BENCHMARKING SERVICE QUALITY PERFORMANCE OF AIRLINES IN TURKEY

Yiğit KAZANÇOĞLU
Yrd.Doç. Dr. İzmir Ekonomi Üniversitesi, İİBF İşletme Bölümü
İpek KAZANÇOĞLU
Yrd. Doç. Dr. Ege Üniversitesi, İİBF İşletme Bölümü

Türkiye'deki Havayollarının Hizmet Kalitesi Performansının Kıyaslanması

Özet

Bu çalışmanın amacı ülkemizdeki havayollarının iç hatlardaki yolcu taşıma faaliyetine ilişkin hizmet kalitesi faktörlerini belirlemek ve bu faktörleri bulanık mantık tabanlı çok kriterli bir karar verme tekniği kullanarak havayolu firmalarını sıralamak ve kıyaslamaktır. Çalışmada öncelikle hizmet kalitesinin faktörlerini belirlemek için faktör analizi yapılmış ve havayolu firmalarının hizmet kalitesi performanslarını değerlendirmek üzere yolcu görüşleri bulanık dilsel değişkenler yardımıyla analiz edilmiştir. Bu çalışmanın havayolu taşımacılığındaki hizmet kalitesi konusunda gelişmekte olan ülkelerdeki durumu yansıtması, ülkemiz örneğinde havayolu firmalarının üzerinde durmaları gereken hizmet kalitesi faktörlerini açıklaması, bulanık mantık tabanlı çok kriterli karar verme tekniği ile havayolu firmalarını kendi içlerinde bir sıralama ve kıyaslama yapması, her bir firma için bireysel bir yol haritası sunması yönünden yenilikçi olduğu düşünülmektedir. Bu çalışmanın özgünlüğü, bulanık mantık tabanlı çok kriterli karar verme yöntemi ile firmaların rakip firmalara göre hizmet kalitesi kriterlerini kıyaslaması, performanslarının yetersiz kaldığı kriterleri belirlemesi, iyileştirme yapılacak kriterler için önceliklendirme yapması ve eksik olunan kriterlerde örnek almaları gereken firmaları işaret eden bir yol haritası sunmasıdır.

Anahtar Kelimeler: Kıyaslama, Hizmet Kalitesi, Havayolu, Fuzzy TOPSIS, Çok Kriterli Karar Verme.

Benchmarking Service Quality Performance of Airlines in Turkey

Abstract

The aim of this study is to determine service quality factors of Turkish domestic airlines as well as ranking and benchmarking firms according to these factors using a fuzzy multicriteria decision making (MCDM) model. Exploratory factor analysis and fuzzy integral were used for extracting some independent common-factors and integrating the performance ratings of independent attributes in each common-factor, respectively. This paper is innovative in the sense that it helps airlines to identify key service quality factors, rank or benchmark firms in the industry through a fuzzy MCDM point of view, and provide an individual road map for improvement to each firm in a developing country, Turkey. This study is original in the sense that it helps firms compare their service quality criteria with competitors, identify performance insufficiencies by criteria, and choose the target competitors for improving the insufficiencies by identified and prioritized criteria through benchmarking.

Keywords: *Benchmarking, Service Quality, Airline, Fuzzy TOPSIS, Multicriteria Decision Making*

1. Introduction

While the definition of service quality and its influential characteristics continue to be important research issues, the understanding of service quality being offered relative to competitors occupies a significant importance to the strategic management of airlines (Chang and Yeh, 2002: 167-168). Today, the firms in airline industry tend to focus on the commitment of improving customer service quality. The evolution of the industry provides evidence that airlines and airports function in interactive markets, where service quality plays an important role (Macário, 2008: 171).

In a highly competitive environment, where all airline firms have comparable fares and similar frequent flyer programs, airlines are forced to seek competitive advantage in service quality. Therefore, airline managers need a tool to guide the process of improving this. This need is a tool that not only presents the current situation, but provides a road map of improvements and precautions for the future. Thus, this article attempts to fill these gaps in the current literature with an application in domestic airlines in Turkey. Therefore, the aims of this study are, first to define the service quality factors in the sector, second, to evaluate the service quality of Turkish domestic airlines, and finally, with the aid of the results of the proposed model, to present an analytical road map to managers for improvement.

The paper is organized as follows: in the first section, a brief literature review on service quality in airlines is presented. In the second section, the service quality evaluation problem in airlines is scrutinized. Because the application of the study is conducted in Turkey, the structural development of Turkish domestic airline industry is described, including historical background and accompanying statistical figures. In the third section, on the basis of previous research, the data were collected by applying a survey, after which a exploratory factor analysis was used to identify the evaluation factor or criteria for airline service quality. After the determining the main and sub criteria of service quality, the theoretical structure of Fuzzy Logic and Fuzzy Topsis, the proposed MCDM (Multicriteria Decision Making) Model of the study, are presented in the fourth section. In the fifth section, the application is conducted with a group composed of 10 experienced professionals currently engaged in civil aviation. The assessments using fuzzy logic with linguistic variables are made for three airlines firms. In the sixth section presents the results, as a basis for an improvement seeking road map for managers. The finally part offers conclusion and suggestions, and describes the implications and limitations of the research, and future research directions.

2. Literature Review of Service Quality Evaluation in Airlines

Quality has become a significant concern for those in the service industry, specifically in the airline industry. Though people primarily use air transport to satisfy their need to travel, procedures ranging from ticketing, checking, boarding and travelling to baggage handling can also deeply influence travellers' attitudes to the services provided by airlines and their satisfaction with those services (Ling et al., 2005:800). Service quality is a composite of various interactions between customers and airlines, with employees seeking to influence customers' perceptions and the image of the carriers (Gursoy et al., 2005: 57). Service quality is a composite of various attributes, and many interdependent characteristics may be inaccurately evaluated using conventional additive measures. Some important previous studies have tried to identify service quality factors in the airline industry. Many studies have used traditional statistical techniques to assess the service quality of airlines (Ostrowski et al.,1993; Truitt and Haynes, 1994:23; Park et al. 2006: 362; Gursoy, et al., 2005: 60; Chen and Chang, 2005:83; Liou and Tzeng, 2007: 132; Pakdil and Aydın, 2007: 231; Jou and et al. 2008: 586; An and Noh 2009: 294). Others have applied non-additive models based on MCDM methods to accomplish the same goals and to make suggestions for improvement (Chang and Yeh, 2002: 168; Tsaur, Chang and Yeh, 2002: 109; Liou and Tzeng, 2007: 132; Torlak, et al. 2010: 3396; Chen, et al., 2011: 2856; Liou, et al., 2011: 1384).

With respect to the first, the European tradition, the first scholarly contributions on service quality came from Scandinavia and Northern Europe (Grönroos, 1984: 38). Lehtinen and Lehtinen (1982) defined service quality in terms of physical quality (the tangible aspects of a service); interactive quality (the interaction between a customer and a service provider, including automated and animated interactions); and corporate (image) quality (the image attributed to a service provider by its current and potential customers). Lehtinen (1983) defined service quality in terms of "process quality" (judged by a customer during a service) and "output quality" (judged by a customer after a service has been performed (Soteriou and Chase,1998: 496). Grönroos (1984), figure out "Nordic School" (Edvardsson and Mattsson, 1993: 290), defined the dimensions of service quality in terms of: "technical quality" (what the consumer receives; that is, a result oriented dimension); and "functional quality" (how the consumer receives the service; that is, a process oriented dimension) (Sa´nchez et al., 2007: 139). There are many empirical studies concerned with service quality. Parasuraman, Zeithaml and Berry (1985) proposed ten aspects of evaluation criteria in assessing service quality, are reliability, responsiveness, competence, assurance, courtesy of personnel, communications, credibility or trustworthiness of the organization, security or protection from risk, understanding of customer's needs and tangibles or physical elements attesting to the nature of the service.

The service quality characteristics of the various transport solutions, i.e. factors such as reliability of delivery, service frequency, absence of losses, transport time (or speed), and carriers' flexibility in reaction to unexpected demands. Ostrowski, O'Brien, and Gordon's (1993) study of service quality and customer loyalty selected three factors, punctuality, food and beverage quality and seat comfort as the bases for surveying service quality. Thus, an airline can gain a leading position in the market by offering superior quality services relative to its competitors. It is therefore of strategic importance for airlines to understand their relative competitive advantages on service quality (Chang and Yeh, 2002: 174). Truitt and Haynes (1994: 21) used the following for measuring service quality: the check-in process, convenience of transit, luggage processing, timeliness, seat cleanliness, food and beverage quality and customer complaint handing. They also added passenger complaints on items such as flight, reservation, ticketing and boarding problems, fares, refunds, customer service, advertising, and frequent flyer programs (Pakdil and Aydın, 2007: 230). Gilbert and Wong (2003) developed a 26-attribute model incorporating reliability, safety, facilities, employees, flight patterns, customization, and responsiveness dimensions to measure and compare the differences in passengers' expectations of the desired airline's service quality (Liou and Tzeng, 2007: 132). Chen and Chang (2005: 83) examined airline service quality from a process perspective by first examining the gap between passengers' service expectations and the actual service received, and then the gaps associated with passenger service expectations and perceptions of these expectations by frontline managers and employees. Importance–performance analysis was then used to construct service attribute evaluation maps to identify areas for improvement. Pakdil and Aydın (2007: 230) measured airline service quality across 8 dimensions, which are employees, tangibles, responsiveness, reliability and assurance, flight patterns, availability, image and empathy, using factor analysis to present the result that responsiveness and availability are most important dimensions in Turkish airline. Chau and Kao (2009: 113) found that the gap-5 understanding of service quality is applicable for the airline context, with a strong tendency of all the aggregate expected levels of service responses turning out greater than those of perceived levels (perceived as delivered based on experience). There was a statistically significant difference between the perceived and expected levels of service quality in the airline industry; these were affected by such demographic factors as education, occupation and income levels (but not all that were examined); the SERVQUAL model's dimensions represent appropriately the airline industry; and the gap-5 sizes of these quality dimensions had a significant impact on customer satisfaction and service value. Parast and Fini (2010: 459) investigated the effect of productivity and quality on profitability in the US airline industry and on-time performance had been used as a measure of service quality.

Research in service quality has concentrated on the concept of service quality defined in terms of consumers' perceptions relative to expectations. When determining ranks in service quality ranking, in comparison to the competitors, it is very difficult to define a clear attributes for quantitative measurements because consumer judgments are often vague and preferences can not be estimated with an exact numerical value. Therefore some authors developed a non-additive model for evaluating the service quality of airlines. Tsaur et al. (2002: 102) proposed a five dimensional measurement of service quality that includes tangibility, reliability, responsiveness, assurance, and empathy. Analytical hierarchical processes were used to obtain the attribute weight and TOPSIS (Technique for Order of Preference by Similarity to Ideal Solution) in ranking the airlines. They concluded that the attributes of most importance are courtesy, safety, and comfort. Chang and Yeh (2002: 170) used fuzzy multicriteria analysis modelling to formulate the service quality of airlines. Due to the heterogeneity, intangibility, and inseparability of service quality, fuzzy set theory was used to describe the ambiguity between the criteria weight and performance ratings of each airline. Liou and Tzeng (2007: 132) used to factor analysis, fuzzy integral and grey relation analysis to rank the service quality dimensions. These dimensions included employees' service, safety and reliability, on board service, schedule, on time performance, and free ticket and upgrading. Jou and et al. (2008: 586) suggested that safety, convenience and service quality have a major influence on the choice decision of air passengers. This implies that the airlines should improve the various aspects of convenience, e.g. ease in purchasing tickets, baggage handling or flight times, etc. Passengers would prefer to receive comprehensive service, for example – frequent flyer programs, improved food and drinks, in-flight supplies or duty-free merchandise, etc.; all these are effective strategies in gaining passengers (Jou et al, 2008: 586). An and Noh (2009: 300-301) delineated six service quality factors (i.e., in-flight alcoholic beverages and non-alcoholic beverages, responsiveness and empathy, reliability, assurance, presentation style of food, and food quality) for the prestige class service, while the economy class shows five quality factors (i.e., responsiveness and empathy, food quality, alcoholic beverage, non-alcoholic beverage, and reliability). Torlak et al. (2010: 3396) implemented fuzzy TOPSIS multi-methodological approach in the Turkish domestic airline industry. This study reveals the ranking of major air carriers in light of key success variables in the sector. Chen, Tseng and Lin (2011: 2856) focused on the in-flight service quality from the viewpoint of customer perceptions in linguistic preferences, using the grey system approach and exerted the fuzzy set theory. Chou et al. (2011: 2117) evaluated service quality by using the weighted fuzzy SERVQUAL method. The first three service items are safety, the customer complaint handling and the crew courtesy in that order, followed by the on-time departure and arrival, and comfort and cabin cleanliness. Kuo (2011: 1177) proposed an effective approach based on combining VIKOR, GRA, and interval valued fuzzy sets to evaluate service quality of Chinese cross-strait passenger airlines via customer surveys. This study implies that managers pay attention to airline flight safety and security measures and on time performance. Liou et al. (2011: 1385) use a modified grey relational model to investigate the service quality of four major domestic Taiwan airlines. The results suggest the importance of training flight attendants to in offering a sincere and courteous service.

In overall, many studies have been conducted either to explore the service quality aspects of airlines to rank the airlines according to their service quality performance using MCDM and fuzzy theory. However, the literature fails to provide suggestions for managers, based on their rank or benchmark result, in an analytical way.

This study is not limited to presenting the current position or rank, but focuses on what needs to be done. The important contributions are that the suggestions are given for each criterion with a target value equal to that of the target firm which is a comparative leader in that criterion. These suggestions are prioritized according to their urgency.

3. The Structural Development of Turkish Domestic Airline Industry

With a growing population, rapid urbanization, promising foreign tourism industry and an active regional commercial base, Turkey has witnessed a need to further develop civil aviation and airport infrastructure in the current decade.

The liberalization of domestic flights is regarded as the most important development in the post-1983 period of liberalization in Turkey (Gerede, 2010: 71-72). Until 1983, Turkish Airlines (THY) was the only airlines company and had no domestic competitors in the market. In 1983, the market was deregulated and competitors entered the market and began to operate domestic and international flights. However, because of the extreme competition, some airlines went out of busines(Erişim:http://www.byegm.gov.tr/yayinlarimiz/NEWSPOT/1998/Sep/N7.htm). In addition, private airline companies were confronted with bureaucratic obstacles in their entry to domestic flights market. In 1983 Turkish Civil Aviation Law was enacted, providing the private sector the right to operate airlines and airports. After that, a new era began for Turkish Civil Aviation and civil aviation activities grew rapidly. However, THY maintained its monopoly in domestic flights until 2003, and thus, domestic flights made no any progress until the re-deregulation of the Turkish Air Transportation Industry was declared at the end of 2003. This completely changed air transportation politics, and all restrictions on private airline companies operating in scheduled domestic routes were lifted, and tax reduction was provided for these domestic flights (Atalık and Arslan, 2009: 62). With this practice, a several new carriers such as Fly Air, Onur Air, Pegasus Airlines, and Atlas Jet entered the market. The first effect of this new condition was the decrease in ticket fares and increase in competition, creating massive demand for air transportation and market growth. The most important result of the liberalization in domestic flights has been the considerable increase in the number of passengers carried by domestic flights. In a highly competitive environment where all airline firms have comparable fares and similar frequent flyer programs, airlines were forced to seek competitive advantage in service quality.

According to International Civil Aviation Organization Annual Report, with the global economic crisis in 2009, in 190 countries worldwide, the total number of passengers (both domestic and international) carried showed almost no change between 2008 and 2009, increasing only 0.26 % from 2,271,123 to 2,277,192 thousand. In domestic airlines showed a similar situation, where in fact the total fall slightly between 2008 and 2009 from 1,405,089 to 1,405,089 thousand (Annual Report of the Council, 2010). In contrast, in Turkey the total number of passengers (domestic and international) rose from 85 million in 2009 to 102 millions in 2010, representing a 16.6% increase, whereas in the number of domestic line passengers rose from 41.227 million in 2009 to 50.576 millions in 2010, an increase of 18.4 %. In this respect, in contrast to the effects of global economic crisis to airlines in worldwide, the figures represent a growth in demand for air travel in Turkey, which enabled airline firms to increase their capacity and number of passengers carried in Turkey (The Activity Report, 2010: 34).

4. Determination of Service Quality Criteria for Turkish Domestic Airlines

The methodology can be briefly summarized as follows: the data were collected by applying a survey, and then exploratory factor analysis (EFA) was used to identify the evaluation factor or criteria for airline service quality.

4.1. Questionnaire Design

In preparing the questionnaire, we referred to the airline quality service scale and SERVQUAL scale developed by Parasuraman et al. (1985), Chang and Yeh (2002: 169), Yeh and Kuo (2003: 38), Gursoy et al. (2005: 60), Chen and Chang (2005: 83), Pakdil and Aydin (2007: 230). These studies helped to determine airline service quality dimensions. Our 27-item questionnaire includes airline service quality dimensions, which are measured by Likert scale questions, composed of 5 options, i.e. 1 = strongly disagree to 5 = strongly agree. The questionnaire was prepared in Turkish, and the statements were translated into English for the tables.

4.2. Sampling and Data Collection

The sample was taken from domestic airline passengers flying from Izmir Adnan Menderes Airport. The survey was administered over 3 weeks. The field study was conducted in June and July 2011 with a random sample of 950 passengers at the airport, resulting in 932 usable replies from economy class passengers. The survey was restricted to this class in order to provide a reasonably homogeneous sample.

4.3. Determination of Service Quality Criteria

In order to obtain meaningful results, the validity and reliability of the questionnaire was evaluated prior to analysis. The structural validity of the scale was analyzed via a exploratory factor analysis, which was used to group and name related variables. An exploratory factor analyses (EFA) was perfomed on the total sample in order to identify the common factors of the service quality with Varimax rotation. Factor analysis was initially used to extract some independent common factors, and the fuzzy integral was used to integrate the performance ratings of the interdependent attributes in each common factor. Cronbach's alpha coefficient was used to assess reliability for the whole scale, revealing a satisfactory level, with a value of 0.82. Table 1 shows the results of the exploratory factor analysis used to test the individual dimensions and items of the model. We deleted 5 factors whose loadings were less than 0.5. The accumulative explained variance is 64.5 %. Principle component analysis isolated eight common factors as shown in Table 1 21.391 %, 30.412 %, 38.263 %, 44.990 %, 50.625 %, 55.513 %, 60.077 % and 64.505 %. The factors were named as "Personal Quality", "Aircraft Conditions", "Punctuality", "Convenience Of Service", "Baggage Handling", "Customer Complaints", "Availability" and "Performance" in accordance with their respective factor loadings (Table 1). Using these results, Figure 1 shows how the hierarchical structure of the research problem is constructed. The goal is stated as the evaluation of airlines service quality (Level 1). In respect to this goal, the second level represents the main criteria affecting service quality, and the third shows sub-criteria associated with each criterion.

Table 1. Exploratory Factor Analysis Results After Varimax Rotated

Common Factors/Criteria	Variables	Factor Loading	Factor Interpretation (Cumulative % of variance explained)
Personal Quality	Personnel attention for passengers	0.895	21.391 %
	Adequate support for employees	0.842	
	Appearance of flight crew	0.840	
	Seriousness in solving passengers' problems and facilitating the process of meeting their needs	0.776	
	Rapidity of response	0.661	
	Friendliness and helpfulness of flight crew toward passengers	0.537	
Aircraft Conditions	Age and condition of aircraft	0.765	30.412 %
	Cleanliness of rest-rooms	0.710	
	Safety of aircraft	0.679	
	Comfort of chairs and amount of legroom	0.678	
	Quality of airline food and beverage	0.561	
Punctuality	Punctuality of departure	0.835	38.263 %
	Punctuality of arrival	0.832	
Convenience Of Service	Convenience of flight schedule	0.807	44.990 %
	Availability of direct flights	0.768	
Baggage Handling	Efficiency of transfer luggage	0.785	50.625 %
	Fee for excess baggage	0.673	
Customer Complaints	Damaged or lost baggage	0.746	55.513 %
	Problems in reservation process	0.741	
Availability	Opportunity to book and pay for flight through internet	0.851	60.077 %
	Frequency of scheduled flights operating without cancellation	0.789	
Performance	Prompt announcement of flight schedules and the availability of alternative flights in case of delay or cancellation	0.801	64.505 %
	Sufficient flight frequency of airline	0.751	

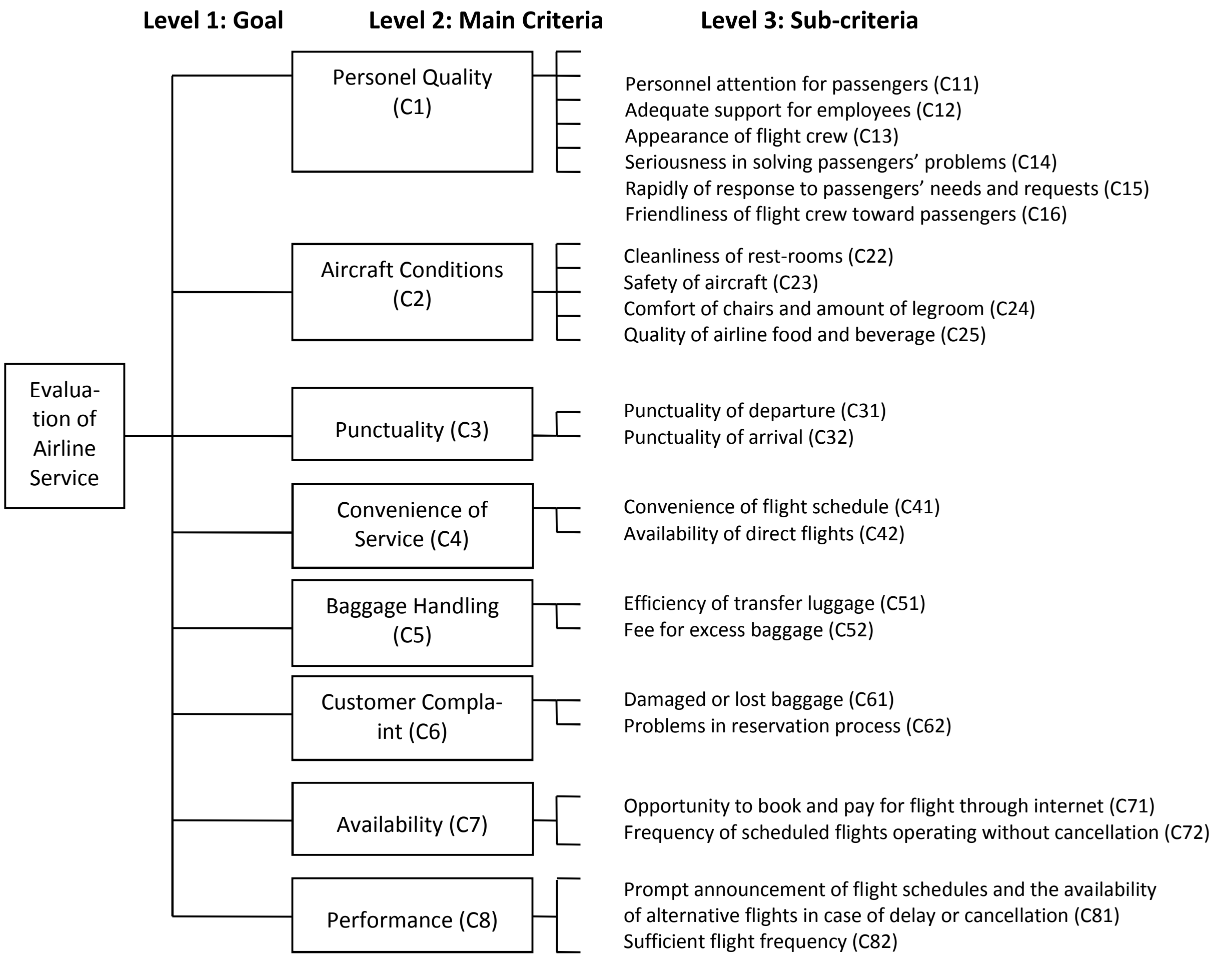

Figure 1. Hierarchical Structure of Airline Service Quality Evaluation

After the determination of service quality main and sub criteria, we formulate the criteria weights, represented as fuzzy sets. Service quality performance evaluations of firms are then evaluated through fuzzy multi criteria analysis. Each expert assesses the relative importance of service attributes and the performance rating of each airline firm, with respect to each service attribute, using the linguistic terms defined in the corresponding term set.

5.Fuzzy MCDM Model

The fuzzy set theory has been applied to the field of management science, such as decision making, (Hutchinson, 1998; Viswanathan, 1999; Xia et al., 2000); however, it is rarely used in the field of service quality. As Chou et al. (2011:2118) suggest, human judgments are often vague and it is not easy for passengers to express the weights of evaluation criteria and the satisfaction of airline service quality using an exact numerical value. It is therefore more realistic to use linguistic terms to describe the expectation value, perception value and important weight of evaluation criteria. Due to this type of existing fuzziness in the airline service quality evaluation, fuzzy set theory is an appropriate for dealing with this uncertainty, and thus was the motive for using fuzzy logic in the proposed model.

5.1. Fuzzy Numbers and Linguistic Variables

A positive trapezoidal fuzzy number (PTFN) $\tilde{n}$ can be defined as (n_1,n_2,n_3,n_4) shown in Figure 2. The membership function, $\mu_{\tilde{n}}$ is defined as (Kaufmann and Gupta, 1991).

$$\mu_{\tilde{n}} = \begin{cases} 0, & x<n_1 \\ (x-n_1)/(n_2-n_1), & n_1 \leq x \leq n_2 \\ 1, & n_2 \leq x \leq n_3 \\ (x-n_4)/(n_3-n_4), & n_3 \leq x \leq n_4 \\ 1, & x>n_4 \end{cases}$$

For a trapezoidal fuzzy number $\tilde{n}$=(n1,n2,n3,n4),if n2=n3, then $\tilde{n}$ is called a triangular fuzzy number. A non-fuzzy number r can be expressed as (r, r, r, r).

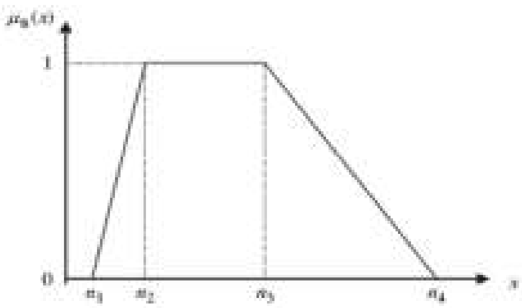

Figure 2. Trapezoidal fuzzy number $\tilde{n}$

A linguistic variable is one whose values are expressed in linguistic terms (Zimmermann, 1991: 287). The concept of a linguistic variable is very useful in dealing with situations which are too complex or not sufficiently well-defined to be reasonably described in conventional quantitative expressions (Zimmermann, 1991: 288). For example, ‘‘weight’’ is a linguistic variable whose values are very low, low, medium, high, very high, etc. Fuzzy numbers can also represent these linguistic values.

5.2.Fuzzy TOPSIS

A systematic approach to extend the TOPSIS is proposed in order to solve the alternative-selection problem under a fuzzy environment in this section. In this paper, the importance weights of various criteria and the ratings of qualitative criteria are considered as linguistic variables. Because linguistic assessments merely approximate the subjective judgment of decision-makers, we can consider linear trapezoidal membership functions to be adequate for capturing the vagueness of these linguistic assessments (Delgado et al., 1998: 178 ; Herrera et al., 1996: 78; Herrera and Herrera-Viedma, 2000: 68). These linguistic variables can be expressed in positive trapezoidal fuzzy numbers, as in Figures 3 and 4. The importance weight of each criterion can be assigned either directly or indirectly using pair-wise comparison (Cook, 1992: 23). It is suggested in this paper that the decision-makers use the linguistic variables shown in Figures 3 and 4 to evaluate the importance of the criteria and the ratings of alternatives with respect to qualitative criteria.

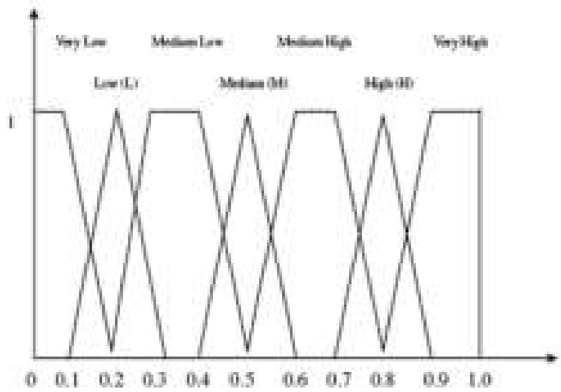

Figure 3. Linguistic variables for importance weight of each criterion

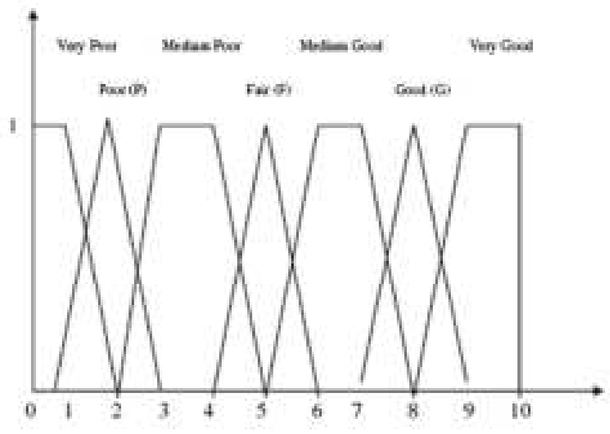

Figure 4. Linguistic variables for ratings

For example, the linguistic variable ''Medium High (MH)'' can be represented as (0.5, 0.6, 0.7, 0.8) the membership function of which is

$$\mu_{MediumHigh}(x) = \begin{cases} 0, & x<0.5 \\ (x-0.5)/(0.6-0.5), & 0.5 \leq x \leq 0.6 \\ 1, & 0.6 \leq x \leq 0.7 \\ (x-0.8)/(0.7-0.8), & 0.7 \leq x \leq 0.8 \\ 0, & x>0.8 \end{cases} \quad (7)$$

The linguistic variable ''Very Good (VG)'' can be represented as (8,9,9,10), the membership function of which is

$$\mu_{VeryGood}(x) = \begin{cases} 0, & x<8 \\ (x-8)/(9-8), & 8 \leq x \leq 9 \\ 1, & 9 \leq x \leq 10 \end{cases} \quad (8)$$

In fact, a group multiple-criteria decision-making (GMCDM) problem may be described by means of the following sets:

(i) a set of K decision-makers called E= $\{D_1, D_2, ..., D_k\}$;

(ii) a set of m possible alternatives called A= $\{A_1, A_2,...., A_m\}$;

(iii) a set of n criteria, C= $\{C_1, C_2,...., C_k\}$;, with which alternative performances are measured;

(iv) a set of performance ratings of A_i (i=1,2,....m); with respect to criteria C_j (j=1,2,....n); called

X= $\{x_{ij}, i = 1,2,....m, j = 1,2,......n\}$.

Assume that a decision group has K decision makers, and the fuzzy rating of each decision maker, Dk (k=1,2,…,K); can be represented as a positive trapezoidal fuzzy number $\tilde{R}_k$ (k=1,2,…,K); with membership function $\mu_{\tilde{R}_k}$ (x). A good aggregation method should consider the range of fuzzy rating of each decision-maker. This means that the range of aggregated fuzzy rating must include the full ranges of all decision-makers' fuzzy ratings. Let the fuzzy ratings of all decision makers be trapezoidal fuzzy numbers $\tilde{R}_k$ (ak,bk,ck,dk) k=1,2,…,K. Then the aggregated fuzzy rating can be defined as

$$\tilde{R} = (a,b,c,d),\ k=1,2,\ldots,K \qquad (9)$$

where,

$$a = \min_k \{a_k\},\ b = \frac{1}{K}\sum_{k=1}^{K} b_k\ ,\ c = \frac{1}{K}\sum_{k=1}^{K} c_k\ ,\ d = \max_k \{d_k\}$$

Let the fuzzy rating and importance weight of the k[th] decision maker be $\tilde{x}_{ijk} = (a_{ijk}, b_{ijk}, c_{ijk}, d_{ijk})$ and $\tilde{w}_{ijk} = (w_{jk1}, w_{jk2}, w_{jk3}, w_{jk4})$; $\{i = 1,2,....m, j = 1,2,......n\}$respectively.

Hence, the aggregated fuzzy ratings ($\tilde{x}_{ij}$) of alternatives with respect to each criterion can be calculated as

$$\tilde{x}_{ij} = (a_{ij}, b_{ij}, c_{ij}, d_{ij}) \qquad (10)$$

$$a_{ij} = \min_k \{a_{ijk}\}, \; b_{ij} = \frac{1}{K}\sum_{k=1}^{K} b_{ijk} \; , \; c_{ij} = \frac{1}{K}\sum_{k=1}^{K} c_{ijk} \; , \; d_{ij} = \max_k \{d_{ijk}\}$$

The aggregated fuzzy weights ($\tilde{x}_{ij}$) of each criterion can be calculated as

$$\tilde{w}_j = (w_{j1}, w_{j2}, w_{j3}, w_{j4}) \qquad (11)$$

where $w_{j1} = \min_k \{w_{jk1}\}, \; w_{j2} = \frac{1}{K}\sum_{k=1}^{K} b_{jk2} \; , \; w_{j3} = \frac{1}{K}\sum_{k=1}^{K} w_{jk3} \; , \; w_{j4} = \max_k \{w_{jk4}\}$

As stated above, problem can be concisely expressed in matrix format as follows:

$$\tilde{D} = \begin{bmatrix} \tilde{x}_{11} & \tilde{x}_{12} & \dots & \tilde{x}_{1n} \\ \tilde{x}_{21} & \tilde{x}_{22} & \dots & \tilde{x}_{11} \\ \vdots & \vdots & \dots & \vdots \\ \tilde{x}_{m1} & \tilde{x}_{m1} & \dots & \tilde{x}_{mn} \end{bmatrix}$$

$\tilde{W} = [w_1, w_2, ..., \; w_n]$ where $\tilde{x}_{ij} = (a_{ij}, b_{ij}, c_{ij}, d_{ij})$ and $\tilde{w}_j = (w_{j1}, w_{j2}, w_{j3}, w_{j4})$; $\{i = 1,2,...m, j = 1,2,.....n\}$ can be approximated by positive trapezoidal fuzzy numbers.

To avoid complexity of mathematical operations in a decision process, the linear scale transformation is used here to transform the various criteria scales into comparable scales. The set of criteria can be divided into benefit criteria (the larger the rating, the greater the preference) and cost criteria (the smaller the rating, the greater the preference). Therefore, the normalized fuzzy-decision matrix can be represented as

$$\tilde{R} = [\tilde{r}_{ij}]_{mxn} \qquad (12)$$

where B and C are the sets of benefit criteria and cost criteria, respectively, and

$$\tilde{r}_{ij} = \left(\frac{a_{ij}}{d_j^*}, \frac{b_{ij}}{d_j^*}, \frac{c_{ij}}{d_j^*}, \frac{d_{ij}}{d_j^*} \right), \; j \in B, \; \tilde{r}_{ij} = \left(\frac{a_j^-}{d_{ij}}, \frac{b_j^-}{d_{ij}}, \frac{c_j^-}{d_{ij}}, \frac{d_j^-}{d_{ij}} \right), \; j \in C,$$

$$d_j^* = \max_i d_{ij}, \; j \in B, \; a_j^- = \min_i a_{ij}, \; j \in C,$$

The normalization method mentioned above is designed to preserve the property in which the elements $\tilde{r}_{ij}, \forall i, j$ are standardized (normalized) trapezoidal fuzzy numbers. Considering the different importance of each criterion, the weighted normalized fuzzy-decision matrix is constructed as

$$\tilde{V} = \left[\tilde{v}_{ij}\right]_{mxn}, \{i = 1,2,....m, j = 1,2,......n\} \quad (13)$$

where $\tilde{v}_{ij} = \tilde{r}_{ij}(.)\tilde{w}_j$

According to the weighted normalized fuzzy decision matrix, normalized positive trapezoidal fuzzy numbers can also approximate the elements $\tilde{v}_{ij}, \forall i, j$. Then, the fuzzy positive-ideal solution (FPIS, A^*) and fuzzy negative-ideal solution (FNIS, A^-) can be defined as

$$A^* = (\tilde{v}_1^*, \tilde{v}_2^*, ..., \tilde{v}_n^*) \quad (14)$$

$$A^- = (\tilde{v}_1^-, \tilde{v}_2^-, ..., \tilde{v}_n^-) \quad (15)$$

Where

$$\tilde{v}_j^* = \max_i \{v_{ij4}\} \text{ and } \tilde{v}_j^- = \min_i \{v_{ij1}\}, \{i = 1,2,....m, j = 1,2,......n\}$$

The distance of each alternative from A^* and A^- can be currently calculated as

$$d_i^* = \sum_{j=1}^{n} d_v\left(\tilde{v}_{ij}, \tilde{v}_j^*\right), \{i = 1,2,....m\} \quad (16)$$

$$d_i^- = \sum_{j=1}^{n} d_v\left(\tilde{v}_{ij}, \tilde{v}_j^-\right), \{i = 1,2,....m\} \quad (17)$$

where d_v (.,.) is the distance measurement between two fuzzy numbers.

A closeness coefficient is defined to determine the ranking order of all possible alternatives once and of each alternative has been calculated. The closeness coefficient represents the distances to the fuzzy positive-ideal solution ( ) and the fuzzy negative-ideal solution ( ) simultaneously by taking the relative closeness to the fuzzy positive-ideal solution. The closeness coefficient (CCi) of each alternative is calculated as

$$CC_i = \frac{d_i^-}{d_i^- + d_i^*}, \ \{i = 1,2,....m\} \quad (18)$$

It is clear that CCi =1 if = and CCi = 0 if = . In other words, alternative is closer to the FPIS ( ) and farther from FNIS ( ) as CCi approaches to 1. We can determine the ranking order of all alternatives according to the descending order of CCi and select the best from among a set of feasible alternatives.

As applied in this paper, TOPSIS and fuzzy TOPSIS applications can be seen in the literature in different types of selection studies such as Parkan and Wu (1999), Chen (2001), Yurdakul and Cogun (2003), Yurdakul and Ic (2005). Chen (2000) attempted to solve place selection problem using an approach similar to fuzzy TOPSIS, but wrote a different algorithm in which regular numbers such as population are used together with fuzzy triangular values, in contrast to Fuzzy TOPSIS, which assigns values to linguistic variables.

In the previous section, eight criteria for service quality in airlines were derived from the exploratory factor analysis. Experts assessed the importance of each main and sub-criterion using fuzzy linguistic variables. Since judgments from experts are usually vague rather than crisp, each judgement should be expressed using fuzzy sets with the capability of representing vague data (Kahraman, et al., 2007 : 144). Due to the existing fuzziness in the airline service quality evaluation, fuzzy set theory is an appropriate method for dealing with uncertainty.

5.3.Turkish Domestic Airline Service Quality Ranking with Fuzzy TOPSIS

The service quality of three airlines was ranked through an application of the Fuzzy TOPSIS model, introduced by Chen (2000). Due to this type of existing fuzziness in the airline service quality evaluation, fuzzy set theory can be considered an appropriate method for dealing with uncertainty. The model evaluates the performance of three Turkish domestic airlines which, in order to preserve confidentiality, are referenced as A1, A2 and A3. These firms were chosen because they are determined as the most preferred firms according to the results of a passenger survey.

The application was conducted through a group composed of 10 experienced professionals currently engaged in civil aviation. The assessments were made for three airlines firms, using fuzzy logic with linguistic variables. The criteria and sub criteria determined in Section 4 which are given in Figure 1 are used in the MCDM application. Therefore the previous questionnaire study given in Section 4 is integrated to the MCDM application presented in this section. The relative comparison is made among the criteria and sub criteria, using the linguistic variables shown in Table 2. The criteria and sub criteria are listed separately and the assessments of evaluators are collected in order to get relative importance with the help of scale shown in Table 2. The alternatives are assessed with the sub-criteria using the linguistic variables shown in Table 3. Similarly the alternatives are listed and the assessments of evaluators for each alternative at each criteria and sub criteria are collected with the aid of scale shown in Table 3. The use of linguistic variables enables the experts to express their assessments.

Table 2. Linguistic Scale Used for Relative Importance of Subcriteria and Criteria

Linguistic variables				
Very High (VH)	0.8	0.9	1	1
High (H)	0.7	0.8	0.8	0.9
Relatively High (RH)	0.5	0.6	0.7	0.8
Fair (F)	0.4	0.5	0.5	0.6
Relatively Low (RL)	0.2	0.3	0.4	0.5
Low (L)	0	0.2	0.2	0.3
Very Low (VL)	0	0	0.1	0.2

Table 3. Linguistic Scale Used for the Assessment of Alternatives

Linguistic variables				
Very Good (VG)	8	9	10	10
Good (G)	7	8	8	9
Moderately Good (MG)	5	6	7	8
Normal (N)	4	5	5	6
Moderately Poor (MP)	2	3	4	5
Poor (P)	0	2	2	3
Very Poor (VP)	0	0	1	2

The weights of the criteria shown in Table 4 are calculated. Among the eight service criteria, the most important attributes are ‘personal quality’, ‘aircraft conditions, ‘convenience of service’, ‘baggage handling’ and “customer complaints”.

Table 4. Weights of Evaluation Criteria

Criteria	Fuzzy Weight			
C1	0.70	0.80	0.80	0.90
C2	0.50	0.73	0.77	0.90
C3	0.40	0.57	0.63	0.80
C4	0.50	0.70	0.73	0.90
C5	0.40	0.63	0.67	0.90
C6	0.40	0.63	0.67	0.90
C7	0.40	0.57	0.63	0.80
C8	0.40	0.53	0.57	0.80

Similarly the weights of the sub-criteria shown in Table 5 are calculated. Among the twenty-three service sub-criteria, the most important attributes are 'personnel attention for passengers', 'cleanliness of restrooms', 'safety of aircraft' and 'friendliness and helpfulness of flight crew toward passengers'. These results suggest the direction for service improvement.

Table 5. Weights of the Sub-Criteria

Subcriteria	Fuzzy Weight				Subcriteria	Fuzzy Weight			
C11	0.70	0.87	0.93	1.00	C31	0.50	0.60	0.70	0.80
C12	0.20	0.47	0.53	0.80	C32	0.50	0.50	0.60	0.40
C13	0.40	0.63	0.67	0.90	C41	0.40	0.50	0.50	0.60
C14	0.00	0.33	0.37	0.60	C42	0.20	0.30	0.40	0.50
C15	0.20	0.47	0.53	0.80	C51	0.20	0.30	0.40	0.50
C16	0.50	0.77	0.83	1.00	C52	0.20	0.30	0.40	0.50
C21	0.40	0.53	0.50	0.60	C61	0.40	0.50	0.50	0.60
C22	0.70	0.87	0.93	0.97	C62	0.50	0.60	0.70	0.80
C23	0.70	0.80	0.80	0.90	C71	0.40	0.50	0.50	0.60
C24	0.20	0.30	0.40	0.50	C72	0.50	0.60	0.70	0.80
C25	0.00	0.20	0.20	0.30	C81	0.40	0.50	0.50	0.60
					C82	0.40	0.50	0.50	0.60

Table 6 shows the highest scores of each criterion to be used in the normalization procedure.

Table 6. Highest Scores of Each Criterion

C1	C2	C3	C4	C5	C6	C7	C8
10	9	10	10	9	9	9	8

A normalization procedure is applied both to the weights of the criteria, and to the sub-criteria. Table 7 shows Normalized Fuzzy Decision Matrix according to the sub-criteria.

Table 7. Normalized Fuzzy Decision Matrix

	A1				A2				A3			
C11	0.70	0.87	0.93	1.00	0.50	0.73	0.77	0.90	0.40	0.63	0.67	0.90
C12	0.78	0.89	0.89	1.00	0.56	0.74	0.81	1.00	0.44	0.59	0.63	0.89
C13	0.80	0.90	1.00	1.00	0.70	0.80	0.80	0.90	0.70	0.80	0.80	0.90
C14	0.70	0.87	0.93	1.00	0.40	0.57	0.63	0.80	0.40	0.63	0.67	0.90
C15	0.78	0.89	0.89	1.00	0.22	0.48	0.52	0.67	0.56	0.67	0.78	0.89
C16	0.78	0.89	0.89	1.00	0.44	0.70	0.74	1.00	0.44	0.59	0.63	0.89
C21	0.56	0.81	0.85	1.00	0.44	0.7	0.74	1.00	0.22	0.63	0.70	1.00
C22	0.56	0.67	0.78	0.89	0.56	0.67	0.78	0.89	0.22	0.33	0.44	0.56
C23	0.63	0.75	0.88	1.00	0.50	0.63	0.63	0.75	0.25	0.38	0.50	0.63
C24	0.63	0.75	0.88	1.00	0.50	0.63	0.63	0.75	0.25	0.38	0.50	0.63
C25	0.78	0.89	0.89	1.00	0.22	0.33	0.44	0.56	0.22	0.33	0.44	0.56
C31	0.63	0.75	0.88	1.00	0	0	0.13	0.25	0.25	0.38	0.50	0.63
C32	0.63	0.75	0.88	1.00	0	0	0.13	0.25	0	0	0.13	0.25
C41	0.63	0.75	0.88	1.00	0	0.25	0.25	0.38	0.25	0.38	0.50	0.63
C42	0.78	0.89	0.89	1.00	0.44	0.56	0.56	0.67	0.44	0.56	0.56	0.67
C51	0.78	0.89	0.89	1.00	0.44	0.56	0.56	0.67	0.44	0.56	0.56	0.67
C52	0.63	0.75	0.88	1.00	0	0.25	0.25	0.38	0	0	0.13	0.25
C61	0.33	0.50	0.67	0.83	0.67	0.83	0.83	1.00	0.67	0.83	0.83	1.00
C62	0	0	0.20	0.40	0.40	0.60	0.80	1.00	0	0.40	0.40	0.60
C71	0	0	0.20	0.40	0.40	0.60	0.80	1.00	0	0.40	0.40	0.60
C72	0.50	0.63	0.63	0.75	0.63	0.75	0.88	1.00	0.50	0.63	0.63	0.75
C81	0.78	0.89	0.89	1.00	0.56	0.67	0.78	0.89	0.56	0.67	0.78	0.89
C82	0	0	0.33	0.67	0	0.67	0.67	1.00	0	0.67	0.67	1.00

Normalized Fuzzy Decision Matrix was multiplied by the weights of the related criteria and sub-criteria, and the Weighted Normalized Fuzzy Decision Matrix was obtained as shown in Table 8.

Table 8. Weighted Normalized Fuzzy Decision Matrix

	A1				A2				A3			
C11	0.34	0.60	0.70	0.90	0.25	0.51	0.57	0.81	0.20	0.44	0.50	0.81
C12	0.11	0.33	0.38	0.72	0.08	0.28	0.35	0.72	0.06	0.22	0.27	0.64
C13	0.22	0.46	0.53	0.81	0.20	0.41	0.43	0.73	0.20	0.41	0.43	0.73
C14	0	0.23	0.27	0.54	0	0.15	0.19	0.43	0	0.17	0.20	0.49
C15	0.11	0.33	0.38	0.72	0.03	0.18	0.22	0.48	0.08	0.25	0.33	0.64
C16	0.27	0.55	0.59	0.90	0.16	0.43	0.49	0.90	0.16	0.36	0.42	0.80
C21	0.11	0.32	0.33	0.54	0.09	0.28	0.28	0.54	0.04	0.25	0.27	0.54
C22	0.22	0.48	0.56	0.64	0.22	0.48	0.56	0.64	0.09	0.24	0.32	0.40
C23	0.22	0.44	0.54	0.81	0.18	0.37	0.38	0.61	0.09	0.22	0.31	0.51
C24	0.06	0.17	0.27	0.45	0.05	0.14	0.19	0.34	0.03	0.08	0.15	0.28
C25	0	0.13	0.14	0.27	0	0.05	0.07	0.15	0	0.05	0.07	0.15
C31	0.13	0.26	0.39	0.64	0.00	0.00	0.06	0.16	0.05	0.13	0.22	0.40
C32	0.13	0.21	0.33	0.32	0	0	0.05	0.08	0	0	0.05	0.08
C41	0.13	0.26	0.32	0.54	0	0.09	0.09	0.20	0.05	0.13	0.18	0.34
C42	0.08	0.19	0.26	0.45	0.04	0.12	0.16	0.30	0.04	0.12	0.16	0.30
C51	0.06	0.17	0.24	0.45	0.04	0.11	0.15	0.30	0.04	0.11	0.15	0.30
C52	0.05	0.140	0.23	0.45	0	0.05	0.07	0.17	0	0	0.03	0.13
C61	0.05	0.16	0.22	0.45	0.11	0.26	0.28	0.54	0.11	0.26	0.28	0.54
C62	0	0	0.09	0.29	0.08	0.23	0.37	0.72	0	0.15	0.19	0.43
C71	0	0	0.06	0.19	0.06	0.17	0.25	0.48	0	0.11	0.13	0.29
C72	0.10	0.21	0.28	0.48	0.13	0.26	0.39	0.64	0.10	0.21	0.28	0.48
C81	0.12	0.24	0.25	0.48	0.09	0.18	0.22	0.43	0.09	0.18	0.22	0.43
C82	0	0	0.09	0.32	0	0.18	0.19	0.48	0	0.18	0.19	0.48

Fuzzy Positive and Negative Ideal Solutions were calculated and shown in Table 9.

Table 9. Fuzzy Positive and Negative Ideal Solutions

	A*				A-			
C11	0.90	0.90	0.90	0.90	0.20	0.20	0.20	0.20
C12	0.72	0.72	0.72	0.72	0.06	0.06	0.06	0.06
C13	0.81	0.81	0.81	0.81	0.20	0.20	0.20	0.20
C14	0.54	0.54	0.54	0.54	0	0	0	0
C15	0.72	0.72	0.72	0.72	0.03	0.03	0.03	0.03
C16	0.90	0.90	0.90	0.90	0.16	0.16	0.16	0.16
C21	0.54	0.54	0.54	0.54	0.04	0.04	0.04	0.04
C22	0.64	0.64	0.64	0.64	0.09	0.09	0.09	0.09
C23	0.81	0.81	0.81	0.81	0.09	0.09	0.09	0.09
C24	0.45	0.45	0.45	0.45	0.03	0.03	0.03	0.03
C25	0.27	0.27	0.27	0.27	0	0	0	0
C31	0.64	0.64	0.64	0.64	0	0	0	0
C32	0.33	0.33	0.33	0.33	0	0	0	0
C41	0.54	0.54	0.54	0.54	0	0	0	0
C42	0.45	0.45	0.45	0.45	0.04	0.04	0.04	0.04
C51	0.45	0.72	0.72	0.72	0.04	0.04	0.04	0.04
C52	0.45	0.45	0.45	0.45	0	0	0	0
C61	0.54	0.54	0.54	0.54	0.05	0.05	0.05	0.05
C62	0.72	0.72	0.72	0.72	0	0	0	0
C71	0.48	0.48	0.48	0.48	0	0	0	0
C72	0.64	0.64	0.64	0.64	0.10	0.10	0.10	0.10
C81	0.48	0.48	0.48	0.48	0.09	0.09	0.09	0.09
C82	0.48	0.48	0.48	0.48	0	0	0	0

The Distance to Ideal Solutions of Each Alternative From A* and A- are calculated and shown in Table 10. A* represents the theoretical best answer, and A- stands for the worst. As far as possible, an alternative should be distant from A- and closer to A*.

Table 10. The Distance to Ideal Solutions of Each Alternative from A* and A-

	A^*			A^-				A^*			A^-		
	A1	**A2**	**A3**	**A1**	**A2**	**A3**		**A1**	**A2**	**A3**	**A1**	**A2**	**A3**
C11	0.33	0.42	0.47	0.48	0.39	0.36	**C31**	0.35	0.59	0.46	0.40	0.08	0.24
C12	0.40	0.43	0.47	0.39	0.37	0.32	**C32**	0.12	0.30	0.30	0.26	0.05	0.05
C13	0.37	0.42	0.42	0.37	0.31	0.31	**C41**	0.27	0.45	0.38	0.35	0.12	0.20
C14	0.34	0.38	0.37	0.32	0.25	0.28	**C42**	0.25	0.31	0.31	0.24	0.15	0.15
C15	0.40	0.52	0.44	0.42	0.25	0.36	**C51**	0.44	0.51	0.51	0.24	0.15	0.15
C16	0.39	0.48	0.52	0.48	0.43	0.36	**C52**	0.27	0.38	0.42	0.26	0.09	0.06
C21	0.26	0.29	0.32	0.32	0.30	0.29	**C61**	0.35	0.29	0.29	0.22	0.29	0.29
C22	0.23	0.23	0.39	0.41	0.41	0.21	**C62**	0.64	0.44	0.55	0.15	0.42	0.25
C23	0.37	0.45	0.55	0.47	0.33	0.25	**C71**	0.42	0.28	0.36	0.10	0.29	0.17
C24	0.26	0.29	0.33	0.26	0.19	0.15	**C72**	0.40	0.35	0.40	0.22	0.32	0.22
C25	0.17	0.21	0.21	0.16	0.09	0.09	**C81**	0.24	0.28	0.28	0.23	0.19	0.19
							C82	0.40	0.32	0.32	0.17	0.27	0.27

The alternatives are ranked and the final ranking results shown in Table 11 indicate that A1 is clearly performing better than the other two. Meanwhile, the difference between the closeness coefficients of alternative 2 and 3 is very small.

Table 11. The Closeness Coefficients and Ranking

Alternative	Overall Score	Rank
A1	0.5271	1.
A2	0.4398	2.
A3	0.4303	3.

5.4.Analysis of the Results For An Improvement-Seeking Road Map For The Managers

The evaluation process and the corresponding outcomes can help an airline identify its competitive advantages relative to its competitors in a specific context. The airline can concentrate on the improvement of those service attributes which have the most significant influence on relative rankings. A competitive analysis can be carried out based on weighted performance evaluation, to examine the airlines' relative competitive strengths and weaknesses on the service attributes identified as important to their customers.

While it is possible to measure an individual firm's position relative to other firms, until now it has not been possible to give precise information on how a firm can improve its performance. This is now possible due to the following analysis, which is also unique in the TOPSIS literature.

The following analysis concentrates on the distance to ideal solutions of each alternative from A- in a relative perspective.   is defined as the distance from A- of each alternative relatively to the other two alternatives at each sub criterion.

As seen in Table 12, the differences of the distances from A- are calculated and the maximum difference is taken (ric) as a measure for the alternative at each sub criterion. If the difference in distances from both of the other two alternatives at the specific sub criterion is minus, then the zero value is assigned. This implies an urgent need for improvement, whereas higher difference value represents sub criterion where the alternative is good, and the others are potential but not urgent improvement areas.

$$r_{ic} = \underset{j}{MAX}(d_{ic}^{-} - d_{jc}^{-};0)\ \forall i,c$$

$$\{i = 1,2,\ldots m\}\ \{j = 1,2,\ldots m\}\ \{c = 1,2,\ldots n\}\ i \neq j$$

Table 12. The Maximum Values of the Relative Differences of the Distances to A- for Each Alternative at Each Sub Criteria (ric)

	A1	A2	A3		A1	A2	A3
C11	0.12	0.03	0	**C31**	0.32	0	0.15
C12	0.07	0.06	0	**C32**	0.22	0	0
C13	0.07	0	0	**C41**	0.23	0	0.09
C14	0.08	0	0.03	**C42**	0.10	0	0
C15	0.16	0	0.10	**C51**	0.09	0	0
C16	0.11	0.07	0	**C52**	0.21	0.04	0
C21	0.03	0.01	0	**C61**	0	0.07	0.07
C22	0.21	0.21	0	**C62**	0	0.27	0.10
C23	0.22	0.09	0	**C71**	0	0.19	0.07
C24	0.11	0.04	0	**C72**	0	0.10	0
C25	0.08	0	0	**C81**	0.04	0	0
				C82	0	0.11	0.11

Table 13 shows for each airline criteria met successfully, criteria in need of urgent improvement, and criteria less urgently in need of improvement. The leading airline, A1 performs well in most aspects of service, while A3 performs less satisfactorily in many areas. In general, A1 performs better in respect of personal quality, punctuality, convenience of service and baggage handling, while A2 outperforms others in customer complaints management and flight availability, while A3 has a best record on baggage handling and flight frequency.

Table 13. The Improvement Road Map for Each Firm

	Successful In	**In Need of Improvement**	**In Need of Urgent Improvement**
A1	C11, C12, C13, C14, C15, C16, C23, C24, C25, C31, C32, C41, C42, C51, C52	C21, C22, C81	C61, C62, C71, C72, C82
A2	C21, C22, C61, C62, C71, C72, C82	C11, C16, C23, C24, C52	C13, C14, C15, C25, C31, C32, C41, C42, C51,C81
A3	C61, C82	C14, C15, C31, C32, C41, C62, C71	C11, C12, C13, C16, C21, C22, C23, C24, C25, C42, C51, C52, C72, C81

At this stage, the company managers are aware of criteria which need improvement, and especially the ones which need urgent improvement. However, to prevent any doubt about which sub criteria to prioritize among the ones in need of urgent improvement, managers need a second ranking. Table 14 shows ranking of the sub-criteria which need urgent improvement.

The values of the sub criteria, which belong to the group called in need of urgent improvement, are equal to 0. Then to rank the sub criteria with 0 values, their corresponding values are calculated as shown below and listed in Table 14.

if $r_{ic} = 0$ then $t_{ic} = \underset{j}{MAX}(\left|d_{ic}^{-} - d_{jc}^{-}\right|)\ \forall i, c$

$$\{i = 1,2,\ldots m\}\ \{j = 1,2,\ldots m\}\ \{c = 1,2,\ldots n\}\ i \neq j$$

Table 14. Prioritization of the Sub criteria In Need of Urgent Improvement

A1				A2				A3			
	Diff.	Criteria	Target		Diff.	Criteria	Target		Diff.	Criteria	Target
1.	0.27	**C62**	**A2**	**1.**	0.32	**C31**	**A1**	**1.**	0.22	**C23**	**A1**
2.	0.19	**C71**	**A2**	**2.**	0.23	**C41**	**A1**	**2.**	0.21	**C22**	**A1-A2**
3.	0.11	**C82**	**A2-A3**	**3.**	0.22	**C32**	**A1**	**3.**	0.21	**C52**	**A1**
4.	0.10	**C72**	**A2**	**4.**	0.16	**C15**	**A1**	**4.**	0.12	**C11**	**A1**
5.	0.07	**C61**	**A2-A3**	**5.**	0.10	**C42**	**A1**	**5.**	0.11	**C16**	**A1**
				6.	0.09	**C51**	**A1**	**6.**	0.11	**C24**	**A1**
				7.	0.08	**C25**	**A1**	**7.**	0.10	**C72**	**A2**
				8.	0.08	**C14**	**A1**	**8.**	0.10	**C42**	**A1**
				9.	0.07	**C13**	**A1**	**9.**	0.09	**C51**	**A1**
				10.	0.04	**C81**	**A1**	**10.**	0.08	**C25**	**A1**
								11.	0.07	**C12**	**A1**
								12.	0.07	**C13**	**A1**
								13.	0.04	**C81**	**A1**
								14.	0.03	**C21**	**A1**

The target column mentions on each sub criterion that can be used by the company as a potential target for the future. The so called target company is the company which has the maximum ric value at the corresponding sub criteria.

Although A1 is in the leading position in Turkish market, there is still an urgent need for improvement in the following areas: the reservation process, opportunity for online payment, improved flight frequency, cancelation prevention and baggage handling. While the performance of A2 and A3 are similar, the latter has more areas in need of urgent improvement than the former. Table 14 shows that the quality factors in need of urgent improvement for A3 are airline safety, restrooms cleanliness, excess baggage charges, personnel attention to passengers, flight crew attitude, chair comfort and leg room, cancellations rates, range of domestic routes, luggage transfer and delivery, in flight food and beverage service, employee support, flight crew appearance, prompt announcement of schedules and the provision of alternative flights in the case of delay or cancellation, and the age and condition of aircraft. A2 should be more focused on "departure time, convenience of flight schedule, arrival time, the provision of a greater number of direct flight routes, luggage transfer and delivery, the quality of in-flight food and beverage, attention to passenger problems and requirements, flight crew appearance, prompt announcement of schedules and the availability of alternative flights in case of delay or cancellation".

5. Conclusion and Suggestions

The intense competition of the Turkish domestic airline market under deregulation has forced airlines to focus on understanding the needs of customers and attitudes towards customer-oriented service quality.

This research has been conducted to identify service quality factors using a questionnaire, benchmarking with Fuzzy TOPSIS to rank firms in the Turkish domestic airline industry according to their service quality performance as evaluated by passengers, and providing suggestions for action to be taken by managers thereafter. Even though conducted in the Turkish domestic airline sector, the proposed model has the potential to be used worldwide in determining service quality criteria, benchmarking the service quality of their airlines and, particularly, the developing a road map for improvement with target values for each criteria with corresponding level of urgency. The reason for this global applicability is that the proposed methodology can easily and reliably be applied due its analytical content. However it is suggested that when employing this method, managers should use criteria derived from the questionnaire specially aimed at their own customers. Therefore, the suggested analysis provides useful information for airlines for evaluating their objectives and strategies.

The four main contributions of this study to airlines managers can be itemized as follows:

By conducting the questionnaire and factor analysis, airlines managers will able to identify and rank the service quality criteria unique to their customers

Experts will be enabled to conduct their evaluations with linguistic variables in a fuzzy structure

Fuzzy TOPSIS will be available as a benchmark tool for comparing their performance with other airlines in terms of ranking

A unique feature of this study is the use of Fuzzy TOPSIS not only for ranking, but as a guide for managers to help them qualitative identify the following aspects: the degree of success in each criteria, and therefore the criteria most in need of immediate improvement like criteria which is in most immediate need of improvement, and also the assisting in the identification of competitors as a role models for each criteria where the firm’s performance is less than adequate.

Therefore, the results of this study can help airlines to understand their relative positions with regard to competitors and develop more effective strategies for fulfilling customers’ needs. This study presents a customer-driven approach to service quality, which enables airlines to better understand their position in service quality relative to their competitors. The results can enable airlines to manage their competitive advantages and provide incentives to improve quality levels of specific services, relative to their competitors.

Although the present study makes a significant contribution to the literature, it still has some limitations. The main limitation was that only the domestic airlines in Turkey are evaluated. Due to time and monetary constraints, it was only possible to conduct the surveys at one location, Izmir Airport.

For further studies, it is possible to apply the proposed methodology to foreign airlines, thus facilitating international and cross-national comparisons, and the achievement of a global understanding of customer views on service quality in airlines.

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