İşletme Fakültesi Dergisi, Cilt 7, Sayı 1, 2006, 41-63

QUALITY FUNCTION DEPLOYMENT IN EFFECTIVE WEBSITE DESIGN: AN APPLICATION IN E-STORE DESIGN

Süleyman Barutçu*

ABSTRACT

Understanding customers' expectations from a product and service is one of the most important issues in marketing. Quality Function Deployment (QFD) is an effective tool to develop a product, service, process, software, website and finally e-store (online shopping website) design from customers' perspectives or wants. In this paper, how an e-store can be designed using QFD and House of Quality (HOQ) methodologies is highlighted. Researches and interviews are conducted on 30 e-customers (electronic or online shopping customers) in order to find out what e-customers want and to understand e-customers' expectations from e-store design. At the end of this study, some e-store design recommendations that will enable the e-store designer to deliver a higher level of e-customer satisfaction are made.

Keywords: Quality Function Development, House of Quality, Website Design, Internet Marketing

ETKİLİ WEB TASARIMINDA KALİTE FONKSİYON GÖÇERİMİ: SANAL MAĞAZA TASARIMINDA BİR UYGULAMA

ÖZET

Pazarlama faaliyetlerinde müşterilerin, bir mal veya hizmetten isteklerinin ve beklentilerinin belirlenmesi en önemli sorunlardan birisidir. Kalite Fonksiyon Göçerimi (KFG), müşterilerin bakış açılarına ve isteklerine göre bir mal, hizmet, süreç, yazılım, web sayfası ve sanal mağaza (internette alışveriş yapılan web sayfası) tasarımında etkili bir araçtır. Bu makalede, sanal mağaza tasarımında KFG ve Kalite Evi yöntemlerinin nasıl kullanıldığı açıklanmıştır. Sanal mağaza müşterilerinin, sanal mağaza tasarımından beklentilerinin anlaşılması ve müşterilerin ne istediklerinin ortaya çıkarılması amacıyla 30 sanal mağaza müşterisiyle görüşmeler ve araştırmalar yapılmıştır. Bu çalışmanın sonunda, sanal mağaza tasarımcılarının e-müşteri memnuniyeti düzeyini arttırmakta yararlanabilecekleri tasarım önerilerinde bulunulmuştur.

Anahtar Kelimeler: Kalite Fonksiyon Göçerimi, Kalite Evi, Web Sayfası Dizaynı, İnternette Pazarlama

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QUALITY FUNCTION DEPLOYMENT IN EFFECTIVE WEBSITE DESIGN: AN APPLICATION IN E-STORE DESIGN

INTRODUCTION

The concepts of internet marketing and e-store (electronic store) made a revolution in marketing and retailing fields and provided competitive advantage for online merchants. Traditional shopping started to move aggressively into the use of e-stores in the developed countries. For example, in 2002, internet sales increased to $76 billion, 48% more compared to the prior year, and internet sales were expected to continue to grow up to $269 billion by 2005 in the USA ("Forrester Research", 2002; "Forrester Research", 2003). In 2005, 13.93% of the population was internet users between April and June, and 5.59% of internet users benefited from purchasing/ordering goods and services over the internet in Turkey ("Türkiye İstatistik Kurumu-Turkish Statistical Institute", 2005). Therefore, online shopping in Turkey is in the very early stages of development compared with the USA, but e-store sales are expected to grow not only in the USA but also in Turkey.

Since the internet has received a great deal of attention, many companies have set up e-stores. Despite the popularity and importance of the e-stores, there are few studies on how e-stores should be designed. The concept of e-stores design should be taken into consideration for successful internet marketing and sales, because a good e-store design can keep e-customers shopping and returning. In the e-store, there are no salesclerk service, checkout cashier, touch of the products and very different store atmosphere. Therefore, usability of the e-store is very important to find products and get desired information easily. If e-customers feel that they have to make too many clicks to look for the products or services, they are likely to leave that e-store. Moreover, changing the e-store is at the click of a button and it is very easy to lose e-customers. Therefore, the successful e-store designed from e-customers' point of view would positively affect internet marketing and internet sales, and increase customer returns and loyalty.

There are some techniques for developing and designing e-stores. One of them is Quality Function Deployment (QFD). QFD is a technique that can be used to improve the quality of products and services. QFD can be a very useful tool to find out customer wants, expectations and e-store design requirements. The aim of this study is to illustrate how QFD is applied to design an e-store and develop different e-store design guidelines through the QFD/ House of Quality (HOQ) approaches. The study consists of two main parts: literature review about QFD/HOQ and website design and an application of QFD in the e-store design. Customer interviews and two researches have been conducted to determine e-consumers' expectations from e-store design.

LITERATURE REVIEW: QUALITY FUNCTION DEPLOYMENT IN SOFTWARE AND WEBSITE DESIGN

Shigeru Mizuno and Yoji Akao developed QFD technique in Japan in the late 1960s. The technique was first applied at Mitsubishi's Kobe shipyard site in 1972 and introduced to the USA in 1983. From that time, it has quickly spread to many other countries. Since 1966, QFD has been used world wide in many industries to (1) prioritize spoken and unspoken customer wants and needs, (2) translate these needs and wants into actions and designs such as technical characteristics and specifications, and (3) build and deliver a higher quality product or service by focusing on various business functions toward achieving customer satisfaction (Cohen, 1995; "Quality Function Deployment", 2005).

There are many studies, articles and books, congresses, symposiums, special lectures and seminars about world-wide use of QFD. For instance, Akao (1997) analyzed on the early days of QFD, the current status, and future challenges. Chan and Wu (2002) categorized and reviewed about 650 QFD studies in various sources in order to provide a comprehensive and up-to-date source of QFD studies and applications. The authors also presented 10 informative QFD publications and references. Herzwurm and Schockert (2003) identified the differences between traditional QFD in manufacturing industries and software development. Moreover, various conferences and symposiums have been held since late 1980s. For instance, the Symposia on QFD have been held since 1989 in North America to highlight the latest applications and methods, the annual International Symposium on QFD has been held since 1995, and 11th International Symposium on QFD was held in İzmir-Turkey in 2005.

Quality Function Development

Akao (1990) defined QFD as "a method and technique used for developing a design quality aimed at satisfying the consumer and then translating the consumer's requirements into design requirements and major quality assurance points to be used throughout the production stage". Mazur (1993) paraphrased this definition and defined QFD as "a system and procedures to aid the plan and development of products and services and assure that they will meet or exceed customer expectation". QFD is defined in the official source for QFD ("Quality Function Deployment", 2005) as:

- Understanding customer requirements
- Quality systems thinking + psychology + knowledge
- Maximizing positive quality that adds value
- Comprehensive quality system for customer satisfaction
- Strategy to stay ahead of the game.

The critical and first step in any quality improvement program is to understand the Voice of the Customer (VOC) - the words and phrases that customers use to describe their wants and needs. Customers can be satisfied only with products and services that meet or exceed their wants at a price that represents value. This means that companies must actively seek out and understand what their customers really want. The QFD methodology provides a structured framework for concurrent engineering that propagates the VOC through all phases of product development. In fact, QFD translates the VOC, the spoken and unspoken customer requirements, into the internal language of the company, its engineers and designers (Govers, 1996; Klien, 1990).

QFD is one of the most important methods to satisfy the customers and to transform customers' requirements into design aims. The QFD process involves four stages: (1) product planning: HOQ, (2) product design: parts deployment, (3) process planning, and (4) process control. In the product planning matrix, customer requirements are determined and translated into design requirements. The second QFD matrix relates potential product features to the delivery of performance characteristics. Process characteristics and production requirements are related to engineering and marketing characteristics with the third and fourth matrices. The majority of QFD applications end with the completion of HOQ. Many companies, such as Volvo, have found that a great deal of benefit can be achieved from just completing HOQ (Han, Chen, Ebrahimpour and Sodhi, 2001). HOQ is the first matrix that a product development team uses to initiate a QFD process. This matrix is powerful because of the amount of information that can be documented and analyzed. In this study, only HOQ, the first matrix of the QFD structure, is analyzed.

Lockamy and Khurana (1995) explained the design benefits of QFD as (1) fewer and early design changes, (2) less time in developments, (3) fewer start-up problems, (4) lower start-up costs, (5) fewer field problems, (6) more satisfied customers, and (7) the identification of comparative strengths and weaknesses of products with respect to competition. Although QFD is one of the improvement tools that should enable companies to achieve high quality, there are some difficulties about its implementation such as methodological problems, organizational problems and product policy. QFD cannot provide results by itself. It must be developed to reflect the companies' culture and management visions. QFD is a panacea for neither solving design problems nor developing perfect products. It refers to deploying customers' desires and wants. It can be an excellent tool to plan and control the product or service development process (Govers, 2001).

House of Quality

House of Quality (HOQ) was named by Hauser and Clausing (1988). HOQ provides a basic implementation tool for managing QFD throughout the design, development, and manufacturing of a product and service. The completion of the HOQ is important. The cornerstone of the HOQ is determining the customer requirements (WHATs). Determining customer requirements, wants and needs is very difficult because it requires obtaining and expressing what the customer truly wants and not what we think or he/she expects (Govers, 2001). The customer requirements (WHATs) are translated into design characteristics (HOWs) on the basis of research and interview with customers. For example, Chan and Wu (2005) presented a fried Chinese vegetable example that involves 10 customer needs (WHATs), nine technical measures (HOWs) and five restaurants so as to fully illustrate their proposed HOQ model.

In the literature, different HOQ approaches can be found, because different authors build different HOQ models that contain different elements and employ different scales to measure the relevant concepts, which may puzzle the practitioners on adopting the most proper HOQ models (Chan and Wu, 2005). For example, in Figure 1, seven steps of HOQ for e-store design model are illustrated:

Step 1. Identify e-customers' needs and wants (WHATs),
Step 2. Determine the relative importance ratings of e-customer needs,
Step 3. Generate e-store design requirement (HOWs),
Step 4. Identify competitors, rivals and conduct customer competitive analysis,
Step 5. Determine the relationships between HOWs and WHATs,
Step 6. Determine relative importance of HOWs vs WHATs,
Step 7. Determine design targets.

Chan and Wu (2005) explained eighteen elements in HOQ process: customer, customer needs (WHATs), structuring customer needs, correlation matrix of customer needs, relative importance ratings of customer needs, competitors, customer competitive assessment, goals for customer needs, sales-point, final importance ratings of customer needs, technical measures (HOWs), correlation matrix of the HOWs, relationship matrix of WHATs vs. HOWs, improving directions of the HOWs, technical competitive assessment, goals for the HOWs, probability factors and importance ratings of the HOWs.

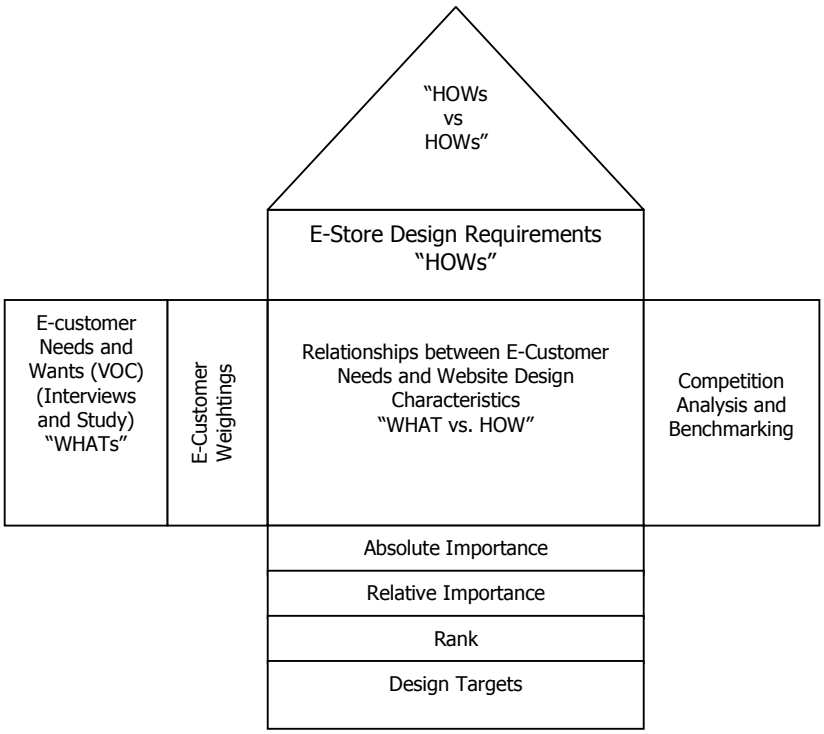


Figure 1: Steps to Creating a HOQ for E-store Design

From e-store design perspectives, HOQ links the VOC to the "voice of the designer" through which process and production plans can be developed in the other phases of the QFD system (Chan and Wu, 2005). HOQ is based on deploying e-customer wants (WHATs) in terms of e-store design parameters (HOWs) for the new e-store design. This process is represented by a succession of double entry "WHATs/HOWs" tables allowing the correlations between entries to be identified and prioritized. In addition to "WHATs/HOWs" correlations, HOQ allows the integration of elements related to analyzing product competition and to identifying synergies and/or contradictions between different e-store design characteristics. Thus, HOQ offers the twin advantage of facilitating the transition between the world of the user and that of the designer, and of combining in the same document all effective data for decision-making in relation to e-store design (Marsot, 2005).

The most important issue in QFD is designing the concept that you want to analyze, because QFD requires qualitative thinking. As the development of HOQ is a difficult process, requiring use of mathematics, a number of specialized software has been developed to simplify HOQ usage in recent years in order to use HOQ easily ("QFD Capture", 2005).

Ideally, QFD should be custom-tailored for each company. Thus, relying on software to do a QFD project can be risky and QFD processes should be designed carefully ("QFD Software", 2005).

Quality Function Deployment in Software Development and E-Store Design

The success of e-store design quality depends on how well it addresses the wants and needs of e-customers. Successful application of QFD requires that customer wants has to be carefully prioritized, manipulated, and translated through the website design.

QFD methodology has been used as a tool for listening to the VOC and deploying quality into the design of product, process, and production so that all aspects of an organization are truly customer driven (Natarajan, Martz and Kurosaka, 1999). Moreover, QFD is used for a new product and service development and process improvement and it provided a mechanism for integrating the Total Quality Management (TQM) philosophy into the new product development process (Lockamy and Khurana, 1995). Therefore, QFD is applied in many different industries. One of the application areas is software development process (Barnett and Raja, 1995; Chan and Wu, 2002; Erikkson and McFadden 1992; Haag, Raja and Schkade, 1996; Herzwurm and Schockert, 2003).

Erikkson and McFadden (1992) applied QFD to the development of software for a clinical testing laboratory. Barnett and Raja (1995) criticized current software development process using QFD and proposed the following four-stage model for performing QFD that is grounded in both the quality and software development literature: (1) refinements to the deployment scheme used for QFD, (2) the development of meaningful quantitative measures to evaluate the priority of requirements, (3) the development of quantitative measures to support trade-offs between implementation deployments, and (4) formal feedback mechanisms to evaluate the level of improvement attained in meeting the support requirements of business processes. Barnett and Raja (1995) also emphasized that particular attention should be paid to how e-customer requirements are gathered and translated into e-store design characteristics.

Haag et al. (1996) made an important contribution to the literature on software quality. They adapted QFD to software design and called Software Quality Function Deployment (SQFD). The authors defined SQFD as "a front end requirements solicitation technique, adaptable to any software engineering methodology that quantifiably solicits and defines critical customer requirements". Moreover, they described SQFD as an adaptation of the HOQ and a front end process that proceeds the software development life cycle. Although using QFD is not new for the software industry, it is important for e-store development process; because it provides a methodology for handling the customer wants

about e-store design quality. Herzwurm, Schockert and Melis (2000) emphasize that Requirements Engineering and QFD techniques are good methods for software development because it is becoming more and more complex and dynamic.

The software industry recognized the benefits of the QFD method much later than automobile industry. At QFD conferences, the following companies reported on employing QFD in software development projects: Hewlett Packard, Hughes Aircraft, IBM, Motorola, NTT Data Corporation, Roche Diagnostics, Siemens, Texas Instruments, Toshiba, and Unisys etc. In an analysis of 25 software development projects in five companies (Digital Equipment, AT&T, Hewlett-Packard, Texas Instruments, IBM, CSK) by the University of Texas at Arlington, software development with QFD is rated better regarding all 12 criteria used than software development with traditional methods. One of the reasons for success is indicated to be better communication among the development team as well as between customers and developers, and better fulfillment of customer expectations (Herzwurm et al., 2000).

Because software design quality is very important, International Standard Office (ISO) provides a framework for structuring the customer needs to betterly plan the technical responses to customer needs.

There are six international standards to evaluate software quality, even though they are still under revision ("ISO/IEC 9126", 1991). Software quality can take on many different forms. According to this standard software, quality can be evaluated by six standards:

- Functionality (suitability, accuracy, interoperability, compliance, security)
- Reliability (maturity, fault tolerance, recoverability)
- Usability (understandability, learnability, operability)
- Efficiency (time behavior, resource behavior)
- Maintainability (analyzability, changeability, stability, testability)
- Portability (adaptability, installability, conformance, replaceability) ("ISO/IEC 9126", 1991)

Briefly, the studies in the literature confirm that QFD can impact software and e-store design in many ways to increase e-customer satisfaction and improve e-store design quality.

E-STORES IN INTERNET MARKETING

Marketing approaches, prices of products and services, behaviors of sales person, characteristics and layouts of stores etc. are vitally important factors for a successful marketing strategy. Internet Marketing (also known as Electronic Marketing, Web Marketing, Online Marketing etc.) can be defined as the promotion of products or services through the Internet. Internet marketing requires Internet usage for providing information, communicating with customers and buying products and

services. Internet is a ubiquitous information platform, allowing internal and external customers to reduce marketing, selling and buying costs or transaction costs for both companies and customers (Sharma and Sheth, 2004).

Because of the tremendously increasing internet usage, today's e-customers have more choices and alternatives than in the past and they are more informed about products' characteristics and prices. Therefore, companies face more competition than past in all industries in the 21st century.

Companies should identify the opportunities and advantages of the Internet marketing. Many managers of e-stores have already realized starting online business does not necessarily guarantee selling products or services, even though they offer better values (Wan, 2000).

E-store is the company–customer interface, the primary source of customer experience and therefore, the most important communication element of Internet marketing and online shopping. It is the virtual product display, promotional material, price catalogue, and sales/distribution point. Therefore, e-store is the functional platform of communication, interaction and transaction with the e-customer. The primary mission of the e-store is attracting e-customers, and establishing contacts with them (Constantinides, 2002).

E-store must be highly interactive, because an effective e-store should guide e-customers for shopping. For example, Staples.com (one of the biggest office stores in the USA) determined that the key to online success and increased market share was to make its e-store as usable and efficient as possible. Designers of staples.com spent hundreds of hours evaluating users' working environments, decision-support needs, and tendencies when browsing and buying office products through e-store (Marcus, 2002).

E-store is the interaction facility for both the e-customers and the e-tailing (electronic retailing or online merchant). E-store design is as important as characteristics of physical stores and e-store design features contribute to the effective delivery of messages, quality of products and services in Internet. E-store must be highly interactive and customized. In order to attract new and repeat customers, an e-store must add value beyond being an electronic catalog of products. An effective e-store design should be guided by its customers and the ergonomics criteria (Barutçu and Özdipçiner, 2004; Marsot, 2005), and be changeable according to their suggestions.

The benefits of an e-store include browsing and inspecting goods without being hassled by commission-based staff, having 24-hour access opportunity, and reducing the time that is spent for searching for the relevant department. The prices of products in e-stores are usually lower than the physical stores and a larger selection scale of products is offered. Another significant benefit for e-consumers is that if e-customers do not like a particular e-store, they can easily switch to another one.

This situation is also one of the reasons why e-store design quality is important. Therefore, e-store design is one of the important factors in order to attract and retain more e-customers, and increase internet sales.

Some of the e-store objectives and tasks are:

- Communicating and promoting the products, services, images, and labels,
- Providing company information for customers and stakeholders,
- Effectively communicating the firm promotional activities,
- Providing customer service and helpdesk functionality in order to enhance the customer loyalty and retention,
- Providing sales leads and customer/market data,
- Allowing customers to communicate and interact with the company as well as creating online content,
- Allowing direct sales and facilitating online payments (transactional sites) (Constantinides, 2002). These e-store objectives and tasks also show why e-store design is important for Internet marketing.

E-store content is identified as one of the main factors contributing to repeat visits. E-store content on the e-store includes text, pictures, graphics, layout, sound, and motion etc. Making the right website content decisions are critical to effective e-store design. While an understanding of marketing strategies that attract e-customers to e-store is emerging, it is still unclear how to convert web surfers to repeat customers (Rosen and Purinton, 2004). Usability of e-stores is often the most neglected aspect. If e-customers cannot use e-store easily, they can leave and switch to other e-stores or physical stores. Since Internet provides e-customers lower searching cost, and a great variety of choices; e-customers do not have to choose among poorly designed e-stores. To make an e-store usable and to increase e-store design quality, managers of e-stores should involve potential e-customers in e-store design process (Nielsen, Coyne and Tahir, 2001).

Changing e-store because of having an unsatisfactory e-store design is at the click of button. To design e-store correctly is important for more successful Internet marketing. Thus, an e-store should be carefully designed (Wan, 2000). Wan (2000) explained a framework for analysis of e-store designs. The framework indicates areas where e-customers may be concerned and they should help website designers in developing better e-stores. Nielsen et al. (2001) suggested that e-store designers should involve e-customers throughout the e-store design phase. The communication between the e-customers and e-store designers is important in order to guarantee that the correct requirements are specified. In this process, QFD is an ideal method to design an e-store, because e-customers' wants and desires can be explored through interviews (why customer wants effective e-store

design), exploration (what is required to design successful e-store) and design (how to design e-store).

AN APPLICATION OF QFD AND HOQ FOR E-STORE DESIGN

Turkey is a potentially large Internet market with 70 million people. In the last two years, because of ADSL Internet connection, privatization of Türk Telekom and decreasing Internet connection cost, Turkey experienced one of the fastest growth rates in Internet usage in the world. Moreover, it is expected that Internet usage level will continue to grow significantly in the coming years and Internet marketing and shopping will become more popular in Turkey as in the world. There are many e-stores (e.g., hepsiburada.com, weblebi.com, sibermarket.com etc.) in Turkey and they have spent much money on designing, building and maintaining their e-stores.

For successful Internet marketing, in fact, it is very important to determine new e-store design characteristics from the point of e-stores' customers and users, not from the points of designers. Therefore, starting new e-store design should begin with understanding e-customers' wants, and this study explores to determine new characteristics of e-stores using different methodology in order to reveal their wants.

Methodology

The main objective of this study is to determine new e-store design requirements applying QFD, HOQ and Analytic Hierarchy Process (AHP) methodologies. Even though complete and illustrative examples of QFD, HOQ and AHP do not appear frequently in the literature (Chan and Wu, 2005), in this study, all these methodologies for e-store design process are presented.

This study was carried out among e-customers. In the study, target customers are people who shop from the Internet or surf the Internet to gather information about price, quality and comments etc. of products or services. In the sampling stage, a convenience sampling method that is one of the nonprobability sampling techniques was used and 30 e-customers were chosen non-randomly from among students, academicians and e-customers who are searching information about products and services or purchasing products and services and, who are interested in e-store design. In the convenience sampling method, target e-customers are selected by the researcher in order to obtain necessary and required information, because all e-customers are not interested in e-store design.

QFD team consisted of two website design experts. In questionnaire design stage, they also helped to determine and categorize e-customer wants from e-store design. In other words, VOC and design

elements were collected from a group of e-customers and two website design experts.

In this study, two questionnaires were applied. In the first questionnaire, there were thirty questions. Four of them were about demographic characteristics of respondents. Twenty-six of them were about customers' expectations from e-store design and buying behaviors towards e-store. There were twenty-five close ended questions (scaled from 1=extremely unimportant to 7=extremely important) to weight e-customer wants and one open ended question to reach the real customer wants. In the second questionnaire, there were 11 e-customer wants, and respondents were asked to compare their wants with each other's (11*11 matrix) using a five-point itemized rating scale from 1-extremely less important to 5-extremely more important.

In order to prioritize e-customer wants, Analytic Hierarchy Process (AHP) is used to calculate importance degrees of e-customer wants from e-store design using second questionnaire data. All questionnaires were in Turkish and the results were translated into English.

Results of Study

Interviewees' consisted of more males (70%) than females (30%), of people from age groups with mostly between 21–40 (90%), of the highly educated (%80) and employed in university (70%) [academic members (40%) and employees (30%)], and students (30%). The results exposed, at least in terms of the sample, that the 70% of the respondents have never bought anything from an e-store, but always searched for products information, and 10% of the respondents make a purchase from e-store less than once per month. In the study, nine of the respondents were asked to list five important reasons to buy something from e-store. They ranked five important reasons to buy something from e-store as: (1) prices of products and services, (2) less time to buy from e-store than physical store, (3) comparing products and services easily (4) 24-hour/7-days shopping, (5) easily gathering information about products and services. Even though low price of products and services is the most important factor to attract e-customers, e-store design is also important to capture and retain e-customers.

Developing House of Quality for E-store Design

The first stage of HOQ involves identifying and formalizing various e-customers' wants with regard to new e-stores to be designed ("WHATs" list). This "WHATs" list was obtained from the findings of the study conducted on e-customers.

Based on the research result, the cut-off method was used to eliminate some e-store design requirements which were not very important. Fourteen design requirements in which the mean values ($\bar{\times}$)

were lower than 6 ($\bar{\times} \leq 6$) were not evaluated. Therefore, easy membership and ordering procedures, listing the top ten products selling in each category, view e-customers' previous orders, listing customer comments etc. are not included in further analysis.

Finally, 11 e-customer wants (CW1-CW11- CW_i are the abbreviation of each e-customer wants as listed in Table 1) were determined following special features that they want to see in e-store. For example, user friendly menu of e-stores is the most important wants for e-customers and giving e-store profile and history is the least important design characteristics for e-customers.

Table 1: E-Customer Wants List

E-customer Wants (WHATs List)	Mean	SD
(CW 1) Easy to use menu (user friendly menu)	6.33	0.327
(CW 2) Less screen complexity (simple layout)	6.25	0.453
(CW 3) Easy list of product categories	6.21	0.415
(CW 4) Easy product selection	6.45	0.315
(CW 5) List the products by price differences	6.14	0.513
(CW 6) Fast and easy to compare products	6.28	0.513
(CW 7) Fast search engine	6.05	0.715
(CW 8) Fast to open and download e-store	6.65	0.215
(CW 9) Good appearance of products	6.51	0.295
(CW 10) Easy to compare prices in different e-stores	6.60	0.320
(CW 11) Attractive e-store design	6.08	0.845

Scaled from "1" extremely unimportant to "7" extremely important

An affinity diagram which was used to organize customer interviews and research into detailed e-customer needs are shown in Figure 2. Important e-customer wants were categorized as the "Appearance", "Performance" and "Usability" of e-stores.

The next step in HOQ model is prioritizing e-customer wants. AHP is used to calculate importance degrees of customer wants from e-store, because AHP is a useful tool in prioritizing customer needs (Armacost, Componation, Mullens and Swart, 1994). However, as Cohen (1995) explained, AHP requires very complicated mathematical calculations in order to determine the priority of customer wants.

What is the relative importance of CW1 when compared to CW2? The answers of such questions are computed with AHP as represented in Tables 2, 3, and 4. E-customer wants were placed into matrix's line and column in the same order as in AHP. According to the first respondent, a pair-wise comparison and the importance level of e-customer wants are scored and shown in Table 2.

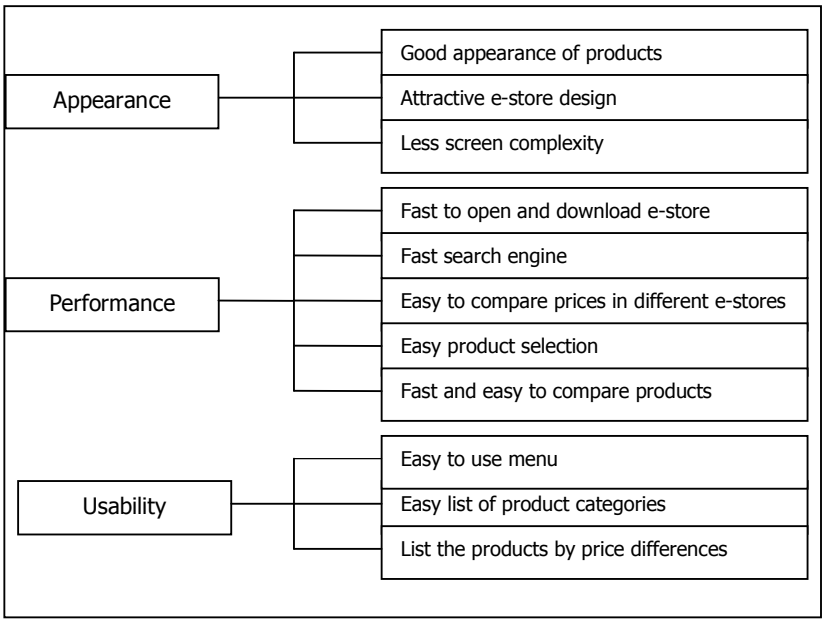


Figure 2: Affinity Diagram for E-customer Wants

While comparing the relative importance of e-customer wants in AHP, "1" indicates equally important, "3" indicates that CW_i is more important than CW_j, "5" indicates that CW_i is extremely important than CW_j, and 0,2 and 0,33 indicate reciprocals when relative importance them are reversed. For example, according to the first respondent, user friendly menu (CW_1) and easy list of products categories (CW_3) are equally important. On the other hand, user friendly menu (CW_1) is more important than less screen complexity (CW_2), and fast to open and download e-store (CW_8) is extremely important than user friendly menu (CW_1). All these comparisons are shown in Table 2 for the first respondent.

Table 3 depicts weighting factors of the e-customers wants. Matrix intersections, $CW_{ij,}$ denote the importance of the CW_i compared to the CW_j. For example, the values of CW_{11} and CW_{12} were calculated as follows; CW_{11} = 1/18,99=0,053, and CW_{12}= 3/20,33=0,148. These calculations are made for every cell in Table 3 for questionnaires in order to calculate relative importance of each e-customer want. At the end of AHP process for 30 questionnaires, the results of weighting e-customer wants are shown in the last column in Table 3.

Table 2: Initial AHP Matrix to Determine Weighting E-customer Wants for the First Respondent

	CW1	CW2	CW3	CW4	CW5	CW6	CW7	CW8	CW9	CW10	CW11
CW1	1	3	1	3	0,33	0,33	1	0,2	1	3	0,33
CW2	0,33	1	0,2	1	3	1	0,33	1	0,33	1	1
CW3	1	5	1	5	1	0,2	0,2	0,33	0,2	0,33	0,33
CW4	0,33	1	0,2	1	0,33	0,33	3	1	1	1	3
CW5	3	0,33	1	1	1	3	5	0,2	0,33	0,33	1
CW6	3	1	5	1	0,33	1	3	1	1	3	0,33
CW7	1	3	5	0,33	0,2	0,33	1	0,33	0,33	0,2	0,33
CW8	5	1	3	1	5	1	3	1	1	1	3
CW9	1	3	5	1	3	1	3	1	1	0,33	1
CW10	0,33	1	3	1	3	0,33	5	1	3	1	0,33
CW11	3	1	3	0,33	1	3	3	0,33	1	3	1
	18,99	20,33	27,4	15,66	18,99	11,52	27,53	7,39	10,19	14,19	11,65

Table 3: Total Weighting Factors (TWF) of the E-customer Wants for 30 Respondents in AHP Matrix

	CW 1	CW 2	CW 3	CW 4	CW 5	CW 6	CW 7	CW 8	CW9	CW10	CW11	Total		TWF
CW1	0,053	0,148	0,036	0,192	0,017	0,029	0,036	0,027	0,098	0,211	0,028	0,876	…	23,433
CW2	0,017	0,049	0,007	0,064	0,158	0,087	0,012	0,135	0,032	0,070	0,086	0,719	…	19,556
CW3	0,053	0,246	0,036	0,319	0,053	0,017	0,007	0,045	0,020	0,023	0,028	0,848	…	9,672
CW4	0,017	0,049	0,007	0,064	0,017	0,029	0,109	0,135	0,098	0,070	0,258	0,854	…	28,354
CW5	0,158	0,016	0,036	0,064	0,053	0,260	0,182	0,027	0,032	0,023	0,086	0,938	…	17,139
CW6	0,158	0,049	0,182	0,064	0,017	0,087	0,109	0,135	0,098	0,211	0,028	1,140	…	18,878
CW7	0,053	0,148	0,182	0,021	0,011	0,029	0,036	0,045	0,032	0,014	0,028	0,599	…	7,329
CW8	0,263	0,049	0,109	0,064	0,263	0,087	0,109	0,135	0,098	0,070	0,258	1,506	…	32,435
CW9	0,053	0,148	0,182	0,064	0,158	0,087	0,109	0,135	0,098	0,023	0,086	1,143	…	21,351
CW10	0,017	0,049	0,109	0,064	0,158	0,029	0,182	0,135	0,294	0,070	0,028	1,137	…	22,433
CW11	0,158	0,049	0,109	0,021	0,053	0,260	0,109	0,045	0,098	0,211	0,086	1,200	…	13,663

The result of AHP for e-customer weightings are calculated and shown in Table 4. For example, "fast to open and download e-store" is the most important and "fast search engine" is the least important for e-customers. These e-customer weightings are added to Figure 3, HOQ for e-store design.

Table 4: E-customer Wants From E-store Design

E-customer wants	Total	Relative Importance	%
(CW 1) Easy to use menu	23,433	0,1094	10,94
(CW 2) Less screen complexity	19,556	0,0913	9,13
(CW 3) Easy list of products categories	9,672	0,0451	4,51
(CW 4) Easy product selection	28,354	0,1323	13,23
(CW 5) List the products by price differences	17,139	0,0800	8,00
(CW 6) Fast and easy to compare products	18,878	0,0881	8,81
(CW 7) Fast search engine	7,329	0,0342	3,42
(CW 8) Fast to open and download e-store	32,435	0,1514	15,14
(CW 9) Good appearance of products	21,351	0,0997	9,97
(CW 10) Easy to compare prices in different e-stores	22,433	0,1047	10,47
(CW 11) Attractive e-store design	13,663	0,0638	6,38
Total	214,243	1,000	100

The next step in HOQ model was identifying e-store design characteristics, "HOWs", which would respond to e-customer wants and expectations. The design requirements (HOWs) represent the designer's response to the e-customer wants. In this step, two website design experts helped in ranking these characteristics. E-store design characteristics are ordered as:

- New e-store comparing prices in different e-stores
- Simple e-store design
- Good e-store composition and organization
- Enlargeable and 360^{o} views of products
- Suitable colors and background in e-store
- No advertisement and banner in e-store
- Animation and soft music
- Detailed product information and customer comments
- High Server CPU speed and hard disk capacity
- Expert system for easy product selection

Finally HOQ for e-store design that involves 11 e-customer wants (WHATs) and 10 e-store design characteristics (HOWs) are added and presented in Figure 3.

Meanwhile, what is the expert system? The expert system is a computer program developed by researchers in artificial intelligence during the 1970s and applied commercially throughout the 1980s ("Expert System", 2005). The primary goal of expert systems research is to make expertise available to decision makers and technicians who need answers quickly. A web-based expert system can be developed for easy product selection (Li, 2005). Using web-based expert system software in buying decision processes helps e-customers in selecting and buying products and solving service problems very fast. By the help of web-based expert system, e-customers can buy the exact products and services they want.

After determining e-store design characteristics, correlation matrix of "HOWs" is analyzed. The correlation matrix is used to identify features requiring collateral improvement. This matrix is to help the website design experts to determine which HOWs are correlated and the extent of these correlations. This stage of the HOQ process involves a pair-wise comparison of the different design characteristics. The roof-shaped half-matrix allows design characteristics to be identified in terms of synergies (+) and opposites (−). In other words, in the matrix (+) indicates a positive correlation and (−) indicates a negative correlation. For example, there is positive correlation between "simple e-store design" and "no advertisement and banner". However, there is negative correlation between "simple e-store design" and "animation and soft music in e-store".

The next step of HOQ model is determining the relationships between WHATs and HOWs. This stage is very important in HOQ and it is performed carefully and collectively by design expert team. This relationship could be determined by analyzing to what extent the HOWs could technically be related to the WHATs. In this study, a three level rating scale (1- very weak relationship, 5-medium relationship, 9-very strong relationship) is used to indicate the degree of strengths of relations between HOWs and WHATs. For example, there is very strong relationship between "good appearance of product" and "enlargeable product photos and 360^{o} views of products", or very weak relationship between "good appearance of products" and "good e-store composition and organization". The existing relationship in e-store design is placed in HOQ as shown in Figure 3.

To determine the absolute and relative e-customer satisfaction degrees that e-store design characteristics provide, the following formulations were used:

Absolute importance = matrix weight*e-customer expectation importance degrees

Relative importance = (absolute importance\total importance)*100

The most important e-store design responses to address, based on the relative importance (column weights) are: good e-store composition and organization, high server CPU speed and hard disk capacity, simple e-store design, expert system for easy product selection etc. The results of absolute and relative importance degrees are also given in Figure 3.

After determining the relative importance and ranking e-store design requirements (HOWs), the design targets must be taken into consideration. It is very helpful to identify in which direction each HOWs should be improved to better e-customer satisfaction. There are three types of improving directions: "+" increasing, "-" decreasing, and "0" no effect. From the HOQ chart in Figure 3, the most important e-customer wants and issues can be clearly extracted for developing e-stores. For example, "good e-store composition and organization, high server CPU speed and hard disk capacity, simple e-store design, expert system for

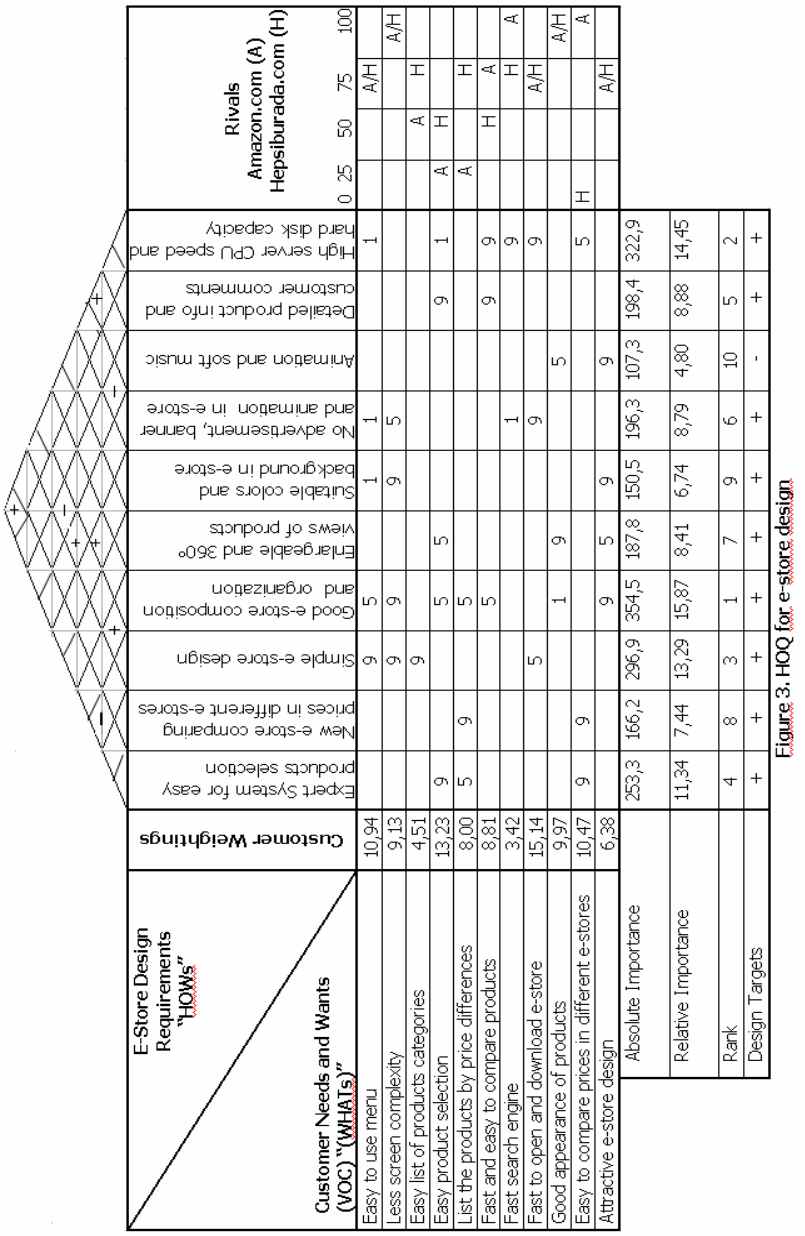
easy products selection and new e-store compared prices in different e-stores" are design requirements that should be developed, but "animation and soft music" should not be used in e-store design process.

Evaluating different e-store designs is very important in HOQ, because knowing e-store strengths and constraints in all aspects of e-store design is important if it is desired to improve e-store competitiveness in the relevant e-stores. Many managers and designers of e-stores adopted the Amazon's design format when developing their own sites (Rosen and Purinton, 2004). In fact, Amazon.com is a good example to capture and hold its customers' attention in the USA or world and Hepsiburada.com is a good example in Turkey. Therefore, Amazon.com and Hepsiburada.com are benefited to benchmark in HOQ process, because they are well organized e-stores and several products and product categories. In the evaluation process, expert team evaluated the relative design performance of the e-stores (Amazon.com and Hepsiburada.com) on the e-customer's wants identified and expressed by the 5 point scales (0-very poor, 100-very good). For example, "compare prices in different e-stores" is easier in Amazon.com than Hepsiburada.com. Amazon.com has a better fast search engine and a system for easily comparing price with different e-stores. Therefore, in order to have better e-store design, e-store designers should take into considerations these evaluations.

According to the answers of open ended questions and interviews, it is found out that "new e-store searching and comparing prices of products" and "expert system for easy product selection" delighted e-customers. These features of e-store design should be used to obtain higher level of e-customer satisfaction.

The main contribution of this study is to reveal e-store design characteristics. The result of these researches and analyzes revealed the voice of e-customers and the duties of e-store designers.

In the future, managers of e-stores and website designers who are willing to increase their competitive advantages in internet marketing should take into consideration the following design requirements, respectively: (1) good e-store composition and organization, (2) high server CPU speed and hard disk capacity, (3) simple e-store design, (4) expert system for easy product selection, (5) detailed product information and customer comments, (6) no advertisement and banner in e-store, (7) enlargeable and 360^{o} views of products, (8) new e-store comparing prices in different e-stores, (9) suitable colors and background in e-store, and (10) animation and soft music. The new e-store designed using these characteristics makes e-customers more satisfied and purchasing from e-stores easier. In other words, if an e-store designer takes into consideration these characteristics, e-customers would be highly satisfied.



E-Store Design Requirements "HOWs" / Customer Needs and Wants (VOC) "(WHATs)"	Customer Weightings	Expert System for easy products selection	New e-store comparing prices in different e-stores	Simple e-store design	Good e-store composition and organization	Enlargeable and 360° views of products	Suitable colors and background in e-store	No advertisement, banner and animation in e-store	Animation and soft music	Detailed product info and customer comments	High server CPU speed and hard disk capacity	Rivals Amazon.com (A) Hepsiburada.com (H) 0 25 50 75 100
Easy to use menu	10,94			9	5		1	1			1	A/H
Less screen complexity	9,13			9	9		9	5				A/H
Easy list of products categories	4,51			9								A H
Easy product selection	13,23	9			5	5				9	1	A H
List the products by price differences	8,00	5	9		5							A H
Fast and easy to compare products	8,81				5					9	9	H A
Fast search engine	3,42							1			9	H A
Fast to open and download e-store	15,14			5				9			9	A/H
Good appearance of products	9,97				1	9			5			A/H
Easy to compare prices in different e-stores	10,47	9	9								5	H A
Attractive e-store design	6,38				9	5	9		9			A/H
Absolute Importance		253,3	166,2	296,9	354,5	187,8	150,5	196,3	107,3	198,4	322,9	
Relative Importance		11,34	7,44	13,29	15,87	8,41	6,74	8,79	4,80	8,88	14,45	
Rank		4	8	3	1	7	9	6	10	5	2	
Design Targets		+	+	+	+	+	+	+	-	+	+	

Figure 3. HOQ for e-store design

Figure 3: Managerial Implications and Recommendations for E-store Designers

CONCLUSION

The e-stores are marketplaces where sellers and buyers meet. E-stores should offer not only better quality and lower price but also an effective design, because e-customers' willingness to purchase is affected by the e-store design. In order to improve e-store design quality, the voice of e-customers should be listened and QFD methodology should be employed by e-store designers. QFD is an important and different methodology, because it looks for and prioritizes customer wants and maximizes positive quality that creates more customer satisfaction. This methodology helps e-store designers to recognize e-customers' wants from e-store design and define e-store design requirements to meet e-customer needs successfully.

This study shows how QFD is applied to e-store design. First, e-customer wants were determined from e-customers' point of view. According to this, the e-stores should have some design characteristics categorized in three sections: "Appearance", "Performance" and "Usability" as shown in Figure 2. Therefore, e-store designer should take into consideration the following features: (1) user friendly menu, (2) less screen complexity or simple layout (3) easy list of product categories, (4) easy product selection, (5) list the products by price differences, (6) fast and easy to compare products, (7) fast search engine, (8) fast to open and download e-store, (9) good appearance of products, (10) easy to compare prices in different e-stores and (11) attractive e-store design. Second, these e-customer wants were converted to e-store design requirements. These requirements were marked as: (1) good e-store composition and organization, (2) high server CPU speed and hard disk capacity, (3) simple e-store design, (4) expert system for easy product selection, (5) detailed product information and customer comments, (6) no advertisement and banner in e-store, (7) enlargeable and 360^{o} views of products, (8) comparison of prices in different e-stores, (9) suitable colors and background in e-store, and (10) less animation and soft music.

According to the completed HOQ, there are two important new e-customer wants from e-store designer; e-customers would like (1) to have a new e-store that searches and compares prices of products in different e-stores on the Internet and (2) to select and compare products with each other easily using expert systems. Therefore, e-store designers have to develop expert systems for easy product and service selection and a new e-store to compare price of products and service easily among different e-stores.

To sum up, QFD has been used successfully in many studies like new product development, process improvement and finally website and e-store design. The implementation of QFD results in many significant improvements in e-store design; starting with e-customer wants and converting them into e-store design characteristics.

REFERENCES

Akao, Y. (Ed.) (1990), Quality function deployment: integrating customer requirements into product design. (Translated by Glenn Mazur) Cambridge: Productivity Press.

Akao, Y. (1997), QFD: Past, Present, and Future, International Symposium on QFD '97. Retreived June, 15, 2005, from http://www.qfdi.org/QFD_History.pdf

Armacost, R.L., Componation, P.J., Mullens, M.A., and Swart, W.W. (1994), An AHP Framework for Prioritizing Customer Requirements in QFD: An Application to Industrialized Housing. IIE Transactions, 26 (4), 72-79.

Barnett, W.D. and Raja, M.K. (1995), Application of QFD to the software development process. International Journal of Quality and Reliability Management, 12 (6), 24-42.

Barutçu, S., and Özdipçiner, N. (2003), Ergonomics in Website Design and Marketing Activities Relations (An application in e-stores), 9th National Ergonomics Congress Proceeding, Pamukkale University, 32-40. (Published in Turkish) Web Tasarımında Ergonomi ve Pazarlama Faaliyetleri İlişkisi (Sanal Mağazalarda Bir Uygulama), 9.Ulusal Ergonomi Kongresi Bildiri Kitabı, Pamukkale Üniversitesi, 32-40.

Chan, L., and Wu, M. (2005), A systematic approach to quality function deployment with a full illustrative example. Omega, 33 (2), 119-139.

Chan, L., and Wu, M. (2002), Quality Function Deployment: A literature review. European Journal of Operational Research, 143 (3), 463-497.

Cohen, L. (1995), Quality Function Deployment: How to Make QFD Work for You. Reading, MA: Addison-Wesley.

Constantinides, E. (2002), The 4S Web-Marketing Mix model. Electronic Commerce Research and Applications, 1 (1), 57-76.

Erikkson, I., and McFadden, F. (1992), Quality function deployment: a tool to improve software quality. Information and Software Technology, 35 (9), 491-8.

Expert System, Retrieved June, 15, 2005, from en.wikipedia.org/wiki/Expert_system

Forrester Research (2002), Online sales soared 48 percent in 2002, Retreived June, 15, 2005, from www.forrester.com/ER/Press/Release/0,1769,801,00.htm

Forrester Research (2003), Q2 2003 Online Sales: Same (old) Growth Story, Retreived June, 15, 2005, from www.forrester.com/ER/Research/Brief/Excerpt/0,1317,17238, 00.html

Govers, C.P.M. (2001), QFD not just a tool but a way of quality management. International Journal of Production Economics, 69 (2), 151-159.

Govers, C.P.M. (1996), What and how about Quality Function Deployment (QFD), International Journal of Production Economics, 46–47, 575-585.

Haag, S., Raja M.K., and Schkade L.L. (1996), Quality Function Deployment Usage in Software Development. Communications of the ACM, 39 (1), 41-49.

Han, B.S., Chen S.K., Ebrahimpour, M., and Sodhi, M.S. (2001), A conceptual QFD planning model. International Journal of Quality and Reliability Management, 18 (8), 796-812.

Hauser, J.R., and Clausing, D. (1988), The House of Quality. Harvard Business Review, May-June 1988, 63-73.

Herzwurm, G., and Schockert S. (2003), The leading edge in QFD for software and electronic Business. International Journal of Quality and Reliability Management, 20 (1), 36-55.

Herzwurm, G., Schockert, S., and Melis, W. (2000), Joint Requirements Engineering: QFD for Rapid Customer-Focused Software and Internet-Development. Braunschweig, Wiesbaden, Germany: Vieweg-Gabler.

ISO/IEC 9126 (1991), Information technology-Software Product Evaluation-Quality characteristics and guidelines for their use. Retrieved June, 15, 2005, from www.cse.dcu.ie/essiscope/sm2/9126ref.html

Klien, L.R. (1990), New Techniques for Listening to the Voice of the Customer, The 2nd Symposium on Quality Function Deployment, June 1990, Retrieved June, 15, 2005, from www.ams-inc.com/publications/reprints.asp?id=3

Li, S. (2005), A Web-enabled hybrid approach to strategic marketing planning: Group DelphiCa Web-based expert system. Expert Systems with Applications, 29, 393–400.

Lockamy, A., and Khurana, A. (1995), Quality function deployment: total quality management for new product design. International Journal of Quality and Reliability Management, 12 (6), 73-84.

Marcus, A. (2002), Return on Investment for Usable User-Interface Design: Examples and Statistic. Retrieved June, 15, 2005, from http://www.amanda.com/resources/ROI/AMA_ROIWhitePaper_28Feb02.pdf

Marsot, J. (2005), QFD: A Methodological Tool for Integration of Ergonomics at the Design Stage. Applied Ergonomics, 36 (2), 185-192.

Mazur, G. (1993), QFD for service industries: From Voice of Customer to Task Deployment,__Fifth Symposium on Quality Function Deployment, Michigan, June 1993.

Natarajan, R.N., Martz, R.E., and Kurosaka, K. (1999), Applying QFD to Internal Service System Design. Quality Progress, 32 (2), 65-70.

Nielsen, J., Coyne, K.P., and Tahir, M. (2001), Make it usable. PC Magazine. Retrieved February, 06, 2001, from http://www.pcmag.com/article2/0,4149,33821,00.asp

Quality Function Deployment, Retrieved June, 11, 2005, from www.qfdi.org

QFD Software, Retrieved June, 11, 2005, from www.qfdi.org/software.htm

QFD Capture, Retrieved June, 11, 2005, from www.qfdcapture.com

Rosen, D.E. and Purinton, E. (2004), Website design: Viewing the web as a cognitive landscape. Journal of Business Research, 57(7), 787-794.

Sharma, A. and Sheth, J.N. (2004), Web-based marketing: The coming revolution in marketing thought and strategy. Journal of Business Research, 57 (7), 696-702.

Türkiye İstatistik Kurumu-Turkish Statistical Institute, Retrieved September, 21, 2005, from www.tuik.gov.tr

Wan, H.A. (2000), Opportunities to enhance a commercial website. Information and Management, 38 (1), 15-21.

www.amazon.com, Retrieved June, 15, 2005.

www.hepsiburada.com, Retrieved June, 15, 2005.