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Aligning Culture and Business Strategy

Identifying and refocusing the organization's cultural DNA

Assessing readiness for new strategic directions

Tackling transformative cultural change effectively

When an organization's culture is built on a foundation of customer focus, quality function deployment becomes a strategic tool for ensuring alignment of products and services.

Quality Function Deployment

Voice of Customer Meets Voice of Process

Glenn H. Mazur

W. Edwards Deming is widely credited with planting the seeds of statistical process quality control in Japan. The Japanese, as willing learners, carried forward his use of data-driven management into broader company-wide applications.[1] One of these applications, quality function deployment (QFD), applies Deming's quality principles (see "Deming's 14 Points" in the online supplement to this article) to the field of new product development. The goal of QFD is to uncover positive quality that will excite the customer, and then to ensure the quality of all downstream activities in design, manufacturing, service, etc.

Fundamentals of QFD

Traditional approaches to ensuring quality typically focus on solving problems within the work process, whether it is manufacturing, service, or software. Consistency and an absence of problems, however, are often insufficient to create lasting value for the customer, especially when customers are more demanding. With traditional quality approaches, the best we can get is nothing wrong—but is this good enough? In addition to eliminating negative quality, we must also maximize positive quality throughout the organization. This creates value, which leads to customer satisfaction.

QFD is a comprehensive quality system aimed specifically at satisfying the customer. It concentrates on maximizing customer satisfaction (positive quality) by seeking out both spoken and unspoken needs, translating these into actions and designs, and communicating these throughout the organization (see "QFD Aligns Development Efforts to Ensure Value to Customer" in the online supplement). Further, QFD allows customers to prioritize their requirements and benchmark us against our competitors, and then directs us to optimize those aspects of our product, process, and organization that will bring the greatest competitive advantage.

Most projects cannot afford to apply limited financial, time, and human

resources to low-priority issues. With budgets, time, and personnel always limited, QFD helps the organization get its biggest bang for the buck by enabling a data-driven approach to allocating constrained resources. Priorities can be derived using psychologically friendly judgments that can be transformed, based on sound mathematical principles, into proportioned weights that can be used to calculate money, man hours, and staff.

The underlying principles are as follows:

- Voice of the customer analysis helps identify critical stakeholders and their most important needs.
- Cause and effect help clarify the complex relationships between different levels of design.
- Prioritization facilitates compromise by limiting the scope of the issues, assembling relevant data, and building a defensible argument of the conclusions.

Voice of the Customer

Early QFD was primarily concerned with end-to-end alignment of requirements in the production side of the organization. As internal business processes improved, QFD began to look upstream at where the requirements came from and where improvements could be made. As a result, QFD encouraged marketing and sales input, traditionally the most customer oriented. In recent years, QFD has devised numerous tools to bring this fuzzy front end into clearer focus. The problem is exacerbated when customers are not always able to articulate what outcome they want, and instead attempt to demand what features the product itself should have. Successful product developers know that just doing what the customer asks is not sufficient, and that by analyzing the stated "voice" they can understand the underlying outcomes and needs. Modern QFD has several new tools to aid this analysis. These tools are engineer-friendly in that they help parse complex customer problems into discreet elements that can be analyzed more easily.

Cause and Effect

QFD models the cause-and-effect relationships of customer needs (effect) and design issues (cause). This is especially useful in trying to understand true customer needs that underlie customer words and behavior. Cause and effect also help explain the relationships among product characteristics, process characteristics, and material properties. By parsing complex problems into groupings like customer needs, design characteristics, manufacturing and process characteristics, material properties, etc., and showing their cause-and-effect relationships, technical people can analyze the nature of the design intent and how to achieve it.

Prioritization

The analytic hierarchy process (AHP) is used by customers to prioritize their needs, which are then deployed through various levels of design, build, and service to identify critical-to-quality actions and measures to ensure the needs are fulfilled. Matrices, like the house of quality, and tables are often utilized.

Tools of Modern QFD

Early QFD models from the 1960s used cause-and-effect analysis diagrams (Ishikawa or fishbone diagrams) to map customer needs into critical-to-quality characteristics[2] (see "Cause-and-Effect Analysis Applied to Positive Outcomes—Customer Needs" in the online supplement). The concept was that if the causes of negative outcomes could be diagrammed, couldn't the design elements that contribute to positive outcomes, such as customer needs, be identified in the same way?

In some instances, the simple fishbone diagram is replaced with a more comprehensive series of matrices, the first of which came to be called the house of quality, due to its various "rooms" or attached tables, as illustrated in Table 1.

In some applications, the house of quality grew to as many as 1,000 customer needs and 1,000 technical characteristics, taking two years to complete, and this was only the first of several subsequent matrices necessary to deploy down to manufacturing and production parameters. Today's businesses rarely have the time and staff to complete such a comprehensive analysis. This constraint led to the development of a more streamlined approach called Blitz QFD®, as shown in Figure 1.

In this modern approach, the house of quality and the downstream matrices are optional, "heavy artillery" to be deployed only when deeper analyses are required. Other issues with traditional QFD have also been addressed in the Blitz QFD including filtering customer needs out of other voice-of-customer statements and using AHP to correct math problems resulting from improper use of ordinal scale numbers.

The key to Blitz QFD is limiting scope. Only a small number of customer needs are analyzed end to end

Table 1: Traditional House of Quality Matrix for Umbrella

Technical classifications / Customer needs	Size	Number of ribs	Weight	Material dry time	Importance rating	Our current product	Tote	Burberrys	Plan	Improvement ratio	Sales point	Absolute weight	Customer need weight
Fashionable	○ 75	Δ 25			3	2	1	4	4	2.00		6	25
I stay	⊙ 468	○ 156		○ 52	5	3	2	5	5	1.67	1.5	12.5	52
A child can use easily	⊙ 36	○ 4	⊙ 36		1	2	1	3	2	1.00		1	4
Stores easily	⊙ 171	○ 57		○ 57	3	2	1	3	3	1.50		5	19
Absolute weight	750	242	36	109									
Technical char. wt.	67	21											
Current product	90	6											
Tote	80	6											
Burberrys	110	8	450	20									
Design target	100	8	225	2[illegible]									
Unit of measure	Dia (cm)	#	g	min									

Legend	
⊙	9
○	3
Δ	1

1. Business and marketing strategy
2. Customer satisfaction
3. Competitive benchmarking
4. Strong casual correlation
5. Multiple correlations summed
6. Technical benchmarking

Figure 1: Blitz QFD Flowchart

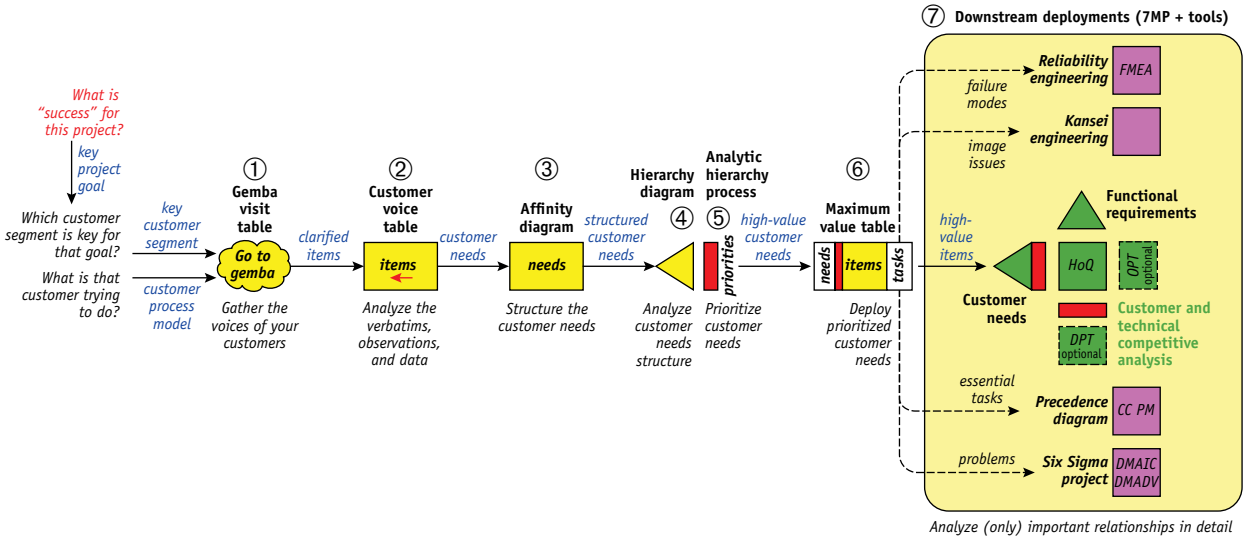
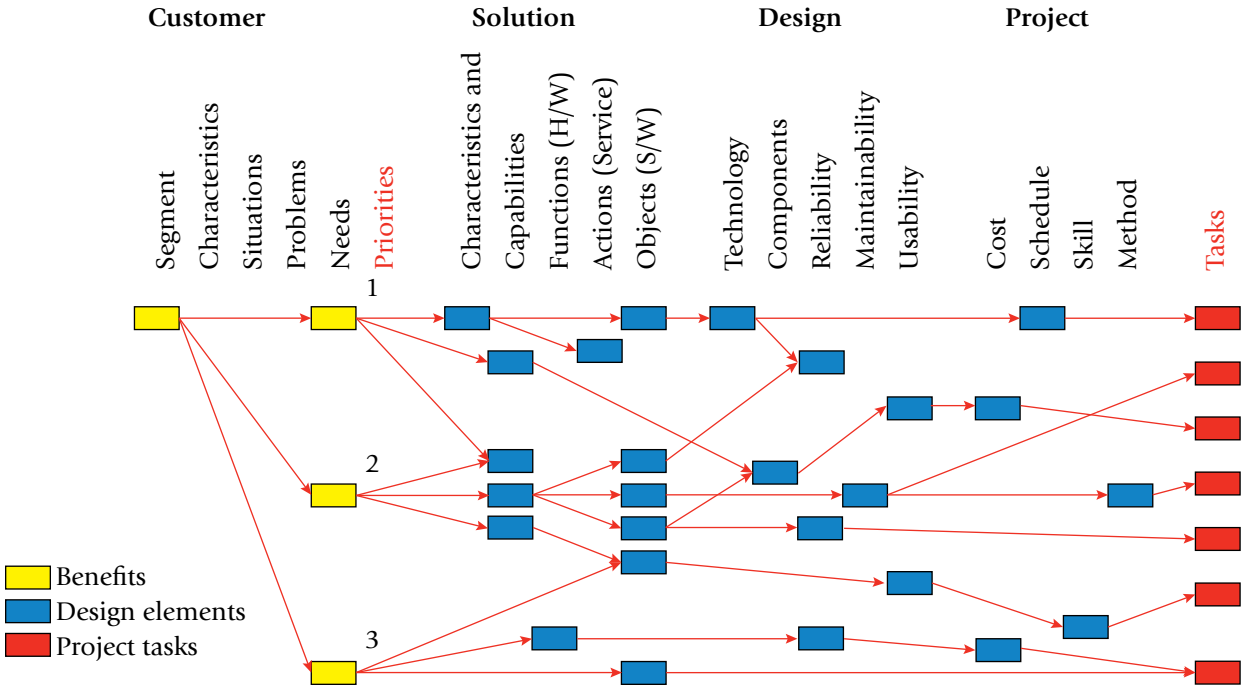


Table 2: Maximum Value Table Links Voice of Customer to Voice of Process (Step 6)



across the organization, while in the house of quality and downstream matrices, hundreds of needs are analyzed. Instead, only the key data are included in a single analytic tool, the maximum value table, shown in step 6 in Figure 1. Table 2 illustrates the conceptual framework of the maximum value table, and it is here that the voice of the customer (translated into needs) meets the voice of the process (solution, design, and project requirements).

Analyzing the Voice of the Customer

The key to narrowing the scope of the QFD process is to focus on a small number of customer needs. The problem is that customers do not always provide clear statements of need; instead they interleave them in their minds with wants and wishes for product features, and then talk to us about those features (see "Customers Interleave Problems, Needs, and Features" in the online supplement). That is because customers are untrained at giving requirements; they have no tools or techniques to fully explore their requirements.

Fortunately, we don't have to completely fulfill all the customer's requirements to satisfy them. To understand why this is the case, we must realize three things:

- The relative effect on customer satisfaction of meeting certain types of requirements
- The relative importance of the customer's requirements
- What requirements are—and how they are different from needs and features

In QFD we take a very different approach to exploring and then engineering the requirements. We ask customers to define "value" by telling us or demonstrating important problems they face that prevent them from achieving their personal or business goals, by identifying opportunities they cannot currently seize, and by revealing things that make them look good to others or feel good about themselves. These become the starting point for further analysis. For example, problems (negative statements of what is wrong or what needs to be changed) can be reworded into positive needs or benefits (what to change to). On the other hand, opportunities and image issues that are usually already positively stated can be reworded into needs or benefits.

Remember, customer problems are not the same as complaints or problems with the product. Customer opportunities are not the same as product features or solutions. Regardless of how the customer expresses himself, his words or behavior must be analyzed for greater breadth and depth of meaning. Don't stop with customer comments—they

Table 3: Customer Voice Table for Health Insurance Provider

Problems	Customer needs	Characteristics and capabilities	Functions	Reliability	Technology	Information	Communications
"Attract and retain key employees"	I can hire best new college graduates						
	I can attract best employees from competitors						
	My employees know exactly what they are entitled to		Publish coverage	Employees feel cheated			"Health plans are easy to understand"

can express the same to our competitors. Advantage belongs to those who make the effort to go beyond the obvious. We must learn both what the customers are saying and why they are saying it. Even if the customer is wrong, it is our responsibility to find out what they really need. Caveat emptor has become caveat vendor.

We should define customer needs as the positive restatement of customer problems, opportunities, or image issues independent of the product or solution. All other requirements, features, specifications, and technical issues are sorted and translated in the customer voice table as shown in Table 3. The example here is from an American health insurance provider, Blue Cross Blue Shield of Florida (now Florida Blue), trying to develop new products to meet the needs of small to medium enterprises (SME).[3]

Verbatim customer comments are in quotations, and include a customer problem statement, such as "Attract and retain key employees" and a product attribute, such as, "Health plans are easy to understand." Following the arrows, we see that the QFD team translated "attract and retain key employees" into customer need statements of "I can hire the best new college graduates" and "I can attract best employees from competitors." "Health plans are easy to understand" is a product attribute because it is the health plan that is easy to understand, not the customer that is easy to understand. The QFD team saw this as a communication issue to prevent a failure mode of "employees feel cheated." This requires that the insurance company perform the function of "publish coverage" in a way that is clear and complete, so that "employees know exactly what they are entitled to."

This analysis is similar to a fishbone diagram where the columns to the right represent the various bones and sub-bones, and the customer needs are the heads. The analogy can be carried further as there is a causal correlation between the bones and the head, with the bones being independent X variables over which the insurance company has control, and the heads being dependent Y variables, which are the outcomes of a well-designed product. In Design for Six Sigma, this is called the Y=f(X) transfer function.[4] Steps 3-5 in the Blitz QFD flowchart in Figure 1 then have the customers prioritize their needs, and the key needs are deployed in the maximum value table shown in Table 2. Then, if more detailed analyses are required, the house of quality and other tools would be deployed (step 7).

The customer voice table is thus the modern QFD tool used to translate any customer input into customer needs, which are then prioritized and deployed into solutions and quality assurance activities by a cross-functional team. These various tools are linked in an end-to-end system that can be replicated across different market segments, product lines, and product generations. They are also useful in predicting the effects of quality decisions on customer satisfaction and competitiveness. It can be used to document product and technical knowledge and aid in the training of new employees as well.

Conclusion

Deming's teachings were transformed by the Japanese to carry the quality message to all operations in an organization. When applied to new product development, they called it QFD. As business conditions have changed, QFD has adapted to become faster and more customer focused. The Blitz QFD approach uses several new tools to understand

how to design new products and services that address key customer needs. In the global Internet economy of the 21st century, customers have more choice than ever, and success will come to those businesses that make the effort to understand their customers, regardless of where they are located.

References

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4. Charles Huber and Glenn Mazur, "QFD and Design for Six Sigma," *Transactions of the 14th Symposium on QFD*, 2002, QFD Institute.

More Online

To view an additional table and figures associated with this article, see the supplemental information at **www.asq.org/pub/jqp**.

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Glenn H. Mazur has been active in QFD since its inception in North America, and has worked extensively with the founders of QFD on their teaching and consulting visits outside Japan. He is a leader in the application of QFD to service industries and consumer products, conducts advanced QFD research, and is the conference chair for the annual North American Symposium on Quality Function Deployment. Mazur is the executive director of the QFD Institute and International Council for QFD, adjunct lecturer on TQM at the University of Michigan College of Engineering (ret.), president of Japan Business Consultants Ltd., and is a Senior member of ASQ and the Japanese Society for Quality Control (JSQC). He is a certified QFD Red Belt® (highest level), one of two in North America. He is a certified QFD-Architekt #A21907 by QFD Institut Deutschland. He is covenor of the ISO working group writing ISO 16355 for QFD, and an academician in the International Academy for Quality. Additional papers and related topics can be found at **www.mazur.net**.

Supplemental Figures for Quality Function Deployment

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The following table and figures provide additional information to support the concepts presented in the print article.

Table 1: Deming's 14 Points

1. Create constancy of purpose for the improvement of product or service.
2. Adopt the new philosophy.
3. Cease dependence on inspection to achieve quality.
4. End the practice of awarding business on the basis of price tag alone. Instead, minimize total cost by working with a single supplier.
5. Improve constantly and forever every process for planning, production, and service.
6. Institute training on the job.
7. Adopt and institute leadership.
8. Drive out fear.
9. Break down barriers between staff areas.
10. Eliminate slogans, exhortations, and targets for the workforce.
11. Eliminate numerical quotas for the workforce and numerical goals for management.
12. Remove barriers that rob people of pride of workmanship. Eliminate the annual rating or merit system.
13. Institute a vigorous program of education and self-improvement for everyone.
14. Put everybody in the company to work to accomplish the transformation.

Figure 1: QFD Aligns Development Efforts to Ensure Value to Customer

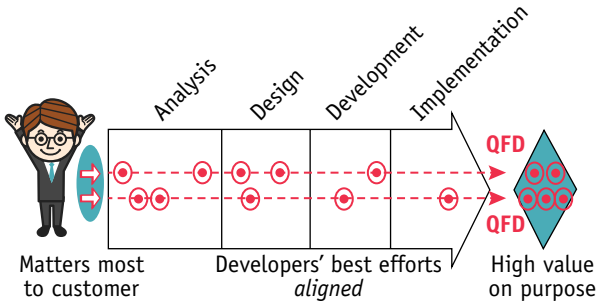

Figure 2: Cause-and-Effect Analysis Applied to Positive Outcomes—Customer Needs

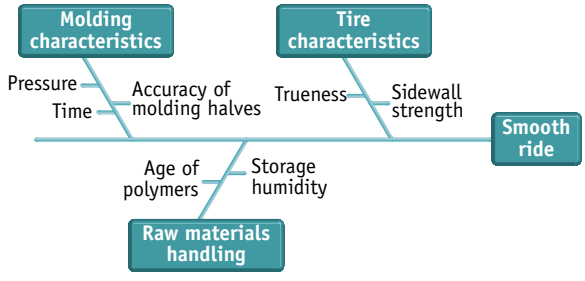
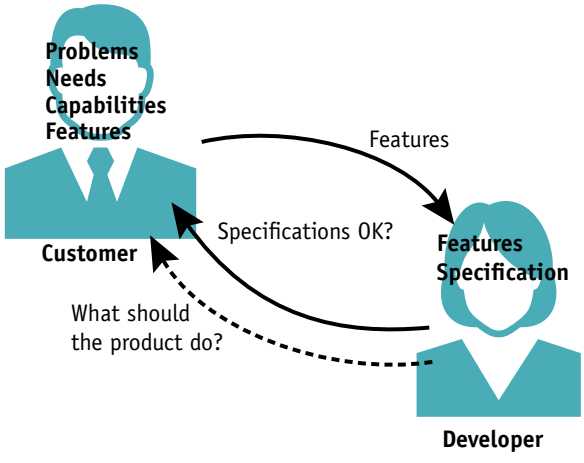
Figure 3: Customers Interleave Problems, Needs, and Features