Jennifer Tapke
Allyson Muller
Greg Johnson
Josh Sieck

House of Quality

Steps in Understanding the House of Quality

House of Quality

Steps in Understanding the House of Quality

Introduction

Every successful company has always used data and information to help in its planning processes. In planning a new product, engineers have always examined the manufacturing and performance history of the current product. They look at field test data, comparing their product to that of their competitor's product. They examine any customer satisfaction information that might happen to be available. Unfortunately, much of this information is often incomplete. It is frequently examined as individual data, without comparison to other data that may support or contradict it.

By contrast, Quality Function Deployment (QFD) uses a matrix format to capture a number of issues that are vital to the planning process. The House of Quality Matrix is the most recognized and widely used form of this method. It translates customer requirements, based on marketing research and benchmarking data, into an appropriate number of engineering targets to be met by a new product design. Basically, it is the nerve center and the engine that drives the entire QFD process. According to Hauser and Clausing, it is "a kind of conceptual map that provides the means for interfunctional planning and communication."

There are many different forms of the House of Quality, but its ability to be adapted to the requirements of a particular problem make it a very strong and reliable system to use. Its general format is made up of six major components. These include customer requirements, technical requirements, a planning matrix, an interrelationship matrix, a technical correlation matrix, and a technical priorities/benchmarks and targets section.

The Voice of the Customers

The initial steps in forming the House of Quality include determining, clarifying, and specifying the customers' needs. These steps lay the foundation for a clearly defined venture and will ensure a project or process is well thought out prior to any further development.

Clarifying Customer Needs

Customers buy benefits and producers offer features. This seems like a relatively simple notion, however, unless customers and producers are perfectly in tune with one another, it may be very difficult to anticipate these features, or each underlying benefit from each producer. It is of utter importance to translate the wishes of each and every customer into some tangible values that can be turned into engineering specifications. Some of theses features include but are not limited to:

• Parts	• Costs	• Functions
• Quality Character& Reliability	• Processes	• Tasks

• Figure 1: Examples of Customer Needs

Specifying the Customer Needs

After determining what items are most important to the customer, organizations must translate them into particulate specifications. Nothing can be produced, serviced or maintained without detailed specifications or some set of given standards. Each aspect of the desired item must be clearly defined: Measurements must be defined, heights specified , torques stated, and weights targeted.

These values can be derived from several locations. Organizations can use known data from market research, or conduct new studies to gather necessary information. In any event, the needs, which were clarified and then explicitly stated, should be satisfied to the best of that organization's ability.

Technical Requirements

The next step of the QFD process is identifying what the customer wants and what must be achieved to satisfy these wants. In addition, regulatory standards and requirements dictated by management must be identified.   Once all requirements are identified it is important to answer what must be done to the product design to fulfill the necessary requirements. Figure 2 explains how to use a requirement chart to help the design process.

Requirements	What
A list of requirements from customers, management and regulatory standards	An expanded list of what needs to be done to the product to fulfill the requirements

- Figure 2. Requirement Chart

Planning Matrix

The next step in the QFD process is forming a planning matrix. The main purpose of the planning matrix is to compare how well the team met the customer requirements compared to its competitors. The planning matrix shows the weighted importance of each requirement that the team and its competitors are attempting to fulfill. Customer ratings, typically ranging from 1 to 5, are given to each company under each requirement. The customer ratings are combined with the weighted performance of each demand to produce an overall performance measure for the companies. The planning matrix is a part of the "House of Quality" matrix.

Interrelationship Matrix

The main function of the interrelationship matrix is to establish a connection between the customer's product requirements and the performance measures designed to improve the product. The first step in constructing this matrix involves obtaining the opinions of the consumers as far as what they need and require from a specific product. These views are drawn from the planning matrix and placed on the left side of the interrelationship matrix.

With this customer overview, the company can begin to formulate a strategy to improve their product. In doing this, the strengths and weaknesses of the company are weighted against the customer priorities to determine what aspects need to be changed to surpass the competition, what aspects need to change to equal the competition, and what aspects will be left unchanged. The optimal combination is desired.

Knowing what improvements need to be made allows the list of performance measures to be generated and displayed across the top of the interrelationship matrix. By definition, a performance measure is a technical measure evaluating the product's performance of a demanded quality (Terninco). In other words, the company must take the voice of the customer and translate it into engineering terms. The matrix will have at least one performance measure for each demanded quality.

After setting up the basic matrix, it is necessary to assign relationships between the customer requirements and the performance measures. These relationships are portrayed by symbols indicating a strong relationship, a medium relationship, or a weak relationship. The symbols in turn are assigned respective indexes such as 9-3-1, 4-2-1, or 5-3-1. When no relationship is evident between a pair a zero value is always assigned. The interrelationship matrix should follow the Pareto Principle keeping in mind that designing to the critical 20% will satisfy 80% of the customer desires (Terninco). Therefore, there should not be a significant number of strong relationships between pairs.

Technical Correlation Matrix

Performance measures in existing designs often conflict with each other. The technical correlation matrix, which is more often referred to as the Roof, is used to aid in developing relationships between customer requirements and product requirements and identifies where these units must work together otherwise they will be in a design conflict. The following symbols are used to represent what type of impact each requirement has on the other.

- 🖹   - Strong positive
- 🖂   - Positive
- **x**   - Negative
- **xx**   - Strong negative

These symbols are then entered into the cells where a correlation has been identified. The objective is to highlight any requirements that might be in conflict with each other.

Any cell identified with a high correlation is a strong signal to the team, and especially to the engineers, that significant communication and coordination are a must if any changes are going to be made. If there is a negative or strongly negative impact between requirements, the design must be compromised unless the negative impact can be designed out. Some conflicts can't be resolved because they are an issue of physics. Others can be design-related, which leaves it up to the team to decide how to resolve them. Negative impacts can also represent constraints, which may be bi-directional. As a result, improving one of them may actually cause a negative impact to the other. Sometimes an identified change impairs so many others that it is just simply better to leave it alone. According to Step-By-Step QFD by John Terninko, asking the following question when working with this part of the House of Quality helps to clarify the relationships among requirements: "If technical requirement X is improved, will it help or hinder technical requirement Z?"

Many technical requirements are related to each other so working to improve one may help a related requirement and a positive or beneficial effect can result. On the other hand, working to improve one requirement may negatively affect a related requirement as mentioned above. One of the principal benefits of the Roof is that it flags these negative relationships so they can be resolved. If these issues aren't settled satisfactorily, some aspects of the final product will dissatisfy the customer.

Technical Properties & Targets

The technical properties matrix uses specific items to record the priorities assigned to technical requirements. It also provides a technical performance achieved by competitive products and the degree of difficulty in developing each requirement. The final output of the matrix is a set of target values for each technical requirement to be met by the new design. In some cases, organizations are not able to create the most optimum design because of constraints related to cost, technology, or other related items.

Setting Design Targets & Benchmarks

The customer requirements are distributed across the relationships to the quality characteristics. This gives an organization prioritized quality characteristics. High priority quality characteristics usually indicate that working on this technical issue will deliver great value to the customer. A high quality characteristic weight indicates strong relationships with high priority demanded quality items.

An organization's current products can be benchmarked technically with competitors' products on the high priority quality characteristics. In many cases, organizations should not be surprised to learn that competitors are better at a given task or characteristic. QFD assists organizations to identify technical areas and to develop areas where they can achieve the most cost effective customer satisfaction. Organizations can then examine the Customer Context for usage concerns that must be accounted for, and set design target specifications for our quality characteristics. At a minimum, current performance standards should be maintained.

Conclusion

The House of Quality functions as a living document and a source of ready reference for related products and future upgrades. While it is a great communication tool at each step in the process, the matrices are the means and not the end. Its purpose is to serve as a vehicle for dialogue to strengthen vertical and horizontal communications.

Through customer needs and competitive analysis, the House of Quality helps to identify the critical technical components that require change. Issues are addressed that may never have surfaced before. These critical issues are then driven through the other matrices to identify the critical parts, manufacturing operations, and quality control measures needed to produce a product that fulfills both customer needs and producer needs within a shorter development cycle time.

The net effect of all of this is that the items that drive the company's actions are driven by the customer's requirements. There is an increased focus on the customer and an increased awareness of their wants. Because of this focus, the process leads to improved customer understanding and the ultimate outcome – a satisfied customer.
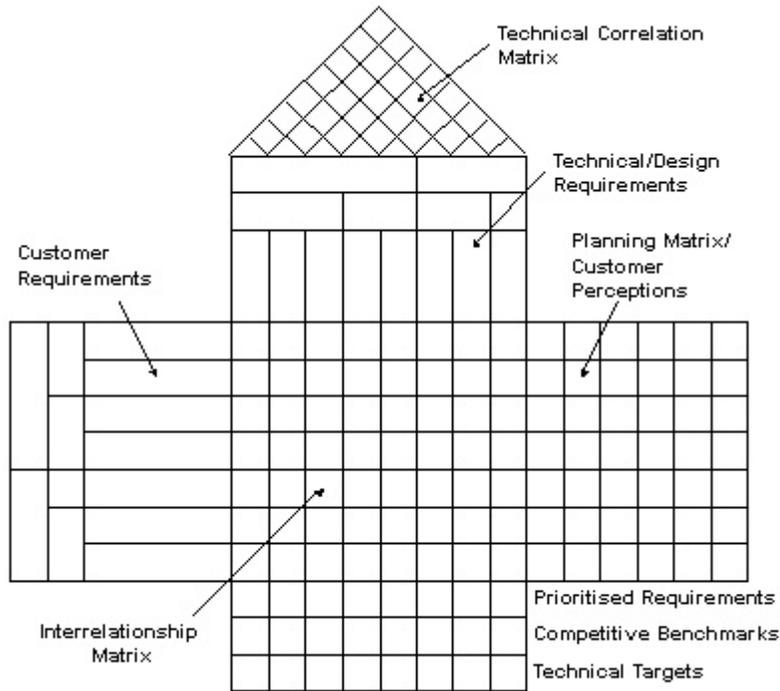
Appendix

Figure 3: House of Quality

References

Terninko, John; Step-by-Step QFD Customer Driven Product Design; Second Edition, St. Lucie Press, 1997.

Shillito, Larry M.; Advanced QFD Linking Technology to Market and Company Needs; John Wiley & Sons, Inc.; 1994.

Day, Ronald G.; Quality Function Deployment-Linking a Company with its Customers; ASQC Quality Press; 1993.

http://www.shef.ac.uk/~ibberson/QFD-IntroIII.html

http://www.soce.org/papers/crow-qfd/crow-qfd.htm

http://www.proactdev.com/pages/ehoq.htm