

Integrated Product Definition: Using QFD for the Business of Product Development

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Quality function deployment (QFD) techniques have long been recognized as a potentially invaluable tool in successful product development. QFD techniques provide a systematic methodology for translating market opportunities and customer needs into clear product specifications that engineers and scientists can use for design, formulation, and development. But despite QFD's long history of success stories, companies have not yet come close to realizing its full potential for enhancing either product development or other business processes.

Failures of QFD techniques often stem from a fundamental misunderstanding of the techniques themselves and of the value they can convey. The fact is that although QFD has been around for more than 20 years and has been applied in many industries, QFD techniques are not well understood – even by most companies that are actively trying to apply them. A lot of companies that have experimented with using QFD for product development have thrown it out the window without a thorough trial.

From the start, these experiments have missed the point – and the fundamental benefits – of QFD methodologies. There are three sure ways to doom a QFD project to failure:

- By „bringing in the QFD expert“ to perform an analysis
- By assigning teams the responsibility for performing an analysis without the proper training and support
- By focusing too heavily on QFD, believing that QFD techniques alone will provide a specification

Perhaps most importantly, management needs to recognize that the value of the QFD process extends far beyond the final work product. In fact, most of the benefit of QFD lies in the process of going through the tradeoffs inherent in a team environment. At its heart, QFD provides a systematic way of optimizing tradeoffs. These can go well beyond the technical tradeoffs required in designing a product; in fact, optimizing tradeoffs is key to the resolution of all critical business issues. But because QFD has been limited to the core issues of product development, and because product development specialists typically do not involve themselves in a truly integrated way with the larger business issues surrounding product development, companies have not yet made the leap to applying QFD to other parts of the business, such as manufacturing, distribution, service, hiring, and training. We believe they are missing a significant opportunity.

In this article we take a fresh look at how QFD can enhance a successful product creation process and how its fundamental methods can be applied beyond product design.

Why QFD?

To introduce a successful product, you need to do a lot of things right besides having the right product. *You* need to make a lot of smart decisions about which people to hire, whether to make or buy certain components, how best to service the new product, etc. But at the point where the project team members shift their attention away from the product itself and onto the many other crucial issues they must deal with to launch the new product, something astounding happens. The very same people who have meticulously worked through a product definition process – whether with QFD or another methodology – turn around and make „gut decisions.“ It's like wearing a life jacket on the QEII all the way across the Atlantic and then roaring through Manhattan on a motorcycle without wearing a helmet.

A major problem with gut decisions is that they are typically based on incomplete or outdated information. In our work for clients, we have observed that products that fail typically do so for reasons that the development team did not address or anticipate, but which they could have addressed if they had followed a systematic methodology like QFD.

Another major problem with gut decisions is that the rationale used for making them cannot be effectively shared. As a result, management teams may base their decisions on conflicting assumptions or differing goals. In addition, operating on a gut level prevents people from sharing best practices and learning from past failures. Understanding how to make tradeoffs – and being able to review the ways similar conflicts were resolved in the past – streamlines an organization and reduces the time required to get new products to market.

QFD is a structured approach that allows a group to develop and share a set of needs or assumptions. Once these are out in the open, the group can evaluate alternatives and make tradeoffs.

The Roots of QFD

To best understand how QFD can be applied broadly, it makes sense to understand it from its roots. QFD was developed as a methodology to allow companies to consider the qualities of a product, process, or service and

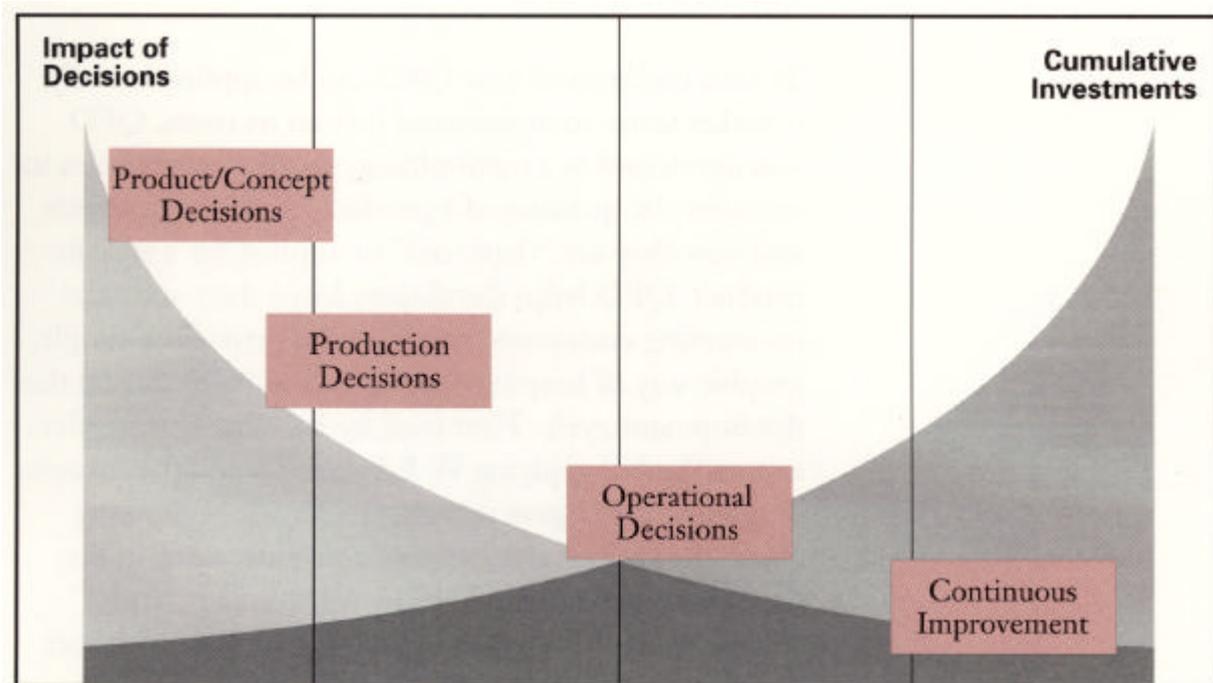
how they are „deployed“ or applied for a specific product. QFD helps developers focus their activities on meeting customers' needs, and it provides a simple, graphic way of keeping those needs in focus during the development cycle. First used by Japanese shipbuilders as a method of applying W. Edwards Deming's concepts of quality, QFD gave designers a means of thinking about the various attributes of a product early in the development process. The key word here is „early.“ As anyone who has been through a complete product development cycle can testify, decisions made early cost less than those made later (Exhibit 1). Unfortunately, the attention of senior managers tends to track the cumulative investment curve, so that their attention really focuses on a program only when major commitments come due – too late to effectively influence the process.

Toyota and other Japanese manufacturers refined QFD and reaped the benefits of fewer design changes, shortened development time, lower development costs, and more attractive products that achieved great success in the United States. Americans could literally look out their car windows and see the results of QFD passing them by. American car makers took up QFD, and it soon spread to aircraft manufacturers and other industries as well.

QFD methodology focuses on what is called the „House of Quality,“ so named because the graphics involved resemble the profile of a house (Exhibit 2).

Exhibit 1

The Impact of Decisions and Cumulative Investment Over Time



The graphics represent the interrelationships of tradeoffs between the customer's „wants“ and the product developer's „hows,“ or ways of meeting those wants.

The House of Quality has as its foundation the „Voice of the Customer“ matrix. This is a format for interpreting the needs of the customers for a given product or service. Techniques used to collect this information typically include mail surveys, focus groups, telephone surveys, and one-on-one interviews.

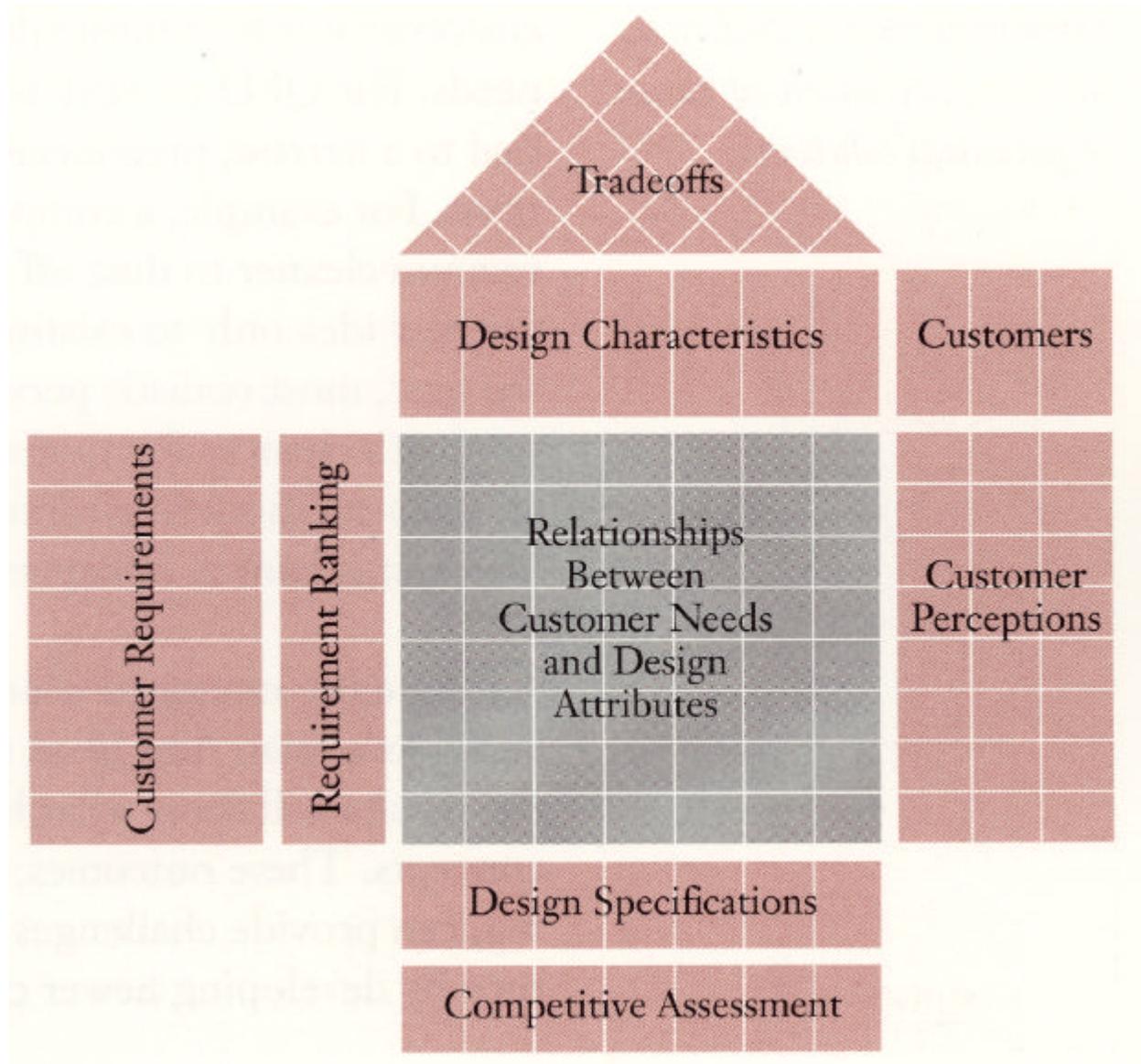
Those who misunderstand QFD think that the process itself will define a product. QFD was never meant to do that. It was designed instead as a tool with two purposes: first, to ensure that a team has considered all the alternatives; and second, to make sure that a team has thoroughly evaluated the product definition it has come up with against the marketing opportunity it is trying to fill. The team needs a way of understanding the implications of the tradeoffs it must make.

It's as simple as that. And as complicated.

Just as the large grinding stones found in old mills are useless without grain, QFD is no good without a set of alternatives on which to work.

Exhibit 2

The QFD House of Quality



Finding Grist for the QFD Mill

To come up with ideas to run through QFD, product developers can use storyboarding, brainstorming, etc. The method used is less important than ensuring that the right people are on the team – people with a solid set of creative, technical, and market skills and expertise. This sounds obvious, yet managers repeatedly ignore it and squander weeks and months hoping that new concepts will emerge from people with limited experience in the field the company is examining.

Once the right team is in place and knows what the customer wants, it must address ways of meeting those needs. For QFD to work well, the team must not be tied to a narrow, preconceived range of potential solutions. For example, a company thinking of making a vacuum cleaner to dust off table tops cannot compare the new idea only to existing vacuum cleaners. To get the best, most realistic perspective on the proposed product's chances for success, the team should consider all other methods of cleaning tables – dishrags, bare hands, mechanical sweepers, etc.

A frequently untapped source of new ideas is QFD itself. As a team runs ideas through the QFD process, the results will show what is wrong with some of the concepts. These outcomes, while initially disappointing, can provide challenges that can be overcome in turn by developing newer concepts.

Ideas generated by the above methods, as well as competing concepts, should be subjected to precise analytical

evaluations, prototyping, and testing in a competitive environment. In this sifting and sorting process, QFD is but one of the tools to use.

The QFD Process

The QFD process consists of eight steps, as outlined below.

1. Identify the people who have an interest in this product. „You gotta know the territory,“ insists one of the traveling salesmen in *The Music Man*. A product development team sometimes has to look beyond the immediate customer – the person or organization that makes the purchase. Who are that customer’s customers? For instance, a company might sell a state government a system for testing exhaust emissions, yet those machines will be used by personnel in gas stations, garages, and automobile dealerships – and operated by people with varying degrees of proficiency. They, in turn, have customers of their own, people who bring their cars and trucks in to be tested.

2. Determine the needs of those who have an interest in the product. Merlin Gerin, the electrical engineering arm of the French Schneider group, has been very successful in identifying not only its customers’ customers but the latter’s needs. Merlin Gerin designed its low-voltage power switches, for example, to be particularly easy to install, adjust, and maintain. These attributes have made the company very popular with electrical equipment dealers and their customers, the installers, who control a large part of the market.

3. Establish customer perceptions. Products don’t emerge in a market by themselves. Typically, the needs the product will eventually meet are already being met in some way. What is the perceived competition for this product? A fax machine, for example, first competed with mail and phone messages before E-mail and other techniques came along. Establishing the customer’s perceptions of how competing approaches meet needs provides critical insight into potential advantages to be stressed or disadvantages that must be addressed.

Raytheon’s Beech Starship provides a case study of misunderstood customer perceptions. The product was designed to embody an exciting concept, turbo-prop corporate aircraft, at a time when customers were seeking ways to lower the high cost of jet fuel. By the time the product was launched, however, declining energy prices made fuel costs less important to buyers. While the drop in fuel prices would have been difficult to predict, the sleek, stylish look of the plane was deemed too „flashy“ by older, CEO-level executives – the very people who make the decisions about what plane to buy. Worse, by the time the Starship came out, companies could buy, for the same money, a jet that offered far greater speed, much longer range, and the kind of image the buyers wanted to project.

4. Determine the product attributes. Once a team has a solid sense of the market and its needs, product developers can begin zeroing in on how the product can fulfill those needs. These attributes should be measurable when possible and should imply direction, i.e., improve reliability or decrease maintenance. It is important at this point not to worry about how such attributes will be attained. Save the details for a later stage. Addressing them at this point may prematurely focus the analysis.

For a company designing a plastic cover for propane barbecue grills, an obvious need is durability. The attributes that fulfill this need might call for a tough, stain-resistant material that is able to withstand extremes of temperature.

5. Decide how important each attribute is in meeting customer needs. The typical assessment is that everything is important. Kano concepts – which categorize attributes as threshold, performance, or excitement categories – play a critical role in performing this analysis properly (Exhibit 3). Introducing a characteristic that may potentially provide an excitement feature is more important than gradually adding performance capability to something that is already good enough. The importance of improvement depends on the assumed level of performance. Just because you *can* do something doesn’t necessarily mean you *should* do it!

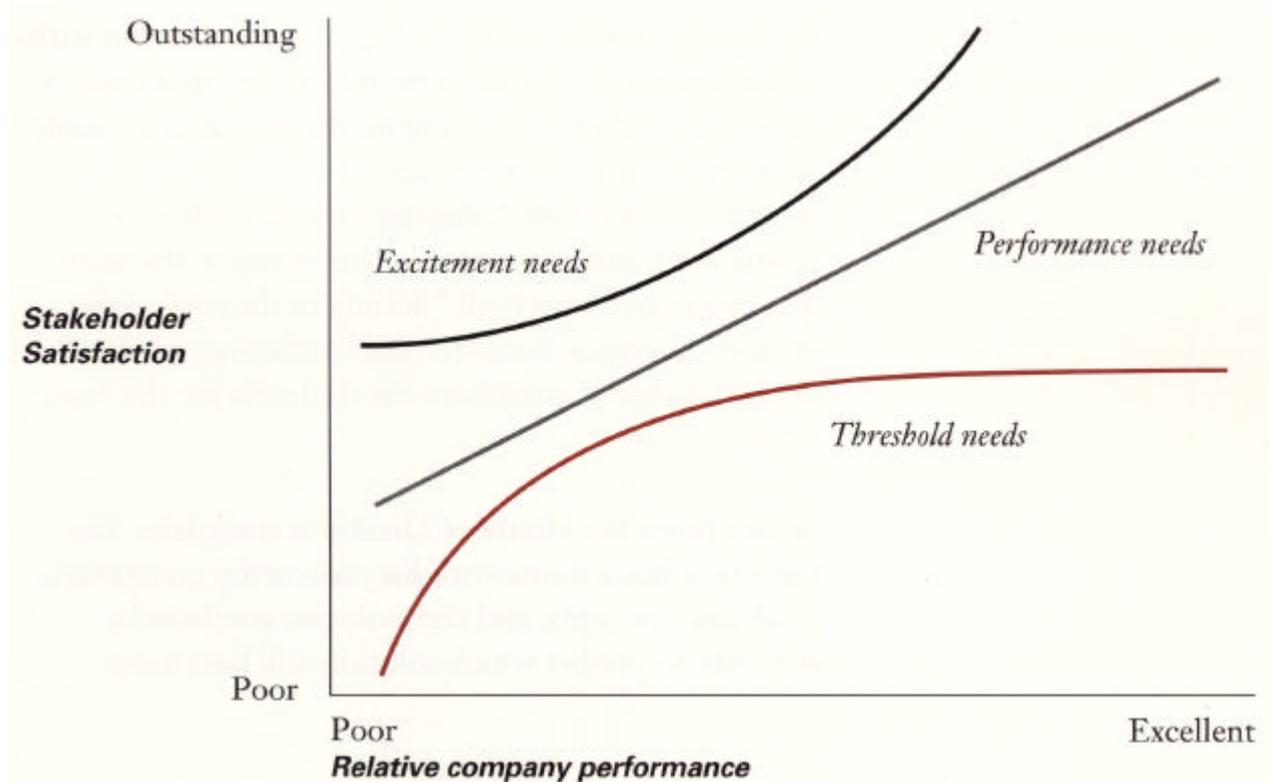
Continuing with the gas grill cover example, a performance attribute might be tolerance of extreme weather, while an excitement attribute might be a cover that could be pulled over the grill while it is still hot.

Characterizing needs based on the Kano concepts and assumed level of performance is critical to properly assigning relative importance to improving any attribute. You don’t want to spend time and energy improving something that provides little added benefit when you could be focusing on areas with more potential leverage.

For example, if the gas grill cover could already withstand the cold extremes of most climates, its ability to do so would be a threshold attribute, and spending time and effort to improve that ability would be a low priority. If, on the other hand, the cover could not withstand typical extremes of cold temperatures, this same feature would have a high priority. Its importance depends on the assumed level of performance.

Exhibit 3

Kano Concepts for Stakeholder Satisfaction Attributes



The team completes the House of Quality by rating the ability of each attribute of the new product to fulfill customers' needs, characterizing this ability in each case as „strong relationship,“ „medium relationship,“ or „weak relationship.“ If our gas grill customer wants a stain-resistant grill cover, the fact that our grill cover could be put on a hot grill would most likely have a weak relationship – if any – to its stain resistance.

6. *Identify technical tradeoffs.* A grill cover that can withstand heat might not be as flexible as one that doesn't have this attribute. Speeding up the motor in a blender might make it crush ice faster yet make the motor noisier or less reliable. Playing various attributes against each other is useful in conveying to the team that „you can't have it all.“ Filling in the roof of the matrix indicates synergistic and conflicting relationships and clearly articulates the tradeoffs for the team to remember.

At this point the House of Quality is complete. The team now has a framework for comparing competitive products, concepts, and technologies attribute by attribute to predict which solution will best meet customers' needs. Going a step further, the team can evaluate proposed product specifications against competitors' products or competing techniques.

7. *Assign target specifications.* Having completed the House of Quality and compared the proposed product with those of competitors, the team can begin assigning target specifications for each attribute. For our gas grill cover, for example, the team could set a figure for melt temperature.

8. *Determine the competitive leverage and iterate.* Often – maddeningly often, in product development and in life – there is no one clearly best solution. Several approaches emerge from the pack and must be weighed against each other. A gas grill cover with the exciting attribute of being able to be placed on a hot grill may cost too much to be competitive. At this point the QFD matrix plays a critical role in helping the team understand how various alternative concepts stack up in the competitive environment, so that the team can arrive at a consensus about which approach to take.

Beyond Product Development

The eight steps sketched above suggest how to apply QFD methodology when developing a new product. The second major use of QFD is in making business decisions that are related to the product but managed by other functions in the company – functions such as Human Resources, Purchasing, Manufacturing, and Distribution. A world-class product development process, such as the one we use at Arthur D. Little, ensures that all these business functions participate throughout the development process and that the transitions among them are

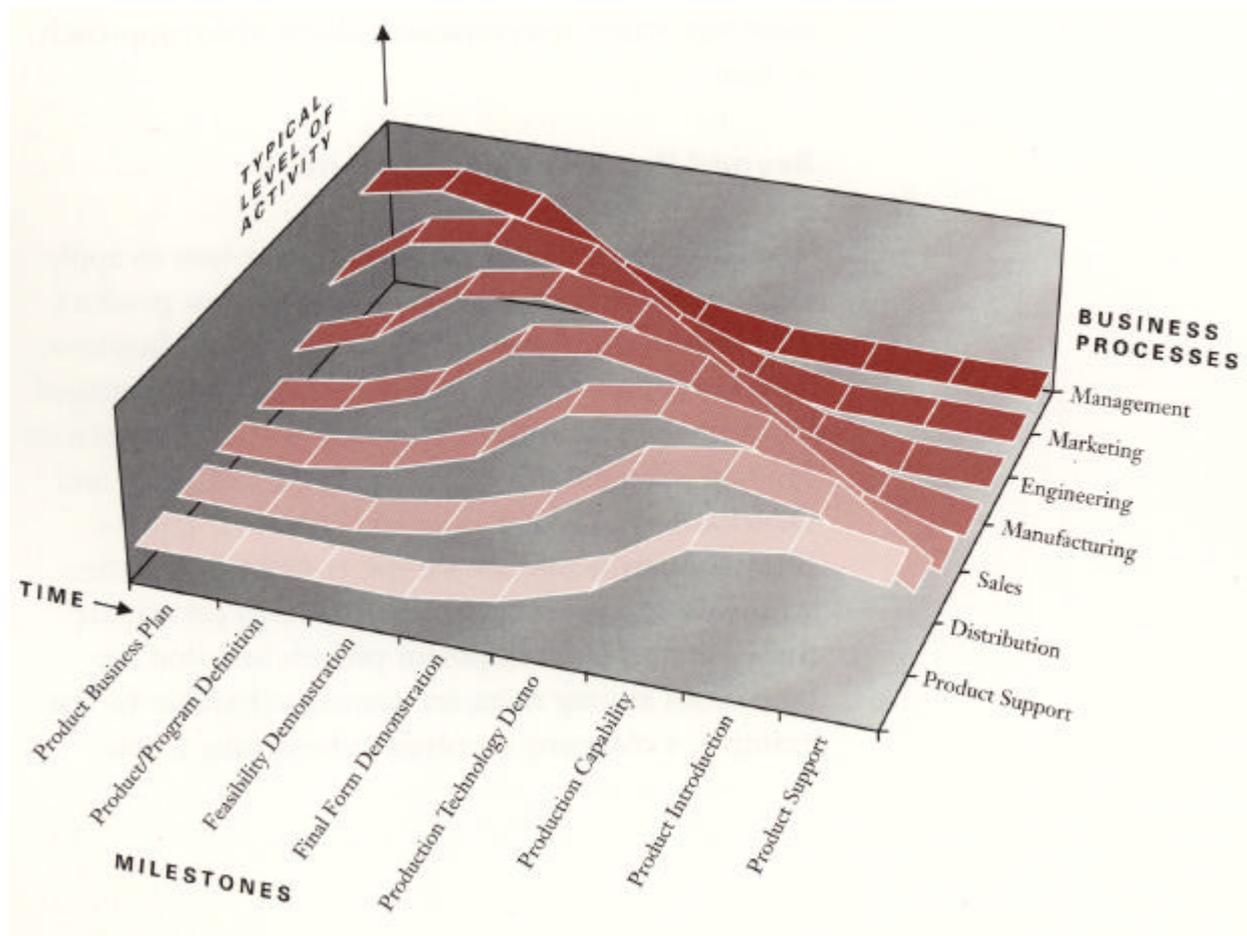
seamless (Exhibit 4). For example, a company involved in launching a new product will almost certainly be involved in hiring people, training them, and planning the most efficient distribution system possible.

Hiring. New products often create the need for new personnel. The tradeoffs involved in selecting the types of people needed as well as the individuals themselves are tailor-made for QFD methodology.

Here's a typical scenario. A Europe-based electronics manufacturer decides to enter the Asian high-definition television market. To expedite its new product, it plans to build a research center in Singapore adjacent to the factory. Who should head that center? Should it be a person from the company's main research complex in Europe, someone from Singapore who knows the lay of the land there, or someone from the factory, who will understand the manufacturing hurdles the new product will face?

Exhibit 4

The Arthur D. Little Milestone Matrix Product Development Process



The same methodology that helped define the specifications for the new TV can be helpful for making these kinds of decisions. In the same way that QFD helps expose agendas and preconceptions, it can help bring intracompany politics onto the table to be dealt with openly and honestly.

Training. When cutting-edge new products are involved, training becomes particularly important. Yet taking people away from their posts for training is expensive – in money, time, and opportunity costs.

At Arthur D. Little, we face this dilemma not only in our clients' organizations but in our own. To weigh the tradeoffs involved in training, we use QFD methodology. Working through the process helps us to determine what amount of training uses our consultants' time most effectively. QFD also helps us justify the time and expense to the firm's senior management. We have used QFD to design a course to teach new staff members what they need to know about product development. Knowing who could be affected by the training, what they needed, how to deliver it, and what tradeoffs were involved allowed us to design a very successful three-day training course. Today that course serves as the foundation of our ability to do hands-on product development for a continually expanding pool of clients.

Distribution. Getting a new product to the people who need it when they need it is often a key element in its success. Distribution issues might include a „make or buy“ decision, which might require finding a noncompeting company with an especially good distribution system already in place. For a particularly perishable product, for example, the company might consider locating production in the Memphis, Tennessee, area to take advantage of the huge Federal Express hub.

QFD can help the organization avoid making these decisions in a vacuum by allowing it to factor in the competitive analysis that led to the new product in the first place. Rethinking distribution can become another vehicle for product positioning.

Cautions

QFD is a wonderfully powerful and elegant tool for helping teams arrive at wise decisions. But users should keep five caveats in mind:

- QFD results are only as good as the data going in, the team executing the process, and the support behind the team.
- Complicated or expansive situations should not be attacked all at once. Analyze problems at a high level, then break them down.
- It is essential to have objective data about the company.
- Don't let the process become cumbersome – or turn into a goal in itself.
- QFD must be a genuine team exercise; it cannot be imposed by a domineering team leader.

One client, having worked through a complicated problem, finished a QFD session by asking, „Do gut feelings have any place in this House of Quality?“ Our answer was simple. „They will as long as human beings are designing products and running businesses.“ Some attributes, in product development as well as in the business surrounding the product, cannot be justified on absolutely logical, defensible grounds. Personal judgment and expressions of taste, particularly about the way a product will look or feel, must be factored into the methodology and will inevitably play a critical role in decisions. That's fine – so long as personal judgments are clearly identified and articulated.

When used correctly, QFD is one of the more effective methodologies for developing new products, exposing assumptions, and handling complex tradeoffs in business decisions.

¹ For a more detailed, discussion of the Milestone Matrix approach to product development, see „Controlling the Product Creation Process“ by Herman J. Vantrappen and John M. Collins in the Second Quarter 1993 issue of Prism.

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