THE HOUSE OF QUALITY

Digital Equipment, Hewlet Packard, AT&T, and ITT are getting started with it. Ford and General Motors use it - at Ford alone there are more than 50 applications. The "house of quality", the basic design tool of the management approach known as quality function deployment (QFD) originated in 1972 at Mitsubishi's Kobe shipyard site. Toyota and its suppliers then developed it in numerous ways. The house of quality has been used successfully by manufacturers of consumer electronics, home appliances, clothing. integrated circuits, and agricultural engines. Designers use it for services, retail outlets and even for planning apartment layouts.

A set of planning and communication routines, quality function deployment focuses and coordinates skills within an organization, first to design, then to manufacture and market goods that customers want to purchase and will continue to purchase. The foundation of the house of quality is the belief that products should be designed to reflect customer's desires and tastes - so marketing people, design engineers, and manufacturing staff must work closely together from the time a product is first conceived.

The house of quality is a kind of conceptual map that provides the means for interfunctional planning and communications. People with different problems and responsibilities can thrash out design priorities while referring to patterns of evidence on the house's grid.

There are many dimensions to what a consumer means by quality and it is a major challenge to design products that satisfy all of these at once. Strategic quality management means more than avoiding repairs for consumers. It means that companies learn from customer experience and reconcile what they want with what engineers can reasonably build.

Before the industrial revolution, producers were close to their customers. Marketing, engineering, and manufacturing were integrated - in the same individual. If a knight wanted armor, he talked directly to the armorer, who translated the knight's desires into a product. The two might discuss the material - plate rather than chain armor - and details like fluted surfaces for greater bending strength. Then the armorer would design the production process. For strength - who knows why? - he cooled the steel plates in the urine of a black goat. As for a production plan, he arose with the cock's crow to light the forge fire so that it would be hot enough by midday.

Today's fiefdoms are mainly inside corporations. Marketing people have their domain, engineers theirs. Customer surveys will find their way onto designer's desks, and R & D plans reach manufacturing engineers. But usually, managerial functions remain disconnected, producing a costly and demoralizing environment in which product quality and the quality of the production process itself suffer.

Top executives are learning that the use of interfunctional teams benefits design. But if top management could get marketing, designing, and manufacturing executives to sit down together, what should they talk about? How could they get their meeting off the ground? This is where the house of quality comes in.

Consider the location of an emergency brake lever in one American sporty car. Placing it on the left between the seat and the door solved an engineering problem. But it also guaranteed that women in skirts could not get in and out gracefully. Even if the system were to last a lifetime, would it satisfy customers?

Today, with marketing techniques so much more sophisticated than ever before, companies can measure, track, and compare customer's perceptions of products with remarkable accuracy; all companies have opportunities to compete on quality. And costs certainly justify an emphasis on quality design. By looking first at customers needs, then designing across corporate functions, manufacturers can reduce prelaunch time and after-launch tinkering.

There is nothing mysterious about the house of quality. There is nothing particularly difficult about it either, but it does require some effort to get used to its conventions. Eventually one's eye can bounce knowingly around the house as it would over a roadmap. We have seen some applications that started with more than 100 customer requirements and more than 130 engineering considerations.

What do customers want? The house of quality begins with the customer, whose requirements are called customer attributes (CAs) - phrases customers use to describe products and product characteristics. A typical application would have 30 to 100 CAs. A car door is "easy to close" or "stays open on a hill", "doesn't leak rain" or allows "no road noise". Some companies simply place their products in public areas and encourage potential customers to examine them, while design team members listen and note what people say. Usually, however, more formal market research is called for via focus groups, in-depth qualitative interviews, and other techniques.

CAs are often grouped into bundles of attributes that represent an overall customer concern like "open-close" or "isolation". Usually the project team groups CAs by consensus, but some companies are experimenting with state-of-the-art research techniques that derive groupings directly from customers' responses (and avoid arguments in team meetings).

CAs are generally reproduced in the customers' own words. Experienced users of the house of quality try to preserve customers' phrases and even clichés - knowing that they will be translated simultaneously by product planners, design engineers, manufacturing engineers, and salespeople. Of course, this raises the problem of interpretation: What does a customer really mean by "quiet" or "easy"? Still, designers' words and inferences may correspond even less to customers' actual views

and can therefore mislead teams into tackling problems customers consider unimportant.

Not all customers are end users, by the way. CAs can include the demands of regulators, the needs of retailers, the requirements of vendors, and so forth.

Are all preferences equally important? Imagine a good door, one that is easy to close and has power windows that operate quickly. There is a problem, however. Rapid operation calls for a big motor, which makes the door heavier and, possibly, harder to close. Sometimes a creative solution can be found that satisfies all needs. Usually, however, designers have to trade off one benefit against another.

To bring the customer's voice to such deliberations, house of quality measures the relative importance to the customer of all CAs. Weightings are based on team member's direct experience with customers or on surveys. Some innovative businesses are using statistical techniques that allow customers to state their preferences with respect to existing and hypothetical products. Other companies use "revealed preference techniques," which judge consumer tastes by their actions as well as their words - an approach that is more expensive and difficult to perform but yields more accurate answers. (Consumers say that avoiding sugar in cereals is important, but do their actions reflect their claims?)

Weightings are displayed in the house next to each CA - usually in terms of a percentage, a complete list totaling 100%.

Will delivering perceived needs yield a competitive advantage? Companies that want to match or exceed their competition must first know where they stand relative to it. So on the right side of the house, opposite the CAs, we list the customers evaluations of competitive products matched to our own.

Ideally, these evaluations are based on scientific surveys of customers. If various customer segments evaluate products differently - luxury vs economy car buyers, for example - product planning team members get assessments for each segment.

Comparison with the competition, of course, can identify opportunities for improvement. Take our car door for example. With respect to "stays open on a hill," every car is weak, so we could gain an advantage here. But if we looked at "no road noise" for the same automobiles, we would see that we already have an advantage, which is important to maintain.

How can we change the product? The marketing domain tells us what to do, the engineering domain tells us how to do it. Now we need to describe the product in the language of the engineer. Along the top of the house of quality, the design team lists those engineering characteristics (ECs) that are likely to affect one or more of the customer attributes. If a standard engineering characteristic affects no CA, it may be

redundant to the EC list on the house, or the team may have missed a customer attribute. A CA unaffected by any engineering characteristic, on the other hand, presents opportunities to expand a car's physical properties.

Any EC may affect more than one CA. The resistance of the door seal affects "easy to close" as well as "doesn't leak rain".

Engineering characteristics should describe the product in measurable terms and should directly affect customer perceptions. The weight of the door will be felt by the customer and is therefore a relevant EC. By contrast, the thickness of the sheet metal is a part characteristic that the customer is unlikely to perceive directly. It affects customers only by influencing the weight of the door and other engineering characteristics, like "resistance to deformation in a crash."

In many projects, the interfunctional team begins with the CAs and generates measurable characteristics for each, like foot-pounds of energy required to close the door. Teams should avoid ambiguity in interpretation of ECs or hasty justification of current quality control measurement practices. This is a time for systematic, patient analysis of each characteristic, for brainstorming. Vagueness will eventually yield indifference to things customers need. Characteristics that are trivial will make the team lose sight of the overall design and stifle creativity.

How much do engineers influence customer-perceived qualities? The interfunctional team now fills in the body of the house, the "relationship matrix", indicating how much each engineering characteristic affects each customer attribute. The teams seeks consensus on these evaluations, basing them on expert engineering experience, customer responses, and tabulated data from statistical studies or controlled experiments.

The team uses numbers or symbols to establish the strength of these relationships. Once the team has identified the voice of the customer and linked it to engineering characteristics, it adds objective measures at the bottom of the house beneath the ECs to which they pertain. When objective measures are known, the team can eventually move to establish target values - ideal new measures for each EC in a redesigned product. If the team did it's homework when it first identified the ECs, tests to measure benchmark values should be easy to complete. Engineers determine the relevant units of measurement - foot-pounds, decibels, etc.

Incidentally, if customer evaluations of CAs do not correspond to objective measure of related ECs - if, for example, the door requiring the least energy to open is perceived as "hardest to open" - then perhaps the measures are faulty or the car is suffering from an image problem that is skewing consumer perceptions.

How does one engineering change affect other characteristics? An engineer's change of the gear ratio on a car window may make the window motor smaller but the window

will go up more slowly. And if the engineer enlarges or strengthens the mechanism, the door probably will be heavier, harder to open, or may be less prone to remain open on a slope. Of course, there may be an entirely new mechanism the improves all relevant CAs. Engineering is creative solutions and a balancing of objectives.

The house of quality's distinctive roof matrix helps engineers specify the various engineering features that have to be improved collaterally. To improve the window motor, you may have to improve the hinges, weather-stripping, and a range of other ECs.

Sometimes one targeted feature impairs so many others that the team decides to leave it alone. The roof matrix also facilitates necessary engineering trade-offs. The foot-pounds of energy needed to close the door, for example, are shown in negative relation to "door seal resistance" and "road noise reduction". In many ways the roof contains the most critical information for engineers because they use it balance the trade-offs when addressing customer benefits.

Incidentally, we have been talking so far about the basics, but design teams often want to ruminate on other information. In other words, they custom build their houses. To the column of CAs, teams may add other columns for histories of customer complaints. To the ECs, a team may add the costs of servicing these complaints. Some applications add data from the sales force to the CA list to represent strategic marketing decisions. Or engineers may add a row that indicates the degree of technical difficulty, showing in their own terms how hard or easy it is to make a change.

Some users of the house impute relative weights to the engineering characteristics. They'll establish that the energy needed to close the door is roughly twice as important to consider as, say, "check force on 10 degree slope". By comparing weighted characteristics to actual component costs, creative design teams set priorities for improving components. Such information is particularly important when cost cutting is a goal.

There are no hard and fast rules. The symbols, lines, and configurations that work for the particular team are the ones it should use.

How does the house lead to the bottom line? There is no cookbook procedure, but the house helps the team to set targets, which are, in fact, entered on the bottom line of the house. For engineers it is a way to summarize basic data in a usable form. For marketing executives it represents the customer's voice. General managers use it to discover strategic opportunities. Indeed, the house encourages all of these groups to work together to understand one another's priorities and goals.

The house relieves no one of the responsibility of making tough decisions. It does provide the means for all participants to debate priorities.

The principles underlying the house of quality apply to any effort to establish clear relationships between manufacturing functions and customer satisfaction that are not easy to visualize. Suppose that our team decides that doors closing easily is a critical attribute and that a relevant engineering characteristic is closing energy. Setting a target value for closing energy gives us a goal, but it does not give us a door. To get a door, we need the right parts, the right process to manufacture the parts and assemble the product, and the right production plan to get it built.

If our team is truly interfunctional, we can eventually take the "hows" from our house of quality and make them the "whats" of another house, one mainly concerned with detailed product design. Engineering characteristics like foot-pounds of closing energy can become the rows in a parts deployment house, while parts characteristics - like hinge properties or the thickness of the weather-stripping - become the columns.

This process continues to a third and fourth phase as the "hows" of one stage become the "whats" of the next. In the last phase, production planning, the key process operations become the "whats", and the production requirements become the "hows". These successive houses implicitly convey the voice of the customer through to manufacturing.

None of this is simple. An elegant idea ultimately decays into process, and processes will be confounding as long as human beings are involved. But that is no excuse to hold back. If a technique like house of quality can help break down functional barriers and encourage teamwork, serious efforts to implement it will be many times rewarded.

What is not so simple is developing an organization capable of absorbing elegant ideas. The principal benefit of the house of quality is quality in-house. It gets people thinking in the right directions and thinking together. For most companies, this alone amounts to a quiet revolution.

Mr. Harrington's ideas are presented courtesy of ***VIRTUAL OFFICE NETWORK*** *and Harrington Enterprises offering services in consulting, training, project development, and computers. Mr. Harrington has written for several business publications and is best known for the book Management Engineering For Quality In Products And People.*

House Of Quality

Sample Study - Pizza Rolls