DOKUZ EYLÜL UNIVERSITY
GRADUATE SCHOOL OF NATURAL AND APPLIED SCIENCES

RE-EVALUATION OF THE AFTER-SALES SERVICES QUALITY CRITERIA USING QUALITY FUNCTION DEPLOYMENT METHODOLOGY

by
Serap TAŞKIRAN KÜÇÜKÖZKUL

February, 2023
İZMİR

RE-EVALUATION OF THE AFTER-SALES SERVICES QUALITY CRITERIA USING QUALITY FUNCTION DEPLOYMENT METHODOLOGY

A Thesis Submitted to the
Graduate School of Natural and Applied Sciences of Dokuz Eylül University
In Partial Fulfillment of the Requirements for the Degree of Master of Science
in Industrial Engineering, Industrial Engineering Program

by

Serap TAŞKIRAN KÜÇÜKÖZKUL

February, 2023

IZMIR

M.Sc. THESIS EXAMINATION RESULT FORM

We have read the thesis entitled **"RE-EVALUATION OF THE AFTER-SALES SERVICES QUALITY CRITERIA USING QUALITY FUNCTION DEPLOYMENT METHODOLOGY"** completed by **SERAP TAŞKIRAN KÜÇÜKÖZKUL** under the supervision of **ASSOC. PROF. DR. ÖZCAN KILINÇCI** and we certify that in our opinion it is fully adequate, in scope and quality, as a thesis for the degree of Master of Science.

…….....

Assoc. Prof. Dr. Özcan KILINÇCI

_____

Supervisor

…….....	…….....
Prof. Dr. Hasan SELİM	Asst. Prof. Dr. Hülya GÜÇDEMİR
_____	_____
(Jury Member)	(Jury Member)

_____

Prof. Dr. Okan FISTIKOĞLU

Director

Graduate School of Natural and Applied Sciences

ACKNOWLEDGEMENT

During my Master's education and thesis time, I got lots of help from my family. I would not be able to complete this research, and thesis without their tremendous support.

First of all, I would like to thank and gratitude my thesis supervisor, Assoc. Prof. Dr. Özcan KILINÇCI, for his endless support and patience throughout my thesis process. He guided me with his knowledge throughout my graduate education and illustrate my way to prepare this work, and without refraining from his contributions at all stages of my research.

I also would like to thank Prof. Dr. Hasan SELİM and Asst. Prof. Dr. Hülya GÜÇDEMİR who are member of the jury, for their participation in my thesis defense and present my respects.

I would like to express my huge thanks to my managers Esra AKGÜN and Ercan KÖSE, my colleague Sedef TANIR and all my colleagues whose names I cannot mention, for their support and guidance during the implementation of the study.

Finally, I would like to express my infinite appriciation to my dear husband Ali KÜÇÜKÖZKUL, my best friend Fulden Aras EKMEKÇİ and my family for their continuous support and encouragement throughout my life.

Serap TAŞKIRAN KÜÇÜKÖZKUL

RE-EVALUATION OF THE AFTER-SALES SERVICES QUALITY CRITERIA USING QUALITY FUNCTION DEPLOYMENT METHODOLOGY

ABSTRACT

Globalization and the rapid development of technology have increased the competitive pressure in all sectors and brought the concept of customer satisfaction to the fore. In today's competitive conditions, customers not only demand buying products, but also purchasing the services along with the products, they have purchased. This cyle triggers the after-sales services, which is a huge sector to the forefront for satisfaction and loyalty of the customers.

This study aims to re-evaluate the service quality criteria based on customer expectations for providing customer satisfaction and operational excellence in the After Sales and Customer Services operations.

For this purpose, Quality Function Deployment, which has an important place in quality studies, the Servqual model, which is one of the most preferred models in service quality evaluations, and the Analytical Hierarchy Process model as a decision-making method in hierarchical problems synthesized and used.

Keywords: After-sales services, quality function deployment, service quality, servqual, analytical hierarchy process

SATIŞ SONRASI HİZMET KALİTE KRİTERLERİNİN KALİTE FONKSİYON YAYILIM METODOLOJİSİ KULLANILARAK YENİDEN DEĞERLENDİRİLMESİ

ÖZ

Küreselleşme ve teknolojinin hızla gelişmesi tüm sektörlerdeki rekabet baskısını arttırmış ve müşteri memnuniyeti kavramını ön plana çıkarmıştır. Günümüz rekabet koşullarında müşteriler sadece bir ürünü satın almak için değil, satın aldıkları ürünlerle birlikte hizmetleri de satın almak istemektedirler. Bu durum müşteri memnuniyeti ve sadakati için satış sonrası hizmetler sektörünü ön plana çıkarmaktadır.

Bu çalışma, Satış Sonrası ve Müşteri Hizmetleri sektöründe müşteri memnuniyetini ve operasyonel mükemmelliği sağlamak için hizmet kalitesi kriterlerini müşteri beklentilerine göre yeniden değerlendirmeyi amaçlamaktadır.

Bu amaçla kalite çalışmalarında önemli bir yere sahip olan Kalite Fonksiyon Göçerimi, hizmet kalitesi değerlendirmelerinde en çok tercih edilen modellerden biri olan Servqual modeli ve hiyerarşik problemlerde karar verme yöntemi olarak kullanılan Analitik Hiyerarşi Proses modelleri sentezlenmiş ve kullanılmıştır.

Anahtar Sözcükler: Satış sonrası hizmetler, kalite fonksiyon yayılımı, hizmet kalitesi, servqual, analitik hiyerarşi proses

CONTENTS

Page

THESIS EXAMINATION RESULT FORM ii
ACKNOWLEDGEMENT iii
ABSTRACT iv
ÖZ v
LIST OF FIGURES x
LIST OF TABLES xi
ABBREVIATIONS xii

CHAPTER 1- INTRODUCTION 1

CHAPTER 2 - AFTER-SALES SERVICES AND SERVICE QUALITY 4

2.1 Service Concept 4
2.1.1 Services Features 5
2.1.1.1 Intangibility 5
2.1.1.2 Variability 5
2.1.1.3 Inseparability 6
2.1.1.4 Perishability 6
2.2 After-Sales Services 6
2.2.1 Importance of After-Sales Services Sector 7
2.2.2 The Elements of After-Sales Services 8
2.3 Service Quality 9
2.3.1 Service Quality Models 10
2.4 Service Quality Method: SERVQUAL 11
2.4.1 Perceived Service Quality 13
2.4.2 Expected Service Quality 14
2.4.3 Criticisms of the SERVQUAL Model 16

CHAPTER 3 - QUALITY FUNCTION DEPLOYMENT 17

3.1 The Definition of QFD 17
3.2 History of QFD 18
3.3 The Benefits and Difficulties of QFD 20
3.4 QFD Models 21
3.4.1 Four Phase Model 22
3.4.1.1 Phase1: House of Quality (HoQ) 22
3.4.1.2 Phase 2: Part Deployment Matrix 23
3.4.1.3 Phase 3: Process-Planning Matrix 23
3.4.1.4 Phase 4: Product-Planning Matrix 23
3.5 Establishment of House of Quality (HOQ) 24
3.5.1 Part A. Customer Needs (WHATs) 25
3.5.1.1 Step 1: Determine Customer Demands (WHATs) 25
3.5.1.2 Step 2: Determine the Relative Importance of Ratings of Customer Demands 26
3.5.2 Part B. Planning Matrix 26
3.5.2.1 Step 3: Identify Competitors and Conduct Customer Competitive Analysis 26
3.5.2.2 Step 4: Determine the Final Importance Ratings of Customer Demands 27
3.5.3 Part C. Technical Measures (HOWs) 27
3.5.3.1 Step 5: Generate Engineering Characteristics (HOWs) 27
3.5.4 Part D. Relationship Matrix 28
3.5.4.1 Step 6: Determine the Relationships Between HOWs and WHATs 28
3.5.5 Part E. Technical Correlation Matrix 28
3.5.6 Part F. Technical Matrix 29
3.5.6.1 Step 7: Determine Initial Technical Ratings of HOWs 29
3.5.6.2 Step 8: Perform Technical Competitive Analysis 30
3.5.6.3 Step 9: Obtain the HOWs Final Technical Ratings 30
3.6 Analitycal Hierarchy Process 30
3.6.1 Basic Principles of AHP 31
3.6.2 Axioms of AHP 31
3.6.3 Steps of Analytic Hierarchy Process 32

3.6.3.1 Identifying the Essential Problem and the Desired Information..... 33
3.6.3.2 Structure the Decision Hierarchy..... 33
3.6.3.3 Creating Pairwise Comparison Matrices 34
3.6.3.3.1 Determination Of Importance Values 35
3.6.3.3.2 Consistency Ratio..... 36
3.6.3.4 Prioritizing Each Alternative 37
3.7 Literature Review 37

CHAPTER 4 - QUALITY FUNCTION DEPLOYMENT APPLICATION IN AFTER-SALES SERVİCES SECTOR..... 45

4.1 Company Presentation..... 45
4.2 Problem Definition..... 46
4.3 Aim of the Study 47
4.4 Methodology 48
4.5 Application of the QFD Model 49
4.5.1 Application of First House of Quality 50
4.5.1.1 Defining customer expectations..... 50
4.5.1.2 Explanations of customer expectations..... 52
4.5.1.3 Determining the importance levels of customer expectations 55
4.5.1.4 Determining the Final Importance Weights of Customer Expectations 59
4.5.1.5 Determination of Technical Characteristics..... 61
4.5.1.6 Technical Corelation (Roof) Matrix 63
4.5.1.7 Creating the relationship matrix..... 64
4.5.1.8 Creating the Technical Matrix 65
4.5.2 Implementing the Second House of Quality: Transforming processes into service quality assessment factors 69
4.5.2.1 Explanations of service quality criteria..... 71
4.5.2.2 Creating relationships matix 74
4.5.2.3 Re-scoring service quality criteria 76

CHAPTER 5 - CONCLUSION **77**

5.1 Suggestions 78

REFERENCES 79

LIST OF FIGURES

Page

Figure 2.1 Servqual methodology 14
Figure 3.1 The four-phase model 22
Figure 3.2 House of quality 24
Figure 3.3 House of quality: 9-step description 25
Figure 3.4 Decision hierarchy example 33
Figure 4.1 Process flowchart 61
Figure 4.2 Roof matrix of the first house of quality 64
Figure 4.3 The first house of quality 68
Figure 4.4 The second house of quality 75

LIST OF TABLES

Page

Table 3.1 Symbol and score of relationship matrix 28
Table 3.2 Scoring scale of technical correlation matrix 29
Table 3.3 Importance scale of comparison matrix 34
Table 3.4 Value of random index 37
Table 3.5 Literature review of QFD in the service sector 38
Table 4.1 Customer expectations, score, and target value 51
Table 4.2 Target formulation table 52
Table 4.3 Pairwise comparison matrix of main criteria 56
Table 4.4 Pairwise comparison matrix of tangible subcriteria 56
Table 4.5 Pairwise comparison matrix of reliability subcriteria 56
Table 4.6 Pairwise comparison matrix of responsiveness subcriteria 57
Table 4.7 Pairwise comparison matrix of assurance subcriteria 57
Table 4.8 Pairwise comparison matrix of empathy subcriteria 57
Table 4.9 Main criteria weights and consistency ratio 57
Table 4.10 Tangible subcriteria weights and consistency ratio 57
Table 4.11 Reliability subcriteria weights and consistency ratio 58
Table 4.12 Responsiveness subcriteria weights and consistency ratio 58
Table 4.13 Assurance subcriteria weights and consistency ratio 58
Table 4.14 Empathy subcriteria weights and consistency ratio 58
Table 4.15 Criteria final weights 59
Table 4.16 Criteria weights, performance level, target value and final importance .. 60
Table 4.17 Relationship matrix of the first house of quality 65
Table 4.18 Technical matrix of the first house of quality 66
Table 4.19 Planning matrix of the second house of quality 69
Table 4.20 Service quality assessment criteria 70
Table 4.21 Criteria and weights 76

ABBREVIATIONS

QFD	: Quality Function Deployment
AHP	: Analytical Hierarchy Process
HOQ	: House of Quality
ASI	: American Supplier Institute
SPC	: Statistical Process Control
HMM	: Hidden Markov Model
TRIZ	: Theory of Inventive Problem Solving
VOC	: Voice of Customer
MCDM	: Multiple Criteria Desicion Making
FQFD	: Fuzzy Quality Function Deployment
IPA	: Importance Performance Analysis
FIS	: Fuzzy Inference System
S-CoCoSo	: Stratified Combined Compromise Solution

CHAPTER 1
INTRODUCTION

Globalization and the rapid acceleration of the technology have increased the competition in whole industries and brought the concept of customer satisfaction. Today's agonistic conditions, customers wanted to be bought the services of the products. This situation brings the after-sales services sector to the forefront for customer delight and loyalty.

After-sales services are among the criteria that customers consider while purchasing a product. Companies are need to be ensured the customer satisfaction with after-sales services and standardize the quality of those services to gain new customers and enhance the dependence on existing customers. However, they have varios features such as, intangibility and variability, unlike physical products. These properties of services make it hard to define the quality of the service.

When the previous researches are examined in terms of service quality, it is seen that quality is generally defined as a level of meeting customer demands and anticipations. In terms of providing a qualified services, it is necessary to understand the needs and expectations of the customers as a first step. Then, the customer demands and expectations are needed to be transformed into service standards.

The Quality Function Deployment (QFD) method that is developed in scope of Total Quality Management is frequently used to convert customer needs into criteria. Although the QFD method is advance to transform customer expectations into design attributes, it is used in many areas with the ease of its application and flexibility. In the literature, it is seen that it is quality assessments is frequently used in the service sector.

There are many studies and methodologies in the literature on the concept of services and service quality. However, there are limited examples of comprehensive studies on the evaluation of the quality of after-sales services in the durable consumer goods sector.

This study purposes to re-evaluate the after-sales services quality supplied by the Customer Services General Directorate of a company that offers products and after-sales services to its customers in white goods and electronic products range for the durable consumer goods sector, in terms of perspective of customer expectations. Due to this purpose, Quality Function Deployment, which has a crucial place in quality studies, the SERVQUAL model, which is one of the most favored model in service quality evaluation, and the Analytical Hierarchy Process (AHP) model as a decision-making method in hierarchical problems are synthesized to be used.

In the first part of the study, information about the concept of the service and its features, after-sales services, service quality, and SERVQUAL method is presented to express the after-sales services sector and to make it better understood.

In the second part of the study includes these features of the QFD: Its definition, brief history, methodology, and studies about it are explained. In addition, the AHP methodology, which is frequently used for the analysis of the importance levels of customer expectations in QFD studies, is also viewed in scope of this study.

In the third part of the study, the general methodology that is proposed and applied in after-sales company, and the findings are caused by that application. The study carry out in three-stage method and a two-stage house of quality (HOQ) is studied to transform customer expectations into service quality criteria. In order to implementation of the first house of quality, customer expectations are defined under the dimensions of the Servqual model. Then, the customer expectations are weighted with the AHP method and their importance levels are determined. As a final step, relationship matrix is established between the customer expectations and the processes. Thus, the weights of the processes are determined.

The reason of creating the second house of quality is to weighted service quality criteria by associating the process weights that is obtained from the first house of quality. In that case, service quality criteria is specified, the relationship matrix and the final weights of each criterion have been founded.

In the last stage of the application, the service quality criteria, which is created and weighted by taking into account the customer expectations, are transferred into the histogram chart for re-scoring.

In the fourth part of this study, the results, findings, and suggestions obtained as a result of the presented application method.

CHAPTER 2
AFTER-SALES SERVICES AND SERVICE QUALITY

In this section, the concept and, the characteristics of the service is mentioned. In addition, after-sales services are briefly summarized. Then, as an objective of the study, the concept of service quality and the Servqual model, which is used to classify the customer expectations that constitute the HOQ are demonstrated.

2.1 Service Concept

The service sector cannot produce a tangible output or product as a delta of the service and manufacturing industries. This varity triggers the concept of service is being subjective and not well defined. Service does not offer a property to customers and is usually consumed at the time of its production.

There are various researches on the concept of service in the literature and there are many explanations of the concept of service. Some of these definitions are given in further paragraphs.

According to the definition of the American Marketing Association, service is independently identifiable actions that satisfy the consumer requirements, and demands while marketing the customers, regardless to the sale of a good (Ersöz et al., 2009).

Bayat et al. (2015) define service as an intangible product that is out of the production of goods, has no physical output, and is consumed as soon as it is produced.

Service is defined as nonfigurative elements that cannot be touched, smelled, easily wasted, and not standardized in terms of quality. In addition, services are defined as support activities for goods offered to consumers (Zengin & Erdal, 2000).

The term of service is clarified as the whole of social activities that are proposed for sale at certain price ranges to meet the requirements of customers and that does not require the ownership of any goods, and that create benefits and satisfaction (Bulduklu & Satır, 2017).

2.1.1 Services Features

The definition of the concept of service has been made in the previous title. As it can be understood from these definitions, some specific service features distinguish them from physical products. Service cannot be stored, standardized, or consumed at its produced, and it is not visual, objective, and physical (Eleren & Kılıç, 2007).

In the literature, the specific features of the service are defined as intangibility, variability, inseparability, and perishability. Descriptions of these features are given in further parts.

2.1.1.1 Intangibility

Services are intangible that do not exist physically. Therefore, they cannot be seen, touched, smelled, and tasted. Due to the intangibility of services, it is very difficult for service providers to clearly explain and make them specific. For the same reason, it is difficult and subjective for customers to evaluate the services they bought (Devebakan, 2001).

2.1.1.2 Variability

The service industry is generally a labor-oriented. Thus, the quality of the service may vary from person to person who provide the service. Even, the same person can provide different quality. Moreover, service quality may change depending on time, place, and conditions of the environment (Bayat et al., 2015). It is crucial to standardize the service as much as possible to minimize such variability. Since competition

advantages, service providers should decrease variability and standardize their services (Devebakan, 2001).

2.1.1.3 Inseparability

In contrast to the manufacturing industry, services are bought first, then manufactured and consumed together. This is due to the inseparability feature of the services. This feature makes the service provider part of the service and the customer's interest can be reflected positively or negatively on the service quality (Bayat et al., 2015).

2.1.1.4 Perishability

Service is not physical, so cannot be stored. Due to this features, service is consumed immediately after produced. Briefly, service is perishable, and cannot be pre-produced and stocked for later use.

2.2 After-Sales Services

The service sector can be classified as education, consultancy, restaurant, tourism, transportation, and distribution, entertainment, health services, and after-sales services. In this section, after-sales services activities, which are the application sector, are explained.

After-sales services, after the completion of the sales process, is the activities that involve efforts such as transportation, delivery, installation, demonstration of the use, maintenance, warranty, repair, spare parts, and dealing with customer complaints to ensure the sustain of the sale.

After-sales services are crucial services offered for customer delight and loyalty, as well as influencing purchasing decisions. After-sales services can be considered as a unit that undertakes the relation between the customer and the firm after the product is

sold. They are the first point, which customers contact for all kinds of failures and requests that may arise during product life cycle. Moreover, services provide input to the manufacturers with feedback from the customers.

According to Özgeren (2012), companies need to choose an appropriate strategy to implement their after-sales services plan. Appropriate after-sales services strategies enable customers to have a positive experience by increasing their sense of satisfaction. These positive experiences will translate into customer loyalty.

2.2.1 Importance of After-Sales Services Sector

After-sales services are crucial in terms of the marketing power of companies. (Özgören, 2012). Especially in the durable consumer goods sector, the products have a long-life and consumers pay attention to the support that they can receive from companies in case of possible failures while making their purchasing choices.

Goffin & New (2001) explained the importance of after-sales services given below:

- Plays an important role in customer satisfaction and loyalty
- Can provide a competitive advantage
- New products designed with customer support can promote the achievement rate of new products, as they will be more efficient and cost-effective
- Customer support revenues over the product life cycle can increase income for producers as they can be much higher than initial product revenue

In Turkey, after-sales services and consumer rights are guaranteed by the law. The service life of the products, minimum number of technical services, the responsibilities and competencies of technical services, manufacturers and importers, the necessary documents, maximum repair times, spare parts are guaranteed by the "After Sales Services Regulation". In addition, “Warranty Certificate Regulation” enacts the minimum warranty periods, warranty conditions, consumer rights, and responsibilities of the companies.

During the product life cycle, especially during the warranty period, the responsibility for processes such as maintenance and repair belongs to the company. Paid services are provided if the warranty period has expired. However, the company has an obligation to keep spare parts during the product life cycle. In case the legal conflict, the service authorizations of the companies may arise up to the cancellation, as well as the losing customers.

2.2.2 The Elements of After-Sales Services

An essential issue for customers is that the product or service should not cause any problems in their life cycle, ease of use, and support service (Kalkan, 2015). The customers expect a benefit from the services, and want to be satisfied. This benefit depends on meeting their expectations, and problems are generally related to service quality.

To meet these demands and needs of customers effectively, some after-sales services and their features are also defined and limited by laws. These features are given in further paragraphs (Goffin & New, 2001).

Installation: The first service given to the customer after the product is purchased is installation. Installations are preferred for complex or potentially sensitive products that require special expertise.

User Training: Especially complex products may be necessary to inform users. These briefings can be prepared as simple or comprehensive content for use, cleaning, and maintenance.

Documentation: Required for product use and maintenance such as user manuals, certificate of warranty. The requirements and conditions of documantation are defined by law in Turkey.

Maintenance and Repair: They are an important parts of after-sales services. Maintenance prevents possible malfunctions. Repair is refers to the elimination of faults and, has to be fast to ensure customer loyalty.

Online Support: Telephone advice or remote communication is important. Online consultation is provided to customers to assist in the efficient use of products or sometimes to trace the cause of malfunctions. With the development of technology, these services include online channels such as whatsapp, youtube.

Warranty: The law determines minimum warranty periods in Turkey. Many companies provide additional paid or free guaranteed sales to their customers.

Upgrades: Customers may be preferred the chance to improve the performance of products. To illustrate, software updates extend the product life cycle.

2.3 Service Quality

Owing to the characteristics of the service such as intangibility, variability, inseparatability, and perishability, it is very difficult to standardize, and provide a certain level of quality. Therefore, it is quite difficult to define service and its quality.

The general definition of quality is expressed as the comparison of customer expectations. Product quality is easier to define because products can be physically touched and seen. Therefore, it is easier to express the expected performance from products and convert them into technical specifications. However, since services are abstract concepts, so it is very difficult to express its expectations and specifications.

It is hard to evaluate the service quality due to the intangible and subjective features of the services. Indeed, service quality is associated with the level of meeting customers' expectations. Service quality has a multi-factor structure that includes customers and firms. While firms try to meet quality standards with their processes, customers are interested in their satisfaction level. In case of inconsistency in the

quality criteria of the firms and the customer, customer dissatisfaction occurs (Ürgün, 2022).

Grönroos (1984), who made one of the first studies on service quality, defines service quality as the comparison of customers' feelings about the service and their requirements. Similarly, Parasuraman et al. (1985) focus on the inconsistency (gap) between perceived and expected service quality. Rita et al. (2019) define service quality as the service provider's ability to improve service performance and satisfy the customer.

Ensuring quality in the service sector is very significant for customer satisfaction and loyalty. Ensuring customer satisfaction and loyalty brings companies to competitive advantages. When services are in line with customer expectations, customer satisfaction is achieved, but if expectations are not met, customer dissatisfaction will occur (Mahsyar & Surapati, 2020). Therefore, it is substantial for companies to understand customer expectations well, and provide qualified service that will meet these expectations to stay ahead of the competition.

2.3.1 Service Quality Models

Due to service quality characteristics, it is very difficult to measure service quality. For this reason, there are studies and methodologies for assessing service quality. In the literature, service quality has focused on two conceptual models. The first of these is the "Scandinavian" perspective developed by Grönross, which identifies the aspects of service quality as result from functional quality, technical quality, and image. Technical quality refers to what the customer receives as a result of service. Functional quality refers to the performance of the service offered, that is, how the customer obtains the service functionally (Grönroos, 1984). However, this model is general and does not offer any specific and practical method for predicting quality (Ali et al., 2021).

Second, the model known as the "American" perspective uses terms to describe service features. The widely used model in this perspective is the Servqual model. The Servqual model, which is widely used in service quality assessment, was enhanced by Parasuraman, Zeithalm, and Berry in 1985. The model is also named the “gap model” and focuses on the difference between perceived quality and expected quality (Parasuraman et al., 1985). Perceived service refers to customers' judgments and evaluations of the service. Expected service refers to what kind of benefit the consumer expects to receive from the service. The fact that the perceptions of the customers are more than their expectations means that the perceived service meets the expectations. Namely, customer satisfaction is achieved (Ergün, 2018). Important points regarding service quality assessment are given below (Parasuraman et al., 1985).

- Service quality is harder to assess than product quality.
- Service quality consists of a comparison between customer needs and service.
- Quality assessments are not made only on the outcome of a service; they also comprise assessments of the process of service.

Cronin & Taylor (1992) proposed the performance-based Servperf model to overcome the shortcomings of the Servqual model. Servqual has been considered insufficient because customers do not have any expectations about the service before using the service and do not know exactly what to expect. Servperf model determines the relation between customer delight, purchasing tendency, and service quality. The proposed model is validated by a case study, it is concluded that service quality has an antecedent effect on delight, satisfaction has an effect on purchasing decisions, and service quality is less effective.

2.4 Service Quality Method: SERVQUAL

Parasuraman, Zeithalm, and Berry developed the Servqual model, also known as the Gap Model and widely used in service quality assessment, in 1985. In the model, service quality is the difference between perceived and expected quality. If there is a

positive difference, it is shown that the quality of service is high, and if there is a negative difference, the service quality is low (Yıldız & Erdil, 2013).

In the study, Parasuraman et al. (1985) conducted the following ten dimensions are determined to measure service quality (Parasuraman et al., 1985).

- Reliability
- Responsiveness
- Competence
- Access
- Courtesy
- Communication
- Credibility
- Security
- Understanding/Knowing the customers
- Tangibles

In the study, Parasuraman et al. (1988) conducted a model, it is simplified and grouped under five factors consisting of 22 different suggestions. Unlike the first study, the following five dimensions are determined to measure service quality. (Parasuraman et al., 1988).

- Tangibles
- Reliability
- Responsiveness
- Assurance
- Empathy

The scopes of the five dimensions are given in further paragraphs (Parasuraman et al., 1985; Murali et al., 2016).

Tangibles: refers to physical facilities, personal appearance, equipment of the service providers, physical agents of the service, other customers in service,

accessibility of service center, quality and accessibility of documents, approachability of information, and offer in the service center.

Reliability: refers to the continuity of service quality, selection, and scale of service, supply of spare parts, providing of service as assured, accuracy in invoicing, keeping accurate records, and performance of the service at the appointed time.

Responsiveness: refers to immediate mailing the transaction receipt, calling back the customer quickly, fast service, reasonable guarantee policy, responding to customer complaints, resolution time of the complaint, and comprehensible cost of service.

Assurance: Refers to knowledge and skill of the communication between personal and operational personnel, attention to the consumer's property, explanations and information, company image, physical and financial safety, confidentiality, professionalism of service people, and interpersonal behavior of service personnel.

Empathy: refers to understanding the specific requirements of the customer, providing individual attention, getting to know regular customers, the organization's accessibility, and waiting time for service.

2.4.1 Perceived Service Quality

Perceived quality is directly proportional to perceived value. Perceived value can be explained as the cost-benefit assessment between the benefit when service is received and the value paid for that service. If the customer considers the money is appropriate, they will purchase the service.

While the performance is an important determinant of perceived quality, brand, prestige, reputation, reputation, etc. factors may also be among the variables that affect the perceived benefit of customers. While it is easy to measure the monetary dimension

of perceived value, the non-monetary dimension is more difficult to measure (Serin, 2016).

Service quality should meet customer expectations completely, and sustain the customer satisfaction. In other words, the customers should feel that the service meets their expectations, or even better. For the sustainability of satisfaction, the service quality must be continuous, well organized, and errors must be minimized in the process of service.

2.4.2 Expected Service Quality

Service expectations can be shaped by many uncontrollable factors, from consumers' experiences with other service businesses and their promotion to their psychological state. As a result, consumers' expectations can be as different as their education, values, experiences, lifestyles, and attitudes. Consumers may exhibit different states at different times and have different expectations (Serin, 2016).

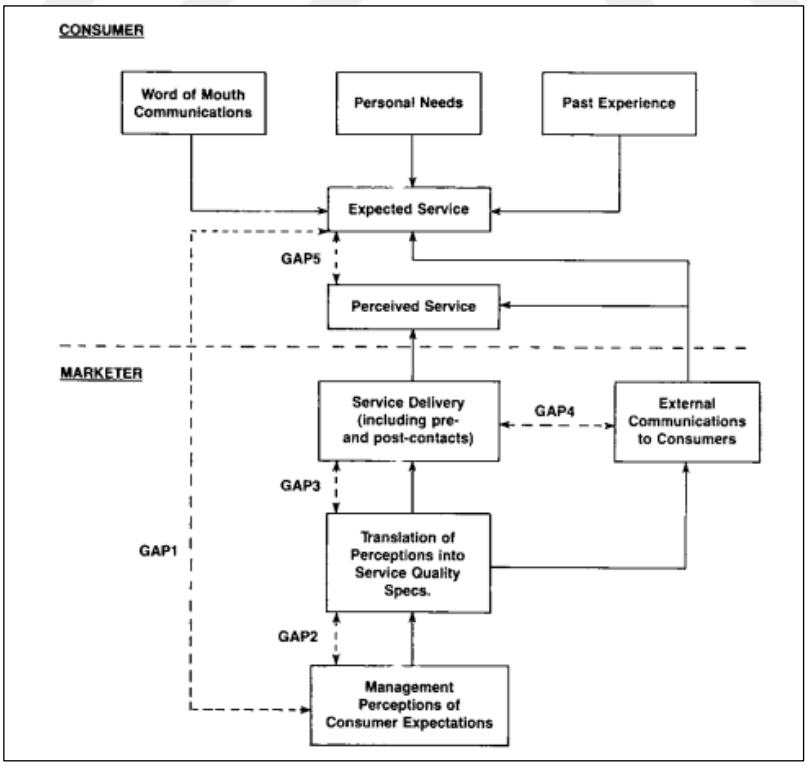


Figure 2.1 Servqual methodology (Parasuraman et al., 1985)

The differences are shown in figure 2.1, expressed briefly and summarized below (Parasuraman et al., 1985):

GAP 1: The difference between customer expectations and management perception. This difference arises because customer expectations are not properly understood by the service provider. To minimize this difference, service providers should define the features of a service, and the level of performance in their processes. In addition, employees who are in one-to-one communication with customers should understand customer expectations well, and the communication network between employees should be strengthened.

GAP 2: The difference between management perception, and service quality standards. The reason for this difference is that the business understands customer expectations correctly, but there are no quality standards to meet these expectations properly. Elimination of this difference can be eliminated by allocating sufficient resources to the quality units of the enterprise and making improvements (Değer, 2012).

GAP 3: The difference between service quality standards and the provided service. This difference arises from the contradiction between the service and the service quality standards created by the enterprise. To minimize this difference, good teamwork among employees, proper job descriptions, and the right quality processes for the right service should be established (Polat, 2016).

GAP 4: The difference between the service provided and the service promised. This difference is since businesses describe the service as different or more than it is, to gain more customers. Elimination of this difference can only be achieved by consistently and accurately explaining the service information to the customer. Consistent announcement of the services will contribute to the company image, customer delight, and loyalty in the long run.

GAP 5: The difference between expected service and perceived service. This difference is a sum of the other differences. Therefore, this difference can only be eliminated by minimizing the other four differences. While the other four differences originate from the business, this difference is mainly caused by the customer.

2.4.3 Criticisms of the SERVQUAL Model

In the gap analysis, the factors that prevent the services from being satisfactory in various sectors and minimizing the gaps are discussed in detail. Therefore, the Servqual scale is a widely practiced model for evaluating service quality (Polat, 2016).

However, it has been subject to several theoretical and functional criticisms. Criticisms of the model are listed as the model's high measurement of expectations, inability to catch the dynamics of changing expectations, failure to capture less controllable dimensions, dimensions not being universal, uncertainty in the measurement of expectations, keeping businesses with the same score equal, and variability in evaluations (Yıldız & Erdil, 2013).

CHAPTER 3
QUALITY FUNCTION DEPLOYMENT

It is crucial to exceed customer expectations to define quality in the service sector and bring it to a certain standard. For this purpose, the customer expectations should be transformed into service specifications. In this section, the Quality Function Deployment methodology, which is widely studied in the service sector and relates customer expectations to technical specifications, is discussed.

3.1 The Definition of QFD

Today's competition conditions have made “quality” more prominent and it has become an crucial issue to develop proactive approaches against possible error. In this context, Total Quality Management introduces to exist in increasing competition conditions for companies. Many techniques developed to ensure customer satisfaction, which is based on the understanding of total quality management, and realizing continuous improvement principles. One of these techniques is Quality Function Deployment (Demirbağ & Çavdar, 2016).

Quality Function Deployment defines as understanding the expectations of the customers in all processes from design, production, sales, and marketing to customer services, and transforming them into suitable systems for the company. QFD is an effective method to improve the development time, provide better quality, reduce costs, increase the level of customer delight, and the competitiveness of many large and small companies all over the world (Singh et al., 2015). QFD is also a planning tool for design and development activities (Vonderembse & Raghunathan, 1997). According to Hauser & Clausing (1988), QFD first focus on design skills in an organization then focuses on producing and marketing products, and coordinates these activities. The fundamental of the method is based on the products must be designed to reflect the expectations of the customers.

Pakdil et al. (2012) define QFD as an effective tool that takes into account both the customer's voice and the company's capacities. Customer's voice means to hear the customer's needs, and expectations. According to Yenginol (2008), the most important feature of Quality Function Deployment is the correct determination of qualities or functions according to customer requests. Because of listening to the customer, it can decide to add some new features to the product or realize that some features are unnecessary.

In summary, QFD can briefly define as focusing on the requirements of the customer, and transforming these necessities into product or service criteria. QFD is also suitable for use in many areas because it takes into account customer expectations and is a flexible method.

Although QFD mainly uses specifically for design, quality, and customer necessity analysis, for it is recommended to develop higher quality products to meet or exceed customer needs. Moreover, it is also used in wider areas such as design, planning, decision-making, engineering, management, and teamwork (Chan & Wu, 2002).

3.2 History of QFD

Quality Function Deployment is a methodology first developed by Akao. In the late 1960s, Akao introduced Quality Function Deployment, whose Japanese origin is "Hinshitsu KiNo TenKai", as a new product development concept that come within the Total Quality Control when the Japanese industry adopted the concept of design based on originality rather than copying in product designs (Akao, 1997).

The two main factors that trigger the emergence of QFD;

1. To gain importance of the "quality of design"
2. To provide quality control before new products are produced (Akao & Mazur, 2003).

Later in the Second World War, the importance of statistical quality control and total quality control methods emerged in Japan and the Japanese automobile industry was growing through new good design processes and model changes. In 1966, a process assurance table was offered by Mr. Kiyotaka Oshiumi of Bridgestone Tire Corp. Akao added a design perspective to this table, enabling it to be used in new product development processes.

In 1972, Akao created a method to identify the essential quality characteristics required to guarantee design quality before production begins. In the same year, Mitsubishi Heavy Industry's Kobe Shipyards under the guidance of Mizuno and Fukukawa published a quality chart and the first application of QFD was realized. Later, with the works of Akao and Muzino, it spread first in Japan and started to be used by companies operating in many sectors.

QFD Research Group, chaired by Akao in 1987, determined the purpose of use of QFD with a research report attended by 80 Japanese companies. These purposes are determining the design quality, making comparisons, new product development and competitive analysis, market quality analyses, transferring information to the next processes, extending the design objectives to production, determining control points, reducing initial quality problems, design changes, development time, cost, and increasing market share.

In 1983, QFD Akao's article published by the American Society of Quality Control, and the Society invited to Akao to give a QFD seminar (Wolniak, 2017). Subsequently, QFD studies started in America for the first time in 1986.

In Europe, QFD studies first started in Italy in 1993 (Akao, 1997). In this manner, QFD spread to America and Europe. In Turkey, QFD was first practiced in the production of dishwashers by Arçelik in 1994 and then expanded to other product groups (Akbaba, 2005). Today, QFD continues to be used successfully in many different areas from the manufacturing to service sector.

3.3 The Benefits and Difficulties of QFD

Thanks to its application flexibility, QFD can be easily used in all processes in the product life cycle such as design, supplier selection, production, quality control, marketing, and customer service. The benefits of the QFD method, which is used in many different fields and for different purposes, are listed below.

- The concepts of customer and customer's voice have an important place in the QFD method. The QFD method harmonizes the technical characteristic with the customer's expectations and ensures that the customers and companies speak the same language (Öter & Tütüncü, 2001). Owing to this advantage of QFD, customer satisfaction and loyalty are increased.

- QFD is a flexible method and it is integrated with other methods easily. QFD is helped in data analysis and increased teamwork, cooperation, and communications (Carnevalli & Miguel, 2008).

- QFD also reduces product/service development time and costs by minimizing design changes (Chan & Wu, 2002). Thereby, QFD increases efficiency and productivity.

- QFD also increases communication between customers and the company (Akbaba, 2005). Communication can be increased by focusing on the expectations of the customer.

- QFD provides an understanding of strengths and weaknesses relative to competitors and can also be used for strategic planning (Wolniak, 2018). Companies can determine their strengths and weaknesses compared to their competitors, so they can increase the quality of products and services by taking into account the expectations and requirements of customers.

Although the QFD method has many benefits, it can also bring difficulties. The creation of large-scale matrix structures complicate the method. It is very important to understand the customer's voice, and an incorrect design may result if the customer's voice is not transferred to the matrices correctly. After the design phase, making changes is difficult and expensive. Moreover, QFD is needed support from upper management, team engagement, and focus on the project. All these difficulties can keep from the use of QFD (Carnevalli & Miguel, 2008).

3.4 QFD Models

Quality Function Deployment is a methodology first created by Akao, and Akao's OFD model includes the large number of matrices and is called the "Matrix of Matrices" (Lager, 2005). The QFD model, which is frequently used in the literature, is the Four-Phase model, which is simpler than Akao's model, and is also named the Clausing model or ASI (American Supplier Institute) model (Chan & Wu, 2002).

The matrix of matrices consisted of 16 matrices and contained four areas: Quality Deployment, Technology Deployment, Cost Allocation, and Reliability Deployment. Akao's advice is to use enough matrices for the implementation (Lager, 2005).

The Four-Phase Model is designed as a four-stage process consisting of four matrices. The first stage is to gather customer demands (WHATs) and then translate those demands into technical specifications (HOWs.) This stage is very essential to the product development process, so the first stage QFD matrix is called House of Quality (HOQ) (Chan & Wu, 2002). The second stage is to transform the technical features in the first stage into part features called Parts Deployment. Key part properties are converted into the process parameters in the third stage called Process Planning. Production Planning is the last stage of Four –Phase Model. In this stage, process parameters are converted into manufacturing requirements. The four-phase model is shown in figure 3.1.

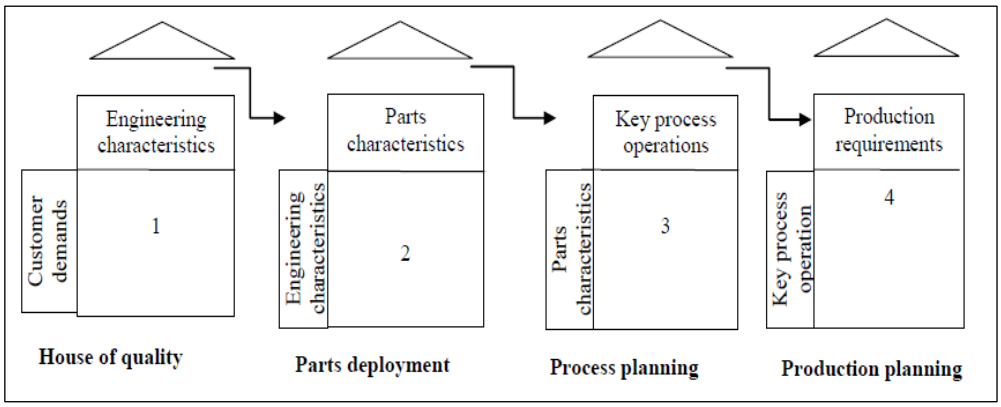


Figure 3.1 The four-phase model (Thangaiah, 2018)

3.4.1 Four-Phase Model

Four-Phase model proposes to divide a product design and development process into 4 matrices. These matrices are respectively:

- Phase 1: House of quality, which aims to convert customer expectations into design characteristics.
- Phase 2: Parts deployment, which aims to transform design characteristics into parts characteristics.
- Phase 3: Process planning, which aims to transform part characteristics into key process operations.
- Phase 4: Production planning, which aims to transform key process operations into key production requirements.

3.4.1.1 Phase1: House of Quality (HOQ)

The first step of the QFD methodology is the establishment of the House of Quality matrix. This matrix contains many matrices and forms the basic structure of QFD. At the top of this structure, there is a technical correlation roof matrix. For this reason, the QFD matrix is likened to the house shape and named the HOQ.

The HOQ shows the relationships between customer expectations or necessity, and technical specifications. The purpose of establishing the HOQ is to identify customer

requirements and translate them into technical specifications or engineering characteristics. In this process, employees from different departments of the business come and work together. The house of quality serves as a roadmap for the process.

3.4.1.2 Phase 2: Part Deployment Matrix

In the second step, the prioritized design specifications in the house of quality are moved to the rows of the part deployment matrix. The part properties form the columns of the matrix. Then, the effect of the part properties on the engineering characteristic is determined. Part properties are prioritized by considering the effects and the importance levels of engineering characteristics.

3.4.1.3 Phase 3: Process-Planning Matrix

In the third stage of the quality function deployment, the matrix shows the processes required to produce the product. To create this matrix, the part properties in the second phase are transferred to the lines. The columns of the matrix contain critical process steps/parameters that have an impact on the part properties. Then, the impact of the process parameters on the part attributes is determined.

3.4.1.4 Phase 4: Product-Planning Matrix

In the last stage of the quality function deployment, the production-planning matrix is obtained, which acts as a control form for the production planning steps. To create this matrix, critical process parameters in the third phase are transferred to the lines. Production and quality control activities such as statistical process control procedures, operator training, error prevention approaches, and preventive maintenance processes are placed in the columns section (Akbaba, 2005). Then, the necessary planning steps to be implemented to secure the process parameters are determined. With the plan formed after the completion of the matrix, responsibilities should be assigned.

3.5 Establishment of House of Quality (HOQ)

The HOQ reveals important data about customer demands and expectations, the engineering characteristic required to meet them, and the level of meeting these needs of the company and its competitors.

A classic house of quality consists of six components as shown in figure 3.2. These components include customer demands that define what is important to the customer, engineering characteristics, the relationship between customer demands and engineering characteristics, the correlation between engineering characteristics, planning matrix, and technical matrix.

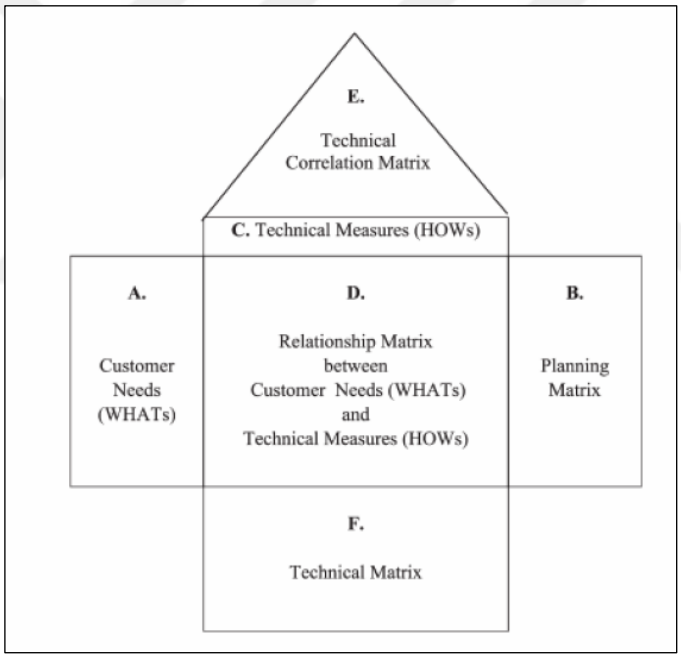


Figure 3.2 House of quality (Cudney & Elrod, 2011)

To avoid inconsistencies and facilitate the application, the 9-step HOQ model presented by Chan & Wu (2005) is shown in figure 3.3.

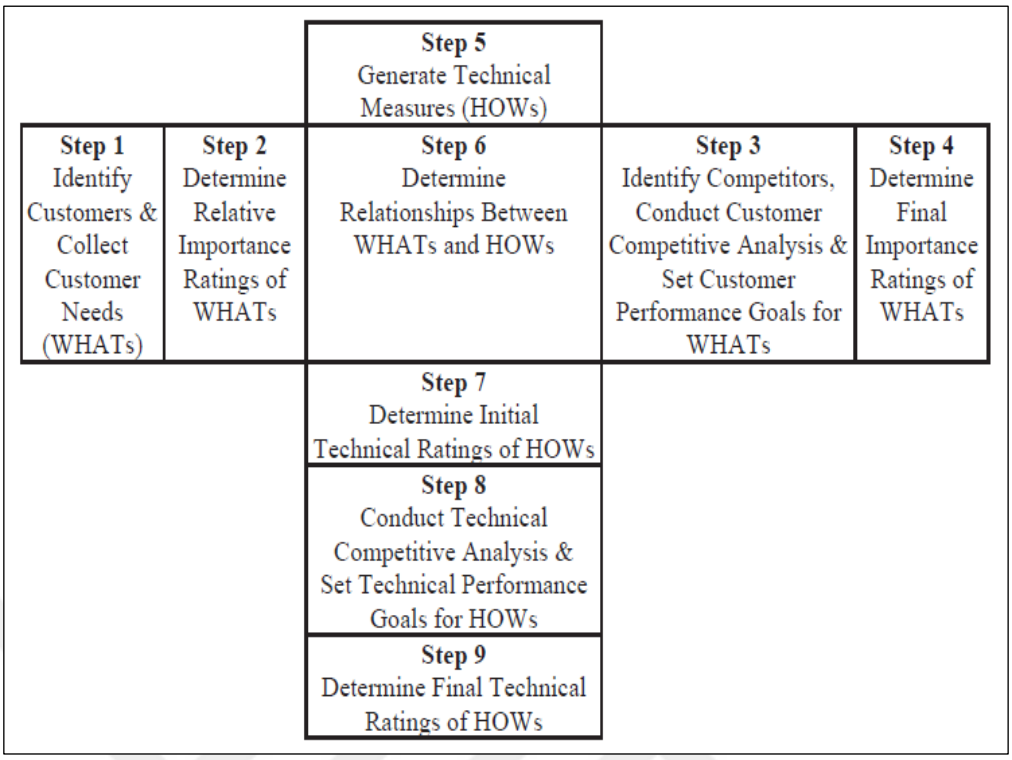


Figure 3.3 House of quality: 9-step description (Chan & Wu, 2005)

3.5.1 Part A. Customer Needs (WHATs)

The first step in HOQ is the definition of customer expectations. However, to define the necessity of the customers, first of all, it is necessary to define who the customer is. Customers can be external customers such as buyers and consumers, as well as internal customers such as other departments of the business, and employees. Identifying key customers is very important for an effective QFD.

3.5.1.1 Step 1. Determine Customer Demands (WHATs)

The first step in the house of quality is understanding the customers' demands (WHAT). The customers' demands must be transformed into meaningful and measurable metrics for the business (Savaş & Ay, 2005). Requirements should be prioritized with a specific hierarchical structure.

To determine customer demands, firstly, the customers are should be defined. After the customers are determined, the customer needs are should be defined. Surveys,

focus groups, interviews, observation, feedback, complaints, sales records, warranty tracking, and publication data can be used to define customer demands (Chan & Wu, 2002).

3.5.1.2 Step 2: Determine the Relative Importance of Ratings of Customer Demands

The significance levels of customer demands are different from each other and companies should focus on the most important of these demands to use their resources at the optimum level. To identify the importance of the demands, the importance levels should be asked along with the questions in the method of demand collecting. Kano Model and Analytical Hierarchy Process (AHP) are the most used methods in the QFD method to determine the importance levels of the customer expectations in the literature.

3.5.2 Part B. Planning Matrix

The second stage of QFD is the creation of the planning matrix. The previous stage is the determination of customer expectations and importance levels. At this stage, first, a competitive analysis including competitors and products is made. Then, with the competitive analysis obtained, the final importance levels of customer expectations are determined.

3.5.2.1 Step 3. Identify Competitors and Conduct Customer Competitive Analysis

At this step, the current and potential competitors of the company that is producing similar products or services should be determined first. If companies want their products to be successful in the market, they should make comparisons by determining the strengths and weaknesses with competitive analysis.

With the competition analysis, the level of meeting the customer expectations of the competitors is also determined. The competition analysis are asked about

competitors to customers, but an appropriate statistical sample should be determined at this stage. After analyzing the competitors and the company's performance, improvement targets should also be determined to meet customer expectations and to succeed in competitive advantage in expectations where competitors perform better.

3.5.2.2 Step 4. Determine the Final Importance Ratings of Customer Demands

Companies should pay more attention to high-priority customer demands and high-priority competition elements because it means high competitive advantages. Therefore, the final importance of demands should be defined. The final importance level of customer expectations can be calculated with the following formula:

$$Final\ importance = (Target\ Performance\ Value/Performance\ Value) \times Relative\ Importance \quad (3.1)$$

3.5.3 Part C. Technical Measures (HOWs)

This section lists the technical characteristics corresponding to customer expectations. These technical characteristics are determined by the experts in QFD team.

3.5.3.1 Step 5: Generate Engineering Characteristics (HOWs)

After the customer demands are determined, it should be determined HOWs (technical measurements/requirements). The technical team should do this analysis. Technical measurements are company metrics, design specifications, methods, and quality specifications that relate to customer demands (Chan & Wu, 2002). Engineering characteristics can be met with existing technical measurements, or new requirements can be determined to meet customer demands.

3.5.4 Part D. Relationship Matrix

3.5.4.1 Step 6: Determine the Relationships between HOWs and WHATs

The relation between engineering characteristics and customer demands is generally clarified by analyzing how engineering characteristics are effective with customer demands and to what extent they can meet the demands.

Various symbols or numbers are used in the literature to clarify the relation between engineering characteristics and customer expectations. This symbol and the its represented numbers are shown in table 3.1. To construct the relationship matrix, it must be evaluated how the engineering requirements in each column affect customer expectations in each row.

Table 3.1 Symbol and score of relationship matrix

Symbol	Score	Meaning
⊗	9	Strong relationship
O	3	Moderate relationship
Δ	1	Weak relationship
(-)	0 (-)	No relationship

3.5.5 Part E. Technical Correlation (Roof) Matrix

The technical correlation matrix is an evaluation matrix that shows which engineering characteristics are related to each other and how strong these relationships are. This matrix is not used much in QFD applications. However, it is very useful in determining improvement priority, as it shows which technical characteristic interacts with the other characteristic. In particular, it shows the difficulties that can be experienced in the solution of two technical characteristics that interact negatively with each other. In addition, it allows for the characteristics that interact positively with each other to be prioritized with the less costly or easier-to-improve characteristics.

The technical correlation matrix evokes the housetop as it forms a triangle in shape. For this reason, the matrix is called as the roof matrix. The symbols used in the literature to determine the relationships in the matrix and their meanings are given in table 3.2.

Table 3.2 Scoring scale of the technical correlation matrix

Symbol	Meaning
++	Strong positive
+	Moderate positive
-	Moderate negative
-	Strong negative

3.5.6 Part F. Technical Matrix

The technical matrix is the final stage of the house of quality. At this stage, the values of the technical characteristics in each column in the relationship matrix are multiplied by the final importance levels of the relevant row in the planning matrix. Then, by summing the row values, the importance of the technical characteristics is found.

At this stage, a competitive analysis is also made, and the final importance levels of technical specifications are determined together with the competition analysis.

3.5.6.1 Step 7: Determine Initial Technical Ratings of HOWs

The matrix shows the importance of each engineering characteristic and how it relates to customer demands. The matrix shows the fundamental importance of HOWs improved concerning WHATs and is determined by two factors: the final severity of WHATs and the association between HOWs and WHATs (Chan & Wu, 2002).

3.5.6.2 Step 8: Perform Technical Competitive Analysis

Later finding the relative importance of HOWs, the next pace is to perform a technical competitive analysis to check the technical performance of rival products. Not to analyze technical competition may result in negative position in the market.

3.5.6.3 Step 9: Obtain the HOWs Final Technical Ratings

HOWs with higher initial high priority of engineering characteristics, the most important technical priorities, and higher rates show the focus on work and market opportunities for the companies.

3.6 Analytical Hierarchy Process

Analytical Hierarchy Process, another preferred method in the study, is frequently used to identify the significance of customer expectations in the QFD method. Therefore, the AHP methodology also briefly is mentioned in this section.

Analytical Hierarchy Process use in solving complex problems. AHP was first proposed by Myers in 1968 and modeled by Saaty in 1977 (Yaralıoğlu, 2001). AHP is developed for complicated decision-making problems used in multi-criteria and multi-objective decision-making situations where there are many decision-makers while choosing from many alternatives in a certain or uncertain environment.

AHP provides the opportunity to explain the purpose, criteria, sub-criteria, and the relationship of alternatives to each other in a hierarchical order of a complex problem. The most significant attribute of AHP is that offers individuals the opportunity to involve both their objective and subjective thoughts in the problem-solving process. In this way, the knowledge, experience, and thoughts of the decision-maker are evaluated within the framework of logic during the problem-solving phase (Kuruüzüm & Atsan, 2001).

3.6.1 Basic Principles of AHP

AHP aims to achieve results by creating a hierarchy in multi-criteria decision-making processes. In the AHP method, the problem is divided into smaller items, and is predicated on subjective evaluations and pairwise comparisons. AHP has three basic principles. These principles are defined in further paragraphs (Satty, 1986).

Decomposition: refers to creating a hierarchy by breaking the problem into parts. For an effective hierarchy, it must be descended from the highest level to the lowest. Thus, the hierarchy goes from the more general to specific. Then, the lowest-level alternatives and the next-level features are determined.

Comparative Judgments: refers to pairwise comparison matrices to find the relative importance of second-level items against the first-level overall objective. If there are enough n elements to compare the level determined in the hierarchy, a total of n(n-1)/2 pairwise comparisons is made (Özcan, 2022).

Synthesis of Priorities: refers to based on the weights acquired from the lowest level of the hierarchy, the priorities for the highest-level goal are obtained. Although multiple normalizations are used, the most common usage is the value obtained by dividing the elements of each column by the sum of that column. Then, the row sum of these values is taken and the total is divided by the number of elements in the row. Thus, a priority vector is obtained for each criterion (Kuruüzüm & Atsan, 2001).

3.6.2 Axioms of AHP

Saaty has defined four axioms for Analytic Hierarchy Process. These axioms are defined below (Saat, 2000; Saaty, 1986).

Axiom 1 – Reciprocal: The decision maker must determine the strength of the alternatives to make a choice. If A is preferred over B as x multiple, then B should be

preferred over A at 1/x multiple. This is a simple but powerful axiom for solving multi-criteria decision-making methods.

Axiom 2 – Homogeneity: refers to the comparison of similar elements and is required for AHP. If there is heterogeneity among the elements, they should be clustered.

Axiom 3 – Principle of Hierarchic Composition: When preferences are expressed, the criteria are assumed to be independent of the characteristics of the alternatives. This statement means that the priorities of the upper-tier criteria will hold when the alternative is not changed (Kuruüzüm & Atsan, 2001).

Axiom 4 – Expectations: All ideas that match expectations must be included in the hierarchy. In case of violation of Axiom 4, the result will be insufficient.

3.6.3 Steps of Analytic Hierarchy Process

Saaty has defined the steps of the Analytical Hierarchy Process as follows (Saaty, 2008).

1. Identifying the essential problem and the desired information.
2. Determining the purpose of the decision at the top of the decision hierarchy, then determining the criteria and alternatives at the bottom level. Thus, the decision hierarchy is structured.
3. Creating pairwise comparison matrices and comparing each factor
4. Collecting the weighted values after the priorities obtained from the pairwise comparisons for each factor and determining the overall priority. In this way, to rank the alternatives.

3.6.3.1 Identifying the Essential Problem and the Desired Information

In the decision-making phase, the problem must first be defined. Problem definition is carried out in two stages. First of all, the decision points should be determined. In the next pace, the factors affecting the decision points should be determined. Accurate identification of factors are important for the consistency of comparisons.

3.6.3.2 Structure the Decision Hierarchy

The AHP is a method dedicated to the solution of multi-criteria decision making problems by creating a hierarchical structure. In AHP method, the purpose is determined first and criteria are determined in line with this purpose. Then, the alternatives are ranked based on the criteria and a basic hierarchical structure is created. The number of steps in the decision hierarchy relies on the complexity and degree of detail of the problem (Kuruüzüm & Atsan, 2001). An example of decision hierarchy is shown in figure 3.4 below.

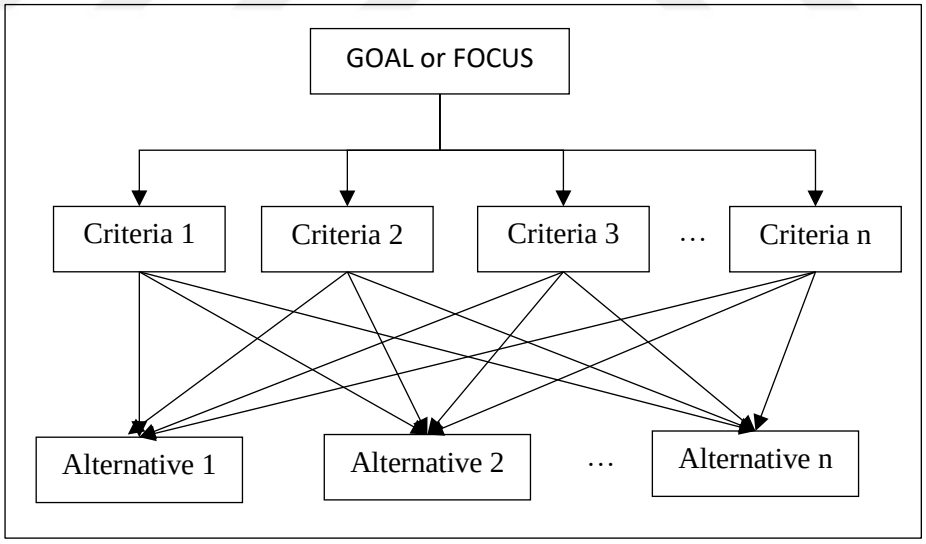


Figure 3.4 Decision hierarchy example

3.6.3.3 Creating Pairwise Comparison Matrices

Later the hierarchical structure is established, pairwise comparison matrices are created. The criteria at each level are compared with the criteria at the next level, and the relative importance coefficient of each criterion is calculated. Briefly, pairwise comparison matrices measure the extent to which criteria in a hierarchical order affect the criteria above (Özcan, 2022). While creating the pairwise comparison matrix, the importance levels developed by Saaty are used. This importance scale is given in table 3.3 below.

Table 3.3 Importance scale of comparison matrix

Intensity of importance	Definition	Explanation
1	Equal importance	Two criteria contribute equally to the objective
3	Moderate importance	Experience and judgement slightly favour one criteria over another
5	Strong importance	Experience and judgement strongly favour one criteria over another
7	Demonstrated importance	A criteria is favoured very strongly over another
9	Extreme importance	The evidence favouring a criteria over another is of the highest possible order of affirmation
2,4,6,8	Intermediate value	

The pairwise comparison matrix between criteria is an n x n square matrix. Values on the diagonals (i=j) in the matrix take the value 1 because they are compared with themselves (Yaralıoğlu, 2001). In addition, due to the reciprocal axiom of AHP;

$$a_{ji} = \frac{1}{a_{ij}} \tag{4.1}$$

The pairwise comparison matrice:

$$A = \begin{bmatrix} a_{11} & a_{12} & \cdots & a_{1n} \\ a_{21} & a_{22} & \cdots & a_{2n} \\ \vdots & \vdots & \ddots & \vdots \\ a_{n1} & a_{n2} & \cdots & a_{nn} \end{bmatrix} = \begin{bmatrix} 1 & a_{12} & \cdots & a_{1n} \\ 1/a_{12} & 1 & \cdots & a_{2n} \\ \vdots & \vdots & \ddots & \vdots \\ 1/a_{1n} & 1/a_{2n} & \cdots & 1 \end{bmatrix} \tag{4.2}$$

3.6.3.3.1 Determination of Importance Values. The comparison matrix shows the relative importance of the criteria but does not give the importance levels as a whole. To clarify the importance levels of the criteria in the whole, column vectors are used and vectors of n n-component columns are created. The formula for obtaining the column vector:

$$b_{ij} = \frac{a_{ij}}{\sum_{i=1}^{n} a_{ij}} \tag{4.3}$$

$$B_i = \begin{bmatrix} b_{11} \\ b_{21} \\ \vdots \\ b_{n1} \end{bmatrix}_{nx1} \tag{4.4}$$

When the equation is repeated for all criteria, n B matrices are created. By combining the B matrices, the C matrix is formed.

$$C = \begin{bmatrix} b_{11} & b_{12} & \cdots & b_{1n} \\ b_{21} & b_{22} & \cdots & b_{2n} \\ \vdots & \vdots & \ddots & \vdots \\ b_{n1} & b_{n2} & \cdots & b_{nn} \end{bmatrix}_{nxn} \tag{4.5}$$

With the C matrix, the percent importance distributions show the relative importance values of the factors with respect to each other. For this, the arithmetic average of the row elements of the C matrix is taken and the column vector W, called the priority vector, is obtained. The sum of the relative importance values of the criteria in the W vector is equal to one.

$$w_i = \frac{\sum_{j=1}^{n} c_{ij}}{n} \tag{4.6}$$

The first row in the w vector has the priority of the first element, the second row the priority of the second element, and the last row the priority of the element n. This method is applied to the pairwise comparison matrices of the criteria. First to find the relative priority vector of the criteria, and then to the pairwise comparison matrices of

the alternatives according to each criterion to find the relative priority vectors of the alternatives.

3.6.3.3.2 Consistency Ratio. In the methods, the last step is finding the consistency ratio. The consistency ratio is very important for the significance of the results. AHP does not demand perfect consistency. It allows for inconsistency but provides a measure of inconsistency in every judgment. A consistency ratio suggested by Saaty and Saaty has set the upper limit for the consistency ratio as 0.1. If the ratio is higher than 0.1, the judgments and hierarchy should be reconsidered (Kuruüzüm & Atsan, 2001).

The Consistency Ratio (CR) calculation is based on the number of factors and the basic value (λ). When calculating λ, the D column vector is created by multiplying the A and W matrices.

$$D=\begin{bmatrix} a_{11} & a_{12} & \cdots & a_{1n} \\ a_{21} & a_{22} & \dots & a_{2n} \\ \vdots & \vdots & \ddots & \vdots \\ a_{n1} & a_{n2} & \cdots & a_{nn} \end{bmatrix} x \begin{bmatrix} w_1 \\ w \\ \vdots \\ w_n \end{bmatrix} \quad (4.7)$$

The base value (E) of the evaluation factors is obtained from the division of the D and W column vectors. The arithmetic mean of these values gives the base value (λmax) for the comparison (Yılmaz, 2022).

$$E_i = \frac{d_i}{w_i} \quad (4.8)$$

$$\lambda_{max} = \frac{\sum_{i=1}^{n} E_i}{n} \quad (4.9)$$

The formulas of consistency index (CI), random index (RI), and consistency ratio(CR) are given below:

$$CI = \frac{\lambda_{max}-n}{n-1} \quad (4.10)$$

$$CR = \frac{CI}{RI} \tag{4.11}$$

Random index values are given in table 3.4.

Table 3.4 Value of random index

Matrix size	1	2	3	4	5	6	7	8	9	10
Random Index (RI)	0	0	0.58	0.90	1.12	1.24	1.32	1.41	1.45	1.49

3.6.3.4 Prioritizing Each Alternative

The last step of the AHP is to solve the decision problem. A mixed priority vector is created to rank the alternatives to achieve the main goal. To create this vector, the weighted average of the priority vectors determined for each existing variable is taken.

The alternatives are ranked according to their priorities by multiplying the interacting elements with each other from the highest level to the lowest level alternatives. The ranking score of an alternative is equal to the sum of its weighted values. The alternative with the highest priority reached after these calculations is expressed as the best alternative to the decision problem.

3.7 Literature Review

In this section, a review of previous studies in the service sector is provided. Many QFD studies in the literature also focus on different aims and areas. This research attempts to provide an exhaustive description of the concepts and methods of QFD. To better understand the QFD methodology, and see how it is combined with other methodologies, articles have been analyzed and classified in table 3.5.

Table 3.5 Literature review of QFD in the service sector

Reviewed Article	Aim	Methodology	Application Area
Chowdhurya & Quaddus (2016)	"sustainable service concept" is proposed, which links service design with sustainable dimensions (social, environmental, and economic) goals. The article uses the multi-stage 0-1 optimization model within the fuzzy FQFD.	FQFD	Sustainable service design
Khorshidi et al. (2016)	to propose a model for using statistical process control (SPC) in services. For this purpose, SERVQUAL combines QFD, normal distribution, control charts, and process capacity.	Servqual QFD AHP SPC	Transportation sector
Pakizehkara et al. (2016)	to identify and show the precedence level of customers' expectations through the combination of Kano's model, AHP, and House of quality.	QFD Kano Model AHP	Agricultural bank services
Bolar et al. (2017)	to assess customer expectations using the possibilities of focus areas of concern to users as covert parameters	QFD HMM	Infrastructure Service
Wagner et al (2017)	To evaluate the service quality of Higher Education Institution (HEI) from the viewpoint of the employee using the SERVQUAL scale, AHP method, and QFD method.	QFD Servqual AHP	Education sector
Wang et al. (2017)	create a scalable and interoperable ordering model for self-service restaurants. The proposed method is the combination of TRIZ (Theory of Inventive Problem Solving), QFD, and service blueprint approaches.	QFD TRIZ	Self service restaurants
Aktepe et al. (2018)	QFD is used to minimize the ergonomic problems of the patients in the hospital and to enhance the quality of the service they receive.	QFD	Hospital Service Quality
Awasthi et al. (2018)	To evaluate the service quality by taking the expectations of multi-stakeholders, and this purpose, gap analysis, QFD and AHP methods are synthesized.	QFD, AHP, Gap Analysis,	logistics industry
Chen et al. (2018)	Kano model, DINESERV, and QFD are combined to comprehend how customers sense service characteristics.	QFD Kano Model DINESERV	Fast Food Restaurant Service Quality
Adiandaria et al. (2019)	QFD is used to analyze and process service quality improvement suggestions for the use of internet banking services.	QFD	Bank services
Altuntaş & Kansu (2019)	Combined with Servqual, QFD, and FMEA for improving service quality and validated by case study	QFD Servqual FMEA	Service Quality

Table 3.5 Continued

Hasibuan et al. (2019)	QFD application of Government General Hospital	QFD	Hospital industry
Lestari & Dachyar (2020)	The combined QFD and six sigma methodology is proposed to increase customer satisfaction and loyalty.	QFD Six Sigma	Communication industry
Pandey (2020)	Assess the strategic design criteria of the Low-Cost airport, and the needs of Low-Cost Airlines.	QFD Fuzzy MCDM	Low-cost airway service design
Caesaron et al. (2021)	Servqual is used to measure perceived quality. Refined Kano model for the importance of attributes for customers, Importance Performance Analysis (IPA), and QFD to correlate with technical characteristics.	Kano Model Servqual QFD IPA	Transportation sector
Lizeralli et al. (2021)	proposed a model of a combination Servqual, Analytical Kano (A-Kano), and QFD to eliminate the uncertainties of customer perceptions.	Servqual A-Kano, QFD	Education Sector
Villapando et al. (2021)	Servqual is used to determine customer satisfaction levels from couriers. AHP is used to sort couriers. Using the prioritization matrix and QFD, necessary dimensions and strategies to improve service quality are determined.	Servqual, QFD, AHP, Prioritization Matrix,	Lojistic Sector
Nie et al. (2022)	To propose a cloud-support QFD model with combined BWM in the health industry	QFD BWM	health industry
Torkayesh et al. (2022)	Proposed a decision support system for technology harmony in the transport/mobility segment in the context of Industry 4.0 in Spain.	QFD BWM S-CoCoSo	Mobility sector
Ürgün & Ük (2022)	Increasing airline service quality by synthesizing Servqual, Kano model and QFD	Kano Model Servqual QFD	Airline sector

Chowdhurya & Quaddus (2016) practiced the cloud-based production service concept to fill the sustainable service design methodology gap in the literature. For this purpose, a "sustainable service concept" is proposed, which links service design with the achievement of the organization's sustainable dimensions goals. The article uses the multi-stage 0-1 optimization model within the fuzzy QFD (FQFD) approach. The proposed methodology has been applied to health service design. As a consequence of the application, the factors that prevent the provision of an effective service are determined.

Khorshidi et al. (2016) propose a model for using statistical process control (SPC) in services. For this purpose, Servqual combines QFD, normal probability distribution, control charts, and process capability. The model applies a Servqual survey for the internal services of the train and prioritizes the importance weights of the Servqual dimensions with AHP. Then, these dimensions are associated with internal measurements with the QFD method.

Pakizehkar et al. (2016) aim to identify and show the precedence levels of customers' expectations through the integration of Kano's model, AHP, and HOQ matrix. The methodology used in the article focuses on the integration of three models. The methodology has been applied to agricultural bank services in Iran. In the study, customer expectations that are obtained with the help of questionnaires are divided into three categories motivational, operational, and basic using the Kano model. Later, with the AHP method, a pairwise comparison of each expectation is made and the weights of three categories are found. Then, the necessary technical specifications are determined to meet customer expectations and the HOQ matrix is created. As a result of the matrix, the weights of the technical specifications are found and prioritized.

Bolar et al. (2017) have been prioritize users' expectations in infrastructure services and proposed a framework for QFD. They uses the hidden Markov model (HMM) to assess dynamic customer expectations using the possibilities of focus areas of interest to users as convert parameters. Since the expectations of the infrastructure user are dynamic and variable, having indicators that anticipate customer expectations will help QFD implementations. In the article, focus areas for customer expectations are defined and these focus areas are considered hidden parameters in HMM. Based on expert opinions, possibilities for a transition to the next possible state of focus areas are created. These hidden parameters are used to update the HOQ. To demonstrate the applicability of the methodology proposed in the article, a case study is applied using a customer survey used by California Transportation.

Wagner et al. (2017), evaluate the service quality of Higher Education Institution (HEI) from the viewpoint of the employee using the Servqual scale, AHP, and QFD method. The AHP, Servqual, and QFD methods provide support for the data of customer expectations, and evaluation of key quality variables. With the assumption of QFD, the "Human" requirement, which shows the prioritization of human resources in the construction of quality and providing quality service, has come to the fore with the highest importance.

Wang et al. (2017) create a scalable and interoperable ordering model for self-service restaurants. The combination of TRIZ (Theory of Inventive Problem Solving), QFD, and service blueprint approaches is used. A combination of QFD and TRIZ conflict analysis is practiced. During the solution assessment phase, a cloud-based self-service ordering system is proposed and then the plan for the new food service is presented. The contribution of the methodology has been to increase the performance and competitiveness of service innovation.

Aktepe et al. (2018) have used the QFD methodology to identify and improve patient priorities in service quality. The focus of the study is minimizing ergonomic problems. In the study, a survey is made to 250 patients and the results are analyzed with SPSS software. Then, 10 technical requirements are determined and a house of quality is established for its relationship with the patient’s expectations.

Awasthi et al. (2018) evaluate the service quality by taking the expectations of multi-stakeholder in the logistics industry, and Servqual, QFD, and AHP methods are synthesized. The aim of the Servqual method is to identify the gaps between expected and perceived quality. QFD is used to transform these gaps into technical requirements. AHP is used to assess attempts to improve service quality.

Chen et al. (2018) have used to improve critical service features by combining the refined Kano model, and the QFD method for healthy fast-food restaurants. In the study, the improved Kano model is used for customers' perception of service features developed based on the five dimensions of DINESERV measurements. QFD is used

to identify and prioritize relationships between critical service features and improvement strategies.

Adiandaria et al. (2019) have analyzed and processed improvement suggestions for the use of internet banking services based on the QFD method. As a results of the analysis, it is known that there are 11 indicators as the first priority and 4 indicators as the second priority, which should improve the service quality of the internet banking.

Altuntas & Kansu (2019) proposed an innovative methodology combining Servqual, QFD, and failure mode and effect analysis (FMEA) methodologies to improve service quality. In the study, Servqual is used to measure service quality, and the QFD method is used for associating expectations with service design. On the other hand, FMEA focuses on failures that may be encountered during service delivery. A case study at the hospital is also employed to validate the proposed model.

Hasibuan et al. (2019) have applied QFD in a Government General Hospital. First of all, patient needs are determined. As a result of the HOQ matrix, the service quality of the State Hospital, and the priority variables to improve their quality are obtained.

Lestari & Dachyar (2020) combined the six sigma and the QFD method for handling the voice of the customer (VOC) and turning it into the main interest of service quality for the customer's perceived value and behavioral intention. The purpose of the research is to increase customer satisfaction and loyalty in service quality based on the importance level of the VOC, which is transformed into the QFD matrix by using the Six Sigma method.

Pandey (2020) evaluates the strategic design characteristics of Low-Cost airport and meets the service requirements of Low-Cost Airlines (LCA). The study uses the Fuzzy Multiple Criteria Decision Making Method (MCDM) to evaluate how well Low-Cost airport service requirements meet expectations. The Fuzzy Quality Function Deployment (FQFD) has been used to integrate the expectations into the technical characteristics of the airline under study by characteristics of the airline.

Caesaron et al. (2021) have conducted a study focusing on improving service quality to ensure customer loyalty in the transportation sector. In the study, Servqual is used to measure perceived quality, the refined Kano model for the role of features in customer satisfaction, Importance Performance Analysis (IPA), and QFD to correlate with technical characteristics.

Lizeralli et al. (2021) have proposed a model that combines Servqual, Analytical Kano (A-Kano), and QFD to eliminate the uncertainties of customer expectations. The proposed framework concerned identifying quality character and service processes. The Kano Model is combined with Servqual and Fuzzy Inference System (FIS). In addition, the outputs of A-Kano and Servqual is combined with the QFD matrix to identify development projects to address the opportunities in the previous stages. The proposed model has been validated at a training company providing experiential services.

Villapando et al. (2021) have examined customer satisfaction levels and the issues that should be given priority among the couriers serving in the logistics sector in the Philippines. For the study, first, customer satisfaction is compared with five Servqual dimensions. In addition, couriers are sorted using AHP. Finally, the necessary dimensions and strategies to improve service quality is determined using the prioritization matrix and QFD.

Nie et al. (2022) propose a cloud-support QFD model in the health industry. In the article, patient requirements are identified and prioritized with the best-worst method. Then, they transform into technical characteristics by the QFD. The prioritizing of technical characteristics is proposed based on the TODIM method to better reflect patients' psychological behaviors. The proposed model is applied to a case study to show its reliability of it.

Torkayesh et al. (2022) have developed a decision support system for technology adoption in the transport/mobility segment in the context of Industry 4.0 in Spain. Various alternatives (options) and variables (criteria) must be assumed to find the

technology adopted in this sector. An integrated decision-making system that includes QFD and the best-worst method (BWM) to find the importance weight of each criterion is combined and proposed. The stratified combined compromise solution (S-CoCoSo) is used to rank the alternatives. The results are analyzed with sensitivity analysis.

Ürgün & Ük (2022) used Servqual, Kano model, and QFD methods to eliminate the deficiencies of the airline industry and improve service quality. Service quality dimensions are determined with Servqual and Kano models. The service quality dimensions and the technical features of the sector are correlated and the importance levels of the technical features are determined by the QFD.

There are various studies and methodologies in the literature on the concept of services and service quality. However, there are limited examples of comprehensive studies on the evaluation of the quality of after-sales services in the durable consumer goods sector.

CHAPTER 4
QUALITY FUNCTION DEPLOYMENT APPLICATION IN THE AFTER-SALES SERVİCES SECTOR

4.1 Company Presentation

This study is applied in the customer services of a company that sells and manufactures white goods and home electronics in the durable consumer goods sector. The company offers products and services to customers with wide product range and after-sales service network.

Customer Services is an operational unit that operates company's after-sales services in Turkey. In the Customer Services, mainly assembly and repair services are provided. Assembly services contain transportation, exploration, customer briefings, and special demands processes. Assembly and repair services are operated by authorized technical services in 81 provinces. Authorized technical services only serve for the relevant brand, but they are legally separate businesses.

Besides authorized technical services, there are also central technical services directly affiliated with the compay. These services operate VIP services. In addition, "Call Center" operations are executed to receive customer demands and maintain customer relations.

The company has designed all processes based on customer satisfaction. Call Center support with the communication channels such as Whatsapp in order to maintain customer satisfaction and to be accessible at any time. Besides these communication channels, the company receives feedback from all stakeholders through surveys and analysis. These analysis and surveys show that overall customer satisfaction and loyalty are high.

The company has createad organizational and process structure to meet customer expectations and needs. In this context, the services offered by the company can be summarized as follows:

- Providing customer briefings with Call Center Services
- Transportation, exploration and assembly operations of the purchased goods
- Giving information and tips about usage, cleaning, and maintenance
- Respond and diagnose the malfunctions requests
- Spare part services
- Product exchange processes

4.2 Problem Definition

The aim of the company is to provide a perfect service experience and ensure customer satisfaction. In line with this purpose, the company manages its processes to understand customer expectations and perform services in accordance with these expectations. The organization is structured in line with this purpose. At the same time, the company conducts surveys to measure the service quality from end to end. In addition to these surveys, it measures service quality performance in line with certain criteria.

To measure the end-to-end service quality, 94 criteria are determined under the headings of appointment, spare parts, malfunction, panel repair, document review, customer interview, record keeping, exchange process, paid replacement, product addition, and delivery. These criteria are weighted between 5 and 100 points by scoring based on experience. In line with these criteria, calls are examined by sampling method and a total service quality score is obtained. Each call starts with 100 points, and when non-compliance is detected, points are reduced by the weight of the criterion. Therefore, if more than one non-compliance is detected, negative scores may result.

The question to be asked for these criteria is whether it really meets the expectations of the customer. In other words, it should be questioned how important these criteria

are for the customer or whether there should be other more important criteria. It is necessary to define the relation between the criteria and customer delight.

In this research, the processes and criteria are re-evaluated with the QFD to adapt the service quality criteria to meet the customer expectations.

4.3 Aim of the Study

In the service industry, meeting customer needs completely and even above expectations is very important for ensuring customer satisfaction and sustainable business management. This research determines to re-evaluate the service quality criteria based on customer expectations to ensure customer delight and operational excellence in the After-Sales and Customer Services sector.

QFD methodology is used to reconstruct the service quality criteria with customer expectations. In this research, customer expectations is associated with processes, and the relation between processes and customer needs are shown clearly. At the same time, the following objectives are aimed to achieve in this study.

1. Determining customer expectations and their importance level for customers
2. Determining the processes weights by using the QFD method
3. Determining and weighting the service quality criteria with the process weights
4. Determining the new scores of service quality criteria

In line with the above purposes, the study synthesize the Servqual, QFD, and AHP methodologies. First, customer expectations analyzed and matched with Servqual service quality dimensions. Then, customer expectations and the processes transferred to the HOQ. To find the significance weights of customer expectations in the HOQ, expectations are prioritized using the AHP methodology.

The weights of the processes are found with a completed house of quality. Then, process and process weights are transferred to a second house of quality and associated

with service quality criteria. In the wake of the second HOQ, the weights of the service quality criteria are found. In the last stage, service quality criteria's weights are re-scored using a histogram.

There are studies that synthesize Servqual, QFD, and AHP methodologies in the literature. However, examples of evaluating service quality in the after-sales and customer service industry are limited.

4.4 Methodology

This research determines to re-evaluate the service quality criteria in the after-sales and customer service sector by integrating Servqual and AHP into the QFD methodology. For this purpose, first, customer expectations in the after-sales and customer services sector are determined and these expectations are aligned with Servqual dimensions. Thus, customer expectations are defined under each service quality dimension.

For an effective and successful QFD analysis, it is essential to determine the significance levels of customer expectations as well as expectations. In the study, the AHP method is applied to specify the significance levels of each customer expectations. Expert opinions are used to specify the significance levels in the AHP method. AHP surveys are sent to 10 experts who worked in regional directorates in contact with the customer, and received training on quality assessments and the voice of the customer. In the AHP surveys, service quality dimensions are evaluated and then customer expectations under each dimension are evaluated for themselves. The survey results are analyzed with the AHP method and the weights of each dimension and customer expectations are determined. In addition, the current performance and target of the company in meeting expectations are analyzed and an improvement rate is calculated. The final importance is determined by multiplying the improvement rate and the relative importance levels of customer expectations.

After determining customer expectations and their final importance levels, the process flow is re-examined and determined. Then, customer expectations and processes are transferred to a house of quality, and process weights are determined. Then, the process are transferred to the second HOQ.

In the second HOQ, process weights are used as importance levels and a house of quality is formed. With the analysis of the HOQ, the weights of the service quality criteria are obtained. Thus, service quality criteria are prioritized.

The purpose of research is not only to prioritize service quality criteria. At the same time, it is re-scoring service quality criteria and presenting an effective and simple evaluation system for evaluators. For this reason, it is necessary to create a scoring scale by making use of the criteria weights. For this reason, the importance of the service quality criteria is transferred to a histogram graph and placed on a certain scale.

The method of the study is summarized below.

1. Creating to the first house of quality
    - Creating planning matrix of the first HOQ
    - Aligning customer expectations with Servqual dimensions
    - Analyzing the importance of customer expectations with AHP
    - Creating technical correlation matrix of first HOQ
    - Creating relationship matrix of the first HOQ
    - Creating the technical matrix of thefirst HOQ
2. Creating to the second house of quality
3. Re-scoring of service quality criteria

4.5 Application of the QFD Model

The QFD model can be performed in various sectors and for many problems. In this research, the QFD method is practiced to re-evaluate the service quality criteria in the after-sales services sector, considering customer expectations. In line with the purpose,

a multidisciplinary QFD team consisting of experts is established to apply the QFD method. The QFD team is given training on the purpose and the implementation of the method, and provides input together.

The company adopts customer satisfaction and loyalty as a principle and the services must be compatible with the customer's requests and demands. Consequently, it is important to harmonize the service quality assessment with customer expectations. For this purpose, two-stage house of quality is applied in the study.

4.5.1 Application of First House of Quality

First HOQ is aimed to reveal the relation between customer expectations and the processes. The steps of the HOQ are explained in the following sections, respectively.

4.5.1.1 Defining customer expectations

In order to define customer expectations of service quality, first, literature and previous studies are reviewed. There are various studies and methods on service quality and its expectations. The most preferred one is the Servqual model, which measures the gap between perceived and expected quality. The Servqual model and its sub-dimensions are used to classify expectations in the research, as they are compatible with the surveys that the company currently uses to measure customer perceptions.

In the Servqual model dimensions in the literature, customer expectations are defined in accordance with the company's field of activity and the services. In order to determine customer expectations, customer satisfaction surveys and calls from customers were examined and detailed. The complaints of the calls and surveys are examined, and grouped with the QFD team.

The Servqual model dimensions and customer expectations are listed in table 4.1.

Table 4.1 Customer expectations, score, and target value

Customer Expectations	Survey Score	Target Value
Tangible		
E1- Quick and easy access to the call centers	83	85
E2- Ability to transmit the suggestions and complaints to the call center	91	91
E3- Getting information from the call center	89	90
E4- Having the mandatory equipment of authorized technical service	90	90
E5- By keeping the places clean during the service	92	92
Reliability		
E6- Providing qualified and sustainable service	87	88
E7- Providing spare part needs	87	88
E8- Performing the service appropriately on time	88	89
E9- Compling an appointment time	93	93
Responsiveness		
E10- Providing convenience approach for out-of-warranty services	93	94
E11- Providing obligatory information about complaints	68	73
E12- Listening and solving complaints professionally	60	65
Assurance		
E13- Professionality level of authorized technical service	89	90
E14- Giving an information about the product as authorized technical service	90	90
Empathy		
E15- Easy and quick access to authorized technical service	92	92
E16- Understanding and dealing with customers' problems	93	93

After listing customer expectations, customer satisfaction surveys are re-examined from this perspective. Customer satisfaction surveys with 3000 samples, which are carried out in 2021, are used in the research, and the level of meeting customer needs of the company is determined on a scale of 100. For confidentiality reasons, the survey results are used by multiplying by the coefficient. The level of meeting the determined customer needs is shown in table 4.1.

In order to practice the QFD method and to weight the customer expectations, the level of meeting the customer needs and the level of target value that the company wants to achieve are also important. For this reason, the desired level is determined. For this reason, the target-setting approach is used in accordance with the company's management by targets procedure for the desired level. The target formulation table,

which is multiple by the coefficient in accordance with the modified survey results, is given in table 4.2.

Table 4.2 Target formulation table

Current Performance	**Explanations**	**Target Boost Value**
59 and below	Serious Problem	9
60-69	Problem	5
70-74	Intermediate level	4
75-79	Intermediate level	3
80-84	Satisfaction	2
85-89	Satisfaction	1
90 and above		Level protection

In accordance with the table above, the targeted level of meeting customer expectations for each customer expectation has been determined and is shown in table 4.1.

4.5.1.2 Explanations of customer expectations

In the literature, after-sales services are clarified in detail in the previous chapters. In this section, the customer expectations are explained in detail.

E1- Quick and easy access to the call center: Call center activities and services are very important in the after-sales services sector. Thanks to the Call Center, customers can directly reach the general directorate of the company, and can submit their products and malfunction complaints, assembly and transportation requests, access to authorized technical service, and information requests about products and services.

It is very important to wait for short periods to reach the call center in after-sales services, and connect directly to the customer representative, to meet the customer expectations quickly. When the voice of the customer is listened, it is seen that the call centers are seen as the first contact with the company and it is very important to reach the call center quickly, especially for customers who have malfunctions.

E2- Ability to transmit the suggestions and complaints to the call center: In the after-sales services sector, being able to transmit suggestions and complaints is as essential as the existence of call centers. It is very important that these suggestions and complaints are taken into account and handled appropriately. Resolving the suggestions and complaints submitted by the customers through the call centers and providing information on the subject play an important role in customer satisfaction.

E3- Getting information from the call center: Call centers are the first point of contact with the company and therefore differentiate the reasons for reaching call centers. At this point, customers need to receive information directly about the product, receive regular information about the status of the requests, and the records.

E4- Having the mandatory equipment of authorized technical service: Repair or assembly requests are provided with service at home or in the workshop by authorized services. For the service to be completed on time, the authorized services must have the technical, and required equipment.

E5- By keeping the places clean during the service operations: While performing repair and assembly services, equipment like drills, etc. can be used. At the same time, it is crucial to do no harm the customer's house and the product while performing the service. In this direction, all authorized technical services should take perform without damaging the house.

E6- Providing qualified and sustainable service: The service must exceed the expectations of the customer, that is, it must be a high quality. Also, it is necessary to ensure the continuity of the service, that is, the company should provide solutions whenever the customers need them and give confidence to the customers.

E7- Providing spare part needs: In Turkey, the regulations have determined the service life of each product, and the spare parts is guaranteed during this lifetime. In addition, it is important to use original spare parts and provide these parts by the

manufacturers in cases spare part replacement is required for the product to keep promised performance.

E8- Performing the service appropriately on time: It is important to perform the service as soon as possible for both assembly and repair processes in after-sales services. Consequently, the service must be performed as soon as possible on time, completely, and accurately.

E9- Compling an appointment time: As mentioned in the previous expectation, the services should be carried out as soon as possible. Appointment days and hours for services should not be postponed or changed, and service should be provided on the appointment day and time.

E10- Providing convenience approach for out-of-warranty services: According to the regulations, a minimum 2 years of warranty period for durable consumer goods, and within this scope, the services provided for assembly, transportation, and troubleshooting should be provided free. However, in case of malfunctions that will occur after the warranty period expires, labor and spare part fees are charged for the services. These services vary according to the size of the malfunction and create costs for customers. The customers anticipate that the firm provides discounts or advantages in out-of-warranty services, and spare part prices are kept at reasonable levels.

E11- Providing obligatory information about complaints: Customers can submit all kinds of complaints about products and services, processes and procedures through the Call Center. It is one of the expectations of the customers to be informed about the results of these complaints and the necessary information on time. The company has ISO 10002 Customer Complaints Management Certificate and all notifications are made through the call center and SMS.

E12- Listening and solving complaints professionally: In the previous expectation, complaints and notifications for complaints are mentioned. This expectation means to hedge customer delight by examining the complaints in a way that understands the

customer's requests and demands, taking professional action, and offering solutions to the customers.

E13- Professionality level of authorized technical service It is important that the authorized technical service should be expertise and has received the required training for provide qualified, timely, and accurate service. Customers want to receive service from authorized technical services following the brand image and reputation of the products.

E14- Giving an information about the product as authorized technical service: For customers who are given assembly service, the usage, cleaning, and maintenance instructions of the product are very important for the performance of the product. At the same time, in case of the product malfunctions, it is important to provide the customers with full and accurate information about what the malfunction is, the source and solution methods of its, and the price of spare parts.

E15- Easy and quick access to authorized technical service: Customers can request information by directly contacting the authorized technical service for their products. At this point, they demand to reach the authorized technical services, to receive easy and professional service during the service, or in case of malfunctions.

E16- Understanding and dealing with customers' problems: Considering the sector and product portfolio of the company, the quality of life is adversely affected, especially in cases of malfunctions. For this reason, call center customer representatives and authorized service personnel, who are in first contact with the customers, understand the demands and requests of the customers correctly, empathize with them and put their best effort to find a solution is crucial for customer satisfaction.

4.5.1.3 Determining the importance levels of customer expectations

In the QFD model, it is crucial to determine the importance levels of these expectations as well as customer expectations. Because every customer expectation is

different from each other and companies need to prioritize these expectations to allocate their resources at the optimum level.

In this research, the AHP method is used to identify the importance levels of customer expectations. To practice Analytical Hierarchy Process, a questionnaire is applied to 10 experts and the relative importance of the criteria concerning each other is determined. In the study, the survey results are given by multiplying by the coefficient.

As a result of the survey, the geometric averages of the relative importance levels obtained from each participant are taken, and then AHP matrices are created. The pairwise comparison matrices of each criterion are given in tables 4.3, 4.4, 4.5, 4.6, 4.7, and 4.8 below.

Table 4.3 Pairwise comparison matrix of main criteria

Criteria	Tangible	Reliability	Responsiveness	Assurance	Empathy
Tangible	1	0.52	0.53	0.68	0.39
Reliability	1.93	1	3.33	2.45	3.44
Responsiveness	1.89	0.30	1	1.21	1.46
Assurance	1.47	0.41	0.82	1	1.20
Empathy	2.53	0.29	0.68	0.83	1

Table 4.4 Pairwise comparison matrix of tangible subcriteria

Criteria	E1	E2	E3	E4	E5
E1	1	3.91	0.53	0.45	0.87
E2	0.26	1	0.61	0.50	0.94
E3	1.87	1.63	1	0.53	1.05
E4	2.21	2	1.89	1	1.87
E5	1.15	1.06	0.95	0.53	1

Table 4.5 Pairwise comparison matrix of reliability subcriteria

Criteria	E6	E7	E8	E9
E6	1	1.82	0.74	0.95
E7	0.55	1	0.85	1.09
E8	1.36	1.17	1	1.78
E9	1.05	0.92	0.56	1

Table 4.6 Pairwise comparison matrix of responsiveness subcriteria

Criteria	E10	E11	E12
E10	1	0.92	0.70
E11	1.09	1	0.70
E12	1.43	1.43	1

Table 4.7 Pairwise comparison matrix of assurance subcriteria

Criteria	E13	E14
E13	1	1.36
E14	0.74	1

Table 4.8 Pairwise comparison matrix of empathy subcriteria

Criteria	E15	E16
E15	1	1.07
E16	0.93	1

Pairwise comparison matrices are shown that the relative importance levels of each criterion are determined by applying the formulas in the previous sections. To determine the consistency of the results, the consistency ratio is calculated for each criterion. The relative importance levels and consistency ratio of each criterion are given in tables 4.9, 4.10, 4.11, 4.12, 4.13, and 4.14 below.

Table 4.9 Main criteria weights and consistency ratio

Main Criteria	Weights
Tangible	0.11
Reliability	0.40
Responsiveness	0.18
Assurance	0.16
Empathy	0.16
Consistency ratio	*0.051*

Table 4.10 Tangible subcriteria weights and consistency ratio

Criteria	Weights
E1- Quick and easy access to the call centers	0.19
E2- Ability to transmit the suggestions and complaints to the call center	0.12
E3- Getting information from the call center	0.20
E4- Having the mandatory equipment of authorized technical service	0.32
E5- By keeping the places clean during the service operations	0.17
Consistency ratio	*0.069*

Table 4.11 Reliability subcriteria weights and consistency ratio

Criteria	Weights
E6- Providing qualified and sustainable service	0.26
E7- Providing spare part needs	0.21
E8- Performing the service appropriately on time	0.32
E9- Compling an appointment time	0.21
Consistency ratio	*0.031*

Table 4.12 Responsiveness subcriteria weights and consistency ratio

Criteria	Weights
E10- Providing convenience approach for out-of-warranty services	0.28
E11- Providing obligatory information about complaints	0.30
E12- Listening and solving complaints professionally	0.42
Consistency ratio	*0.001*

Table 4.13 Assurance subcriteria weights and consistency ratio

Criteria	Weights
E13- Professionality level of authorized technical service	0.58
E14- Giving an information about the product as authorized technical service	0.42
Consistency ratio	*Incalculable (RI=0)*

Table 4.14 Empathy subcriteria weights and consistency ratio

Criteria	Weights
E15- Easy and quick access to authorized technical service	0.52
E16- Understanding and dealing with customers' problems	0.48
Consistency ratio	*Incalculable (RI=0)*

The importance levels of the main criteria and the sub-criteria are determined with the AHP method. Then, the importance level of each sub-criterion is multiplied by the importance weight of its main criterion, and the final relative importance weights of all criteria are found. The importance levels of all criteria are shown in table 4.15 below.

Table 4.15 Criteria final weights

Customer Expectations	Weight	Final Weight
Tangible	**0.11**	
E1- Quick and easy access to the call centers	0.19	0.021
E2- Ability to transmit the suggestions and complaints to the call center	0.12	0.014
E3- Getting information from the call center	0.20	0.023
E4- Having the mandatory equipment of authorized technical service	0.32	0.036
E5- By keeping the places clean during the service operations	0.17	0.019
Reliability	**0.40**	
E6- Providing qualified and sustainable service	0.26	0.104
E7- Providing spare part needs	0.21	0.084
E8- Performing the service appropriately on time	0.32	0.128
E9- Compling an appointment time	0.21	0.084
Responsiveness	**0.18**	
E10- Providing convenience approach for out-of-warranty services	0.28	0.049
E11- Providing obligatory information about complaints	0.30	0.053
E12- Listening and solving complaints professionally	0.42	0.074
Assurance	**0.16**	
E13- Professionality level of authorized technical service	0.58	0.091
E14- Giving an information about the product as authorized technical service	0.42	0.066
Empathy	**0.16**	
E15- Easy and quick access to authorized technical service	0.52	0.081
E16- Understanding and dealing with customers' problems	0.48	0.075

4.5.1.4 Determining the Final Importance Weights of Customer Expectations

To prioritize customer expectations, the level of meeting the expectations of the company are determined by analyzing the questionnaires applied to the final consumers. In the current situation, the level of meeting the expectations of the company is determined in line with the target-setting approach, and the improvement rates are determined. The formulation is given the formula 4.1.

$$Improvement\ Rate = Target\ Value / Performance\ Level \quad (4.1)$$

The improvement rate for the target value is multiplied by the relative importance levels of the criteria, and the final importance levels of each criterion are determined. The formulation is given the formula 4.2. In the last case, the importance levels

obtained for each criterion, the level of expectations, the target level, the improvement rate, and the final importance levels are given in table 4.16 below.

*Final importance =criteria final relative importance*improvement rate* (4.2)

Table 4.16 Criteria weights, performance level, target value, and final importance

Customer Expectations	**Criteria Weight**	**Performance Level**	**Target Value**	**Improvement Rate**	**Final Importance**
Tangible					
E1- Quick and easy access to the call centers	0.021	83	85	1,024	**0.0215**
E2- Ability to transmit the suggestions and complaints to the call center	0.014	91	91	1	**0.0140**
E3- Getting information from the call center	0.023	89	90	1,011	**0.0233**
E4- Having the mandatory equipment of authorized technical service	0.036	90	90	1	**0.0360**
E5- By keeping the places clean during the service operations	0.019	92	92	1	**0.0190**
Reliability					
E6- Providing qualified and sustainable service	0.104	87	88	1,011	**0.1052**
E7- Providing spare part needs	0.084	87	88	1,011	**0.0850**
E8- Performing the service appropriately on time	0.128	88	89	1,011	**0.1295**
E9- Compling an appointment time	0.084	93	93	1	**0.0840**
Responsiveness					
E10- Providing convenience approach for out-of-warranty services	0.049	93	94	1,011	**0.0495**
E11- Providing obligatory information about complaints	0.053	68	73	1,074	**0.0569**
E12- Listening and solving complaints professionally	0.074	60	65	1,083	**0.0802**
Assurance					
E13- Professionality level of authorized technical service	0.091	89	90	1,011	**0.0920**
E14- Giving an information about the product as authorized technical service	0.066	90	90	1	**0.0660**
Empathy					
E15- Easy and quick access to authorized technical service	0.081	92	92	1	**0.0810**
E16- Understanding and dealing with customers' problems	0.075	93	93	1	**0.0750**

4.5.1.5 Determination of Technical Characteristics

In the QFD model, after determining the customer expectations, it is necessary to determine how these expectations are met, so technical features are required. When the literature is reviewed, it is noticed that these technical features are diversified as all methods, metrics, design requirements, quality specifications, and processes related to customer expectations.

In this study, on the other hand, technical features are determined as the main processes that are effective in meeting customer expectations. Since the study deals with the existing evaluation system, it is aimed to spread from general to specific.

For the study, first, the process flowchart, which resulted in the receipt of customer requests and their finalization, is created end-to-end. The process flowchart is shown in figure 4.1. Then, all the processes in the flow are transferred to the columns of the house of quality.

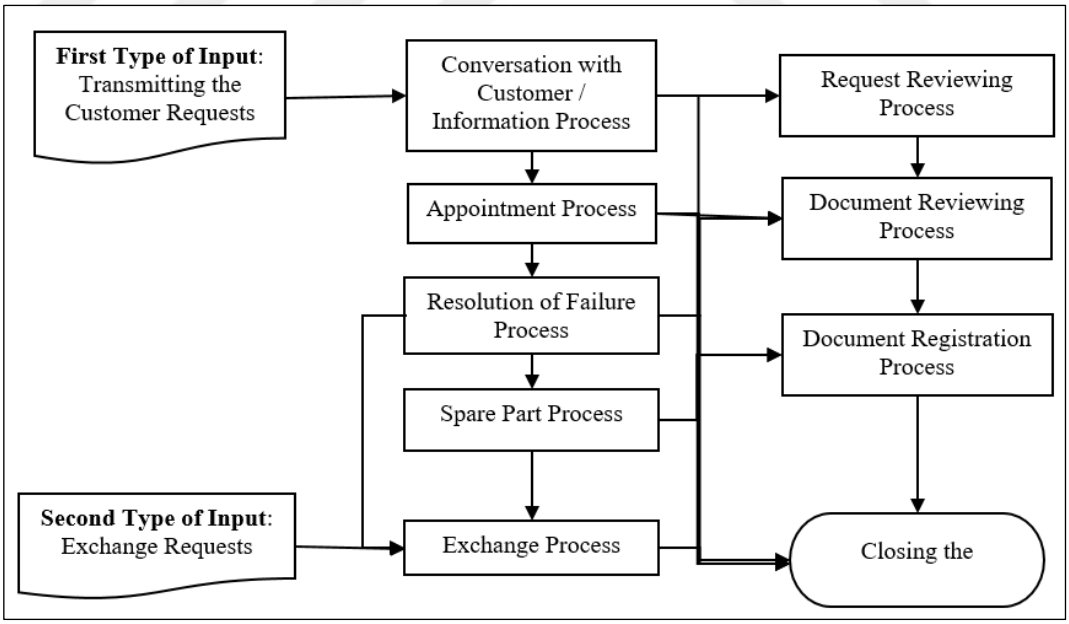


Figure 4.1 Process flowchart

The explanations of the process flowchart in figure 4.1 are given below.

First type of ınput- transmitting the customer requests: The quality assessment process handled begins with customers requests, suggestions, and complaints. All calls are recorded in line with standards.

Second type of ınput- exchange requests: Customers may request a replacement in cases such as the repetition of product failures or the extension of the repair period.

Conversation with customer / information process: At this stage, the customer has different requests such as opening a process or just getting information. The requests of the customers are recorded following the processes and can be transferred to different teams. Customer representatives generally close customer information requests.

Appointment process: customer representatives evaluate customer requests from various channels and appoint an appointment for repair and assembly processes. They receive customer confirmation and ask the preliminary information questions included in the procedures for both types of transactions. The technicians also informs that they will arrive at least 30 minutes before the appointment time.

Resolution of failure process: In the case of a malfunction, repairs can be made in the house or workshop. For customer satisfaction, rapid detection of the source and rapid intervention is important. In the product's failure resolution, solution in the first intervention, correct fault detection, and timely effective intervention are checked. According to the regulations, the fault resolution process should not exceed 20 days.

Spare part process: In a possible case, the source of the malfunction may be the spare part. The spare part must be replaced to solve the malfunction. Spare parts must be supplied quickly for resolution. If the product is to be repaired at the house, the appointment procedure rules are followed on the second visit to the customer's home.

Request reviewing process: In the conversation, sincere communication, and effective solution method are evaluated. It is important to provide fast feedback and to

display a solution-oriented approach. This process examines the service process holistically, and interacts with the relevant unit at the blocked points. In this process, resolution time and change requests should be evaluated within 24 hours.

Document reviewing process: All requests received through the call center are transferred to the relevant departments along with their documents. All departments involved in the process are obliged to enter information about the tasks and documents opened completely on time.

Document registration process: Especially in the resolution of failure, and exchange processes, all documents should be recorded in the system. There should be no missing entries in the tasks.

Exchange process: Customers may request a replacement in cases such as the repetition of product failures or the extension of the repair period. In this case, the process should be carried out in line with procedures. Requests should be responded to within 24 hours and a replacement should be provided with suitable product. The transportation of product must be on time, and undamaged.

4.5.1.6 Technical Correlation (Roof) Matrix

The technical correlation matrix shows the relationship between technical features with each other. Since the technical features are defined as processes in the first HOQ, the technical correlation matrix in this study shows the relationship between processes. Improving one process can affect other processes positively or negatively. Therefore, processing this matrix is very important for the continuation of the studies.

The symbols used in the roof matrix and their meanings are given in table 3.2 in chapter 3. A positive relationship indicates that if a process is improved, other process and their outputs will also be improved. In a negative relationship, in the case of improving a process, other process and their outputs cost, quality, etc. will be negatively affected by these factors.

The processes are created from the perspective of customer satisfaction and reflect the end-to-end customer experience and there is no negative relationship between the processes. The roof matrix is shown in figure 4.2.

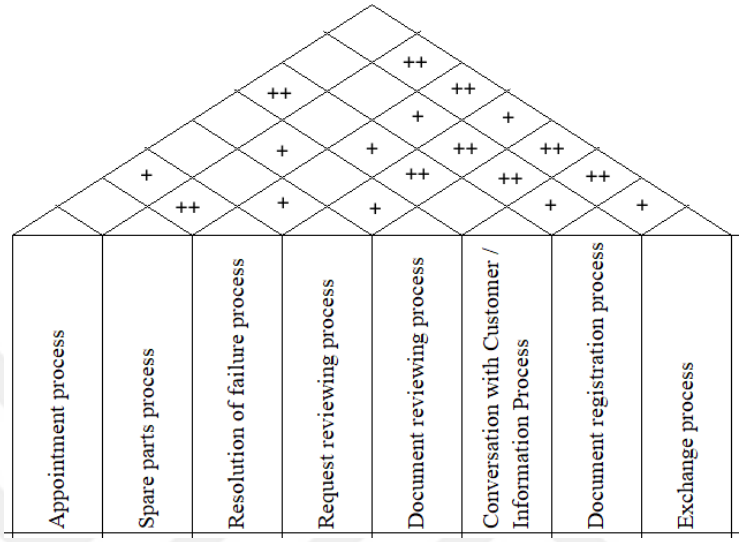


Figure 4.2 Roof matrix of the first house of quality

In the house of quality, the spare part process has a strong positive relationship with the failure resolution process and exchange process. The failure resolution process has a positive relationship with the request review process and customer conversation process and document registration process.

4.5.1.7 Creating the relationship matrix

The most important part of the HOQ is the relationship matrix. Because at this stage, it is necessary to evaluate which processes (technical features) and customer expectations are affected and the extent of this effect.

Various symbols are used in the literature to show the association between customer expectations and technical features. However, basically, all of these symbols are used in terms of strong, medium, and weak relationships and are scored as 9, 3, 1, respectively. In this study, the relationship matrix is scored as 9, 3, 1. The meanings of the scores are given in table 3.1 in chapter 3.

In the study, the support of the QFD team is taken to create the relationship matrix and the association between the customer demands and the processes is determined. Relationship matric is shown in table 4.17.

Table 4.17 Relationship matrix of the first house of quality

Processes / Customer Expectations	Appointment process	Spare parts process	Resolution of failure process	Request reviewing process	Document reviewing process	Conversation with Customer / Information Process	Document registration process	Exchange process
Tangible								
E1- Quick and easy access to the call centers	9		3	9	9	9	3	3
E2- Ability to transmit the suggestions and complaints to the call cen	1	3	9	9	9	3	3	9
E3- Getting information from the call center	1	9	9	9	9	9	3	9
E4- Having the mandatory equipment of authorized technical service		3	9		3			1
E5- By keeping the places clean during the service operations		3	9			3		9
Reliability								
E6- Providing qualified and sustainable service		9	9	3	3	3	3	3
E7- Providing spare part needs		9	9	3		1	3	3
E8- Performing the service appropriately on time	9	9	9	3	3	1	1	9
E9- Compling an appointment time	9	1	9					3
Responsiveness								
E10- Providing convenience approach for out-of-warranty services		9	9	3	1	3	3	3
E11- Providing obligatory information about complaints	1	3	3	9	3	9	3	1
E12- Listening and solving complaints professionally			3	9	3	9	3	3
Assurance								
E13- Professionality level of authorized technical service		3	9			3		
E14- Giving an information about the product as authorized technical service			9	3		9	3	
Empathy								
E15- Easy and quick access to authorized technical service	1	1	9			3		1
E16- Understanding and dealing with customers' problems	9	1		9	3	9	3	3

To illustrate, as can be shown in table 4.17, quick and easy access to the call center has a strong relationship with the appointment process. It has a moderate relationship with the resolution of faliure process because malfunction and assembly request appointments are taken through the call center. At the same time, it has no relation with the spare part process.

4.5.1.8 Creating the Technical Matrix

The last stage of the HOQ is the creation of the technical matrix. At this stage, the final importance of the processes is identified by taking into account the interrelationships of the other matrices.

In order to create the technical matrix, it is essential to multiply the final importance level of the customer expectations to which the characteristics in each column are related and the level of relationship and add all the rows belonging to that column.

In this study, since a second HOQ is applied, the technical characteristic weights are divided by the total value of all columns and recalculated as a percentage. The formulations are given formulas 4.3 and 4.4

$$Technical\ Characteristic\ Weight = \sum_{i=1}^{n} relationship\ score * final\ importance\ of\ each\ demands \quad (4.3)$$

$$Weight\ (percent) = \frac{weight\ of\ a\ column}{total\ weight} \quad (4.4)$$

For example, the weight of the appointment process is calculated below. The technical matrix of the first house of quality is given in table 4.18.

$$Appointment\ process\ weight = (9*0.215) + (1*0.014) + (1*0.0233) + (9*0.1295) + (9*0.084) + (1*0.0569) + (1*0.081) + (9*0.075) = 2.96 \quad (4.5)$$

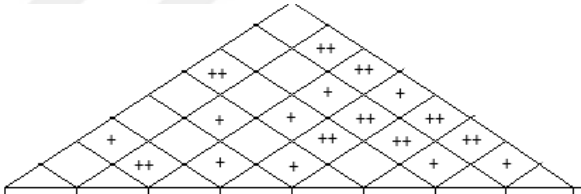
$$Weight\ (percent) = 2.96 / (2.96+4.33+7.54+3.74+2.03+4.20+1.86+3.35) = \%9.85 \quad (4.6)$$

Table 4.18 Technical matrix of the first house of quality

	Appointment process	Spare parts process	Resolution of failure process	Request reviewing process	Document reviewing process	Conversation with Customer / Information Process	Document registration process	Exchange process
Technical Characteristic's Weights	**2.96**	**4.43**	**7.54**	**3.74**	**2.03**	**4.20**	**1.86**	**3.35**
Weight (Percent)	**9.85%**	**14,70%**	**25.03%**	**12.43%**	**6.73%**	**13.96%**	**6.18%**	**11.12%**

The results and final house of quality of all matrices created to form the HOQ are shown in figure 4.3. As a result of the first house of quality, the most important and most effective process is found to be the resolution of failure process with 25.03%. The spare parts process, conversation with customer process, request reviewing

process, exchange process, appointment process, document-reviewing process, and document registration process, follows the resolution of failure process.



	Appointment process	Spare parts process	Resolution of failure process	Request reviewing process	Document reviewing process	Conversation with customer / information process	Document registration process	Exchange process	Expectations weights	Performance Level (Customer Satisfaction)	Target Customer Satisfaction Value	Improvement Rate	**Absolute importance weights**
Tangible													
E1- Quick and easy access to the call centers	9		3	9	9	9	3	3	0.021	83	85	1.024	**0.0215**
E2- Ability to transmit the suggestions and complaints to the call center	1	3	9	9	9	3	3	9	0.014	91	91	1	**0.014**
E3- Getting information from the call center	1	9	9	9	9	9	3	9	0.023	89	90	1.011	**0.0233**
E4- Having the mandatory equipment of authorized technical service		3	9		3			1	0.036	90	90	1	**0.036**
E5- By keeping the places clean during the service operations		3	9			3		9	0.019	92	92	1	**0.019**
Reliability													
E6- Providing qualified and sustainable service		9	9	3	3	3	3	3	0.104	87	88	1.011	**0.1052**
E7- Providing spare part needs		9	9	3		1	3	3	0.084	87	88	1.011	**0.085**
E8- Performing the service appropriately on time	9	9	9	3	3	1	1	9	0.128	88	89	1.011	**0.1295**
E9- Compling an appointment time	9	1	9					3	0.084	93	93	1	**0.084**
Responsiveness													
E10- Providing convenience approach for out-of-warranty services		9	9	3	1	3	3	3	0.049	93	94	1.011	**0.0495**
E11- Providing obligatory information about complaints	1	3	3	9	3	9	3	1	0.053	68	73	1.074	**0.0569**
E12- Listening and solving complaints professionally			3	9	3	9	3	3	0.074	60	65	1.083	**0.0802**
Assurance													
E13- Professionality level of authorized technical service		3	9			3			0.091	89	90	1.011	**0.092**
E14- Giving an information about the product as authorized technical service			9	3		9	3		0.066	90	90	1	**0.066**
Empathy													
E15- Easy and quick access to authorized technical service	1	1	9			3		1	0.081	92	92	1	**0.081**
E16- Understanding and dealing with customers' problems	9	1		9	3	9	3	3	0.075	93	93	1	**0.075**
Technical Characteristic's Weights	**2.96**	**4.43**	**7.54**	**3.74**	**2.03**	**4.20**	**1.86**	**3.35**					
Weight (Percent)	**9.85%**	**14,70%**	**25.03%**	**12.43%**	**6.73%**	**13.96%**	**6.18%**	**11.12%**					

Figure 4.3 The first house of quality

4.5.2 Implementing the Second House of Quality: Transforming Processes into Service Quality Criteria

The objective of this study is to re-evaluate the service quality criteria in the after-sales services sector with the QFD method. For this purpose, first, customer expectations and the processes are determined, their relations with each other are shown, and finally, the relative importance of the processes in terms of customer expectations is determined.

In this section, the processes and their importance levels are transferred to the second house of quality. This matrix can be thought of as the part deployment matrix mentioned in chapter 3. Because, with a similar logic, the processes obtained from the first house of quality are written on the lines and the service quality evaluation criteria are written on the columns.

For the house of quality discussed in this section, the processes are used as customer expectations. For the planning matrix, the process percentage weights from the previous house of quality are used. The planning matrix is given in table 4.19.

Table 4.19 Planning matrix of the second house of quality

Proses	Weight of importance
Appointment process	2.96
Spare parts process	4.43
Resolution of failure process	7.54
Request reviewing process	3.74
Document reviewing process	2.03
Conversation with customer / information process	4.20
Document registration process	1.86
Exchange process	3.35

One of the most important parts of the second house of quality is the determination of service quality criteria. For the service quality criteria, 94 service quality criteria that are currently being used are analysed with the QFD team. The fact that the service quality criteria are specified in detail affects the efficiency of the process.

In consideration of evaluation, to increase the efficiency of the service evaluation process, 94 quality criteria currently used are reduced to 23 quality criteria with the QFD team. While determining the quality criteria, factors such as the non-repetition of similar criteria and the fact that the criteria serve the same purpose are evaluated and grouped. In addition, rude behavior towards customers and unethical behavior that will create costs are unacceptable and are not included in the house of quality. These criteria are scored as 100 points, excluding the house of quality. The new criteria are given in table 4.20.

Table 4.20 Service quality assessment criteria

C1- Receiving a confirmation by the customer before the appointment.
C2- Compliance with an appointment time.
C3- Accurate, undamaged, and complete transportation of spare parts orders on time.
C4- Responsing the logistics forms on time
C5- Compliance with an appointment time, after the spare parts are delivered to the service.
C6- First response to the malfunction without any delay.
C7- Delivery of consignment products
C8- Ensuring that there is no repetitive failures and timely shutdown after the service process.
C9- Accurete analysis of customer demand.
C10- Effective persuasion negotiations and evaluation for all alternative solutions.
C11- Closure of decisions on time.
C12- Responding the task documents and support forms complete manner on time.
C13- Closure of complaint documents on time.
C14- Responding the decisions of the consumer arbitration committee on time.
C15- Providing proper negotiation with customers in compliance with procedures
C16- Providing non-technical jargon in customer negotiations.
C17- Get rid of noises and technical faults in phone calls.
C18- Closure the calls in compliance with procedures on time.
C19- Demonstration of all documents into the call.
C20- Leading change request processes in compliance with procedures.
C21- Providing consignment products, which is suitable for the customer's needs.
C22- Completing customer information appropriately.
C23- Providing logistic processes without any delay, or demage.

4.5.2.1 Explanations of service quality criteria

In this part, detailed explanations of the service quality criteria are given.

C1- Receiving a confirmation by the customer before the appointment: Appointment requests are made centrally by the call center in the company. Appointment assignments vary according to the level of expertise required by the process, so processing time, and distance criteria must be taken into account. At the same time, customer approval should be obtained for the appointment day and time.

C2- Compliance with an appointment time: Appointments assigned after receiving customer confirmation should not be delayed, and compliance should be ensured.

C3- Accurate, undamaged, and complete transportation of spare parts orders on time: Spare parts orders must be given on time and completely by authorized services to the repair service completed on time. In addition, spare parts must be transport on time, accurately, completely and undamaged. Spare part replacements must take place on time.

C4- Responsing the logistics forms on time: During the shipping of spare parts, transportation-related damages may occur. Logistics forms are used in accordance with the procedures for the solution of transportation damages. These forms should be answered on time.

C5- Compliance with an appointment time, after the spare parts are delivered to the service: Spare part replacements require a second visit to the customer's house. Therefore, a new appointment should be appointed and compliance should be ensured.

C6- First response to the malfunction without any delay: the solution process must be a short period in repair services, so it is necessary to analyze the source of the problem. Therefore, the level of expertise of the technician, and the appropriateness of training, and technical bulletins are evaluated.

C7- Delivery of consignment products: In the durable consumer goods industry, failure of products negatively affects the customer's quality of life. For this reason, consignment products should be delivered to ensure customer satisfaction. It is evaluated that the consignment product is delivered and that the delivered consignment product complies with the procedures.

C8- Ensuring that there is no repetitive failures and timely shutdown after the service process: means that the solution is permanent and the product does not cause a failure again after its repair. Similar to the criterion of first response to malfunction, the criterion should be complied with training and technical bulletins.

C9- Accurete analysis of customer demand: To meet customer expectations on time and correctly, it is necessary to understand customer demands correctly. The demand should be transmitted to the relevant process owner.

C10- Effective persuasion negotiations and evaluation for all alternative solutions: Especially in the repair service, customer can claim exchange requests such as product replacement or repayment. In these requests, customer representatives must offer the all alternatives in line with the procedures.

C11- Closure of decisions on time: In case of customer special requests, the process is transferred to the relevant responsible persons. They make a decision by examining the relevant request, and documents. To meet customer expectations on time, it is important that these decisions are made quickly.

C12- Responding the task documents and support forms complete manner on time: In cases of authorized technical services cannot meet customer demands or solve the malfunction, they request support from the technical personnel. To meet customer expectations on time, the support forms should be responsed on time

C13- Closure of complaint documents on time: Complaint records and documents should be finalized on time and information should be provided in accordance with both customer satisfaction and ISO 10002 standard.

C14- Responding the decisions of the consumer arbitration committee on time: sometimes, if the customers are not satisfied with the results, they can apply to the consumer arbitration committees. In such cases, the defense letters must be answered on time and completely.

C15- Providing proper negotiation with customers in compliance with procedures: The conversation with customer process has also been brought under certain standards to ensure customer satisfaction. Talking rudely in conversations, trying to hang up the phone, etc. behaviors is unacceptable.

C16- Providing non-technical jargon in customer negotiations: Conversations should be understanding to clear information, and agreement. Therefore, abbreviations and technical terms should not be used.

C17- Get rid of noises and technical faults in phone calls: There should be no noise and technical problems in phone calls to ensure a clean conversation, and avoid misunderstandings

C18- Closure the calls in compliance with procedures on time: Conversations should be closed on time in accordance with procedures.

C19- Demonstration of all documents into the call: All documents should be recorded to evidence of the process.

C20- Leading change request processes in compliance with procedures: Products may be changed in cases of customers are not satisfied with the solution. The new product must be similar to the existing product and the steps in the procedure must be followed completely.

C21- Providing consignment products, which is suitable for the customer's needs: Consignment products are delivered to customers to relief. It means that the consignment product has similar characteristics to the defective product.

C22- Completing customer information appropriately: In assembly services, the product's usage, cleaning, and maintenance instructions must be fully explained. Similarly, in fault operations, the fault, its cause, and the solution process should be explained. At the same time, it means that customers are informed regularly during the solution process.

C23- Providing logistic processes without any delay, or demage: It means the timely transportation of a new or replacement product, without damaged. At the same time, the product should be transported on time.

4.5.2.2 Creating relationships matrix

After the service quality criteria are determined, the relationships between these criteria are determined as explained in the previous section.

Then, the relation between processes and service quality criteria is determined as described in the previous part, thus the relationship matrix is defined. After the completion of the relationship matrix, the final importance levels and percentage importance of the service quality evaluation criteria are determined.

The final figure of the HOQ is shown in figure 4.4 below. With the HOQ analyzed, the most important three criteria are, respectively, effective persuasion negotiations and evaluation for all alternative solutions with 6.61%, compliance with an appointment time with 6.41%, ensuring that there is no repetitive failures and timely shutdown after the service process with 6.05%.

Criteria / Proses	C1	C2	C3	C4	C5	C6	C7	C8	C9	C10	C11	C12	C13	C14	C15	C16	C17	C18	C19	C20	C21	C22	C23	Weight of importance
Appointment process	9	9			9	3		1	3							3	3		1					**2.96**
Spare parts process		1	9	3	1	3	3	3		3		1	1		3					3				**4.43**
Resolution of failure process	3	9	9	9	9	9	9	9		3	3		1		3			1	3		3		3	**7.54**
Request reviewing process						3	1		9	9	9	3	9			9	3	9	3	9	9	3		**3.74**
Document reviewing process			1	9				3	3			9	9	9				1	9	3	1	1	1	**2.03**
Conversation with customer / information process	3	1			3		1		9	9	1		3		9	9	9	1	1			9		**4.20**
Document registration process	3		1	9	3	3	3	3	3			9	3	3	3		1	9	9	3		3	1	**1.86**
Exchange process	3	9	1			1	3	9	1	9	1		1	9				3	1	9	9	9	9	**3.35**
Technical Characteristic's Weights	**77.5**	**133.2**	**114.88**	**116.1**	**117.1**	**110.1**	**104.7**	**125.8**	**95.4**	**137.5**	**63.8**	**50.6**	**85.4**	**53.9**	**79.3**	**80.4**	**59.8**	**74.2**	**79.3**	**88.7**	**88.4**	**86.8**	**56.6**	
Weight (Percent)	**3.73%**	**6.41%**	**5.52%**	**5.58%**	**5.63%**	**5.30%**	**5.03%**	**6.05%**	**4.59%**	**6.61%**	**3.07%**	**2.43%**	**4.11%**	**2.59%**	**3.81%**	**3.87%**	**2.88%**	**3.57%**	**3.81%**	**4.27%**	**4.25%**	**4.17%**	**2.72%**	

Figure 4.4 The second house of quality

4.5.2.3 Re-scoring service quality criteria

In the study, service quality criteria are re-evaluated, and these criteria are weighted to exceed the expectations and needs of the customer, together with the two-stage houses of quality. However, the results from the house of quality are not suitable for easy control by evaluators and direct use in assessments. For this reason, the results are placed on a scale between 0-90 with the histogram graph and rescored.

The weights of the service quality criteria found by the QFD methodology and the final values acquired by the histogram are given in table 4.21 below.

Table 4.21 Criteria and weights

Criteria	Weight	Criteria Score
C1- Receiving a confirmation by the customer before the appointment.	50.62	5
C2- Compliance with an appointment time.	53.93	5
C3- Accurate, undamaged, and complete transportation of spare parts orders on time.	56.61	10
C4- Responsing the logistics forms on time	59.80	10
C5- Compliance with an appointment time, after the spare parts are delivered to the service.	63.84	15
C6- First response to the malfunction without any delay.	74.22	25
C7- Delivery of consignment products	77.51	30
C8- Ensuring that there is no repetitive failures and timely shutdown after the service process.	79.28	30
C9- Accurete analysis of customer demand.	79.32	30
C10- Effective persuasion negotiations and evaluation for all alternative solutions.	80.40	35
C11- Closure of decisions on time.	85.42	40
C12- Responding the task documents and support forms complete manner on time.	86.77	40
C13- Closure of complaint documents on time.	88.44	40
C14- Responding the decisions of the consumer arbitration committee on time.	88.74	40
C15- Providing proper negotiation with customers in compliance with procedures	95.40	50
C16- Providing non-technical jargon in customer negotiations.	104.66	55
C17- Get rid of noises and technical faults in phone calls.	110.14	65
C18- Closure the calls in compliance with procedures on time.	114.88	65
C19- Demonstration of all documents into the call.	116.07	70
C20- Leading change request processes in compliance with procedures.	117.11	70
C21- Providing consignment products, which is suitable for the customer's needs.	125.83	80
C22- Completing customer information appropriately.	133.25	85
C23- Providing logistic processes without any delay, or demage.	137.51	90

CHAPTER 5
CONCLUSION

The competitive pressure brought about by globalization and rapid developments is dominant and this situation has led to the concept of quality and customer satisfaction being even more prominent. Especially in the service sector, changing customer expectations and not being able to define expectations clearly due to the isolation of the service makes it difficult to measure service quality. This service is possible by standardizing the existing quality and providing customer visits during the increasing competition times in the industry due to the cost.

In this research, it is proposed to establish service evaluation criteria for the systematic evaluation of the service supplied to the customers in a company that provides after-sales services in the durable consumer goods (white goods and electronic products) sector. The Servqual model, which defines the service quality dimensions for the intended study, the QFD model for converting customer expectations into quality criteria, and the AHP method for determining the importance level of customer expectations in the QFD model are synthesized and used.

For the study, first, customer expectations are defined. In this context, the perception surveys, customer calls, and complaints reasons reports are examined and customer expectations are defined under the Servqual dimensions. Sixteen customer expectations are defined under the five dimensions of Servqual.

Customer expectations determined by the AHP method are prioritized in the QFD model. In line with AHP analysis, the most important customer expectation is “Providing the service in the promised time” with a weight of 0.128. The customer expectation with the lowest weight is “Send suggestions and complaints to the call center” with 0.014 points. As a result of the AHP analyzes, consistency analyzes are made for each matrix and it is seen that the consistency ratios remained below 0.1. So the analyzes are consistent.

In this study, a two-stage QFD model is designed to transfer customer expectations to service quality criteria. The first house of quality is created to show the relationship between customer expectations and processes, and then a second house of quality is created to show the relationship between processes and service quality criteria.

The analysis of the first HOQ shows that the most important process is the failure resolution process. On contrary, the least important process is determined as the record-keeping process. The weights of the service quality criteria are found with the second house of quality created with the process weights obtained in the first HOQ. According to the results obtained from the analysis of the second HOQ, the most important criterion is the effective persuasion negotiations and evaluation of all alternatives with 6.61%. The least important criterion is the answering task documents and support forms in a timely and complete manner with 2.43%.

In the last part of the study, the QFD method is applied to re-score the service quality criteria so that scoring can be used more effectively by the process owners. Results gathered are explained in a histogram graph with the scoring from 5 to 90.

5.1 Suggestions

Service quality scores will be determined by evaluating the obtained service quality criteria. As a consequence of these evaluations, the criteria that decrease the service quality score should be prioritized and analyzed. As a result of the analysis, suggestions for improvements should be presented and process improvements should be observed.

Process improvements will not only enhance the service quality score but will also enhance the perceived quality of customers. The results of the perception surveys will change in the future, and this will change the performance level and the targeted value in the planning matrix of the HOQ. Therefore, criteria must be constantly reviewed under changing conditions to ensure a quality assessment in line with customer expectations.

REFERENCES

Adiandari, A., Winata, H., Fitriandari, M., & Hariguna, T. (2020). Improving the quality of internet banking services: An implementation of the quality function deployment (QFD) concept. *Management Science Letters*, *10*(5), 1121-1128.

Akao, Y. (1997, October). QFD: Past, present, and future. *In International Symposium on QFD*, *97(2)*, 1-12.

Akao, Y., & Mazur, G. H. (2003). The leading edge in QFD: past, present and future. *International Journal of Quality & Reliability Management*, *20(1)*, 20–35.

Akbaba, A. (2005). Müşteri odaklı hizmet üretiminde kalite fonksiyon göçerimi (KFG) yaklaşımı: Konaklama işletmeleri için bir uygulama çalışması. *Anatolia: Turizm Araştırmaları Dergisi*, *16*(1), 59-81.

Akkawuttiwanich, P., & Yenradee, P. (2018). Fuzzy QFD approach for managing SCOR performance indicators. *Computers & Industrial Engineering, 122*, 189-201.

Aktepe, A., Ersöz, S., Hayyaoğlu, A. N., & Şakar, B. B. (2018). Kalite fonksiyon yayılımı yaklaşımı ile özel bir hastanede hizmet kalitesi iyileştirme üzerine bir uygulama. *International Journal of Engineering Research and Development*, *10*(2), 245-251.

Ali, B. J., Saleh, P. F., Akoi, S., Abdulrahman, A. A., Muhamed, A. S., Noori, H. N., & Anwar, G. (2021). Impact of service quality on the customer satisfaction: Case study at online meeting platforms. *International Journal of Engineering, Business and Management*, *5(2)*, 65-77.

Altuntas, S., & Kansu, S. (2019). An innovative and integrated approach based on SERVQUAL, QFD and FMEA for service quality improvement: A case study. *Kybernetes*, *49(10)*, 2419-2453.

Avikal, S., Singh, R., & Rashmi, R. (2020). QFD and Fuzzy Kano model based approach for classification of aesthetic attributes of SUV car profile. *Journal of Intelligent Manufacturing, 31(2),* 271-284.

Awasthi, A., Sayyadi, R., & Khabbazian, A. (2018). A combined approach integrating gap analysis, QFD and AHP for improving logistics service quality. *International Journal of Logistics Systems and Management*, *29*(2), 190-214.

Beheshtinia, M. A., & Farzaneh Azad, M. (2019). A fuzzy QFD approach using SERVQUAL and Kano models under budget constraint for hotel services. *Total Quality Management & Business Excellence*, *30(7-8),* 808-830.

Balinado, J. R., Prasetyo, Y. T., Young, M. N., Persada, S. F., Miraja, B. A., & Redi, A. A. N. P. (2021). The effect of service quality on customer satisfaction in an automotive after-sales service. *Journal of Open Innovation: Technology, Market, and Complexity*, *7(2),* 116.

Bayat, M., Baydaş, A., & Atlı, C. (2015). Hizmet sektörünün kavramsal tanımı ve ulusal ekonomilerdeki önemi. *Bingöl Üniversitesi Sosyal Bilimler Enstitüsü Dergisi*, *5(9),* 59-88.

Bolar, A. A., Tesfamariam, S., & Sadiq, R. (2017). Framework for prioritizing infrastructure user expectations using Quality Function Deployment (QFD). *International Journal of Sustainable Built Environment, 6(1),* 16-29.

Bulduklu, Y., & Satır, M. (2017). Hizmet sektöründe müşteri ilişkileri ve iletişim. *Halkla İlişkiler ve Reklamcılık Özel Sayısı Necmettin Erbakan Üniversitesi Sosyal Bilimler Dergisi*, *3(2),* 30-41.

Can, P., (2016). Hizmet kalitesinin SERVQUAL ölçeği ile ölçülmesi: Uşak Üniversitesi merkez kütüphanesi üzerine bir araştırma. *Karabük Üniversitesi Sosyal Bilimler Enstitüsü Dergisi*, *6*(1), 63-83.

Caesaron, D., Makapedua, J., & Lukodono, R. P. (2021). Evaluation of online-based ride hailing services using service quality (Servqual) method, refined kano model, importance performance analysis (IPA), and Quality Function Deployment (QFD): A case study of Grab Bike Indonesia. *ComTech: Computer, Mathematics and Engineering Applications*, *12(2)*, 75-88.

Carnevalli, J. A., & Miguel, P. C. (2008). Review, analysis and classification of the literature on QFD—Types of research, difficulties and benefits. *International Journal of Production Economics*, *114(2)*, 737-754.

Chan, L. K., & Wu, M. L. (2002). Quality function deployment: A literature review. *European Journal of Operational Research*, *143*(3), 463-497.

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

Chen, K. J., Yeh, T. M., Pai, F. Y., & Chen, D. F. (2018). Integrating refined Kano model and QFD for service quality improvement in healthy fast-food chain restaurants. *International Journal of Environmental Research and Public Health*, *15*(7), 1310.

Chowdhury, M. M. H., & Quaddus, M. A. (2016). A multi-phased QFD based optimization approach to sustainable service design. *International Journal of Production Economics*, *171*, 165-178.

Cronin Jr, J. J., & Taylor, S. A. (1992). Measuring service quality: a reexamination and extension. *Journal of marketing*, *56*(3), 55-68.

Cudney, E., & Elrod, C. (2011). A comparative analysis of integrating lean concepts into supply chain management in manufacturing and service industries. *International Journal of Lean Six Sigma*, *2*(1), 5-22.

Değer, Ç. (2012). *Kano modeli ile bütünleştirilmiş servqual analizinin kalite fonksiyon yayılımına uygulanarak hizmet kalitesinin iyileştirilmesi ve bir sağlık kuruluşunda uygulanması* [Doctoral Thesis]. Dokuz Eylül University.

Demirbağ, Ş., & Çavdar, E. (2016). Kalite fonksiyon yayılımı planlama matrisinde Kano modelinin kullanılması: Akıllı telefonlar üzerine bir uygulama. *Ege Academic Review*, *16*(2), 211-226.

Devebakan, N. (2001). *Sağlık işletmelerinde kalite ve algılanan hizmet kalitesinin ölçülmesi.* [Master's Thesis]. Dokuz Eylul University.

Dincer, H., Yüksel, S., & Martinez, L. (2019). Balanced scorecard-based analysis about European energy investment policies: A hybrid hesitant fuzzy decision-making approach with Quality Function Deployment. *Expert Systems with Applications, 115,* 152-171.

Eleren, A., & Kiliç, B. (2007). Turizm sektöründe servqual analizi ile hizmet kalitesinin ölçülmesi ve bir termal otelde uygulama. *Afyon Kocatepe Üniversitesi İktisadi ve İdari Bilimler Fakültesi Dergisi, 9*(1), 235-263.

Erdil, A. (2019). An Evaluation on lifecycle of products in textile industry of Turkey through Quality Function Deployment and Pareto Analysis. *Procedia Computer Science, 158,* 735-744.

Ergün, İ., (2018). Hizmet sektöründe halkla ilişkiler faaliyetlerinin hizmet kalitesi ve müşteri memnuniyetine etkileri. [Master's Thesis]. Avrasya University.

Ersöz, S., Pınarbaşı, M., Türker, A. K., & Yüzükırmızı, M. (2009). Hizmet kalitesinin Servqual metodu ile ölçümü ve sonuçların yapısal esitlik modelleri ile analizi: Ögretmen evi uygulaması. *International Journal of Engineering Research and Development, 1*(1), 19-27.

Goffin, K., & New, C. (2001). Customer support and new product development: An exploratory study. *International Journal of Operations & Production Management, 21*(3), 275-301.

Gómez, J. C. O., & España, K. T. (2020). Operational risk management in the pharmaceutical supply chain using Ontologies and Fuzzy QFD. *Procedia Manufacturing*, 51, 1673-1679.

Grönroos, C. (1984). A service quality model and its marketing implications. *European Journal of Marketing*, *18*(4), 36-44

Gündoğdu, F. K., & Kahraman, C. (2020). A novel spherical fuzzy QFD method and its application to the linear delta robot technology development. *Engineering Applications of Artificial Intelligence, 87*, 103348.

Hauser, J. R., ve Clausing, D. (1988). The house of quality. *Harward Business Review,* May-June, 63-73.

Hasibuan, A., Parinduri, L., Sulaiman, O. K., Suleman, A. R., Harahap, A. K. Z., Hasibuan, M., Daengs, G. A. (2019). Service quality improvement by using the quality function deployment (QFD) method at the government general hospital. *Journal of Physics: Conference Series, 1363, 012095.*

Kalkan, M. (2015). *Dayanıklı Tüketim Sektöründe Satış Sonrası Müşteri Hizmetlerinin Kalitesi: Vestel Örneği.* [Master's Thesis]. Yaşar University.

Kalkan, M., & Yarımoğlu, E. K. (2016). Dayanikli tüketim mallari sektöründe satış sonrası hizmet kalitesi ölçümü. *Uluslararası Yönetim İktisat ve İşletme Dergisi*, *12*(30), 63-80.

Kashi, M., Astanbous, M., Javidnia, M., & Rajabi, H. (2012). A hybrid model of QFD, Servqual and Kano to increase bank's capabilities. *Management Science Letters*, *2*(6), 1931-1938.

Khorshidi, H. A., Nikfalazar, S., & Gunawan, I. (2016). Statistical process control application on service quality using Servqual and QFD with a case study in trains' services. *The TQM Journal*, *28*(2), 195–215.

Kuruüzüm, A., & Atsan, N. (2001). Analitik hiyerarşi yöntemi ve işletmecilik alanındaki uygulamaları. *Akdeniz IIBF dergisi*, *1*(1), 83-105.

Lager, T. (2005). Multiple progression—a proposed new system for the application of quality function deployment in the process industry. *International Journal of Innovation Management*, 9(03), 311-341.

Lestari, D. P., & Dachyar, M. (2020). Improvement of service quality for customer satisfaction with lean six-sigma method and development quality function deployment. Case: telecommunication company in Indonesia. *International Journal of Advanced Science and Technology*, *29*, 3605-3613.

Mahsyar, S., & Surapati, U. (2020). Effect of service quality and product quality on customer satisfaction and loyalty. *International Journal of Economics, Business and Accounting Research (IJEBAR)*, *4*(01), 204-2011.

Mesbahi, J. E., Buj-Corral, I., & Mesbahi, A. E. (2020). Use of the QFD method to redesign a new extrusion system for a printing machine for ceramics. *The International Journal of Advanced Manufacturing Technology*, 111(1), 227-242.

Mesiha, S. A. A. T. (2000). Çok amaçlı karar vermede bir yaklaşım: analitik hiyerarşi yöntemi. *Gazi Üniversitesi İktisadi ve İdari Bilimler Fakültesi Dergisi*, *2*(2), 149-162.

Mistarihi, M. Z., Okour, R. A., & Mumani, A. A. (2020). An integration of a QFD model with Fuzzy-ANP approach for determining the importance weights for engineering characteristics of the proposed wheelchair design. *Applied Soft Computing*, 90, 106-136.

Murali, S., Pugazhendhi, S., & Muralidharan, C. (2016). Modelling and investigating the relationship of after sales service quality with customer satisfaction, retention and loyalty–a case study of home appliances business. *Journal of Retailing and Consumer Services*, *30*, 67-83.

Nie, R. X., Tian, Z. P., Kwai Sang, C., & Wang, J. Q. (2022). Implementing healthcare service quality enhancement using a cloud-support QFD model integrated with TODIM method and linguistic distribution assessments. *Journal of the Operational Research Society*, *73*(2), 207-229.

Özcan, Ö., (2022). *Analitik hiyerarşi prosesi ile yurt dışı mağaza açılışı için ülke belirleme: Perakende sektöründe bir uygulama*. [Master's Thesis]. Yıldız Teknik University.

Özgören, Ö. G. F. (2012). Satiş sonrasi hizmetin müşteri sadakatine etkisi ve Ericsson örneği. *Marmara Sosyal Araştırmalar Dergisi*, (2), 1-23.

Öter, Z., & Tütüncü, Ö. (2001). Turizm işletmelerinde kalite fonksiyon göçerimi: Seyahat acentelerine yönelik varsayımsal bir yaklaşım, *Dokuz Eylül Üniversitesi Sosyal Bilimler Enstitüsü Dergisi, 3*(3), 95-117.

Pakdil, F., Işın, F. B., & Genç, H. (2012). A quality function deployment application using qualitative and quantitative analysis in after sales services. *Total Quality Management & Business Excellence*, 23(11-12), 1397-1411.

Pakizehkar, H., Sadrabadi, M. M., Mehrjardi, R. Z., & Eshaghieh, A. E. (2016). The application of integration of Kano's model, AHP technique and QFD matrix in

prioritizing the bank's substructions. *Procedia-Social and Behavioral Sciences*, 230, 159-166.

Pandey, M. M. (2020). Evaluating the strategic design parameters of airports in Thailand to meet service expectations of low-cost airlines using the fuzzy-based QFD method. *Journal of Air Transport Management, 82,* 101738

Parasuraman, A., Zeithaml, V. A., & Berry, L. L. (1985). A conceptual model of service quality and its implications for future research. *Journal of Marketing*, *49*(4), 41-50.

Parasuraman, A., Zeithaml, V. A., & Berry, L. (1988). SERVQUAL: A multiple-item scale for measuring consumer perceptions of service quality. *Journal of Retailing*, *64*(1), 12-40.

Rita, P., Oliveira, T., & Farisa, A. (2019). The impact of e-service quality and customer satisfaction on customer behavior in online shopping. *Heliyon*, *5*(10), e02690.

Saaty, T. L. (1986). Axiomatic foundation of the analytic hierarchy process. *Management Science*, *32*(7), 841-855.

Saaty, T. L. (2008). Decision making with the analytic hierarchy process. *International Journal of Services Sciences*, *1*(1), 83-98.

Savaş, H., & Ay, M. (2005). Üniversite kütüphanesi tasarımında kalite fonksiyon göçerimi uygulaması. *Dokuz Eylül Üniversitesi Sosyal Bilimler Enstitüsü Dergisi, 7*(3), 80-98.

Serin, T., (2016). *Satış sonrası hizmet kalitesinin tüketicilerin tercihleri üzerinde etkisi (Bolu ilinde örnek bir araştırma).* [Master's Thesis]. Gazi University.

Singh, M., Sarfaraz, A., Sarfaraz, M., & Jenab, K. (2015). Analytical QFD model for strategic justification of advanced manufacturing technology. *International Journal of Business Excellence*, 8(1), 20-37.

Shokouhyar, S., Shokoohyar, S., & Safari, S. (2020). Research on the influence of after-sales service quality factors on customer satisfaction. *Journal of Retailing and Consumer Services*, *56*, 102139.

Tian, Z. P., Nie, R. X., Wang, J. Q., & Li, L. (2019). Group multigranular linguistic QFD for prioritizing service designs with combined weighting method. *Expert Systems*, *36*(4), e12419.

Thangaiah, I. S., Sharma, V., & Sundharam, V. N. (2018). Analysing of customer feedback on critical quality parameters to improve productivity in manufacturing–a case study. *International Journal of Productivity and Quality Management*, 23(3), 349-368.

Torkayesh, A. E., Yazdani, M., & Ribeiro-Soriano, D. (2022). Analysis of industry 4.0 implementation in mobility sector: An integrated approach based on QFD, BWM, and stratified combined compromise solution under fuzzy environment. *Journal of Industrial Information Integration*, *30*, 100406.

Unsal, G., & Öztürkoğlu, Y. (2022). Quality function deployment implementation on service sector. *Journal of Turkish Operations Management*, *6*(1), 1028-1041.

Ürgün. G., (2022). *Hizmet kalitesi iyileştirilmesinde Servqual ve Kano modellerinin kalite fonksiyon yayılımı yöntemi ile bütünleştirilmesi: Havayolu sektöründe bir uygulama.* [Master's Thesis]. Ondokuz Mayıs University.

Ürgün, G. K., & Ük, Z. Ç. (2022). Hizmet Kalitesi İyileştirilmesinde Servqual ve Kano modellerinin KFY ile bütünleştirilmesi: Havayolu sektöründe bir uygulama. *Güncel Turizm Araştırmaları Dergisi*, *6*(2), 554-580.

Villapando, K. D. C., Agunos, A. J. S., Sanchez, A. A., Loto, L. D. B., & Borres, R. D. (2021, August) *SERVQUAL Model Application: Integration of AHP, Prioritization Matrix, and QFD in Assessing Various Delivery Courier Services in the Philippines.* [Conference presentation abstract]. Proceedings of the International Conference on Industrial Engineering and Operations Management Rome, Italy. http://ieomsociety.org/proceedings/2021rome/626.pdf

Vonderembse, M. A., & Raghunathan, T. S. (1997). Quality function deployment's impact on product development. *International Journal of Quality Science*, *2*(4), 253-271.

Wagner, A., Merino, E. A. D., Martinelli, M., Polacinski, É., da Silva Wegner, R., & Godoy, L. P. (2017). The quality of services in a higher education institution: an evaluation for the integration of AHP, Servqual and QFD methods. *Disciplinarum Scientia Sociais Aplicadas*, *13*(1), 109-130.

Wang, Y. H., Lee, C. H., & Trappey, A. J. (2017). Service design blueprint approach incorporating TRIZ and service QFD for a meal ordering system: A case study. *Computers & Industrial Engineering*, *107*, 388-400.

Wolniak, R. (2018). The use of QFD method advantages and limitation. *Production Engineering Archives*, *18*, 14-17.

Yaralıoğlu, K. (2001). Performans değerlendirmede analitik hiyerarşi proses. *Dokuz Eylül Üniversitesi İktisadi İdari Bilimler Fakültesi Dergisi*, *16*(1), 129-142.

Yenginol, F. (2008). Neden kalite fonksiyon" göçerimi"?. *Dokuz Eylül Üniversitesi İşletme Fakültesi Dergisi*, *9*(1), 7-15.

Yıldız, O., & Erdil, S. (2013). Türkiye havayolu yolcu taşımacılığı sektöründe hizmet kalitesinin karşılaştırmalı ölçümlenmesi. *Öneri*, *10*(39), 89-100.

Yılmaz, Ö. (2022). Analitik hiyerarşi proses ile üniversite tercihini etkileyen kriterlerin belirlenmesi: SDÜ örneği. *Osmaniye Korkut Ata Üniversitesi İktisadi ve İdari Bilimler Fakültesi Dergisi*, *6*(1), 36-51.

Zhang, F., Yang, M., & Liu, W. (2014). Using integrated quality function deployment and theory of innovation problem solving approach for ergonomic product design. *Computers & Industrial Engineering*, 76, 60-74.

Zengin, E., & Erdal, A. (2000). Hizmet sektöründe toplam kalite yönetimi. *Journal of Qafqaz University*, *3*(1), 43-56.