4-02-60 Requirements Definition Using the Customer Interaction Model

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Payoff

To help IS manage continuous change in the demands of users of systems, this article discusses the creation of a Customer Interaction Model that brings the voice of the customer to each stage of systems development. This model augments the skills of the IS staff in developing and implementing customer requirements. This article tells how to integrate the Customer Interaction Model into the total quality management approach to systems development.

Introduction

IS departments must produce quality, cost-effective products for increasingly demanding customers. Within an enterprise, all end users requiring information are customers of the IS department. The requirements of the customer are the primary goals for the IS department in the development of information systems. Systems analysts then manifest these goals in the product.

Problems and issues arise as a result of this interaction (or lack of interaction) between IS and its customers in the identification and analysis of product characteristics. Tools and methodologies such as Software Quality Assurance, Quality Function Deployment, structured analysis, and prototyping help to manage some problems, but they are only part of the solution. More important is how these tools can be used in combination to help IS maintain customer interaction throughout the systems development process.

The Customer Interaction Model developed in this research is a synthesis of quality function deployment and structured analysis. Using this model, a link is developed between quality function deployment and the systems development process (see Exhibit 1). This approach enables IS management to tailor the customer interaction methodology to its development environment. To test and validate the ideas behind the Customer Interaction Model, this article also describes how the principles are applied in an actual test site.

Connection Between QFD and Systems Development Processes

Evolution of Quality Systems

Although quality has emerged as a formal management function, the discipline is still evolving. Once exclusive to manufacturing departments, quality now embraces functions as diverse as purchasing, engineering, and marketing research and commands the attention of senior management in all industries. Despite the increased interest, quality is a term that remains easily misunderstood. Different companies mean different things when they use the word quality, as do different groups within the same firm.

In Total Quality Management, it is the customer who defines quality. Quality refers to the organization's ability to meet or exceed customer requirements while maintaining a
competitive market position. This customer-driven perspective on quality can also be applied to systems development work within the IS department. Even though the development of information systems is significantly different from the manufacture of hardware products, relevant quality assurance (QA) concepts that have their theoretical foundation in systems tried and tested in other industries can be adopted by IS departments. One example is the concept of process improvement as a means of assuring a quality product.

**Quality Assurance and Systems Development**

Quality assurance in systems development has evolved from inspection methods and procedures into systems of control. QA is characterized by the requirement of conformance to formal procedures. In systems development work, associated problems include:

- The user's difficulty in specifying requirements.
- The intangible nature of information systems.
- The apparent ease of change of software and systems architecture.
- The quantities of information to be handled.
- The difficulty of exhaustively testing information systems.

Accompanying these problems are associated costs. These costs occur right through the systems development life cycle to maintenance. Many of the problems of systems development can be traced to the difficulty of defining user requirements during the analysis phase of the project. Structured techniques and Computer-Aided Software Engineering tools attempt to deal with this issue, but further development is still necessary.

A basic information systems framework for requirements definition is the core of this article. The Quality Function Deployment methodology is a strategy that recognizes the importance of the customer in the development of new products. This article is mainly concerned with the interaction of the Quality Function Deployment process with the systems development process and the early stages of implementation of quality function deployment in an IS department.

**Quality Function Deployment**

QFD is a planning and management methodology used for the design or redesign of products or services. It employs an approach in which customer requirements are translated (deployed) into design and manufacturing requirements in order to deliver products or services that meet or exceed the needs of the customer. It is a way of relying on the voice of the customer to drive the product development process. Japanese industries were the first to formalize and use approaches of quality deployment based on concepts researched by Yoji Ako. Quality Function Deployment as a concept was first brought to Western industry in the 1980s. When incorporated into systems development work,

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quality function deployment is a structured and disciplined process that provides a means for the IS staff to identify and carry the customer perspective through each stage of systems development and implementation.

**Problem-Solving Tools for Building the Customer View**

Planning tools for productivity and quality improvement are an essential feature of quality function deployment. These tools give individuals the ability to contribute to the planning step. Seven tools in particular that have evolved from operations research are now widely employed in strategic planning in organizations. These tools are referred to as the seven new planning tools, to distinguish them from the seven tools for continuous quality improvement. The seven new tools include:

- Affinity diagrams.
- Tree diagrams.
- Matrix diagrams.
- Matrix data analysis.
- Relational diagrams.
- Program decision process charts.
- Arrow diagrams.

**Affinity Diagram.**

Of the seven planning tools, one that has the widest application in the quality function deployment methodology is the affinity diagram, which provides a method for building an overall structure of ideas from a set of unstructured ideas. The hierarchy of ideas is built from the bottom up. The affinity diagram organizes the customer's views in a structure that reveals patterns and general areas of focus. The seven new planning tools, including the affinity diagram, have proved to be useful at all levels of management in an organization.

**Contextual Inquiry.**

Vital to the successful design of a new IS product or service is a thorough understanding of the requirements of the customer. Customer requirements must be gathered in a thorough and orderly fashion. A technique called contextual inquiry, developed by Digital Equipment Corporation in the late 1980s, is a means of gathering information from customers about their work practices and experiences.\(^{80}\) The contextual inquiry approach is based on field research techniques and focuses on interviewing users as they do actual work. Although contextual inquiry is currently used primarily in software development, the technique can be used for the design of other products and services.

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When the requirements of the customer are gathered, they must be analyzed using the quality function deployment process.

**How the QFD Process Works**

Quality function deployment, as originally developed in the 1970s, covers several aspects of design and development of products, processes, and services—for example, customer requirements, value engineering, reliability, new technology, bottleneck engineering, and other disciplines. These disciplines were integrated using many matrices to analyze relationships between different aspects of product development. Researchers have since developed a more simplified approach to quality function deployment. One approach in particular is dubbed the House of Quality.⁸¹

The House of Quality approach (see Exhibit 2) identifies the level of importance of each customer requirement and how well the enterprise is able to meet these requirements. Most important, the House of Quality identifies a number of key areas for breakthrough development of a world-class product, process, or service. For an enterprise implementing quality function deployment as part of product development, this process yields effective results in a relatively short amount of time. The House of Quality analyzes the relationships between the requirements of the customer and the design characteristics of the product being developed. This analysis investigates conflict in product characteristics and allows for a competitive assessment with similar products.

**House of Quality**

To link the quality function deployment methodology with the systems development process, it is necessary to model this interaction as shown in Exhibit 3. A modeling technique called IDEF0 is used to illustrate this link. With the IDEF0 methodology, each activity in the system is represented by a box and each activity may be hierarchically decomposed to greater levels of detail. The IDEF0 methodology also distinguishes between the various types of input to the system. The input is divided into controls, input about customers, and resources. These distinctions enhance the value of the model at greater levels of detail.

**Customer Interaction Model Using the IDEF0 Methodology**

**QFD and Systems Development**

The systems development process occurs in a number of distinct stages called the systems development life cycle; the cycle includes systems analysis, design, development, implementation, and maintenance stages. Traditionally, emphasis has been on design and development, with the result that the early stages of customer requirements analysis were neglected. It is the aim of the Quality Function Deployment methodology to correct this weak customer link and carry the requirements of the customer through every stage of product development.

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Building the Customer Interaction Model

In the high-level diagram of the Customer Interaction Model shown in Exhibit 3, the quality function deployment function is identified as a separate function to give it priority as an important component in the development of a quality product that successfully meets customer requirements. Quality Function Deployment is also an ongoing function with many components (including quality function deployment planning and contextual inquiry) that maintains a direct line of communication between the customer and the systems development team throughout the development and maintenance of the product. The controls in the Customer Interaction Model are illustrated as arrows entering the model from the top.

Marketplace feedback is the first control and includes customer complaints, field reports, and returns. Information on customers (i.e., end users) is illustrated as a single input to the model. This information includes all customer categories including potential customers.

Among the resources for the quality function deployment function are the quality function deployment tools and technique. The quality function deployment facilitator is a separate resource. The facilitator is a trained person who manages the entire Quality Function Deployment process. The final resource of the quality function deployment function is inherent in any ongoing business and includes personnel, facilities, technology, experience, and equipment. IS management is depicted as an output from the systems development function and feeds into the quality function deployment function as a resource. IS managers and other personnel (including enterprise management) are trained in quality function deployment and subsequently act as a resource to the systems development function. This completes a very important loop in the training of personnel in the principles of the quality function deployment methodology.

There are two other links in the Customer Interaction Model in Exhibit 3. As a result of the analysis of customer data by the quality function deployment function, ideas and new product concepts may arise. The quality function deployment output is the final link between the Quality Function Deployment and systems development functions of the Customer Interaction Model. The quality function deployment output may be summarized in the form of Pareto diagrams. The output of the model is Quality Information System.

> The QFD Function Decomposed

The quality function deployment function may be decomposed into three activities in the next level of detail (see Exhibit 4):

- A function to manage customer interaction.
- A facilitator to manage the quality function deployment process.
- The implementation of quality function deployment results in the product development process.

QFD Function Decomposed

These three activities reflect the three distinct phases that take place in the quality function deployment methodology.
The first function, for managing customer interaction, has two goals:

- Preparation for the quality function deployment process.
- Maintaining a customer link during the product development process.

The quality function deployment facilitator usually conducts an actual quality function deployment planning session for the benefit of those who will be conducting this study. The goals of the quality function deployment planning session are to:

- Decide the focus of the quality function deployment.
- Identify customer categories.
- Identify any competitors.
- Plan and manage customer visits.
- Prepare the logistics of the quality function deployment process.

Whereas the quality function deployment planning session may be a one-time occurrence, the customer link must be maintained during the development process to get feedback on progress and other aspects of system design. This element of the customer interaction function results in a closed loop and a continuous communication link between the systems builders and the customers throughout the life cycle.

The second activity of the quality function deployment function is to conduct the actual quality function deployment process and the House of Quality analysis. The final activity is implementing the results of the quality function deployment. The results of quality function deployment are implemented by the systems development team members that participate in the quality function deployment process.

**Systems Development Function Decomposed**

The systems development function is decomposed into the four components in Exhibit 5. The systems development group develops design specifications for the system. It then develops the information system based on design specifications and subsequently tests these products. The systems development group supplies instructions and resources to maintain the products in successful use in the field. These functions are integrated and directed by the managerial function, which directs and administers the total systems development operation.

**Systems Development Function Decomposed**

Input to the systems development function comes mainly from the quality function deployment function of the Customer Interaction Model. The input includes new product concepts and quality function deployment output. The systems development function uses the input to create its output: systems, documentation, support resources, and progress reports to enterprise management. The output of the Quality Function Deployment also influences the product definition at an enterprise management level.
Two resources that are an outcome of the quality function deployment function act as input to the systems development function: the quality function deployment report and the personnel trained in the quality function deployment process. The Quality Function Deployment output is only a summary of the results of the quality function deployment and therefore needs a detailed report to support its content. Reports and new product concepts are essential feedback in order to guide the organization in its development of quality products and services.

QFD: A Cornerstone of TQM

IS Case Study

To test and validate the Customer Interaction Model, it was applied in an industrial test site in the IS department of a US multinational company. A case study is presented that highlights the main points of implementing the Quality Function Deployment methodology.

The responsibility for implementation of the quality function deployment methodology rests with the voice of the customer group, which is a subset of the QA group. The voice of the customer group members consists primarily of IS department members and includes representatives from the entire enterprise.

An examination of the product development process within the IS department was initially done to uncover the weak links between customers and the developers of information systems within the enterprise. Next, a plan was prepared for building a customer interaction process in the IS department. Three distinct stages were identified for the adoption of the quality function deployment methodology in the IS department:

- Management breakthrough thinking.
- Awareness and training (phase one implementation).
- Full integration to the systems development process (phase two implementation).

Management Policy.

As with the implementation of any process that involves system changes at an enterprise level, corporate management must see and understand the need for such changes. A management policy was published within the enterprise that outlined management's commitment to strengthening the customer interaction process within the IS department as a means of improving quality. The first priority of the IS management was to initiate a renewed awareness among IS personnel of the importance of customer interaction in the design process.

Implementing the QFD Methodology.

A number of milestones were reached in the implementation of phase one over a 12-month period. An implementation plan was developed by the voice of the customer group, and a study was conducted on the processes and tools necessary for the quality function deployment methodology. The application of each process and tool was identified along with its relevance to the IS department and whether or not training was required. The
main points of the implementation plan, developed by the voice of the customer group, are listed in Exhibit 6. Some sample metrics are shown in Exhibit 7.

## Implementation Plan

### Voice of the Customer Metrics

<table>
<thead>
<tr>
<th>Metric</th>
<th>Jan</th>
<th>Feb</th>
<th>Mar</th>
<th>Apr</th>
<th>To Date</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of software development groups supported by voice of the customer program</td>
<td>1</td>
<td>4</td>
<td></td>
<td></td>
<td>5</td>
</tr>
<tr>
<td>Number of groups using QFD</td>
<td>1</td>
<td>1</td>
<td></td>
<td></td>
<td>2</td>
</tr>
<tr>
<td>Number of direct customer visits</td>
<td>1</td>
<td>1</td>
<td>2</td>
<td></td>
<td>4</td>
</tr>
<tr>
<td>Number of customer contacts (surveys, phone, etc.)</td>
<td>0</td>
<td>0</td>
<td>30</td>
<td>30</td>
<td>30</td>
</tr>
<tr>
<td>Number of field reports received</td>
<td>0</td>
<td>0</td>
<td>1</td>
<td></td>
<td>1</td>
</tr>
</tbody>
</table>

A document was published within the IS department entitled “Guide to Customer Visits” that outlines important aspects in conducting a contextual inquiry, including recommended forms and questions that may be asked during the interview (see Exhibit 8). This document helps to achieve a reasonable degree of consistency between different interviewers visiting different sites.

### Exhibit 8. Interview Tips from the Guide to Customer Visits

**Establishing Partnership with the Customer**

To establish a partnership, the interviewer should:

- Explain the importance of customer participation in the interview.
- Explain that the customer knows his or her work.
- State that there is no prepared list of questions.
- State that you want the customer to show you what is important to his or her work.
- Ask specific questions about the customer’s position in the company, background and education, past experience with computers, experience with a specific product (if appropriate) and what customer liked or disliked about that system.
- Know the customer's full name.

**Contextual Inquiry**

To uncover design opportunities, the interviewer should:

- Let the customer’s work guide the discussion.
- Keep questions open-ended.
- Expand or change focus if necessary.
- Probe for solutions or workarounds.
- Follow-up on comments that contradict your entering assumptions.
- Interpret the work with the customer.

**Discuss the Work**
When discussing the work, the interviewer should:

- Ask to see an example when customer refers to any kind of work. The interviewer should guide the customer to speak from concrete, ongoing work or recent projects.
- Ask the customer to perform some work using a particular tool that he or she mentions.
- Use questions that keep the conversation focused (e.g., “What are you doing and why? Is that what you expected? Can you show me?”).
- Highlight important points when taking notes and refer to these points in the wrap-up interview.

** Probe Behind Workarounds**
Here, the interviewer should:

- Ask about the workarounds that the customer has developed to avoid or solve problems.
- Probe behind the workaround to see how the customer thinks about the structure of his or her work.
- Ask the customer to pay close attention to how and when the tools disrupt work flow.
- Check that his or her assumptions about specific problems are the same as the customer's.

**Design a Solution**
To design the best possible solution, the interviewer should:

- Share interpretation and design ideas, stopping to confirm that the interviewer is hearing the customer correctly.
- Ask why the customer requested changes to software.
- Use Post-It notes to represent concepts or design ideas so that the customer can visualize the ideas and validate them.
When illustrating a prototype, ask the customer to interpret the meaning of an object or display.

Note what matches and does not match his or her intention; probe behind the mismatches to see how the customer thinks about the work.

Work with the customer on design alternatives that match the customer's interpretation of work.

Note how long it takes to explain a concept that the customer does not intuitively understand.

Note your process for clarifying information.

**Wrap Up the Interview**

In closing, the interviewer should:

- Summarize the critical issues for the customer.
- Ask if there is anything the customer thinks the interviewer should follow up on or capture.
- Ask about preferred questions or design ideas that did not arise during the interview.
- Give the customer hints or suggestions on system use as appropriate.
- Ask to call or visit again; invite the customer to call with any additional questions or information.
- Thank the customer for participating.

The final part of phase one implementation centered on the quality function deployment process. The most effective approach to training design groups in the quality function deployment process is to use a real-life project. This approach was adopted under the direction of the voice of the customer group. The goal of the pilot quality function deployment was to provide input to an upgrade version of an existing system. Another important aim was to train several-in-house Quality Function Deployment facilitators, which enables the IS department to continue with an independent implementation of the quality function deployment methodology. A skilled quality function deployment facilitator from corporate training was assigned to lead the pilot quality function deployment. The voice of the customer group and the quality function deployment facilitator then put a plan together to execute the pilot Quality Function Deployment process.

A planning session for the pilot quality function deployment was scheduled and attended by the facilitator, the development team, and personnel being trained in quality function deployment facilitation. A four-day quality function deployment was then conducted on the system. A systems development team emerged, familiar with the quality function deployment process and with tangible input to the upgrade version of the system being examined. Better trained in-house facilitators also emerged. A “QFD Facilitator’s Handbook” was published by the IS department. The document outlines the quality function deployment process, but more important, the handbook highlights important
pointers for resolving conflict within the group and developing interpersonal sensitivity, organization, and motivation skills that facilitate the process. This approach to on-the-job training maintains the momentum of the implementation of phase one within the group.

Phase two of the quality function deployment implementation in the industrial test site is presently being examined in detail. Phase two implementation is the total integration of the quality function deployment methodology into the systems development process after the IS department is familiar with the Quality Function Deployment process and its impact, based on the pilot project.

**Conclusion**

The Customer Interaction Model described in this article was developed in conjunction with the early implementation of the Quality Function Deployment methodology in an IS department. The real-world experience adds value to the model for other IS departments developing a similar customer interaction process in their enterprise.

The Customer Interaction Model is a synthesis of the quality function deployment methodology and the systems development process. The primary goal of the process described is to provide IS managers and their staff with a road map on how best to make the Quality Function Deployment methodology a routine part of the systems development process. The model addresses both social and technical integration issues. The IDEF0 modeling technique was used to create the model because it clearly describes QFD's impact on the systems development process and identifies popular tools and techniques, highlighting the stage of the quality function deployment methodology where they are applicable. The structure of the model, in its gradual decomposition of detail, highlights the need for management commitment for the successful implementation of the quality function deployment methodology.

The quality function deployment methodology is a principle cornerstone in the broad-based pursuit of a Total Quality Management culture in an IS department, and when integrated through the use of the Customer Interaction Model, it can help improve operations and effectively orchestrate many of the desired attributes, processes, and tools of total quality management (TQM). The Customer Interaction Model illustrates that the quality function deployment methodology has great potential in the development of a more holistic approach to information systems design.

**Author Biographies**

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William J. Egenton is a process development engineer in the Process Technology Group, Corporate Technology Europe, Raychem Ltd., in Swindon, United Kingdom. His work and development of the Customer Interaction Model was conducted while serving as a research engineer with Digital Equipment Corp., Galway, Ireland.

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David O'Sullivan is a lecturer and research manager with the Quality Assurance Research Unit of University College Galway. He has more than 10 years' experience in industry as a design engineer, manufacturing engineer, and more recently as a systems analyst. His current research interests are in business systems redesign.
Identify Processes and Tools of the QFD Methodology
- Customers Surveys
- Contextual Inquiry
- QFD Process
- Seven Management Tools

Guide to Customer Visits

Manage Customer Requirements Gathering
- Contextual Inquiry Training
- Customer Visit Planning
- Conduct Customer Visits

QFD Facilitator or Handbook

Conduct Pilot QFD Process
- QFD Planning
- Training in QFD
- QFD Process
- Results of QFD

Prioritized Customer Requirements and Design Characteristics