THE REPUBLIC OF TURKEY

BAHCESEHIR UNIVERSITY

INDUSTRIAL ENGINEERING

A FUZZY AHP WEIGHTED QFD FOR SERVICE QUALITY IMPROVEMENT IN A FITNESS CENTER

Master's Thesis

HAMID TALEBI

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ABSTRACT

A FUZZY AHP WEIGHTED QFD FOR SERVICE QUALITY IMPROVEMENT IN A
FITNESS CENTER

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Industrial Engineering

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With the epidemic of obesity on the world, health and fitness centers have been getting
growing popularity and importance among countries and communities. For instance,
the rate of obesity in the United States increase slightly by 1987 to 2007 and one fifth
of the population ended up obese. When it comes to Turkey, if obesity is known by
BMI 30 kg/m^2, one fourthof the men from Turkey are more than thirty years old n
terms of women approximately 50 percent of themwere identified as obese.Having
defined, the fitness and health centers can be a great place to fight with obesity and has
gained a great deal attention in the last decade.

The revenue belonging to health club which is comes from Eastern Europe is
approximately 1.1 billion euro. In terms of emerging market regarding health club and
fitness Turkish and polish market are considered as number ones being superior.

Since fitness and health centers have been drawn utter attention, the service quality
comes to play a pivotal role in fitness industry. The target of this research and study is
to find real customer requirements and find the most effective and efficient way(s) to
satisfy these. To do so, SERVQUAL concept and Fuzzy AHP are used in quality
function deployment method. According to the conducted research, 21 main customer
needs were drawn which 5 most important VOC are as follows, respectively: accuracy
in given information and promise, prompt solving, courtesy and politeness,
understanding members specific needs and cleanliness.

Keywords: Quality Function Deployment, Fuzzy AHP, House of Quality,
SERVQUAL, Service Quality, Gym.

ÖZET

BİR SPOR SALONUNDA HİZMET KALİTESİNİ GELİŞTİRMEK İÇİN BULANIK AHP İLE AĞIRLIKLANDIRILMIŞ KALİTE FONKSİYONU YAYILIMI KULLANIMI

Hamid Talebi

EndustriMühendisliği

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Hızlı yayılan obezliksalgını ile birlikte, sağlık ve spor merkezleri sürekli artan birşekilde önem kazanmaya başlamıştır. Örneğin, Amerika Birleşik Devletleri' ndeo beziteoranı 1987-2007'de hafifçe artmış ve nüfus unbeştebiri obez olmuştur. Türkiye'ye gelince, obezitelik BMI 30 kg/m^{2}şeklinde tanımlanırsa, 30 yaşın üzerin deki erkeklerin dörtte biri (yüzde 25,2),kadınlarında yaklaşık yarısı (yüzde 44,2) obez olarak sınıflandırılabilir. 2002-2004 yılları arasında yapılanTürkiye Sağlık Sorunları Araştırması'nagöre, local anemicaynaklı 31519 veinmekaynaklı 10269 ölüm, yeterlifizikselfaaliyetleönlenebilirdi. Bu yüzden, sporsalonlarıobezliğekarşıyapılansavaştaönemlibir role sahipolmuşve son on yıldabüyükönemkazanmıştır.

Doğu Avrupa'nın gelişmekte olan pazarları, 6.900 spor merkezi, 2,3 milyonüye ve yaklaşık 1,1 milyar Euroluk geliriyle bu konuda iyi durumdadır. Polonya veTürkiye ise, Pazar büyüklüğü, kulüp sayısı ve üyelikler açısından lider konumdadırlar.

Spor ve sağlık merkezleri söz konusu olduğunda, hizmet, kalitesikavramı çok önemlibirhalalır. Bu çalışmanın amacı gerçek müşteri isteklerini tanımlamak ve buisteklerin en etkin ve verimli birşekilde nasıl karşılanabileceğini belirlemektir. Bunun için, SERVQUAL yaklaşımı ve Bulanık Analitik Hiyerarşisüreci (Bulanık AHP),Kalite Fonksiyonu Yayılımı (KFY) için de kullanılmıştır. Çalışmada 21 temel müşteri ihtiyacı belirlenmiş olup, bunlardan en önemli 5 tanesi,sırasıyla; verilenbilginin ve sözlerin doğruluğu, sorunların çözüm hızı, nezaket, müşteriye özel ihtiyaçların anlaşılması ve temizliktir.

AnahtarKelimeler:Bulanık Analitik Hiyerarşi Süreci, SERVQUAL, Kalite Fonksiyonu Yayılımı, Kalite Evi, Hizmet Kalitesi, SporSalonu.

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ABBREVIATIONS

QFD: Quality Function Deployment

AHP: Analytical Hierarchy Process

TFN: Triangular Fuzzy Numbers

STFN: Symmetrical Triangular Fuzzy Number

HOQ: House of Quality

VOC: Voice of Customer

TR: Technical Requirement

WHATs: Customers' Needs

HOWs :   Technical Requirement

SEM   :   STRUCTURAL EQUATION MODELING

SN   :   SUBJECTIVE NORM

BMI   :   BODY MASS INDEX

SWOT :   Strength Weakness Opportunity Threat

LSD   :   Least Significant Difference

ANOVA: Analysis of Variance

IHRSA :   International Health, Racquet &Sportsclub Association

TQM   :   Total Quality Management

FIA   :   Fitness Industry Association

REPs :   Register of Exercise Professionals

CR   :   Consistency Ratio

SYMBOLS

Weights That Vary Across People and Contexts:	w_i
The Behavior :	B
Attitude toward a behavior:	A
Design feat:	X_i
Standardized partial regression coeffici:	β
Random Error Term:	ε

1. INTRODUCTION

1.1 FITNESS HISTORY

With the epidemic of obsession on the United States and all around the world, health and fitness centers have been getting growingly popularity and importance among countries and communities. For instance, the rate of obesity in the United States increase slightly by 1987 to 2007 and one fifth of the population ended up obese. One billion people around the world are known over ideal weight and 33 percent of the united state population are considered clinical obese. Having defined, the fitness and health centers can be a great place to fight with obesity and has gained a great deal attention in the last decade. There are too many who are sick or suffering from one, two or more problems amongst the western countries which called civilization's problem such as depression, malnutrition, stress, alcoholism etc. in order to solve all of theseissues and the problems resulting in mental and physical issues, we should improve people's mental and physical situation. In this regards fitness and health gym and recreation center can be best option for us.

On the other hand, the low provision of leisure and physical activities space by growing dense of urban population fitness club has been taking importance in recent year. By the same token, sport and fitness sector have got a dynamic and fast growing area.

1.2 CURRENT SITUATION OF OBESITY IN TURKEY

The underlying cause of inequality of nutritional problem which result in taking wrong kind of food and using wrong type of ingredient in meals by the same token it result in nutritional problems.

Bread and grain are the main food in Turkey. The daily calories intake used by 44% from only bread and in general 58% of daily calories come from bread and other various type of grains.

It was seen among Turkish people that fast food has got growing appreciation during the last years.

The survey was implemented by "Turkey Burden of Disease" in the years 2002-2004 in Turkey. It was shown that 31519 deaths and 10269 deaths from ischemic cardiac and stroke respectively might be prevented by sufficient physical activity.

Disease burden and death numbers which can be attributed to high BMI are given with their causes in table 1.

Table 1.1: Distribution of Disease Burden and Death Numbers as a Result of High BMI

Cause	Attributable Deaths	Attributable YLL	Attributable YLD	Attributable DALYS	Attributable DALYS rate in total DALY
Ischemic heart diseases	29.581	317.790	28.504	346.294	3.2
Hypertensive heart diseases	7.174	57.723	4.073	61.796	0.6
Ischemic Stroke	11.109	93.794	53.136	146.930	1.4
Diabetes Mellitus	7.674	73.921	78.319	152.240	1.4
Osteoarthritis	0	0	61.035	61.035	0.6
Breast cancer	724	7.141	1.718	8.859	0.1
Colon and rectum cancers	646	6.583	717	7.300	0.1
Corpus uteri cancer	235	2.079	651	2.730	0.0
Total	57.143	559.032	228.151	787.183	7.3

Source: Turkey Burden of Disease Study

1.3   PHYSICAL HEALTH AND COUNTRIES ECONOMIC'S ROBUSTNESS

Physical activity is known as a underlying of physical problems and over-weighted that the healthy living style occur when we have a regular physical activity as a result the health cost will be decreased considerably at the end it contribute to boost countries economy.

1.4   IMPORTANCE OF SPORT AND FITNESS SECTOR

Since the need for exercise and recreation is realized by people more than before, the fitness service industry became a fast growing industry. For instance, in the United Statesthere are more than 33000 fitness and recreation centers; however, in Europe quantity is fewer but is growing. Afhintos et al. 2005 says there are approximately 1300 private fitness center owning 311500 members in Greece.

Fitness and sport industry is positioned second and third level and classified into following group:

a. Investment Products manufacturer: sport clothing, equipment production, sport facilities constructions
b. Product consumers
c. Service provider in the profit sector: Fitness centers, recreation agencies, multifunctional sports facilities, sport equipment stores, sport sponsoring agencies, sport insurance
d. Service provider in the non-profit sector: Sport associations, sports club (Woratschek 2000)

Which our concentration would be in service provider in the profit sector (fitness centers, gym, recreation agencies)

In order to attract wide range of people also to be survived in the competitive environment, fitness centers are delivering extensive services including body building, swimming, skin-care, Pilates, ball game, sauna, SPA therapy, aerobic dance, yoga, basketball, spinning, tennis, ping pong. Furthermore, health and fitness centers are gradually changed to be customer-orientated service and customer satisfaction became the imperative factor.

Since "fitness clubs" are classified in a service-oriented industry, the approaches and methods to achieve customer satisfaction is significant issue. All services incorporating four unique characteristic as follows: intangibility, perishability, heterogeneity and inseparability. Inseparability is known as key service quality difference from products. While service is delivered, a service failure or insufficient service quality can be

occurred which result in customers complaints and dissatisfaction. On the other side, delivering service without any failure and mistakes with content customers is a great deal difficult job. Prompt solution in service inefficiency is a significant issue since achieving frustrated customer's satisfaction result in royalty of customers. As times goes, due to rising of people awareness, they start asking further and various request from service provider and service industry became more competitive and complex. It is essential to service provider to know, how to attract new customer while maintaining existing customer. It is said that achieving new customers costs 3-10 times more than keeping current customers (Luo 2001). It means that if an enterprise is not able to sustain its existing customer, it will pay much more to find new customers. Reichheld and Sasser (1990) also found out that an enterprise net profit can be enhanced as much as 25 percent to 85 percent by reduction of as little as 5 percent in customer churn. Hence, sustaining customer loyalty for enterprise is paramount important from two point of view:

I.   Cost
II. Profit

The quality evaluation of service is mentioned as success of provider or fitness center, because the dissatisfied customer normally will complain to at least seven person. The service quality is a subjective issue; on the other side, services are prepared and consumed simultaneously, make it complex to assess the service quality.

In today's competitive market service and product quality is one of the most essential selling point. In terms of improvement of quality, majority of companies are applied total quality management (TQM). According to Cohen 1995 andAkao 1990TQM is as decision tool with the use of approach such as quality function deployment (QFD), statistical process control, design for manufacturability etc. among this methods quality function deployment is used to translate customer requirement to engineering design characteristics through engineering, design, marketing, manufacturing, and other related department of an organization.

In this thesis QFD approach applied which it is a management tool for each phase of service or product development providing a structured method for translating customer

expectation into design requirement. QFD is the method enabling an organization to improve its service or product quality to levels meets or exceeds customer expectations.

The HOQ sometimes named A-1 matrix, is the most commonly used matrix in the QFD methodology. The main concentration in HOQ is identification of correlation between customer need which is called WHATs and design characteristics, also named HOWs.

For categorization of customer needs SERVQUAL concept is applied which SERVQUAL five dimensions.

For the purpose of finding the prioritization regarding customer needs AHP method is employed in this thesis. The analytical hierarchy priority (AHP) is a multi-criteria decision making technique to evaluate the situation or problem by multi-criteria choices which the subjective and intangible criteria can be involved.

Also AHP approach allows decision maker to check the consistency and stability of decision and if the pair-wise comparison is not consistent sufficiently it supplies with mechanism to enhance the consistency. The AHP was originated by Saaty(1980) supporting by simple mathematics and suggested by Akao(1990) and Aswad(1989) as an innovative and creative approach to give the weight to customer needs.

The fuzzy set theory is utilized in order to overcome the uncertainty which was introduced by Zadeh (1965) for the first time. Fuzzy set theory introduces an approach with mathematical concept through which uncertainty can be considered (Zimmermann 1991). In other words, fuzzy-AHP reflects human thought while does not include cumbersome mathematics. As a matter of fact, fuzzy set theory is a practical approach to measure the ambiguous concepts of linguistic terms associated with human being subjective judgment. A linguistic variable is a type of variable whose values are not numbers, however; its values or objects are phrases in natural language. In dealing with too complex or not well defined situation to be expressed in quantitative expression, linguistic variable are very helpful.

The most frequently utilized fuzzy numbers are triangular and trapezoidal fuzzy numbers. Considering the fact that easiness in calculation and features, triangular fuzzy number (TFN) often used in practice. Consequently in this thesis standard triangular fuzzy number (STFN) is applied to represent linguistic variable. A TFN is indicated as $M = (l, m, u)$ and the membership function associated to that is $\mu_A (x)$ which is equal to:

$$\mu_A\ x\ =\ \begin{cases} 0, & x < l \ or \ x > u \\ \dfrac{x-l}{m-l}, & l \le x \le m \\ \dfrac{x-u}{m-u}, & m \le x \le u \end{cases} \tag{1}$$

The main arithmetic rules for two positive triangular fuzzy numbers M_1 and M_2 are as follows (Kaufmann & Gupta 1991):

$$M_1 \oplus M_2 = (\ l_1+l_2, m_1+m_2, u_1+u_2\ ) \tag{2}$$

$$M_1 \ominus M_2 = (\ l_1-u_2, m_1-m_2, u_1-l_2\ ) \tag{3}$$

$$M_1 \otimes M_2 = (l_1 l_2, m_1 m_2, u_1 u_2\ ) \tag{4}$$

$$\lambda \otimes M_1 = (\lambda l_1, \lambda m_1, \lambda u_1) \tag{5}$$

$$M_1^{-1} = (1/u_1,\ 1/m_1,\ 1/l_1) \tag{6}$$

$$M_1 \div M_2 = (\dfrac{l_1}{u_2}, \dfrac{m_1}{m_2}, \dfrac{u_1}{l_2}) \tag{7}$$

The linguistic scale applied in Fuzzy-AHP is as below:

Table 1.2: The Linguistic Scale

Linguistic Scale For Importance	Triangular Fuzzy Numbers	Triangular Fuzzy Reciprocal Scale
Just Equal	(1,1,1)	(1,1,1)
Equally Importance	(1,1,3)	(1/3,1,1)
Weakly Importance	(1,3,5)	(1/5,1/3,1)
Essentially Importance	(3,5,7)	(1/7,1/5,1/3)
Very Strongly Importance	(5,7,9)	(1/9,1/7,1/5)
Absolutely Importance	(7,9,9)	(1/9,1/9,1/7)

There are several fuzzy-AHP approach offered in the literature; however, the method applied in our research is the Buckley's extension based on fuzzy-AHP algorithm. In order to determine criteria weights of our service quality factors, we utilize Buckley 's fuzzy-AHP approach because of easiness of expanding it to the fuzzy case and assure us of a unique solution to the reciprocal comparison matrix , on the other hand progressing by this approach is relatively more comfortable than the other fuzzy-AHP approaches.

Since between service and product quality a great deal differences is perceived, by the same token Parasuraman et al. (1985) and Zeithaml et al. (1990) invent an approach in order to measure service quality which is called SERVQUAL. One of the targets of the SERVQUAL's study is to ascertain any actual or perceived gap between customer expectation and perception of the service quality. SERVQUAL's studies are published in the field of mental health service, computer services, car servicing, channel partners, accounting firms, architectural service, recreational services, hospitals, airline catering, banking, apparel retailing, local government, business school, higher education, travel

and tourism, dental services, business-to-business and apparel retailing (Buyukozkan et al. 2012).

2. LITERATURE REVIEW

This chapter reviews existingstudies to find out what kind of effort have been spent on service quality improvement in fitness and health industry.

2.1 SERVICE QUALITY ASSESSMENT IN FITNESS INDUSTRY

Service quality has been interpreted as an ambiguous and abstract concept (Parasuraman et al. 1988). Categorization of a variety of activity's scope which is classified as service plays as a hindrancein terms of quality elusiveness resulting in the improvement of different taxonomies for service companies (Babbar 1992, chase 1978, Fitzgerald et al. 1993, Ghobadian et al. 1994, Petit 1986). It is widely acknowledged that services vary in comparison with manufactured products because service products are intangible, simultaneously provided and consumed, perishable and heterogeneous (Fitzgerald et al. 1993). Therefore, there is consensus within literatures on these service attributes compound the situation for service provider to measure, count, fulfill checks and eliminate defects in service before it used by customers (Lewis 2003).

The service quality is described the difference between customer expectations and perceptions of quality of provided services (Zeithaml et al. 1990, Gronroos 1984, Lewis and Booms 1983). The importance of quality assessment is derived from a dissatisfied customer whichwill usually complain at least seven other people (Rintjema 1998). Terzoglou et al. (2012) evaluate the service quality in gymnastic gym based on the relationship between demographic features and gym participation. This study incorporated of 250 adult men and women (63.2 percent women, 36.4 percent men) which their average age was 24 years old, who participate at private gym in eastern Thessaloniki. The applied questionnaire was based on modified SERVQUAL model by Alexandris et al. (2004) consisting of five aspects:

   a. Tangibles-5 items
   b. Personnel-6 items
   c. Responsibility-4 items
   d. Reliability-4 items
   e. Outcome-6 items

In which the SPSS-16 software package was used in statistical analysis. According to this study, the occupation and education were not related with quality service evaluation in private gym. However, it seems that frequency of participation is related to quality evaluation of provided services. The members' desire to keep attending in gym program and exercise in the gym depends on the credibility of description of each program, accuracy of the schedule and personnel's punctuality and the expected outcome of exercise.

Terzoglou et al. (2012) proposed a plan for practical improvement:

  i.   Improvement of gym facilities
  ii. Up to date the equipment
  iii. Continuous staff training
  iv. Introduction of new means
  v.   Training methods
  vi. Emphasis on personnel's punctuality and daily program[6]

As service quality has a vital role to distinguish as an outstanding gym among fitness clubs, Moxham and Wiseman (2009) assess the development, delivery and measurement of service quality in a leading UK fitness club and present a number of conceptual models for developing, delivering and measuring service quality. Breakthroughs show that measuring the performances comparing with standards and targets is the mystery of sustaining the service quality in high level. By considering this fact, three key measures is proposed by Moxham and Wiseman (2009) for measurement scales of quality as following:

a. Retention rates
b. Adherence to professional standards
c. Adherence to internal targets

Safe in the knowledge that there is no consensus among literature about how high level of service quality can be sustained consistently; however, the literature identifies that improving and delivering high level of service quality is dependent on some contributors as shown in table 2.1.

Table 2.1: Some Contributors of High Service Quality

Row	Contribution	Publication
1	Measuring member retention	(Iwasaki and Havitz 2004)
2	Measuring inputs, throughputs and outputs	(Chang and Chelladurai 2003)
3	Setting targets, setting standards and identifying evaluators of service quality	(Chelladurai and Chang 2000, Parasuraman et al. 1988)
4	Monitoring health and safety	(Tawse and Keogh 1998)

It is with regret seen that there is limited attention and research. Moxham and Wiseman (2009) undertookthe research in this area which they took a fitness organization called The Gym and Swim Plc that was achieved third place among 10 top UK health clubs in terms of membership. The concentration of study was on single case study with two matters of analysis:

  i.   corporate level
  ii. Operational level

The research target was to investigate the correlation between development policy, delivery and measurement of quality which during four months qualitative data was collecting.

In terms of developing service quality, the Gym and Swim Plc approach was setting performance standards and targets which was "top-down". Their performance standards driven from delivering consistently high service quality to customers as "club class" and some of performance standards driven from industry good practice and other from sharing good practice on " bottom up" approach. club class's slogan is "outstanding service, every member, every time" and "Club class" is defined: saying hello and using members names, proactive health and fitness which contains talking with all members of club, a great food and beverage experience, a clean and fresh smelling club, plenty of activities and events available, saying goodbye and thank you to all members.

In terms of measuring service quality The Gym and Swim Plc organization utilized some approaches as following:

i. Retention rate

ii. Adherence to professional standards

iii. Internal quality audit by the board of directors and regional manager

iv. Internal quality audit by the club manager

v. Mystery shopper

vi. Informal feedback from club members

Retention rate: this rate is the calculation of monthly "leaver and joiner" which express the net attract and loss members per each month.

Adherence to professional standards: the Gym and Swim PLC organization adhere all parts of organization with several known national standards such as: the register of exercise professionals (REPs), the fitness industry association (FIA). REPs is a worldwide training quality standards for fitness club employees providing a comprehensive list of fitness professionals who have achieved qualifications to reps standards. The register target is to assure that fitness instructors are skilled and perfectly qualified to instruct. The FIA is a non-profit association that its members represent a number of elements: health and safety for all personnel visiting or working on club premises, staff training to the appropriate standards the reps and customer care meaning, provide customers with health and exercise history.

Internal quality audit by the board of directors and regional manager: the clubs was visited by both "planned and surprise visits" which surprise visits is known by phrase "don t expect, inspect".

Internal quality audit: the assistant club manager in each Gym and Swim PLC perform twice daily inspections.

Mystery shoppers: two mystery shoppers investigate the Gym and Swim PLC club service quality on the basis of monthly reported. They were offered six month free membership in exchange for reporting monthly regular analysis.

Informal feedback from club members: feedback comment by members was documented on a database to permit easy recognition of longer-term trends or recurring complaints and suggestions that can help for future decision making.

It is widely accepted that a key aspect of delivering quality in leisure activity is health and safety (Tawse and Keogh 1998). The empirical findings related Gym and Swim Plc shows that this organization by being member of the FIA was committed to health and safety in addition to promoting 'standards of safety and health that will minimize risks and avoid accidents and ill health (FIA 2005). It is worthwhile to mention that contrary to low cost/high membership clubs in the fitness area, Gym and Swim PLC was not targeting to gain high volume of new membership by competing in membership fee. Mass membership would change quality and atmosphere of internal physical environment (Chang and Chelladurai 2003), at the peak hours facilities would become crowded and less clean, high usage of equipment would increase maintenance cost and scheduling, occur queuing particularly.

[7]Agnes Szabo (2010) carried out the research by the purpose of complete literature review which is intended to answer the following questions: what are the main differentiating characteristics of leisure sport service provider in Hungary? What are the important dimensions of service quality for the leisure sport services in Hungary?

Leisure sport service providers have understood only recently the importance of service quality. Earlier they had concentrated on facilities, activities and the communities for market and management style during recent decades has been changing which is shown in table 2.2.

According to the study carried out by the institute of environmental research, which it is said only 4 percent of unsatisfied customers will complain about the poor service, 90 percent of customers who are unsatisfied will not continue doing business with that organization and 96 percent of unsatisfied customers would not complain.

Table 2.2: Management Style in Sport and Leisure Services

Time Scale	Early 1970's	Late 1970's Early 1980's	Mid 1980's	Late 1980's Early 1990's	Late 1990's
Management Focus	Facility focus	Activity focus	Community focus	Market focus	Quality focus
Objectives	Maximize income	Maximize participation	Maximize opportunities for problem	Economic revenue	Maximize quality and achieve best value
Management Style	centralized	decentralized	Decentralized, Advocacy, catalytic role	Expert marketer	Agent of organizational change
Mode of Consultation	professional	consultant	partnership	Market research	Customer surveys
Attitudes to Clients	Regulation, control of users	Encouragement of under-users	Positive support of disadvantaged	Identify appropriate market segments, customer care	Citizens: one among group of stakeholders
Program Emphases	reactive	Informal, fun and sociability	Proactive, creative, developmental	Selling lifestyle, health and fitness	Meeting corporate goals through leisure

Source: Robinson (2004)

Agnes Szabo (2010) explained 10 main characteristics of leisure sport services, and the major differences between leisure sport service providers and other service providers:

    a. Sport participants achieve unique motivation from advantages they receive from sport engagement, in turn it is important to establish participative motivation and customers problems (Ko-Pastore 2004)

    b. In the fitness club variety of processes are carried out by different employees and some of them are routine process which can be standardized, however some of them are more sophisticated and should be customized. The quality of customized process is dependent on human performance while the behavior and performance of employees determines the level of service quality (Chelladurai-Chang 2000).

c. Customers have two role, they not only attend, but also actively participate in the service production.

d. Participation in fitness center is a social process in which customers interact and influence each other. Also, Inter-client interaction must be taken into consideration (Ko-Pastore 2004;Chelladurai-Chang 2000)

e. Client of fitness center get habituated to the service and they spend longer time to receive service in comparison with other services.

f. Customer satisfaction can be affected by some factors which are out of control of service providers, such as weather and social group (Crompton and Mackay 1989).

g. Physical facilities and equipment are more important contributors when clients want to decide to join a particular fitness club

h. In the sport industry, the major outcome is customer's experience

i. Outcomes in fitness industry are divided into two groups such as: post-consumption tangible, post-consumption intangible. Outcomes can be achieved just after a meaningful period of time and regular exercise. Therefore, quality judgments require to be delayed.

j. In terms of evaluation, it is important to separate program quality and outcome quality.

Some dimensions in the fitness industry are introduced by different people as below: Chelladurai et al. (1987) introduced 5 dimensions of fitness service in Canada as following

    i. Primary-professional

    ii. Primary- consumer

    iii. Primary-peripheral

    iv. Primary-facilitating goods

    v. Secondary goods and service

Interpretation: the first dimension refers to core service while rest of the dimensions are reflecting context

Cromptom-Mackay (1989) employed SERVQUAL model to identify service quality dimensions in public recreation and after 2 years he examined the stability of this model

and found out that just four of five SERVQUAL factor are statistical supported: assurance, reliability, responsiveness and tangible.

Howat et al. (1996) determined 4 dimensions:

    i.   Core service

    ii.   Staff quality

    iii.   General facility

    iv.   Secondary service

Interpretation: core service incorporate program information, range of activity, facility comfort, value for money and quality equipment. Staff quality, incorporate staff responsiveness, staff knowledge and officials. General facilities incorporate safe parking and facility cleanliness. Secondary service, incorporate good food and drink and child minding.

Chang and chelladurai's (1999) introduced three dimensions:

a. Input stage

b. Throughput stage

c. Output stage

Interpretation: input stage includes 3 dimensions; management commitment to service quality, developing service climate, designing core service. Throughput stage includes 5 dimension; interpersonal interactions with employees, task interactions with employees, physical environment, contact with other customers and service failure and recovery. Output stage; perceived service quality.

Combining and summarizing different approach and breakthrough of researchers the 5 major dimensions of leisure sport service quality are as following (Agnes Szabo 2010):

    i.   The core service

    ii.   The physical context

    iii.   The interpersonal interaction

    iv.   Outcome quality

    v.   Secondary service

The core service is described as similar to reliability in the SERVQUAL approach, including excellence of program, the program information, range of program, range of activities and opening time. Physical context is described as similar as tangible in

SERVQUAL, including physical facilities, equipment, amenities, design, ambience, cleanliness, convenience, accessibility, surroundings, location, safe parking which were very important everywhere(in the USA, Canada, Greece)

Afthinos et al. (2005) utilized QUESC approach to investigate that different group of members have different desires with respect to service delivery. Their survey showed most important common criteria was "cleanliness" and also "professional knowledge", "responsibility" and "courtesy" of employees were the highest-ranked of aspect considered by customers in leisure and fitness sector.

American fitness club members have done survey showed 9 dimension of fitness-service quality as below:

    a. Service climate

    b. Management commitment to service quality

    c. Programming

    d. Personal interaction

    e. Task interaction

    f. Other clients

    g. Service failure

    h. Service recovery

    i. Perceived service quality

Stefan and Yvonne (2007) researched in the field of service quality specified in health-and-fitness industry by the purpose of:

    a) To discover quality dimensions for the health-and-fitness industry

    b) To examine quality-management practices in this industry

Stefan and Yvonne (2007) applied a grounded-theory approach in their study. The objective of using grounded theory is to generate reliable and useful information to practitioner (Glaser and Strauss 1967; Strauss and Corbin 1990) which the students were trained to carry out in-depth qualitative interviews, on the other hand much emphasis was placed on being ensure that interviewers don't impose their presuppositions on respondents. The interview with respondent had conversational nature feature, and no fixed set of questions was used. The findings are categorized into:

    i. Quality dimensions: what the customers need and want

ii.   Enablers: they are required elements to create quality

The results are illustrated in figure 2.1

Figure 2.1: The Original Framework for Fitness Quality Management
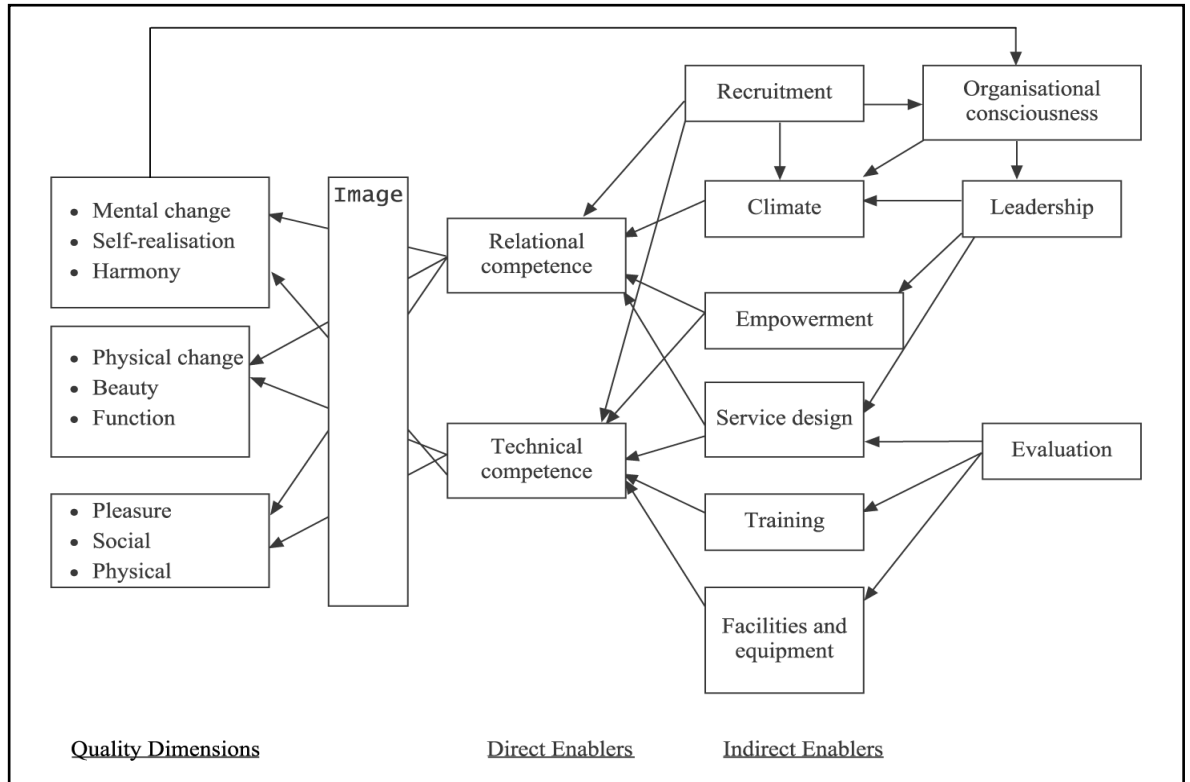
From Stefan and Yvonne (2007) framework, Quality dimensions were identified as follow:

Physical change: the basic and major objective of fitness service is to assist customers to improve their physical status.

Beauty: the beauty is referred to various aesthetic features of members with respect to bodily appearance such as slimmer body, enhanced muscle mass, smoother skin in other word, generally healthier look.

Function: it is referred to bodily performance such as muscular strength, increased endurance.

Mental change: it is referred to positive psychological effects of physical exercise.

Pleasure: it is referred to the social pleasure of interaction with other members and employees.

The enablers were divided into 2 "direct factors" and 6 "indirect factors" which the direct factors were as follows:

Technical competence: this refers to a service provider's ability to provide a required service.

Relational competence: this is corresponding employee behavior and attitude in interaction with customers in such way displaying friendliness, empathy, attention to customer needs.

Indirect enablers were as follows:

Facilities: these included the promises, training equipment and tools used to provide treatments.

Training: it refers to the training of instructors.

Evaluation: this is referred to identification of issues that require enhancement.

Empowerment: in the sophisticated service functions of fitness center, it is so hard to deal with all in details and overcome problems, therefore it is important to have empowered and committed employees.

Climate: the "climate" of fitness center is referred to harmonious collaboration and smooth interaction between personnel and also smooth collaboration between the company and its external partner.

Leadership: it is referred to ability of manager to motivate and encourage their employees.

Image: it is referred to brand, image and credit of the organization.

Cheng (2010) carried out studies on improving of service quality at fitness centers through applying of the six sigma process. He applied 5 recommended steps of six sigma aiming to reduce the incidence of service failures at fitness clubs in Taiwan. As it is known six sigma process is constituted of five phases as define the problem and its goal, measure, analyze, improve and control respectively.

Define: the goal is to reduce service failure rates which most service failures in fitness club defected in service delivery systems or ill-equipped facilities. In this research random variable "X" are considered as the number of failure in the fixed period of time, so "X" is the random variable of Poisson distribution and the probability density function is:

λis a parameter of Poisson distribution expressing variance and mean of service failure occurrence that minimizing service failure is the top priority.

Measure: λ is used average number of failure in service, while U is the upper tolerance limit of failure. L_{index}isused as a measurement index in this study defined as follow:if the average number of failure is equal U the L_{index} = 100 percent meaning the occurrence of failure have reached the tolerance limit. When average number of failure became greater than U, thenL_{index} would be greater than 100 percent and vice versa.

Measurement: uniformly minimum variance unbiased estimator was used in this study. A Poisson distribution can be exchanged with Z-distribution with a large number of possible event. When λ is small, it stands for high quality service and thus the measurement index is expected to be small. When a company expects that its service quality should be: L_{index} ≤ v (0<v<1), the smaller v stressing on the high service quality (Chen and Li 2002). The hypothesis test for measurement as follow:

$H_0 = L_{index}$ ≤ v (good service quality)

$H_a = L_{index}$ > v (poor service quality)

First, we estimate the value through given a sample of k.

Second, the p-value is calculated with the v value and then compared with the significant level α = 0.05.

Analysis: in this phase the cause and effect diagram is constructed as an analytic tool. In this article 6 main aspect which cause failure in investigated being as follow:

I.   Defects in the service delivery system
II.   Products below expectation
III.   Ill-equipped facilities
IV.   Employee characteristics
V.   Employee's responses to customers' requests
VI.   Problem behaviors of customers

Improvement:

Body-building dept.

Membership service department

Marketing department

Control: if there are a large number of samples, standard normal (Z) distribution can be applied in accordance with the central limit theorem. The control chart will have 3 standard deviations as control limit:

P (-3≤ Z ≤ 3) = 99.73 percent

The measurement index will be:

P (v-3σ ≤ w ≤v+3σ) = 99.73 percent

YanniAfthinos, Nicholas DTheodorakis and NassisPantelis (2005) fulfilled research on service quality in Greek fitness centers aiming to identify the dimensions of service quality whose considered most important by the customers of the Greekfitness centers and investigate whether their desire differ with respect to the type of fitness center they have membership as well as according to certain demographic pattern such as age, gender and motivation. The study was carried out on 346 individuals who were members of public and private fitness centers. Survey implemented through questionnaire based on QUESC instrument developed by Kim and Kim and analysis of variance (ANOVA) test per each items of the instrument have conducted.

The most desired aspect of service quality referred to the tangible criteria of facility, the personnel behavior and abilities, cost of membership, programming and scheduling of services provided. It is unveiled also that there is a significant difference of desire between male and females as well as between members of public and private gyms. Kim and Kim (1995) concluded that there is no significant difference in customer expectation regarding gender, age and purpose in Korean fitness centers. Kim and Kim (1998) accomplished another result in terms of Seoul's fitness center members that users approach to service quality are not corresponded with age and amount of individual's income; however, the gender has an effect on their expectation.In this research the 43-items QUESC instrument was applied because it was specially developed to measure service quality in sport centers by Kim and Kim (1995). QUESC has two part which first part measure the desirability of the list of items in service quality and second part is the same list of items applying to measure perceptions of the quality of delivered service. In the study just first part of the questionnaire was used.

Table 2.3: Data Analysis Comparison between Public and Private Fitness Center

Criteria	Public Center	Percent	Private Center	Percent
predominate gender	women	88	equally	50.9, 49
age group	> 40 years old	30.6	> 40 years old	7.1
time period being in gym	fewer than 2 hours	100	more than 2 hours	20.3
times of workout per week	three times	64	four to seven	52
preferred activity	aerobic	69.7	weight lifting	38.3
most motivated reason	health	16.2	health	41.3

A total of 13 statistically significance differences of member's expectation regarding demographical scales:

Women: more available space, convenient schedule, variety of sports, programs floating, comprehensive brochure, convenient access. In terms of employees' attitudes the desire of women differed from whom men regarding staff courtesy, professional knowledge and dissemination of clear instructions.

Men: on the contrary, men was more interested in the provision of membership packages, the opportunity to meet other people and bring guest.

Table 2.4: QUESC Items Priority in Greek Fitness Centers

Row	SERVICE QUALITY SCALE	M	SD
1	cleanliness	4.81	0.48
2	professional knowledge	4.64	0.62
3	responsibility	4.6	0.65
4	courteous employees	4.52	0.72
5	emergency procedure	4.52	0.78
6	willingness to help	4.5	0.75
7	clear instructions	4.48	0.77
8	convenient schedule	4.47	0.74
9	pleasant interior	4.45	0.75
10	modern facility	4.41	0.75
11	adequate space	4.41	0.74
12	comfortable temperature in the gym	4.4	0.82
13	variety of sport	4.39	0.77
14	responsive to complaints	4.38	0.81
15	interested in customer progress	4.34	0.83
16	moderate fee	4.31	0.87
17	no loss or damage to goods	4.28	1.01
18	play, goal differentiation	4.25	0.81
19	stimulation	4.23	0.87
20	consistency	4.18	0.93

Table 2.4: QUESC Items Priority in Greek Fitness Centers

Row	SERVICE QUALITY SCALE	M	SD
21	brightness	4.16	0.8
22	instructions on how to use the facility	4.11	0.9
23	privacy	4.11	0.99
24	safety measure	4.09	1.01
25	easy to obtain membership	4.04	1.06
26	comprehensive brochure	4.01	0.9
27	convenient transportation	3.92	1.13
28	comfortable temperature in locker room	3.91	0.97
29	customized program	3.91	1.07
30	provision of membership package	3.91	1.13
31	skill recognition	3.87	1.02
32	programs renewed	3.71	1.02
33	easy access to drinks	3.66	1.11
34	customer record keeping	3.6	1.12
35	family program	3.5	1.23
36	location near a shopping area	3.36	1.36
37	ability to bring guest	3.26	1.33
38	interaction among members	3.24	1.2
39	children program	3.11	1.2
40	opportunity to meet people	3.01	1.29
41	grooming facilities provided	2.88	1.28
42	snack bar	2.44	1.28

The conclusion of the defined research shows that the aspects of most desired service by customers in Greek fitness centers are related to: tangible elements of facilities, attitudes and abilities of staff members, cost of participation, programming and scheduling of the services provided.

3. DATA AND METHODOLOGY

In this chapter we explain about research model and hypotheses which illustrate the use of QFD approach and FUZZY-AHP and concepts of SERVQUAL.

3.1 QUALITY FUNCTION DEPLOYMENT

In today's competitive market service and product quality is the one of most essential selling point. In terms of improvement of quality, majority of companies applied total quality management (TQM) which TQM is a management approach for long-term achievement through customer satisfaction which participate all members of an organization for enhancing of process, product, service and the culture of companies in which they work. TQM is as decision tool with the use of approach such as quality function deployment (QFD), statistical process control, design for manufacturability etc. among this methods quality function deployment is used to translate customer requirement to engineering design characteristics through engineering, design, marketing, manufacturing, and other related department of an organization (Cohen 1995; Akao 1990).

QFD is the method enabling an organization to improve its service or product quality to the level meets or exceeds customer expectations. It would work in company when there is a commitment from management department involving functional-team to implementation. The QFD is a disciplined approach providing both an outline and structured process to enhance organization ability to documentation, communication, analyze, targeting and prioritization with regard of customer needs.

The terms quality function deployment (QFD) originated from a Japanese phrase which is: *HinShitsu Kino Ten Kai,* incorporating 3 characters with following meaning:

i. *HinShitsu*, which usually means "features", "quality", "attributes" or qualities"

ii. *Kin*, which usually means "mechanisms" or "functions"

iii. *Ten Kai*, which can mean "deployment", "diffusion", "development" or "evolution"

According to the translation of this Japanese phrase, QFD mean deploying of the all attribute of service or product through which customers throughout all the appropriate functional components of an organization (Re Velle et al. 1998)

According to Akao (1990), QFD is defined as a method to improve a design of quality by means of translating customer's needs into design characteristic which is targeted in customer satisfaction and this method is used to identify imperative quality points to be utilized throughout the production phase. Sullivan (1986) conceptualized QFD as a method to help companies to bring new products into market as soon as possible in a competitive environment with lower cost and improved quality.

Quality function deployment according to the American Supplier Institute (ASI) is described as a system for translating customer requirement into appropriate company requirement at every stage like: research, product design, development, manufacturing, distribution, installation, sales, marketing and service.

According to Growth Opportunity Alliance of Lawrence, Massachusetts/Quality Productivity Center (GOAL/QPC), QFD is defined as a system for designing services and products based on customer needs which is involved all members of an organization in cross-functional team. And it is known sometimes as most advanced quality control in Japanese style.

QFD is the systematic way to gain voice of customers and translating them into technical requirement which make them heard throughout an organization while customer's voice have to be met throughout supply chain (Hutton 2001). Consequently, the set of prioritized targets is determined to designers, production people and even suppliers to aim at, in order to produce or provide desired product or service by the customers.

In order to achieve an overall best solution while design trade-offs is needed, QFD become more valuable in particular. QFD also provide a great deal of useful information to be summarized in one or more charts.

QFD is sometimes called by other names such as *voice of the customers* (VOC) because of its use as an approach of communicating customer needs with companies, or *house of quality* (HOQ) from the house shape of a QFD chart which is shown in figure 3.1.

Figure 3.1: The House of Quality is the Basic Matrix of Structure Used to VOC
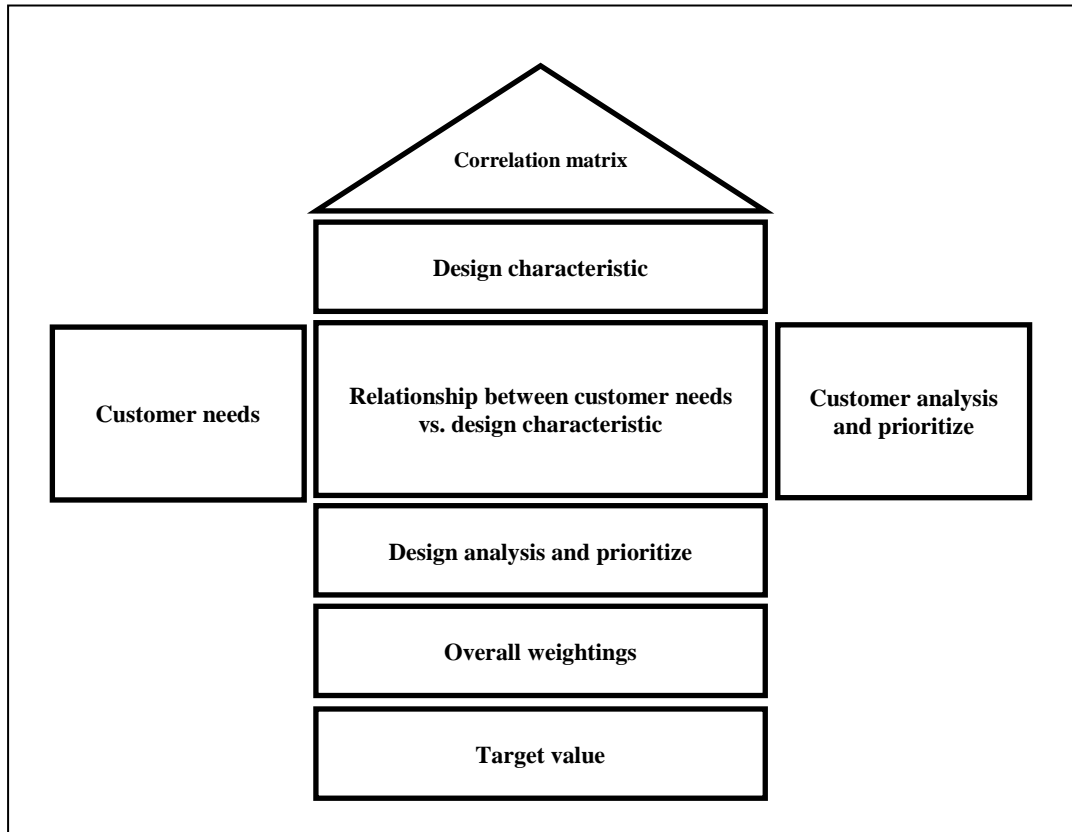
Generally, QFD is a management tool for each phase of service or product development providing a structured method for translating customer expectation into design requirement. Its outstanding power is emphasized on the fact that it reveals an organization improvement processes while showing these process's interaction with customer needs resulting in customer satisfaction (Rayanor 1994).

Two popular models illustrate the QFD approach or process. Which one is called "four-phase model" developed by Hauser and Clausing (1988) which is probably the most widely explained and utilized. The other model is named the "matrix of matrices" introduced by Akao (1990) which is considered gigantic and far reaching (Cohen 1995). Four- phase model is described here briefly in following key words and figure 3.2.

The four-phase model is constituted by the following four key phases (Sullivan 1986)

i. Overall customer expectation planning matrix – *translate the general customer expectation into certain final product characteristics.*

ii. Final product characteristic development matrix − *translate the outcome of planning matrix into important component or part characteristic.*

iii. Process plan and quality control charts − *identify critical product and process parameters and develop checkpoints and control for these parameters.*

iv. Operating instructions − *identify operations to be performed by plant personnel to ensure that important parameters are achieved.*

Figure 3.2: Four-phase QFD model
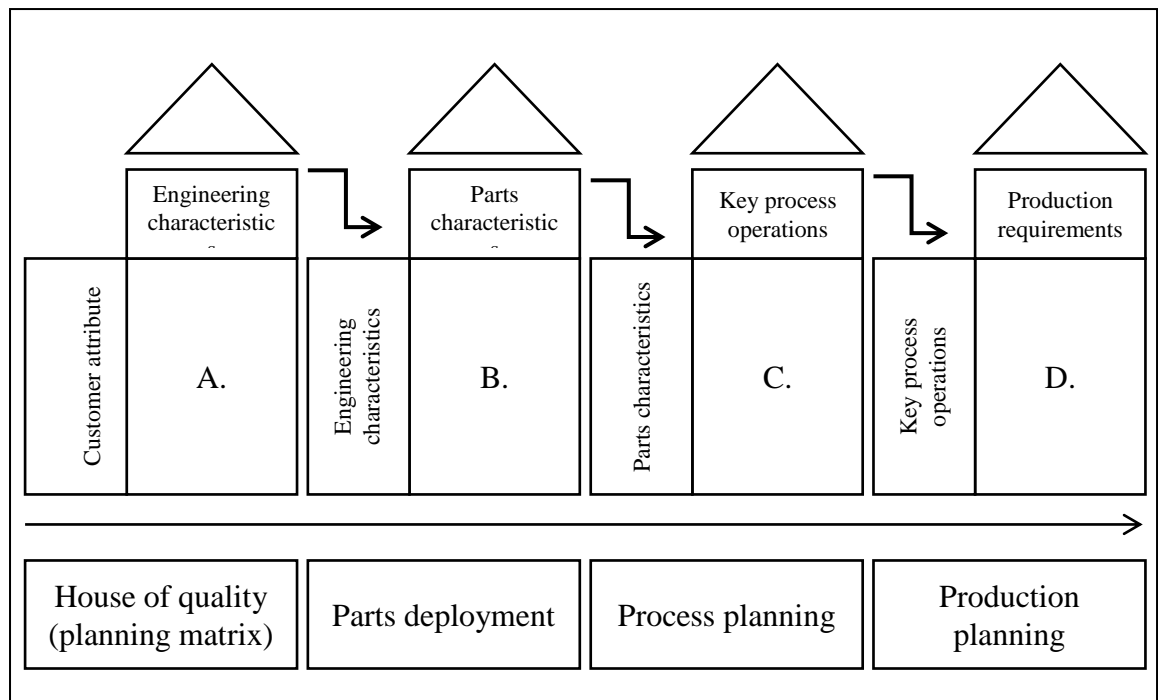
Source: Hauser and Clausing 1988

3.1.1 The Reason of Applying QFD Among Other Tools and Concepts

Businesses are usually established because their owners believe in that they know customer needs and can provide their needs and wants with distinctive and new approach in competitive environment. No matter the extent to which effectively a company meets or exceeds initial needs of customers, it must keep up with their changeable wants and be alert and responsive with regard to their needs. By passage of time their service or product will erode its early advantage.

Most companies understand the importance of keeping touch with costumer to be cognizant of customer wants and needs. Many companies establish a system for

customers to register and response to their complaints. They force their sales and marketing manpower to be familiar with customer satisfaction in regard with their service or product at any changing customer needs. Also some companies employ questionnaire to measure satisfaction.

However, questionnaire is not sufficient to achieve customer real needs because it is very dependent ontype of questions and respondents can be misleading. One of the most common problems in terms of questionnaire approach is with interpretation of questions. The questionnaires had been employed without supplemental one-by-one interviews, could have been drawn fallacious conclusions in turn taken actions that might not have addressed the real customer concerns. Failure to properly understand the customer's voice (customer needs and wants) means that any endeavor to revise or improve new products starts with a major hindrance. Because it is customer who is going to buy and pay for identified products or services therefore customers have to be satisfied and products must be developed with their needs considering as the underlying inputs into product improvement projects. In terms of redesigning of products and services, corrective action is expensive and time-consuming on the other hand, it is never as effective as investigation based on customer's needs inputs.

Challenges for improving business are diverse and they can incorporate decreasing part variability in manufacturing to reduce cost, scarp and rework, inventory reduction, improved delivery times or new design concepts for company's products.

Many tools have been presented to accompany companies for effectiveness in areas such as problem solving, inventory control, quality assurance, variation simulation and design practices. Some of these tools are illustrated on figure 3.3.

However, many of these tools have a tendency to remain on narrow focus because they are designed to address a specific issue. For example, a tool may address the issue of cost savings and assembly simplification without fully considering the ultimate impact on manufacturing quality and customer perception.

Figure 3.3: Number of Engineering Changes in Process vs. Project Timing
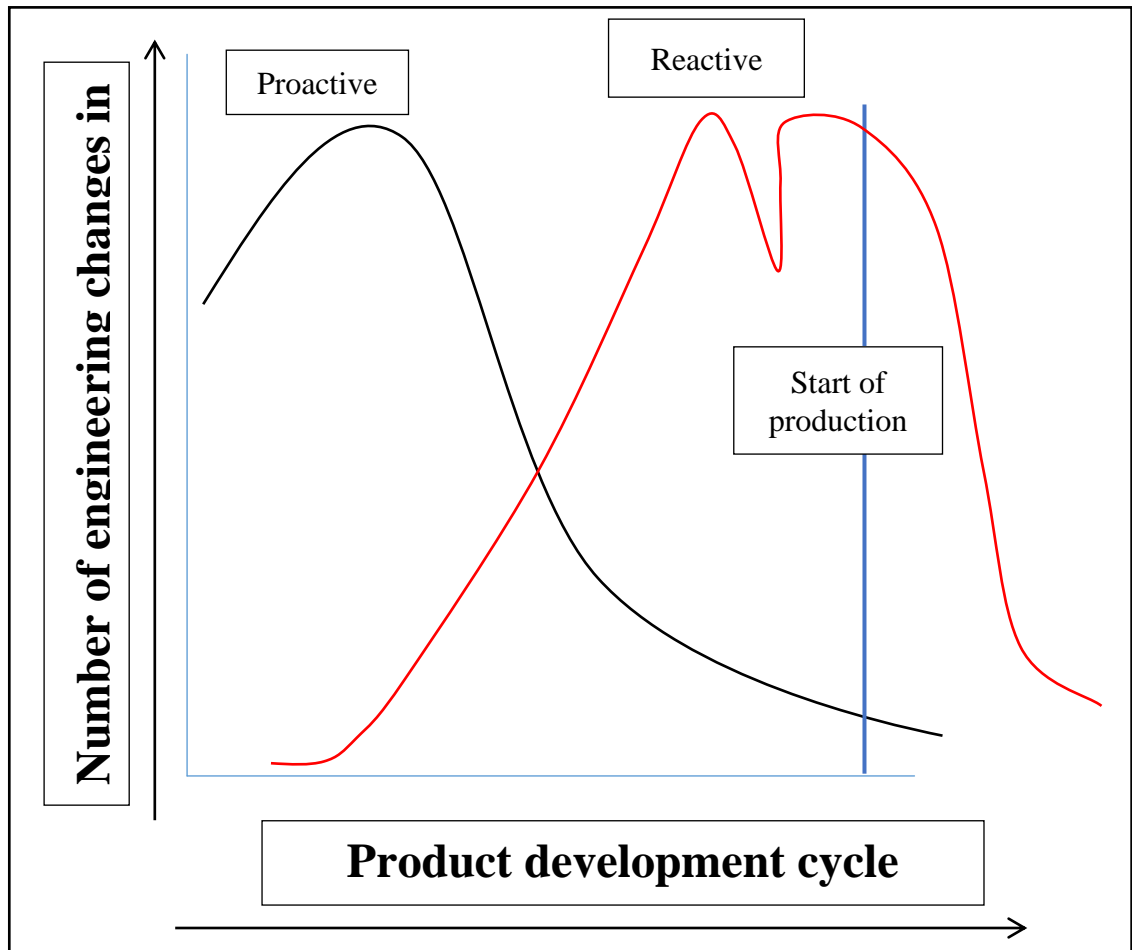
Source: Dearborn 1992

Sufficient evidence exists that Japanese companies dedicate considerably more time in initial planning. Companies which are supplier to Japanese firms or working with them in joint ventures have undergone. In figure 3.3 shows the result of a study fulfilled by a U.S. company involved in a joint venture with one of the better Japanese companies which both involved in a design, development, and ultimate production of similar products. The curve is labeled as "reactive" and "proactive" for U.S. companies and Japanese companies respectively. The reactive curve illustrates a few changes was applied at the early stage of product development however by going ahead in stages towards final production it has been seen dramatic change and revision in product improvement's cycle. The reason of this phenomenon stems from since company has started to gather information and concepts to build prototype and test it simultaneously, problems occurred. Part variability was encountered while affecting performance,

appearance, quality and manpower time. As it is shown, revisions start to dramatic increase as the product cycle moved into prototype and pilot stages.

By contrast, Japanese companies precisely examine the development project evaluating it in detail and make changes early in the time frame. At this stage, the changes include concepts and plans instead of materials and parts which basically the changes represent "paper changes" being faster and far less expensive to make. To put the issue in a nutshell, the effect of this attention to details in the planning stage results in far fewer changes in the later "pilot" and "production" stages. Making changes in these stages involve tools, major time and expense.

There is a growing awareness that companies need to be more proactive and keep up with customers and design products and services by customers mind. Therefore, it is perceived that tools referred to earlier stage of development project have very beneficial impact in cost, time and using manpower. In the pursuit of new approach referred to early stage of development that consumers convince developers and engineers to apply a method called Quality Function Deployment. QFD is not a tool however, is a planning process which helps pinpoint those areas of customer concern resulting team involvement and the use of specialized tools can be most effective.

3.1.2   House of Quality (HOQ)

The HOQ sometimes named A-1 matrix, is the most commonly used matrix in the QFD methodology. The underlying philosophy of an HOQ is that services and products should be produced or provided on the base of customer expectation or wants. Therefore, all staff of companies from different department such as manufacturing staff, design engineers and marketing people must work closely and diligently together by the time of conceptualization to manufacturing. The HOQ is a type of conceptual map which provide a tool for inter-functional planning and communication (Hauser and Clausing 1988).

The main concentration in HOQ is identification of correlation between customer need which is called WHATs and design characteristics, also named HOWs. Under the best of circumstance, an HOQ should be developed by cross-functional team which being constituted with members of various department. It incorporates several sub-matrices which each of them include informative information related to others.

The structure of QFD make a shape like house and due to that it is called *house of quality* and its structure is shown in figure 3.4 and the component of HOQ are explained as follow:

The exterior rectangles located in left and right side are customer expectation or requirement which on the left side is customer requirements and the one on right side is the prioritized customer requirement expressing importance and priority of this expectations.

The priority is indicated based on some analysis such as: target value, sales point, competitive benchmarking, customer importance rating and scale-up factor.

The ceiling of house lists engineering characteristic, also it has another names such as: technical descriptors, design characteristic, voice of company or engineering requirement which describe technical parameters and attributes in a company.

The center rectangle of house holds the relationships between technical attribute and customer needs. As a matter of fact, this room translate the voice of customer into technical attribute

The roof of the house (triangular part) incorporates the interrelationship among technical attributes which some of correlations are divergent and others are convergent.

The below rectangle of the house constitutes prioritized technical attributes.

Figure 3.4: Elements in the House of Quality

31
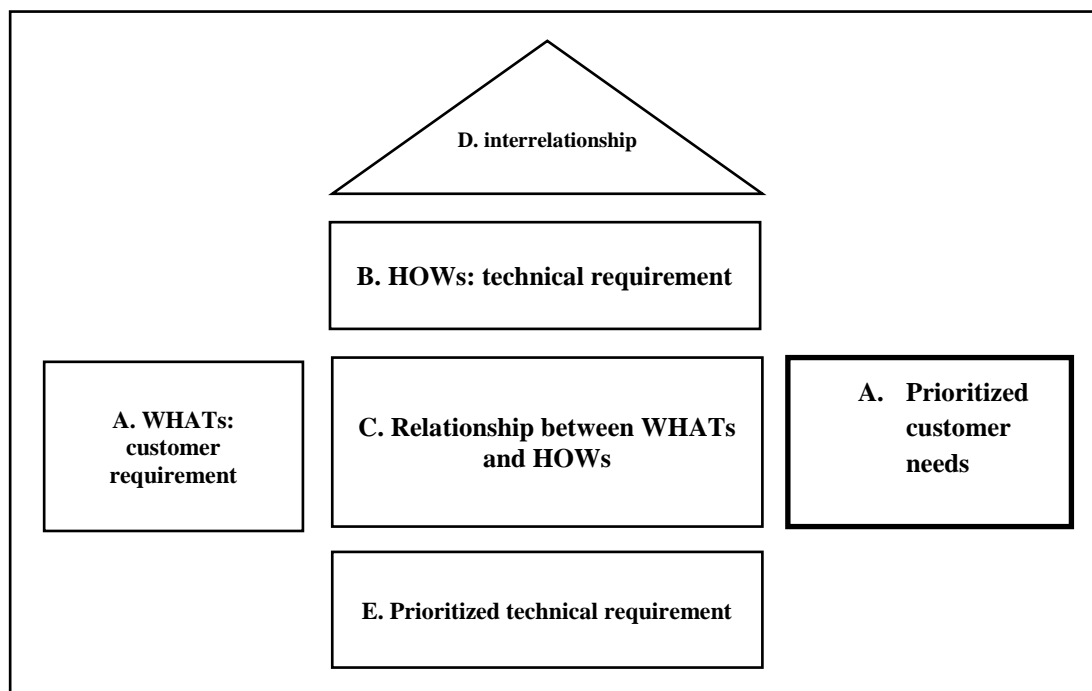
3.1.3   Construction of The House Of Quality (HOQ)

The house of quality has 6 steps to be completed starting through customer requirement because HOQ procedure is the customer-oriented process and the first step is to find customer needs which can be obtained by face-to-face interview, surveys, customer complaints, direct observations, panels and so on. (Shilllito 1994, Cohen 1993, Griffin and Hauser 1993)

3.1.3.1   Customer expectation (WHATs)

QFD starts with listing of the customer expectation or needs which called also "WHATs" belongs to a particular product or service referring to targets or objectives of QFD approach and all endeavor of this system is to achieve them.

The primary customer requirement is obscure and general in nature. By being more precise and adding further definition to primary expectation the secondary list of customer's requirement would be achieved which is more tangible and implicit. The secondary customer expectation support primary customer expectation in the way in which they are new and more precise. In other word, a primary customer need can incorporate several secondary customer requirement. On the other hand, the items listed on the secondary customer requirement represent greater details than those located on the primary list. Consequently, the list of customer requirement can divide into a hierarchy of primary, secondary and tertiary customer requirements as illustrated in figure 3.5

Figure 3.5: Hierarchy of customer expectation

	Customer needs (WHATs)								
Primary									
Secondary									
Tertiary									

3.1.3.2 Engineering characteristics (HOWs)

The QFD objective is to design or improve the design of a service or product. Since, customer needs is listed as customer requirement, now is time that cross-functional team come up with some technical attributes which affect at least one current customer requirement while a variation of technical parameters occur. This engineering characteristic must be expressed in measurable terms while affecting directly customer expectation.

Step 3: development of relationship matrix between WHATs and HOWs

The next step in constructing QFD is to identify respective correlation between technical requirements and customer requirements. This step can become very complex because each customer requirement can affect more than one technical attribute and vice versa.

Now the relationship matrix is filled by the QFD team showing graphically influence degree between WHATs and HOWs. This step can take a long time because the number of evaluation comes from the customer requirement amount and the technical requirement amount. Using the symbols to show their relationship's degree is common. For instance, the following system can be adopted:

A dark circle represents a strong relationship………………………….. ●

A single circle represents a medium relationship…………………….. ○

A triangle symbol represents a weak relationship…………………… ▽

A box is left blank it represents no relationship exist.

For quantitative analysis, the symbols are substituted by numbers to represent weights of relationship between HOWs and WHATs. The substitution occurs by following numbers:

For strong relationship, the dark circle is exchanged by number…………………..5 or 9

For medium relationship, the single circle is exchanged by number……………… 3

For weak relationship, the triangle symbol is exchanged by number…………….... 1

In the relationship matrix, the empty rows and columns may be seen which an empty row means a customer expectation is not being addressed by any of technical requirements. Thus it means the customer needs is not being met, by the same token the

additional technical attribute must be taken into consideration to satisfy determined customer requirement. An empty column indicates that particular technical requirement does not have any influence on the customer needs and after more analysis may be taken it away from the list.

3.1.3.3 Development of interrelationship matrix between pairs of HOWs

Interrelationship (correlation) matrix located on the roof of HOQ is used to determine weight of any relationship between pairs of technical attributes. It is a triangular matrix that the system similar to relationship matrix can be used as following

A dark circle represents a strong positive correlation……………………….. ●

A single circle represents a medium positive correlation…………………......○

A multiple symbol represents a negative correlation………………………... X

A double multiple symbol represents a strong negative correlation………...XX

It should be pointed out that the interrelationships are usually simplified to have only just two type of strength of correlation in interrelationship triangular matrix. The two type of correlation are negative by symbol of (-) and positive by symbol of (+).

3.1.3.4 Competitive benchmarking assessment

The competitive benchmarking is a table which compares the performance of current product or service with other competitors in terms of their key specifications. The competitive benchmarking constitute of a set of columns associating to each customer requirement in the HOQ approach on the right side of relationship matrix. The integer numbers 1 through 5 are utilized in competitive assessment columns to identify the companies from worst to best with regards to the certain specification while numbers from 1 to 5 are assigned from worst to best companies respectively. This assessment is important because it reinforce the understanding of where its service or product stands in the competitive market.

First and foremost the companies are determined which offer the same functions and then the rating of companies would be done based on interviews, team members experience and colleagues feedback. The ratings are compiled and indicated on the right side HOQ and the dotted line traces the position of the design with respect to competitor service or product.

Competitive benchmarking includes two parts:

    a. Process of competitive benchmarking

    b. Identifying objective target value

Also with the competitive assessment result a clear idea is obtained on the service requirements that identify not only strength and weakness, but also opportunities and threat of our service.

3.1.3.5 Prioritize customer requirements

The prioritized customer requirement is the result of columns calling importance to customers, target values, scale up factors, sales point and finally absolute weighting of the customer needs.

i) Importance rating: the ranking of importance of customer needs can be performed by some ways like AHP, Fuzzy-AHP, utility model, score model and by interviewing customers and colleagues asking them to assign the customer needs number 1 through 10 are listed. Number 1 signifies the lowest importance and number 10 signifies the highest importance rating.

ii) Target value: the target value scale is as same as the customer competitive assessment. The following scale can be used: 1 for the worst, 5 for the best. This column is where the QFD team decides to keep its service or product unchanged, improve the product or provide better service than other competitors.

iii) Scale-up factor: the scale-up factor is the ratio of the target value to the current product given rating in the competitive benchmarking assessment.

iv) Sales point: the sales point express the extent to which satisfying customer requirement will improve the sales of service or product. The sales point can be normalized to a value of 1.5 for the most influence of sales point and number 1.2 for moderate influence and number 1 for the customer needs whose it does not have effect on sales point

v) Absolute weight: finally the absolute weight is calculated as follows:

Absolute weight = (importance rating) * (scale-up factor) * (sales point)

3.1.3.6 Prioritized engineering characteristics

The prioritized engineering characteristics include three rows which are the degree of difficulty, the target values, relative weights and finally absolute weights. These measures provide specific target and the guideline for the next step of design. On the other hand, it reinforces the minimization of subjective opinions.

Degree of difficulty: It is common to use degree of technical difficulty to evaluate the ability to implement of identified technical attribute.

Target value: The target value is the certain magnitude to be attained by the company and meeting considered engineering characteristic, meet or exceed customer expectations.

Absolute weight: the easy way to calculate engineering attribute's weight is to dedicate numbers to symbols in relationship matrix. The absolute weight of engineering characteristic is given by the following formula:

$$a_j = \sum_{i=1}^{n} R_{ij} c_i, \qquad j = 1,2,3 \ldots \ldots m$$

Where:

R_{ij} = weight dedicated to the relationship matrix by row i and column j (I = 1, 2, 3.....,n , j = 1, 2, 3,..m)

c_i = importance degree of customer's expectation in respect with R_{ij} (i = 1, 2, 3,....,n)

n = the number of customer needs

m = the number of engineering characteristic

3.1.4 The normalization of HOQ

It is common to normalize the relationship between customer needs and engineering characteristics in quantitative analysis to better illustrate the correlation between WHATs and HOWs by normalized number. For the first time, normalized relationships proposed by Lyman (1990) which is accurate only when engineering characteristic do

not show high degree of dependency among themselves, however, three year after an extension of Lyman's normalization procedure proposed by Wasserman (1993) which can embed dependency among design characteristics. In the Wasserman's model there is one assumption that voice of customers are independent of each other. However, if there is dependency between VOCs there are several approaches that can be used such as dividing related customer needs into separate parts.

To the Wasserman model design characteristic is incorporated by ϑ_k , k = 1, 2,….n. to explicit dependencies between design requirements, the γ_{jk} is introduced and it describes the correlation between design characteristic j and k :

$$\gamma_{jk} = \vartheta_j . \vartheta_k$$

And the normalization is performed by:

$$R_{ij} = \frac{\sum_{k=1}^{n} R_{ij} . \gamma_{kj}}{\sum_{j=1}^{n} \sum_{k=1}^{n} R_{ij} . \gamma_{jk}}$$

Where R_{ij} can be interpreted, as the *j*th technical attribute is taken into practice to certain level, it would affect incremental change in the level of fulfillment of the *i*th VOC.

3.2 ANALYTICAL HIERARCHY PROCESS(AHP)

The analytical hierarchy priority (AHP) is a multi-criteria decision making technique to evaluate the situation or problem by multi-criteria choices which the subjective and intangible criteria can be involved. Also AHP approach allows decision maker to check the consistency and stability of decision and if the pair-wise comparison is not consistent sufficiently it supplies with mechanism to enhance the consistency. AHP provides a comprehensive framework for making multi-attribute decisions by organizing problem into hierarchical structure. It decomposes a general decision problem into sub-problem by creating hierarchy concept to able decision maker evaluates the problem in hierarchy level. It determines the priority of each element in certain hierarchy through a series of pair-wise comparison judgments to identify the relative effect and strength of each element in the hierarchy and finally combining the priorities to determine the overall priority of alternatives. Multi-criteria of hierarchical structure of objective, criteria, sub-criteria and alternatives are used to obtain the weights of importance of the decision criteria. A decision or problem can also be

incorporated issues such as: cost, performance characteristic, CUP speed, availability of product, maintenance, expendability etc. to choose the best alternative. On the other hand, sometimes it is used to determine the relative importance of all the alternatives under the certain condition. For instance, a company is planning to dedicate the budget to a set of competing project which now are alternative, then the corresponding importance of these project is necessary to the considered budget is distributed among project on the base of priority.

As the matter of fact, Multi-criteria decision making (MCDM) is utilized in extensive field from local or federal government, industry, business activity to our real life, therefore it plays a vital role in our real life.

The AHP was originated by Saaty(1980) supporting by simple mathematics and suggested by Akao(1990) and Aswad(1989) as an innovative and creative approach to give the weight to customer needs.

The common numerical numbers in AHP technique are 1, 3, 5, 7, 9 meaning the preference between alternatives equally, moderately, strongly, very strongly and absolute strong in pair-wise comparisons and also 2, 4, 6, 8 interpreted as intermediate values. The pair-wise comparison represents an estimate of the ratio of priority or weighting between elements and the pair-wise comparison matrix are calculated for each level of the hierarchy by Saaty's eigenvector method.

The basic scale for pair-wise comparison in AHP is illustrated in table 3.1

Table 3.1 Scale of Relative Importance

Degree of Importance	Interpretation	Explanation
1	Equally importance	Two activity contribute equally to the objective
3	Weak importance of one over another	Experience and judgment favor one activity over another
5	Strong or essential importance	Experience and judgment strongly favor one activity over another
7	Very strong or demonstrated importance	An activity is strongly favored and its dominance demonstrated in practice
9	Absolute importance	The evidence favoring one activity over another is of the highest possible order of affirmation
2,4,6,8	Intermediate value between two adjacent judgments	When compromise is needed
reciprocals of above nonzero numbers	If activity i has one of the above nonzero numbers assigned to it when compared with activity j, then j has the reciprocal when compared with i	

Source: Saaty 1980

3.2.1 AHP Approach Steps

I. Define the problem.

II. Explain and break the sophisticated problem into hierarchical structure.

III. Constitute the pair-wise comparison matrix to measure the relative importance or weight of the elements in each hierarchy level.

IV. Compute the local weighting of the elements at each level with regard to an element located at upper level in hierarchy

V. Use hierarchical composition to combine the weighting to obtain the global weightings for the alternatives.

VI. Check the model and consistency and repeat any part as required.

However the linguistic scale for relative importance in weight matrix is shown table3.2 which is applied in our survey by Hseih et al. (2004)

Table 3.2: Linguistic Scale for Weight Matrix

No	English Expression	Turkish Expression
6	Absolutely important	Aşırıderecedahaönemli (kıyaslanamaz bile)
5	Very strongly important	Çokdahaönemli
4	Essentially important	Belirginderecededahaönemli
3	Weakly important	Dahaönemli
2	Equally important	Birazdahaönemli (neredeyseaynı)
1	Just equal	Tam olarakeşitönemesahip, tamamenaynı

Source: Hseih Et Al. 2004

3.2.2 Hierarchical Structure

The highest level in hierarchical structure reflects the general objective. After having defined the goal of the MCDM, the qualitative and quantitative attribute, sub-attribute, criteria, sub-criteria, alternatives should be determined. It is imperative to notice that the selected criteria and sub-criteria should be independent in comparison to each other in each level for effective AHP analysis. The computations in the AHP methodology are underlying on the principle that the elements on a single level of the hierarchy are independent and their relative importance does not depend on the elements located at higher level. Figure 3.6 is illustrated the hierarchical structure.

Saaty (1982) implemented a "functional" hierarchy to multi-attribute decision making as follows:

He considered highest or top level as "focus" including just one element which is our overall objective. The subsequent levels can have several element; however, the number of each level should be considered efficiently small between 5 and 9. Because the

elements in one level are to be compared with others elements and then against a criterion in the next higher level.

Figure 3.6The Standard Form Of Hierarchy
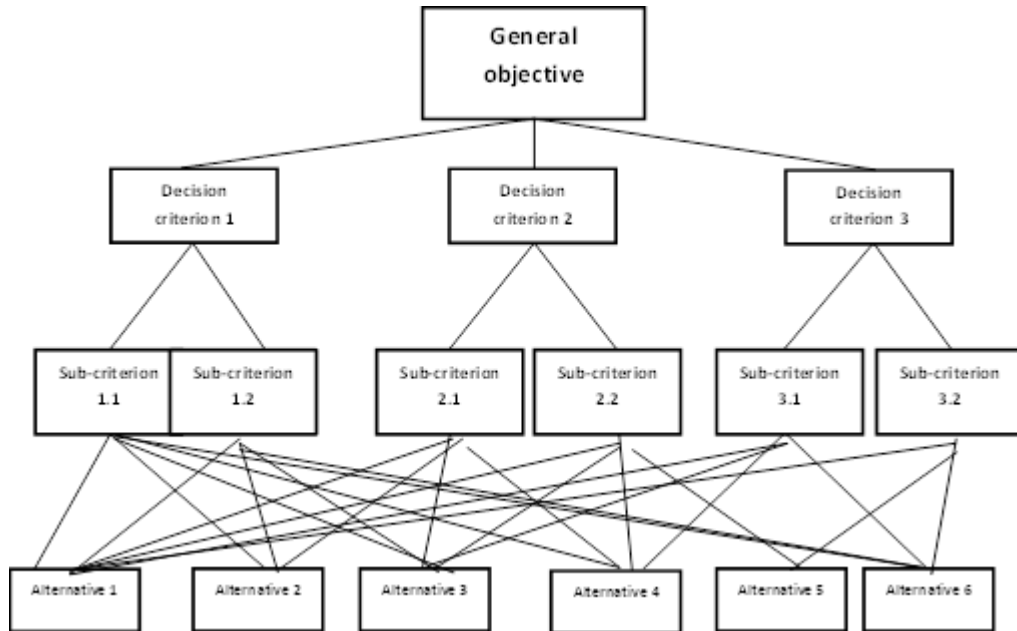
One of the most sensible approaches in AHP methodology is that it permits marginal non-consistent pair-wise comparisons because if all the pair-wise comparisons are completely consistent, any combination of comparison must always conform to the following relation in pair-wise comparison matrix:

$$a_{ij} = a_{ik}.\,a_{kj}$$

3.2.3 Principal Eigenvector Method

In order to compute the relative importance of alternatives:

A) Consider judgment matrix A:

$$A = [\,a_{ij}\,] = \begin{array}{cccc} 1 & a_{12} & \cdots & a_{1n} \\ \dfrac{1}{a_{12}} & 1 & \cdots & a_{2n} \\ \vdots & & \ddots & \vdots \\ \dfrac{1}{a_{1n}} & \dfrac{1}{a_{2n}} & \cdots & 1 \end{array}$$

B) Divide each entry in column j of A by the sum of the entries in column j. this
   result is a new matrix called B, in which the sum of the entries in each

column will be 1: $B = \begin{bmatrix} \dfrac{a_{11}}{a_{i1}} & \dfrac{a_{12}}{a_{i2}} & \cdots & \dfrac{a_{1n}}{a_{in}} \\ \vdots & & \ddots & \vdots \\ \dfrac{a_{n1}}{a_{i1}} & \dfrac{a_{n2}}{a_{i2}} & \cdots & \dfrac{a_{nn}}{a_{in}} \end{bmatrix}$

C) Compute w_i as the average of the entries in row i of B matrix to yield the

column vector w. $w = \begin{bmatrix} w_1 \\ w_2 \\ \vdots \\ w_n \end{bmatrix} = \begin{bmatrix} \dfrac{\frac{a_{11}}{a_{i1}}}{n} + \dfrac{\frac{a_{12}}{a_{i2}}}{n} + \cdots + \dfrac{\frac{a_{1n}}{a_{in}}}{n} \\ \vdots \quad \ddots \quad \vdots \\ \dfrac{\frac{a_{n1}}{a_{i1}}}{n} + \dfrac{\frac{a_{n2}}{a_{i2}}}{n} + \cdots + \dfrac{\frac{a_{nn}}{a_{in}}}{n} \end{bmatrix}$

3.2.4   Consistency Ratio

In AHP methodology an important focus is checking the consistency of judgments in
pair-wise comparison matrix. It means if A 2 times as important as B and B 3 times as
important as C, then A should be 6 times as important as C, otherwise the judgment is
not consistent, however perfect consistency rarely occurs in practice. Saaty (1980)
introduced the Consistency Ratio (CR) saying the judgment matrix (pair-wise
comparison matrix) is taken into consideration to be adequately consistent if the
corresponding Consistency Ratio (CR) becomes less than 0.1

For given judgment matrix of size N, CR can be calculated as:

$$CR = \frac{CI}{RCI}$$

$$CI = \frac{\lambda_{max} - N}{N - 1} \text{Where;}$$

CI: Consistency index of judgment matrix

RCI: Random consistency index of judgment matrix

λ_{max}: The maximum eigenvalue for the judgment matrix

N: Number of rows or columns of the judgment matrix

3.2.5 Principal Eigenvalue (λ_{max})

Let consider the alternatives by $\{A_1, A_2, \ldots, A_n\}$ which, n is the number of alternatives and their current weights are $\{w_1, w_2, w_3, \ldots, w_n\}$ and the ratio matrix of all weights are given by:

$$W = \left[\frac{w_i}{w_j}\right] = \begin{bmatrix} \frac{w_1}{w_1} & \frac{w_1}{w_2} & \cdots & \frac{w_1}{w_n} \\ \frac{w_2}{w_1} & \frac{w_2}{w_2} & & \frac{w_2}{w_n} \\ \vdots & & \ddots & \vdots \\ \frac{w_n}{w_1} & \frac{w_n}{w_2} & \cdots & \frac{w_n}{w_n} \end{bmatrix}$$

The pair-wise comparison matrix $A = [a_{ij}]$ reflects the severity of decision maker's preference between pairs of alternatives like: A_i versus A_j for all $i,j = 1,2,\ldots,n$

The judgment matrix is achieved where the cell a_{ij} represents the preference weight of A_i in comparison with A_j.

$$A = [a_{ij}] = \begin{bmatrix} 1 & a_{12} & \cdots & a_{1n} \\ \frac{1}{a_{12}} & 1 & & a_{2n} \\ \vdots & & \ddots & \vdots \\ \frac{1}{a_{1n}} & \frac{1}{a_{2n}} & \cdots & 1 \end{bmatrix}$$

The a_{ij} is the estimate of the ratio of $\frac{w_i}{w_j}$ and W is the vector of all these ratio of alternatives located in W matrix which is our goal.

If a matrix A is completely consistent, then it is noticed that A = W meaning ideal consistency condition and the principal consistency is equal to n, e.g "$\lambda_{max}=n$"

Our objective is to calculate a vector of weights $\{w_1, w_2, w_3, \ldots, w_n\}$ corresponding to matrix A. according to the Perron-Frobenius Theorem, if A is an square matrix which is mean n*n and non-negative, then one of its eigenvalues is positive and great than or equal to rest of eigenvalues, and there is a positive eigenvector w corresponding to that eigenvalue which is a simple root of characteristic equation as shown in following equation: $Aw = \lambda_{max}w$

Where λ_{max} is calculated by:

$$\lambda_{max} = \frac{1}{n} \sum_{i=1}^{n} \frac{ith\ entry\ of\ A.W\ matrix}{ith\ entry\ of\ w\ matrix} = \frac{1}{n} \sum_{i=1}^{n} \frac{x_i}{w_i}$$

Where λ_{max} is the maximum eigenvalue of judgment matrix

3.2.6 Quantity of Pair-Wise Comparison in AHP Method

If the problem has N alternatives and M criteria, then the referee must construct" m" pair-wise comparison matrix of order "n×n" and one pair-wise comparison matrix of "m×m" which each matrix include $\frac{n-1\ .n}{2}$ pairs comparison meaning:

$$Q = m. \frac{n-1\ .n}{2} + \frac{m-1\ .m}{2}$$

Where the final priorities denoted by A_{AHP}^i of alternatives with respect to all the combined criteria calculated by following formula:

$$A_{AHP}^i = \sum_{j=1}^{m} a_{ij}.w_j \ , \text{for i} = 1, 2, 3,\ldots, n$$

Where

a_{ij} = the decision (relative preference) matrix with respect to alternatives of lower level in hierarchy

w_j = the priority vector (relative preference) of criteria with respect to alternatives, the level located one level upper.

A_{AHP}^i: we need to multiply each ranking by the local (relative) priority of its criterion and sub-criterion and then consider the resulting weighs for each alternative as its final priority (global priority), which we call this part of process "synthesis".

3.2.7 Ideal Mode AHP

Beside AHP approach wide acceptance and performance, it comes across with some criticism both in theoretical and practical reasons. Since early days it was revealed that there are some problems with the way pair-wise comparisons are utilized and the way AHP assesses alternatives. At the first time, Belton and Gear (1983) found out that AHP may reverse the ranking of the alternative when an alternative identical to one of the already existing alternatives which is introduced. To be able to overcome of the fault, Belton and Gear (1983) submitted an approach that each column of judgment matrix in AHP be divided by maximum entry of that column to get normalized. Therefore, they

proposed a new version of original AHP which is called "revised-AHP" and now it is called the Ideal Mode AHP.

3.2.8 Fuzzy AHP

Fuzzy sets and fuzzy numbers:

For dealing with vagueness of human thought, the fuzzy set theory was introduced by Zadeh (1965) for the first time. Fuzzy set theory provide a strict mathematical framework in which vague and uncertain conceptual phenomena can be precisely and rigorously studied (Zimmermann 1991). In other words, fuzzy-AHP reflects human thought while does not include cumbersome mathematics. As a matter of fact, fuzzy set theory is a practical approach to measure the ambiguous concepts of linguistic terms associated with human being subjective judgment. A linguistic variable is a type of variable whose values are not numbers, however; its values or objects are phrases in natural language. In dealing with too complex or not well defined situation to be expressed in quantitative expression, linguistic variable are very helpful. In other words, fuzzy set theory was developed to solve problems in which descriptions of objects are subjective, vague and imprecise. Herrera and Herrera-Viedma (2000) reinforce the idea that linguistic variables are instinctively easier to utilize when decision makers express their subjective and imprecise assessment. For this reason the fuzzy set theory is applied in this thesis to overcome the imprecision of decision maker in weighing the criteria of service quality.

Linguistic terms usually incorporates uncertainty and ambiguity, in turn a membership function is used to relate the linguistic terms to a set enabled us to dispose of vagueness and uncertainty. A fuzzy set theory applies class of objects which are identified by boundaries that are not sharply defined (blurred boundaries), such a set which is described by membership function while in the classical set theory, an entity was a member of a set or not.

Let X= {x} be considered as a traditional set of objects calling universe. Fuzzy numbers is a special fuzzy set $A = \mu_A(x) \mid x \in R$ while tilde "~" placed above a symbol is representative of a fuzzy set. A fuzzy set A in X is characterized by membership function $\mu_A x$ which assign each object in X a grade membership belonging to A between interval zero and one [0,1]. The most frequently utilized fuzzy numbers are

triangular and trapezoidal fuzzy numbers. Considering the fact that easiness in calculation and features, triangular fuzzy number (TFN) often used in practice. Consequently in this thesis symmetrical triangular fuzzy number (STFN) is applied to represent linguistic variable. A TFN is indicated as $M = (l, m, u)$ and the membership function associated to that is $\mu_A(x)$ which is equal to:

$$\mu_A\ x\ =\ \begin{cases} 0, & x < l \text{ or } x > u \\ \frac{x-1}{m-1}, & l \leq x \leq m \\ \frac{x-u}{m-u}, & m \leq x \leq u \end{cases}$$

Where the parameters l, m and u that describing fuzzy number representing smallest possible value, the most promising value and the largest possible value respectively. A triangular fuzzy number M is shown in figure 3.7 (Deng 1999)

Figure 3.7: A Triangular Membership Function $\mu_A\ x$
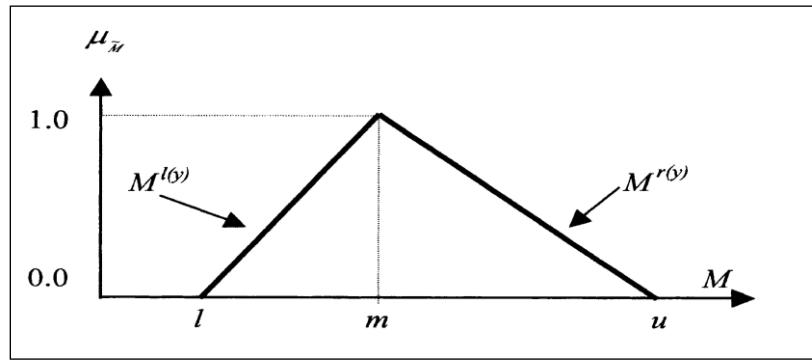
Source: Deng 1999

The main arithmetic rules for two positive triangular fuzzy numbers M_1 and M_2 are as follows (Kaufmann & Gupta 1991):

$M_1 \oplus M_2 = (\ l_1 + l_2, m_1 + m_2, u_1 + u_2\ )$

$M_1 \ominus M_2 = (\ l_1 - u_2, m_1 - m_2, u_1 - l_2\ )$

$M_1 \otimes M_2 = (l_1 l_2, m_1 m_2, u_1 u_2\ )$

$\lambda \otimes M_1 = (\lambda l_1, \lambda m_1, \lambda u_1)$

$M_1^{-1} = (1/u_1, 1/m_1, 1/l_1)$

$M_1 \div M_2 = (\frac{l_1}{u_2}, \frac{m_1}{m_2}, \frac{u_1}{l_2})$

The linguistic scale with fuzzy numbers for importance in pair-wise comparison matrix and its reciprocal scale (conversion) are shown in table 3.3

Table 3.3: Linguistic Scale and Fuzzy Numbers

Linguistic Scale For Importance	Triangular Fuzzy Numbers	Triangular Fuzzy Reciprocal Scale
Just Equal	(1,1,1)	(1,1,1)
Equally Importance	(1,1,3)	(1/3,1,1)
Weakly Importance	(1,3,5)	(1/5,1/3,1)
Essentially Importance	(3,5,7)	(1/7,1/5,1/3)
Very Strongly Importance	(5,7,9)	(1/9,1/7,1/5)
Absolutely Importance	(7,9,9)	(1/9,1/9,1/7)

3.2.8.1 The Buckley's extension based Fuzzy-AHP

There are several fuzzy-AHP approach offered in the literature; however, the method applied in our research is the Buckley's extension based on fuzzy-AHP algorithm. In order to determine criteria weights of our service quality factors, we utilize Buckley 's fuzzy-AHP approach because of easiness of expanding it to the fuzzy case and assure us of a unique solution to the reciprocal comparison matrix , on the other hand progressing by this approach is relatively more comfortable than the other fuzzy-AHP approaches.

3.2.8.2 Buckley's fuzzy-AHP algorithm

Buckley's fuzzy-AHP algorithm steps can be illustrated as follows:
step1. Construct pair-wise comparison matrices amongst all customer needs on each level of hierarchy structure. Then, dedicate the linguistic terms having defined in table3.3 by individual interview or group focusing through asking which one of the criteria is more important between each two criteria in hierarchy structure such as:

$$M = \begin{matrix} 1 & a_{12} & \cdots & a_{1n} \\ a_{21} & 1 & & a_{2n} \\ \vdots & & \ddots & \vdots \\ a_{n1} & a_{n2} & \cdots & 1 \end{matrix} = \begin{matrix} 1 & a_{12} & \cdots & a_{1n} \\ \frac{1}{a_{12}} & 1 & & a_{2n} \\ \vdots & & \ddots & \vdots \\ \frac{1}{a_{1n}} & \frac{1}{a_{2n}} & \cdots & 1 \end{matrix}$$

Where: $a_{ij} = \begin{matrix} 1,3,5,7,9 & \textit{criteria i has relative importance to criteria j} \\ 1 & i=j \\ 1^{-1},3^{-1},5^{-1},7^{-1},9^{-1} & \textit{criteria i has less importance to criteria j} \end{matrix}$

Step2. After building pair-wise comparison matrices per each customer, an aggregated matrix would be established as below:

$$A = \begin{matrix} 1 & a_{12} & \cdots & a_{1n} \\ a_{21} & 1 & & a_{2n} \\ \vdots & & \ddots & \vdots \\ a_{n1} & a_{n2} & \cdots & 1 \end{matrix}$$

In the aggregated matrix A, a_{ij} is the triangular fuzzy number represents the geometric mean of all customer's evaluation in comparison matrices. Geometric means calculated as follows:

$$a_{ij} = \sqrt[k]{a_{ij}^1 \otimes a_{ij}^2 \otimes a_{ij}^3 \ldots a_{ij}^k}$$

Where a_{ij}^k is the comparison between criteria i and j belonging to k^{th} customer

Step3. The fuzzy weight matrix is calculated by Buckley's extension method (Kahraman and Cebi 2009) as follows:

$$r_i = \sqrt[n]{(a_{i1} \otimes a_{i2} \otimes \ldots \otimes a_{in})}$$

Where a_{in} is the proportion of criteria i to criteria n, and r_i express the geometric mean of criteria i with respect to each criterion.

Step4. Calculate the fuzzy relative importance of each criterion applying below equation:

$$w_i = r_i \otimes (r_1 \oplus r_2 \oplus \ldots \oplus r_n)^{-1}$$

Where w_i is the fuzzy weight of criterion i with respect to others criterion which can be expressed by $(w_i l, w_i m, w_i u)$. There are three numbers presenting w_i which $w_i l$, $w_i m$ and $w_i u$ stand for the lower , middle and upper values of fuzzy weight of the ith criterion.

Step5. To order to finding out the Best Non-fuzzy performance (BNP) value (crisp weights of each criterion) the Center of Area (COA) method is utilivzed.

$$BNP w_i = [(uw_i - lw_i) + (mw_i - lw_i)] / 3 + lw_i [16]$$

Or

$$w_i = \dfrac{w_i}{\sum_1^n w_i}$$

3.2.9 Group Decision Making

There are two important subjects in group decision making which the first one is "how to aggregate individual judgments implemented in group into one single representative judgment" for the entire group, an the another issue is " how to construct a group judgment representing all individual choices". In combining of several judgments into get single judgment the reciprocal property plays important role. "The judgments must be combined so that the reciprocal of the synthesized judgments is equal to the syntheses of the reciprocals of these judgments, also it has been proved that the geometric mean (not the frequently used arithmetic mean) is the only way to do that." (Saaty 2008)

3.3 SERVICE

In our daily life, we getting delivered service in fitness center, healthcare, education, finance, banking, transportation (highway, subway, airway and railway) and hotel etc. which some of them are known as a product, some as service and some of them as combination of service and product (Kotler 2000). Also some companies conceived that for getting superior situation when there is a similarity in product and service, the service quality would play a key role. Considering the former fact that, getting survived amongst companies in competitive world, the importance of service quality more than anything shows up and has started to spread between the companies. Also some companies conceived that for getting superior situation when there is a similarity in product and service, the service quality would play a key role. The cost of poor or insufficient quality is estimated about 30 to 40 percentage of turnover (Crosby et al. 1979). According to Rust and Oliver (1994), service quality is a subjective concept to deal with which meansperception of what the customers feel about service quality is vital to get effective management. There are 3 pertinent concepts which are crucial to get perceived as follows:

  a. customer satisfaction

b. service quality

c. customer value

Service quality and customer satisfaction are different in terms of dimension and form which Service quality is a long-term overall evaluation, even though customer satisfaction is a transaction of specific measurement. Furthermore, service quality is a gap between perceived and desired service level, while customer satisfaction is a function of the gap between perceived and predicted service level. In specific terms, expectation can be seen as a belief in future performance of the product or service (GulcinBuyukozkan et al. 2012). There is not necessity for acquiring perception in service quality, however satisfaction is totally experimental. Customer value stems from perceived quality in combination with price, on the contrary with service quality and customer satisfaction.

Service is a sort of product aiming to satisfy customer needs and it excludes material characteristic. At the same time service can be considered as an economic activity taking time, place, shape and psychological benefits (GulcinBuyukozkan et al. 2012). Edvardsson and Olsson (1996) fulfilled in service concept as elaborated description what is to be done and how this to be obtained to touch customer satisfaction. However Goetsch and Davis (1998) view service as a work to fulfill for someone else. In another idea, service is a social activity which is entitled to make a dialogue among customers and who offering service (Tarim 2000). Goldstein et al. (2002) see it a mixture of physical and non-physical synthesized to build service package. Safe in the knowledge that, there are many ideas about service concept according to authors; however, they all actually originated from the same issue that is "customer" (GulcinBuyukozkan et al. 2012). Considering the factthat defined above, managing customer's perceptions is imperative in service, also as Edvardsson and Olsson (1996) mentioned "what the customer does not perceive does not exist".

3.3.1 Service Quality Concept

Service quality means different things to different people and underlying cause of that quality is a multidimensional concept. Usually customers touch and feel and then purchase product and evaluate them through their experience of using them. If they had

a positive experience about product, they would offer it to others. The image of product will be established by telling the quality of product during customer's usage in word of mouth way. By same token, service quality has elusive and indistinct structure (Parasuraman et al. 1985). As time went on, service quality has obtained growing appreciation becoming an important research topic which the major contributor of that is it's pertinent with cost, profitability, customer satisfaction, customer retention, and positive word of mouth (Buttle 1996). Many research have unveiled high profitability and customer's retention stems from delivering service with high quality. It is more likely that a satisfied customer continue purchasing the services, engage in positive word-of –mouth publicity, and increase the volume of purchases (Howat et al. 1999). There have been several attempt in terms of understanding the concept of service through its characteristic. Parasuraman et al. (1985) and Zeithaml and Bitner (1996) determined the main features of service concept which are intangibility, heterogeneity, simultaneous production and consumption and perishability. However, this viewpoint were criticized by some pointing out that this characteristic can't apply to all service sectors which through this concentration there would be a tendency to ignore the role of customers in service delivery. Kim and Kim (1995) and Chelladurai and Chang (2000) determined inseparability as a key feature of services. In many studies it was accepted that consumer's perception of current service quality is underlying of customer's previous service expectation and their subsequent perception of the actual service performance (Gronroos 1984 and Parasuraman et al. 1985, 1988). Therefore, the customer's expectation of a service playing the underlying issue in the service quality assessing. Several factors might be affected customer's expectation including word of mouth communication from other customers, personal needs of customers, past experience and external communications with from service providers, indicating price quality relationship (Howat et al. 1996)

3.3.2 SERVQUAL Approach

Since between service and product quality a great deal differences is perceived, by the same token Parasuraman et al. (1985) and Zeithaml et al. (1990) invent an approach in order to measure service quality which is called SERVQUAL. One of the targets of the SERVQUAL's study is to ascertain any actual or perceived gap between customer

expectation and perception of the service quality. SERVQUAL's studies are published in the field of mental health service, computer services, car servicing, channel partners, accounting firms, architectural service, recreational services, hospitals, airline catering, banking, apparel retailing, local government, business school, higher education, travel and tourism, dental services, business-to-business and apparel retailing (GulcinBuyukozkan et al. 2012). Since service quality encompasses intangibility, inseparability and heterogeneity it becomes more complex to measure. The research conducted by Parasuraman et al. (1985) identified 10 components of service quality as following:

  i.   Tangible: the physical environment in which the service is presented
  ii. Reliability: the consistency of performance and dependability
  iii. Responsiveness: the willingness to help the customer
  iv. Competence: the possession of the required skills and knowledge to perform the service
  v.   Courtesy: the supplier's behavior (politeness, consideration and kindness)
  vi. Credibility: trustworthiness, believability and honesty of service provider
  vii. Security: freedom from danger, risk and doubt
  viii. Access: the ease of making contact with the supplier
  ix. Communication: the ability of talking in a way that is understandable to the customer
  x.   Empathy: the interest and possibility of becoming acquainted with the role of the customer

In parallel with enhancement of SERVQUAL method, it is ascertained by Parasuraman et al. (1988) that some of 10 dimensions expressed above, were substantially related and then they collapsed these component into five dimensions as follows:

  a. Tangibles: physical evidence of the service, physical facilities, tools and equipment, appearance of providers, appearance of other customers in the service facility
  b. Reliability: consistency of performance and dependability, performs service right at the first time, honors its promises, keeps accurate records, correct billing and performs service at the designated times

c. Responsiveness: willingness to help customers and to provide prompt service.

d. Assurance: knowledge, competence and courtesy of employees, convey trust and confidence, having required skills and knowledge, polite and respectful

e. Empathy: caring, individualized attention that an organization provides to its customers and effort in understanding the customer's needs

It is seen that from 10 dimensions version, reliability, tangibles and responsiveness are remained as major dimension, however rest of seven dimensions collapsed into other two main dimensions, assurance and empathy.

A great deal of studies using SERVQUAL determined that reliability is by far the most important dimension among five dimensions expressed above; however, tangibles have least importance and three other dimensions have virtually the same level of importance for a wide range of service industries (Bergman 1994). Even though, the conclusion should not be generalized to other industries and cases.

4. FINDINGS AND DATA ANALYSIS

4.1 INTRODUCTION TO CURRENT COMPANY CALLED JATOMI

JATOMI Fitness center isthe largest chain of fitness clubs' in Turkey, including 13 clubs currently in Istanbul/Turkey and another 60 clubs of JATOMI being spread out in other countries as following: in Poland, Czech Republic, Bulgaria, Romania, Indonesia, Malaysia.Then are aiming to open more clubs in Turkey during next years.

Figure 4.1: JATOMI's gym around the world

The 13 clubs of JATOMI in Istanbul and their size and properties are as follows:

    I.   TRUMP TOWER VIP:

Size: 2200 sqm

Features: Exercise studio, terrace, steam room, sauna, steam room, luxury locker rooms, vitamin bar,

    II.   TRUMP TOWERS:

Size: 3300 m2

Features: Sauna, vitamin bar, terrace, 2 studios, basketball court,new spinning room, pilates studio, private ladies-only gym

III.   TORIUM:

Size: 2100sqm

Features: 23 x treadmills, 1 x rowing machine, 32 x spinning bikes, 2 x exercise, studios, 3 lane running track

IV.   MARMARA PARK:

Size: 3600 sqm

Features: 30 x treadmills, 13 x cross-trainer, 6 x stepper, 5 x stair-mills, 4 x recumbent, bicycles, 10 x upright bicycles

V.   MARMARA FORUM:

Size: 3500 sqm

Features: Large group exercise studio, small group exercise studio, cycling-studio, private lessons studio, pilates reformer, terrace, sauna and steam room, woman only gym, solarium

VI.   MAÇKA RESIDENCE:

Area: 2,750 sqm

Features: Spa, swimming pool, 2 x meeting rooms, vip locker rooms, cycling studio, pilates studio, general usage studio, free weight area

VII.   FORUM ISTANBUL:

Size: 3600sqm

Features: Vitamin bar, creche, 2 x solarium, 4 x table tennis, pool table, basketball, court, 2 x studio, 2 x jacuzzi, 4 x sauna

VIII.   DEMIROREN:

Size: 2000 m2

Features: Group exercise studio, spinning studio, functional area, free weight area, 11 x member computers

IX.   CITY'S MALL:

Size: 1300 sqm

Features:Spa, reformer and cadillacpilates room, 1 x exercise studio, 1 x kinesis

X.   BELLEVUE RESIDENCE:

Size: 4000 sqm

Features: Spinning studio, pilates studio, 2 x group exercise studio, stretching area, sunbathing area, valet parking, swimming pool (semi-olympic)

XI.   BAHCE PARK:

Size: 2350 msq

Features: 2 x Exercise studio, 1 x Spinning studio, Cafe with terrace, 2 x saunas, Functional training zone (Synergy 360)

XII.   ASTORIA:

Size: 2.500 m2

Features: Group Exercise studio, spinning studio, pilates studio, basketball court, 40-functional training area, play-station area

XIII.   AKASYA:

Size: 4000 m2

Features: Indoor swimming pool, outdoor swimming pool, sunbathing area, kids club, cardio area, group exercise studio

4.2   DATA COLLECTION

Data gathering in this thesis is conducted by interviewing with the active members of JATOMI's different fitness centers located in different type of area differing in level of education, financial condition and culture.

4.2.1   Gathering The Customer's Needs (CN)

QFD is a customer-oriented method which start by searching with voice of customer or expects from a particular service or product. The VOC is considered as a backbone of the whole QFD process playing an imperative role of front-end stage of QFD. The many number of techniques have been applying in QFD by the purpose of collecting customer needs encompassing surveys, focus groups, customer complaints, interviews, direct observations, panels and so on. However, the most effective approach is one-to-one interview (Shillito 1994; Cohen 1995). The customer needs are usually tend to be vague, general and sometimes can be misunderstood by technical requirement; therefore, to have effective customer needs collection one-to-one interview is applied in this stage. According to Griffin and Hauser (1993) comprehensive research and discussion on the vice of customer result in as follows:

- To encompass 90 percent or more information of customer needs it is required to take 20 to 30 interviews.
- Survey measures of importance can predict how customer will react to product concepts although there is no single best measure.

By the same token, 25 interviews are taken to get 90 percent of customer needs and also direct observation is combined to obtain VOC. The interview includes three kind of questions to understand VOC as much as possible which the questions were as follows:

- What are the member expectations in delivering service?
- What are the member complaints about available service?
- What does member come up with improving the service performance?

The JATOMI gym has 13 fitness center in Istanbul, Turkey in different neighborhoods as follows: Trump Tower, Astoria, Istanbul Forum, Torium, Marmara Park, Marmara Forum, Bellevue, Akasya, Cities, Maslak Residence, Bahce Park which interviews are conducted through current members of the fitness center and by personnel working in the fitness centers including trainers. Having mentioned, the 25 interviews by through 3 questions have been conducted. For categorization of customer's requirements SERVQUAL concept was adopted and customized.

4.2.2 Structuring Customer's Needs

The primary voice of customer are classified into 6 categories as follows: tangible, empathy, reliability, assurance, responsiveness, features. This list of primary customer are usually vague and uncertain; therefore, for being more precise the secondary VOC are defined through 21 customer needs. As it is seen in table3.4, the voice of customers constitute hierarchy structure by assigning five needs to tangible criteria, three needs to empathy, three needs to reliability, five needs to assurance, three needs to responsiveness and two needs to features.

a. Tangible:
    I. Up-to-date equipment (modern looking)
    II. Completeness of equipment
    III. Easy-accessible location
    IV. Easy-accessible location

b. Empathy:
   I. Understanding members specific needs by trainer
   II. Easiness in communication
   III. Not being too crowded to use

c. Reliability:
   I. Not being too crowded to use
   II. Feeling safe in delivery of service on time
   III. Accuracy (accuracy and consistency of given information and promise)

d. Assurance:
   I. Feeling safe and relax in gym
   II. Knowledge and competence of trainer
   III. Cost
   IV. Courtesy and politeness of employee
   V. Keeping member's fitness-motivation

e. Responsiveness:
   I. Announcement of services
   II. Willingness to help
   III. Effective and prompt failure solving

F. Features:
   I. Group lessons
   II. Social activities

Table 3.4: VOC In Fitness Center by Adopting SERVQUAL Concept

	Primary Requirement	Secondary Requirement
Customer Needs in Fitness Center Using SERVQUAL Concept (WHATs)	Empathy	Modern Looking
		Various of Equipment
		Easy-Accessible Location
		Specious and Fresh Gym
		Cleanliness and Hygiene
	Empathy	Individual Attention
		Understanding Members Specific Needs
		Easiness in Communication
	Reliability	Not Being too Crowded to Use
		Feeling Safe in Delivery of Service
		Accuracy and Consistency of Info and Promise
	Assurance	Feeling Safe and Relax in Gym
		Competence of Trainer
		Cost of Membership
		Courtesy of Employee
		Keeping Members Fitness-motivated
	Responsiveness	Announcement of Services
		Willingness to Help
		Prompt Failure Solving
	Features	Group Lessons
		Social Activities

4.3 AHP-DERIVED IMPORTANCE OF WHATs:

Buckley's Fuzzy-AHP is applied in order to find relative importance of member's needs by through the linguistic terms as follows: just equal, equally importance, weakly importance, essentially importance, very strongly importance and absolutely importance

by fuzzy triangular numbers (1,1,1), (1,1,3), (1,3,5), (3,5,7), (5,7,9) and (7,9,9) respectively. Fuzzy comparison matrix is conducted through one-by-one interviews with current members of JATOMI fitness center to be most effective. According to Griffin and Hauser (1993) there is no best single measure for the number of survey must be done and can be changed by different surveys. On the other hand, considering the journals like: multi-attribute comparison of catering service comparison using fuzzy AHP (CengizKahraman et. al. 2003) conducted 55 survey in total from 3 different catering company's customer and strategic analysis of healthcare service quality using fuzzy AHP methodology (GulcinBuyukozkan et. al. 2011) used just 5 survey conducted by doctors of different hospitals. As it is seen the number of survey for Fuzzy-AHP can have a great deal of difference. However, 100 survey (pair-wise comparison matrix) are conducted in total by the current members of 5 different JATOMI fitness center located in various neighborhood by this quantity: 50 survey from Trump Tower, 8 survey from Astoria, 15 survey from Istanbul Forum, 12 survey from Cities and 15 survey from Marmara Park fitness center.

4.3.1 Importance of Tangible's sub-criteria

The aggregated matrix$A$ for Tangible's sub-criteria:

, a_{ij} is the triangular fuzzy number represents the geometric mean of all customer's evaluation in comparison matrices. Geometric means calculated as follows:

$$a_{ij} = ^k \overline{a_{ij}^1 \otimes a_{ij}^2 \otimes a_{ij}^3 \dots a_{ij}^k}$$

Where a_{ij}^k is the comparison between criteria i and j belonging to k^{th}customer

Table 4.1: The Aggregated Matrix or Tangible's Sub-Criteria

	Modern Looking			Completeness			Easy Access			Big And Specious			Cleanliness		
Modern Looking	1.00	1.00	1.00	0.39	0.57	0.99	0.38	0.58	0.87	0.28	0.45	0.72	0.20	0.25	0.38
Completeness	1.01	1.75	2.55	1.00	1.00	1.00	0.74	1.21	1.74	0.57	0.95	1.41	0.26	0.35	0.53
Easy Access	1.14	1.73	2.60	0.57	0.83	1.34	1.00	1.00	1.00	0.69	1.09	1.60	0.28	0.37	0.52
Big And Specious	1.39	2.20	3.52	0.71	1.05	1.77	0.62	0.92	1.45	1.00	1.00	1.00	0.27	0.34	0.53
Cleanliness	2.60	3.95	5.05	1.88	2.84	3.82	1.93	2.71	3.53	1.88	2.93	3.76	1.00	1.00	1.00

The fuzzy weight matrix (ri)

The fuzzy weight matrix is calculated by Buckley's extension method   (Kahraman and Cebi 2009) as follows:

$$r_i = \sqrt[n]{(a_{i1} \otimes a_{i2} \otimes \ldots \otimes a_{in})}$$

Where a_{in} is the proportion of criteria i to criteria n, and r_i express the geometric mean of criteria i with respect to each criterion.

Table 4.2: the fuzzy weight matrix of tangible's sub-criteria

	ri		
Modern Looking	0.385	0.520	0.750
Completeness	0.645	0.933	1.271
Easy Access	0.663	0.895	1.237
Big And Specious	0.696	0.938	1.369
Cleanliness	1.778	2.455	3.033

The fuzzy relative importance of each criterion (wi):

Calculate the fuzzy relative importance of each criterion applying below equation:

$$w_i = r_i \otimes (r_1 \oplus r_2 \oplus \ldots \oplus r_n)^{-1}$$

Where w_i is the fuzzy weight of criterion i with respect to others criterion which can be expressed by $(w_i l, w_i m, w_i u)$. There three numbers located on w_i which are $w_i l$, $w_i m$ and $w_i u$ stand for the lower , middle and upper values of fuzzy weight of the ith criterion.

Table 4.3: fuzzy relative importance of tangible's sub-criteria

	wi		
Modern Looking	0.050	0.091	0.180
Completeness	0.084	0.162	0.305
Easy Access	0.086	0.156	0.297
Big And Specious	0.091	0.163	0.328
Cleanliness	0.232	0.428	0.728

Table 4.4: Crisp relative importanceof tangible's sub-criteria

	Crisp
Modern Looking	0.095
Completeness	0.163
Easy Access	0.159
Big And Specious	0.172
Cleanliness	0.410

Table 4.5: Global weight of Tangible's sub-criteria

	weight
Modern Looking	0.015
Completeness	0.026
Easy Access	0.026
Big And Specious	0.028
Cleanliness	0.066

4.3.2 Importance of Empathy's sub-criteria

The aggregated matrix A for Empathy's sub-criteria:

, a_{ij} is the triangular fuzzy number represents the geometric mean of all customer's evaluation in comparison matrices. Geometric means calculated as follows:

$$a_{ij} = ^k \overline{a_{ij}^1 \otimes a_{ij}^2 \otimes a_{ij}^3 \ldots a_{ij}^k}$$

Where a_{ij}^k is the comparison between criteria i and j belonging to k^{th} customer

Table 4.6: the aggregated matrix for Empathy's sub-criteria

	Individual Attention			Specific Needs			Easy Communication		
Individual Attention	1.000	1.000	1.000	0.483	0.756	1.174	0.620	0.965	1.472
Specific Needs	0.852	1.322	2.071	1.000	1.000	1.000	0.997	1.593	2.435
Easy Communication	0.679	1.036	1.612	0.411	0.628	1.003	1.000	1.000	1.000

The fuzzy weight matrix (ri)

The fuzzy weight matrix is calculated by Buckley's extension method　(Kahraman and Cebi 2009) as follows:

$$r_i = {}^n \overline{(a_{i1} \otimes a_{i2} \otimes \dots \otimes a_{in})}$$

Where a_{in} is the proportion of criteria i to criteria n, and r_i express the geometric mean of criteria i with respect to each criterion.

Table 4.7: the fuzzy weight matrix of Empathy's sub-criteria

	ri		
Individual Attention	0.669	0.900	1.200
Specific Needs	0.947	1.282	1.715
Easy Communication	0.653	0.867	1.174

The fuzzy relative importance of each criterion (wi):

Calculate the fuzzy relative importance of each criterion applying below equation:

$$w_i = r_i \otimes (r_1 \oplus r_2 \oplus \dots \oplus r_n)^{-1}$$

Where w_i is the fuzzy weight of criterion i with respect to others criterion which can be expressed by $(w_i l, w_i m, w_i u)$. There three numbers located on w_i which are $w_i l, w_i m$ and $w_i u$ stand for the lower , middle and upper values of fuzzy weight of the ith criterion.

Table 4.8: fuzzy relative importance of Empathy's sub-criteria

	wi		
Individual Attention	0.164	0.295	0.529
Specific Needs	0.232	0.420	0.756
Easy Communication	0.160	0.284	0.517

Table 4.9: Crisp relative importance of Empathy's sub-criteria

	Crisp
Individual Attention	0.294
Specific Needs	0.419
Easy Communication	0.286

**Table 4.10: Global weight of
Empathy's sub-criteria**

	weight
Individual Attention	0.047
Specific Needs	0.067
Easy Communication	0.045

4.3.3   Importance of Reliability's Sub-Criteria

The aggregated matrix A for Reliability's sub-criteria:

, a_{ij} is the triangular fuzzy number represents the geometric mean of all customer's evaluation in comparison matrices. Geometric means calculated as follows:

$$a_{ij}=^k \overline{a_{ij}^1 \otimes a_{ij}^2 \otimes a_{ij}^3 \dots a_{ij}^k}$$

Where a_{ij}^k is the comparison between criteria i and j belonging to k^{th} customer

Table 4.11: the aggregated matrix for Reliability's sub-criteria

	Not Being Crowded			Timeliness			Honesty In Ads		
Not Being Crowded	1.000	1.000	1.000	1.284	1.794	2.528	0.325	0.430	0.641
Timeliness	0.396	0.557	0.779	1.000	1.000	1.000	0.207	0.284	0.446
Honesty In Ads	1.560	2.327	3.075	2.240	3.526	4.835	1.000	1.000	1.000

The fuzzy weight matrix (ri)

The fuzzy weight matrix is calculated by Buckley's extension method   (Kahraman and Cebi 2009) as follows:

$$r_i =^n \overline{(a_{i1} \otimes a_{i2} \otimes \dots \otimes a_{in})}$$

Where a_{in} is the proportion of criteria i to criteria n, and r_i express the geometric mean of criteria i with respect to each criterion.

Table 4.12: the fuzzy weight matrix of Reliability's sub-criteria

	ri		
Not Being Crowded	0.748	0.917	1.175
Timeliness	0.434	0.541	0.703
Honesty In Ads	1.518	2.017	2.459

The fuzzy relative importance of each criterion (wi):

Calculate the fuzzy relative importance of each criterion applying below equation:

$$w_i = r_i \otimes (r_1 \oplus r_2 \oplus \dots \oplus r_n)^{-1}$$

Where w_i is the fuzzy weight of criterion i with respect to others criterion which can be expressed by $(w_i l, w_i m, w_i u)$. There three numbers located on w_i which are $w_i l, w_i m$ and $w_i u$ stand for the lower , middle and upper values of fuzzy weight of the ith criterion.

Table 4.13: fuzzy relative importance of Reliability's sub-criteria

	Wi		
Not Being Crowded	0.172	0.264	0.435
Timeliness	0.100	0.156	0.260
Honesty In Ads	0.350	0.580	0.911

Table 4.14: Crisp relative importance of Reliability's sub-criteria

	crisp
Not Being Crowded	0.270
Timeliness	0.160
Honesty In Ads	0.570

Table 4.15: Global weight of Reliability's sub-criteria

	Weight
Not Being Crowded	0.051
Timeliness	0.030
Honesty In Ads	0.108

4.3.4   Importance of Assurance's sub-criteria

The aggregated matrix A for Assurance's sub-criteria:

, a_{ij} is the triangular fuzzy number represents the geometric mean of all customer's evaluation in comparison matrices. Geometric means calculated as follows:

$$a_{ij} = \sqrt[k]{a_{ij}^1 \otimes a_{ij}^2 \otimes a_{ij}^3 \dots a_{ij}^k}$$

Where a_{ij}^k is the comparison between criteria i and j belonging to k^{th} customer

Table 4.16: the aggregated matrix for Assurance's sub-criteria

	Being Safe			Trainer			Cost			Politeness			Motivation		
Being Safe	1.00	1.00	1.00	0.83	1.26	1.86	1.29	2.01	2.84	0.51	0.72	1.05	0.57	0.81	1.25
Trainer	0.54	0.79	1.20	1.00	1.00	1.00	1.26	2.01	3.02	0.50	0.75	1.12	0.57	0.88	1.25
Cost	0.35	0.50	0.77	0.33	0.50	0.79	1.00	1.00	1.00	0.32	0.48	0.78	0.37	0.61	0.99
Politeness	0.95	1.39	1.96	0.89	1.33	1.98	1.28	2.09	3.09	1.00	1.00	1.00	1.05	1.55	2.26
Motivation	0.80	1.24	1.75	0.80	1.14	1.74	1.01	1.63	2.71	0.44	0.65	0.96	1.00	1.00	1.00

The fuzzy weight matrix (ri)

The fuzzy weight matrix is calculated by Buckley's extension method   (Kahraman and Cebi 2009) as follows:

$$r_i = \sqrt[n]{(a_{i1} \otimes a_{i2} \otimes \ldots \otimes a_{in})}$$

Where a_{in} is the proportion of criteria i to criteria n, and r_i express the geometric mean of criteria i with respect to each criterion.

Table 4.17: the fuzzy weight matrix of Assurance's sub-criteria

	ri		
Being Safe	0.794	1.079	1.472
Trainer	0.722	1.011	1.384
Cost	0.425	0.592	0.861
Politeness	1.026	1.431	1.933
Motivation	0.780	1.083	1.512

The fuzzy relative importance of each criterion (wi):

Calculate the fuzzy relative importance of each criterion applying below equation:

$$w_i = r_i \otimes (r_1 \oplus r_2 \oplus \ldots \oplus r_n)^{-1}$$

Where w_i is the fuzzy weight of criterion i with respect to others criterion which can be expressed by ($w_i l, w_i m, w_i u$). There three numbers located on w_i which are $w_i l$, $w_i m$ and $w_i u$ stand for the lower , middle and upper values of fuzzy weight of the *i*th criterion.

Table 4.18: fuzzy relative importance of

Assurance's sub-criteria

	wi		
Being Safe	0.111	0.208	0.393
Trainer	0.101	0.195	0.369
Cost	0.059	0.114	0.230
Politeness	0.143	0.275	0.516
Motivation	0.109	0.208	0.403

Table 4.19: Crisp relative importance
of Assurance's sub-criteria

	Crisp
Being Safe	0.207
Trainer	0.194
Cost	0.117
Politeness	0.272
Motivation	0.210

Table 4.20: Global weight of Assurance's sub-criteria

	Weight
Being Safe	0.053
Trainer	0.049
Cost	0.030
Politeness	0.069
Motivation	0.053

4.3.5   Importance of Responsiveness's Sub-Criteria

The aggregated matrix A for Responsiveness's sub-criteria:

, a_{ij} is the triangular fuzzy number represents the geometric mean of all customer's evaluation in comparison matrices. Geometric means calculated as follows:

$$a_{ij} = \sqrt[k]{a_{ij}^1 \otimes a_{ij}^2 \otimes a_{ij}^3 \dots a_{ij}^k}$$

Where a_{ij}^k is the comparison between criteria i and j belonging to k^{th} customer

Table 4.21: the aggregated matrix for Responsiveness's sub-criteria

	Announcement			Willingness			Prompt Solving		
Announcement	1.000	1.000	1.000	0.2274	0.3247	0.5592	0.2009	0.2764	0.4732
Willingness	1.7882	3.08	4.3974	1.000	1.000	1.000	0.6484	1.0485	1.5739
Prompt Solving	2.1133	3.6176	4.9764	0.6354	0.9538	1.5423	1.000	1.000	1.000

The fuzzy weight matrix (ri)

The fuzzy weight matrix is calculated by Buckley's extension method   (Kahraman and Cebi 2009) as follows:

$$r_i = \sqrt[n]{(a_{i1} \otimes a_{i2} \otimes \dots \otimes a_{in})}$$

Where a_{in} is the proportion of criteria i to criteria n, and r_i express the geometric mean of criteria i with respect to each criterion.

Table 4.22: the fuzzy weight matrix of Responsiveness's sub-criteria

	ri		
Announcement	0.358	0.448	0.642
Willingness	1.051	1.478	1.906
Prompt Solving	1.103	1.511	1.973

The fuzzy relative importance of each criterion (wi):

Calculate the fuzzy relative importance of each criterion applying below equation:

$$w_i = r_i \otimes (r_1 \oplus r_2 \oplus \dots \oplus r_n)^{-1}$$

Where w_i is the fuzzy weight of criterion i with respect to others criterion which can be expressed by ($w_i l, w_i m, w_i u$). There three numbers located on w_i which are $w_i l$, $w_i m$ and $w_i u$ stand for the lower , middle and upper values of fuzzy weight of the ith criterion.

Table 4.23: fuzzy relative importance of Responsiveness's sub-criteria

	wi		
Announcement	0.079	0.130	0.256
Willingness	0.232	0.430	0.759
Prompt Solving	0.244	0.440	0.785

Table 4.24: Crisp relative importance of Responsiveness's sub-criteria

	Crisp
Announcement	0.139
Willingness	0.424
Prompt Solving	0.438

Table 4.25: Global weight of Responsiveness's sub-criteria

	Weight
Announcement	0.024
Willingness	0.073
Prompt Solving	0.076

4.3.6 Importance of Feature's sub-criteria

The aggregated matrix A for Feature's sub-criteria:

, a_{ij} is the triangular fuzzy number represents the geometric mean of all customer's evaluation in comparison matrices. Geometric means calculated as follows:

$$a_{ij} = \sqrt[k]{a_{ij}^1 \otimes a_{ij}^2 \otimes a_{ij}^3 \dots a_{ij}^k}$$

Where a_{ij}^k is the comparison between criteria i and j belonging to k^{th} customer

Table 4.26: the aggregated matrix for Feature's sub-criteria

	Group Lessons			Social Activities		
Group Lessons	1.000	1.000	1.000	0.904	1.290	1.788
Social Activities	0.559	0.775	1.106	1.000	1.000	1.000

The fuzzy weight matrix (ri)

The fuzzy weight matrix is calculated by Buckley's extension method (Kahraman and Cebi 2009) as follows:

$$r_i = \sqrt[n]{(a_{i1} \otimes a_{i2} \otimes \dots \otimes a_{in})}$$

Where a_{in} is the proportion of criteria i to criteria n, and r_i express the geometric mean of criteria i with respect to each criterion

Table 4.27: the fuzzy weight
matrix of Feature's sub-criteria

	ri		
Group Lessons	0.951	1.136	1.337
Social Activities	0.748	0.880	1.052

The fuzzy relative importance of each criterion (wi):

Calculate the fuzzy relative importance of each criterion applying below equation:

$$w_i = r_i \otimes (r_1 \oplus r_2 \oplus \ldots \oplus r_n)^{-1}$$

Where w_i is the fuzzy weight of criterion i with respect to others criterion which can be expressed by ($w_i l, w_i m, w_i u$). There three numbers located on w_i which are $w_i l$, $w_i m$ and $w_i u$ stand for the lower , middle and upper values of fuzzy weight of the ith criterion.

Table 4.28: fuzzy relative importance
of Feature's sub-criteria

	wi		
Group Lessons	0.398	0.563	0.787
Social Activities	0.313	0.437	0.619

Table 4.29: Crisp relative importance
of Feature's sub-criteria

	Crisp
Group Lessons	0.561
Social Activities	0.439

Table 4.30: Global weight of
Feature's sub-criteria

	Weight
Group Lessons	0.036
Social Activities	0.028

4.3.7 Importance of Criteria

The aggregated matrix A for criteria:

, a_{ij} is the triangular fuzzy number represents the geometric mean of all customer's evaluation in comparison matrices. Geometric means calculated as follows:

$$a_{ij} = {}^k \overline{a_{ij}^1 \otimes a_{ij}^2 \otimes a_{ij}^3 \dots a_{ij}^k}$$

Where a_{ij}^k is the comparison between criteria i and j belonging to k^{th} customer

Table 4.31: the aggregated matrix for criteria

	Tangible			Empathy			Reliability			Assurance			Responsiveness			Features		
Tangible	1.00	1.00	1.00	0.66	1.03	1.63	0.49	0.70	1.07	0.52	0.76	1.29	0.56	0.86	1.45	1.49	2.42	3.59
Empathy	0.61	0.97	1.51	1.00	1.00	1.00	0.52	0.84	1.37	0.37	0.53	0.90	0.60	0.89	1.39	1.79	2.90	4.27
Reliability	0.94	1.44	2.04	0.73	1.20	1.93	1.00	1.00	1.00	0.41	0.57	0.91	0.77	1.16	1.80	1.82	3.13	4.77
Assurance	0.78	1.31	1.92	1.11	1.90	2.69	1.10	1.74	2.42	1.00	1.00	1.00	1.04	1.58	2.38	2.18	3.73	5.46
Responsiveness	0.69	1.16	1.80	0.72	1.13	1.67	0.56	0.86	1.31	0.42	0.63	0.97	1.00	1.00	1.00	1.81	3.08	4.54
Features	0.28	0.41	0.67	0.23	0.34	0.56	0.21	0.32	0.55	0.18	0.27	0.46	0.22	0.32	0.55	1.00	1.00	1.00

The fuzzy weight matrix (ri)

The fuzzy weight matrix is calculated by Buckley's extension method (Kahraman and Cebi 2009) as follows:

$$r_i = {}^n \overline{(a_{i1} \otimes a_{i2} \otimes \dots \otimes a_{in})}$$

Where a_{in} is the proportion of criteria i to criteria n, and r_i express the geometric mean of criteria i with respect to each criterion.

Table 4.32: the fuzzy weight matrix of criteria

	ri		
Tangible	0.720	1.022	1.506
Empathy	0.709	1.016	1.494
Reliability	0.856	1.237	1.770
Assurance	1.135	1.717	2.335
Responsiveness	0.771	1.140	1.607
Features	0.286	0.398	0.611

The fuzzy relative importance of each criterion (wi):

Calculate the fuzzy relative importance of each criterion applying below equation:

$$w_i = r_i \otimes (r_1 \oplus r_2 \oplus ..... \oplus r_n)^{-1}$$

Where w_i is the fuzzy weight of criterion i with respect to others criterion which can be expressed by $(w_i l, w_i m, w_i u)$. There three numbers located on w_i which are $w_i l$, $w_i m$ and $w_i u$ stand for the lower , middle and upper values of fuzzy weight of the ith criterion.

Table 4.33: fuzzy relative importance of criteria

	wi		
Tangible	0.077	0.157	0.336
Empathy	0.076	0.156	0.334
Reliability	0.092	0.189	0.395
Assurance	0.122	0.263	0.522
Responsiveness	0.083	0.175	0.359
Features	0.031	0.061	0.137

Table 4.34: Crisp relative importance of criteria

	Crisp
Tangible	0.160
Empathy	0.159
Reliability	0.190
Assurance	0.254
Responsiveness	0.173
Features	0.064

Table 4.35: AHP-Derived Prioritization of VOA

Rating	Customer Needs	AHP-Derived Importance
1	Accuracy In Given Info And Promise	0.108
2	Prompt Problem Solving	0.076
3	Willingness to Help	0.073
4	Courtesy And Politeness	0.069
5	Understanding Specific Needs	0.067
6	Cleanliness	0.066
7	Motivation	0.053
8	Feeling Safe	0.053
9	Not Being Crowded	0.051
10	Competence Of Trainer	0.049
11	Individual Attention	0.047
12	Easiness in Communication	0.045
13	Group Lesson	0.036
14	Timeliness	0.03
15	Cost	0.03
16	Social Activities	0.028
17	Big And Specious Salon	0.028
18	Completeness Of Equipment	0.026
19	Easy Access	0.026
20	Announcement	0.024
21	Modern Looking	0.015

	Customer Needs	AHP-Derived Importance
1	Accuracy In Given Info And Promise	0,108
2	Prompt Problem Solving	0,076
3	Willingness To Help	0,073
4	Courtesy And Politeness	0,069
5	Understanding Specific Needs	0,067
6	Cleanliness	0,066
7	Motivation	0,053
8	Feeling Safe	0,053
9	Not Being Crowded	0,051
10	Competence Of Trainer	0,049
11	Individual Attention	0,047
12	Easiness in Communication	0,045
13	Group Lesson	0,036
14	Timeliness	0,03
15	Cost	0,03
16	Social Activities	0,028
17	Big And Specious Salon	0,028
18	Completeness Of Equipment	0,026
19	Easy Access	0,026
20	Announcement	0,024
21	Modern Looking	0,015

Table 4.35: Absolute Weight and Final Relative Weight of VOC

	Rating	Absolute weight	Final Relative Weight
Accuracy and Consistency of Info and Promise	1	0.260	12.225%
Keeping Members Fitness-motivated	2	0.200	9.413%
Prompt Failure Solving	3	0.182	8.549%
Understanding Members Specific Needs	4	0.166	7.827%
Courtesy of Employee	5	0.138	6.511%
Social Activities	6	0.135	6.348%
Competence of Trainer	7	0.123	5.789%
Willingness to Help	8	0.117	5.513%
Individual Attention	9	0.117	5.492%
Announcement of Services	10	0.096	4.509%
Feeling Safe and Relax in Gym	11	0.084	3.965%
Cleanliness and Hygiene	12	0.079	3.705%
Not Being too Crowded to Use	13	0.077	3.616%
Feeling Safe in Delivery of Service	14	0.061	2.856%
Easiness in Communication	15	0.061	2.850%
Various of Equipment	16	0.065	3.02%
Group Lessons	17	0.043	2.027%
Specious and Fresh Gym	18	0.041	1.945%
Easy-Accessible Location	19	0.038	1.800%
Cost of Membership	20	0.036	1.685%
Modern Looking	21	0.023	1.071%

Appendix B: House of Quality Regarding to Criteria's in Fitness Center

QFD: House of Quality

Correlations
Positive	+
Negative	−
No Correlation	

Relationships
Strong	●
Moderate	○
Weak	▽

Direction of Improvement
Maximize	▲
Target	◇
Minimize	▼

Functional Requirements (Columns)

Column #	Functional Requirement
1	modern equipment
2	interior design
3	completeness of equipment
4	newness of equipment
5	hygiene control
6	availability of cafeteria
7	replying to comments left in the complaint box
8	setting on central location
9	Education and training course for trainers and employees
10	consistency of promise services by gym
11	members follow-up system (development, absence, program)
12	up to dating all services on online time table system
13	correcting members while doing wrong exercise
14	medical service
15	partner matchmaking service
16	the number of high-demanded group lessons per week
17	the variety of high-demanded social activities
18	great air conditioning system
19	setting reasonable price for different part of day
20	call center (customer support)
21	courtesy and happy face employee
22	delivering the promised service on time
23	proactive inspection of all equipment
24	availability of authorized employee
25	availability security guard

Customer Requirements Table

Row #	Relative Weight	AHP-Derived Customer Importance	Max Relationship	Customer Requirements (Explicit and Implicit)	Target Value	Improvement Ratio	Sales Point	Absolute Weight	Final Relative Weight	Our Product: Jasmi	Competitor #1: Hill Side	Competitor #2: MAC	Competitor #3: My Club
1	1.518%	0.0152	9	modern looking	4	1	1.5	0.0228	1.05%	4	4	5	5
2	2.610%	0.0261	9	various of equipment	5	1.67	1.5	0.07	3.02%	3	3	4	5
3	2.552%	0.0255	9	easy-accessible location	5	1	1.5	0.0383	1.77%	5	3	3	3
4	2.757%	0.0276	3	spacious and fresh gym	5	1	1.5	0.0414	1.91%	5	3	4	5
5	6.565%	0.0656	9	cleanliness and hygiene	5	1.25	1.2	0.0985	4.55%	4	4	3	5
6	4.670%	0.0467	9	individual attention	5	1.67	1.5	0.1168	5.40%	3	4	3	2
7	6.657%	0.0666	9	understanding members specific needs	5	1.67	1.5	0.1664	7.70%	3	4	3	3
8	4.545%	0.0455	9	easiness in communication	4	1.33	1	0.0606	2.80%	3	3	4	3
9	5.125%	0.0512	9	not being too crowded to use	3	1.5	1	0.0769	3.56%	2	1	3	4
10	3.036%	0.0304	9	feeling safe in delivery of service	5	1.67	1.2	0.0607	2.81%	3	3	3	5
11	10.830%	0.1083	9	accuracy and consistency of info and promise	4	2	1.2	0.2599	12.02%	2	4	4	3
12	5.269%	0.0527	9	feeling safe and relax in gym	4	1.33	1.2	0.0843	3.90%	3	4	3	4
13	4.923%	0.0492	9	competence of trainer	5	1.67	1.5	0.1231	5.69%	3	4	5	5
14	2.980%	0.0299	9	cost of membership	4	1	1.2	0.0358	1.66%	4	4	3	4
15	6.921%	0.0692	9	courtesy of employee	5	1.67	1.2	0.1384	6.40%	3	4	3	3
16	5.337%	0.0534	9	keeping members fitness-motivated	5	2.5	1.5	0.2001	9.26%	2	5	3	3
17	2.397%	0.0240	9	announcement of services	4	4	1	0.0959	4.43%	1	4	4	3
18	7.326%	0.0733	9	willingness to help	4	1.33	1.2	0.1172	5.42%	3	4	4	5
19	7.573%	0.0757	9	prompt failure solving	4	2	1.2	0.1817	8.41%	2	4	2	3
20	3.591%	0.0359	3	group lessons	4	1	1.2	0.0431	1.99%	4	5	4	5
21	2.812%	0.0281	9	social activities	4	4	1.2	0.135	6.24%	1	5	2	3

Totals: Relative Weight 100.000% | AHP 1.000 | Final Relative Weight 100.00%

Objective Target (per column)

Col	Objective Target
1	high modern-level equipment
2	maintain current level
3	availability of all kind of equipment for workout
4	highly separated gym
5	very clean and high-level hygiene control
6	cafeteria with dirty food
7	reply at least 80% of complaint
8	maintain central location
9	very high level of education
10	being very clear in service presentation
11	each 3 weeks
12	everyday updating all the service in online system
13	as much as possible
14	availability of doctor and first aid kit
15	as much as possible
16	high level of frequency of group lessons different time
17	existing at least 1 social activity per week
18	exactly good system with well-adjustment
19	maintain current level
20	availability of call center with 9 hours
21	highly motivated and happy
22	with at most 10 min tolerance
23	at most 3 days prompt solution
24	highly level availability of responsible person
25	maintain current level

Technical Importance

Col	Max Relationship	Technical Importance Rating	Relative Weight
1	9	13.66	0.81%
2	3	12.83	0.76%
3	9	23.49	1.40%
4	3	30.03	1.78%
5	9	107.11	6.36%
6	3	44.65	2.65%
7	9	135.23	8.03%
8	9	22.96	1.36%
9	9	104.22	6.19%
10	9	136.21	8.09%
11	9	181.24	10.76%
12	9	28.90	1.72%
13	3	56.75	3.37%
14	3	37.79	2.24%
15	9	80.02	4.75%
16	9	35.87	2.13%
17	3	50.40	2.99%
18	3	49.10	2.92%
19	9	73.00	4.34%
20	9	73.72	4.38%
21	9	94.11	5.59%
22	9	43.33	2.57%
23	9	111.49	6.62%
24	9	78.30	4.65%
25	9	59.42	3.53%

Total Technical Importance Rating: 1683.828 | Relative Weight 100%

5. DISCUSSION AND CONCLUSION

5.1 DISCUSSION

The customer requirement in fitness service and its AHP-derived importance has been obtained in the previous chapter (Table: 4.35). The five most important customer-oriented requirements are as follow:

I. Accuracy in given information and promises

II. Prompt problem solving

III. Willingness to help

IV. Courtesy and politeness

V. Understanding specific needs

As it is realized from the table 4.35 which the customers have consideredthese requirements as the most important needs belonging to four primary categories which are reliability, responsiveness, assurance and empathy; however, it is should not be underestimated the importance of tangible and features categories. In the service-concept product or service there are two kind of criteria regarding to customer appetite-wise to buying the service which are named pre-sale criteria and post-sale criteria.

Among these six categories tangible and features are considered as the pre-sale criteria and the rest of categories naming empathy, assurance, responsiveness and reliability are considered as the post-sale categories.

Pre-sale criteria: the criteria whose mostly affect customer's decision to purchase the service/product or not.

Post-sale criteria: the criteria which mostly affect customer satisfaction and his/her royalty to the company which is providing the service. These criteria are taken into consideration in customer retention issue and its cost.

According to competitive benchmarking and SWOT analysis there are some strengths, weaknesses, opportunities and threats for our case study company called JATOMI. In the competitive part 5-point scale are used with the range of 1 to 5 as is clear in table 5.1 and from the internal and external situation SWOT analysis has been implemented as in figure 5.2.

Table 5.1: Competitive Benchmarking for Customer Needs (CN)

	Our Product: JATOMI	Competitor #1: Hill Side	Competitor #2: MAC	Competitor #3: My Club
Modern Looking	4	4	5	5
Various of Equipment	3	3	4	5
Easy-Accessible Location	5	3	3	3
Specious and Fresh Gym	5	3	4	5
Cleanliness and Hygiene	4	4	3	5
Individual Attention	3	4	3	2
Understanding Specific Needs	3	4	3	5
Easiness in Communication	3	3	4	3
Not Being too Crowded to Use	2	1	3	4
Feeling Safe in Delivery of Service	3	3	3	5
Consistency of Info and Promise	2	4	4	3
Feeling Safe and Relax in Gym	3	4	3	4
Competence of Trainer	3	4	4	5
Cost of Membership	4	4	3	4
Courtesy of Employee	3	4	3	3
Keeping Members Fitness-motivated	2	5	3	3
Announcement of Services	1	4	4	3
Willingness to Help	3	4	4	5
Prompt Failure Solving	2	4	2	3
Group Lessons	4	5	4	4
Social Activities	1	5	2	3

According to internal situation and competitive benchmarking, easy accessible location 5:5, specious and fresh gym 5:5, modern looking 4:5 and cost of membership 4:5 are considered as the Strengths of service provider. From performance competitive table some weaknesses are seen in terms of announcement of service 1:5, competence of trainer 3:5, social activities 1:5, prompt failure solving 2:5 and willingness to help 3:5 in JATOMI's gyms in comparison with other gyms and in reality that the required measurements should be fulfilled to overcome these failures. From external situation and other gyms performance some issues are considered as opportunities for fitness center as following: Turkish growing fitness market, easiness in communication,

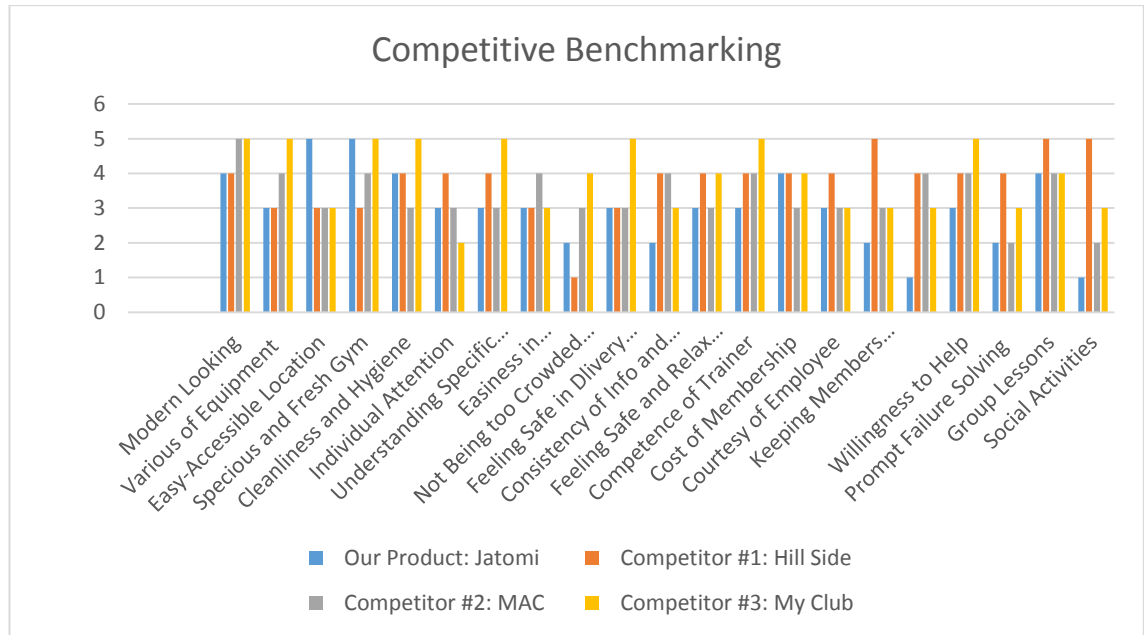**Figure 5.1: Competitive Benchmarking for JATOMI Fitness Center**

Figure 5.2: SWOT Analysis for VOC Regarding JATOMI Membership

Internal Origin	**Strengths S**	**Weaknesses W**
	I. Easy Accessible Location II. Specious And Fresh Gym III. Cost Of Membership IV. Modern Looking	I. Social Activities II. Competence Of Trainer III. Willingness To Help IV. Announcement Of Service V. Prompt Failure Solving
External Origin	**Opportunities O**	**Threats T**
	I. Turkish Growing Fitness Market II. Easiness In Communication III. Keeping Members Fitness-Motivated	I. Consistency Of Info And Promises II. Very Low Rate Of Customer Retention III. Emerging New Competitive Fitness Centers

Keeping members fitness-motivated.Well noted that easiness in communication and keeping members fitness-motivated are post-sale criteria being known opportunity for fitness center because in the competitive market it is seen that other gyms are evaluated by low score so then, these criteria can be great opportunities to meet customer opportunities and rate of customer retention.

From Table: 4.35 the AHP-Derived importance of VOC are seen; however, the absolute weight and final relative weight is derived by multiplying:

Absolute weight: (target value)*(scale-factor)*(AHP-Derived importance)

Which the 5 final most criteria are as follows respectively:

   i.   Accuracy and Consistency of Info and Promise

  ii.   Keeping Members Fitness-motivated

 iii.   Prompt Failure Solving

 iv.   Understanding Members Specific Needs

  v.   Courtesy of Employee

According to our house of quality, the final technical requirement are seen by their weight in the HOQ chart. As it is seen in weight bar-chart, the first 5 most important technical characteristics which should be taken required measurements are as follow respectively:

  a. Member follow-up system (development, absence, program): 10.76 percent

  b. Consistency of promised services by gym: 8.09 percent

  c. Replying to comments left in the complaint box: 8.03 percent

  d. Proactive inspection of all equipment: 6.62 percent

  e. Education and training of all employees: 6.19 percent

Member follow-up system:

This is an organized system which being followed up member absence and updating member workout program, physical improvement indicating fat ratio, muscle index, blood pressure, weight etc.

Consistency of promised services by gym:

It means that big fitness centers are providing many services such as: group lessons, social activity, private lessons, first physical index measurement, follow-up system,

services which advertised by gym or sale's person which have to be consistent with what is promised.

Replying to the comments left in the complaint box:

There is a complaint box saying "General Manager Attention" and responding to the complaints and comments corresponding with customer satisfaction and level of expectation. A study was implemented by the technical assistance research program in Washington, D.C. on the products in the price range of 100-300 unveiling that 50 percent of customers or consumers who have a problem never complain to anyone, and 45 percent of them express their unsatisfactory to retailer or sale's persons and only 5 percent of customers who having problem went to management. This research was carried out on product and not service, however; we can get an insight regarding to importance of complaint box in the fitness center of anywhere.

Proactive inspection of all equipment:

It is an organized schedule for inspection of all equipment and check whether there is a failure being occurred in prospector not to be able bring a prompt solution.

Education of all employees:

Education of trainers continuously is very important in trainer's competency and integration of knowledge among all the personnel in order to updating knowledge are important.

Cost index:

By considering cost index per month in terms of implementation of technical attribute, the priority of 5 first important technical requirement will be changed.

    a. Consistency of promised services by gym: --: 8.09 percent

    b. Member follow-up system: 1070 TL: 10.76 percent

    c. Replying to comments left in the complaint box: 1300 TL: 8.03 percent

    d. Proactive inspection of all equipment: 1500 TL: 6.62 percent

    e. Education and training of all employees: 3000 TL: 6.19 percent

5.2 CONCLUSION

Service quality means different things to different people and underlying cause of that quality is a multidimensional concept. Usually customers touch and feel and then purchase product and evaluate them through their experience of using them. If they had a positive experience about product, they would offer it to others. The image of product will be established by telling the quality of product during customer's usage in word of mouth way. By same token, service quality has elusive and indistinct structure (Parasuraman et al. 1985). As time went on, service quality has obtained growing appreciation becoming an important research topic which its major contributor is apparent correspondence with cost, profitability, customer satisfaction, customer retention, and positive word of mouth (Buttle 1996).

As times goes, due to rising of people awareness, they start asking further and various request from service provider and service industry became more competitive and complex. It is essential to service provider to know, how to attract new customer while maintaining existing customer. It is said that achieving new customers costs 3-10 times more than keeping current customers (Luo 2001). It means that if an enterprise is not able to sustain its existing customer, it will pay much more to find new customers. Reichheld and Sasser (1990) also found out that an enterprise net profit can be enhanced as much as 25 percent to 85 percent by reduction of as little as 5% in customer churn.

Having defined, we have to consider the service-concept products through 2 dimension which are pre-sale criteria and post-sale criteria. Post-sale criteria which mostly affect customer satisfaction and his/her royalty to the company after purchasing to the company which is providing the service. These criteria are taken into consideration in customer retention issue and its cost. According to our HOQ and the research, it can be found out the importance of post-sale criteria.

For further research, it can be suggested to add constraints to the HOQ. In practice, there could be a number of different constraint on our QFD problem which cost index and minimum percentage of satisfaction increment can be added to the HOQ.

Another further research regarding analysis of variance can be implemented. When we have a complete data, it can be important task that whether there is a significant

difference between the means with subject to each engineering characteristic considered as a treatment. According to final mean importance of engineering characteristic, there should be significant importance difference amongst them to spend more concentration on them. In order to detect significant differences between technical characteristic, we have to analyze the variance of each of them which ANOVA play imperative role. There are a number of procedure for comparing and ranking a group of treatments which the popular ones are Tukey's test and Fisher Least Significant Difference (LSD) method can be applied.

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APPENDICES

Appendix A:Questionnairefor Gathering VOC

NO	ENGLISH EXPRESSION	TURKISH EXPRESSION
6	Absolutely Important	Aşırıderecedahaönemli (kıyaslanamaz bile)
5	Very Strongly Important	Çokdahaönemli
4	Essentially Important	Belirginderecededahaönemli
3	Weakly Important	Dahaönemli
2	Equally Important	Birazdahaönemli (neredeyseaynı)
1	Just Equal	Tam olarakeşitönemesahip, tamamenaynı

Pair-Wise Comparison: Tangible

Criteria	AşırıDereceDahaÖnemli (Kıyaslanamaz Bile)	ÇokDahaÖnemli	BelirginDerecedeDahaÖnemli	DahaÖnemli	BirazDahaÖnemli (NeredeyseAynı)	Tam OlarakEşitÖnemeSahip, TamamenAynı	BirazDahaÖnemli (NeredeyseAynı)	DahaÖnemli	BelirginDerecedeDahaÖnemli	ÇokDahaÖnemli	AşırıDereceDahaÖnemli (Kıyaslanamaz Bile)	Criteria
Up-To-Date Equipment (Modern Looking)												Completeness of Equipment
Up-To-Date Equipment (Modern Looking)												Easy-Accessible Location
Up-To-Date Equipment (Modern Looking)												Big and Specious Gym
Up-To-Date Equipment (Modern Looking)												Cleanliness and Hygiene
Completeness of Equipment												Easy-Accessible Location
Completeness of Equipment												Big and Specious Gym
Completeness of Equipment												Cleanliness and Hygiene
Easy-Accessible Location												Big and Specious Gym
Easy-Accessible Location												Cleanliness and Hygiene
Big and Specious Gym												Cleanliness and Hygiene

Pair-Wise Comparison: Individual Attention

Criteria	AşırıDereceDahaÖnemli (Kıyaslanamaz Bile)	ÇokDahaÖnemli	BelirginDerecedeDahaÖnemli	DahaÖnemli	BirazDahaÖnemli (NeredeyseAynı)	Tam OlarakEşitÖnemeSahip, TamamenAynı	BirazDahaÖnemli (NeredeyseAynı)	DahaÖnemli	BelirginDerecedeDahaÖnemli	ÇokDahaÖnemli	AşırıDereceDahaÖnemli (Kıyaslanamaz Bile)	Criteria
Individual Attention												Understanding Members Specific Needs By Trainer
Individual Attention												Easiness In Communication
Understanding Members Specific Needs By Trainer												Easiness In Communication

Pair-Wise Comparison: Reliability

Criteria	AşırıDereceDahaÖnemli (Kıyaslanamaz Bile)	ÇokDahaÖnemli	BelirginDerecedeDahaÖnemli	DahaÖnemli	BirazDahaÖnemli (NeredeyseAynı)	Tam OlarakEşitÖneme Sahip, TamamenAynı	BirazDahaÖnemli (NeredeyseAynı)	DahaÖnemli	BelirginDerecedeDahaÖnemli	ÇokDahaÖnemli	AşırıDereceDahaÖnemli (Kıyaslanamaz Bile)	Criteria
Not Being Too Crowded To Use												Timeliness (Feeling Safe In Delivery Of Service On Time)
Not Being Too Crowded To Use												Accuracy (Accuracy And Consistency Of Given Information And Promise)
Timeliness (Feeling Safe In Delivery Of Service On Time)												Accuracy (Accuracy And Consistency Of Given Information And Promise)

Criteria	Aşırı Derece Daha Önemli (Kıyaslanamaz Bile)	Çok Daha Önemli	Belirgin Derecede Daha Önemli	Daha Önemli	Biraz Daha Önemli (Neredeyse Aynı)	Tam Olarak Eşit Öneme Sahip, Tamamen Aynı	Biraz Daha Önemli (Neredeyse Aynı)	Daha Önemli	Belirgin Derecede Daha Önemli	Çok Daha Önemli	Aşırı Derece Daha Önemli (Kıyaslanamaz Bile)	Criteria
Feeling Safe and Relax In Gym												Knowledge and Competence of Trainer
Feeling Safe and Relax In Gym												Cost
Feeling Safe and Relax In Gym												Courtesy and Politeness of Employee
Feeling Safe and Relax In Gym												Keeping Members Fitness-Motivation
Knowledge and Competence of Trainer												Cost
Knowledge and Competence of Trainer												Courtesy and Politeness of Employee
Knowledge and Competence of Trainer												Keeping Members Fitness-Motivation
Cost												Courtesy and Politeness of Employee
Cost												Keeping Members Fitness-Motivation
Courtesy and Politeness of Employee												Keeping Members Fitness-Motivation

Pair-Wise Comparison: Features

Criteria	AşırıDereceDahaÖnemli (Kıyaslanamaz Bile)	ÇokDahaÖnemli	BelirginDerecedeDahaÖnemli	DahaÖnemli	BirazDahaÖnemli (NeredeyseAynı)	Tam OlarakEşitÖneme Sahip, TamamenAynı	BirazDahaÖnemli (NeredeyseAynı)	DahaÖnemli	BelirginDerecedeDahaÖnemli	ÇokDahaÖnemli	AşırıDereceDahaÖnemli (Kıyaslanamaz Bile)	Criteria
Group Lessons												Social Activity

Pair-Wise Comparison: Responsivenes

Criteria	AşırıDereceDahaÖnemli (Kıyaslanamaz Bile)	ÇokDahaÖnemli	BelirginDerecedeDahaÖnemli	DahaÖnemli	BirazDahaÖnemli (NeredeyseAynı)	Tam OlarakEşitÖneme Sahip, TamamenAynı	BirazDahaÖnemli (NeredeyseAynı)	DahaÖnemli	BelirginDerecedeDahaÖnemli	ÇokDahaÖnemli	AşırıDereceDahaÖnemli (Kıyaslanamaz Bile)	Criteria
Announcement of Services												Willingness To Help
Announcement of Services												Effective and Prompt Problem Solving
Willingness To Help												Effective and Prompt Problem Solving

Pair-Wise Comparison: Criteria

Criteria	AşırıDereceDahaÖnemli (Kıyaslanamaz Bile)	ÇokDahaÖnemli	BelirginDerecedeDahaÖnemli	DahaÖnemli	BirazDahaÖnemli (NeredeyseAynı)	Tam OlarakEşitÖneme Sahip, TamamenAynı	BirazDahaÖnemli (NeredeyseAynı)	DahaÖnemli	BelirginDerecedeDahaÖnemli	ÇokDahaÖnemli	AşırıDereceDahaÖnemli (Kıyaslanamaz Bile)	Criteria
Tangible												Empathy (Attentiveness)
Tangible												Reliability
Tangible												Assurance
Tangible												Responsiveness
Tangible												Features
Empathy (attentiveness)												Reliability
Empathy (attentiveness)												Assurance
Empathy (attentiveness)												Responsiveness
Empathy (attentiveness)												Features
Reliability												Assurance
Reliability												Responsiveness
Reliability												Features
Assurance												Responsiveness
Assurance												Features
Responsiveness												Features