

Georg Herzwurm, Stefan Reiß, Sixten Schockert

University of Stuttgart  
Chair for Information Systems  
BWI, Department IX  
70174 Stuttgart, Germany  
Tel.: +49 711 1212384  
Fax: +49 711 1212384  
Email: georg@herzwurm.de  
WWW: <http://www.wi.uni-stuttgart.de>

QFD-Institut Deutschland e. V. (QFD-ID)  
Eupener Str. 70, 52066 Aachen, Germany  
Tel.: +49 241 6009 1925  
Fax: +49 711 1212384  
Email: [info@qfd-id.de](mailto:info@qfd-id.de)  
WWW: <http://www.qfd-id.de>

## The support of Quality Function Development by the customer orientated evaluation of software tools

### Abstract

For many enterprises QFD is a helpful tool for developing new products or services. The complexities of the method are the reason, that merely the House of Quality is made, the application of secondary tables, matrices or tools is neglected.

One possibility for improvement is the use of a software tool that simplifies, accelerates and that makes - by a combination of different quality techniques - the work with QFD even more efficient. This essay identifies QFD software tools and reviews them on the basis of customer statements.

### Table of contents

|   |          |
|---|----------|
| <b>1. INTRODUCTION .....</b>                                    | <b>3</b> |
| <b>2. MARKET OVERVIEW .....</b>                                 | <b>3</b> |
| <b>3. EVALUATION OF QFD SOFTWARE TOOLS .....</b>                | <b>6</b> |
| 3.1 Why this evaluation ? .....                                 | 6        |
| 3.2 Evaluation Concept .....                                    | 6        |
| <b>4. PRACTICAL APPLICATION OF THE EVALUATION CONCEPT .....</b> | <b>7</b> |
| 4.1 Customer requirements .....                                 | 7        |
| 4.2 Customer satisfaction .....                                 | 9        |
| 4.3 Results .....   | 10       |
| ... of the general product evaluation .....                     | 10       |

... of the individual product evaluation..... 13

**4.4 Conclusions ..... 16**

**5. OUTLOOK.....17**

**6. REFERENCES .....18**

**ABOUT THE AUTHORS.....19**

## **1. Introduction**

Quality Function Deployment (QFD) is a customer oriented method of product development which is applied in many enterprises of different branches and which is based on presented group meetings. Due to the size and the complexity of the data imposed and processed by QFD a support by software tools is almost imperative.

To be able to offer a decision base for the software choice to a potential buyer of a QFD software tool, it is at first required to represent the market situation and to examine products for their functionality more nearly. Furthermore it is useful to question customers who have already gained experience with QFD software about their assessment to these tools. The usefulness of the software in practice and the suitability for planned projects can be tested by the critical judgment of experienced users.

This work shall clarify on one hand, how needs of the customers are covered by already available software solutions, and on the other examine, which new or unfulfilled requirements are existing among customers that could influence following further software developments.

## **2. Market overview**

The following market overview (data: June 2003) wants to introduce existing QFD software tools briefly. It contains the most important internationally sold software tools which completely or in parts support QFD. The software overview of the QFD institute Germany (QFD ID) (cf. [QFD02]) as well as the "Software Directory" of the magazine "Quality progress" (cf. [ASQ02]) gave the background information for the market overview.

| Product/<br>latest version             | Manufacturer   | demo-Version | Licence agreement   | Price  |
|--|--|--------------|---|--|
| <b>Commercial Software-Tools</b>       |  |              |   |  |
| Decision/Capture<br>Version: 1.5       | International TechneGroup Incorporated<br>ITI Deutschland GmbH<br><br>Grossmannswiese 1<br>D-65594 Limburg-Ennerich<br>Deutschland<br><br>Tel.: ++49-(0)6431-9907-0<br>Fax: ++49-(0)6431-9907-88<br>E-Mail: <a href="mailto:qfd-europe@iti-global.com">qfd-europe@iti-global.com</a><br><a href="http://www.iti-global.com">http://www.iti-global.com</a>  | •            | Decision/Capture - Basic Edition<br>Decision/Capture - Standard Edition<br><br>Enterprise-wide license possible<br>.  | 50,- €<br>225,- €<br><br>Prices excl. taxes  |
| QFD/Capture<br>Version: 4.0            | International TechneGroup Incorporated<br>ITI Deutschland GmbH<br><br>Grossmannswiese 1<br>D-65594 Limburg-Ennerich<br>Deutschland<br><br>Tel.: ++49-(0)6431-9907-0<br>Fax: ++49-(0)6431-9907-88<br>E-Mail: <a href="mailto:qfd-germany@iti-oh.com">qfd-germany@iti-oh.com</a><br><br><a href="http://www.iti-oh.com">http://www.iti-oh.com</a><br><a href="http://www.qfdcapture.com">http://www.qfdcapture.com</a>                                   | •            | QFD/Capture - Professional Edition<br>QFD/Capture - Network Edition (5 Users)<br>QFD/Capture - Network Edition (10 Users)<br>QFD/Capture - Network Edition (20 Users)<br><br>Enterprise-wide license possible | 1.200,- €<br>10.000,- €<br>20.000,- €<br>40.000,- €<br><br>Prices excl. taxes              |
| CIMOS QFD<br>Version: 2.0 <sup>1</sup> | MBFG GmbH & Co. KG<br><br>Klarenbergstrasse 250<br>D-73525 Schwäbisch Gmünd<br>Deutschland<br><br>Tel.: ++49-(0)7171-929927<br>Fax: ++49-(0)7171-929926<br>E-Mail: <a href="mailto:mbfg.gmbh@t-online.de">mbfg.gmbh@t-online.de</a><br><br><a href="http://www.irmler.com">http://www.irmler.com</a>   |              | Single user and Network-Version   | 395,- €<br><br>Price per workstation   |
| QFD2000<br>Version: 2.0                | Total Quality Software<br><br>3 Lynden Avenue, Gonerby Hill Foot<br>Grantham, Lincolnshire<br>England<br>NG31 8JW<br><br>Tel.: ++44-(0)1476-574299<br>Fax: ++44-(0)1476-594056<br>E-Mail: <a href="mailto:office@totalqualitysoftware.co.uk">office@totalqualitysoftware.co.uk</a><br><br><a href="http://www.totalqualitysoftware.co.uk">http://www.totalqualitysoftware.co.uk</a><br><a href="http://www.qfd2000.co.uk">http://www.qfd2000.co.uk</a> | •            |   | 550,- UK £   |
| QFD Designer<br>Version: 4             | QualSoft LLC<br><br>725 S Adams Road, Suite 70<br>Birmingham, MI 48009<br>USA<br><br>Tel.: ++1-248-433-3380<br>Fax: ++1-248-433-3384<br>E-Mail: <a href="mailto:info@qualisoft.com">info@qualisoft.com</a><br><br><a href="http://www.qualisoft.com">http://www.qualisoft.com</a>  | •            | Single-Named-User (Standalone)<br>Single-User Concurrent (Network)<br><br>Division-Wide License<br><br>Quantity discount possible:<br>Named-User (up to 5 users)<br>Concurrent-User (up from 3 users)         | US \$1250,-<br>US \$3750,-<br><br>on request<br><br>Prices per user/<br>Prices excl. taxes |

| Product/latest version   | Manufacturer   | Demo-Version   | Licence agreements   | Price   |
|--|--|----------------|--|---|
| QFD Scope<br>Version: 1.1  | Integrated Quality Dynamics, Inc.<br><br>3848 Carson Street, Suite 216<br>Torrance, California 90503<br>USA<br><br>Tel.: ++1-310-540-6142<br>Fax: ++1-310-540-6392<br>E-Mail: iqd@iqd.com<br><br>http://www.iqd.com  | •              | QFD Scope Stand-Alone Version<br>QFD Scope Network Version (5 user)<br>QFD Scope Network Version (10 users)<br>QFD Scope Network Version (25 users)<br>QFD Scope Network Version (50 users)<br>QFD Scope Network Version (100 users) | US \$ 200,-<br>US \$ 350,-<br>US \$ 500,-<br>US \$ 950,-<br>US \$ 1700,-<br>US \$ 3200,-<br><br>Preise zzgl. Steuern                |
| Qualica QFD<br>Version: 2.5<br><br>Version: 3.0 <sup>1</sup>               | Qualica Software GmbH<br><br>Frankfurter Ring 193a<br>D-80807 München<br>Deutschland<br><br>Tel.: ++49-(0)89-323-696-03<br>Fax: ++49-(0)89-323-696-05<br>E-Mail: info@qualica.de<br><br>http://www.qualica.de  | •              | Qualica QFD (ab 1 user)<br>Qualica QFD (ab 3 users)<br>Qualica QFD (ab 5 users)<br>Qualica QFD (ab 10 users)<br>Qualica QFD (ab 20 users)<br>Qualica QFD (ab 50 users)   | 2950,- €<br>2596,- €<br>2360,- €<br>1770,- €<br>1475,- €<br>1180,- €<br><br>Price per user;<br>excl. Taxes;<br>incl. 1 year support |
| <b>Noncommercial Software-Tools</b>  |  |                |  |   |
| QFDT<br>Version: 1.0.6.88  | Yamanashi University<br>Faculty of Engineering,<br>Dep. of Computer Science<br><br>4-3-11 Takeda, Kofu,<br>400 Japan<br><br>Tel.-Fax: ++81-552-20-8400<br>E-Mail: shindo@esi.yamanashi.ac.jp<br><br>http://www.is.esi.yamanashi.ac.jp<br>/intl/services/qfd/<br>http://www.syncinfo.co.jp/services/qfd/<br><br>Designed by: Prof. Hisakazu Shindo<br>Coded by: Yunarso Anang<br>Distributed by:<br>SYNC Information System Co., Ltd. | • <sup>2</sup> |  | <b>Noncommercial!</b>   |
| QFD.NET<br>(Web-based QFDT)  | Yamanashi University<br>http://www.is.esi.yamanashi.ac.jp/user/qfd.net/  |                |  | <b>Noncommercial!</b>   |
| Easy QFD<br>Version: 2.0 <sup>1</sup>                                      | QFD Institut Deutschland<br>http://www.qfd-id.de   |                |  | <b>Noncommercial!</b>   |
| Notice:<br>1...new release (not available yet)<br>2...available on request |  |                |  |   |

Table 1: Market overview: Product list

It is to be mentioned that the products CIMOS QFD 2.0 and Qualica QFD 3.0 as well as the noncommercial software Easy QFD are new developments which still are not available at present and therefore could not be tested by the author. All information about it is based on the statements of the manufacturers. The tools QFDT and QFD.NET are non-commercial developments of the Yamanashi University, Japan.

### **3. Evaluation of QFD software tools**

To be able to evaluate software tools by using a uniform scheme, it is required to find suitable criteria for judgment (cf. [Hein00], p. 9). Since software is a complex product whose use is not foreseeable in practice, there are no general evaluation criteria (cf. [PrKr00], p. 50). These criteria only can be found out by asking the customers about their wishes, requirements and their specific needs of the product (cf. [Jura91], p. 50).

To be able to find out everything about the customer requirements, first of all an evaluation concept had to be developed. This evaluation concept will be summarized and introduced in the following.

#### **3.1 Why this evaluation ?**

This evaluation shall allow conclusions on customer needs and their actual fulfillment by the used products.

As relevant evaluation objects we will look at commercial QFD software solutions. The interviewees are QFD users, since knowledge to QFD (request analysis) and experiences in using these software products (satisfaction analysis) are required in the interviews.

Due to the suggested two-steply laid out evaluation method several different results can be achieved. On one hand customer needs will be shown by the customer requirements and on the other critical judgments to the efficiency of the individual QFD software tools will arise from the satisfaction of the customers. A target/actual comparison delivers results that will show the gap between customer needs and wants and nowadays software reality.

#### **3.2 Concept**

The Evaluation is carried out in two steps. At first the customers are questioned about their needs and requirements on QFD software. A second interview will find out the concrete meaning of the requirements and examine the customers satisfaction exactly.

The first questionnaire mainly deals with the identification of customer requirements. The interviewee is asked directly for his requirements and can answer on this individually and without any specifications. Furthermore positive and negative experiences by using a QFD software tool are identified with the help of the Critical Event Technique. The person asked can comment on events which are of special importance for him.

This explorative procedure helps to collect as much information about customer requirements as possible to serve as further criteria for the evaluation of customer satisfaction. The customer requirements have to be found out from this set of qualitative data. It has to be checked whether the customer already knows exactly what he wants or if the mentioned requirements have to be analyzed first.

To be able to use the customer requirements in the further evaluation the criteria has to be structured and summarized by an affinity diagram. Furthermore it is possible to represent the hierarchical structure of the requirements in form of a tree diagram which con-

tains three, at most four hierarchy levels. A request collection which is subdivided into several main categories (1st hierarchy level) is derived from it. The requirements which stand at the second level of the tree diagram are assigned to these categories. The information of all wider levels is summarized as description and enclosed to describe the respective requirements even better. The first customer interview provides qualitative data that can be used as a substantial catalogue of customer needs and requirements. That will be the basis for the actual rating of existing software products.

The customer satisfaction with the used QFD software tools has to be examined by a second questionnaire. Therefore the requirements found out in the first questionnaire are presented to the customers and used as rating criteria.

This rating is also carried out in two steps. At first the main categories are to be measured by using a constant sum scale related to the clients approach. Anybody had to judge all listed requirements. The rating of the category is transferred to all subordinate features instead. After that the user shall assess if the used software product satisfies the found out criteria. Every criterion is embedded into a five-stage rating scale ('*complete consent*' to '*complete rejection*'). Moreover it is possible to give a neutral answer or to leave the question unanswered (e.g. if no statement can be met). By these techniques an exact measurement of customer satisfaction is given and completed by the additional customer statements. The statements written down on the rating scale can be changed into (predefined) numerical values for a better evaluation.

As a result of the second customer interview quantitative data are available. This data permit an assessment of the requirements on one hand and a comparative, feature oriented judgment of the individual software products on the other. **It should** be possible with the help of the suggested evaluation method above to find out more about customer requirements and to measure the customers satisfaction regarding single product features.

#### **4. Practical application**

Two customer interviews were carried out with members of the Quality Function Deployment Institutes, members of the QFD institute Germany and subscribers of the QFD JISCMail list. The essential results I want to introduce to you now.

It was of great importance to find interview participants who have sufficient knowledge to QFD and QFD software and who were able to formulate specific requirements exactly. It can be assumed that the participants serve this criterion very well. It is questionable whether the made choice statistically represents a sample for the (unknown) QFD users, since a comparable composition of sample cannot be guaranteed (cf. [BoDö02], p. 401; [Kast95], p. 79).

##### **4.1 Customer requirements**

To guarantee the customer orientation of the evaluation of QFD software it is required to know customer needs and to base the evaluation upon these data. The first interview delivers the data basis of a far-reaching criteria catalog that is used for the rating. It has to be assumed that the customers view of a software product arises from the assessment of different performance components (cf. [Herz00], p. 398). The more extensive and more detailed the customer requirements can be worked out in the interviews, the

more precisely the judgment by the customers can be carried out. The participation of the customer is necessary to make sure that the customer satisfaction is measured by features of actual relevance (cf. [Herz00], p. 398).

To find out more about the specific customer requirements a questionnaire to be answered in writing was used. The interview participants were asked to mention QFD software and to comment on them. In addition, the critical event method was used to put together positive and negative experiences with QFD tools. The questionnaire was answered 30 times in a period of 35 days, 27 answers could be included in the analysis. By using these 27 questionnaires altogether 183 specific requirements on QFD software tools could be found out. Out of this 137 answer the questions about requirements and 46 the questions about positive and negative experiences with QFD software. Usually customer statements are created into requirements during personal meetings. If there are any problems in understanding the customer needs you can ask the client personally. But such feedback was not possible during to the anonymous interview. Therefore partial acceptances had to be made about the meaning of the statements to transfer them into requirements. The requirements found out were structured and summarized with the help of an affinity diagram. Table 2 gives a summary of the results of this examination section.

|  |   |
|--|---|
| <ul style="list-style-type: none"> <li>• <b>Ergonomics</b> <ul style="list-style-type: none"> <li>▪ simple serviceability</li> <li>▪ fast learning</li> <li>▪ short response times</li> </ul> </li> <li>• <b>Data Input</b> <ul style="list-style-type: none"> <li>▪ flexible data input possibilities</li> <li>▪ variably definable data types</li> <li>▪ simple data take-over</li> <li>▪ import functions for inserting data from external applications</li> <li>▪ iterative procedure</li> </ul> </li> <li>• <b>Data Processing</b> <ul style="list-style-type: none"> <li>▪ multi-user mode</li> <li>▪ data processing in one/several application windows</li> <li>▪ use of templates</li> <li>▪ reuse of results</li> <li>▪ fast result availability</li> <li>▪ matrix chains</li> <li>▪ open representation</li> <li>▪ undo functionality</li> </ul> </li> <li>• <b>Data Output</b> <ul style="list-style-type: none"> <li>▪ good print quality</li> <li>▪ flexible pressure options</li> <li>▪ export functions</li> <li>▪ attractive graphic representation</li> <li>▪ emphasis by colored schemes</li> <li>▪ beamer version optimized</li> </ul> </li> <li>• <b>Functional Construction of the QFD Tool</b> <ul style="list-style-type: none"> <li>▪ modular construction</li> <li>▪ integration of external applications</li> </ul> </li> <li>• <b>QFD Support Functions</b> <ul style="list-style-type: none"> <li>▪ „voice of the customer“</li> <li>▪ competition analysis</li> <li>▪ analysis of interdependences</li> <li>▪ automatic evaluations</li> </ul> </li> </ul> | <ul style="list-style-type: none"> <li>• <b>Integration of Additional Methods and Tools</b> <ul style="list-style-type: none"> <li>▪ integration of additional methods</li> <li>▪ methods for the data management</li> <li>▪ availability of evaluation tools</li> </ul> </li> <li>• <b>Help functions</b> <ul style="list-style-type: none"> <li>▪ direct help</li> <li>▪ hypertext based on-line help</li> </ul> </li> <li>• <b>Flexibility and Configurability</b> <ul style="list-style-type: none"> <li>▪ interactive Configuration possibilities</li> <li>▪ free design of matrices and matrix elements</li> <li>▪ completion of matrices</li> <li>▪ free definition of calculations</li> <li>▪ application of different QFD approaches</li> </ul> </li> <li>• <b>Data Security and Stability</b> <ul style="list-style-type: none"> <li>▪ automatic data saving</li> <li>▪ restoration of the database</li> <li>▪ robust software behaviour and error tolerance</li> </ul> </li> <li>• <b>Support by the Manufacturer</b> <ul style="list-style-type: none"> <li>▪ technical support</li> <li>▪ training offers</li> <li>▪ secondary services</li> </ul> </li> <li>• <b>Economical License Models</b></li> </ul> |
|--|---|

Table 2: Summary of the structured customer requirements



## **4.2 Customer satisfaction**

In the first interview the customers have been asked about their requirements on QFD software tools. The answers have been structured and are now basis for the second questionnaire, in which an assessment of available QFD software shall be carried out. Object of the second interview is the determination of comparable (numerical) indicators with which an assessment of the strength and weak points of the respective product can be made and all products can be compared. The extensive list of requirements makes a very subtly differentiated judgment possible.

However, aim of the research is not to find a "super tool", that is able to satisfy as much customers as possible. The results shall rather give notice how the individual products are judged by the customer regarding their functionality and their features. The subjective customer satisfaction shall be found out.

The second questionnaire covers five complexes of questions.

At first the interviewee was asked for his favorite tool. A number of possible products was provided (question 1). It was absolutely necessary to find out what kind of software the interviewee uses, because if the person asked doesn't use any software tool to support his work with QFD, he of course cannot judge its features either.

In question 2 the interviewee as asked for a far-reaching statement about the software he uses. Having in mind that an all over satisfaction corresponds to the average satisfaction in the chosen individual features, it can be deduced from such a far-reaching judgment, whether the chosen factors represent the customer satisfaction adequately (cf. [OrRa96], p. 1287; [ScKi98], p. 105).

Since it couldn't be assumed that all of the customer have the same point of view about the needs, it was at first necessary to find out the importance of the individual software attributes (cf. [LiSc91a], p. 111). In question 3 the customers were asked to distribute 100 points on twelve performance features. That procedure will help to find out the relative weighting of their needs. By the application of this *constant sum technique* the person asked had to make a decision and the effect of demand inflation was avoided (cf. [LiSc91b], p. 32).

The multi-attributive judgment of the satisfaction is the essential part of the questionnaire (question 4). The customer requirements found out with the help of the first questionnaire were used as appraisal factors. The rating of the requirements satisfaction is transferred into five-stage rating scale (from '*complete consent*' to '*complete rejection*' in respect to the corresponding item). This is equivalent to a satisfaction scale of '*completely content*' to '*completely dissatisfied*'.

The second questionnaire was answered 57 times in a period of 36 days.

## 4.3 Results...

### ... of the general product evaluation

The first evaluation step wants to find out the importance of the individual requirements for the interviewee. The assessment of the grouped requirements is transferred to the respectively subordinate requirements (see illustration 1). The average weighting per feature arises from the arithmetical average of all given judgments independently of whether the person asked uses a software tool or not. Since the sum of the request is 100, the average values can be taken as per cent value.

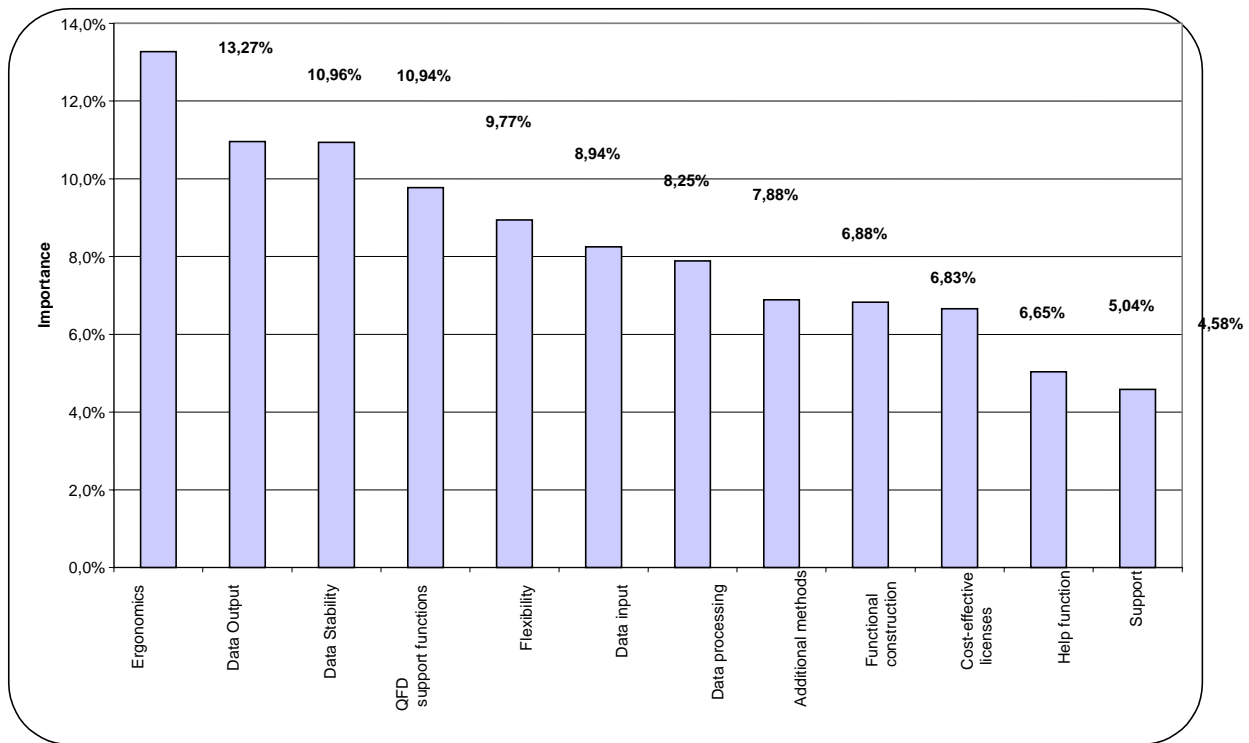


Illustration 1: Average weighting of the categories

Illustration 9 shows a graphic of the average importance of a feature in a descending order. The analysis of this rating shows that four categories: ergonomics, data output, data stability, and QFD support functions concentrate 45% of the rating scale. This result corroborates the first questioning about positive and negative events, in which problems with printing, data export and software stability were the crucial points and the majority of the customers wanted a more simplified application. The attributes 'cost-effective license models' 'help functions' and 'manufacturer support' can be found at the end of the row. The cost factor obviously plays a subordinate role in enterprises, but the importance of the other two attributes doesn't allow the conclusion that these factors are of no importance to the interviewees. It should rather be considered that these requirements are taken for granted.

Finally it is remarkable that no feature is neither over- nor underrated. Reason may be that the grouping of the requests is on one hand very equivalent and on the other the categories do not contain any meaningless features.

This result made statements about the customer needs possible, but to be able to carry out a judgment of the customer satisfaction, however, the evaluation of the multi-attributive satisfaction examination is required. (cf. [LiSc91a], p. 114)

At first the satisfaction factors are evaluated with reference to the customer requirements. Therefore the arithmetic mean of the satisfaction judgements of all software users has to be built. For that purpose it is of no importance which specific product they rated. (cf. table 3).

| Feature                 | Average satisfaction verdict | Share of dissatisfied customers (in %) (values 1 and 2) | Share of indifferent customers (in %) (value 3) | Share of content customers (in %) (values 4 and 5) |
|-------------------------|------------------------------|---|---|--|
| Ergonomics              | 3.67                         | 21.2  | 13.6  | 65.2   |
| Data input              | 3.72                         | 18.3  | 22.4  | 59.3   |
| Data processing         | 3.46                         | 25.3  | 22.2  | 52.5   |
| Data output             | 3.91                         | 12.9  | 19.2  | 67.9   |
| Functional construction | 3.28                         | 35.8  | 20.8  | 43.4   |
| QFD support functions   | 3.19                         | 34.3  | 20.5  | 45.2   |
| Additional methods      | 2.93                         | 44.3  | 19.7  | 36.0   |
| Help functions          | 2.83                         | 50.0  | 12.5  | 37.5   |
| Flexibility             | 3.95                         | 14.1  | 10.0  | 75.9   |
| Stability               | 3.28                         | 32.7  | 10.2  | 57.1   |
| Support                 | 4.08                         | 9.7   | 17.2  | 73.1   |
| Costs                   | 3.76                         | 14.3  | 23.8  | 61.9   |

Table 3: Average satisfaction rating on group level

It is remarkable that no criterion is judged excessively badly. Most factors are above 3.0 and with that in the positive area of the satisfaction scale. The manufacturer 'support' (value: 4.08) scores the highest satisfaction rating, the questioned customers are least satisfied with the 'help functionality' of the applications (value: 2.83). Furthermore the cost factor is judged very positively what supports the thesis, too, that the cost factor of software on enterprise level has a subordinate position.

Now the customer satisfaction shall be examined in combination with the determined importance in another step. A so-called **importance satisfaction portfolio** in which the stressed importance of a feature on the abscissa and the non stressed satisfaction values of the same feature are taken down on the ordinate of a two-dimensional coordinate system is suitable as a two-dimensional analysis instrument. While the division of the satisfaction axis is arising from the formed scale of the satisfaction values (1 to 5), the dimension importance is divided up from 0% to a variable upper scale factor. This upper limit amounts double of the average rating of all features on which the horizontal subdivision of the portfolio quadrants also depends. By the position of a feature regarding to the respective quadrant strategic decisions on further development can arise (cf. [Her + 00 ], p. 136; [Wern98], p. 162).

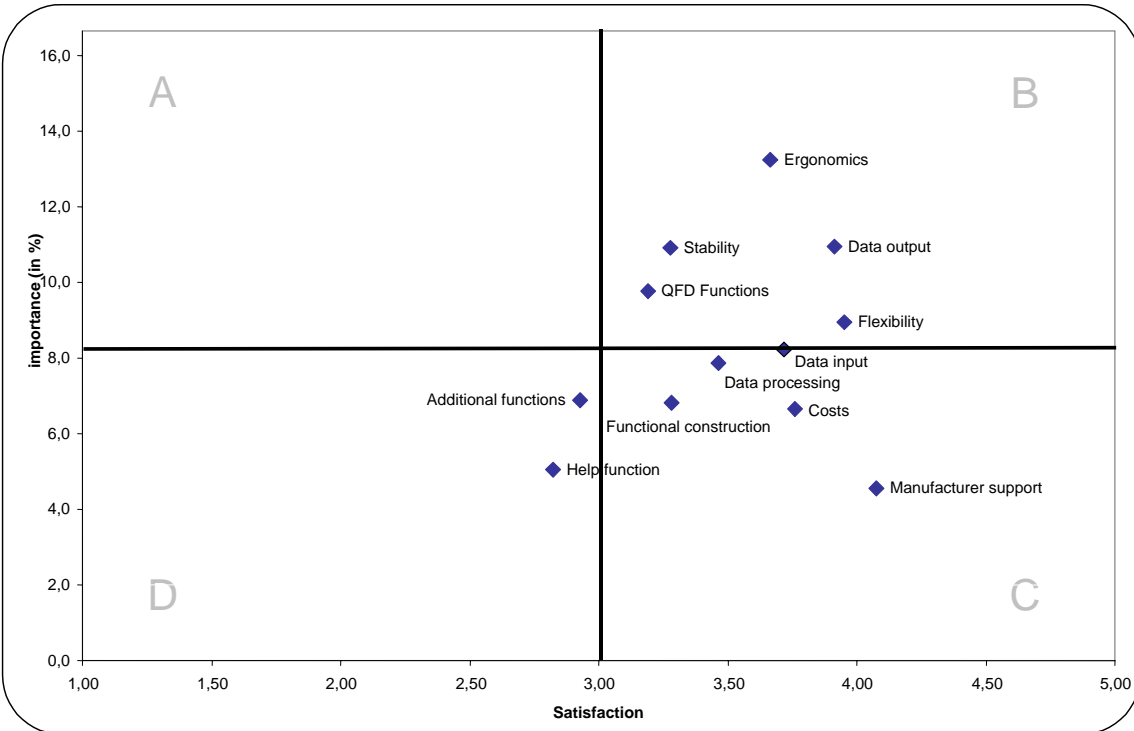


Illustration 2: Importance satisfaction portfolio: Summary

Illustration 2 shows the *importance satisfaction portfolio* of the requirements on group level. The separation of the quadrants proceeds on the satisfaction axis at 3.0 and on the importance axis at 8.3:

$$\left( \frac{\text{sum of importances}}{\text{number of criteria}} = \frac{100}{12} = 8,3 \right)$$

The placement of the requirements can be interpreted as follows cf. [ Her + 00 ], p. 37 p.:

- Quadrant A, Divergence between expectation and performance = Critical Area**  
 Features in this quadrant are of high priority to the manufacturer. Since they have a high importance for the customer, the features mentioned here should be improved to satisfy the customer. No ratings can be found here. Conclusion is that all available software on market fulfills these essential customer requirements.
- Quadrant B, Customer expectations are fulfilled**  
 In this quadrant you can find the features that are of essential importance to the customer and are successfully worked out by the manufactures. These usually are related to key competences of the enterprises which must be sustained and improved. That shows that the three most important features 'ergonomics', 'data output' as well as 'data security and 'stability' also donate the highest satisfaction.. The 'QFD specific functions', principal ingredient of a QFD software tool, also lie in this area.
- Quadrant C, Exceeding the customer needs**  
 These assessment features (e.g. 'data processing', 'costs' or 'manufacturer support') cause a high customer satisfaction; however, have a minor meaning for the customers. They should therefore be only developed further when the requirements are fulfilled in the areas of A, B and D.

- **Quadrant D, Possible improvement potential**

The performance of the features listed here is not fulfilled satisfactorily from the customer view, but hardly influence the complete satisfaction (e.g. 'help functions'). Basically the fulfillment of these features is necessary, if this is practicable with acceptable effort and if in quadrant A there are no further requirements to be fulfilled. Since there is no open demand, an improvement in the features mentioned here would be possible and suitable to improve the complete satisfaction of the customers.

### ... of the individual product evaluation

We have heard about the customer statements about the QFD software tools in general, let us see the results regarding to every individual software product now.

To be able to compare the measuring values with each other it is possible to describe the indicators of the numerical series by a standardized numerical value. Such a value is described as an index figure (cf. [Har<sup>+</sup>, 95, ], p. 62).

In the *customer satisfaction research* often the so-called **customer satisfaction index (CSI)** is found out to describe complete customer satisfaction. The satisfaction level is connected with the weighting of the feature. The calculation can be carried out both, for a single product or for all data handed in. The CSI calculates itself out of the relation:

$$KZI = \sum_{i=1}^n (W_i \cdot Z_i)$$

*N* stands for the number of weighted requirements, *W<sub>i</sub>* for the importance of the respective request group (in %) and *Z<sub>i</sub>* for the satisfaction level of the individual feature (cf. [Her<sup>+</sup> 00 ], p. 252; [LiSc91a], p. 114 p.).

In this examination the rating scale with *Z<sub>i</sub>* ranges from 1 to 5 that means that the index value *CSI = 0* can not be reached; the minimal index amounts to 20%. An index of *CSI = 0* is, however, meaningful if e.g. the complete dissatisfaction with a product shall be expressed. To compensate this, the equation is modified as follows:

$$KZI = \sum_{i=1}^n (W_i \cdot (Z_i - Z_{i-min}))$$

with *Z<sub>i-min</sub>* -- lowest scale factor, i.e. 'complete discontent'.

In illustration 3 the customer satisfaction index is converted to a percent rate related to a 'complete satisfaction' after the following equation:

$$KZI = \frac{\sum_{i=1}^n (W_i \cdot (Z_i - Z_{i-min}))}{(Z_{i-max} - Z_{i-min})}$$

with *Z<sub>i-max</sub>* -- highest scale factor, i.e. 'complete satisfaction'.

The CSI also serves as a unique indicator and with that as a scale for the comparison of different products or investigation results (e.g. in the context of satisfaction studies repeated regularly). The index number then makes the comparison of the results possible, even if the evaluation criteria differ from each other (cf. [Her<sup>+</sup>00], p. 252, too; [LiSc91a], p. 114 p.).

The determination of the CSI is carried out for every single tool and the weightings are transferred to the summarized requirements. The CSI values of the products determined by the customers are compared in illustration 3. It stands out that the ratings of the tools are not fundamentally different - with exception of Hyper QFD which was replaced by Qualica QFD in the meantime. The highest index value achieves Qualica QFD with 77.9%, while the software tool Hyper QFD is scoring the lowest CSI value with 35.3%. As expected the index values of QFD/Capture and Decision/Capture lie very close. That can be explained by the much alike basic construction while the function-related differences are not recognizable immediately.

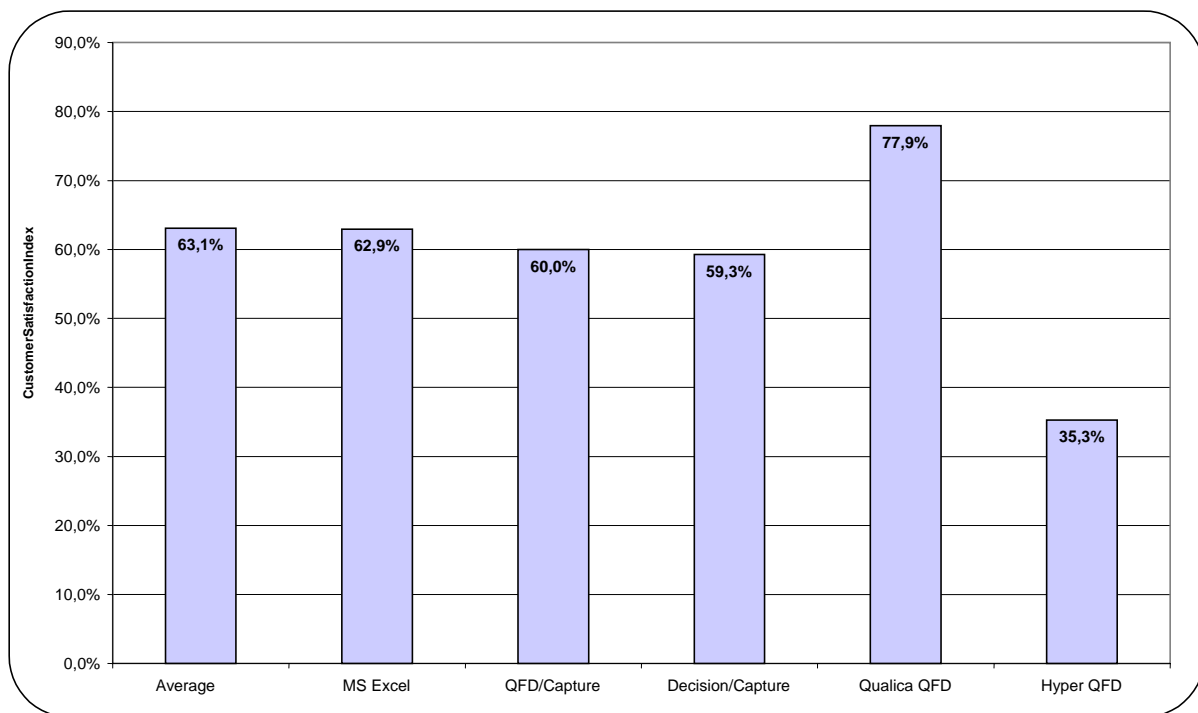


Illustration 3: Customer Satisfaction Index

In conclusion a so-called **polarity profile** (here in the context of the product-related evaluation: **strength-weakness-analysis**) shall come to use. The comparison of the customer satisfaction is now possible regarding to the individual product (cf. [Meff92], p. 186).

Illustration 4 shows the strength-weakness-analysis for the grouped features. In this illustration Hyper QFD is taken into account to clarify which weaknesses lead to a high dissatisfaction with the product.

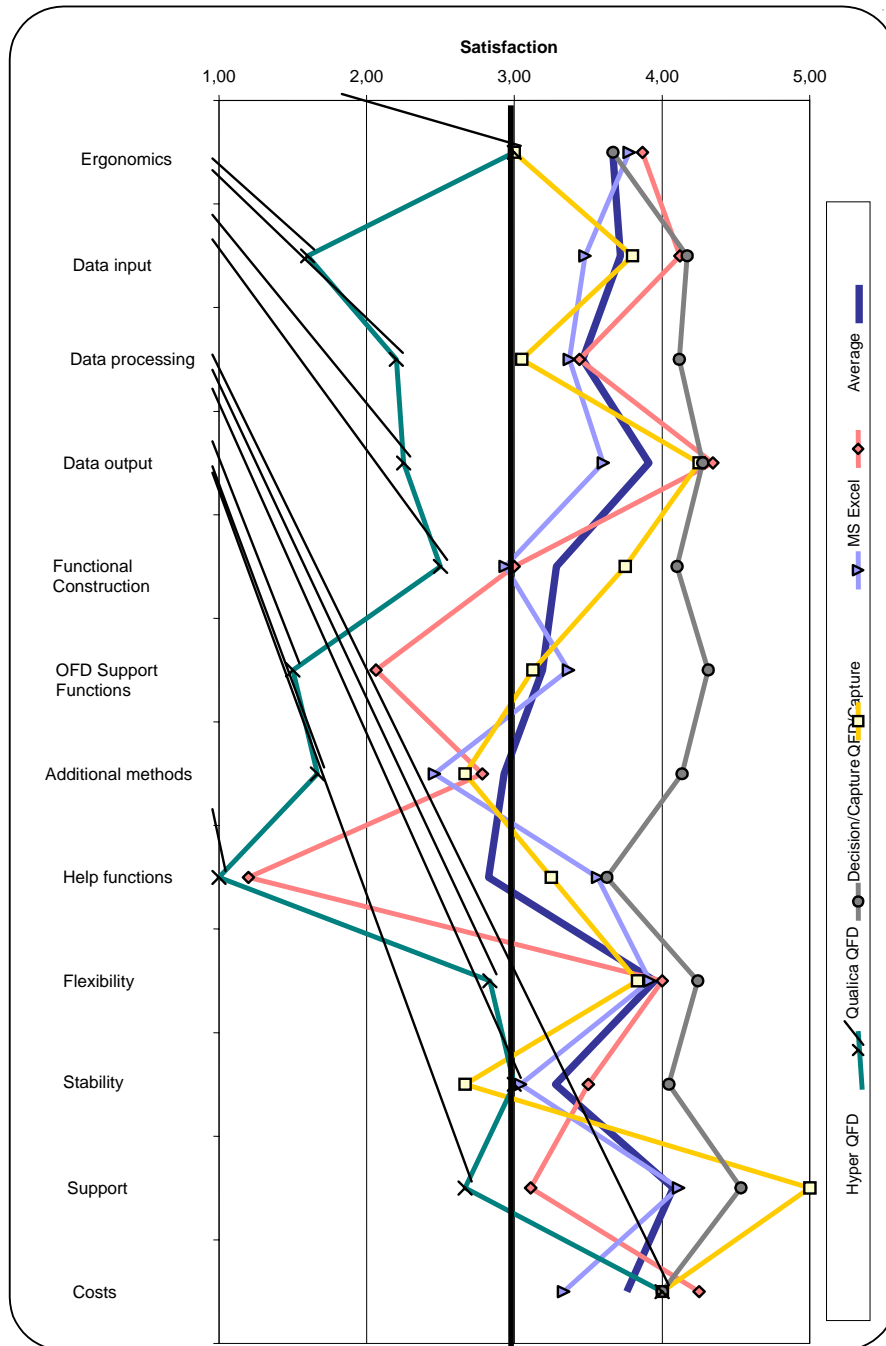


Illustration 4: Strength-Weakness-Profile

It is obvious that Qualica QFD fulfills eight request groups with the highest satisfaction; this applies to Excel in three and to Decision/Capture in one case. As expected Hyper QFD most frequently reaches the lowest satisfaction value (10 groups), followed by Decision/Capture (2) and QFD/Capture (1). Regarding the requirements "ergonomics" and

"data output" the customers are most satisfied with MS Excel, regarding " QFD supporting functions" and "stability" Qualica QFD wins on points. Hyper QFD is judged worst three times ('ergonomics', 'data output', 'QFD supporting functions') and Decision/Capture twice ('ergonomics', 'stability').. A large range of the values (73%) altogether lies between 3.0 and 5.0 within the neutral or positive area of the satisfaction scale.

With this polarity profile again gets clear, that the customers are quite satisfied with most features of the used QFD software tools. With the exception of Hyper QFD no product has more weak than strong features. This underlines the found out results of the customer satisfaction indices. In addition, it has to be point out that the majority of the products has judged negatively merely at four features ('multi-user mode', 'VoCA', 'automatic evaluations', and 'integration of additional methods').

#### **4.4 Conclusions**

The results of the research show that the customer satisfaction with the used QFD software tools is rare high. The predominant number of the users (72%) does not notice any performance deficits in using the software. On the other hand, a moderate or extreme discontent can be stated merely with 14% of the participants while another 14% of the statements are providing an indifferent satisfaction judgement. The average importance-satisfaction-portfolio of all customer statements points out that especially these product features that are considered as very important can fulfill the satisfaction values quite well. The product features 'automatic evaluations', 'multi-user mode' and 'undo functionality' do have clear deficits. The available 'help functions' are also judged negatively, but are not considered as of special importance. It should therefore be recommended to the manufacturers of QFD software to improve and to enlarge the available functionality to succeed in getting even more customer satisfaction.

In our opinion the manufacturers of software should pay special attention to the user convenience and to a higher flexibility as well. These are the essential features which drive any QFD user to despair if they do not work in the wanted way; so finally the user ends up in creating his own Excel solutions. For this kind of user, software has to be fast and simple in usage to prepare tables and matrices in which correlations between requirements and attributes can be determined, and the necessary indicators can be calculated. The construction of the matrices should be flexible due to changing requirements. These essential needs don't require the use of a commercial QFD tool. For these customers expensive automated analysis instruments or the application of further QM-proceedings are of minor importance.

Summarizing we can notice, that the available software is definitely suitable to support the QFD process. It permits the practitioner to concentrate himself on his essential work while recurring services can be automated. The customer ratings show that the different products are not identical, therefore completely interchangeable. It has to be checked thoroughly which kind of software the customer needs. It has to be find out, what kind of services should be supplied, what kind of supporting features are really needed. If the



actual differences aren't recognisable immediately, a decision maybe is made due to subjective impressions

## **5. Outlook**

The customer oriented evaluation leads to the positive result that the use of a software tool can support the work with Quality Function Deployment effectively.

The low questionnaire return was of some hindrance during the research and led partly to rather coincidental results. Reasons for that could be the size and contents of the second questionnaire. To specificate the valuation criteria the customer statements had to be translated in concrete requirements. Similar requirements were grouped and summarized. One shortcoming of the questionnaire was that the statements weren't separated clearly, what aggravated the judgment by the customer in individual cases. So basically the problem is to find a compromise from clear valuation criteria, a great request variety and a short questionnaire. That is definitely hard to translate into practice. In my view that questionnaire I am talking about is an acceptable compromise.

Some participants criticized the inclusion of questions about so-called base requirements (e.g. 'fall safety', 'data security'). But the inclusion resulted directly from the results of the survey of positive and negative experiences in dealing with QFD software tools. Negative experiences will lead to dissatisfaction even more so if security factors are involved. The consequence was to ask questions about these important basic features.

Finally I have to mention that many manufacturers (e.g. MBFG, Qualica and QualSoft) are currently working on new products or rather on further developments of already existing software. Consequence is that the results of our research could get obsolete very fast.

## 6. References

- [ASQ02] ASQ - AMERICAN SOCIETY FOR QUALITY (Hrsg.): *Quality Software : Software Showcase & Directory*. <http://www.asq.org/pub/qualityprogress/directories/0902/softwareDirectory01.html>, Download: 17.12.2002, September 2002
- [BoDö02] BORTZ, J.; DÖRING, N.: *Forschungsmethoden und Evaluation für Human- und Sozialwissenschaftler*. 3., überarb. Auflage. Berlin: Springer Verlag, 2002
- [Har<sup>+</sup>95] HARTUNG, J.; ELPELT, B.; KLÖSENER, K.-H.: *Statistik : Lehr- und Handbuch der angewandten Statistik*. 10., durchges. Auflage. München, Wien: Oldenbourg Verlag, 1995
- [HeHi96] HERZWURM, G.; HIERHOLZER, A.: *Kundenorientierung durch Software Customer Value Management (SCVM)*. In: HERZWURM, G. (Hrsg.); HIERHOLZER, A. (Hrsg.); MELLIS, W. (Hrsg.): *Kundenorientierte Softwareherstellung*. Lehrstuhl für Wirtschaftsinformatik, Systementwicklung; Universität zu Köln, 1996 (Studien zur Systementwicklung; Bd. 9), S. 1–77
- [Hein00] HEINRICH, L. J.: *Bedeutung von Evaluation und Evaluationsforschung in der Wirtschaftsinformatik*. In: HEINRICH, L. J. (Hrsg.); HÄNTSCHEL, I. (Hrsg.): *Evaluation und Evaluationsforschung in der Wirtschaftsinformatik*. München, Wien: Oldenbourg Verlag, 2000, S. 7–21
- [Her<sup>+</sup>97c] HERZWURM, G.; SCHOCKERT, S.; WEINBERGER, C.: *Kundenorientierte Evaluierung von Software-Tools zur Unterstützung von Quality Function Deployment*. In: MELLIS, W. (Hrsg.); HERZWURM, G. (Hrsg.); STELZER, D. (Hrsg.): *Studien zur Systementwicklung; Bd. 12*. Lehrstuhl für Wirtschaftsinformatik, Systementwicklung; Universität zu Köln, 1997
- [Her<sup>+</sup>00] HERZWURM, G.; SCHOCKERT, S.; MELLIS, W.: *Joint Requirements Engineering. QFD for Rapid Customer-Focused Software and Internet Development*. Braunschweig, Wiesbaden: Vieweg Verlag, 2000. – Vieweg Business Computing
- [Herz00] HERZWURM, G.: *Messung der Studierendenzufriedenheit*. In: HEINRICH, L. J. (Hrsg.); HÄNTSCHEL, I. (Hrsg.): *Evaluation und Evaluationsforschung in der Wirtschaftsinformatik*. München, Wien: Oldenbourg Verlag, 2000, S. 395–409
- [Jura91] JURAN, J. M.: *Handbuch der Qualitätsplanung*. 3., durchges. Auflage. Landsberg/Lech: Verlag Moderne Industrie, 1991
- [Kast95] KASTIN, K. S.: *Marktforschung mit einfachen Mitteln : Daten und Informationen beschaffen, auswerten und interpretieren*. München: Verlag C. H. Beck, 1995
- [LiSc91a] LINGENFELDER, M.; SCHNEIDER, W.: *Die Kundenzufriedenheit : Bedeutung, Meßkonzept und empirische Befunde*. In: *Marketing : Zeitschrift für Forschung und Praxis*, 13. Jg. (1991) Heft 2, S. 109–119
- [LiSc91b] LINGENFELDER, M.; SCHNEIDER, W.: *Die Zufriedenheit von Kunden - Ein Marketingziel?* In: *Marktforschung und Management : Zeitschrift für marktorientierte Unternehmenspolitik*, 35. Jg. (1991), 1. Quartal, S. 29–34

- [Meff92] MEFFERT, H.: *Marketingforschung und Käuferverhalten*. 2., vollst. überarb. und erw. Auflage. Wiesbaden: Gabler Verlag, 1992
- [OrRa96] ORLOWSKI, S.; RADTKE, P.: *Total Quality Deployment : Ein einfaches und praxisnahes Verfahren zur Erhöhung der Kundenzufriedenheit*. In: QZ - Qualität und Zuverlässigkeit : Qualitätsmanagement in Industrie und Dienstleistung, 41. Jg. (1996) Nr. 11, S. 1287–1291
- [PrKr00] PRAHALAD, C. K.; KRISHAN, M. S.: *So lässt sich Qualität bei Software bewerten*. In: Harvard Business Manager, (2000) Nr. 2, S. 48–57
- [QFD02] QFD INSTITUT DEUTSCHLAND (Hrsg.): *Marktübersicht von Software-Tools für QFD*. <http://www.qfd-id.de/werkzeuge/tools.html>, Download: 13.10.2002, August 2002
- [ScKi98] SCHARNBACHER, K.; KIEFER, G.: *Kundenzufriedenheit : Analyse, Meßbarkeit und Zertifizierung*. 2., unwes. veränd. Auflage. München, Wien: Oldenbourg Verlag, 1998
- [Wern98] WERNER, H.: *Merkmalsorientierte Verfahren zur Messung der Kundenzufriedenheit*. In: SIMON, H. (Hrsg.); HOMBURG, C. (Hrsg.): *Kundenzufriedenheit : Konzepte – Methoden – Erfahrungen*. 3., aktual. und erw. Auflage. Wiesbaden: Gabler Verlag, 1998, S. 145–164

### **About the Authors**

Prof. Dr. GEORG HERZWURM

is Chair of the Information Systems Department at Stuttgart University. He holds a Masters degree and a Ph. D. in Business Administration from the University of Cologne. The main research fields are development and application of standard software, software quality management, and customer-oriented software strategies. G. Herzwurm is founder and president of the QFD Institut Deutschland e. V., a non-profit organization aiming to improve knowledge, application, methodology and use of QFD in all areas of academics and industry. G. Herzwurm is recipient of the 2000 Akao Prize. He was awarded for out-standing contribution to the advancement of QFD.

STEFAN REISS

studied information systems at the Technical University Dresden. QFD software tool evaluation was the subject of his diploma theses.

SIXTEN SCHOCKERT

is researcher and lecturer at the Information Systems Department of Prof. Herzwurm at the University of Stuttgart. He holds a Masters Degree in Information Systems from the University of Cologne. Main research interests are Software Quality Management, customer-oriented software development and Requirements Engineering. Founder member of the QFD Institut Deutschland e. V.

Contact address:

University of Stuttgart, Department for Information Systems II, Breitscheidstr. 2c 70174 Stuttgart; Germany,

Tel.: +49(0)711/121-2384; Fax: +49(0)711/121-2388, Email: [georg@herzwurm.de](mailto:georg@herzwurm.de)