



## A COMPUTERIZED QUALITY FUNCTION DEPLOYMENT APPROACH FOR RETAIL SERVICES

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(Received 1 October 1995)

**Abstract**—Product and service quality can only be effectively improved when the most important needs of customers are satisfied. Quality Function Deployment (QFD) is an approach used to guide R&D, manufacturing, and management toward the development of products and services that satisfy the needs of consumers. The QFD operations are performed by way of a diagram called the House of Quality (HOQ). The HOQ contains information about the customers' needs (what), mechanisms to address these needs (how), and the criterion for deciding which "what" is the most important and which "how" provides the greatest customer satisfaction. A less familiar application of QFD is for the improvement of retail services. When QFD is applied to retail services, a computerized HOQ approach becomes integral to the process for providing continuous, iterative quality improvement. The objective of this research is to develop a formal QFD methodology for the retail industry and to build a computerized retail QFD system. The system provides a HOQ architecture for specifying and analyzing the customers' needs, deriving improvement strategies, and formalizing records of progress. Furthermore, two ranking methods that apply customer satisfaction theory are used to assist managers improve retail services. This system provides an integrated workbench for building retail HOQs and designing retail service strategies. Copyright © 1996 Elsevier Science Ltd

### 1. INTRODUCTION

The definition of product quality to the consumer is the ability of that product to achieve the expected functions [1]. When the product matches these basic expectations, not much happens to the consumer's conception of the product. However, exceeding the consumer's expectations develops a feeling of satisfaction and brand loyalty toward the company and product [2]. When the product fails to satisfy the consumer's expectations, the consumer becomes dissatisfied and the company loses the competitive and strategic advantage of product quality [3]. In the retailing sector, products for sale include both goods and services. Since the consumer's expectations are the key elements in determining satisfaction with the quality of products, retail management faces a challenge to link these expectations of quality with their goods and services [4].

Quality Function Deployment (QFD) is a team based, graphically oriented approach for concurrent quality improvement of products directly influenced by the Voice Of the Consumer (VOC) [5]. The deployment of the technique requires people from different departments (e.g. management, marketing, design, engineering and production) to work together. As a team, these people link the consumer's expectations of quality with actual designs, plans, processes, and solutions for products and services. The team uses a graphic medium called the House of Quality (HOQ) to integrate and communicate ideas [5].

The HOQ facilitates group decision making by providing team members with a structured framework and an organized approach to improve the product/service quality and to satisfy the customer's expectations. Figure 1 [5, 6] depicts the basic structure of the HOQ. Brown [5] proposes six basic steps for building the HOQ:

- (1) Identify the VOC as WHATs. Determine what the customer feels is important about the product. The WHATs express; in the customer's own words, the original information about the production functionality. In addition, some parameters given to the WHATs establishes the rating or priority for the WHATs to be achieved or improved.

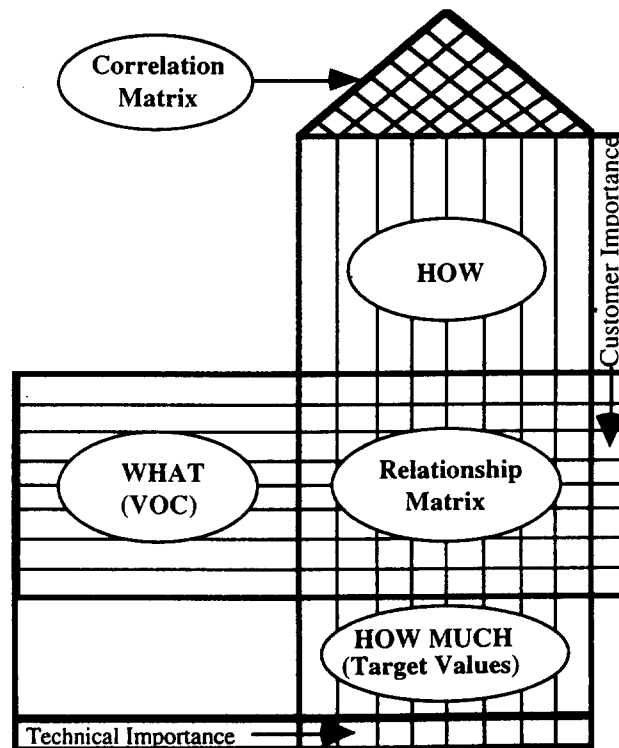


Fig. 1. The house of quality.

- (2) Identify the HOWs. Possible plans of action result from the team's review of what the consumer thinks is important about the product. Thus, the HOWs specify the plan of action to satisfy the customer.
- (3) Relate the WHATs with the HOWs. A relationship matrix links the consumer's list of items to management's action plans. Each relationship weight signifies the degree of satisfaction achieved by the plan of action.
- (4) Specify the interactions between the HOWs. The roof of the HOQ represents a correlation matrix identifying the degree of interdependence between plans of action.
- (5) Determine HOW MUCH. After considering the different WHATs for each HOW, a decision specifies HOW MUCH. In essence, this step places a dimension on each plan of action.
- (6) Rank the HOWs. Each HOW satisfies the WHATs to different degrees (step 3), which describes the technical importance of the HOWs. Thus, the technical importance ranks the HOWs according to satisfaction of the WHATs.

The objective of this research is to develop a formal QFD methodology for the retail industry and to build a computerized retail QFD system. Based on the retailing characteristics, we provide a HOQ architecture and a practical procedure for collecting QFD data, analyzing the retail customers' needs, and deriving the improvement strategies. Furthermore, two unique evaluation algorithms, based on customer satisfaction theory, are developed to assist the manager making the improvement decisions. This system provides an integrated workbench for building retail HOQs and designing retail service strategies.

## 2. APPROACHES FOR RETAIL QFD

The objective of this research is to develop a formal QFD procedure for retail industry, particularly to improve retail services. The procedure provides retailers with a framework for communications and a platform for building and structuring knowledge about services. Since there are many differences between engineering applications and retail applications, it is not suitable to use the engineering QFD approach directly. As indicated by Apte and Reynolds [7], quality

Table 1. Retail QFD application vs. engineering QFD application

	QFD for retail	QFD for engineering
WHAT	Dynamic, unpredictable	Predictable
HOW	Creative approaches	Crisp engineering attributes
Target value	Dynamic	Fixed
Decision making	Biased, too much data	Design of experiments
HOQ architecture	More flexible	Stage by stage

management in manufacturing follows from understanding the consumer, defining the product based upon this understanding, and then producing the product according to specifications. But designing high quality retail service operations requires including the consumer as an integral part of the process. As an integral part of the process, the consumer's interaction with the environment and the outcome of the interaction weigh heavily in building and maintaining satisfaction. Table 1 lists the comparison of retail QFD applications and engineering QFD applications. For an engineering QFD application, the objective is to bring new or carryover products to market sooner than the competitors with lower cost and improved quality [8]. Since the basic functions of a product are pre-determined and do not change quickly or extremely, the design requirements from management and customers are fairly stable and predictable. The product control characteristics for meeting these requirements are crisp. Engineers set the target specifications for the product based upon their experiences, historical data, and product design research. The HOQ architecture transmits design requirements and the consumer's requirements through all manufacturing stages to assure that final products meet the requirements.

Unlike the engineering QFD application, the customer service targets for retail organizations are extremely flexible and dynamic. More often than not, the retailer is overloaded with data from multiple sources. The retailer has data from check-out registers, data from vendors, data from employees, and data from the customers. Without a method to integrate the data, and due to the time constraints of retail decision making, the manager uses whatever data is on hand and on the desk and often making biased decisions [9]. The consumer's requirements for service are often neglected in the service design process. Furthermore, the determination of customer requirements, service targets, and priorities often result from habit and convention, not from integrated planning. Thus, retail managers need new algorithms, new knowledge-based systems, and new computer platforms for decision making [10]. The retail QFD has a greater need for flexibility and automated decision making, and the HOQ architecture must be able to organize multiple types of data, assist the manager to identify problems, and provide a framework for solution. The following sub-sections discuss the main steps in retail QFD implementation carried out in this research. Section 2.1 describes a method for collecting data from the consumers (the VOC). Section 2.2 depicts how the WHATs and the HOWs can be ranked and partitioned using heuristic algorithms. Finally, Section 2.3 describes the computerized HOQ system that provides the retailer with a framework and workbench for customer information management and quality improvement decision making.

### 2.1. Survey methodology

The process of collecting the VOC begins with the Critical Incident Technique [14]. The technique has found widespread use in leadership, management, human resource, and education studies but has only recently emerged as a contender to the more popular survey type assessments of customer service [11–13]. The Critical Incident Technique is less rigid and less culturally bound than structured consumer surveys. The technique reveals the incidents of the experience because it simply asks people to explain what causes satisfaction and dissatisfaction in their own words. There is no pre-determination of what will be important to a customer. All narratives written by customers are analyzed and prevailing themes are identified [14]. Based upon the frequency of the themes, a formal attitude survey is designed to collect the VOC data. Since there are so many service dimensions to explore, the most frequently mentioned themes are good bases for forming the attitude questionnaire.

Following the critical incident survey, a multi-attribute questionnaire is applied as a structured approach to measure consumer attitudes [15]. There are two parts to the questionnaire. First, the

customer is asked to rate the relative *importance* of a set of attributes which describe a general product or service. Second, given a product or service of a particular retail store, the consumer is asked to use the same set of attributes as the basis of evaluation. The second part of the survey measures the customer *beliefs* about the product or service provided by the retail store. The importance attributes are used to weigh the belief attributes. The weighted sum of the attributes is the multi-attribute measure of consumer attitude. The use of both importance and belief measures helps to clarify and to focus the management's attention on the right product or service characteristics.

After the critical QFD method and service quality improvement, feedback is used to modify the survey. Re-surveying provides more information about dissatisfaction and other service problems as they emerge. Survey planning for the retail QFD application is depicted in Fig. 2.

## 2.2. Evaluation algorithms

The QFD process usually generates a large amount of data [16], particularly in retail applications. In addition, the number of plausible solutions for satisfying the customer may be large. Since it is impossible to meet all customer needs, management sets priorities and selects items for implementation. Two ranking methods are developed, using customer satisfaction theory [17] to set the priorities of the WHATs and the HOWs.

*Quality Attribute Ranking.* Since all QFD operations are derived from the result of VOC surveys, a general and practical framework is desired for accurately measuring the VOC, structuring the customer's needs, and rating the priorities of these needs. The Quality Attribute Ranking method is developed to undertake this task. This methodology assumes that a multi-attribute questionnaire is used to record the VOC. In order to create a subset of the attributes most critical to the consumer, the following ranking and sub-setting procedure is used:

- $RI_i$ :  $RI_i$  is the importance rank of attribute  $i$ . When there are  $n$  attributes,  $RI_i$  is an integer between 1 and  $n$ . When  $RI_i = 1$ , the attribute is the most important attribute among the group of attributes. When  $RI_i = n$ , the attribute  $i$  is the least important attribute among the group of attributes.
- $RB_i$ :  $RB_i$  is the belief rank of attribute  $i$ . When there are  $n$  attributes,  $RB_i$  is an integer between 1 and  $n$ .  $RB_i = 1$  represents that the attribute  $i$  is the most believed attribute among the group of attributes.  $RB_i = n$  represents the attribute  $i$  is the least believed attribute among the group of attributes.
- $VI_i$ :  $VI_i$  is the importance scale value of attribute  $i$ . Typical survey instruments used to measure the VOC use integer values ranging from  $-2$  to  $2$  (Table 2). The larger the value, the more important the attribute to the consumer when evaluating a general type of product. Afterward,  $VI_i$  is rescaled to  $VI_i^* = (3/2) \times VI_i$  (ranging from  $-3$  to  $3$ ) in order to be on the same scale range as  $VB_i$  to prevent the significance deviation.

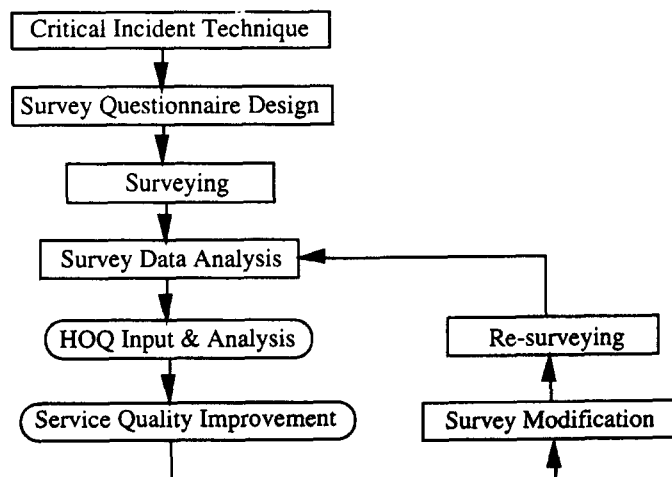


Fig. 2. Survey planning and implementation.

Table 2. The importance part of the customer requirement survey

How important to you are the following customer service goals?(Use a $\sqrt{\quad}$ )					
	Not at All Important	Not Very Important	Cannot Decide	Somewhat Important	Very Important
1 clerk is happy and willing to serve	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>
2 clerk does not argue or complain	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>
3 store is clean	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>
4 store has product discounts and sales	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>
5 store has good product quality	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>
⋮					

$VB_i$ :  $VB_i$  is the belief scale value of attribute  $i$ . The integer values ranges from  $-3$  to  $3$  (Table 3). The greater the value, the greater the consumer’s belief that the company’s product has the attribute.

The multiplications of the adjusted importance and belief scales are used to compute the consumer’s “attitude” toward the corresponding attribute [22]:

$$Q_i = VI_i^* \times VB_i.$$

Further, the difference between importance and belief rank values are used to compute the degrees of incongruence [18]:

$$K_i = RI_i - RB_i.$$

$A_i$  represents the consumer’s attitude toward a given service attribute measured by the specific belief scale and weighted by the importance scale.  $K_i$  represents the ranked difference between the consumer’s importance and belief of a specific service attribute. Both indices ( $A_i$  and  $K_i$ ) are the first-step indication of whether a specific attribute yields customer satisfaction and whether the attribute should be selected to improve customer satisfaction. Thus, given the ranks, the scale values, the measures for attitude  $A_i$  and the congruence  $K_i$ , a subset of the most “critical attributes” can be created. In our retail HOQ, the service attributes consisting of both negative  $K_i$  and negative  $A_i$  (i.e. when  $VI_i$  is positive and  $VB_i$  is negative) values are selected as the critical attributes for improvement. Thus, the  $K_i = 0$  and  $A_i = 0$  lines are used to split the attribute set into four quadrants in the 2-axis ( $K_i \times A_i$ ) space (an example shown in Fig. 3). Given the split sets, the items in the third quadrant, are further ranked using two criterion. First, when  $K_i$  is smaller (a negative smaller value), the corresponding attribute  $i$  should have a higher priority to be improved. Second, when  $A_i$  is smaller (a negative smaller value), the corresponding attribute  $i$  should have a higher priority to be improved. Using these steps, a sub-set of the top attributes (WHATs) is created, enabling the QFD team to focus efforts on the priority issues.

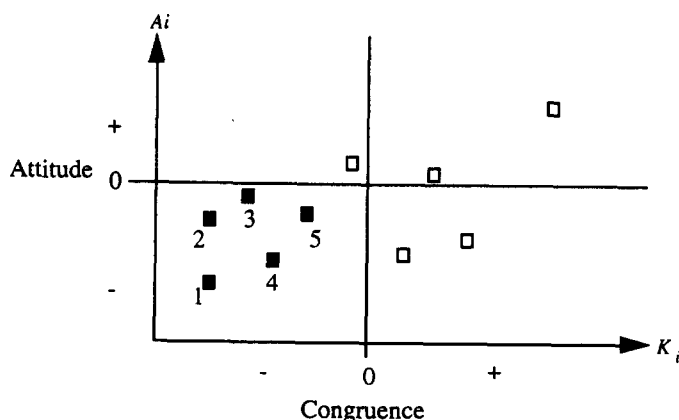


Fig. 3. Distribution of the quality attributes in terms of congruence and attitude (numbers indicate attribute rank from 1 = highest priority to 5 = lowest priority).

	central distribution	advertising	.....	clerk training	$P_i$	$W_i$
store has reasonably priced products	7.5	5			1	$m/s$
products are fresh	8	4			2	$m-1/s$
.....			$M_{ij}$			
clerk is happy and willing to serve				7	$m$	$1/s$
$C_j$	9	6		5		
$U_j$	$U_1$	$U_2$		$U_n$		

Fig. 4. Utility function ranking for the HOWs.

**Utility Function Ranking.** The Utility Function Ranking method is used to rank and reduce the HOWs. This method considers the HOWs' contribution to customer satisfaction ( $\sum W_i \times M_{ij}$ ) and the cost of implementing a solution ( $C_j$ ). The trade-off between customer satisfaction and cost depends on the manager's decision emphasis. An adjustment factor  $R$  represents the trade-off. Thus, the objective of the Utility Function Ranking method is to provide the greatest customer satisfaction under the allowed costs. As depicted in Fig. 4, the following items are needed for ranking the HOWs:

- $P_i$ :**  $P_i$  is the priority of WHAT <sub>$i$</sub> , ranked by the Quality Attribute Ranking algorithm. When there are  $m$  reduced WHATs,  $P_i$  is an integer between 1 and  $m$ . When  $P_i = 1$ , the corresponding WHAT <sub>$i$</sub>  is the most important WHAT among the group of reduced WHATs.
- $W_i$ :**  $W_i$  is the weight of reduced WHAT <sub>$i$</sub> . The higher the WHAT priority is, the greater its weight is. In order to make the sum of  $W_i$  equal to 1,  $s = \sum P_i$  is used to normalize  $W_i$ . Hence, the  $W_i$  values range from  $m/s$  to  $1/s$ , where  $i$  is from 1 to  $m$ .
- $C_i$ :**  $C_i$  is the cost of implementing HOW <sub>$i$</sub> . It is deterministic value set by the manager.
- $M_{ij}$ :**  $M_{ij}$  is the effectiveness of HOW <sub>$j$</sub>  action toward WHAT <sub>$i$</sub>  consumer's need. The effectiveness values range from 1 to 10. The greater the value, the greater the HOW <sub>$j$</sub> 's contribution to achieving WHAT <sub>$i$</sub> . The value is generally assigned by the manager in assessing the HOW-WHAT relationship.
- $R$ :** It is an uncertain trade-off factor which can be derived with fuzzy inference [19]. This value provides a weight to reflect the management's attitude toward profit- or cost-orientation. For instance, when  $R$  is set as a large value, it represents the management is rather conservative in spending money for customer satisfaction.

The variables described above are used to calculate each HOW's utility:

$$U_j = \sum_{i=1}^m W_i \times M_{ij} - R \times C_j \quad \forall i = 1, \dots, m, \quad \forall j = 1, \dots, n.$$

Finally, utility values are ranked. When  $U_j$  is greater, the corresponding HOW  $j$  should have a higher implementation priority. In order to reduce the number of HOWs, the mean utility value is used to partition the set into subsets.

### 2.3. Retail HOQ architecture

There are two HOQ transformations which are useful for analyzing retail service offerings—the hierarchical HOQ and the reduced HOQ (Fig. 5). The hierarchical HOQ provides a structure for detail and strategic action. Each WHAT and HOW can be subdivided from the HOQ to establish a new HOQ. Because these HOQs are linked, information can be communicated from one house to another. On the contrary, the reduced HOQ provides a structure for minimizing the size of HOQ. The WHATs and HOWs are reduced by evaluation algorithms such as the Quality Attribute Ranking method and the Utility Function Ranking method. The reduced HOQ allows the manager to focus on critical customer needs and specific tasks. The procedure of building a set of HOQs using these transformations is depicted in Fig. 5.

QFD concepts combined with these service-oriented approaches construct a prototype of the retail QFD application. The HOQ execution procedure requires accurate data input from various sources, record keeping in stages of decision making, and computerized algorithmic calculations. Thus, an interactive software environment is developed to automate and facilitate this group decision process. Details about the computer-aided QFD system are provided in Section 3.

## 3. IMPLEMENTATION

The object-oriented programming environment [20] is selected to implement the QFD. First, the OOP concepts for the retail QFD application are described. Second, the interactive software called computer-aided QFD (CAQFD) system is described. All the man-machine interfaces are designed based on the retail HOQ architecture. The system provides computerized tools to assist the QFD operations previously described.

### 3.1. QFD representation with OOP concepts

The QFD for retail application is represented with object orient concepts in the Smalltalk interactive environment [21]. All classes in Smalltalk form a hierarchy by way of super- and sub-class relationships. A class can inherit properties from its super class. The root of this hierarchy is a system default class called *Object* which is the primary class for all classes to be inherited. The following list describes two kinds of classes declared for the QFD implementation. One class is for data representation and the other class is for the specification of QFD operations [4]. The OOP representation maps naturally to the QFD objects and data used to describe the contents of HOQ [21].

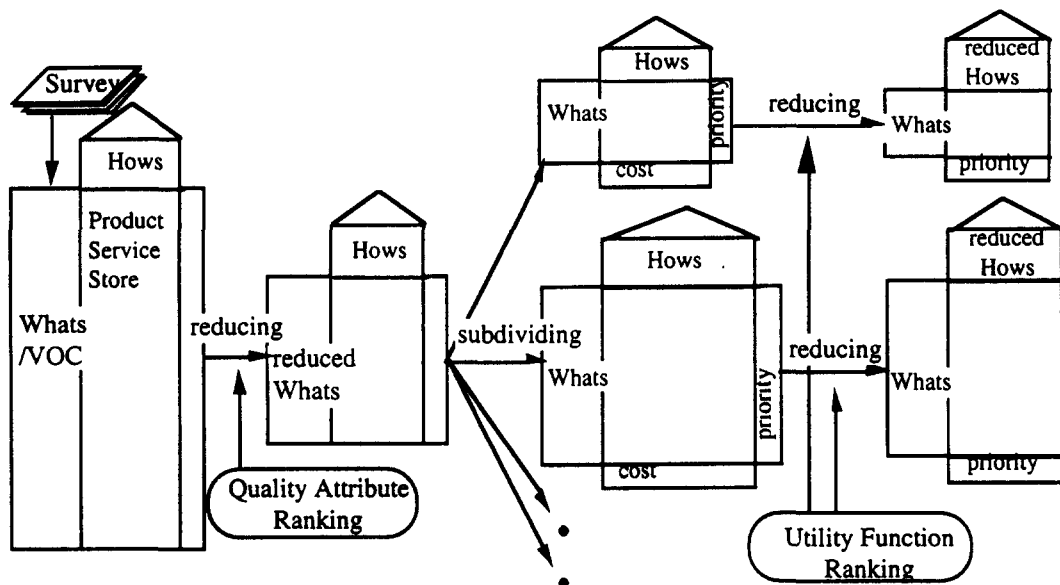


Fig. 5. The retail HOQ practice procedure.

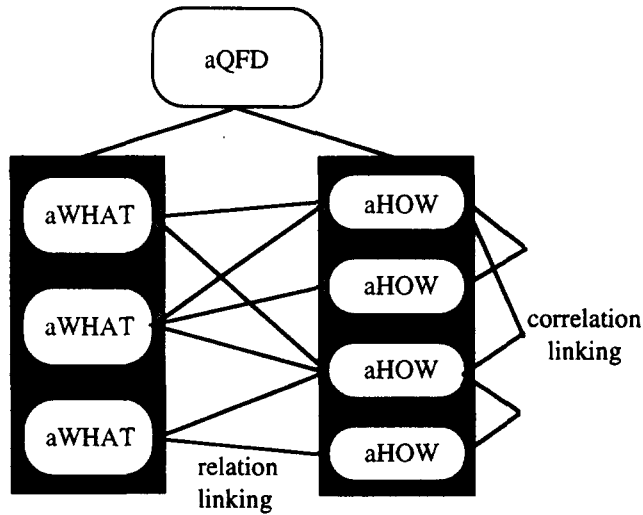


Fig. 6. HOQ data and links.

- (1) *QFD*, *WHAT*, and *HOW* are three classes for describing the basic data of the HOQ. The class definition creates the class's inheritance connection with its super-class. It also locates the class in the class hierarchy. Instances created from *QFD* class are used to store the information of the HOQs. The *WHAT* instances and *HOW* instances are used to record the *WHAT* data and the *HOW* data. The relationships of *QFD*, *WHAT*, and *HOW* are shown in Fig. 6. The variables are also defined in the class definition. The class variables record the common attributes shared with all class instances and the instance variables record the private attributes which are varied from instance to instance. In addition, the programmer defines the protocols for each class. The protocols contain many methods (subroutines) which are used to specify the behavior of class such as data accessing and data processing.
- (2) *QFDManager* and *HOQManager* are two classes for handling QFD operations. The instance of *HOQManager* performs the HOQ operations using interactive windows. The

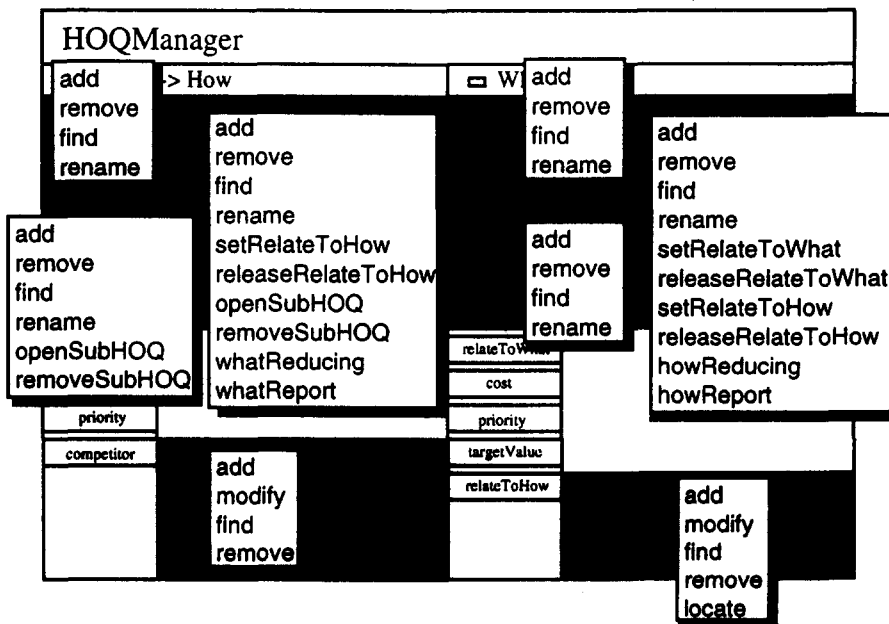


Fig. 7. Menus for the CAQFD interface.



QFDManager instance is created to manage the QFD data base. These two “managers” bring the QFD operations from the paper diagram to a multi-window, menu-driven environment with interactive man-machine interfaces.

### 3.2. CAQFD system development

The CAQFD interface shown in Fig. 7 represents the computer-based extension of the graphical HOQ depicted in Fig. 1. This interface uses the Model-View-Controller (MVC) architecture. The MVC architecture provides a mechanism for specifying the data model, the display view, and the interactive controlling flexibly [21].

The CAQFD interface is driven by pop-up menus. The menu options for each view are shown in Fig. 7. The interface uses dialog windows for requesting input and warns the user when incorrect operations occur. The operations are organized as follows.

- (1) **WHAT manipulation:** The categorized customer requirements are added to the left half of the CAQFD interface. Some dialog windows pop-up to request the input of data. Other operations such as removing, finding, and modifying are performed by selecting the menu’s commands or pressing the information buttons. Information displayed in the WHAT-information view and the customer-perception view will update automatically when the WHAT view is selected.
- (2) **HOW manipulation:** Similar to the manipulation of WHAT, the HOWs are categorized into the right half of the CAQFD interface. Information about the HOWs are input via dialog windows. The HOWs are manipulated the same way as the WHATs.
- (3) **Setting relationship:** If the relationship setting commands are selected, links will be established between the selected WHATs and the selected HOWs. To establish the relationship between two HOWs, the user selects the relationship setting command in related-HOW view and follows the guidance of the dialog windows. At the current development, the correlation of HOWs can be defined as a reference to the manager, but the data are not applied in strategic decision supports. There are two switch buttons in the top of CAQFD interface. If “What → How” button is highlighted, the HOWs related to the selected WHAT will be marked with “\*”. On the contrary, the WHATs related to the selected HOW will be marked with “\*” if “What ← How” button is highlighted.
- (4) **HOQ subdividing:** If the user wants to focus on critical requirements for satisfaction, HOQ subdividing operations are performed to separate these requirements and create a sub-HOQ for each item or category of items.
- (5) **Evaluation:** The Quality Attribute Ranking algorithm is activated by selecting the “whatReducing” command in the menu of the WHAT view. The user is asked how many items are to be reduced and a WHAT-reduced HOQ is created. Similarly, the Utility Function Ranking algorithm is activated by selecting the “howReducing” command in the menu of the HOW view and a HOW-reduced HOQ is created.
- (6) **Report output:** Both menus of the WHAT view and the HOW view include a command for generating reports, i.e. whatReport and howReport.

Not all operations are allowed without specification. For example, if no WHAT or HOW is selected, the operations of setting relationship can not be performed. Hence, the menu of each must be state-dependent. Thus, the menu provides different commands for different operation states and prevents incorrect operations from occurring.

## 4. CAQFD FOR SUPERMARKET SERVICE QUALITY IMPROVEMENT

The objective of this research is to create a prototype of QFD for retail application. We have discussed the QFD method and established some specific decision supporting approaches for retail application. To validate the prototype, the CAQFD system is applied to a supermarket service improvement study. We call the supermarket “P supermarket” and the software was used to assist its service quality improvement program.

The QFD team includes P supermarket’s managers, the suppliers, and researchers. The researchers conducted the customer research and developed the QFD prototype. The participating

Table 3. The belief part of the customer requirement survey

How do you rate P supermarket? (Use a $\surd$ to select one)						
Extremely So	Quite the Case	Slightly So	Neither the Case	Slightly So	Quite the Case	Extremely So
1 P clerks are happy and willing to serve			P clerks are unhappy and unwilling to serve			
2 P never argue or complain			P clerks always argue or complain			
3 P is not clean			P is clean			
⋮						

managers came from the merchandise, finance, administrations, operations, and personnel departments. In addition to meetings with the researchers, the managers meet with suppliers to determine plausible improvement policies. Information obtained from the meetings and from the consumers is manipulated and analyzed using the CAQFD system.

Based upon the themes derived from the critical incident technique, fifty-one basic customer requirements were determined. Each requirement provided two questionnaire items, one for asking the importance and the other for asking the belief of the customers. The customer requirements survey which contains the two parts is shown in Tables 2 and 3.

Surveys from all stores are collected and analyzed. The fifty-one customer requirements with their average importance measure and average belief measure are input into the HOQ (CAQFD interface) (Fig. 8). These requirements are categorized by product, service, and store. To find the critical customer requirements, the Quality Attribute Ranking algorithm is activated. CAQFD

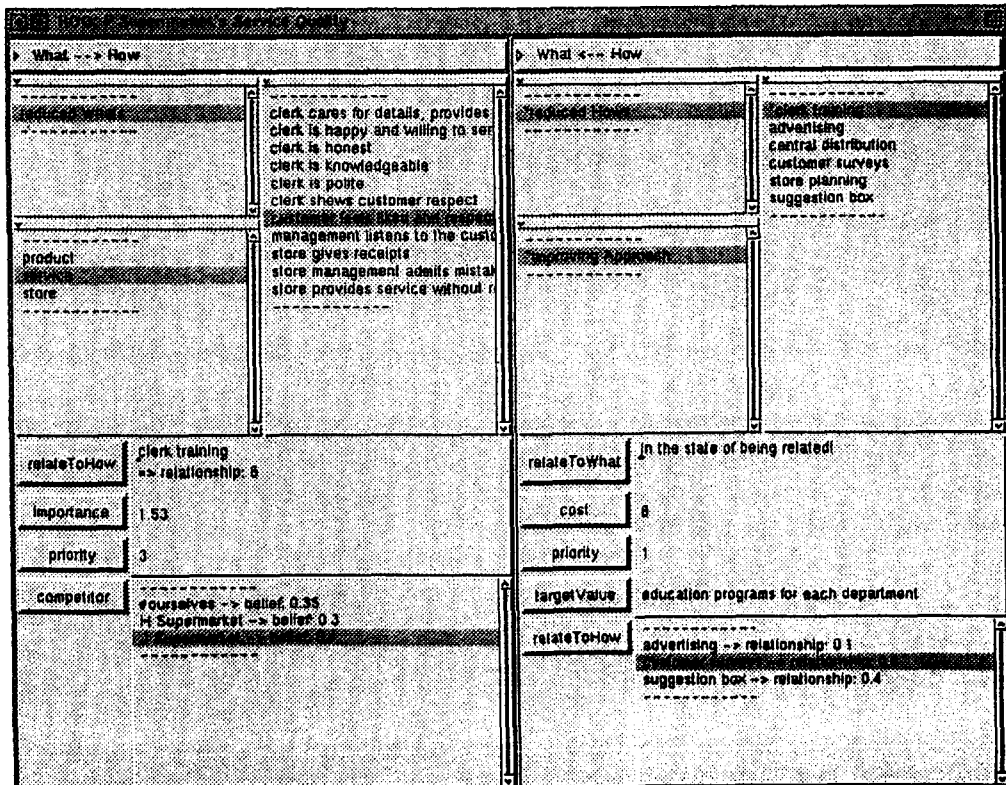


Fig. 8. CAQFD interface for the supermarket study.

provides separate HOQ interfaces and reports to assist managers to make critical decisions. The HOQ-subdividing operations of CAQFD interface provides the capability for managers to analyze the critical requirements in more detail and to create the corresponding HOWs individually (Fig. 5). There are six HOWs for meeting all the critical customer requirements: advertising, central distribution, clerk training, customer surveys, store planning, and a suggestion box. Each HOW represents an improvement program and includes a series of activities. To make tradeoffs, the Utility Function Ranking algorithm is applied to the HOWs. The priority of each critical HOW in CAQFD interface represents its contribution of meeting the critical customer requirements with consideration of cost effect. These priorities are also the basis for solving conflicting HOWs. For example, the store planning program specifies the use of green colored decorations for supporting the customers' impression of freshness. The clerk training program, however, specified a red uniform to make customers feel comfortable toward clerk. The manager decides to change the uniform color because the priority of the clerk training program is lower than the store planning program.

After implementing the improvement approaches, a new survey is distributed. The new survey focuses on the critical customer requirements originally identified and is designed for evaluating whether the customer satisfaction has improved or not. During the first quarter report for P supermarket, the consumer indicated fruit and vegetables were popular and fresh. Meat and fish, however, was considered to be less fresh than similar merchandise offered for sale in traditional wet-markets. After analysis of the CAQFD output, the manager asked the project team to focus on two new questions:

- (1) What has changed from the customer's viewpoint?
- (2) Why is P supermarket's meat offer not satisfying the customer?

To solve these problems, another QFD procedure was initiated. The second QFD procedure was used to develop more detailed and specialized service improvement strategies and actions for meat and fish products.

## 5. CONCLUSION

QFD is a unique organizational approach used to integrate a variety of data and management's objective into effective customer strategic plans. As described in this paper, the actual implementation of QFD creates a network of information which is managed to provide greater customer satisfaction. To assist the retail manager, a prototype of an object-oriented QFD system is developed. The prototype incorporates new algorithms for prioritizing the VOC items.

Our future research plan is to further develop the system for the chain of supermarkets. In addition to the goal of integrating decision making tools, we will further develop and improve computer-based algorithms and an expert system module to manipulate, link, and synthesize the data. On the other hand, a formal evaluation method needs to be implemented to compare the performance of algorithms and to provide a better decision making strategy.

*Acknowledgement*—This research is partially supported by National Science Council (NSC85-2416-H-009-002) in Taiwan, R.O.C.

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