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Integrating the Kano model, AHP and planning matrix

QFD application in library services

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Abstract

Purpose – The purpose of the study is to analyze the user (as a customer of the library) requirements related to library services by using service-based quality function deployment (QFD) and employ QFD to identify visible marketing strategies in a service sector.

Design/methodology/approach – In this study, QFD is applied to central library services of Dokuz Eylul University (DEU) in Izmir, Turkey. Basically, the methodology used in this study integrates the Kano model, AHP and planning matrix of house of quality. First, a focus group study is held to find out the requirements of university students for the university library that are then classified using the Kano model. The requirement categories are ranked with respect to their relative importance using analytical hierarchy process (AHP). In the last step, all findings are transferred to the planning matrix and strategies for DEU Central Library are developed.

Findings – The paper reveals marketing strategies for a non-profit organization, a state university library, and helps the library find out its competitive position.

Research limitations/implications – User requirements are determined through focus group studies held with undergraduate students. Other library users like academicians, external users, university staff and graduate students are ignored. Consideration of all possible user categories will give a whole picture of the requirements and their importance. In addition, a fair number of requirements limited the application of AHP only to the primary requirement categories.

Practical implications – The strategic importance of requirements was identified more precisely and service elements were allocated more effectively.

Originality/value – This study investigates the user requirements for library services in depth. It attempts to integrate AHP, Kano and QFD methods in library services for the first time to find out the most strategically important requirements. Therefore, it sheds light to library managers how to allocate their budget, arrange their services and develop their marketing strategies.

Keywords Quality, Analytical hierarchy process, Information services, Quality function deployment

Paper type Research paper

Introduction

Universities are one of the important educational institutions where people develop intellectual abilities that they will use throughout their lives. They do not only plan careers but also provide a basis for creative and critical thinking (Hwarng and Teo, 2001). Universities may offer better quality services through their academic and administrative staff, and technical equipment they have. However, the quality of the services provided depends on the users of that service as well. Library services are an integral part of this quality chain since libraries are cornerstones of the improvement of the academic staff and the students. Libraries are expected to offer convenient media to

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study and to research, and to have sufficient number of current sources. They should provide high quality services in order to satisfy their customers.

Improving quality does not always result in satisfied customers since what customers want or expect from a product/service is not high quality all the time. The critical issue is what the customer expects from a product/service and how much the product/service meets these expectations. As far as the product/service meets these expectations, it can be said to have high quality. Therefore, quality can be defined as "the characteristics of a product/service that bear on its ability to satisfy stated or implied customer needs" (The American Society for Quality, 2005). Today, this customer – driven approach to quality has become a strategic weapon for many organizations.

Moreover, characteristics of services make quality a more critical and essential issue for the service providers. Intangible nature of services forces users to look for clues of service quality to reduce uncertainty. Users of services detect signals about quality from the environment where the services are provided, the equipment used, people working in the service environment, and the medium of communication. Therefore service providers should support the intangible attributes of services besides the tangible ones. This is true for library services as well. Library management should try to improve intangible components such as library image, the impression conveyed by contact employees etc. in addition to tangible ones such as equipment, sources used etc. (Kotler and Armstrong, 2004; Snoj and Petermanec, 2001).

Different approaches are used to improve quality. One of those approaches is QFD. QFD is "a methodology for the development or deployment of features, attributes or functions that give a product/service high quality" (Hwarng and Teo, 2001). QFD provides an understanding of customer expectations and needs, and applies features that will meet these expectations and needs to the product/service. The major focus of QFD is to design the product/service so that it will satisfy the customer.

This paper applies planning matrix of the QFD process to figure out the user requirements for university library services. Depth analysis is conducted to find out user requirements and their importance levels are partially determined by the application of AHP method. In addition, the requirements are categorized with respect to the Kano model to understand which requirements are more critical for the satisfaction of the users. The satisfaction levels of users from their own university library and that of the competition are measured and compared. We present the application for the Central Library of Dokuz Eylul University (DEU), Izmir, Turkey.

Literature review

The role of libraries and the importance of marketing knowledge

Access to and usage of information has been one of the essential developments in our century. Besides the physical or mechanical strengths, intellectual and professional knowledge started to become dominant to be successful in business. Libraries that are a part of this intellectual and knowledge chain provide service to access to accurate information. This fact emphasizes the importance of libraries in the information industry (Snoj and Petermanec, 2001). They are information centers and have a vital importance on especially academic improvements of students and academicians. The academic achievement of undergraduate students was found to be correlated with their usage of variety of library resources and services (Wells, 1995). Furthermore, Jager

(2002) obtained the result that students of humanities who do well in their exams tend to borrow more books from the library than unsuccessful students.

While libraries aid the academic achievement as an information center, their environmental conditions change. These changing environmental conditions are technological developments, rising user expectations, increasing competition, growing importance of quality in library services (Snoj and Petermanec, 2001). Under these circumstances, marketing knowledge has gained special status in the management of libraries.

The Central Library of Dokuz Eylul University

Izmir, the third largest city in Turkey, hosts three state universities and two private universities. DEU, which is one of those state universities, was founded in 1982. Presently DEU owns ten faculties, five schools, five vocational schools, five graduate schools and ten institutes in ten different locations. On the other hand, the Central Library of DEU is located in one of the campuses of DEU. It is one of the largest academic reference centers in Izmir. It was established in 1982 and now has 78,110 printed books, membership to 1,109 printed journals and 26 online databases (it covers the 21,256 e-journals, 18,585 e-books and 600,000 dissertations) and several audio-visual materials. Besides, it supplies 60 computer terminals and three photocopiers. Services of the central library consist of reference (books, periodicals, dissertations) facilities, online searching, photocopying service, study rooms and inter-library loan.

QFD

QFD is a technique used in more proactive product development and quality improvement in many fields (Tan and Shen, 2000). QFD was originated in Japan in the 1970s and has been applied successfully by many American, Japanese and European companies to develop products (Chan and Wu, 2002-2003). QFD technique investigates customer requirements in intensive detail and enables organizations to outperform effective competitive strategies. Hence, QFD is a customer-driven quality management system (Kaulio, 1998) aiming to create higher customer satisfaction.

QFD is defined by its founder (Akao, 1990) as "a method for developing a design quality aimed at satisfying the customer and then translating the customer's demand into design targets and major quality assurance points to be used throughout the production phase". Sullivan's (1986) definition of QFD is "a system to assure that customer needs drive the product design and production process". Both of these definitions are based on production. Whereas Terninko's (1997) definition adds competition and market share perspective to the previous definitions. He defines QFD as "a modern quality system aimed at increasing market share by satisfying the customer. This system strategically selects and makes customer requirements that are important for outperforming the competition visible".

The needs and requirements of customers are called voices of customers. QFD guarantees the design quality at the design stage of the product/service. Companies applying QFD design quality into the product rather than inspecting quality at the end of production. In this respect, Guinta and Praizler (1993) refers to QFD as "designed-in quality" rather than traditional "inspected-in quality".

QFD provides organizations with increased market share and greater profit. In addition, QFD decreases the start-up and introduction costs of new products, shortens design cycles, increases effectiveness and saves time. QFD increases the number of satisfied customers since their needs and desires are met or exceeded by the product/service. Moreover, various functions of an organization easily cooperate and communicate with each other (Terninko, 1997; Hauser and Clausing, 1988). Marketing and manufacturing departments, design engineers should co-operate closely to form the final product that will meet the customers' requirements.

QFD process starts with understanding and analyzing the requirements of the customers. This is the most critical and the longest step in the QFD design. Customer requirements are collected by forming focus groups; applying questionnaires, conducting depth interviews or observing the customers. Afterwards, the requirements are prioritized regarding their importance. The organization's product/service is compared with those of the competition through a competitive analysis by asking customers the performance levels of the products/services of the company and the competitors on each requirement. This provides the opportunity for the organization to see whether it has competitive advantages and if they do, on which important customer requirements.

The personnel of the firm can discuss the requirements necessary to meet the wants and needs of the customers. These needs are translated into manufacturing processes and control systems. All this information is analyzed in a matrix called house of quality (HOQ) which "links customer needs to the development team's technical responses to meet these needs" (Chan and Wu, 2002-2003). The HOQ matrix is shown in Figure 1. A typical planning matrix includes raw importance, customer competitive evaluations, strategic goals for WHATs (target and improvement ratio), sales points, and strategic importance (see Figure 1).

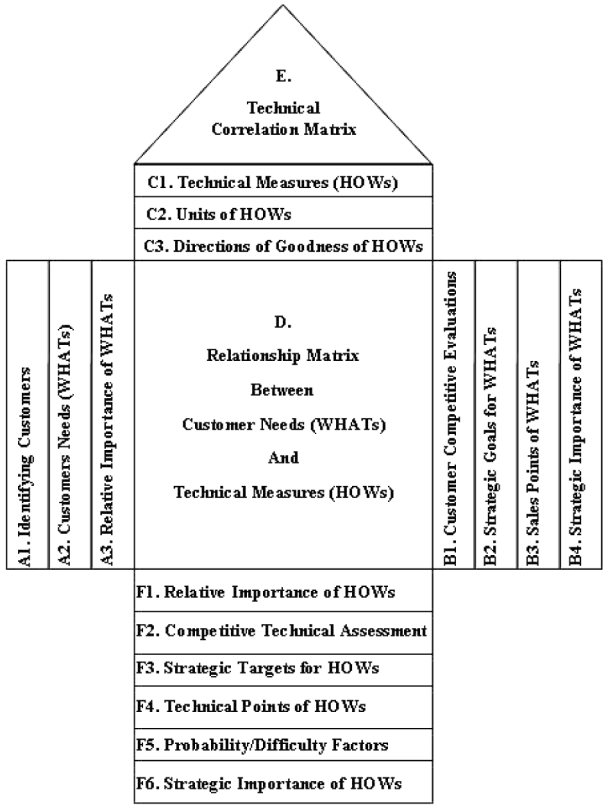
This study only deals with customer needs (WHATs) and the planning matrix. The voices of customers are transferred to the planning matrix – a sub matrix – of the HOQ. Although some requirements may be evaluated as important by the customers, their performance level may be perceived poor. Therefore, integrating the information about the importance of each requirement and the performance of the product/service relative to competition can be helpful for the organization in designing its final product/service. This study integrates this information in library services by using Kano model, AHP technique and the planning matrix.

Kano model

Kano is a model that provides an effective tool to categorize needs and to understand the nature of them (Matzler and Hinterhuber, 1998). The Kano model tries to explain how customer satisfaction will change as customer requirements are met by the organization. This relationship is shown in Figure 2.

Kano groups can be examined mainly in three categories:

(1) *Must-be (basic) needs*. These needs are so fundamental that they are not expressed by the customer. However, they must be identified since they are very important for the customer. This feature is thought to exist in the product/service. If the product/service does not meet this need, the customer becomes very dissatisfied. Wheels for cars are a basic need. Customers do not



Source: Chan and Wu (2002-2003)

Figure 1.
Detailed description of house of quality

indicate wheels as a requirement since this feature is thought to exist. Must-be attributes can be learned from complaints (King, 1995).

(2) *One-dimensional (performance) need*. If these needs are satisfied with improvement in their performance, the customer satisfaction will increase. The better the performance, the happier the customer is. These kinds of needs are generally expressed by the customer. Gas mileage in a car is a one-dimensional need. One-dimensional attributes are most often identified by surveys (King, 1995).

(3) *Attractive (excitement) needs*. These are dreams of customers so they are not expressed. The absence of the attribute does not cause dissatisfaction because the customers are unaware of these needs. If these needs are met, the product/service satisfies and delights the customer. Meeting attractive needs will provide competitive advantage to the organization and the organization will find the opportunity to differentiate itself from the competition. Customers will not be dissatisfied if cars do not use solar energy but they will be delighted if it is provided. Attractive attributes are obtained from suppliers, in general (King, 1995).

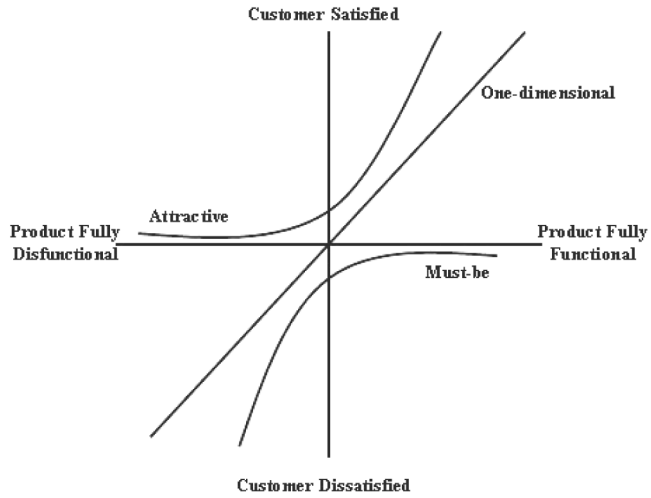


Figure 2.
The Kano model

Source: Berger *et al*. (1993)

In addition to these three basic Kano categories, "indifferent", "reverse" and "questionable" outcomes can also appear (Berger *et al*., 1993; Kano *et al*., 1984):

(1) *Indifferent*. Means that the customer is not concerned with this product attribute and is not very interested whether it is present or not.

(2) *Questionable*. This situation occurs if there is a contradiction in the customers' answers to the paired questions. A questionable rating indicates incorrectly phrased question, misunderstanding of a question, or an incorrect response.

(3) *Reverse*. Means that some of the respondents' satisfaction decreases with the existence of this requirement, but they also expect the reverse of it.

Needs may alter categories as the product/service improves. The excitement features today will become expected basic features in the future. Hence firms must focus on the must-be needs today but also should allocate some of its resources to excitement needs since they are expected to become must be needs in the future. This is also supported by Robertshaw (1995) who suggested that the first priority should be given to deliver what is expected (Must-be needs); the second is what is specified (one-dimensional needs) and the last is to provide attractive needs.

Analytical hierarchy process (AHP)

Different methods can be used to rank requirements. Application of different methods gives three different types of importance values:

(1) *Absolute importance*. The features can be evaluated on an interval scale. For example, a five point interval scale ranging from "1 = not important at all" to "5 = very important" can be used. The mean value gives "the absolute importance" level of each requirement (Cohen, 1995).

(2) *Ordinal importance*. Respondents are asked to rank the items or distribute 100 points among the items. It indicates that one attribute is more or less important

than the other. The highest number in the ordinal importance points out that the feature is the most important one for the customer (Cohen, 1995).

(3) *Relative importance*. Full pair-wise comparison is still another ranking method which is called AHP. Comparing two items is easier than comparing numerous items at the same time. AHP is a highly developed mathematical system for priority setting of numerous items. It derives ratio scales of relative magnitudes of a set of elements by making paired comparisons (Saaty, 1994). "Relative importance" calculation by AHP is supported by 30 years of research. Saaty (1994) stated that AHP had several benefits. It helps to decompose unstructured problem into a rational decision hierarchy. It can gather more information by employing the pair-wise comparison. Besides, it sets the computations to evaluate weights to the elements. Furthermore, consistency level identification helps to measure the validity of the study. As a result, AHP provides accurate inputs for multi-criteria decision-making.

Research methodology

Objective of the study

The study aims to determine important user requirements for DEU Library services. Besides, it is intended to differentiate the requirements found according to the user satisfaction they will create. The services of the DEU Central Library and its nearest competitor in Izmir – Ege University (EU) Central Library will be compared to find competitive advantages of DEU Central Library. In order to accomplish the intended objectives of the study, Kano and AHP methods are applied to the QFD process. Therefore, another objective of the study is to integrate Kano and AHP techniques with the QFD process.

The research questions are:

- What are the user requirements for library services?
- Which requirements are one-dimensional, must-be, attractive or indifferent needs?
- What is the relative importance of each requirement?
- What are the competitive advantages and disadvantages of the central libraries of DEU and EU?
- Which requirements need more attention and resources for improvement?

Sample

The initial point of QFD process is determining the user requirements. Before starting to identify user needs, the user profile of the Central Library of DEU was characterized. The core user segments of the central library are academicians, graduate students, undergraduate students, administrative staff of the university and external visitors. Different requirements related to library services are a result of distinct characteristics of the segments. For that reason, we focused only on one segment – the undergraduate students of Faculty of Business – through convenience sampling. On the other hand, due to the insufficient experience of freshman and sophomore students with library services, we limited our sample to junior and senior level of students depending on the reasoning of judgmental sampling. In total, there were 406 students in the third and the

forth grades. The questionnaires were applied to all. A total of 251 usable questionnaires were received. The response rate was 61.8 percent.

There were two phases in this study. In the first phase, depth interviews and focus group discussions were conducted to identify user requirements. In the second phase, data were gathered through a questionnaire related to the identified requirements from the undergraduate students.

Depth interviews and focus group discussions

The focus group discussion was carried out with ten students whereas the depth interviews were conducted with 20. According to Griffin and Hauser (1993), 20-30 customers should be interviewed to obtain 90-95 percent of possible customer requirements. Both focus group discussion and depth interviews were used to reduce the disadvantages of each method. The contributors or participants in the focus group and depth discussions were asked to explain the characteristics of an ideal library, to determine the most frequently used services of libraries and to share their experiences (positive or negative) and complaints about library services. The focus group discussion and depth interviews took about 50 minutes. The discussion and all of the depth interviews were recorded to audiocassettes. The focus group discussion was directed by a dual-moderator group (Malhotra, 2004). Depth interviews were conducted by a single interviewer. Participants of the focus group and depth interviews were selected randomly. Cluster analysis was used to form and structure library user requirements and 51 requirements were identified. These 51 tertiary requirements were grouped under six primary requirements: Attributes related to sources, technical attributes, attributes related to library staff, administrative attributes, other library services, attributes related to atmosphere and location.

Questionnaire survey

Questionnaire design. After identifying the requirements, a structured questionnaire, which was composed of five parts, was developed. In the first part, demographic characteristics such as gender, age, monthly household income, department, and grade were asked. In addition to the demographic questions, the first part of the questionnaire included questions on frequency of visiting the library and accessing online library, the university libraries visited before, and the ranking of the library services regarding the frequency of usage.

The second and the third part covered statements used in categorizing the requirements with respect to the Kano model. In the Kano model, the needs are asked in paired questions. The first question asks how one feels if a specific feature exists. The second question asks how one feels if that specific feature does not exist. Therefore, the second part consisted of positively stated requirements while the third part contained their negatives reflecting the functionality and dysfunctionality of the requirements. The scale used was a five-point scale ranging from 1 = "I like it", 2 = "I expect it", 3 = "I am neutral", 4 = "I can tolerate it", and 5 = "I dislike it" which was one of the scales recommended by Berger *et al.* (1993).

There were mainly three questions in the fourth part. The first question asked the respondents to rank tertiary requirements under each primary requirement category in relation to their importance. The reason for asking the respondents to rank the requirements within their category was that it would have been hard and complicated

to rank 51 items at once. The second and the third questions asked the respondents to evaluate the performance of The Central Libraries of DEU and EU[1] which is one of the most important competitors of DEU Central Library in Izmir. Both of the university libraries were assessed considering 51 requirements.

The fifth part of the questionnaire contained a table of six primary requirement groups to be evaluated with respect to the AHP method. The respondents were asked to compare each group with the other primary requirement groups one by one using a five-point scale.

Data analysis

Frequency analysis was conducted to evaluate demographic characteristics of the sample. A table was formed to evaluate the frequency of answers to the Kano questions. Cross matching was done with the answers to the pair of functional and dysfunctional questions. Each requirement was attained to one of the Kano categories regarding the highest frequency they had.

The ranking of 51 requirements was calculated in three steps. First, the raking of each requirement within its primary requirement category was considered. The rankings of the items in each category were normalized to be able to compare the importance of 51 items at once. In the normalization formula, rankings of the items were normalized to five-point scale. The formula below was used in the normalization process:

Normalization formula:

$$\left[4^{*}\left(\frac{\text{Current value} - \text{minimum value of current scale}}{\text{maximum value of current scale} - \text{minimum value of current scale}}\right)\right] + 1.$$

The second step was to rank the primary requirements categories. AHP was used to rank each category's relative importance. AHP is appropriate to use for a maximum of 7 ± 2 items (Sullivan, 1986). This limitation led us to use AHP only in the ranking of the primary categories but not the tertiary requirements within each category or in total. In the third step, the individual importance values of the items were calculated by multiplying the relative importance of each category (eigenvector) with normalized importance scores of each item within the category.

The performance level of each requirement regarding the two libraries was calculated by taking the mean value of user assessments.

Findings

Sample

Table I demonstrates a summary of the demographic characteristics of the respondents. This survey included all of the four departments in the Faculty of Business. A total of 127 respondents (50.6 percent) are from the Department of Business Administration, 62 (24.7 percent) from the Department of Economics, 56 (22.3 percent) from the Department of International Relations, and 6 (2.4 percent) from the Department of Tourism Management. The number of junior and senior students is approximately the same. A total of 55 percent of the respondents are juniors. Most of the participants (40 percent) are 22 years old. More than half of the respondents (58.6

Characteristics		*n*	%
Departments	Business administration	127	50.6
	Economics	62	24.7
	International relations	56	22.3
	Tourism management	6	2.4
Class standing	Junior	138	55.0
	Senior	113	45.0
Age	21 and younger	71	28.4
	22	100	40.0
	23 and older	79	31.6
Gender	Male	104	41.4
	Female	147	58.6
Income[a]	Under 500	7	2.9
	501-1,000	47	19.6
	1,001-1,500	76	31.7
	1,501-2,000	49	20.4
	2,001-2,500	32	13.3
	2,501 and above	29	12.1
Visiting library	Everyday	7	2.8
	Twice or three times a week	66	26.3
	Once a week	45	17.9
	Once in every two weeks	39	15.5
	Once a month or less	94	37.5
Accessing online library	Everyday	21	8.4
	Twice or three times a week	39	15.7
	Once a week	31	12.4
	Once in every two weeks	23	9.2
	Once a month or less	135	54.2
Visiting other university libraries	*Libraries of universities in Izmir*		
	Library of Ege University	137	56.8
	Library of Izmir University of Economics	16	6.6
	Library of Yaşar University	0	0
	Libraries of universities in other cities		
	Library of Middle East Technical University	25	10.4
	Library of Bilkent University	24	10.0
	Others	39	16,2

Table I.
Characteristics of sample

Note: [a] Exchange rates were approximately \$1 = 1.3310 YTL and €1 = 1.6079 YTL when the questionnaire was employed

percent) are females. Nearly one third of the respondents (31.7 percent) indicated that they have a monthly household income between 1,001 YTL and 1,500 YTL.

Additionally, the analysis of data shows that one-third of the respondents (34.5 percent) visited the library once a month or less. The results are similar for accessing the online library. Most of the respondents (54.2 percent) mentioned that they utilized the online library once a month or less. Besides, more than half of the students (54.6 percent) stated that they had visited the library of EU. The Central Library of EU is the most visited library by the respondents.

In the first part of the questionnaire, respondents were asked to rank first four most frequently used library services. The services and their rank frequencies are given in

Table II. The weighted average of usage frequencies are calculated by giving weights to each rank and taking an average. According to these weighted frequencies, mostly used library service is related to books (70.8). This is followed by online publications (46.1), computer usage other than catalogue search (29.8) and canteen (27), respectively. Conference rooms and interlibrary loan are the least used services.

The categorization of the attributes regarding the Kano model

In this part, frequencies of responses to the Kano model evaluations and user satisfaction (CS) coefficients were investigated to categorize the attributes. The following table (Table III) shows the first, the second and the third most frequent responses related to each requirement.

Table III revealed the order of frequent responses. A total of 13 of the requirements were found to be indifferent; the rest was categorized as one-dimensional. "Unworn out sources" and "ability to request sources from other libraries" are indifferent requirements related to sources. Respondents might have evaluated "ability to request sources from other libraries" as an indifferent requirement since this was the second least used library service (see Table III). For the technical attributes, "ability to use notebook computers in the library" is the only user requirement that was evaluated as indifferent. This may be attributed to most of the students' not having their own notebook computers. "Being informed about rival libraries" was also found to be indifferent among attributes related to library staff. There are four indifferent requirements related to administrative attributes. These are "usage of rechargeable cards", "promotion of library facilities", "entering library with personal belongings", and "information about internal settlement". All these four requirements are not effectively applied by the library administration. So, students may perceive these as indifferent because of inexperience. Students are indifferent to "existence of book sales office", "existence of smoking room", "visual attractiveness of the entrance" and "ability to examine the sources in the library garden". Indifferent needs point out that either the students do not need these requirements or these requirements are not important for them.

Library services	1st ranked *n*	2nd ranked *n*	3rd ranked *n*	4th ranked *n*	Weighted average of usage frequencies[a]
Books	136	29	23	31	70.8
Periodicals	10	38	33	20	24.0
Published thesis	7	21	31	26	17.9
Online publications	47	55	36	36	46.1
User services	0	8	2	14	4.2
Interlibrary loan	4	4	7	8	5.0
Computer usage other than catalogue search	13	41	47	29	29.8
Study rooms	12	24	33	26	21.2
Canteen	19	27	31	51	27.0
Conference rooms	2	1	3	4	2.1

Note: [a] Weighted average of usage frequency = [(1st ranked frequency * 4) + (2nd ranked frequency * 3) + (3rd ranked frequency * 2) + (4th ranked frequency * 1)]/10

Table II. Usage of library services

	Most frequent response	2nd	3rd
1. Existence of sufficient number of copies of a specific source	O (100)	M (53)	A (42)
2. Ability to find a specific source on the shelf easily	O (144)	M (55)	I (24)
3. Ability to reach sources on a wide range of subjects	O (131)	M (47)	I (34)
4. Ability to reach numerous sources on a specific subject	O (132)	M (45)	I (38)
5. Ability to reach numerous periodicals of a certain quality through internet	O (134)	A (44)	I (34)
6. Ability to reach audio-visual sources (VCD, DVD, cassette, CD etc.)	I (80)	O (76)	A (64)
7. Ability to reach sources in different languages	O (91)	I (70)	A/M (42)
8. Unworn out sources	I (91)	O (60)	M (50)
9. Ability to reach the current sources	O (125)	M (56)	I (34)
10. Ability to search sources easily and without any problems	O (124)	M (57)	A (35)
11. Ability to request sources from other libraries	I (88)	O (73)	A (48)
12. Ability to reach online sources that are included in the library's database without going to the library	O (121)	A (47)	I (43)
13. Ability to save the online information reached in the library as printout, e-mail, on CD etc.	O (138)	M (43)	A (37)
14. Having no queues to use computers	0 (120)	A (42)	M (40)
15. Ability to examine the contents of the sources of the library from the internet	O (120)	A (48)	I (45)
16. Ability to follow up borrowed books from the internet	O (88)	I (74)	A (54)
17. Ability to use notebook computers in the library	I (102)	O (58)	A (55)
18. Having no problems while taking photocopies are done	O (115)	M (61)	I (46)
19. Behaving ethically	O (117)	M (61)	I (36)
20. Fulfilling their duties carefully	O (109)	M (64)	I (50)
21. Being successful in human relations	O (111)	I (49)	M (47)
22. Recognizing the library staff enjoy doing their work	O (86)	I (72)	M (51)
23. Having sufficient knowledge about their jobs	O (108)	I (65)	M (55)
24. Understanding the users' requirements	O (102)	M (66)	I (57)
25. Obeying the library rules	O (98)	M (70)	I (55)
26. Being informed about rival libraries	I (94)	O (68)	M (48)
27. Ability to borrow more than two books	O (105)	I (63)	A (58)
28. Ability to borrow books longer than 15 days	O (101)	I (68)	A (50)
29. Having photocopy prices at the market level at maximum	O (115)	M (48)	I (46)
30. Taking suggestions and criticisms into consideration	O (116)	A (45)	M (45)
31. Solving the problems related to the library rapidly	O (115)	M (51)	I (40)
32. Having sufficient working hours	O (98)	I (58)	M (53)
33. Utilizing the membership system effectively	O (82)	I (70)	M (55)

Table III.
Frequencies of Kano responses

(*continued*)

	Most frequent response	2nd	3rd
34. Ability to make all the payments within the library with a rechargeable card	I (106)	A (56)	O (48)
35. Promoting the library facilities	I (133)	O (42)	A (39)
36. Ability to enter the library with personal belongings	I (89)	O (78)	A (43)
37. Informing the users about the internal settlement	I (114)	O (53)	A (42)
38. Providing rooms for individual or group studies	O (109)	A (60)	I (52)
39. Existence of book sales office	I (112)	A (54)	O (51)
40. Existence of smoking room	I (111)	M (39)	A (32)
41. Ability to use computers for different purposes than searching sources	O (101)	I (62)	M (43)
42. Existence of canteen	O (95)	I (65)	A (43)
43. Existence of comfortable reading rooms	O (90)	A (68)	I (66)
44. Easy access to the library	O (103)	I (59)	A (54)
45. Visual attractiveness of the entrance	I (108)	O (61)	A (43)
46. Adequacy of illumination	O (118)	M (52)	I (49)
47. Effectiveness of the air-conditioning	O (119)	M (50)	I (44)
48. Having easy to use layout	O (99)	I (60)	M (48)
49. Providing a silent environment	O (130)	M (62)	I/A (28)
50. Providing a clean environment	O (126)	M (60)	I (33)
51. Ability to examine the sources in the library garden	I (88)	O (73)	A (44)

Table III.

Although the most frequent responses were generally categorized as one-dimensional or indifferent, the second and the third most frequent responses were classified under different types of needs. CS coefficients of each requirement were used in order to analyze the user requirements in Table IV, comprehensively. The extent of satisfaction and dissatisfaction columns indicates the user satisfaction (CS) coefficients. The CS coefficient shapes whether satisfaction can be increased by meeting a product/service requirement or whether fulfilling this product requirement merely prevents the user from being dissatisfied (Berger *et al.*, 1993). The CS coefficient indicates how strongly a product attribute may affect satisfaction or dissatisfaction -in the case of its non-fulfillment (Matzler and Hinterhuber, 1998). The formulation of CS coefficients is:

$$\text{For satisfaction (Extent of satisfaction)} : \frac{A+O}{A+O+I+M}$$

$$\text{For dissatisfaction (Extent of dissatisfaction)} : \frac{O+M}{(-1)^{*}(A+O+I+M)}$$

A = Attractive, M = Must-be, O = One-dimensional, I = Indifferent, R = Reversed, Q = Questionable.

Since most of the requirements were found to be one-dimensional, to see how close each one-dimensional requirement is to attractive or must-be characteristics, authors eliminated the frequencies of one-dimensional responses from the equation by adding CS coefficients for satisfaction and dissatisfaction. If the sum of the CS coefficients is positive, the requirement is said to be closer to attractive characteristics. If it is

	Most frequent response	Extent of satisfaction	Extent of dissatisfaction	The sum of the CS coefficients
Attributes related to sources				
2 Ability to find a specific source on the shelf easily	O (144)	0.67	−0.82	−0.15[a]
6 Ability to reach audio-visual sources (VCD, DVD, cassette, CD etc.)	I (80)	0.56	−0.42	0.15[b]
Technical attributes				
7 Having no problems while taking photocopies are done	O (115)	0.56	−0.72	−0.16[a]
5 Ability to follow up borrowed books from the internet	O (88)	0.57	−0.48	0.09[b]
Attributes related to library staff				
7 Obeying the library rules	O (98)	0.49	−0.68	−0.19[a]
Administrative attributes				
6 Having sufficient working hours	O (98)	0.55	−0.61	−0.07[a]
1 Ability to borrow more than two books	O (105)	0.66	−0.51	0.15[b]
Other library services				
3 Existence of smoking room	I (111)	0.18	−0.21	−0.04[a]
6 Existence of comfortable reading rooms	O (90)	0.64	−0.46	0.18[b]
Attributes related to atmosphere and location				
6 Providing a silent environment	O (130)	0.64	−0.77	−0.14[a]
1 Easy access to the library	O (103)	0.63	−0.54	0.09[b]

Table IV.
Kano evaluation

Notes: [a] The requirement closest to the must-be needs within each category; [b] The requirement closest to the attractive needs within each category

negative, then the requirement is seen to be closer to must-be characteristics. The higher the absolute value of the sum, the more the requirements reflect the must-be or attractive characteristics:

$$\text{The sum of the CS coefficients} : \frac{A+O}{(A+O+I+M)} + \frac{O+M}{(-1)^{*}(A+O+I+M)} = \frac{A-M}{(A+O+I+M)}$$

The requirements having the highest and lowest CS coefficients within each primary category are included in Table IV. The requirements having negative CS coefficient values carry much more "must-be" characteristics than the others in a primary category. The ones having positive values are closest to the attractive needs.

"Ability to find a specific source on the shelf easily", "having no problems while taking photocopies are done", "obeying the library rules", "having sufficient working hours", "existence of smoking room" and "providing a silent environment" were found to be closest to the "must-be" needs. Therefore, libraries should concentrate to these requirements since the absence of these requirements may cause dissatisfaction among users. For example, "having no problems while taking photocopies are done" was evaluated as closer to a must-be need. This requirement is one of the most important complaints of the respondents. There was no requirement found closer to the attractive needs within the library staff category. The reason is that no attractive characteristics were associated with the first 3 most frequent response categories (in Table III the requirements numbered from 19 to 26). This means all the requirements related with library staff must be met by the library management.

On the other hand, "ability to reach audio-visual sources (VCD, DVD, cassette, CD etc.)", "ability to follow up borrowed books from the internet", "ability to borrow more than two books", "existence of comfortable reading rooms", and "easy access to the library" reflect attractive characteristics. Providing these requirements to the users would delight them and can provide competitive advantage through service differentiation. But library management should give the priority to the requirements closer to the must-be needs.

Importance and performance levels of user requirements

Importance levels. The importance levels of user requirements were calculated in two steps. In the first step, AHP was used to find the relative importance of each six primary level requirements. The mode values of the responses were considered to calculate the final weights (see Table V). The consistency ratio of 0.066, which is smaller than 0.10 proved that the AHP results were consistent (for all values $n \geq 5$) (Saaty, 1994). In the second step, the ranking scale used in the questionnaire was normalized to be able to rank all of the tertiary level requirements. After the normalization process, the mean value of each requirement was calculated. In addition, AHP was integrated to the normalized mean values to find out the weighted importance of each requirement. The weighted importance of tertiary requirements is the product of normalized mean values and final AHP weights.

The final AHP weights show that "attributes related to sources" is the most important category among primary requirements. This is followed by "technical attributes" and "attributes related to library staff", respectively. "Other library services" category was evaluated as the least important category.

Performance levels and quality improvement indices

In the preceding section, the respondents' assessment of the importance of the requirements was examined. It is also crucial for the library management to understand where their position is in the competitive environment. Regarding this fact, the performances of the DEU and EU central libraries are compared. The mean values of the performances in each category are illustrated in the following table. Quality improvement index (QI) was used to investigate the competitive position of the DEU central library. QI is "the ratio calculated by multiplying the relative importance of a product requirement for the user by the gap value of the perceived product quality (own product versus competitor's product)" (Matzler and Hinterhuber, 1998):

Table V.
AHP mode values and the final weights of the primary level requirements

	AHP matrix						
Primary categories	Attributes related to sources	Technical attributes	Attributes related to library staff	Administrative attributes	Other library services	Attributes related to atmosphere and location	Final weights
Attributes related to sources	1	2	3	3	2	2	0.301526
Technical attributes		1	3	2	2	2	0.222129
Attributes related to library staff			1	2	2	2	0.150828
Administrative attributes				1	2	2	0.128372
Other library services					1	(2)	0.086611
Attributes related to atmosphere and location						1	0.110535
Consistency index (CI)							0.081288
Consistency ratio							0.065555

Notes: Matrix entry indicates that row element is 1 equally; 2 moderately; 3 strongly; 4 very strongly; 5 extremely preferable to column element unless enclosed in parentheses

Quality improvement index: Relative importance
*(Evaluation of own product's performance
− Evaluation of competitor's product's performance).

The tertiary requirements having the highest and lowest QI in each primary requirement categories were considered in Table VI. Besides, QIs of primary requirements were included to identify the competitive position of DEU library. In the previous section, the calculation of the weighted importance levels of tertiary requirements was explained. In Table VI, relative importance of each tertiary requirement within its category was used which was calculated by dividing each individual weighted importance value of a tertiary requirement by the sum of the weighted importance values of all tertiary requirements within the category.

The performance of DEU library is perceived lower than EU library performance in all of the primary requirement categories. Therefore, all of the QIs having negative values indicate that DEU library has competitive disadvantages. The most critical disadvantage is on "attributes related to sources". This is due to the high relative importance value of this category. On the other hand, "other library services" and

	Relative importance (AHP)	DEU performance (means)	EU performance (means)	Quality improvement index
1. Attributes related to sources	*0.30*	*2.84*	*3.27*	*− 0.13*
(2) Ability to find a specific source on the shelf easily	11.69	2.86	3.50	− 7.48
(8) Unworn out sources	6.38	3.05	3.24	− 1.21
2. Technical attributes	*0.22*	*2.57*	*2.94*	*− 0.08*
(1) Ability to reach online sources that are included in the library's database without going to the library	18.21	2.39	2.91	− 9.47
(7) Having no problems while taking photocopies are done	12.10	2.79	2.97	− 2.18
3. Attributes related to library staff	*0.15*	*2.78*	*3.16*	*− 0.06*
(3) Being successful in human relations	14.63	2.79	3.29	− 7.31
(7) Obeying the library rules	10.67	3.02	3.32	− 3.20
4. Administrative attributes	*0.13*	*2.56*	*2.97*	*− 0.05*
(10) Ability to enter the library with personal belongings	7.22	2.33	3.19	− 6.21
(6) Having sufficient working hours	10.10	3.08	3.14	− 0.61
5. Other library services	*0.09*	*2.82*	*3.02*	*− 0.02*
(2) Existence of book sales office	14.58	2.29	2.86	− 8.31
(5) Existence of canteen	16.29	3.56	3.20	5.86
6. Attributes related to atmosphere and location	*0.11*	*3.05*	*3.29*	*− 0.03*
(1) Easy access to the library	14.73	2.72	3.45	− 10.75
(7) Providing a clean environment	12.54	3.44	3.49	− 0.63

Table VI.
Quality improvement indices

"attributes related to atmosphere and location" have negative QIs very close to zero. So, these can be considered as ignorable small disadvantages.

According to the analysis of the tertiary requirements under the primary categories, "ability to find a specific source on the shelf easily", "ability to reach online sources that are included in the library's database without going to the library", "being successful in human relations", "ability to enter the library with personal belongings", "existence of book sales office" and "easy access to the library" were found to be the most critical competitive disadvantages of DEU library. These requirements need to be highly improved regarding its low QI. On the other hand, the gap between performances of two libraries and relative importance of tertiary requirements in each primary requirement category should be analyzed to understand the source of the competitive disadvantage. For example, although there was a small performance gap between DEU and EU libraries on "ability to reach online sources that are included in the library's database without going to the library", having the most critical competitive disadvantage is a result of the high relative importance identification of users in the technical attribute category.

On the other hand, "unworn out sources", "having no problems while taking photocopies are done", "obeying the library rules", "having sufficient working hours" and "providing a clean environment" has significantly lower index values relative to the rest of the requirements in each primary category. This can be attributed to DEU library's performance being closer to the performance of EU library. "Existence of canteen" is the only requirement on which the DEU central library has a competitive advantage. This corresponds to the finding that the canteen is the fourth most frequently used library service (see Table III).

As a result, library management should allocate its resources to the requirements that have the greatest competitive disadvantages rather than the minor ones. Additionally, the causes of competitive disadvantages should be identified carefully and the strategic plan should be designed depending on this analysis.

The integration of Kano model to the planning matrix

In the previous sections, tertiary level requirements were assessed regarding the Kano model and their QIs within each category. The aim of this section is to integrate previous findings with the planning matrix of QFD. In this process, all of the 51 tertiary requirements are considered rather than analyzing them within their categories. This provides a comparison and a better understanding of user requirements. This assessment shows us which requirements are strategically more important for the central library of DEU.

In Table VII, the first 15 strategically most important requirements are considered while Table VIII contains the 15 least important ones. The relative importance column is different than the one used in the previous section. For the planning matrix, the relative importance is found by dividing individual weighted importance value of each tertiary requirement by the sum of the weighted importance values of all tertiary requirements. This enables to compare the relative importance of all 51 requirements at once.

The organization can set a target point and determine how much they have to improve their attributes by computing the improvement ratio. Improvement ratio equation is:

$$\text{Improvement Ratio (IR)} = (\text{Target})/(\text{Organization's current performance level}).$$

Table VII.
The planning matrix (the 15 strategically most important requirements)

		Kano category	Relative importance	DEU performance	EU performance (target)	Improvement ratio	Strategic importance
S2	Ability to find a specific source on the shelf easily	O	4.36	2.86	3.50	1.22	5.34
S3	Ability to reach sources on a wide range of subjects	O	4.28	2.89	3.46	1.20	5.12
S1	Existence of sufficient number of copies of a specific source	O	4.16	2.76	3.38	1.22	5.10
S4	Ability to reach numerous sources on a specific subject	O	4.23	2.93	3.33	1.14	4.80
S5	Ability to reach numerous periodicals of a certain quality through internet	O	3.68	2.84	3.22	1.13	4.17
T1	Ability to reach online sources that are included in the library's database without going to the library	O	3.18	2.39	2.91	1.22	3.88
S9	Ability to reach the current sources	O	3.39	2.97	3.16	1.06	3.60
T3	Having no queues to use computers	O	2.92	2.48	3.03	1.22	3.57
S10	Ability to search sources easily and without any problems	O	3.14	3.05	3.41	1.12	3.51
S6	Ability to reach audio-visual sources (VCD, DVD, cassette, CD etc.)	I	2.68	2.37	3.07	1.30	3.47
S7	Ability to reach sources in different languages	O	3.06	2.99	3.34	1.12	3.41
T4	Ability to examine the contents of the sources of the library from the internet	O	2.73	2.63	3.01	1.14	3.12
T2	Ability to save the online information reached in the library as printout, e-mail, on CD etc.	O	2.94	2.82	2.96	1.05	3.09
S8	Unworn out sources	I	2.38	3.05	3.24	1.06	2.53
T5	Ability to follow up borrowed books from the internet	O	2.10	2.35	2.78	1.18	2.49

Notes: "S" denotes for "attributes related to sources", "T" for "technical attributes"; The numbers next to the abbreviations are the same with their order in the category; For example, "S1" symbolizes the first requirement in the "attributes related to sources" category

Table VIII.
The planning matrix (the 15 strategically least important requirements)

		Kano category	Relative importance	DEU performance	EU performance (target)	Improvement ratio	Strategic importance
ATM4	Effectiveness of the air-conditioning	O	1.42	3.21	3.31	1.03	1.47
A8	Ability to make all the payments within the library with a rechargeable card	I	1.06	2.13	2.77	1.30	1.37
O1	Providing rooms for individual or group studies	O	1.22	2.62	2.94	1.12	1.37
ATM5	Having easy to use layout	O	1.19	3.08	3.43	1.11	1.33
ATM7	Providing a clean environment	O	1.25	3.44	3.49	1.01	1.26
A9	Promoting the library facilities	I	1.00	2.39	2.89	1.21	1.20
O4	Ability to use computers for different purposes than searching sources	O	1.13	2.93	3.06	1.04	1.18
A11	Informing the users about the internal settlement	I	0.94	2.54	2.97	1.17	1.10
O6	Existence of comfortable reading rooms	O	0.95	2.78	3.19	1.15	1.09
LS8	Being informed about rival libraries	I	0.92	2.62	3.10	1.18	1.08
O2	Existence of book sales office	I	0.85	2.29	2.86	1.25	1.06
ATM2	Visual attractiveness of the entrance	I	0.95	2.86	3.19	1.12	1.06
O5	Existence of canteen	O	0.95	3.56	3.20	0.90	0.86
ATM8	Ability to examine the sources in the library garden	I	0.78	2.39	2.48	1.04	0.81
O3	Existence of smoking room	I	0.73	2.74	2.90	1.06	0.77

Notes: "LS" denotes for "attributes related to library staff", "A" for "administrative attributes", "O" for "other library services" and "ATM" for "attributes related to atmosphere and location"; The numbers next to the abbreviations are the same with their order in the category

The improvement ratio is the proportion of the perceived EU library performance to that of DEU library. EU library performance is considered as the target level because EU library was identified as the first most frequently visited university library by our respondents.

The strategic importance values in the planning matrix (see Table VII) which are ranked in descending order demonstrated that the most important tertiary requirements are related to "sources". This is congruent with the AHP results showing that the most important primary requirement category is related to "sources". The tertiary requirements related to sources and technical requirements are within the first 15 most important requirements except T7 (Having no problems while taking photocopies), S11 (Ability to request sources from other libraries) and T6 (Ability to use notebook computers in the library).

On the other hand, most of the tertiary requirements related to atmosphere except ATM1 (Easy access to the library), ATM6 (Providing a silent environment) and ATM3 (Adequacy of illumination) appear within the 15 least important requirements in addition to all other library service requirements (see Table VIII). This was expected since primary requirement categories related to atmosphere and other library services were found to be the least important categories in AHP assessment. Although administrative tertiary requirements has moderate level of importance in AHP assessment, three of them – A8 (ability to make all the payments within the library with a rechargeable card), A9 (promoting the library facilities), and A11 (informing the users about the internal settlement) – occur in the list of 15 strategically least important requirements. Most of the tertiary requirements regarding library staff have a higher strategic importance than requirements included in administration, other library services and atmosphere. But LS8 (being informed about rival libraries) has rather a lower strategic importance.

The requirements perceived as indifferent by the respondents tend to have lower strategic importance; hence they generally appear towards the end of the list. This is due to the low relative importance values. However, some of the indifferent requirements have relatively higher strategic importance. This is not what is expected from an indifferent requirement however a high relative importance value depending on high AHP weights of the primary requirement categories may trigger this result.

Conclusion

Services have different properties compared to physical products that make it harder to assess service quality. Understanding the customer requirements is an essential and critical point for service providers to meet and satisfy their customers' needs. If the customer's first experience is negative, the organization can lose its customer forever. It is also very hard to convince customers that the service is improved since it is intangible. Therefore, service organizations require a careful analysis of customer requirements prior to effective service production. In this sense, QFD is a powerful and structured tool for listening to the voices of customers and for assuring that quality is implemented into new products/services (Kogure and Akao, 1983). The most important process in QFD is identifying the right customer requirements. QFD is a useful tool to rank these requirements with respect to their relative importance. At this point, AHP can be used to assess relative importance levels of requirements. Kano model can be

integrated into QFD process in order to understand customer requirements in more detail and to differentiate them.

In this study, user requirements were gathered from focus group discussions and depth interviews. After identifying the user requirements, survey was employed to integrate the Kano model to QFD, to determine the importance levels of requirements, to compare performances of the DEU and EU central libraries. In the questionnaire, there were six primary requirement categories: items related to sources, technical attributes, library staff, administrative attributes, other library services, and atmosphere and location quality. In total, there were 51 items under these 6 primary requirement categories. The sample consisted of junior and senior students in DEU, Faculty of Business, Izmir-Turkey.

Before applying the QFD planning matrix, the data were analyzed based on Kano Model. Most of the requirements were perceived as a one-dimensional need while few of them were identified as an indifferent need by the respondents. However, neither attractive nor must-be needs were found within 51 items.

Indifferent needs point out that either the students do not need these requirements or these requirements are not important for them.

On the other hand, certain requirements were found to be closer to attractive or must-be needs. "Ability to find a specific source on the shelf easily", "having no problems while taking photocopies are done", "obeying the library rules", "having sufficient working hours", "existence of smoking room" and "providing a silent environment" were found to be closest to the "must-be" needs. On the other hand, "ability to reach audio-visual sources (VCD, DVD, cassette, CD etc.)", "ability to follow up borrowed books from the internet", "ability to borrow more than two books", "existence of comfortable reading rooms" and "easy access to the library" reflected attractive characteristics. Therefore it can be recommended to the DEU central library management to initially focus on must-be needs to provide satisfaction and then attractive needs to provide customer delight.

Sources, technical attributes and library staff were found to be the most important primary requirement categories, respectively regarding the AHP analysis results. Library management should emphasize its collection of sources, follow the technological developments, educate and motivate the library staff to improve its quality. The primary requirement category "other library services" (including existence of book sales office or smoking room) was evaluated as the least important requirement category. Thus, "other library services" may get a smaller share from the resource allocation. These results offered a general perspective about user requirements with respect to library activities. On the other hand, items within each category should be analyzed in order to understand user requirements in depth.

"Ability to find a specific source on the shelf easily", "ability to reach online sources that are included in the library's database without going to the library", "being successful in human relations", "ability to enter the library with personal belongings", "existence of book sales office" and "easy access to the library" were found to be the most critical competitive disadvantages of DEU library. In this sense, DEU library can design effective and comprehensible coding system to facilitate finding sources. In addition, it is very important for library administration to provide accessibility to online library database not only in the library but also from the outside. From marketing point of view, library staff has a critical importance because library staff is

the contact person or it provides the services to the users. Behaviors of library staff can be considered to evaluate the quality of a library. Library administration should monitor the performance of library staff very closely in order to fulfill these requirements. Besides, library staff should be educated about ethical issues and communication strategies.

The above-mentioned requirements and recommendations are related to general expectations of respondents from any university library. In order to prepare a planning matrix for DEU, comparison of its performance with that of its competitor is necessary. The Kano results were found consistent with the relative importance levels. And they were employed to support planning matrix. When the performances of the central libraries of DEU and EU were compared, the performance of the central library of EU excesses the performance of the central library of DEU. Thus, the central library of DEU had competitive disadvantages on all of the items except "existence of canteen". Considering each requirement's strategic importance, the central library of DEU should allocate resources especially to sources, technical attributes and library staff in order to reach the performance of the EU central library.

The authors aim to help library managers in creating strategies and allocating resources by considering user requirements through application of a new method QFD. Although this study has some limitations regarding sampling, it is important since it is one of the first QFD applications in library services. This study is intended to shed light to librarians in determination of user requirements that will help them to develop appropriate and effective strategies. This will provide higher user satisfaction and competitive advantage to that library.

The methodology used in this study integrated the Kano model, AHP and planning matrix of house of quality. This provides researchers to evaluate each requirement regarding its relative importance and its necessity and urgency for satisfaction. Therefore, the strategic importance of requirements was identified more precisely. Consequently, service elements can be allocated more effectively. As a result, combination of these three tools is recommended in QFD applications.

Limitations of the study and recommendation for future studies

The users of university libraries can be academicians, graduate students, undergraduate students, university staff, and external visitors. This study investigated the evaluations of the undergraduate students of a single faculty, Faculty of Business Administration, which is one specific group of users. For that reason, the results cannot be generalized to all academic units of DEU but the results reflect the perspective of administrative students in DEU. On the other hand, high number of requirements (51) limited the application of AHP only to the primary requirement categories.

In further researches, the study may be applied to other groups of users of library services such as academicians, graduate students etc. This will provide a comparison of requirements among user groups and different strategies may be generated for different segments. On the other hand, secondary level requirements may be included in a further study in addition to the primary and tertiary requirements. AHP analysis can also be conducted on the secondary level requirements. Thus, much more accurate relative importance values can be calculated. The authors plan to extend this study to determine service elements and complete the house of quality in the QFD process. This

study is expected to form a base for a further research including the relationship, element planning and operations planning matrices.

Note

1. EU was established in 1955. It currently consists of 11 faculties, five schools (four years), eight vocational training schools (two years), seven institutes and 21 research centers. EU started to give library services in 1960. In this sense, EU has 45 years of experience in library services. EU and its library are the first established university and the library in Izmir. This is one of the reasons of selecting the EU central library the most important competitor of the DEU central library.

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