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PERFORMANCE EVALUATION OF AIRLINE COMPANIES FROM CONSUMERS' PERSPECTIVE BASED ON TOPSIS AND VIKOR METHODS

Yüksek Lisans Tezi

SÜMEYYE ÇETİNKAYA

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TEZ ONAY BELGESİ

İŞLETME (İNGİLİZCE) Anabilim Dalı SAYISAL YÖNTEMLER (İNGİLİZCE) Bilim Dalı TEZLİ YÜKSEK LİSANS öğrencisi SÜMEYYE ÇETİNKAYA'nın PERFORMANCE EVALUATION OF AIRLINE COMPANIES FROM CONSUMERS' PERSPECTIVE BASED ON TOPSIS AND VIKOR METHODS adlı tez çalışması, Enstitümüz Yönetim Kurulunun 13.06.2019 tarih ve 2019-17/14 sayılı kararıyla oluşturulan jüri tarafından oy birliği / ~~oy çokluğu~~ ile Yüksek Lisans Tezi olarak kabul edilmiştir.

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ÖZET

TOPSIS VE VIKOR YÖNTEMLERİ KULLANILARAK MÜŞTERİ AÇISINDAN HAVAYOLU ŞİRKETLERİNİN PERFORMANSLARININ DEĞERLENDİRİLMESİ

Günümüzde artan teknoloji ve küreselleşmenin etkisiyle havayolu taşımacılığı ciddi bir önem kazanmıştır. Artan bu talep doğrultusunda her geçen gün rekabet daha da artmaktadır. Havayolu pazarında kendine yer bulmak ve rekabette güçlü olmak için, firmaların tüketici ihtiyaç ve isteklerini göz önünde bulundurmaları en birincil şartlardandır. Sürekli değişen ve gelişen bu sektörde yalnızca teknik bağlamda ilerlemek tek başına yeterli olmayacaktır. Merkezinde "insan" olan bu sektörde müşteri isteklerini dikkate almak kaçınılmazdır.

Havayolu taşımacılığı, iş seyahati, turistik gezi, eğitim-öğretim gibi birçok farklı sebepten ötürü tercih edilmektedir. Değişen lüks algısı ve artan tüketici hakları bilinciyle müşteriler kurumsallık,

uçak içi hizmetler, uçak içi konfor, ulaşım, bekleme süresi, fiyat, güvenilirlik ve tanınırlık gibi birçok kritere dikkat etmektedir. Havayolu şirketlerinin sürekli artması demek, hem rekabetin artması demek, hem de müşteri için daha fazla kıyas yapma imkânı demektir. Uçmak için farklı şirketleri kullanan müşteriler, firmaları kıyaslayacak ve bu kıyaslama sonucunda da kendi kriterlerine en çok uyan firmayı tercih edeceklerdir. Bu durumda firmalara düşen görev, müşterilerin kriterlerini doğru tespit etmek ve bu tespit doğrultusunda iyileştirmeler yapmaktır.

Bu bağlamda, bu çalışmada ilk hedef, Analitik Hiyerarşi Süreci (AHP) kullanarak müşterilerin havayolu şirketi seçerken hangi kriterlere hangi ölçüde dikkat ettiğini bulmaktır. Çalışmanın devamındaki amaç ise, TOPSIS ve VIKOR yöntemleri kullanılarak, karşılaştırmalı olarak bu kriterler doğrultusunda tüketicilerin en çok hangi havayolunu tercih ettiğini bulmaktır.

GENERAL KNOWLEDGE

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Keywords	: AHP, TOPSIS, VIKOR, Multi Criteria Decision Making, Airline Companies, Customer Satisfaction, Customer Criteria.

ABSTRACT

PERFORMANCE EVALUATION OF AIRLINE COMPANIES FROM CONSUMERS' PERSPECTIVE BASED ON TOPSIS AND VIKOR METHODS

Nowadays, due to the increasing technology and globalization, air transportationas gained serious importance. Due to increasing demand, the competition is increasing day by day. In order to increase the market share and continue sustainable development in the airline market and to be strong in the competition, the airline market and to be strong in the competition, it is one of the primary requirements that companies take into account consumer needs and wishes. In this constantly changing and evolving sector, advancing in the technical context alone will not be enough.

It is inevitable to take into account customer requests in this sector which is "humankind" in its center.

Air transportation is preferred for many reasons such as business travel, touristic trips, education and training. With the perception of changing luxury and increasing consumer rights, customers pay attention to many criteria such as corporate, in-flight services, in-flight comfort, transportation, waiting time, price, reliability and recognition. A continuous increase in airline companies means both increasing competition and providing more comparisons for customers. Customers who use different companies to fly will compare companies and will prefer the company that best fits their own criteria as a result of this comparison. In this case, the task of the firms is to determine the criteria of the customers correctly and to make improvements in this direction.

In this case, the first objective in this study is to rank criteria which have a role in selecting the airline company by customers using the Analytic Hierarchy Process (AHP). And the later aim of the study is to find out which airline preferred the most by using TOPSIS and VIKOR methods.The importance of the criteria according to the results obtained by AHP method is as follows: reliability(safety factor), timing, number of flight points and aircraft, corporate image and public recognition, ticket prices, in-cab comfort and convenience and in-flight service quality. The most preferred airline company is determined according to TOPSIS and VIKOR methods.

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LIST OF ABBREVIATIONS

AHP	Analytic Hierarchy Process
ANP	Analytical Network Process
CI	Condition Index
CR	Condition Ratio
RI	Random Index
DPT	Devlet Planlama Teşkilatı
GP	Goal Programming
ICAO	International Civil Aviation Industry
MADM	Multi Attribute Decision Making
MCDM	Multi Criteria Decision Making
MODM	Multiple Objection Deicision Making
SHGM	Sivil Havacılık Genel Müdürlüğü
SHK	Sivil Havacılık Kurumu
THY	Türk Hava Yolları
TİM	Türkiye İhracatçılar Meclisi
TOPSIS	Technique for Order Preference by Similarity to an İdeal Solution
VIKOR	VIseKriterijumska Optimizacija I Kompromisno Resenje (Multicriteria Optimization and Compromise Solutio

INTRODUCTION

Civil aviation has a great importance in Turkey as well as in the whole world. Today, the concept of time is very important for people. People save time thanks to travelling by plane. Besides the time concept, important factors such as speed, comfort, ease of transportation and service quality take the civil aviation institution a step further.

Civil aviation in Turkey has made great changes from it was founded to the present day. Considering the annual report of Sivil Havacılık Kurumu (SHK), it is possible to say that especially in recent years there is important improvement and huge growth in the airline industry.

1.1. The Aim of Study

The main aim of the thesis is the evaluation of the airline companies which have started to draw attention in recent years, and the number of companies is increasing from consumer's perspective. Since civil aviation undertakes the duty of human transportation, it is possible to say that that customer requests and suggestions have the highest and even the first important issue forthe companies. Nevertheless, we can say that international flights have an important place in terms of country promotion. Air transportation is an important contribution to people today, when the concept of time is very important. The aviation sector is a complex system that covers not only passenger transport but also many areas such as national and international cargo, training activities, ground and catering services, maintenance-control, air traffic services. In this study, passenger transport will be discuss which is only a part of the aviation sector. The satisfaction of the passengers, the criteria they pay attention to and the extent to which these criteria are taken into account will be measured by the AHP (Analytic Hierarchy Process) and the pairwise comparison of the criteria will be measured by the customers, from the generated matrix and the survey to be carried out. The survey will consist of two parts. In the first section, the criteria will be asked to be evaluated among themselves and the criteria will be weighted according to the result. In the second part, customers will be asked to evaluate the airline companies according to these criteria. According

to this result, using the VIKOR and TOPSIS methods, it is aimed to find which airline company is more preferred.

According to a report released by Türkiye İhracatçılar Meclisi (TİM); Turkey's top 10 exporters in 2016 is located within five aviation services provider. Turkish Airlines (THY) ranks first, Pegasus third, Sun Express fifth, TAV airports seventh and Atlasglobal ninth. This situation is indicative of the aviation sector in Turkey is a big power in economic terms. In this study, it is aimed to evaluate this great power from the eyes of the customers and to make a positive contribution to the aviation sector.

1.2. Scope of the Study and Literature Summary

On the purpose of solving the multi-criteria decision making problem Hwang and Yoon developed the TOPSIS method first in 1981.The method is based on the closest distance to the positive ideal solution of the selected alternative and the distance to the negative ideal solution. (Lai, Liu, and Hwang, 1994).Opricovic and Tzeng (2004) used VIKOR method first for multi-choice optimization of complex systems. In this study, VIKOR and TOPSIS methods were compared and more favorable and more unfavorable aspects of the methods are compared.

TOPSIS Method is the most widely used among the Multi Criteria Decision Making Methods. Since VIKOR is more recent method than TOPSIS, there are not as many studies as the TOPSIS Method in VIKOR Method. But also, new studies in literature are being added. Some studies in the literature related to Analytic Hierarchy Process (AHP), TOPSIS and VIKOR methods are given below;

Tzeng, Lin and Opricovic (2005) discussed the use of alternative fuels to be used in public transportation and used VIKOR and TOPSIS methods in their study. TOPSIS and VIKOR methods are compared and applied for the determination of the best fuel mode. The researchers applied to the AHP method in the determination of the weight of the evaluation criteria. Gaudenzi and Borghesi (2006) manage the risk in the supply chain with AHP method, they aimed to create a model to determine the risk in the supply chain with using AHP method. Their model was successful to create awareness of supply chain risk factors. Skibniewski and Chao (1992) use AHP method in the evaluation of advanced structure technology in construction Technologies. Lin and Yang (1996) in the evaluation of machine selection using AHP method, Yazdani and Payam (2015) Ashby, VIKOR and TOPSIS Benitez, Martin and Roman (2007) were used in the selection of the electrostatic actuators of

microelectromechanical systems by comparative study. They made a comparative study for material selection and for had a conformity between three methods. In the study of Li and Qin-Sheng (2006), with the aim of selecting the best tending offerthat took place in the production companies, it was determined by TOPSIS method considering the 12 indicators which are the best bid of the four companies that are tender for some electronic products.

MCDM studies are widely studied and applied in many areas in Turkey as the rest of the countries, TOPSIS method used by Yurdakul and İç (2003) for the performance measurement of Turkish automotive companies. With the TOPSIS method, the ratios calculated and interpreted could be expressed mathematically with a single point and companies can be ranked among themselves according to their success. The method presented in the study has brought a useful approach in determining the degree of success and ranking of success by comparing the firms of the same size with each other according to the same criteria. Kaya, Çetin and Kuruüzüm (2001) used the VIKOR method to analyze the life quality of the European Union and candidate countries. Three different analyzes were performed with VIKOR method for 2003, 2005 and 2007. The common area with the European Union countries (EEA) countries and EU candidate countries, Norway, Croatia, Macedonia and Turkey are evaluated in terms of quality of life indicators. Ersöz and Kabak (2010) made a literature research of multi-criteria decision making methods in defense industry applications. As a result of their study, it has been seen that Goal Programming (GP) method and Analytical Hierarchy Process (AHP), which is known as the oldest method, are used in this field. However, in recent years in Turkey and in the world since the superior properties of the Analytical Network Process (ANP), ANPmethod was used to replace the AHP. Ertuğrul and Özçil (2014) made a comparative study with TOPSIS and VIKOR methods forair conditioning selection. In the application, TOPSIS and VIKOR multi-criteria decision making methods were used in the selection of air conditioners and the results were compared and evaluated. When choosing the air conditioner: product, price and technical preferences are presented according to preference suggestions. The subjective criteria of the consumer were used in determining the weight criteria. While the decision matrix was formed, direct numerical data which were applicable in both methods were obtained. As a result of the study, while the results found in TOPSIS method can be reliable, the results of the VIKOR method were found to be unreliable when compared with the TOPSIS method due to the lack of acceptable advantages and acceptable stability conditions. The reason for this is the failure to meet the conditions of the VIKOR method is explained as the preference order based on Q_j values.

Connected with airlines, Feng and Wang (2000) conducted TOPSIS method in their study of the performance of five Taiwanese airline companies with using 22 variables as financial and transporatation indicators and concluded that financial indicators were more effective in evaluating their performance. Tsaura, Changb and Yen (2002) have measured the quality of airline services using Fuzzy Multi Criteria Selection Methods, Sun (2010) evaluated the performance using Fuzzy AHP and fuzzy TOPSIS Method. In this study, AHP method is used for the evaluation of preference weights. Then TOPSIS method is used to improve the gap between real values and pursued levels to find out the best alternative. Lioua and Tzeng (2007) measured the airlines service quality using Analytical Hierarchy Process. Torlak, Şevkli, Sanal and Zaim (2011) made a comparative evaluation in the Turkish domestic airline company with using fuzzy TOPSIS Method. According to their research they conclude that in the domestic airline industry Turkish Airlines retained its leading role and Turkish Airlines is the most competative company. Pegasus is the second company for the competition, it is the runner-up company. Onur Air and Atlas Jet needs an improvement and they have not been good enough in terms of competititon. Önüt, Akbaş and Yılmaz (2008) measured the service quality comparatively in Turkish airline industry with Analytical Hierarchy Process, Canöz (2017) conducted a research with the aim of evaluating the service concept of airline companies.

2. CIVIL AVIATION INDUSTRY

Air transportation has been in a great development after the Second World War, very rapid technological and structural changes in a short time it has become a transportation sector. Passenger and cargo transportation has made significant progress, especially through the speed it provides in transportation (Devlet Planlama Teşkilatı, 2001).

There have been many primitive flight trials in human history. It is assumed that Hezarfen Ahmed Çelebi made the first flight test in the history of Turkish civil aviation. However, in 1010, after various works, Farablı İmam İsmail Cevheri tied his arms to the door-like wings which has created by himself and left himself to the void over Nişabur Ulucamii. Ismail Cevheri died in this flight attempt and became the first known Turkish air martyr. İsmail Cevheri, was born in Ghaznavids(Gazneliler) period, was a Turkish scholar interested in theology, literature, physics, natural sciences and mathematics (Sivil Havacılık Genel Müdürlüğü, 2018).

Hezarfen Ahmed Çelebi was a Turkish scholar who managed to fly for the first time in the world. Hezarfan Ahmed Çelebi, who conducted experiments in his home and made researches on various subjects. He modeled another Turkish scholar named İsmail Cevheri on himself and carried out the primitive form of today's air vehicles. In order to measure the resistance of the wings that he prepared before the historical flight, he conducted experiments in Okmeydanı and one morning, he moved himself from the Galata tower to the space, moved his wings and crossed the straight and went down to Üsküdar (Sivil Havacılık Genel Müdürlüğü, 2018).

In 1903, Wright Brothers completed the construction of the first motor aircraft; Flyer1. On the morning of December 17, 1903, Orville Wright launched the first manned motorized and supervised flight of the aviation history from a flat surface with no take-off, except for the engine of the aircraft. On December 17, 1903, the first 120-feet flight has led to space flight. In addition, on the earth, this process changed life forever (Wright, 1934).

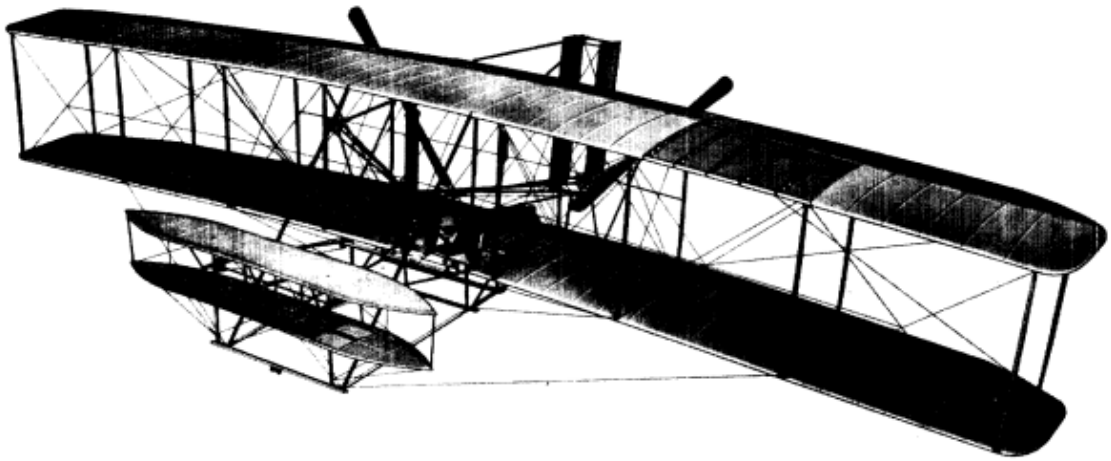

Figure 1. Illustration of the 1903 Wright Flyer by Robert Mclaren and James Fisher.

Source: Orville Wright, "How We Made the First Flight", 1934, pg.8.

2.1. General Structure of Aviation Industry

Airway transportation sector includes airline management, airport management,air navigation and air traffic control services, location and catering services, training,maintenance, related sub and superstructures and other aviation activitiescoordination and supervision according to international rules (T.C. Başbakanlık Devlet Planlama Teşkilatı, Havayolu Ulaştırması Alt Komisyon Raporu,1995).

The International Civil Aviation Organization(ICAO) was established on 7 December 1944 with the signing of the Civil Aviation Convention(Chicago Convention) in order to ensure safe and regular development of civil aviation in the international context and to supervise and support civil aviation. ICAO is an organization that carries out the international standards related to the United Nations air transportation and the regulations necessary for safety. Safety and efficiency and as an intermediary in all matters related to civil aviation between 191 countries which are party to the agreement. ICAO is an organization of the United Nations. The center is Montreal, Canada. The members of the ICAO are states and governments (Sivil Havacılık Genel Müdürlüğü, 2015).

Aviation is examined in two categories as civil aviation and military aviation. Civil aviation, which is examined in this study, is collected under the title of commercial, general and aerial aviation. Main subject of the study is commercial aviation.

Civil aviation, which began to manifest itself in the early 1900s, has continued to develop rapidly with the advances of advancing technology to the present day. The sector, which offers the fastest transportation service to the humanity at national and international level, draws attention not only with its importance in economic but also with cultural development and globalization (Hassu, 2004).

Table1

Proposed ICAO Classification of Civil Aviation Activities

CIVIL AVIATION		
GENERAL AVIATION (GA)	**AERIAL WORK (AW)**	**COMMERCIAL AIR TRANSPORT (CAT)**
Corporate Aviation Company own-use flight operations.	**Agricultural Flying** Use of an aircraft for activities such as crop dusting, chemical or fertilizer spraying, seed dissemination, prevention of frost formation, insect fighting, animal herding.	**Commercial Air Transport Operation** An aircraft operation involving the transport of passengers, cargo or mail for remuneration or hire.
Instructional Flying The use of an aircraft for purposes of formal flight instruction with an instructor. The flights may be performed by aero-clubs, flying school or commercial operators.	**Construction** **Photography** **Surveying** **Observation and Patrol** **Search and Rescue** **Aerial Advertisement**	**Flight** The operation of an aircraft on a flight stage or number of flight stages with the same flight number.

Table1 (Cont.)

Proposed ICAO Classification of Civil Aviation Activities

Business Flying The use of an aircraft to carry personnel and/or property to meet the transport needs of officials of a business, firm, company or corporation.		**Scheduled Air Services** Scheduled services (revenue) are flights scheduled and performed for remuneration according to a published timetable, or so regular or frequent as to constitute a recognizably systematic series, which are open to direct booking by members of the public; and extra section flights occasioned by overflow traffic from scheduled flights.
Pleasure Flying The use of an aircraft for personal or recreational purposes not associated with a business or profession.		**Non-Scheduled Air Transport** A non-scheduled air service is a commercial air transport service performed as other than a scheduled air service. A charter flight is a non-scheduled operation using a chartered aircraft. It falls into four categories: passenger charter flights, cargo charter flights, combined passenger-cargo flights, non-scheduled non-charter flights.
Air Tourism **Recreational Flying** **Air Sports**		**Air Cargo Services** **Air Taxi Operations**

Source: ICAO Working Paper Tenth Session ofthe Statistics Division, November 2009, pgs. 4-8.

2.2. Civil Aviation in Turkey

The first aviation activities in our Turkey, in 1912, nearby Sefaköy, started with two hangars and a small square. In the 10th year of Turkish Republic, “Havayolları Devlet İşletme İdaresi” which is established under the Ministry of Defence, has been appointed to build civil aviation in Turkey (Gerede, 2015).

The first civil air transportation was launched in 1933 with a small fleet of five aircraft. Since the rapid progress of the World Civil Aviation and the great advances in technology, founded under the Ministry of Transport as “Sivil Havacılık Başkanlığı” in 1954 was reorganized according to the conditions of the day as “Sivil Havacılık Genel Müdürlüğü (SHGM)” in 1987 (Gerede, 2015).

In 1944 the number of aircraft of the institution reached 28 and on 21 May 1958 it was converted into Turkish Airlines (THY). Turkey's first private airline established in 1977, was Bursa Airlines. The company, which made a non-scheduled flight on the Istanbul-Bursa route, was closed in 1980 as a result of the lack of adequate government support (Hassu, 2004).

According to Türkiye İhracatçılar Meclisi (TİM) report published in 2018, Türk Havayolları ranks first in the list of Turkey’s 500 major service exporters in 2017. Sun Express ranks the second, Pegasus is the third, Atlasjet is 10th, Onur Air is 16th place in the list. This means that airline companies have an important role in the export of our country. These firms have service export in this sector. Total export quantities are as follows (Türkiye İhracatçılar Meclisi Faaliyet Raporu, 2018);

- Türk Havayolları A.O. $ 8.049.606.630
- Sun Express $ 959.591.716
- Pegasus $ 903.982.342
- Atlasjet $ 403.952.967
- Onur Air $ 288.648.000

According to the Sivil Havacılık Genel Müdürlüğü Annual report is published in 2017, there are 13 airline companies in Turkey and nine of them have airliner.

Table 2

Information of Airline Companies

Airline Companies	Airliner	Seating Capacity	Cargo Plane	Carrying Capacity	Total Aircraft
THY A.O	293	59,058	11	825,000	304
Güneş Ekspres Havacılık A.Ş.	52	9,828	-	-	52
Pegasus Hava Taşımacılık A.Ş.	66	12,084	-	-	66
Onur Air Taşımacılık A.Ş.	24	6,347	-	-	24
MNG Hava Yolları ve Taşımacılık A.Ş.	-		7	352,000	7
Atlasjet Taşımacılık A.Ş.	24	4,764	-	-	24
Hürkuş Havayolu ve Taşımacılık Ticaret A.Ş.	7	1,260	-	-	7
ULS Havayolları Kargo Taşımacılık A.Ş.	-		3	121,575	3
Turistik Hava Taşımacılık A.Ş.	10	1,890	-	-	10
ACT Havayolları A.Ş.	-		5	567,875	5
IHY İzmir Havayolları A.Ş.	7	1,302	-	-	7
Tailwind Havayolları A.Ş.	5	840	-	-	5
***Borajet Havacılık Taşımacılık Uçak Bakım Onarım Tic. A.Ş.**	3	127	-	-	3
TOTAL	**491**	**97.500**	**26**	**1.866.450**	**517**

(*) Borajet Havayoları has decided to pause flights in April, 2017.

Source: Sivil Havacılık Genel Müdürlüğü Faaliyet Raporu, February 2018, pg. 39.

2.3. Civil Aviation from Customers' Perspective

The benefits of transportation for people are mainly caused by displacement and time saving. Transportation, as well as time benefit, is valued to the extent that it allows for favorable and economic displacement. Activities requiring transportation; production, consumption, trade, defense, social life and services (tourism, financial, educational, sportive, religious services, etc.) occur in every point of life, every moment. The ever-growing transport has been an essential factor in economic and socio-cultural development of people for centuries. Nowadays, transportation is one of the basic tools that meet the needs of people's daily life (Kaya, 2012; Gerede, 2015).

In parallel with this definition, air transportation can also be defined as follows; aerial displacement of an airplane, providing the benefit of people, cargo and mail (Gerede, 2002).

One of the most significant features of the airline product (air transportation service) is that it is realized in a service process. It is a service process with untouchable features, not just a seat that has physical properties and carries passengers between two points(Dempsey, Gesell and Crandall, 1997). The airline companies should design their service offerings (including all their components and products) in a way that meets the wishes and needs of the customers. Otherwise, the perceived quality of service, and accordingly, demand and incomes may decrease. For this reason, it is necessary to know what the airline product components are and what they mean for the customer (Gerede, 2015).

2.3.1. Service Quality

The concept of quality in products and services has become a crucial concern of the 1980s. Although tangible goods described and measured by marketers, the service quality remained undefined largely. The fact that the service is intangible can cause firms to have some difficulties in understanding how consumers perceive the quality of services (Parasuraman, Zeithaml and Berry, 1985).

Today, everyone pays attention quality in management, education, health, communication, goods or services and willings to increase the quality of the goods or services that they receive every day. As the quality concept is questioned in goods and services, honest, knowledgeable and characterized people are also determined in human relations. Therefore, quality is very important in every subject (Öztürk, 2013).

Besides the difficulties of service quality description because of the intangibility, the importance of service quality in the service sector is undeniable. It is possible to say that one of the most important dynamics in service sector is service quality and accordingly customer satisfaction. Air transportation, which attracts more and more attention (Sivil Havacılık Genel Müdürlüğü, 2017) with the developing technology, is also located in the important service sector. In this respect, service quality is also of great importance in air transportation.

Sometimes it is seen that the quality of service in air transportation is only evaluated by cabin services. The reason for this is to assume that the airline product only consists of the services provided in the cabin. However, the airline product has more important components in terms of impacting demand. If these components do not meet expectations, satisfaction with in-house services may not improve overall service quality (Gerede, 2015).

Air transportation services consist of three parts: pre-flight, in-flight and post-flight. Before the flight; It starts with the customer requesting information about the airline service and continues with the decision to purchase, make the payment and purchase the ticket. Then, the customer arrives at the airport, receives the service from the airport operation, completes the baggage and ticket transactions, security, passport and customs procedures and then ends with boarding. During the flight; to receive cabin service and after the flight; service is completed by departing from the plane, taking the luggage and finally leaving the airport (Gerede, 2015).

The establishment of the criteria in this thesis was performed depending on the mentioned service components. The service components that are effective in air transportationservice quality are as follows (Doganis, 2002; Wells, 1999);

- **Price Related Components:** These are the cost of service delivery to consumers and other conditions related to the fee.
- **Timetable Related Components:** The most important and fundamental feature of this component group is undoubtedly the total travel time. As a result, air transportation is a relocation service and the displacement period is the essence of the product.
- **Comfort Related Components:** First; the shape of the seats, the distance between the seats, the number of toilets, the spaciousness of the cabin and the appearance of the cabin interior design of the aircraft. The second component group includes in-flight services during the flight. These are; the quality, quantity and presentation of the catering, the number of cabin crews, attitudes and

behaviors, entertainment systems consisting of multimedia applications. Another component of comfort is related to the services provided at the departure and arrival airports. At the beginning of this, there are baggage delivery and check-in operations at the airport.

- **Components of the Image of the Airline**: The image-related components that the airline companies are trying to create on their customers and the wider masses. The airline companies try to make the services they produce a brand. Business slogans, advertising campaigns, perceived safety level of airline business related parts are included in this group. The type and variety of these activities are related to how the airline wants to position itself in the market.

2.3.2. Customer Satisfaction

Since the 1980s, customer satisfaction have been one of the main issues that companies have been discussing in developed countries. It is stated that customer satisfaction, which leads to an increase in the company's profitability, increase in market share and an increase in the company's growth rate, depends mainly on the loyalty of the company (Eroğlu, 2005).

The word 'satisfaction' is the most proper word for understanding the attitudes and feelings of customers about their experiences in an organization. Since customer's future behavoirs forcompanies are determined by the customer attitudes, they are so important to all organizations (Hill, Roche and Allen, 2007). Customer satisfaction is very important for airline companies as well as for all industries.

The air transportation sector which is the important sub-sector of transport sector is an important system formed by the scope of activity, public and private institutions and organizations carrying out the activity, used high-tech tools and hardware, special infrastructure and communicationsystems, qualified manpower, people served, national and international rules and legislations (Devlet Planlama Teşkilatı, 2001).

The main task of marketing-oriented service enterprises isplanning and developing services. The product of the airline is all the services offered, such as in-flight cabin services, ticketing, luggage transfer services, cargo services, which meet the needs of passengers (Wells, 1981).

Customer satisfaction in profit-making enterprises has become one of the most important targets for companies. With developing technology, it is possible to say that customers' comments about firms are easy to reach each other and that positive negative comments affect customer

preferences. In this respect, it is inevitable for the airline companies, who want to reach more customers and enlarge themselves, to make intercorporate arrangements considering the customer satisfaction. In this study, seven of the service quality components affecting customer satisfaction mentioned above were selected.

2.3.2.1. Ticket Prices

In defining the level of demand for products and services, economists have emphasized the price variable for several years. For many industries pricing is a very complex issue. Demand is defined as the different amounts of a product or service that consumers are willing and able to purchase at various prices over a periof of particular time. It can be said that, there is a reverse relationship between price and demand. When price increases, the quantity demand falls or when price falls, demand rises. This inverse relationship is labelled as law of demand by the economists (Wensveen, 2007).

At this point, personal income and the people's budget for flight are the determinants. For this reason, customers make comparisons among airline companies.

2.3.2.2. Corporate Image and Public Recognition

The corporate image is defined as all the effects and impressions created on the target groups(Nguyen and Leblanc, 2001). Therefore, many factors including advertising and promotional activities – one of the most important issue for public recognition-, logos, waiting rooms, in-flight designs and sales offices of airline companies have an important impact on the corporate image of airline companies.

In terms of corporate image and public recognition in the air transportation sector, for example, THY has achieved successful communication activities as well as social responsibility projects. According to Turkish Airlines 2017 annual report, the company has opened a hashtag to help Somalia in social media, sponsored the Euroleague Final Four, reached billions of people through an advertisement with Morgan Freeman, in an American football championship match reached the highest record in television history, the world's largest corporate amateur, sponsored the golf tournament. With these initiatives, Turkish Airlines made important contributions to its corporate identity and brand recognition.

2.3.2.3. In-cab Comfort and Convenience

Although, flights are shorter than other transportation systems, some flights may last for hours. In this case, the comfort of passengers becomes an important element. Here, the comfort and convenience of the cabin means the comfortable seats, sufficient leg spacing along with the front seat, sufficient technological systems (in-flight entertainment systems) and enough overhead cabinets to provide the comfort of the passenger.

The time spent by the passengers on the flight is usually higher than the time spent on the ground. Airline companies should give the importance to in-flight services that they deserved (Chen, Tseng and Lin, 2011).

2.3.2.4. In-flight Service Quality

The aims of passenger services until passengers are checked in and out of the airport to provide baggage, ticketing and check-in operations according to international rules and airline standards, guide passengers at the arrival station to passport control and assisting the problems the passenger faces and expects solutions (Turkish Aviation Academy, 2012).

In-cabin services and catering standards are one of the most important issues to be considered by the airline companies in terms of custumers' satisfaction. In addition to the high standards of catering, the behaviour of the cabin crew for instance being kindness, helpfulness and having smile are having great importance for the image of the airline business.

Airline companies have different policies on food beverages to be served on board. For example, Turkish Airlines serves hot sandwiches and beverages on domestic flights and on international flights offer sandwiches and refreshments for flights that last up to two hours, and offer sandwiches and refreshments as well as cakes and snacks for two hours and morefor economy class passengers. For business class passengers, THY serves various menus from all over the world on porcelain plates. Moreover, passengers can request special meals on all flights except domestic flights according to their needs and preferences. If passengers request, THY prepare menus for their specific medical, diet and religious needs. Turkish Airlines makes a service for all passengers (https://www.turkishairlines.com/tr-tr/ucak-bileti/ucus-deneyimi/ucak-ici-ikram/index.html).

The another example Pegasus has different policies from Turkish Airlines. Pegasus does not reflect the flight cost to the ticket. They also charge food by making food according to customers' wishes. For this purpose, a system called Pegasus Cafe has been established and customers are asked to specify the product they want before the flight. Passengers can order meal until 24 hours before their flight time. If there are less than 24 hours left in flight, passengers cannot order food because the meals cannot be loaded on planes. The potential goal here is to reduce ticket prices (https://www.flypgs.com/bize-yazin/ucak-ici-online-yemek-siparisi#sf-0)

2.3.2.5. Timing

One of the factors that will affect the prestige of airline companies is the punctuality. Customers are expected to pay attention to issues such as the waiting time of the baggage, the length of the check-in process and the delay of the flight. Time is an important factor in determining service quality and must be considered as a primary variable in service level measurements (Sivil Havacılık Genel Müdürlüğü, 2010).

ICAO has set a 45-minute target for all passengers who do not require more than normal control at the international airports, from the aircraft to the exit from the airport to completing the operations of the arriving passengers (SHGM, 2010).

Table 3

Maximum Standby Time for Service Level (minute)

	Short Time andAcceptable Time Interval	**Acceptable Time andLong Time Interval**
Check-in (Economy Class)	0-12	12-30
Check-in (Business Class)	0-3	3-5
Arrving Passenger Passport Control	0-7	7-15
Outgoing Passenger Passport Control	0-5	5-10
Baggage Claim	0-12	12-18
Security	0-3	3-7

Source: SHGM, "Havaalanlarında Kapasite Kriterleri", January 2010, pg.56.

2.3.2.6. Number of Flight Points and Aircraft

One of the most important factors in the selection of the airline companies is their travel destination. Of course, if the airline company has a flight to the point where the passenger wants to arrive, the passenger will prefer that airline. At some points, almost every airline is flying, but only certain companies, sometimes even a single company, fly to some points. In this respect, it is possible to say that the number of aircraft and the number of flight points have significant importance.

According to SHGM Annual Report 2018, while the world average is 74.41% in terms of passengers' access to aircraft, this ratio is 91.34% for Turkey. As a result of the policies implemented since 2003, the number of aircraft of our airline companies increased by 218%, seat capacity by 253% and cargo capacity by 625%. Domestically and abroad flight point number reached to 374.

Table 4

Number of Aircraft by Airline Companies

Airline Companies	Number of Aircrafts in 2018
THY A.O	309
Pegasus Hava Taşımacılık A.Ş.	81
Güneş Ekspres Havacılık A.Ş.	46
Onur Air Taşımacılık A.Ş.	27
Atlasjet Havacılık A.Ş.	16
Turistik Hava Taşımacılık A.Ş.	10
Hürkuş Hava Yolu Taşımacılık ve Ticaret A.Ş.	7
Tailwind Havayolları A.Ş.	5
MNG Hava Yolları ve Taşımacılık A.Ş.	6
ACT Hava Yolları A.Ş.	5
ULS Havayolları Kargo Taşımacılık A.Ş	3
Total	**515**

Source: SHGM Faaliyet Raporu 2018, February 2019, pg.36.

While only one airline company (THY) made flights to 26 destinations in domestic flights in 2003, five airline companies (THY, Onur Air, Sun Express, Atlasjet, Pegasus) made flights to 56 destinations at the end of 2018. And in 2003, two airlines (THY, Sun Express) made flights to 60 destinations in 50 countries. At the end of 2018, 318 points were reached in 124 countries with five airline companies consisting of THY, Onur Air, Sun Express, Atlasjet and Pegasus (SHGM, 2019).

In this study, five airline companies were determined as alternatives since these airline companies (THY, Onur Air, Sun Express, Atlasjet, Pegasus) make domestic and international flights in Turkey.

Figure 2. Domestic Flight Points (2003)

Source: SHGM Faaliyet Raporu 2018, February 2019, pg.44.

In 2003, only one airline company (Turkish Airlines) made domestic flights with 26 destinations in Turkey. Therefore, until 2003, the passengers had no alternative to THY. No alternative means that there is no comparison chance for passengers and they cannot choose another company when they were dissatisfied.

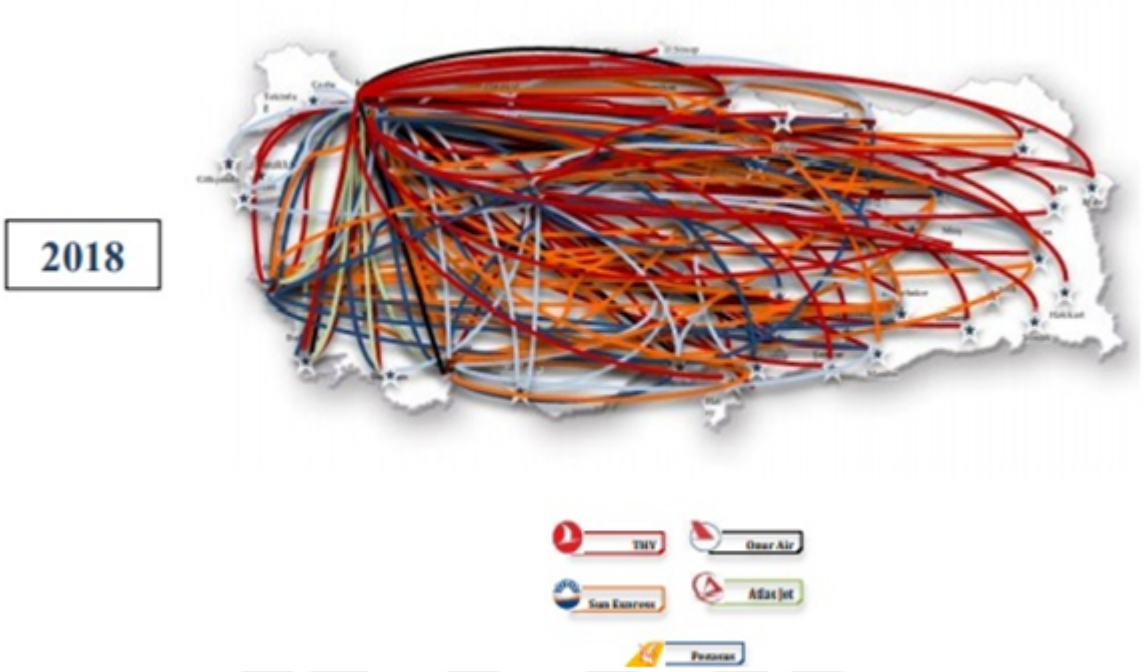

Figure 3. Domestic Flight Points (2018)

Source: SHGM Faaliyet Raporu 2018, February 2019, pg.44.

At the end of 2018, it can be seen that both the number of companies flying and the number of flight points have increased. There becamefive companies that make flights at 56 destinations. This means that passengers have more alternatives and have a chance to make a choice. Although this situation seems to be profitable for only customers, it is also a positive situation for the companies. Because, one firm with no alternative is not good in terms of the developement of the company. In other words, competition is a good motivation for the company to improve itself.

Figure 4. International Flight Points (2003)

Source: SHGM Faaliyet Raporu 2018, February 2019, pg.45.

Same situation seemed to bevalid for international flights. In 2003, two airlines (THY, Sun Express) made flights to 60 destinations in 50 countries. Considering that international flights take longer times, it is more important for passengers to make a choice between more than one aircraft company option.

Figure 5. International Flight Points (2018)

Source: SHGM Faaliyet Raporu 2018, February 2019, pg.45.

At the end of 2018, there are five airline companies to make flights to 124 countries. Besides the perspectives of customers and airline companies this increase is also a beneficial development for the country. Because more flight points with more different countries means reaching more people and attracting more tourists to our country.

Domestic flights of airline companiesaccording to companies' websites;

- THY: 49 cities.
- Onur Air: 3 cities.
- Sun Express: 21 cities
- Atlasjet: 9 cities.
- Pegasus: 36 cities.

International flights of airline companies according to companies' websites;

- THY: 259 countries.
- Onur Air: 4 countries.
- Sun Express: 24 countries.
- Atlasjet:34 countries.
- Pegasus: 69 countries.

2.3.2.7. Reliability (Safety Factor)

The idea of flying in an airplane on air comes with the fear for many people. In this situaition, the most important thing that can calm people is to feel safe. With this concept, it is possible to say that the most important or even the primary important factor during the flight is safety.

To promote the regular and safe development of international civil aviation all over the world the International Civil Aviation Organization (ICAO) was established in 1944 as a specialized agency of the United Nations. The most fundamental strategic aim of these organization is improving the safety of civil aviation systems (ICAO Safety Report, 2018).

Although many people fear flying, air transportation systems are one the most safest transportation systems. According to International Civil Aviation Organization (ICAO) 2018 Safety Report, 2017 having an accident rate of 2.4 accidents per million. This indicater shows that accident involving death rate on air is very low comparing to other trasportation alternatives.

The flights to be carried out using the airspace and airports of our country are carried out in accordance with the relevant legislation and the Aviation Information Publication (AIP) (Gen 1.2) procedures, in particular the Turkish Civil Aviation Law No.2920. Flight permit applications are evaluated by SHGM based on the commercial interests of our country and flight safety and security (SHGM, 2018).

All airlines must comply with the international safety criteria and the equipment they use must be of high quality. In short, the aircraft of all companies are sufficiently safe. In this case, to make the passengers feel safe depends on the pilots' experience and the ability to use aircraft in landing-take-offs.

3. MULTI CRITERIA DECISION MAKING

Making true decision is an essential part of life. People need to make a decision in the whole life. In many cases, such as buying a computer, car, house or choosing school people need to make a true decision in many real world situations. There are many examples that can be found in the life. Actually, making decision is a routine for people. And making the optimal decison in giving situation is the huge problem for humankind. However, developing technology and scientific disciplines helping people to make a best (optimal) decisions. In that time, multi-criteria decision making methods help us. Multi-criteria decision making methods are methods that enable the decision-maker to make better decisions by providing appropriate tools when uncertainty, complexity and conflicting objectives are present (Hahn, 2003). Multi-criteria decision making methods (MCDM) is probably the method that attracts the most attention of people for finding the optimal solution (Triantaphyllou, 2000).

MCDM can be described as a process of considering real-world situations based on various qualitative or quantitative criteria in certain or uncertain or risky environments to suggest a suitable course of action among the available options. With conflicting criteria and more number of decision makers the problem may become more complex. MCDM methods are essential tools for analyzing real-world problems. Because these methods can judge different aletnatives on several criteria for the possible selection of the best alternatives (Kaju and Kumar, 2010).

MCDM methods involve a wide range of quite different approaches. Hwang and Young (1981) suggested that MCDM methods can classified into two categories: MADM (Multiple Attribute Decision Making) and MODM (Multiple Objective Decision Making) methods. The categorization depens on the kinds of the problem: selection problem or a design problem. MODM methods are used for problems in a continous domain with infinitive choices, MADM methods are used for choosing one alternative among a finite number of alternatives. MADM methods try to find best alternative, MODM methods try find optimal solution (Rao, 2007).

MADM methods and MODM methods categorized as follows (Rao, 2007);

MADM methods;

- Simple Additive Weighting (**SAW**)
- Multi Attribute Decision Theory (**MAUT**)
- Analytic Hierarchy Process (**AHP**)
- Analytic Network Process (**ANP**)
- Technique for Order Preference by Similarity to Ideal Solution (**TOPSIS**)
- Vise Kriterijumska Optimizaja I Kompromisno Resenje (**VIKOR**)
- Preference Ranking Organization Method for Enrichment Evaluation (**PROMETHEE**)
- The Elimination and Choice Translating Reality (**ELECTRE**)

MODM methods;

- Linear Programming (**LP**)
- Non-Linear Programming (**N-LP**)
- Goal Programming (**GP**)

3.1. Multiple Attribute Decision Making (MADM)

In modern decision science multiple attribute decision making has an important role. This method assumes that decision maker (DM) should analyze and evaluate a set of alternatives with multiple attributes. The purpose of MADM is to find the most desirable (best) alternative or to list appropriate alternatives to support decision-making (Ding, Liang, Yang and Wu, 2016).

3.1.1. Simple Additive Weighting (SAW)

SAW method is first utilized by Churchman and Ackoff (1954) to deal with portfolio selection problems. Simple additive weighting methos is widely used method among the MADM methods because of its simplicity. The best alternative can be calculated as following equation:

$$A^* = \{u_i(x) | max_i u_i(x) | i = 1,2, \dots, n\},$$

Also

$$u_i(x) = \sum_{j=1}^{n} w_j \, r_{ij}(x),$$

where $u_i(x)$ is the utility of the i^{th} alternative, w_j denotes the weights of the j^{th} criterion and r_{ij} denotes is the normalized preferred ratings of the i^{th} alternative according to the j^{th} criterion. In addition, it is assumed that all criteria are independent (Tzeng and Huang, 2011).

3.1.2. Multi Attribute Decision Theory (MAUT)

MAUT determines the preferences of the decision-maker, which can often be represented as a hierarchical structure, using the proper utility function. By evaluation of the utility function, with the highest utility value, decision maker can choose the best alternative (Tzeng and Huang, 2011).The MAUT method is used to find the most useful alternative based on both qualitative and quantitative criteria. In this method, subjective data can be calculated and it is aimed to find the most beneficial alternative (Keeney and Fishburn, 1974).

The method can be summarized as follows (Ishizaka and Nemery, 2012):

After the determination of alternatives and criteria, the weight values w_j are determined. The total of w_j values must be equal to 1. Then, the values of criteria x_m are determined with respect to pairwise comparison. And the another step is the normalization process. In the normalization process, first, the best worst values are determined for each attribute and the best value is assigned to 1 and the worst value to 0. After the normalization process, in the last step, utility value is determined and the best alternative is found.

3.1.3. Analytic Network Process (ANP)

Analytic network process was designed by Saaty (1996) for enlarging of the AHP with the aim of to prevent the restriction of AHP which is the indication of the independence of criteria (Tzeng and Huang, 2011). This means that, in the decision-making problem, if the criteria and alternatives are independent of each other, the use of AHP is proposed, and if they are dependent, the use of ANP is recommended.

3.1.4. Preference Ranking Organization Method for Enrichment Evaluation (PROMETHEE)

The PROMETHEE method is a multi-criteria decision making technique developed by Brans in 1986. It is easy to understand and implement compared to other multi-criteria decision making

methods. PROMETHEE is more applicable to problems in which a limited number of alternatives are listed and there are conflicting criteria (Goumas and Lygerou, 2000).

In the application of the PROMETHEE weights of criteria dos not provided. By using the comparison matrix which created by the evaluation of alternatives in according to each criteria, the results are obtained. The results are called preference function and it ranges from 0 to 1. 0 represents no difference and 1 represents a huge difference. According to the different relation degrees of each criterion, the method is divided into four approach; PROMETHEE I (partial pre-order), PROMETHEE II (complete pre-order), PROMETHEE III (interval order), PROMETHEE IV (for continuous feasible solutions) (Tzeng and Huang, 2011).

According to Brans (1984) PROMETHEE methods includes three steps;

In the first step, a generalized criteria is constructed. Then, in the second step an outranking relation is determinated. In the first phase of the last step, a preference function is considered. And in the second phase, the outranking relation is evaluated by considering for each alternative leaved or entered.

3.1.5. The Elimination and Choice Translating Reality (ELECTRE)

ELECTRE (Elemination and Choice Translating Reality) method was first introduced by Beneyoun in 1966. The method is based on binary superiority comparisons between alternative decision points for each assessment factor. It is used to select the best choice with maximum advantage and least conflict in the function of various criteria. Method consists of ELECTRE I, ELECTRE II, ELECTRE III and ELECTRE IV (Triantaphyllou, 2000).

ELECTRE Method can be used with other MCDM methods. First, the ELECTRE Methods are used to discard some alternatives to the problem, which are unacceptable. After that another MCDA can be used to select the best one.Applying another MCDA with a restricted set of alternatives saves much time (Baker, 2001).

The advantage of the method is outranking using. However, since the method is complex and needs lots of primary data, it consumes time.

3.2. Multiple Objective Decision Making (MODM)

Multiple objective decision making method are used for optimization problems with conflicting objectives. The main characteritics of MODM are conflicting objectives (more than one objectives) and well-defined constaraints. So, this method is related to mathematical programming to cope with the optimization problems (Tzeng and Huang, 2011).

3.2.1. Linear Programming (LP)

The main aim of the Linear programming is to cope with the problem of optimization (maximizing or minimizing) the linear function with the existance of linear equality or/and inequality constraints. Since the method is applicable for complex and large problems, and the ability of solving problems with effective algorithms and computers to users, Linear Programming is widely used method (Bazaraa, Jarvis and Sherali, 2010).

In LP problems, $c_1x_1 + c_2x_2 + \cdots + c_nx_n$ is the objective function to be minimized and denoted by z. And, $c_1, c_2, \ldots, c_n$ are the cost coefficients, $x_1, x_2, \ldots, x_n$ are the decision variables. The aim is minimize subject to

$$c_1x_1 + c_2x_2 + \cdots + c_nx_n$$

$$a_{11}x_1 + a_{12}x_2 + \cdots + a_{1n}x_n \geq b_1$$

$$a_{21}x_1 + a_{22}x_2 + \cdots + a_{2n}x_n \geq b_2$$

$$\vdots \qquad \vdots \qquad \vdots \qquad \vdots$$

$$a_{n1}x_1 + a_{n2}x_2 + \cdots + a_{nn}x_n \geq b_n$$

Where $\sum_{j=1}^{n} a_{ij}x_j \geq b_i$ denotes the i^{th} constraint (restriction)(Bazaraa, Jarvis and Sherali, 2010).

3.2.2. Non- Linear Programming (N-LP)

Linear Programming solves the optimization problem with linear equality of constraints or objective function. However, complexreal-life needs some non-linear optimizations such fields as operations research, engineering, computer science and economics. At these fields non-linear programming have an important role increasingly. If one or more of the objective function or

restrictions are non-linear then the optimization problem is non-linear program. The main aim of the non-linear programming is to find optimal solution(with maximizing or minimizing the objective function) like linear programming (Avriel, 2003).

3.2.3. Goal Programming (GP)

The starting point of the Goal Programming is like Linear Programming since the GP is an extension of LP. The GP model has constraints (goal constraints/restrictions), an objective function and the nonnegativity restriction function (deviation variables). Goal Programming (GP) is designed to deal with problems involving multiple conflicting objectives. This is a multiobjective technique. Goal programming is a variation of linear programming considering more than one objective (goals) in the objective function.GP was suggested for use in solving unsolvable Linear Programming (LP) problems (Schniederjans, 1995).

3.3. Methods Used in Study: AHP, TOPSIS and VIKOR

In MCDM, VIKOR is helpful tool and easy to understand method and TOPSIS is widely used method for various applications since the reliability of the method. Moreover, these two methods are not complex (Tzeng and Huang, 2011). Since the positive aspects of the methods TOPSIS and VIKOR selected for the research.

In this study, we use VIKOR and TOPSIS method from MADM methods to find the best alternative (the best airline company that chosen by passengers) and AHP method to weight criteria that are necessary for VIKOR and TOPSIS method. The detailed description of these methods is below;

3.3.1. Analytic Hieararchy Process (AHP)

Analytical Hierarchy Process (AHP) was developed by Thomas Saaty in the 1970s. The process provides models in a hierarchical structure that shows the relationship between the decision makers' complex problems, the main objective of the problem, criteria, sub-criteria and alternatives (Kuruüzüm and Atsan, 2001). AHP is the tool of the criteria decision-making among all applications that have been used for decision-making and it is one of the most preferred multiple criteria decision-making methods (Vaidya and Kumar, 2006).

Decision-making has many criteria and sub-criteria that are used to rank alternatives to make a decision. Alternatives need to set priorities in terms of the criteria to be assessed or subcriteria, as well as in the case of alternatives, but also in terms of criteria for higher objectives or alternatives. To make a comparison, we need a number scale which shows that one element how many times more important than another element with respect to the criterion (Saaty, 2008).

3.3.1.1. Properties of the AHP

The Analytic Hierarchy Process (AHP) is a general theory of measurement with ratio scales. In AHP method the hierarchical structure is needed to represent the problem and in order to establish relations within the structure, a pairwise comparison is made. In the use of AHP pairwise comparisons are essential tools (Saaty, 1987).

One of the uses of a hierarchy structure in AHP is that it enables to make a decision separately on each of properties that essential for making a decision (Saaty, 1990).

One of the most important feature of AHP is that the decision maker can include both objective and subjective thoughts in the decision process (Kuruüzüm and Atsan, 2001).

Decision making with AHP based on ranking activities in terms of relative ratio scales. Deriving ratio scales with AHP in terms ofpairwise comparisons (Saaty, 1994).

There is no need to advanced technical knowledge is to use the method. It has a simple and efficient procedure. Even within different experiences and opinions, a conclusion can be reached by decision makers (Saaty, 1994).

It can use both measurable and non-measurable data (Saaty, 1994).

3.3.1.2. Strengths and Weaknesses of the **AHP**

AHP is a technique used to analyze and organize complex decisions. When people are working on complex problems, AHP is most useful for decision makers (Xi and Qin, 2013).

Some strengths of the method as follows (Xi and Qin, 2013; Saaty, 1994; Saaty, 1990; Oğuztimur,2011);

- With the AHP, decision makers can easily understand the elements of the problem by identifying the problem. Thus, it is possible to determine the preferences that overlap with the purpose.
- AHP is a simple and flexible model to evaluate large-scale problems.
- Criteria are compared in binary at each level. AHP gives more information as a result of binary comparisons and allows for consideration of all measured or unmeasured factors and objectives.
- AHP constructs decision problems in a hierarchical way. The decision-maker can focus a part of the problem on the basis of binary comparisons. Thus, the decision-maker makes the final decision easier.
- AHP is a solve the problems succesfuly which involves subjective and objective criteria.

Some weaknesses of the method are listed below; (Saaty, 1994; Oğuztimur,2011)

- One of the most important features of AHP is being subjective. In other words, it is directed by judges directing by decision makers. So, result is not independent. It means that it cannot guarantee the definitely true decision.
- If a new criterion added then whole process has to be restarted.
- If the number of alternatives and criteria increase i.e., the levels in the hierarchy increase, then decision makers will spend more time and effort for building the AHP model.
- AHP is not efficent the criteri with large set.

3.3.1.3. Mathematical Approach of the AHP

In the first step of AHP, construct the decision hierarchy from the beginning with the goal of the decision. Goal, criteria, sub-criteria, alternatives are determined by going from top to bottom in the problem (Saaty, 2008).

The formation of a hierarchical structure, the first stage of decision-making problems, implies the division of the problem into various levels. The decision-maker has the opportunity to effectively compare different evaluation criteria and alternatives with the formation of hierarchical structure. The main purpose of the ECHR in using the hierarchical structure to solve complex problems is to reflect the tendency of the decision-maker's thoughts and to determine the level of influence the function between criteria and alternatives has (Henson, Culoba and Mendoza, 2002).

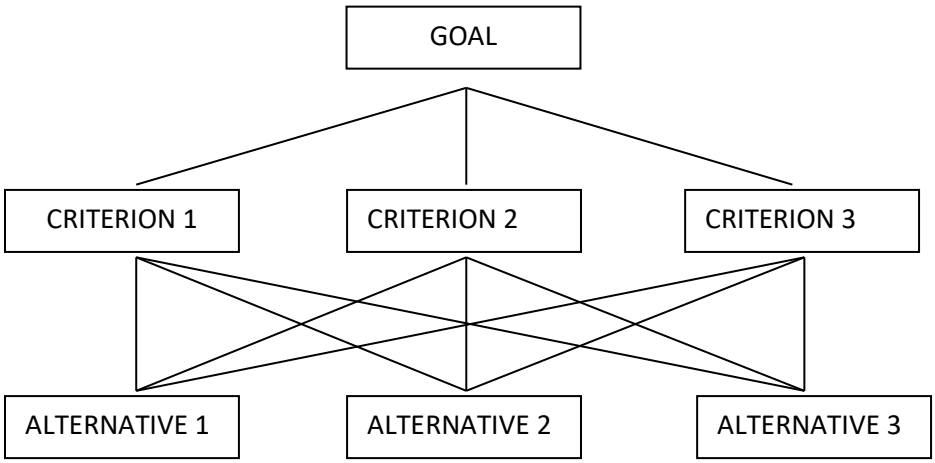

Figure 6:AHP Hierarchical Structure Model

Source: Xi Xi and Qiuli Qin**, "**Product Quality Evaluation System Based on AHP Fuzzy Comprehensive Evaluation", Journal of Industrial Engineering and Management, Volume 6, No 1, 2013, pg.358.

In the second stepafter establishing the hierarchical structure is to determine the relative importance of the elements at the hierarchy level. Relative significance is determined by pairwise comparisons between elements at each level. The main objective at this stage is to determine the relative importance of the elements and to determine the effect of these importance on the main objective. Therefore, in the established hierarchy, the effects of the elements at one level of the hierarchy on the higher level are tried to be determined and the effect of the elements at the lowest level on the main target is determined (Arıkan, 2008).

To make a pairwise comparison matrices and decide which criteria is more important see Table 5 which created by Saaty (2008).

Table 5

The Fundamental Scale of Absolute Numbers

Intensity of Importance	Definition	Explanation
1	Equal Importance	Two activities contribute equally to the objective
2	Weak or slight	
3	Moderate importance	Experience and judgement slightly favour one activity over another
4	Moderate plus	
5	Strong importance	Experience and judgement strongly favour one activity over another
6	Strong plus	
7	Very strong or demonstrated importance	An activity is favoured very strongly over another; its dominance demonstrated in practice
8	Very, very strong	
9	Extreme importance	The evidence favouring one activity over another is of the highest possible order of affirmation
Reciprocals of Above	If activity i has one of the above non-zero numbers assigned to it when compared with activity j, then j has the reciprocal value when compared with i	A reasonable assumption
1.1-1.9	If the activities are very close	May be difficult to assign the best value but when compared with other contrasting activities the size of the small numbers would not be too noticeable, yet they can still indicate the relative importance of the activities.

Source: Thomas L. Saaty, "Decision Making With The Analytic Hierarchy Process", Int. J. Services Sciences, Volume 1, No. 1, 2008, pg.86.

In this step, $n(n-1)/2$ comparisons are required, where n is the number of elements by taking into consideration that diagonal elements are equal to 1 and the other elements represent the comparisons (Vaidya and Kumar, 2006).

And in the last step of AHP the consistency index (CI) and consistency ratio (CR) are calculated to show whether the matrices created are consistent (for validity). If the contingency ratio (CR) is less than 0.1 then it is consistent. But if it is grater than 0.1 then it needs the reconsideration (Kuruüzüm and Atsan, 2001).

As a consequence, the AHP begins with to determine the hierarchy and advances with ordinal ranking further into comparisons from ranking. By making comparisons among the numbers, the reciprocal structure is determined. Thus, from paired comparisons AHPget behavorial judgements of properties (inconsistency, intransitivity). And then, AHP shows that a derived scale should approximate the original scale ensuring the high consistency (Saaty and Vargas, 2012).

The formulation of AHP step by step as follows (Saaty and Vargas, 2012; Saaty, 1990);

Step 1: Define the problem. Determine purpose, alternatives and criteria.

Step 2: Make pairwise comparisons between criteria and between alternatives to determine the relative importance weights. In other words, determine the which element is more important by using the preference scale. (Table 3) And make the comparison matrix. The comparison matrix that created by the comparison between criteria matrix is $n\ x\ n$ size, because n is the number of criteria.

$$A = \begin{pmatrix} a_{11} & \cdots & a_{1n} \\ \vdots & \ddots & \vdots \\ a_{n1} & \cdots & a_{nn} \end{pmatrix}$$

There is a relation between matrix elements;

The matrix $A = (a_{ij}),\quad a_{ij} = {}^{w_i}/_{w_j}\ ,\ \ i,j = 1,\dots,n$ has positive entries and satifies the reciprocal property;

$$a_{ij} = {}^{1}/_{a_{ji}} \text{ and } a_{ii} = 1.$$

Any matrix with this propert called reciprocal matrix.

Step 3: From pairwise comparisons calculate the priority vector.

$$w_i = \frac{\sum_{j=1}^{n} a_{ij} w_j}{n}$$

Step 4: Calculate overall priority vectors.

According to priority vectors, each vector multiplied by the initial comparison matrix and find the overall priority matrix.

Step 5: Calculate the Consistency Ratio(CR).

$$CR = CI/RI$$

The consistency index (CI) measures the inconsistency in the pairwise comparisons with the formula;

$$\mathrm{CI} = \lambda_{max} - \boldsymbol{n}/(\boldsymbol{n}-\mathbf{1}).$$

Where λ_{max} is the principal eigenvalue of A and n is the number of criteria.

The random index (RI) is an index which calculated randomly for every $n$size matrix.

Table 6
Random Index (RI)

Matrix Size	Random Consistency Index
1	0.00
2	0.00
3	0.58
4	0.90
5	1.12
6	1.24
7	1.32
8	1.41
9	1.45
10	1.49

Source: Thomas L.Saaty, "The Analytic Hierarchy Process", 1980, pg.63.

If the consistency ratio (CR) is significantly small (to be about 10% or less), i.e. takes value less than 0.1 then it is called good. But if it is greater than 0.1 then it would be reconsidered.

Step 6: Make a comparison between alternatives by for each criteria. If the number of alternatives is m, then the each comparison matrix must be $m \; x \; m$.

Step 7: Calculate the weighted score of alternatives.

Perform normalization and take the average for each alternative then find priorty vector.

Each vector is multiplied by the weight of the criterion and each alternative values are summed to get the total weights.

Finally, the alternative with the largest point is the most suitable alternative.

3.3.2. TOPSIS Method

TOPSIS (Technique for Order Preference by Similarity to an İdeal Solution) method is presented in Chen and Hwang (1992), with reference to Hwang and Yoon (1981). The basis of the TOPSIS method is based on the principle that the alternative to be chosen should have the the farthest distance from the negative-ideal solution and the farthest distance from the negative-ideal solution (Opricovic and Tzeng, 2004).

The ideal solution (positive ideal solution) is a solution that maximizes the benefit criteria and minimizes the cost criteria. On the other hand, negative ideal solution minimizes the benefit while the cost is maximized. The best alternative is chosen according to distance, i.e, the alternative which is closest to the ideal solution and farthest from the negative ideal solution is the best alternative (Wang and Elhag, 2005).

3.3.2.1. Properties of the TOPSIS

Some properties of the TOPSISmethod can be listed as follows (Shih, Shyur and Lee, 2006; Chung-Hsing and Yeh, 2003);

- TOPSIS is a useful and practical technique.
- The application of the method to many real-world decision making situations is easy and simple.

- Calculation ability is strong.
- TOPSIS allows the measurement of the relative performance of each alternative through a simple mathematical equation.

3.3.2.2. Strengths and Weaknesses of the TOPSIS

TOPSIS is one of the most preferred MCDM methods since it has many strengths compared to other methods such as VIKOR, PROMETHEE and ELECTRE. The fact that it can be easily analyzed and based on understandable results has made this method the most preferred method. The strengths of the method can be listed as (Shih, Shyur and Lee, 2006; Triantaphyllou and Lin, 1996);

- The method is intuitive, implementation and understanding of the methos is easy.
- Provides a combination of both the best and the worst alternatives (positive ideal solution and negative alternative solution).
- Because it is a simple calculation process, it can be easily programmed into tables.
- Unlike previous developments, the procedure includes group preferences.
- The method is unified process to it will be easily applicable to many real-world MCDM situations with no need to increasing complex computations.

There are some weaknesses as well as the strengths of the method. In addition to the positive aspects of the method, to prevent negative situations caused by changes in decision criteria in the face of changing environmental conditions and uncertainty the Fuzzy TOPSIS method is used (Vatansever, 2013). The weaknesses of the method as follows (Wang, Cheng, Cheng, 2009);

- The results may sometimes not fit basic ideas. In this case, the best solution is the nearest option to the positive ideal solution and the most remote option to the ideal negative solution.
- One of he most important weakness encountered in the decision-making process is uncertainty for the decision criteria.
- Initially, to assign a weight value is necessary for each criterion.
- Method is applicable when only criteria are independent.

3.3.2.3. Mathematical Approach of the TOPSIS

The steps of the TOPSIS Method are as follows (Wang, Elhag, 2005);

Step 1: Normalized decision matrix calculation.

The decision matrix is denoted by $X = \left(x_{ij}\right)_{n\,X\,m}$, where the problem has n alternatives and and m criteria.

Normalized value:

$$r_{ij} = {}^{x_{ij}}\Big/\sqrt{\sum_{i=1}^{m} {x_{ij}}^2} \;\; , i = 1,2,\dots,n; \;\; j = 1,2,\dots,m.$$

Step 2: Weightednormalized decision matrix calculation.

$$v = \begin{bmatrix} w_1 r_{11} & \cdots & w_n r_{1n} \\ \vdots & \ddots & \vdots \\ w_1 r_{m1} & \cdots & w_n r_{mn} \end{bmatrix}$$

where w_i is the weight of the i^{th}attribute, and $\sum_{i=1}^{n} w_i$ = 1.

Step 3: Determination of the the ideal and negative-ideal solution.

$$A^* = \left\{\left({}^{max}_{j} v_{ij} \mid i\varepsilon I'\right), \left({}^{min}_{ij} v_{ij} \mid i\varepsilon I"\right)\right\} = \{v_1^*, v_2^*, v_3^*, \dots, v_n^*\}$$

$$A^- = \left\{\left({}^{maxmin}_{j} v_{ij} \mid i\varepsilon I'\right), \left({}^{max}_{j} v_{ij} \mid i\varepsilon I"\right)\right\} = \{v_1^-, v_2^-, v_3^-, \dots, v_n^-\}$$

where I' represents the benefit criteria, and $I"$represents the cost criteria.

Step 4: With using Euclidean distance, calculation of the seperation matrix.

The separation of each alternative from the ideal solution is calculated as:

$$D_j * = \sqrt{\sum_{i=1}^{n} \left(v_{ij} - v_i^*\right)^2}, j = 1,2,\dots,J$$

The separation of each alternative from the negative ideal solution is calculated as:

$$D_j^- = \sqrt{\sum_{i=1}^{n} \left(v_{ij} - v_i^-\right)^2}, j = 1,2, \dots, J$$

Step 5: Calculation of the relative closeness to the ideal solution.

The relative closeness of the alternative aj with respect to A^* is defined as:

$$C_{i^*} = \frac{D_j^-}{\left(D_j^* + D_j^-\right)}$$

where $j = 1,2, \dots, j$.

Step 6: Preference order ranking.

Triantaphyllou (2000) states that "The best (optimal) alternative can now bedecided according to the preference rank order of C_i^* . Therefore, the best alternative is the one that has the shortest distance to the ideal solution. The previous definition can also be used to demonstrate that any alternative which has the shortest distance from the ideal solution is also guaranteed to have the longest distance from the negative-ideal solution."

3.3.3. VIKOR Method

VIKOR is one of the Multi-Criteria Decision Making Method (MCDM) that was developed by Serafim Opricovic to solve decision problems with conflicting and noncommensurable (different units) criteria. The name VIKOR from Serbian: VIseKriterijumska Optimizacija I Kompromisno Resenje appeared in 1990, that means: Multicriteria Optimization and Compromise Solution (Opricovic and Tzeng, 2004).

The aim is tofind a solution that is the closest to the ideal solution, and the the appreciation of the alternatives with respect to all established criteria. VIKOR method ranks alternatives and determines the solution that is the closest to the ideal which is called compromise solution (Opricovic, 1998). Compromise solution is closest the ideal solution with mutual agreements (Zhang

and Wei, 2013). VIKOR method aims the maximum group benefit and and minimum individual regret of competitors. Calculations are quite simple and clear (Ju and Wang, 2013).

Before proceeding to the steps of method, there is a term that is need to be known; $L_p - metric$.Development of the VIKOR method started with the following form of $L_p - metric$ (Opricovic, 1998):

$$L_{p,j} = \left\{\sum_{i=1}^{n}\left[w_i\left(f_i^* - f_{ij}\right)/\left(f_i^* - f_i^-\right)\right]^p\right\}^{1/p},$$

$$1 \leq p \leq \infty; j = 1,2,\ldots J.$$

The various J alternatives are denoted as$a_1, a_2, \ldots, a_j$. For alternative a_j, the rating of the i^{th}aspect is denoted by f_{ij}, i.e. $f_{ij}$is the value of i^{th}criterion function for the alternative a_j; n is the number of criteria.

3.3.3.1. Properties of the VIKOR

The VIKOR method has been applied in many areas is an important tool for prioritizing alternatives considering multiple criteria (e.g. Renewable energy planning (Kaya and Kahraman, 2010; Cristobal, 2011), material selection (Shaniana and Savadogo, 2009), public transportation (Tzeng, Ling and Opricovic, 2005), land-use restraint strategy priorition (Chang and Hsu, 2009). This method focuses on comprimise solutions which will help the decision makers to reach the final solution when there is a problem with conflicting criteria. During the last ten years, VIKOR has become a preferred method for real-life problems with multiple alternatives and criteria (Zeng, Li, Yang, 2013).

Some properties of the VIKOR method can be listed as follows (Opricovic, 1998);

- This method is used for for the multicriteria optimization of complex systems.
- The focal point of this method is selecting and ranking a number of alternatives when there is a confling criteria.
- It is based on the principle of closeness to the ideal solution.
- The preferences of the decision makers are expressed in the weights.
- VIKOR provides the maximum group benefit of the majority and the minimum individual regret of the opposite.

3.3.3.2. Strengths and Weaknesses of the VIKOR

The VIKOR method first mentioned by Opricovic (1998) was used by Opricovic and Tzeng (2004) to solve multi criteria decision making problems. So, is a new method in multi-criteria decision making methods. However, VIKOR is preferred by the practitioners. The strengths of the method, which are the reasons of being preferred by the practitioners, can be listed as follows;

- With a simple and easy-to-understand comparison structure, it achieves an outward sorting between alternatives (Bernroider and Stix, 2003).
- It is used as an effective tool in multi-criteria decision-making if decision makers cannot specify their preferences in the beginning (Opricovic and Tzeng, 2007).
- The method requires a sorting and selection between alternatives, taking into account more than one criteria (Opricovic and Tzeng, 2007).
- Decision makers can better reflect their ideas with VIKOR method (Opricovic and Tzeng, 2002).

3.3.3.3. The Mathematical Approach of VIKOR

The steps of the VIKOR Method are as follows (Opricovic and Tzeng, 2004);

Step 1: Determine the best f_i^* and the worst f_i^- values of all criterion functions, $i = 1; 2; \ldots; n$. If the i^{th} function represents a benefit then:

$$f_i^* = max_j f_{ij}\,, \qquad f_i^- = min_j f_{ij}$$

Step 2: Compute the values S_j and R_j.

$$S_j = \sum_{i=1}^{n} w_i \left(f_i^* - f_{ij}\right)/(f_i^* - f_i^-)$$

$Rj = max_i\left[w_i \left(f_i^* - f_{ij}\right)/(f_i^* - f_i^-)\right]$, where w_i are the weights of criteria.

Step 3: Compute the values $Q_j, where\ \ j\ =\ 1, 2, \ldots, j$, by the relation;

$$Q_j = \frac{v\left(S_j - S^*\right)}{S^- - S^*} + \frac{(1-v)\left(R_j - R^*\right)}{R^- - R^*}$$

where,

$$S^- = minS_j\ ;\ S^* = maxS_j$$

$$R^- = minR_j\ ;\ R^* = maxR_j$$

and v is introduced as weight of the strategy of ''the majority of criteria'' (or ''the maximum group utility''), here v= 0.5.

Step 4: Rank the alternatives, sorting by the values S, R and Q, in increasing order. And create three ranking lists.

Step 5: Propose as a compromise solution the alternative (a') which is ranked the best by the measure Q (minimum) if the following two conditions are satisfied:

C1: Acceptable Advantage

Where a'' is the alternative with second position in the ranking list by Q;

$$Q\left(a^{''}\right) - Q(a') \geq DQ$$

$DQ = {}^{1}/_{J-1}$, J is the number of alternatives.

C2: Acceptable stability in decision making

Alternative a' must also be the best ranked by S or/and R. This compromise solution is stable within a decision making process, which could be: ''voting by majority rule'' (when $v > 0.5$ is needed), or ''by consensus'' $v = 0.5$, or ''with veto'' ($v < 0.5$). Here, v is the weight of the decision making strategy ''the majority of criteria'' (or ''the maximum group utility'').

3.3.4. A Comparison of TOPSIS and VIKOR

TOPSIS and VIKOR are one the popular methods of MCDM methods. Since they are both simple and easy to understand decision makers prefer these methods for real-life problems. The compromise solution that helps decision makers to find a final solution is the closest to the ideal. On other words, reaching the compromise solution needs mutual concessions (Opricovic and Tzeng, 2004).

The TOPSIS method based on the idea that to find the solution with the shortest distance from the ideal solution and the farthest distance from the negative-ideal solution (Hwang and Yoon, 1981). VIKOR based on the measure of closeness to the ideal solution (Opricovic, 1998). So, these two methods both based on the principle of closeness to the reference point(s). However, TOPSIS and VIKOR introduce different forms of aggregating function for ranking. VIKOR method provides a compromise solution addition to TOPSIS method (Opricovic and Tzeng, 2004).

Another different procedure among two methods is normalization. The VIKOR uses linear normalization and the TOPSIS uses vector normalization. In more descriptive manner, the normalized value does not depend on the unit of a criterion in linear normalization.However, the normalized value in vecto normalization could be different for different evaluation unit of a particular criterion (Opricovic and Tzeng, 2004).

The aggregation approach is different in both methods. The VIKOR method focuses on the distance from an ideal solution. The ranking index of VIKORis an aggregation of all criteria, and it considers the relative importance of the criteria. TheTOPSIS method focuses on the distances from the ideal point and from the negative-ideal point. Different from VIKOR, TOPSIS does not consider the relative importance (Opricovic and Tzeng, 2004).

Both methods ensure ranking list. In VIKOR the alternative closest to ideal solution is the highest ranked one. However, it does not mean that always the closest alternative to the ideal solution is the highest ranked in TOPSIS(Opricovic and Tzeng, 2004).

4. FINDINGS

In this section we discuss the survey according to the methods AHP, VIKOR and TOPSIS. In the first section, the weights of the criteria were determined by using the AHP method. In order to determine the weights, the results of the survey applied on eight different passengers traveling with different airline companies were used. Then, seven different alternatives were compared with the TOPSIS and VIKOR methods according to the results of the survey applied to 52 different passengers and the best alternative was determined. In the comparison with TOPSIS and VIKOR methods, the weights are determined by AHP.

4.1. Weighting with Using AHP

In this part of the study, AHP method was used to evaluate the criteria weights required for VIKOR and TOPSIS methods. A questionnaire was applied to eight passengers of different professions who were flying by different airways, and the consistency index (CI) was calculated for each matrix created accordingly.

For the comparison of passengers, seven different criteria were determined;

- Ticket prices (budget-friendly prices),
- Corporate image and public recognition,
- In-cab comfort and convenience (seat knee distance, entertainment systems, seat comfort, toilet hygiene, cab hygiene),
- In-flight service quality(quality of food and quality of staff behavior),
- Timing (delay frequency, check in time length),
- Number of flight points and aircraft(having airline company flights at the desired point),
- Reliability (Safety Factor) (passengers feeling safe during the flight).

For making easy to undertand the tables which will be used for both TOPSIS and VIKOR method, criteria are coded and codes are listed below in the Table 7;

Table 7

Criteria and Codes for the Evaluation of Airline Companies

Code	Criterion
C1	Ticket Prices
C2	Corporate Image and Public Recognition
C3	In-cab Comfort and Convenience
C4	In-flight Service Quality
C5	Timing
C6	Number of Flight Points and Aircraft
C7	Reliability (Safety Factor)

According to the answers given by the passengers in accordance with Table 5, the comparison matrix was created and the weights of the criteria were determined. The consistency index of each matrix was calculated and the results with a consistency index of less than 0.1 were considered as consistent. The results obtained from the comparison matrices were calculated with the geometric mean and the weighted scores of alternatives were calculated. Calculated weights are as in Table 8.

Table 8

Weighted Scores of Alternatives

Criterion	Weight
C1	0.20
C2	0.09
C3	0.11
C4	0.10
C5	0.15
C6	0.15
C7	0.19
TOTAL	**1.00**

3.4. TOPSIS

In this section of the study, five airline companies located their bases in Turkey were selected as the alternatives to be ranked by the customers. These mentioned companies were coded as A1, A2, A3, A4 and A5. Evaluation is acceptable for six criteria since they are subjective issues and passengers' thoughts are essential for these criteria (ticket prices, corporate ımage and public recognition, in-cab comfort and convenience, in-flight service quality, timing, reliability (safety factor)). For these criteria passengers' thoughts are essential because the aim of the research is evaluating airline companies from consumers' perspective. For one criterion which is number of flight points and aircraft has not graded by passengers because this criterion is objective issue and it can be founded from airline companies' websites.

Decision matrix created according to the customers' grades which is necessary for both TOPSIS and VIKOR method is as follows;

Table 9

Decision Matrix

Airline Companies	Ticket Prices	Corporate Image and Public Recognition	In-cab Comfort and Convenience
A1	3.02	4.77	4.6
A2	3.04	2.98	2.9
A3	2.94	2.15	2.5
A4	3.00	2.96	2.8
A5	3.23	3.62	2.8

Airline Companies	In-flight Service Quality	Timing	Number of Flight Points and Aircraft	Reliability (Safety Factor)
A1	4.50	3.63	308	4.75
A2	2.90	3.02	7	3.12
A3	2.60	2.87	72	2.81
A4	2.92	2.94	73	2.98
A5	2.60	2.98	11	3.23

According to the Table 8 and Table 9, steps of TOPSIS method are as folllows;

Step 1: Normalized decision matrix calculation.

Table 10

Normalized Decision Matrix

Airline Companies	**C1**	**C2**	**C3**	**C4**	**C5**	**C6**	**C7**
A1	0.07	0.08	0.09	0.09	0.08	0.00	0.08
A2	0.07	0.05	0.06	0.06	0.06	0.00	0.05
A3	0.06	0.04	0.05	0.05	0.06	0.00	0.05
A4	0.06	0.05	0.05	0.06	0.06	0.00	0.05
A5	0.07	0.06	0.05	0.05	0.06	0.00	0.05

Step 2: Weighted normalized decision matrix calculation.

Table 11

Weighted Normalized Decision Matrix

	C1	C2	C3	C4	C5	C6	C7
Weight	0.20	0.09	0.11	0.10	0.15	0.15	0.19
A1	0.01	0.01	0.01	0.01	0.01	0.00	0.02
A2	0.01	0.00	0.01	0.01	0.01	0.00	0.01
A3	0.01	0.00	0.01	0.01	0.01	0.00	0.01
A4	0.01	0.00	0.01	0.01	0.01	0.00	0.01
A5	0.01	0.01	0.01	0.01	0.01	0.00	0.01

Step 3: Determination of the the ideal and negative-ideal solution.

Table 12

Positive and Negative Ideal Solutions

Airline Companies	C1	C2	C3	C4	C5	C6	C7
A1	0.01	0.01	0.01	0.01	0.01	0.00	0.02
A2	0.01	0.00	0.01	0.01	0.01	0.00	0.01
A3	0.01	0.00	0.01	0.01	0.01	0.00	0.01
A4	0.01	0.00	0.01	0.01	0.01	0.00	0.01
A5	0.02	0.01	0.01	0.01	0.01	0.00	0.01
A*	0.02	0.01	0.01	0.01	0.01	0.00	0.02
A-	0.01	0.00	0.01	0.01	0.01	0.00	0.01

Step 4: Calculation of the seperation measures.

Table 13

Seperation Measures

Airline Companies	D_j^*	D_j^-
A1	0.004	0.010
A2	0.008	0.003
A3	0.010	0.002
A4	0.008	0.003
A5	0.008	0.005

Step 5: Calculation of the relative closeness to the ideal solution.

Table 14

Relative Closeness

Airline Companies	C_i
A1	0.72
A2	0.26
A3	0.14
A4	0.23
A5	0.37

Step 6: Preference order ranking.

Table 15

Ranking

Airline Companies	C_i
A1	0.72
A5	0.37
A2	0.26
A4	0.23
A3	0.14

As a result of TOPSIS method, we conclude that A1 is the most successful and preferred company from consumers' perspective. We can say that A1 is the leader in terms of the performans in the perspective of customers. A5, which comes after A1, is more competitive with A1 than other companies, but it is concluded that there is no big difference between other companies. A2 and A4 have close value. It is seem that A3 needs to develop itself and needs more recognition in customers' perspectives.

3.5. VIKOR

One of the main aim of the study is making a comparative research and having more reliable comclusions. Hence, two methods of the MCDM are selected and applied to solutions of survey. According to the first method -TOPSIS- application we conclude that A1 has the most successful performans according to passengers. Now, we applied the VIKOR method to same results with using decision matrix in Table 9.

The calculated steps of the VIKOR are as folllows;

Step 1: Determine the best f_i^* and the worst f_i^{-} values of all criterion functions, $i = 1; 2; \ldots; n$.

Table 16

Best and Worst Alternatives

Airline Companies	C1	C2	C3	C4	C5	C6	C7
A1	2.02	4.77	4.62	4.50	3.63	308.00	4.75
A2	3.04	2.98	2.88	2.90	3.02	7.00	3.12
A3	2.94	2.15	2.52	2.60	2.87	72.00	2.81
A4	3.00	2.96	2.85	2.92	2.94	73.00	2.98
A5	3.23	3.62	2.81	2.60	2.98	110.00	3.23
f_i^*	3.23	4.77	4.62	4.50	3.63	308.00	4.75
f_i^-	2.94	2.15	2.52	2.60	2.87	7.00	2.81
$f_i^* - f_i^-$	0.29	2.62	2.10	1.90	0.77	301.00	1.94

Step 2: Compute the values S_j and R_j.

Table 17

S_j and R_j Values

Airline Companies	S_j	R_j
A1	0.15	0.15
A2	0.80	0.16
A3	0.96	0.20
A4	0.82	0.17
A5	0.61	0.15

Step 3: Compute the values Q_j for v= 0.5.

Table 18

Q_j Values

Airline Companies	Q_j
A1	0.00
A2	0.51
A3	1.00
A4	0.65
A5	0.29

Step 4: Rank the alternatives, sorting by the values S, R and Q in increasing order. And create three ranking lists.

Table 19

Ranking Lists

Airline Companies	S_j	**Airline Companies**	R_j	**Airline Companies**	Q_j
A1	0.15	A1	0.15	A1	0.00
A5	0.61	A5	0.15	A5	0.29
A2	0.80	A2	0.16	A2	0.51
A4	0.82	A4	0.17	A4	0.65
A3	0.96	A3	0.20	A3	1.00

Step 5: Propose as a compromise solution.

C1: Acceptable Advantage

Where $a^{''}$ is the alternative with second position in the ranking list by Q;

$Q(a^{''}) - Q(a') \geq DQ, \quad DQ = {}^{1}/_{J-1}$; J is the number of alternatives.

Table 20

Acceptable Advantage

Airline Companies	Q_j	$Q(a^{''}) - Q(a')$
A1	0.00	0.29
A5	0.29	
A2	0.51	
A4	0.65	
A3	1.00	

$DQ = {}^{1}/_{4} = 0.25$, $Q(a^{"}) - Q(a')$= 0.29

$0.29 \geq 0.25$

Since $Q(a^{"}) - Q(a') \geq DQ$ then, acceptable advantage is provided.

C2: Acceptable stability in decision making.

Table 21

Acceptable Stability

S_j	R_j	Q_j
A1	A1	A1
A5	A5	A5
A2	A2	A2
A4	A4	A4
A3	A3	A3

For this reason, stability is acceptable since the first alternative is A1 for for all three values S_j**,** R_j and Q_j. A1 is the best alternative for VIKOR method as well as TOPSIS method.

CONCLUSION

The concept of time is very important for today and it is possible to say that the role of airline transportation in saving time is great. It is inevitable to prefer airlines for less time spending and comfortable travel. When we look at the Sivil Havacılık Genel Müdürlüğü (SHGM) Annual report is published in 2017, we see that the aviation sector is developing day by day and growing rapidly.

According to the Sivil Havacılık Genel Müdürlüğü (SHGM) Annual report since 2003, number of aircrafts of the airline companies in Turkey has increased 219%, the number of seats has increased 253% and domestic and overseas flown point number has reached 351. In 2017, Istanbul Atatürk Airport hosted a total of 63 million 727 thousand passengers, including 19 million 450 thousand domestic flights and 44 million 277 thousand domestic flights. In 2017, the passenger traffic of Sabiha Gökçen Airport exceeded 31 million. According to the same report, there are 13 license holder airline companies in Turkey, the number of aircraft is 517 units and there are total 97,500 seatcapacity. When looking at this report, it is possible to say that there is a rapid acceleration of the airline market and increasing demand in Turkey. This growth also means competition and increasing customer requirements.

The figures in the report show that the civil aviation sector is growing rapidly. The needs due to the increasing demands are the most important reasons for the growth in the sector. The growth of the sector means more airlines and therefore more competition. In this case, it is up to the airlines to interfere with the expectations of the customers and improve themselves every day. The evaluations made by the customers are of great importance for the companies in the service sector.

In this study, it is aimed to evaluate the airline companies from the customers' perspective and the criteria are determined by using the literature. A questionnaire was conducted at the 3rd Istanbul Airport for people selected from different occupational groups. As a result of this survey, AHP method was used to determine which criteron is more important and how important according to customers.

As a result of AHP method, it is concluded that ticket price is the most important criterion for passengers with 20% ratio. Passengers first preffer the budget-friendly firms. The second important criterion is reliability (safety factor) with 19% ratio. Passengers want to feel themselves in safe when they fly. Fear have an important role in preference of customers. Actually, according to

ICAO Safety Report 2018, in 2017, there were 4.1 billion passengers travelling by air worldwide and here were only 50 fatal accidents on commercial flights. This means that the fatality rate is 12.2 fatalities per billion passengers. This report shows that, air travel is one of the safest trips, and each aircraft has almost the same level of security as it is complying with the ICAO safety criteria. The third important criteria are timing and number of flight points with 15% ratio. We know that the concept of timing is important for passengers and they do not want to spent more time. In addition, paasengers have to choose the airline company which make a flight the point that passengers willing to fly. So, the multiplicity of flight points becomes important in this case. The fourth one is in-cab comfort and convenience with 11% ratio. The fifth one is in flight services with 10% ratio and the last one is corporate image and public recognition with 9% ratio. According to the passengers, the fact that the corporate image and public recognition gives both the confidence and the think of high quality of service. Hence the last three criteria have close ratios.

The second part of the study is a comparative study. Fort this part, another survey was applied to passengers in İstanbul Airport. In this survey, comparison is made between five alternatives (A1, A2, A3, A4, A5) in terms of seven criteria (ticket prices, corporate image and public recognition, in-cab comfort and convenience, in-flight service quality, timing, number of flight points and aircraft and reliability (safety factor) is requested from passengers. 52 number of passengers answered the questionnaire. The TOPSIS and VIKOR methods were applied separately by using the criteria weights obtained by the AHP method and the decision matrix formed according to the survey. In both methods, the values without any restriction can be evaluated and preserved. The other six criteria except the number of flight points were evaluated according to the survey results. Because the main purpose of the study is to evaluate the criteria from the customer's perspective and the criteria presented require evaluation. Only flight destinations are an objective criterion and the number of flight points is taken into consideration directly from their website. A1 was the first company with a significant difference in both methods.

This study is important due to the fact that there are few comparative studies with VIKOR and TOPSIS methods in our country. The study was conducted for aircraft companies and is applicable in many different fields. However, the study has a form that can be improved by expanding the criteria or by creating sub-criteria.

APPENDIX

Appendix 1. Comparison Matrix for AHP in English

Please make a comparison between criteria, decide which criterion is important and grade between 1-10.

Comparison Among Criteria	Ticket Prices	Corporate Image and Public Recognition	In-cab Comfort and Convenience	In-flight Service Quality	Timing	Number of Flight Points and Aircraft	Reliability (Safety Factor)
Ticket Prices	1						
Corporate Image and Public Recognition		1					
In-cab Comfort and Convenience			1				
In-flight Service Quality				1			
Timing					1		
Number of Flight Points and Aircraft						1	
Reliability (Safety Factor)							1

Appendix 2. Comparison Matrix for AHP in Turkish

Lütfen kriterleri karşılaştırınız, hangisinin daha önemli olduğuna karar verip 1-10 arası puanlayınız.

Comparison Among Criteria	bilet fiyatları	kurumsal imaj ve bilinirlik	kabin içi konfor ve hizmetler	uçuş servis kalitesi	zamanlama	uçuş noktası ve uçak sayısı çokluğu	güvenilirlik (güvenlik)
bilet fiyatları	1						
kurumsal imaj ve bilinirlik		1					
kabin içi konfor ve hizmetler			1				
uçuş servis kalitesi				1			
zamanlama					1		
uçuş noktası ve uçak sayısı çokluğu						1	
güvenilirlik (güvenlik)							1

Appendix 3. Research Questionnaire for Decision Matrix in English

This survey aims to evaluate the airline companies from the customers' perspective according to the Master Thesis research. Your name, age or any specific information will not be included in the survey, only your answers will be used for evaluation purposes. It is very important for the survey that you give correct answers for the consistency of the survey. According to the criteria given in the survey you are asked to score between 1-5 companies. It is a short questionnaire with a total of 7 questions. It is compulsory to fill in each question and every option.

Thanks for your time.

Evaluate the companies between 1-5 in terms of;	A1	A2	A3	A4	A5
Ticket Prices					
Corporate Image and Public Recognition					
In-cab Comfort and Convenience					
In-flight Service Quality					
Timing					
Number of Flight Points and Aircraft					
Reliability (Safety Factor)					

1-bad, 2-not bad, 3-moderate, 4-good, 5-very good.

Appendix 4. Research Questionnaire for Decision Matrix in Turkish

Bu anket, Yüksek Lisans Tezi araştırması doğrultusunda müşteri gözünden havayolu şirketlerinin değerlendirilmesi amacını taşımaktadır. Ankette adınız, yaşınız veya herhangi özel bir bilginiz yer almayacak, yalnızca verdiğiniz cevaplar değerlendirme amaçlı kullanılacaktır. Anket tutarlılığı açısından doğru cevaplar vermeniz anket için çok önemlidir. Ankette sizden verilen kriterler doğrultusunda firmaları 1-5 arasında puanlamanız istenmektedir. Toplam 7 soru olmak üzere, kısa bir ankettir. Her soruyu ve her seçeneği doldurmak mecburidir.

Vakit ayırdığınız için teşekkürler.

Firmaları kriterlere göre 1-5 arasında puanlayınız	A1	A2	A3	A4	A5
Bilet Fiyatları					
Kurumsal imaj ve bilinirlik					
Kabin içi konfor ve hizmetler					
Uçuş servis kalitesi					
Zamanlama					
Uçuş noktası sayısı					
Güvenilirlik(kendini güvende hissetme)					

1-kötü, 2-fena değil, 3-orta, 4-iyi, 5-çok iyi.

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