Customer Oriented Evaluation of QFD Software Tools

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Abstract

This paper describes the results of a customer oriented evaluation of QFD software tools.

More than 60 QFD practitioners have been asked about their requirements concerning software supporting the QFD process. The result is a list of 27 customer requirements. Considering these criteria a customer satisfaction questionnaire was developed. The QFD users were asked to fill out the questionnaire (importance of the requirements and customer satisfaction) for the software packages they are using.

Moreover the planning of QFD software tool product features by using QFD is presented. The result is a House of Quality of the "perfect" QFD software tool. These product features were used to evaluate the most important QFD software products.

1 Introduction

One typical misunderstanding of many QFD users is the reduction of the QFD methodology [1] to the House of Quality.[2] QFD means more than the House of Quality. There are many other tools (e. g. Voice of the Customer Table, affinity- and tree-diagrams, comparisons in pairs, importance-satisfaction-portfolios, Pareto-analyses, etc.) for analyzing customer needs and satisfaction, gathering and examining market information, etc.[3] Therefore QFD software tools have to support more than the House of Quality as well.

Basically there are two possible ways to evaluate QFD software tools.

- From the Customer's point of view

  One manner to judge QFD software tools is by asking the customers about their requirements and their satisfaction with the actually releases of the products they are using. The "best" tool is that with the most satisfied customers.

  This method, however, has one substantial disadvantage: A meaningful survey must include a statistical representative sample of the customers. Besides these kind of examination is very expensive and time consuming.

- From the Expert's point of view

  A considerable reduction of expenditure would result from comparing the relevant QFD software packages with the product features of a "perfect" QFD tool, instead of applying the method described above.

  The handicap of this approach is that probably the QFD tools will be judged by criteria that rather represent the view of the "experts" than the needs of the customers.[4]

Considering these problems in this project both methods for evaluating QFD software tools are linked together by utilizing QFD as an approach for a customer oriented planning of the "perfect" QFD tool. The House of Quality is used as a framework for integration both perspectives, the customer's and the expert's.

2 Customer Satisfaction Survey

The customer satisfaction survey consists of two questionings. In the first phase more than 60 German QFD practitioners (members of the German non-profit organisation QFD Institut Deutschland, which is comparable with the QFD Institute in the USA) have been asked about their requirements concerning software supporting the QFD process. The result was a list of 27 customer requirements. Considering these criteria a customer satisfaction questionnaire was developed. The QFD users were asked to fill out the questionnaire (importance of the requirements and customer satisfaction) for the QFD tools they are using. The quote of returns took about 40 %, so that 26 questionnaires got into the examination.

In the second phase the questionnaire was published via the Internet. Even people who aren't using any QFD software tool were invited to assess the requirements. We received 34 usable answers.

2.1 Customer Requirements

As mentioned above, the persons were at first asked about their requirements. Additionally, they had to report their reasons for stating these needs. The experience shows that if one asks customers directly about valid requirements, these people find that very difficult. Therefore another method, namely the Critical Incident Technique (CIT) [5] 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 directly stated by the customers, 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 customer originates in the process of assimilating and storing some concrete incidents taking place during the use of the software (e. g. the positive experience with a very easily accessible user-interface, or the negative experience of computer crashes which caused the loss of the daily work). CIT, being a qualitative method, aims at the registration of customer experiences during software application. Experiences of that kind display very clearly which aspects of software features are important to a customer, and by that indicates possible criteria for the assessment of software products. 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 software tools.

Every person was asked to list five positive and negative experiences each that they encountered during the use of a QFD software tool. The over 200 received statements were focused to 27 customer requirements, which were categorized and summarized to have eleven criteria of assessment:

1. Ergonomics The QFD software tool is easy to use and easy to learn.	7. Interpretation Graphical interpretations as well as a "What if when"-Function are supported.
2. Individual adaptability It is possible to adapt the QFD software tool to my personal needs.	8. Utilization of QFD-Data Results can be re-used, for example as experience values, and they can be checked for consistency.
3. Work with several users The QFD software tool is able to administer several users so that they can all use it at the same time.	9. Integration of other methods Support of methods, such as comparison in pairs, Conjoint Analysis, etc.
4. Data exchange with other programs It is possible to exchange data with other programs, such as Microsoft Excel.	10. Support for the introduction of QFD Video and/or Multimedia support is available for the training of the participants in a QFD project.
5. Administration of QFD-Data The relevant data can be documented and structured, for example in tree-diagrams.	11. Support by supplier Supplier’s consultation, training, reaction to complaints, etc.
6. Visualization on screen and printer.	

Fig. 2-1: Customer requirements categories for QFD software tools

Some patterns for assessment are judged as more important than others by either customers or non-customers, who aren’t using any commercial QFD software tool at all. Because of this a query was done on the level of importance of every criterion (Fig. 2-2). As a result the greatest differences between customers and non-customers lie in the both most important customer requirements categories "data exchange with other programs" and "ergonomics" as well as the category "individual adaptability". That may point to reasons, why non-customers don’t use a commercial QFD software product at all. One has to take into account that probably some people don’t buy QFD tools, seeing that no product meets their requirements.

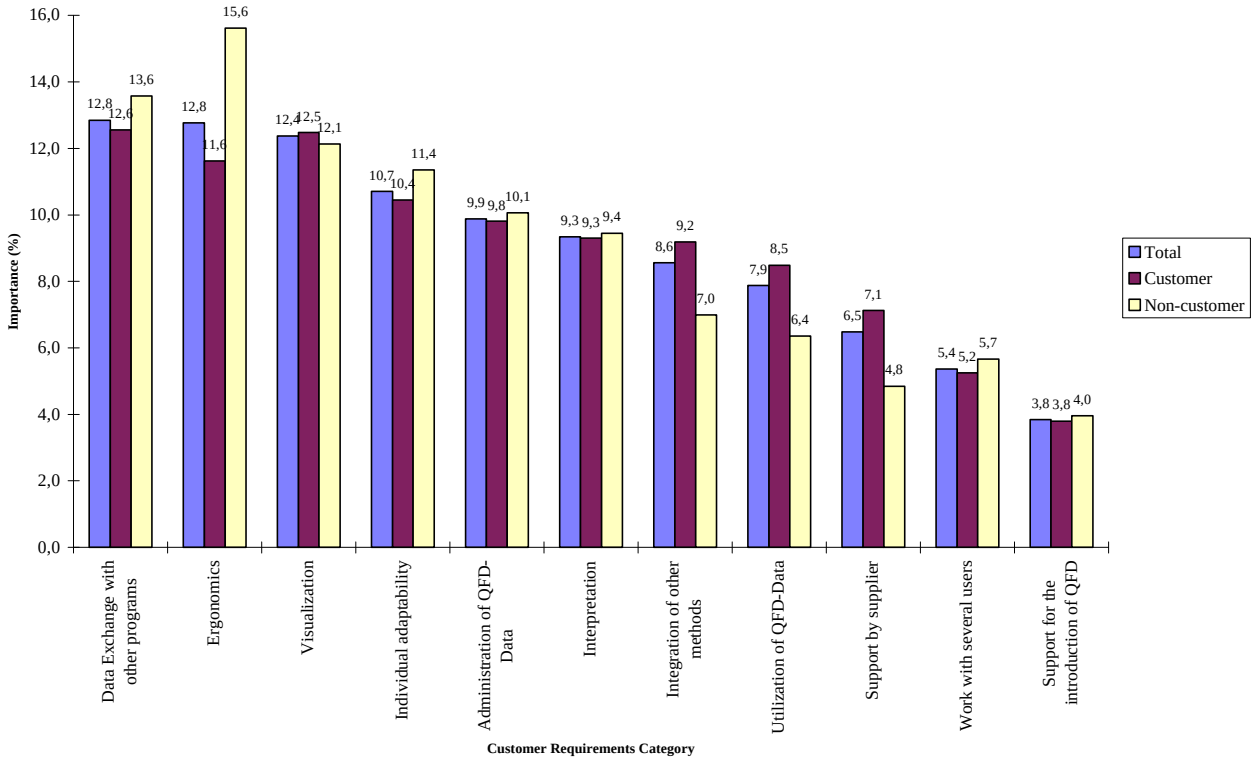

Fig. 2-2: Importance of customer requirements for QFD software tools

2.2 Customer Satisfaction

The requirements were the base for the customer satisfaction questionnaire. The first parts (A - C) asked for some personal data, the kind of QFD software tool the customer uses and his satisfaction with the product as a whole. Then, in part D, we requested them to weight the eleven assessment criteria listed above. The people had to distribute 33 points among the eleven assessment criteria.

In part E we asked in detail the customer's satisfaction with the product they are using, concerning the criteria they assessed in part D. They simply had to mark with a cross their degree of assent to every single statement. Here it was essential, that the customer's answers are based on real experience with a software package. This is even valid for part F, where we asked again for critical incidents concerning the customer's experiences with a QFD software tool in order to continuously improve the questionnaire.

Fig. 2-3 shows an excerpt from the customer satisfaction questionnaire (part E).

E. Assessing your Satisfaction

	Satisfaction
How satisfied are you with the performance of the Software-Tool concerning the following subjects? In the following, you will find statements that refer to the criteria you assessed on page 2. Some statements are similar. In this way we ensure to get your point of view correctly.	Please mark with a cross to what extent you do agree or do not agree with the statements listed below. ☹ 😐 ☺ complete rejection ⟷ complete consent

1. The Software-Tool is easy to handle.					
2. The Software-Tool can be learned quickly.					
3. Calculations can be defined without restrictions.					
4. The procedure of the QFD-method can be determined individually.					
5. The possibilities to model the matrices meet my expectations.					
6. Working with several users is supported adequately.					
7. Data from other programs can be imported easily.					
8. Data can be exported easily to other programs.					
9. All data can be managed easily.					
10. The Data may be structured easily. (e.g. Tree-diagrams)					
11. The print-out meets my expectations.					
12. The presentation on the screen meets my demands.					
13. There are good facilities of graphical interpretation of data.					
14. A "What-if-when"-function has been realized well.					
15. There are sufficient facilities to check the results. (for example for consistency)					
16. (Partial) results can be re-used easily.					
17. Further methods are integrated sufficiently.					
18. The support during the introduction of QFD meets my demands.					
19. The supplier provides a good quality of service.					

Fig. 2-3: Excerpt from the customer satisfaction questionnaire

As an overview Fig. 2-4 includes some QFD software tools offered at the German (and international) market.

QFD Software Tool	Provider	Price
QFD/Capture 3.1 Supplier: International TechneGroup Incorporated	International TechneGroup Incorporated 5303 DuPont Circle Milford, Ohio 45150 USA Tel.: +1-513-576-3900 Fax.: +1-513-576-3394	2.000 DM + tax.
HyperQFD 1.4.10 Supplier: Qualica Software GmbH	Qualica Software GmbH Frankfurter Ring 193a 80807 München Germany Tel.: ++49-89-3236960-3 Fax.: ++49-89-3236960-5	2.950 DM + tax.
QFD Designer 3.15 Supplier: Qualisoft	Qualisoft 4652 Patrick Road West Bloomfield, MI. 48322 USA Tel.: +1-810-6452561 Fax.: +1-810-6452561	970 US $
QFD DesignerQS Supplier: QS Software	American Supplier Institute (ASI) Tel.: +1-313-336-8877 Fax.: +1-313-336-3187	975 US $
org-master QFD Supplier: BFZ	MBFG GmbH Eutighofer Str. 120/1 73525 Schwäbisch Gemünd Germany Tel.: ++49-7171-69957	798 DM + MwSt.
QFD work Supplier: Total Quality Software	Ian Ferguson Associates Crest House 7 Highfield Road Edgbaston Birmingham B15 3ED Great Britain Tel.: +44-021-4405790 Fax.: +44-021-4550324	375 engl. £
QFD Guide Supplier: International TechneGroup Incorporated	International TechneGroup Incorporated 5303 DuPont Circle Milford, Ohio 45150 USA Tel.: +1-513-576-3900 Fax.: +1-513-576-3394	

"Special Tool"	Provider	Price
Microsoft Excel	Microsoft GmbH Edisonstrasse 1 85716 Unterschleissheim Germany Tel.: ++49-180-5251199 Fax.: ++49-8931761000	500 DM

Fig. 2-4: Overview of QFD software tools

We received customer satisfaction questionnaires for the following tools: Hyper QFD, QFD Capture, and QFD Designer. Many practitioners are using their own Microsoft Excel spreadsheet for supporting the QFD method. Therefore we handle Excel like a "special" QFD tool. The fact that many QFD users develop their own software solutions may be an indication for remarkable weaknesses of the tools offered at the market.). Fig. 2-5 exhibits the distribution of the 60 received customer satisfaction questionnaires among QFD software tools.

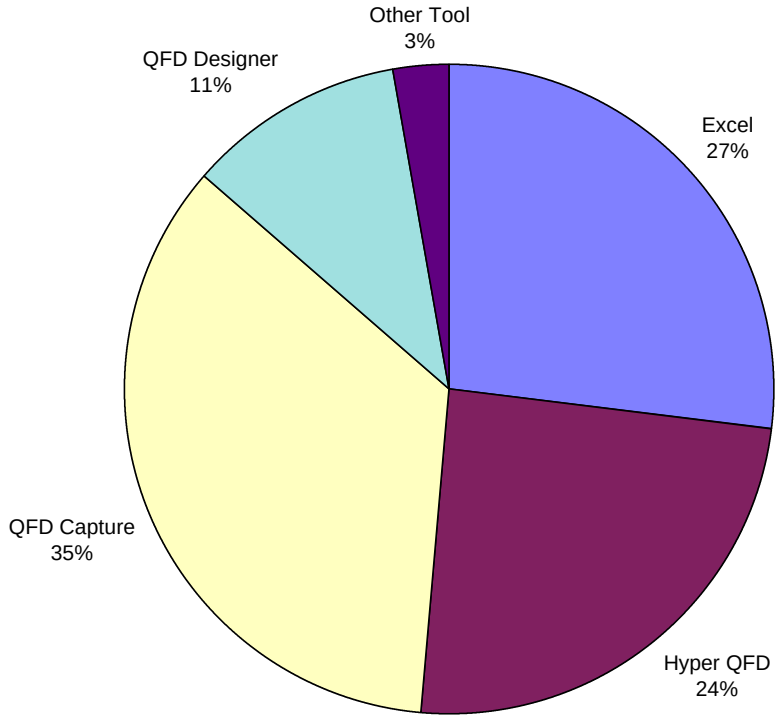

Fig. 2-5: Distribution of received customer satisfaction questionnaires among QFD software tools

For each tool we calculate a customer satisfaction index between 0 (totally dissatisfied) and 100 (totally satisfied):

Customer Satisfaction Index (CSI) for criteria C_i and weight $W_i = \sum_{i=1}^{I} (W_i * C_i)$

One has to take into consideration that the Excel users had to assess their own applications. That may be a reason why Excel is voted for the best QFD tool. The German QFD software package Hyper QFD is ranked highest (51,7) of all commercial QFD products. The index of customer satisfaction for the worst QFD software tool is 34,8 (QFD Designer) while it increases to 66,4 (Excel) for the best. Fig. 2-6 makes clear that there are no significant differences between the various participating countries.

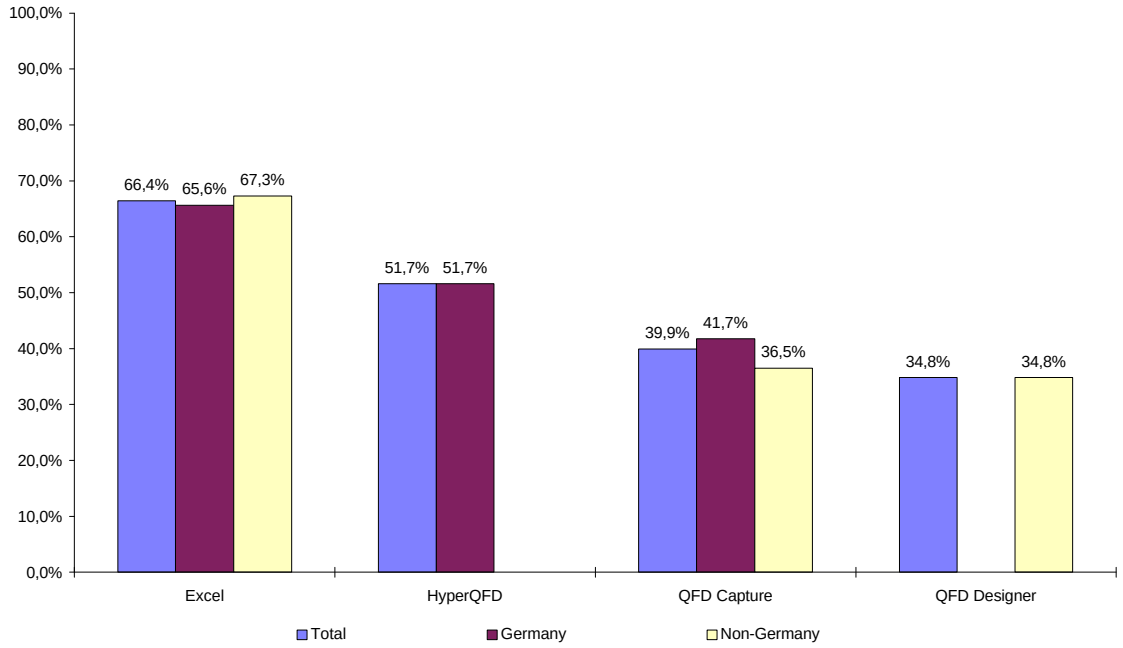

Fig. 2-6: Customer satisfaction indexes for QFD software tools

Fig. 2-7 shows a portfolio for the three best voted QFD tools. The abscissa contains the satisfaction values, the ordinate indicates the requirements importances. In comparison with QFD Capture and Hyper QFD Excel users are more satisfied with the most important requirement categories.

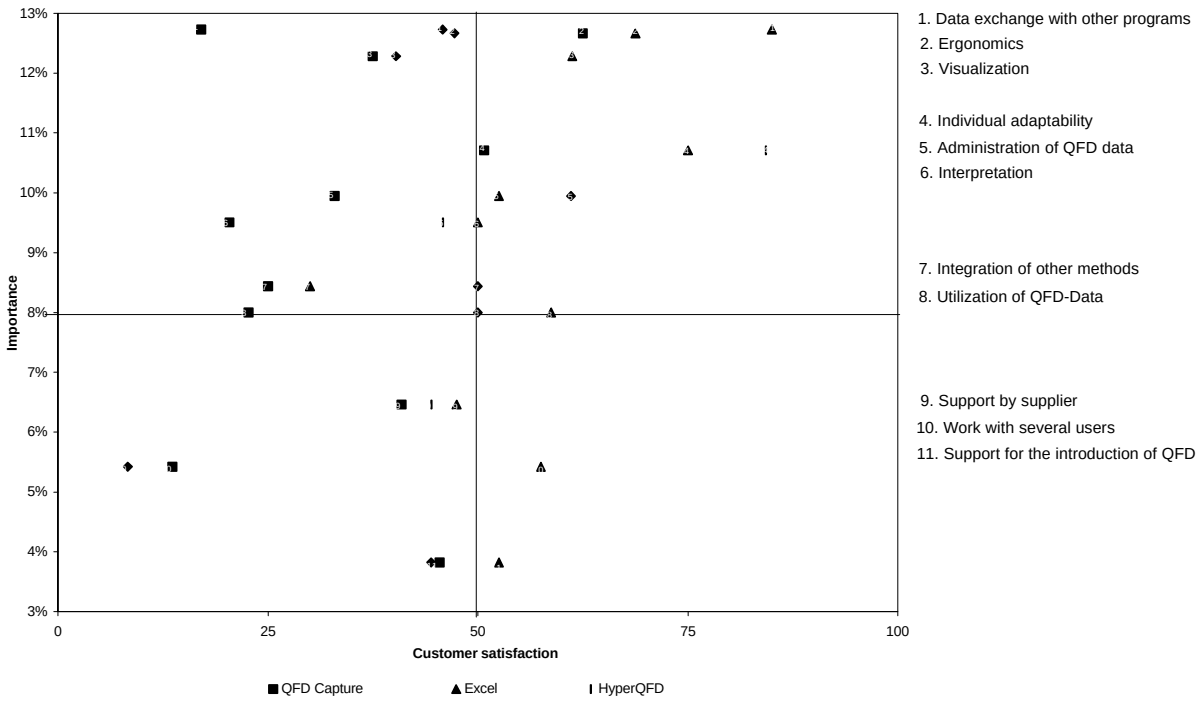

Fig. 2-7: Importance-satisfaction-portfolio for QFD software tools

Fig. 2-8 leads to the same conclusions. The category "data exchange with other programs" causes the main differences between the investigated tools.

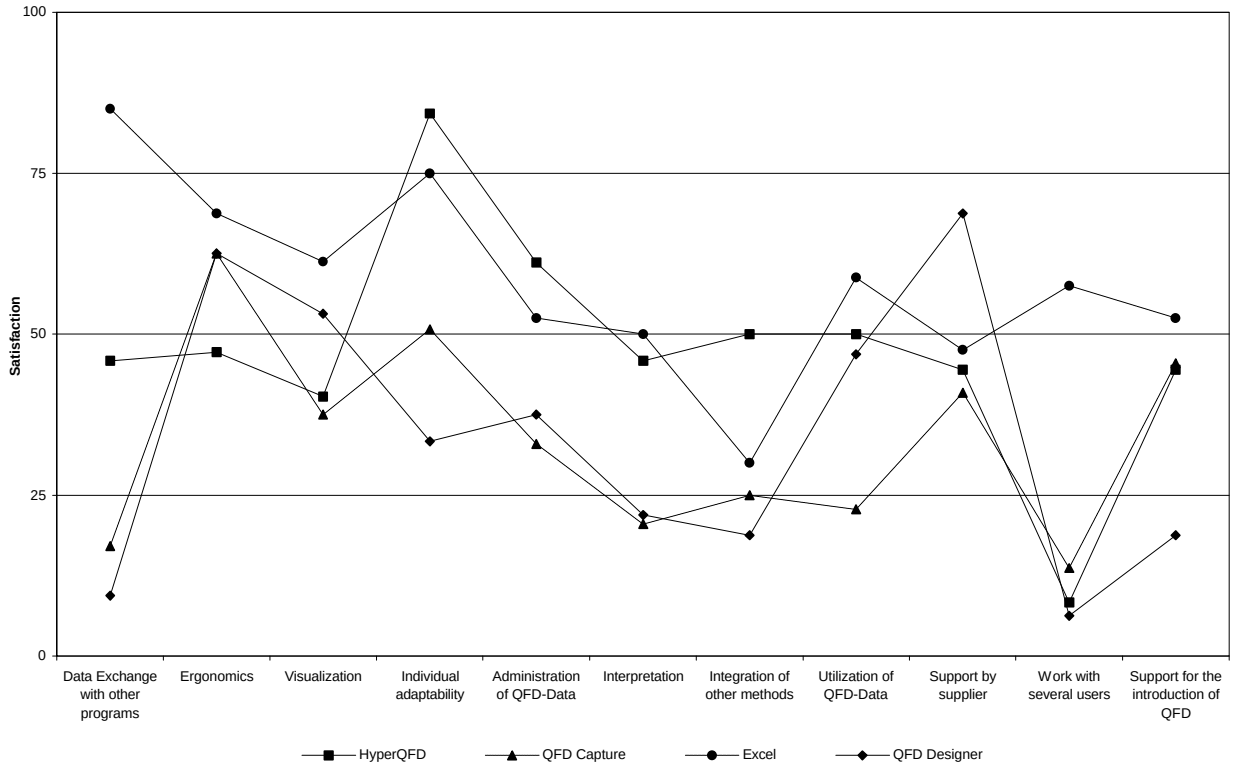

Fig. 2-8: Customer satisfaction for each requirement category

3 Planning a QFD Software Tool with QFD

3.1 Product Features

The product features of the "perfect" QFD software tool were derived by analyzing the capabilities of the commercial software packages. In order to focus the view of the expert evaluation to the customer needs the results of the customer survey were used as well. Because the customer satisfaction survey showed the current weaknesses of the QFD software tools the authors determined additional ideas for product characteristics to meet customer needs.

Fig. 3-1 illustrates the 71 derived product features of the "perfect" QFD tool categorized into 15 groups.

Presentation	**Project management**
View as HoQ, tree structure, matrix	Administration of user rights
Overall view of a project (roadmap)	Administration of project appointments and participants' data
Show/hide matrix elements, list elements, etc.	Management of versions and variants (scenario definition)
Display statistics about matrix elements	Assessment of conflict with shared access
Support of matrix-view with simultaneous overall view	**Table in general**
Administration of windows according to Windows standards	Insert, copy and delete elements
Printing	Adjust appearance of rows/columns
Supporting Color-Printer	Copy/insert column definition
Printing Overall View of the Project and of all Elements	**Adjustment of table column**
Printing across several pages (folding- and cutting points)	Determine the value range and/or the weighting factor of the column
Support of printers, plotters, projectors (slide)	Adjust column to value range
Adjusting choice of matrixes and matrix elements as well as adapting outlook	Determine calculation (calculation path, free choice of functions, separation of negative and positive values)
Help	**Matrix-specific functions**
Context sensitive help function	Adjust view of triangle-matrices with regard to direction of optimization
Assistant ("wizard") for basic functions	Support of matrix sequences
Video-projector-support	Divide up a matrix into partial matrices
Multimedia support	**Graphical objects**
Input of data	Copy graphic to clipboard and save
Structuring list elements with help of tree- and/or affinity diagrams	Print the graphic
Insert values directly into the House of Quality	Select data of any matrix for single axes
Insert values via symbols or entry fields on window border	Adjust appearance of a graphic (axe scales, element selection, zoom, grid, legend)
Note on every relation and element possible and visible	**Templates**
Spelling check	Templates for projects or partial results respectively
Deleting complete contents of matrixes	Templates for reports
Multiple step undo and re-undo function	**Analysis**
Link between elements (hyper links)	Check for empty rows/columns
Defining write protection for any element	Check percentage of filled amount
Sorting data according to any criteria you like considering the hierarchy	Check for conflicts
Data exchange with other programs	Graphical emphasis
Drawing up Reports for every Element possible (Support of Standard-Text-Functions)	**Support**
Data exchange via ASCII and with spreadsheets	Training (offer)
Adjusting choice of matrixes and matrix-elements as well as adapting outlook	Hotline (offer)
Generation of HTML files	Project support (offer)
Embedding external documents (DDE and OLE)	Usergroups (offer)
Settings	**Methods**
Adjusting structure and presentation of reports	Metaplan-Method (group working)
Adjusting font type, font size, font color, zoom factor, etc. of the screen display	Analytical Hierarchy Process (AHP)
Possibility to switch automatic calculation on/off	Comparison in pairs
Starting calculation on an eligible point of entrance	Benchmarking
Abort function for screen display and calculation	Target Costing
Possibility to switch automatic saving on/off	Conjoint Analysis
Possibility to adjust symbols of every matrix according to number, look, value (also negative one) and comment	TRIZ (Theory of Inventive Problem Solving)

Fig. 3-1: Product features of the "perfect" QFD software tool

3.2 Performance Index

Applying the QFD approach the correlation analysis was carried out as well as the calculation of the importance for each product feature. The actual performance of each QFD software tool concerning each product feature was assessed using a five degree scale from totally missed to fully implemented. The importance of the product feature was used as a weighting factor for the actual performance value. Corresponding to the customer satisfaction index a product performance index for each tool was calculated (0 worst value, 100 best value).

Product Performance Index (PPI) for product feature P_i and product feature importance $I_i = \sum_{i=1}^{I} (P_i * I_i)$

Fig. 3-2 confirms the results of the customer survey. The ranking concerning the product performance index is similar to the ranking concerning the customer satisfaction index (see Fig. 2-3), although the lead of Excel decreases a little.

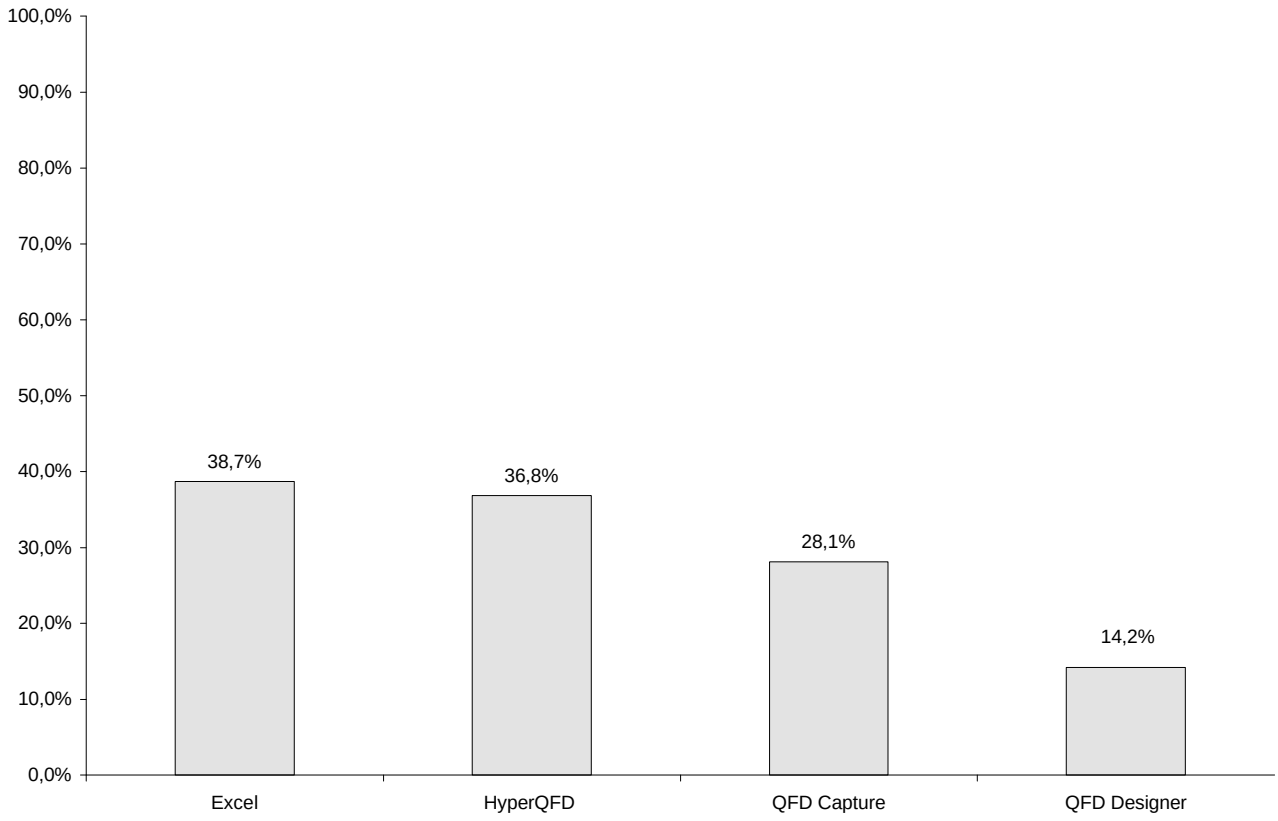

Fig. 3-2: Product Performance Index for QFD software tool

Fig. 3-3 shows an excerpt of the House of Quality (including the 20 most important product features) for the "perfect" QFD software tool and the suitability assessment for each investigated commercial QFD tool.

		Support of matrix sequences	Divide up a matrix into partial matrices	Data exchange via ASCII and with spreadsheets	Structuring list elements with help of tree- and/or affinity diagrams	Determine calculation (calculation path, free choice of functions, separation of negative and positive values)	Drawing up Reports for every Element possible (Support of Standard-Text-Functions)	Overall view of a project (roadmap)	Adjusting font type, font size, font color, zoom factor, etc. of the screen display	Embedding external documents (DDE and OLE)	Adjusting choice of matrixes and matrix-elements as well as adapting outlook	View as HoQ, tree structure, matrix	Sorting data according to any criteria you like considering the hierarchy	Management of versions and variants (scenario definition)	Metaplan-Method (group working)	Support of matrix-view with simultaneous overall view	Adjust appearance of a graphic (axe scales, element selection, zoom, grid, legend)	Templates for projects or partial results respectively	Show/hide matrix elements, list elements, etc.	Templates for reports	Printing across several pages (folding- and cutting points)	Total	Normalized Row Sum
Data Exchange with other programs	*12,73%*			9						9	5											23	5,3%
Ergonomics	*12,66%*	5	3		1	3	1	3	3		1	3	3		3	7	3	5	3	5	5	57	13,0%
Visualization	*12,28%*	7	5		5		5	9	7		3	9	3		3	9	5		7		7	84	19,2%
Individual adaptability	*10,71%*	9	7	3		9	1	3	9	1	9		3	1			3	3	5	3	1	70	16,0%
Administration of QFD-Data	*9,95%*	9	7	5	9	5	3	3		1		3	7	7	5			3	1			68	15,5%
Interpretation	*9,51%*	3	3	5	5	5	9			3		3	3	7			7		1	3	3	60	13,7%
Integration of other methods	*8,44%*			3	5					3					9							20	4,6%
Utilization of QFD-Data	*8,00%*	9	9	3		1	3	1		3				5				9		9		52	11,9%
Support by supplier	*6,46%*																					0	0,0%
Work with several users	*5,42%*													3								3	0,7%
Support for the introduction of QFD	*3,82%*							1														1	0,2%
Total		42	34	28	25	23	22	20	19	20	18	18	19	23	20	16	18	20	17	20	16		
Raw Weight		4,4	3,4	2,9	2,5	2,4	2,2	2,2	2,2	2,1	2,1	2,1	2,1	2,0	2,0	2,0	2,0	2,0	2,0	2,0	1,9		
Normalized Raw Weight		10,35%	8,18%	6,96%	6,01%	5,69%	5,32%	5,28%	5,23%	5,06%	4,97%	4,91%	4,87%	4,82%	4,76%	4,73%	4,70%	4,68%	4,68%	4,65%	4,48%		
perfect' Product		41,4	32,7	27,9	24,1	22,8	21,3	21,1	20,9	20,2	19,9	19,6	19,5	19,3	19,0	18,9	18,8	18,7	18,7	18,6	17,9		
Excel		2	2	5	1	5	1	1	4	4	3	2	2	1	1	1	5	3	2	1	3		
Product Performance Index		10,3	8,2	27,9	0,0	22,8	0,0	0,0	15,7	15,2	9,9	4,9	4,9	0,0	0,0	0,0	18,8	9,4	4,7	0,0	9,0	161,5	36,6%
HyperQFD		5	1	3	1	4	3	5	2	1	4	2	1	1	1	1	3	3	2	1	2		
Product Performance Index		41,4	0,0	13,9	0,0	17,1	10,6	21,1	5,2	0,0	14,9	4,9	0,0	0,0	0,0	0,0	9,4	9,4	4,7	0,0	4,5	157,1	35,6%
QFD Capture		5	1	1	1	3	1	5	3	2	2	4	4	1	1	1	1	4	4	1	2		
Product Performance Index		41,4	0,0	0,0	0,0	11,4	0,0	21,1	10,5	5,1	5,0	14,7	14,6	0,0	0,0	0,0	0,0	14,1	14,0	0,0	4,5	156,3	35,4%
QFD Designer		1	1	4	1	1	1	1	2	1	1	2	1	1	1	1	1	4	2	1	1		
Product Performance Index		0,0	0,0	20,9	0,0	0,0	0,0	0,0	5,2	0,0	0,0	4,9	0,0	0,0	0,0	0,0	0,0	14,1	4,7	0,0	0,0	49,8	11,3%

Fig. 3-3: Excerpt from the House of Quality for the "perfect" QFD software tool

Interpreting the House of Quality in fig. 3-3 one should take into account that the values for the product performance index are based on the 20 most important product features *only*. It becomes clear that regarding these most substantial product features the differences between the QFD tools, including Excel, aren't significant. Taken all in all both judges, the customer's and the expert's, are more negative than positive.

4 Conclusion

The described approach to customer oriented QFD tool evaluation does not provide a scientific proof for the quality of the QFD software packages, but it surely is a fundamental advance compared to a more or less "instinctive" determination. The results give valuable indications about the suitability of QFD tools, even if the results are not representative in terms of statistics.

After appropriate modifications this method of tool assessment might be suitable for application to other software tools as well, e. g. computer aided software engineering tools.

The results of the QFD tool evaluation show that there is no omnipotent tool for solving all problems of QFD software support. Nevertheless it is evident that a QFD tool can improve the productivity of a QFD team. It allows the team members to concentrate on the essential QFD activities but on documentation and calculation. Therefore any tool might be better than no tool. But one still has to note that *people* and the appropriate application of QFD itself are the most important success factors of a QFD project [6]: A fool with a tool still remains a fool only his foolishness is automated!

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Biography of the Authors

Dr. Georg Herzwurm, Prof. Dr. Werner Mellis, Sixten Schockert and Claudius Weinberger, researchers and lecturers at the chair of Business Computing, University of Cologne, member of the QFD Institut Deutschland, manager of several projects in cooperation with industry about computer aided software engineering and software quality management, fields of research: strategies for software companies, customer-oriented software development, particularly Software Quality Function Deployment.