

# Defining Global Requirements with Distributed QFD

by

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## ABSTRACT

Obtaining valid data on customer needs and translating it into optimum product functionality is always a challenge, but especially so when the customers are geographically, culturally, and functionally diverse. Digital's Corporate Telecommunications Software Engineering (CTSE) used groupware techniques supported by the distributed use of Quality Function Deployment (QFD) to identify product features that meet customer needs. By linking engineers, customers, and product personnel from across the globe, CTSE redesigned the QFD model to optimize the use of local and global groups in defining product requirements. During one year, three software products, including Automatic Callback version 2.1, were defined using the Distributed Quality Function Deployment (DQFD) technique. Lessons learned from each interactive session were applied to continuously refine the approach to improving process. The critical follow-up steps after the DQFD ultimately determine the success or failure of the effort.

## THE CHALLENGE OF GLOBAL REQUIREMENTS

Corporate Telecommunications is responsible for managing Digital's worldwide telecommunications resources including voice, video, and data networks. The engineering organization within Corporate Telecommunications develops tools, applications, and solutions to optimize the use of telecommunications services. Developing the right product for a customer depends largely on the accuracy of the requirements defined, which in turn depends on the approach used to gather information about the customer's needs. Traditionally in Digital's Corporate Telecommunications Software Engineering (CTSE), product managers have obtained customer requirements from various geographies by using electronic mail or electronic conferencing. This method was deficient in the delivery of a customer-focused product in several ways.

- o Input did not come from all the corporate geographies that used the product.
- o CTSE had no direct contact with the customer.
- o No data was available on the importance of customer

requirements.

- o There was no clear correlation between product features and customer needs.

This paper discusses the approach taken by CTSE to improve the process used to define customer needs and product features worldwide.

#### COMMITMENT TO IMPROVING THE PROCESS OF DEFINING REQUIREMENTS

In January 1992, CTSE made a commitment to utilize Total Quality Management (TQM) as the foundation for the development and maintenance of their products. As part of this commitment, CTSE began a set of initiatives to increase customer and user satisfaction with Digital's worldwide telecommunications products and services.

CTSE customers are from three internal geographies: the United States, Europe, and the Asia/Pacific and Americas (APA) (formerly General International Area [GIA]). Each area has its own business needs and practices. Product development must ensure that technical solutions meet the common needs of each group. CTSE recognized that the creation of successful products is based on the quality of the requirements against which these products are created. Consequently, CTSE mandated the use of the Quality Function Deployment process for all scheduled projects.

#### QUALITY FUNCTION DEPLOYMENT

Quality Function Deployment (QFD) is a structured approach for proactive planning. QFD provides product planners with a process that translates customer needs into prioritized product features. This method emphasizes the use of quantitative techniques to evaluate various product features based on the impact each has on providing benefits to the customer.

QFD has been used extensively as a product planning tool for companies both in the U.S. and in Japan. Digital, Hewlett-Packard, AT&T, Ford, and Toyota are but a few of the companies that have successfully applied the QFD process to ensure that they are building products that meet customer needs.

As practiced at Digital, the QFD process begins by assembling a cross-functional team that includes customers, customer experts who have timely data on customer needs, and technology experts who know the product capabilities and the competition. The team gathers for a concentrated and focused meeting, usually two or more days in duration.

Team activities during the QFD include

- o Brainstorming. Attendees state as many customer needs and product features as they can and document each need or feature without regard to merit.
- o Affinitizing. The team associates and categorizes the customer needs and product features into appropriate groupings.
- o Value setting through consensus. The team evaluates customer needs according to various attributes, such as customer value, goals, and improvement targets, and assigns a weight to each need.
- o Correlation analysis. The team correlates the needs with the features to determine which features impact which needs and to what extent.

Throughout the QFD, a chart called the "House of Quality" (see Figure 1) graphically displays the work of the team. The customer needs become the rows of the House of Quality, and the features become the columns. The House of Quality allows you to view directly the relationship between any customer need and product feature.

The final result of the QFD is a prioritized list of features, each with an associated numeric sum of weights. This list is often displayed as a Pareto chart, which is a bar graph of the total weights in left-to-right descending order. Figure 2 is an example of such a chart.

#### THE DISTRIBUTED QFD CONCEPT

Traditionally, the QFD process is conducted with all participants in one physical location, thus allowing constant personal interaction. This scheme works well when participants are not widely scattered; however, Digital develops most of its products for the global marketplace. Busy schedules and the high cost of travel prevent all QFD participants from gathering in one location at the same time. The challenge was to overcome the one-location issue and utilize the QFD process in a modified manner to get people in various locations working together. CTSE calls the practice of running a QFD with involvement from multiple physical locations a Distributed QFD (DQFD).

Instead of conducting a regular QFD session at one site, the DQFD session is conducted simultaneously at the two or more sites where the participants are located. Every site has a facilitator. At each site, the DQFD participants are organized into teams connected by means of teleconferencing or videoconferencing equipment. These teams work together through the regular QFD process administered under the control of the designated "primary facilitator."

In the DQFD process, distributed team members discuss product requirements during interactive sessions moderated by facilitators. The result of these discussions is the QFD data (i.e., features, ranks, and needs) and documents (e.g., the House of Quality and the data spreadsheet). The primary facilitator and the organizer collect and process the information from all participating sites and prepare the final QFD documents, such as the product business requirements.

Before starting the session, the organizer and the primary facilitator develop the schedule and the agenda. They select the list of participants, which should include all geographies and span the involved functions such as engineering, sales, support, service, and customers. Often, a questionnaire is distributed to the participants. This questionnaire describes the customer information that is important, such as the tools they use and what unfulfilled needs they have, and should therefore be gathered and brought to the DQFD session. If solid customer data is missing in certain areas described, participants then have the opportunity to collect additional information during the weeks leading up to the DQFD. The best data comes directly from the customer while the customer is actively involved in the activity that the product or service will support. Digital has fostered a technique called Contextual Inquiry, in which the product developers visit the customer's workplace and observe and interview various users while they are engaged in their normal work activities. This technique yields timely and detailed data that often is not forthcoming in surveys, problem reports, and other passive approaches to data gathering.

In addition to the important issues of cultural differences, business relationships, and working environments, the time zones of participating sites are a major consideration when developing the schedule logistics for the DQFD. The DQFD process usually takes two or three sessions (working days). Therefore, while developing the DQFD workflow and schedule, the DQFD organizer and the primary facilitator must review the QFD process with respect to site requirements/time zones and determine the activities that best suit the participating sites.

#### THE DQFD MODEL

Figure 3 portrays the basic steps of the DQFD model. Though similar in appearance to a typical QFD, the DQFD differs in the areas of logistics and training of participants, and in the order and manner in which the actual QFD sessions are conducted. The DQFD model uses videoconferencing and teleconferencing for the overview meeting and throughout the three-day DQFD itself.

#### Preparation

Preparation is a key element of a successful DQFD. Some important

parts of the preparation are

- o Planning. The primary facilitator and the organizer determine the goals and feasibility of the DQFD, the most appropriate participants, and the logistics that will work best.
- o Training the team. A short (one-half day) tutorial in the basics gives the participants sufficient background in the process to contribute effectively.
- o Gathering customer data. The need for accurate, complete, and current customer data as input for the DQFD cannot be overstated. Many techniques are useful for collecting data, including surveys, interviews, problem reports, suggestions, and free-form interview.

#### Overview Meeting

The overview meeting serves several main purposes. This meeting

- o Helps the participants from the various sites to get to know one another.
- o Provides participants with an understanding of the DQFD process and their roles in the process.
- o Gives the planners an opportunity to summarize the project at hand and the issues that the DQFD is intended to address.
- o Allows the team to decide who the customers are for the product or service and, furthermore, which customer is to be considered "primary" for the purposes of the DQFD. Distinguishing the primary customer can help avoid conflicts in the development of the House of Quality.
- o Informs the participants about the preparation required.
- o Answers questions about the logistics and mechanics of the forthcoming DQFD meeting.

The two options for handling the overview meeting in Distributed QFDs are videoconferencing and teleconferencing. CTSE prefers videoconferencing for several reasons.

- o Participants from the various sites who will be working together can see one another, possibly for the first time. The visual image thus created will enhance communication during the DQFD meeting.
- o Participants gain an understanding of the working styles of the facilitators at each site, which helps to move the

process along.

- o The visual aspects of the meeting help promote the feeling of "teamness," which fosters cooperation in the subsequent activities.

#### QFD Meeting

In the western Europe-eastern U.S. DQFD model, the QFD meeting spans three days. The major sites involved in the CTSE meeting described in this section were Valbonne, France, and Littleton, Massachusetts. A six-hour time difference exists between the two locations, so we scheduled the mutual meetings for mornings in the U.S., i.e., 8:00 A.M. to 12:00 M. (noon) eastern standard time (EST), and afternoons in Europe, i.e., 1400 to 1800 coordinated universal time (UTC) (known as Greenwich mean time).

Although undoubtedly inconvenient for some participants, DQFDs are possible in locations where the time difference is greater than six hours. During an earlier DQFD, one team member resided in Australia and worked with the rest of the team from 10:00 P.M. to 2:00 A.M. his time. A better approach is to schedule the DQFD over six days with overlapping sessions of two hours, as described in the section Observations about the DQFD Model.

Figure 4 shows a design of the western Europe-eastern U.S. DQFD model, as managed by the U.S. Note that the two sites work together for four hours each day. Working in overlap for just one half of each workday provided the following advantages:

- o Since interactive QFDs are concentrated efforts, meeting for only four hours per day allows the team to devote their peak energy to this part of the QFD.
- o The schedule allowed part of each day for those sections of the QFD that could not be performed through teleconferencing, such as affinitization, administration, and computer logging of the results. The team that is managing the particular DQFD performs most of these activities.
- o Each team had time between the larger group sessions to review the work of the previous day and to make a list of issues for discussion and resolution.
- o At the start of each group session, participants have a hard copy of the House of Quality with data derived from the previous day's session.

A description of each of the three days of the DQFD follows.

DQFD --- Day 1

The first day of the DQFD starts in the morning for the eastern U.S. and in the afternoon for western Europe. As is typical for all Digital QFDs, the team begins by brainstorming to identify customer needs. Participants contribute ideas alternately, one from Europe and one from the U.S. Both sites record each idea and the contributor's initials on a Post-it note. Later in the QFD, the contributor may be asked to clarify the content of the Post-it note. The team also marks each note sequentially with a number for easy reference. The odd numbers represent the ideas that came from Europe, and the even numbers represent those from the U.S. Once the brainstorming session is complete, a so-called scrubbing process takes place to ensure a common understanding of the content of each Post-it note. The team examines each idea statement and rewrites it if the idea is not clearly understood by all participants. No evaluation of the idea takes place during scrubbing.

At this point, the DQFD diverges from the standard QFD, which would now move to the Planning Matrix. Extending the DQFD to four days would preserve the normal sequence of QFD. To complete our work in three days, however, we elected to follow the customer needs brainstorming session with a similar brainstorming exercise for product features, which are the columns of the House of Quality. Again, we scrub the ideas after completing the brainstorming. The initial mutual session between Europe and the U.S. is now over. We did not find that the change in sequence had an impact on the process.

While the European team goes home for dinner and to sleep, the U.S. team meets during the afternoon to affinitize the customer needs specified in the morning. Affinitizing is a free-form method of grouping like ideas together into categories that will become the rows of the House of Quality. Affinitizing is a highly interactive activity involving constant physical movement of the Post-it notes. Affinitizing would have been difficult across continents without supporting hardware, so we elected to confine this work to a single site.

After completing its afternoon session, the U.S. team sends the results of the affinitization to Europe in an electronic message. When computers are not available, information can be transferred using facsimile machines.

DQFD --- Day 2

On Day 2, while the U.S. team sleeps, the European team reviews the affinitization of the customer needs and compiles a list of questions and issues. When the two teams meet during the European afternoon and the U.S. morning, they raise issues about the customer needs and negotiate to resolve the issues.

The combined group now assigns customer values to each need and

enters these values in the first column of the Planning Matrix, which is on the right side of the House of Quality. Next, the group fills in each row of the Planning Matrix with corresponding values for how the customer rates our current product, how the customer rates our competition, our goal for the next product release, and a sales point that indicates the natural attractiveness of the customer need. The group can now calculate weights for each need as input to the Correlation Matrix. Once the Planning Matrix is complete, the team can add ideas to the product features and scrub them.

After the European team departs at approximately 1800 UTC, the U.S. group goes through an affinitization exercise for the product features and again sends the results to Europe.

### DQFD --- Day 3

During their morning of Day 3, the European team members review the product features' affinitization and compile a list of questions and issues, which are addressed with the U.S. team later that day. The major joint activity for the third day is completing the Correlation Matrix, which is at the center or "heart" of the House of Quality. For each (feature, need) pair, the teams decide how much the feature, if implemented, will contribute to satisfying the need. Each correlation is then multiplied by the weight for that need. The sum of the weights is entered at the bottom of each column.

Now, all the information is available to build a Pareto chart of prioritized features. This chart, which is the desired end product of the DQFD, provides an informed basis for future product direction. The teams do a sanity check of the chart results. If the results appear rather different than expected, the teams may review the steps that led to the results to ensure that those steps were completed accurately, and to understand what data led to the results. In some cases, accurate results lead to counterintuitive but valid conclusions.

At the conclusion of the DQFD, the teams review the issues list, assign action items as appropriate, and then enumerate the next steps. These steps may include determining the resources needed to implement various features and perhaps doing follow-on QFDs to determine more detailed information about the various features.

### Observations about the DQFD Model

- o In the model design just described, the U.S. team did all the affinitizing. This scenario best suited the particular circumstances, i.e., the scheduling constraints and the fact that the most experienced facilitator was located in the U.S.



- o The DQFD could have been managed from Europe with all the affinitization performed there, as illustrated in Figure 5. If the European team members were to do both affinitizations, these activities would take place during their morning hours of the second and third day. Note that using this approach, the U.S. participants must begin no later than 7:00 A.M. EST in order to be ready to meet with the European team at 8:00 A.M. EST.
  
- o A third approach would have been to have one affinitization take place in Europe and the other in the U.S., as shown in Figure 6.
  
- o The model described in detail earlier in this section is appropriate for DQFDs between the eastern U.S. and western Europe and can be used in other instances where the time difference is six hours or less. DQFDs across locations with a time difference greater than six hours are possible but require that the sessions be conducted over more days and the daily overlap in work be confined to a shorter time period of two hours. Even with the expanded schedule, the teams must be willing to work during the early morning and the evening hours to accommodate the time difference. Figure 7 displays the possible organization of activities for long-distance DQFDs. The DQFD is spread out over six days. Note that the team that meets in the early morning hours does the affinitization work. In order for the team at the other location to perform the affinitization, participants at that site would have to work earlier morning hours or the DQFD would take longer than six days to complete.

#### CASE STUDY: AUTOMATIC CALLBACK VERSION 2.1

The Automatic Callback (ACB) software product provides customers, both internal and external, with remote host access and user authentication from personal computer platforms. A goal of the planned update release, ACB version 2.1, was to support the increasing number of customers who use mobile computing solutions while traveling or while otherwise remote from their home offices. A cross-functional team of product developers, planners, technical experts, and user representatives from Valbonne, France; Geneva, Switzerland; and Littleton, Massachusetts, was given the responsibility of developing the product priorities through the DQFD technique.

#### Planning

Several weeks before the DQFD, while in the U.S., the technical project leader and facilitator for the seven-person Valbonne contingent met with the primary facilitator of the five-person Littleton team. They planned all sessions and created ready-to-go

materials, such as flip charts with the House of Quality and appropriate matrices predrawn. This preparation helped ensure that the sets of visual materials used at both sites were exactly the same.

An overview meeting took place one week prior to the DQFD using videoconferencing media. After a discussion of the process, the team discussed the customer base for the product and decided on "security managers" as the major customer.

## Logistics

The DQFD took place over three days, with combined Valbonne-Littleton sessions lasting four hours, as described in the section The DQFD Model. Using teleconferencing, the two teams alternated between site-based activities, such as brainstorming, and interactive activities, such as attaching customer values, goals, and correlations. Throughout the DQFD, the project manager kept track of issues important to the project but not those that would be resolved at the DQFD meeting itself. At the end of the three days, the team associated action items with these recorded issues. The team then conducted a sanity check on the House of Quality results shown in Figure 8. The figure does not contain the detailed subcategories of features and needs that the brainstorming produced. The project team used this additional information after the DQFD to make specific detailed product decisions. The project leader assigned further work to figure in cost-benefit data and to subdivide the prioritized product features.

## Post-QFD

The cross-functional alliances forged at the DQFD continued into the design and development phases of the project. Concurrent engineering was applied to deliver ACB version 2.1 on schedule within a nine-month time frame.

## Lessons Learned

ACB was the first successful DQFD conducted by CTSE, in terms of the participants getting what they sought out of the process. To repeat that success, CTSE examined the factors that helped the process. At the conclusion of the Automatic Callback DQFD, CTSE conducted a short postproject review, asking what went right, what went wrong, and what might be improved. The following are some lessons learned:

1. Planning. The detailed planning done prior to the overview meeting and the DQFD eliminated potential problems and helped the process run smoothly. It is essential that the facilitators at each site understand

the process as it has been modified to function in the DQFD setting. Though not an expert at QFD, the technical project leader's experience working in team situations balanced the primary facilitator's QFD expertise.

2. Automated tools. This DQFD was the first in CTSE to use the QFD/Capture tool in real time during the QFD sessions.[1] After each day's activities, the Littleton site sent a PostScript file or a facsimile of the results of that day's work to the other site. Each site entered the results on the flip charts used to display the information. The automated tool performed all the calculations and displayed the results in an easy-to-read graphical format. CTSE now sees the QFD/Capture tool or a similar tool as a necessity for a smooth-running DQFD.
3. Issues list. Maintaining an issues list accessible to all sites allowed the teams to remain focused. Topics that might sidetrack the discussion were duly noted by the project manager, and the DQFD moved ahead.
4. Videoconferencing. Most participants were impressed with the use of videoconferencing and would have preferred that the entire DQFD, not just the overview meeting, take place via videoconferencing. Something is lost when you do not see the person with whom you are talking.
5. Competitive data. Although the teams had good customer data, they did not have much information about competitive offerings. Such competitive data would have helped the teams establish more accurate weightings to the customer needs.

## RECOMMENDATIONS

With each Distributed QFD conducted, CTSE learns more about how to improve the process and applies this knowledge to future DQFDs. The following are some CTSE recommendations for conducting successful DQFDs:

1. All participants should be educated in the QFD process, i.e., know their roles and the kinds of results to expect. Unknowledgeable participants only add to the confusion of the DQFD. CTSE has developed two half-day learning modules, "Introduction to QFD" and "Improving the Effectiveness of QFDs." Participants who complete the first module consistently contribute effectively at our DQFDs. Those that complete both modules help organize and lead the DQFD and follow-on activities.
2. Designate a primary facilitator. Although it is important to have facilitators at each site, specifying one primary facilitator, with the responsibility of

designing and managing the organization of the meeting, works best. Having two "expert" facilitators who independently "know what is best" and who implement their separate ideas can have a disastrous effect because information may not be in a compatible form for the concurrent sessions.

3. Use a computerized QFD package. Having a support package is nearly essential in DQFD to provide an accurate and quick way to ensure that each team is viewing the same information. We have used QFD/Capture and take advantage of both facsimile and electronic communication to mail updated versions of the House of Quality each day.
4. Be clear about the target customer before the DQFD sessions begin. If the product or service has an array of customers, be sure to specify a primary customer at your overview meeting. Doing so will help you decide which customer or set of customers to differentiate between, should there be a conflict during the DQFD.
5. Encourage attendance throughout all sessions. The work of the DQFD is most effective if all who participate in the overview meeting attend each day of the DQFD. People who arrive for later sessions but have not participated in earlier ones usually have difficulty contributing effectively without extensive updating and rehashing of the work of previous sessions. In addition, latecomers may have trouble adjusting to the different format of the DQFD.
6. The preparation is as important as the DQFD itself. In order for the DQFD to be fruitful, the customer information must be current and accurate. Such data helps establish goals that are competitive in the key areas about which the customer is concerned. When the list of participants is being selected, special care should be taken to ensure a diverse and comprehensive representation of customer interests and corporate functions.

#### SUMMARY

The Distributed Quality Function Deployment technique provides an efficient and effective mechanism to bring together customers and multifunction representatives from across the globe into an interactive setting to exchange information and prioritize product actions in real time. The success of the DQFD rests on a sound implementation model, trained facilitators and participants, preparation and planning, and a team willing to work toward solutions through brainstorming and consensus building. Flexibility is important because adjustments must be made throughout the process to accommodate the multiple physical

sites involved.

Corporate Telecommunications Software Engineering has defined and refined a set of DQFD techniques that has successfully met the goal of establishing consistent and valid product features to meet the business needs of its customers. DQFD has been adopted as a standard part of Digital's software development process.

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1. QFD/CAPTURE (Milford, OH: International TechneGroup Incorporated, 1988).

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#### TRADEMARKS

The following is a trademark of Digital Equipment Corporation: Digital.

QFD/CAPTURE is a trademark of International TechneGroup

Incorporated.

Post-it is a registered trademark of 3M Company.

PostScript is a registered trademark of Adobe Systems Incorporated.

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