the usefulness of QFD mainly originates in its methodical and systematical concept. They get a structured list of customer requirements and preferred product features as a basis for their work. Furthermore these product features could be used for marketing.

In addition it seems likely that the use of QFD requires less money, time and energy than the conventional approach (unfortunately there is no exact data available). On the other hand one
has to take a certain learning effect into consideration, i.e. the instance that the developers could introduce planning results and especially the results of a customer survey into the QFD-sessions.

### 3.3 Results of Success Determination

After finishing the project every person involved was questioned about their overall impression of QFD. The statement “We have a very positive overall impression of QFD” has been agreed to with an average intensity of 3.7 (1 corresponds with total denial; 5 with absolute agreement). From this point of view the pilot scheme can be judged as successful.

According to the general opinion of all involved, the aims of the project have been achieved. The main reason for this was the exceptional team-work.

Here are a few statements of project members to illustrate the benefits:

- **team-work**
  - general cooperation of all departments
  - improved cooperation of the various groups
  - team-work more efficient than working alone
  - different groups/opinions are listened to
  - beneficial discussions
  - cooperation with customers (direct feedback)
  - higher integration of users in the process of development
  - more direct contact with the product

- **QFD**
  - structured methodical approach
  - processing of data (e.g. by creating portfolios)
  - clearly formulated requirements
  - coordination of requirements
  - Tool-support
  - various analyses at Tool
  - product feature survey (e.g. as a source of information for marketing)
  - purposeful realization of customer requirements
  - differentiation between various groups of customers

- **increased customer satisfaction**

During the interviews the members of the project were confronted with various positive and negative statements about QFD to be found in literature (comp. 3.2.2). This survey, after finishing the project, lead to the following results:
According to the diagram QFD has been judged as being beneficial (1 corresponds to total denial; 5 to absolute agreement). In the developers’ opinion the only aspect not to be realized by the use of QFD is the shortening of production cycles.

This overall tendency can be observed as well by analyzing the reactions about the negative statements. Analyzing this data one has to keep in mind that in the following diagram an agreement to a statement means a declaration against QFD.
The developers obviously complain about the large matrices and costly calculations that come with the introduction of QFD. At first glance these efforts seem to be much higher than those in a conventional approach, partly because they are explicit and definable. In a conventional setting comparable efforts emerge more “on the side”, unsystematically and irregularly which is the reason why they quite often are not really seen as efforts. In this context it is important to state that it can be presumed that with the same amount of effort the QFD approach achieves a higher level of customer satisfaction. This can be concluded from a comparison of the results of the survey about the assessment of the Diary with or without QFD. The index of customer satisfaction for the Diary without QFD is 3.86 while it increases to 4.43 for the Diary with QFD.

4 Conclusion

The described approach to QFD success determination does not provide a scientific proof for the success or the failure of a pilot scheme, but it surely is a fundamental advance compared to a more or less “instinctive” determination. After appropriate modifications this method of pilot scheme success determination might be suitable for application to other methods of development as well, e.g. the introduction of object-orientation.

The results of the SAP project show that QFD is no omnipotent solution to all problems of software development. It nevertheless becomes clear that QFD is a fundamental advance in finding a way to establish more customer-oriented software development concepts, even if the results are not representative in terms of statistics.
Literature


Biography of the Authors

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