MULTI CRITERIA DECISION MAKING PROCESS FOR MODELLING OF NETWORK DESIGN TO IMPROVE REGIONAL AVITATION IN TURKEY: CASE OF ANADOLU UNIVERSITY

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ABSTRACT

The development of regional aviation sector has seized the momentum in Turkey. In this process, using the limited resources correctly and transforming and implementing risk management decisions into effective time, cost and expense are the most critical elements of business management. Both the sound strategies and multi criteria decision-making processes are in needed to sustain the development of regional aviation in Turkey. Also decision making process should supported with enterprise risk management approach. To achieving corporate strategies requires implementation risk management based decision making process. The network design in airline management is a process in which decision makers consider many factors together with corporate strategy. The direct or indirect effects of these factors on each other also reveal their relations. Due to relations and interactions between criterions, benefit, opportunity cost and risk modules defined as BOCR criteria based on ANP methods will be used in this study. ANP is a multi-criteria decision making technique that take into consideration also qualitative factors in decision making problems. With concept of this method, it will be supported to literature reviews and receive opinions from executives in globally national and international industry. In this research, we aimed make contribution to the social and economic development of both Turkey and Eskisehir via this inspiration work about regional aviation capacity and capabilities of Turkey via sample of Eskisehir AOE/Hasan Polatkan Airport.

Keywords: Airline Transportation, Analytical Network Process/ANP, BOCR, Capacity Analysis, Corporate strategy, Flight Network Modelling, Multi Criteria Decision-making, Regional Aviation, Risk management.

INTRODUCTION

Air transportation is shaping social structures by allowing access to social services such as art, culture and health (Çancı & Güngören, 2013). the choice of airports served is a key part of any business model, since it affects network structure, routes' traffic density, operating costs, potential incentives, the level of competition with other airlines and other transport modes, etc. (Dobruszkes, Givoni, & Vowles, 2017)

Currently, Strategic Focus has determined as Improving Aviation Safety, Efficiency and Environmental Sustainability in aviaton sector (National Business Forum, 2017). The sector is under intense and growing pressure from many economic, technological and environmental factors (National Business Forum, 2017). In this concept business model should be support corporate strategy in airlines.

Banger and Çalışır defined the business model as 'the way in which an enterprise does business to achieve its sustainability.' (Banger & Çalışır, 2011). According to Nordic Innovation Publication, 'Companies think that the source of sustainability is innovation and that making changes in business model is also a kind of innovation (Nordic Innovation Publication , 2012). Osterwalder and Pigneur define the business model as follows; 'The business model defines how an entity creates, delivers and acquires value' (Osterwalder & Pigneur, 2010). According to Gambardella & McGahan, 'The success of the business model depends on generating profits, which is largely dependent on strategically important sources of the business (Gambardella & McGahan, 2010).

In sum, airport selection can be understood as testimony of the relationship between airlines' strategy and places served in the context of airlines' shareholders intending to yield a profit. They are also important in appreciating new spatial patterns related to the formation of metropolitan areas, which potentially concentrate large amounts of transport demand in or around larger cities. (Dobruszkes, Givoni, & Vowles, 2017)

Short- and medium-haul point to point market is the most profitable model and this allows to keep very low unit costs through high standardization in all categories while raising unit revenues through fare unbundling and ancillary revenues. Regional airlines may develop contractual relationships with network airlines and this can be used by last to drive out inefficient network airlines, applied in less profitable markets and depends on market size and when there are cost advantages. Regional airlines operate short to medium haul routes, low-density routes that are most efficiently served by a small number of daily flights on small aircraft, connecting smaller communities with larger destinations providing feeding into the legacy carriers network. In US aviation industry, almost all regional airlines have agreements with one or more network airlines Gillen, Hashemania and Jiang (2015) (Küçük Yılmaz et al., 2018).

In their research Bitzan and Peoples (2016) mentioned the significant effectiveness of LCCs on industry productivity and the convergence between LCCs and FSCs costs. According to Bitzan and Peoples (2016) Regional airlines can serve a feeders to the FSCs, serving small communities and carry passengers to FSC hub

airports, fly from secondary airports which may achieve faster turnarounds, operate very small jets or turbo-prop aircrafts, offer one class of service and they can contract their capacity to the FSCs and not sell their own tickets.

Burghouwt, Hakfoort and van Eck (2003) examined various groups of airlines in Europe and found that regional airlines can operate single city-pairs in pan-European level. In addition, these airlines implement linear, radial network configurations and combinations of radial with a large amount of point-to-point routes. Most of regional airlines use one or two central hub airports, having also a large amount of point-to-point routes. Regional airlines have much smaller networks and lower concentration rates than the national airlines. The authors stressed the importance of the 5th freedom (the right of an airline of one country to carry passengers between countries outside of its own country of registry as long as the flights originates or terminates in its own country of registry (Button and Taylor, 2000; Küçük Yılmaz et al., 2018).

Kaps in his research (1997) state that regional airlines play an increasingly important role in the national air transportation system Forbes and Lederman (2007) are suspect that regionals will continue to play a large and important role in the commercial aviation industry in looking forward way. According to Simon (2014), Regional Operator Characteristics as both strengths and weakness are:

Strengths

- Stability of major airline affiliations for some
- More concentrated in developed countries
- Strong local or niche franchises
- Less susceptible to international shocks
- More resilient performance in industry cycles

Weaknesses

- Less well known names for independent carriers
- Often poorly capitalised operators
- Many poorly managed & weak small start-ups
- Several unproven niche business models

Decision-making with effective time, cost and opportunity is most critical issue in business management via effective use of corporate sources. Herewith, modelling of flight network is strategic issue for airlines since airline yields and airline reputation directly linked with their scope of network by coupling up risk management and feasibility studies including in Eskişehir and airport. Optimum network models and their application strategies have been envisaged to use by airlines.

Flight network decisions are strategic decision-making concept. Therefore airline companies should develop their model their network according to corporate aims. Network design includes fleet planning, resource (human etc.) optimization and surely risk management to achieve corporate strategies in view of holistic picture.

Analytical Network Process (ANP) is regarded as a useful method for dealing with complex decisions involving dependency and feedback analysed in terms of benefit, opportunity, cost and risk. It is the basis for this work to consider the cost, strategic and risk-filled decision-making process such as flight network modelling in a way that aims at Optimization of Benefit, Cost, Opportunity and Risk which is BOCR criteria in ANP Methodology. This study is structured under Multi-Criteria Decision Making (MCDM) and is structured by administrators on the assumption that optimum network models and their application strategies can be improved. With the results of the research, it aims to contribute to sustainable aviation development both in global and national scale and in the field of strategy and management. Because flight security is critical to risk management of the decision making process in terms of broad benefit, opportunity, risk and cost optimization and increased accessibility in the development of civil aviation.

In this research second part presents contemporary information about both methodology ANP and BOCR literature. In the third part presents ANP based BOCR criteria to Network modelling which identified with experts. In last part present both findings and comments about BOCR criteria about modelling of network design to airlines with future works.

MULTI-CRITERIA DECISION MAKING (MCDM): ANP AND BOCR

Our research problem is dealt with as a "Multi-Criteria Decision Making" (MCDM) problem because many criteria must be taken into consideration. ANP method will be used based on BOCR criteria which are defined as criteria of benefit, opportunity, cost and risk in relation to the criterion because of the relationship and interaction. Within this method, expert opinions were received from managers in the international and national sectors on a global scale and the literature was supported by their studies.

Analytical Hierarchy Process (AHP) method developed and gained in the literature by Thomas L. Saaty (2001) is one of the most important methods used in decision making problems in recent years. The AHP models the decision-making problems in a hierarchical structure with a uni-directional manner and determines the priority order of the factors by evaluating the factors that affect the best decision in a systematic way. However, many factors that affect decision-making problems in real life interact with each other, and making the best decision requires consideration of these relationships among the factors. The ANP methodology, developed by Thomas L. Saaty (2001), takes account of the relationships among the factors in the decision making process and removes the necessity of modelling by adhering to a single direction of the problem. The problem of decision making in ANP method is modelled by a network structure and the dependencies between the factors and the internal dependencies within the factor are considered in the modelling phase. With this structure, the ANP

method ensures that decision-making problems are solved more effectively and realistically (Dağdeviren et al., 2006).

Selecting or prioritizing alternatives from a set of available alternatives with respect to multiple criteria, is often refer to MCDM in both AHP and ANP Methodologies are the common methods by which to solve Multi-Criteria Decision Making problems. The decision problem is structured hierarchically at different levels in both methodologies. The local priorities in ANP are established in the same manner as they are in AHP using pairwise comparisons and judgments. The ANP is the generalization of Saaty's AHP, which is one of the most widely employed decision support tools. Similarly to the AHP, the priorities in the ANP are assessed indirectly from pairwise comparisons judgments. There are four general steps in ANP based multicriteria decision-making process, including model construction; paired comparisons between each two clusters or nodes; supermatrix calculation based on results from paired comparisons; and result analysis for the assessment (Özdemir et al.,2011).

The model, which is hierarchical in AHP, leaves its place in network model in ANP. Thanks to the network structure, ANP produces more accurate solutions to AHP. To show a decision problem in the form of a network model, the problem is first divided into parts. Each of the parts is called a cluster and the subparts of the clusters are called factor. In the graphical representation of the network model, the clusters form node points. The interactions between the clusters are indicated by arrows and the direction of the arrow indicates the direction of effect. Because of the feedback and dependency properties of ANP, factors may be dependent on other factors as well as on themselves. Dependency between clusters is called external dependency and dependency within a cluster is called internal dependency. With internal and external dependencies, interactions both within cluster and between clusters are revealed. By defining the priorities, it is seen as an advantage of the ANP that bridge between the factors and aims, determine the priorities with a proportional scale, include the qualitative and quantitative criteria in the models, enable decision makers to reach consensus and a large number of decision makers can take part in the decision process (Ecer et al.,2009).

ANP method comprises four steps (Görener, 2012; Dağdeviren and Yüksel, 2007; Dağdeviren et al., 2006):

Step 1: Model construction and problem structuring: The problem should be stated clearly and decomposed into a rational system like a network.

Step 2: Pairwise comparisons and priority vectors: In ANP, like AHP, pairs of decision elements at each cluster are compared with respect to their importance towards their control criteria. In addition, interdependencies among criteria of a cluster must also be examined pairwise; the influence of each element on other elements can be represented by an eigenvector. The relative importance values are determined with Saaty's scale (see Table 1).

Step 3: Supermatrix formation: The supermatrix concept is similar to the Markov chain process. To obtain global priorities in a system with interdependent influences, the local priority vectors are entered in the appropriate columns of a matrix. As a result, a supermatrix is actually a partitioned matrix, where each matrix segment represents a relationship between two clusters in a system.

Step 4: Synthesis of the criteria and alternatives' priorities and selection of the best alternatives: The priority weights of the criteria and alternatives can be found in the normalized supermatrix.

Table 1. Pairwise Comparison Scale (Görener 2012; Dağdeviren and Yüksel, 2007)

Intensity of importance	Explanation
1	Two criterion contribute equally to the objective
3	Experience and judgement slightly favor one over another
5	Experience and judgment strongly favor one over another
7	Criterion is strongly favored and its dominance is demonstrated in practice
9	Importance of one over another affirmed on the highest possible order
2,4,6,8	Used to represent compromise between the priorities listed above

The ANP is a useful way to deal with complex decisions that involve dependence and feedback analyzed in the context of benefits, opportunities, costs and risks. It has been applied literally to hundreds of examples both real and hypothetical (Saaty, 2008). There are at least four ways to combine *BOCR* priorities with corresponding normalized weights b, o, c, r obtained by rating *B,* and then *C*, and then *0,* and finally, *R* separately. The first is the traditional one in which weighting amounts to multiplying by the same constant. They are as follows (Saaty ve Özdemir, 2003):

(1) *BO/CR;*

(2) *bB + 00* + c(l/C) + r(l/R);

(3) *bB + 00* + c(1 - *C)* + c(1 - *R);*

(4) *bB+oO-cC-rR.*

BOCR aspects it is understand the items of benefits associated with positive and certain contents, the items of opportunities with positive and uncertain contents, the items of costs with negative and certain contents, and the items of risks with negative and uncertain contents. For ranking and selection, the target is to obtain greater benefits and opportunities, while encountering smaller costs and risks. In addition, different decision makers may give varying degrees of importance to each BOCR aspect, depending on strategic issues or goals.

For synthesizing these four aspects, Saaty further recommended the formula bB+oO−cC−rR for the BOCR calculation. Here, B, O, C, and R are the priorities of the respective aspects, and b, o, c, and r are their weights, respectively. If the resulting value is positive, then it indicates the positive value is higher than the negative value and the choice turns out to be appropriate (Shih et al., 2014).

When the literature of ANP and BOCR model is examined, it is seen that there are publications in different fields. Bottero and Ferretti (2011) have proposed a multi-criteria approach that is able to support decision makers in the choice of the best location for a waste incinerator plant in the Province of Torino (Italy). In this study three alternative sites have been compared through the use of the ANP method. The decision-making process was developed through the identification of 31 environmental and socio-economic indicators that were grouped into clusters and organized in four sub-networks according to the BOCR model in order to compare the three alternatives. The main findings of the present work have proved that the use of quantitative indicators as nodes of the ANP–BOCR structure significantly improves the internal coherence of the model and makes the decision process more traceable and reliable.

Shih et al. (2014) have investigated the environmental impact on the vendor or supplier selection problem. Researchers' used the ANP with the merits of benefits, opportunities, costs, and risks to assess all factors for ranking suppliers for the certain and uncertain effects as well as the dependences and feedback.

Özdemir et al. (2011) have studied selecting aircraft to purchase for the biggest Turkish airline company, Turkish Airlines using one of the MCDM techniques, ANP.

Dağdeviren et al. (2006) have developed a new supplier evaluation method for a company. The ANP method is used in the proposed model. They stated that ANP is a MCDM method that takes into account the dependence and feedback among the factors affecting the decision making process. In their study, the proposed supplier evaluation model has been verified with the supplier representatives and it has been determined to use this model periodically.

Ecer et al. (2009) research has been the first to use the ANP method for hotel selection. The researchers have stated that ANP's method is based on pairwise comparisons, analysed factors and alternatives on the basis of internal and external dependence, and that all interactions and feedback can be taken into consideration through the network structure. They have emphasized that this feature enables ANP to model complex decision problems more accurately and realistically and that ANP has been successfully applied to many decision-making problems to date, even though it has a short history.

Erdoğmuş et al. (2005) has to solve a real-world, multi-criteria, high-tech selection problem by using ANP). The strategic criteria have included into the model to rate benefits (B), opportunities (O), costs (C), and risks (R) and final synthesis of alternatives was obtained by using rated BOCR in their study. Dağdeviren and Yüksel (2007) have determined the factors eligible to be accepted as criteria in personnel selection, and developed a

decision-making model demonstrating the dependency between these factors. Global weights of the factors in the model are estimated by means of Analytic Network Process in their study.
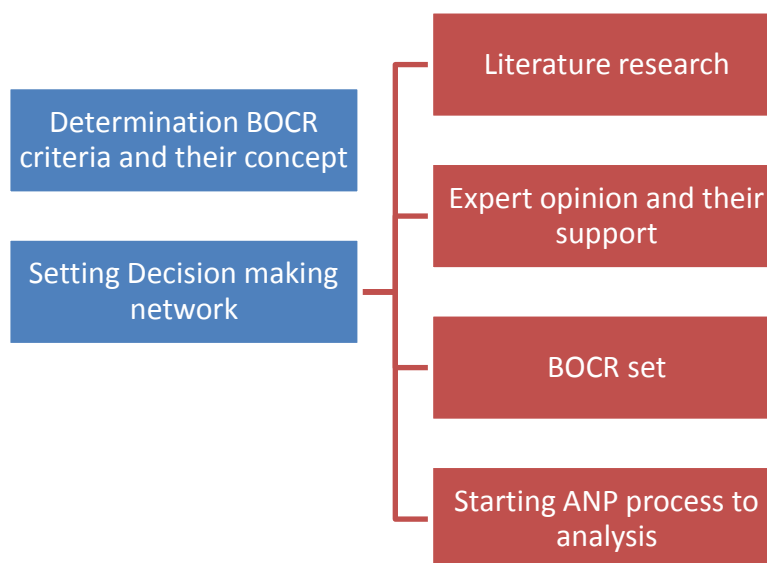

Figure 1. Algorithm to Determination of BOCR Criteria in ANP Methodology (adapted from Erginel et al., 2014).

Yazgan ve Sağır (2007) have evaluated two options related to establishment or non-establishment of a nuclear power plant in Turkey with sub-models of BOCR. Yazgan ve Üstün (2011) have tried to determine the weights of selection criteria for civil pilots by using ANP. Yang et al. (2010) have model the selection problem using analytic network process, a multi attribute decision-making methodology suitable for assessing interdependent elements, both tangible and intangible. They examine the significance of integration and consolidation of shipments, the trade-offs between costs, benefits and risks within activities of the logistics. Baynal ve Yüzügüllü (2013) have used ANP for supplier selection problem of conflicting quantitative and qualitative depending to more than one factor. In their study, suppliers ranked and evaluated their performance and decided to set up the infrastructure for decision making with seven main criteria and fifteen sub criteria. Erdoğmuş et al. (2006) have evaluated the most suitable fuel which can be used for residential heating by using ANP with group decision-making. De Lotto et al.,(2016) have described the use of scenario planning and multi criteria evaluation (ANP method) to deepen suitable strategies at urban level and introduced the first instruments useful for the future application of the presented method: ideal city modelling and evaluation criteria definition. Ustun ve Demirtaş (2008) have calculated the priorities for each supplier by using ANP and four different plastic molding firms working with a refrigerator plant are evaluated according to 14 criteria that are involved in the four clusters: BOCR. Dağdeviren ve Eraslan (2008) have proposed a model based on ANP for evaluating strategic energy policies. This model has been used to assign priorities to strategic energy policies of Turkey. With this model, various people have been included in the decision-making process and the effectiveness of the process has been increased. Lee et al. (2009) have been proposed an analytical approach which applies the ANP and the BOCR concept to base on an electronic components manufacturer in Taiwan to evaluate the forms of buyer–supplier relationship between the manufacturer and its supplier. Yazgan et al.

(2010) have developed an ANP model to select the best dispatching rule in a flexible manufacturing system (FMS). Hasanzadeh vd. (2013) have used ANP to environmental prioritizing criteria for coastal oil jetties site selection in Persian Gulf coasts (Iran) and all criteria were distributed in BOCR merits according to their effects on oil jetties' location.

In this research, basic algorithm for designing grid network to airlines ANP methodology was used via identification BOCR criteria as following Figure 1.

ANP BASED BOCR CRITERIA FOR MODELLING OF NETWORK DESIGN

One of the most common problems of the ANP method is to determine the criteria and sub-criteria. The BOCR criteria establishes the criteria and presents a systematic approach in the ANP network. Benefits in BOCR analysis include current income or profits from positive developments; opportunities will be provided from future positive developments; costs present losses due to negative conditions and risks represent losses due to future negative developments (Erginel et al., 2014). In this study, the BOCR criteria that can be included in the network design were discussed with the help of experts and it was created as shown in Figure 2.

Determining Of BOCR Criteria

Benefits

Benefits are identified as Anadolu University's expertise in aviation sector and cultural flexibility openness, conscientiousness of citizen of **Eskisehir**.

Opportunities

Opportunitie**s** are identified as high and sustainable demand to airline; support of Anadolu University to airlines**;** Anadolu University as an owner of the Airport and Airport operator**; s**uitability and compatibility of city with own airport: City & Airport Harmony and demographic qualifications, population and culture of Eskisehir.

Costs

Costs are identified as additional operational costs of airline from new routes and public relations commercial advertising and promotion expenses.

Risks

Risks are identified as demand volatility based economic reasons/conditions and Inconsistency of fleet planning with connected flight network. In this point selection of wrong fleet type planning by airlines have potential to create risk. (An airline make wrong decision about its fleet. For example in our case airline may prefer ATR 72 since suitable to regional flights but if airline select B 737-800 189 passenger configuration may not suitable).
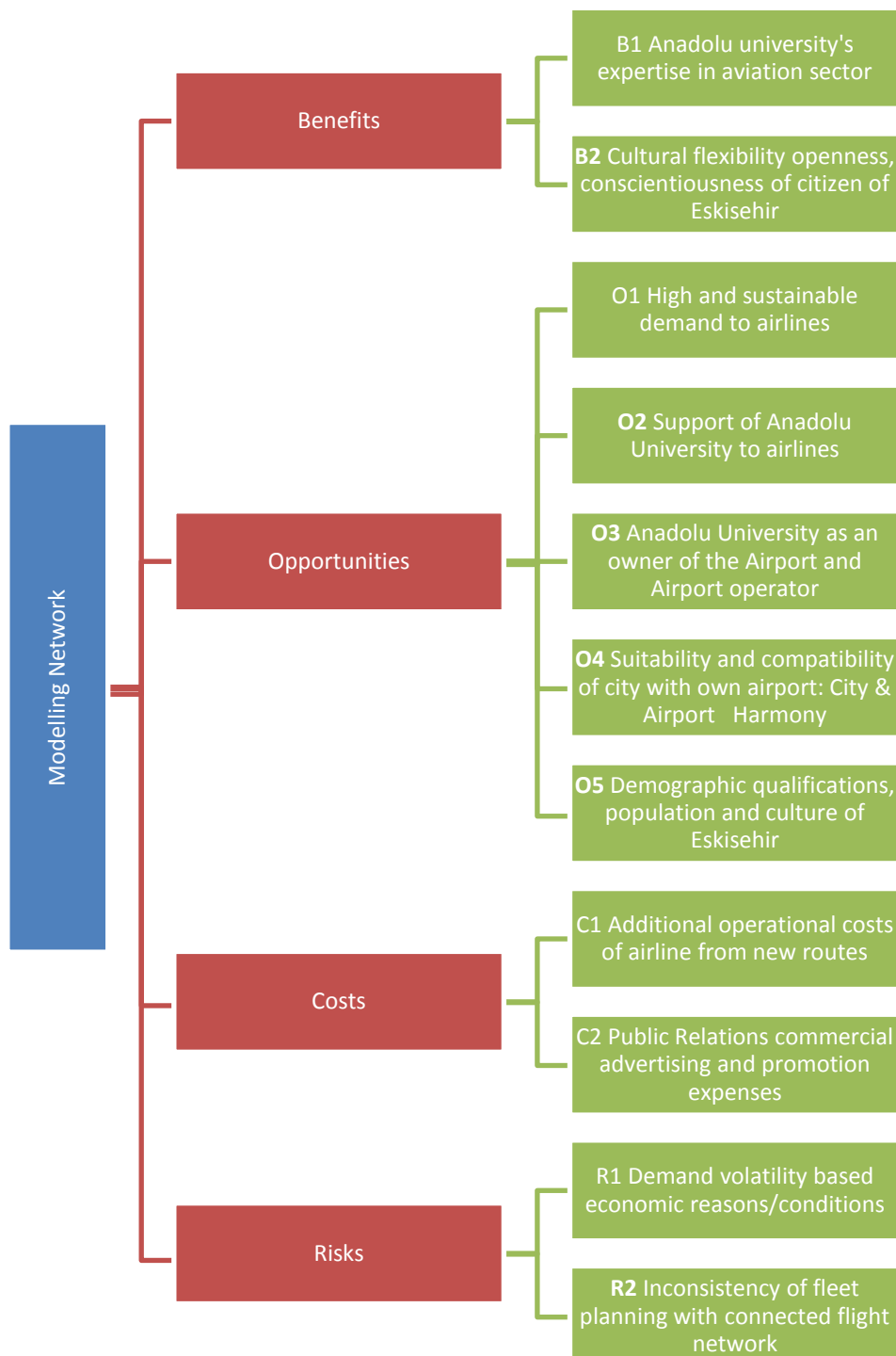
Figure 2. ANP structure with BOCR criteria for Modelling Network

Explanation of Identified Criteria of BOCR Given As Following

Eskisehir, a large industrialized city in west-central **Anatolia**, is one of the oldest settlements (3500 BC) in the Anatolia region. The River Porsuk passes through Eskisehir. Its foundation on the bank of river Porsuk by the Phrygians dates back to the 1st millennium BC. The historical city holds out Phrygian relics and sculptures

through its museums[1]. The city has two universities: Osmangazi University and Anadolu University, so it looks like a university city[2] and the city becomes a place with full of students and young people. Anadolu University was founded on 6th November, 1958 and has a significant role in the city's development through years. It is among the ten biggest universities in the world, with nearly 3 million students (including its Open Education Faculty). Anadolu University is situated in the center of Eskişehir, which is well-known as a city of science, culture and youth. The two campuses house 17 faculties (undergraduate level), five of which are graduate and postgraduate level, and 30 research centres. **Anadolu University** has taken many firsts. Most of important of these is the success of implementing the distance education system. The success in the development of this system has been taken as a model for many institutions in various countries. In its departments equipped with cutting-edge technology[3]. Our university, which we are proud of because it follows technological and scientific developments, educates proactive individuals who will shape the future, and focuses on lifelong learning with an endeavour to include the entire population in the process of learning, has been embracing the World (Küçük Yılmaz et al., 2018).

This city that has been considered as a very important city since the early years of Ottoman Empire establishment, was used to be called Sultan Önü. Later on this city has lost its real value and had an appearance of abandon. The public who also missed their old luxurious days began to call this city Eskisehir (Oldcity). This city is famous for the historical characters such as Yunus Emre, Nasreddin Hoca, hot water thermals which cure the various diseases, production and dressstone the of sea foam. The first residential area of this city is Odun Bazaar (Wood Bazaar). Porsuk Creek with boat trips and national parks are some of the important places for seeing. Eskisehir aims to be an important tourism center with its cultural richness, natural beauty, rich kitchen as well as shopping opportunities[4]. With its regular and modern urbanization attempt, Eskisehir obtaining one of the highest city and life quality title, becomes a role model to other Anatolian cities along with İstanbul and Ankara. Eskisehir with its 100% urbanization rate is one of the leading cities in terms of urbanization in Turkey. Eskisehir has 844,842 population according to 2016 figures. There are many comfortable hotels in Eskişehir (5 stars and 4 stars) and they can accommodate the increased tourist demand (Küçük Yılmaz et al., 2018).

From 2001 onwards, there has been a significant increase in the number of domestic and foreign tourists staying in the city. With the proliferation of touristic attractions in the city, there has also been a large increase in the number of tourists who have spent more than one day in Eskisehir (see Table 2). While the number of domestic and foreign tourists staying in the hotels in 2001 was 61,268 and this number increased to 388,567 in 2015 (an increase of 634%)[5]. Importantly more than 3 million Turkish people who live in European countries (mainly Germany, France and Belgium) and travel very often to Turkey (VFR traffic). Table 3 presents the

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[1] Turkey For You, 2017, retrived from http://www.turkeyforyou.com/travel_turkey_eskisehir
[2] Eskişehir Valiliği,2017, retrieved from http://www.eskisehirab.gov.tr/
[3] Anadolu Üniversitesi, 2017,retrived from https://www.anadolu.edu.tr/en/about-anadolu/institutional/anadolu-at-a-glance
[4] http://www.cityturizm.com/en/eskisehir
[5] Eskisehir Buyuksehir Belediyesi, (2017), retrieved from http://www.eskisehir.bel.tr/icerik_dvm.php?icerik_id=1730&cat_icerik=1&menu_id=24 at May 30, 2017.

number of Turkish people who lives in foreign countries and come to the country to vote. Additionally, a large numbers of academics and students participate in ERASMUS, Mevlana and EU projects and these travel very often (Küçük Yılmaz et al., 2018).

Table 2. Numbers of Tourists Who Overnights in City (Ceylanlar, 2016; Küçük Yılmaz et al., 2018)

Years	Foreign Tourist	Overnight stayed foreign tourist numbers	Domestic tourist numbers	Overnight stayed domestic tourist numbers
2000	2,070	7,780	60,024	76,449
2001	1,975	7,761	40,856	53,507
2002	2,115	4,676	49,525	64,840
2003	2,208	5,699	51,958	87,119
2004	2,980	9,366	65,178	100,330
2005	4,618	20,887	102,482	152,164
2006	3,704	10,333	106,840	164,022
2007	8,413	11,276	130,264	211,015
2008	6,647	16,920	136,952	207,398
2009	6,223	16,657	152,212	227,700
2010	7,266	18,729	166,195	250,420
2011	11,466	27,076	187,867	276,979
2012	10,025	29,496	184,549	283,110
2013	14,361	42,731	195,614	305,657
2014	15,703	40,847	191,159	285,146
2015	18,179	39,052	217,539	349,515

Table 3: Number of Voters in Foreign Countries (Küçük Yılmaz et al., 2018)

Country	Number of Voters	
GERMANY	1,430,000	
FRANCE	326,000	National sustainable potential from foreign country to Turkey and from Turkey to world
HOLLAND	253,000	
BELGIUM	138,000	
AUSTRIA	109,000	
NORTH CYPRUS	105,000	
USA	100,000	
SWEDEN	95,000	
UNITED ARAB EMIRATES (UAE)	93,000	

Eskisehir is existing in UNESCO Tentative list with both Odunpazarı historical Urban Site[6]. Eskisehir has considerable potential in alternative health tourism. Eskisehir is one of Turkey's most important road junctions because of its location. Especially on weekends Eskisehir's many rounds are organized which in these tours, mostly held on a day or two-day basis, are mostly tourists from Ankara, Istanbul and Izmir. City has increased the daily number of domestic and foreign tourists from Istanbul, Ankara and Konya, and that the high-speed train became an important means of transportation for those travellers who visit Eskisehir. Also, Eskisehir, is a Museum city[7], owing to considerable qualifications and the touristic Eskisehir city entitled as "***Little Venice!***" **(**Küçük Yılmaz et al., 2018).

Hasan Polatkan Airport (AOE) is **first licensed University Airport** since 2007, operating and owned by Anadolu University. Airport can serve international and domestic operations. AOE presents considerable advantages as follows (Küçük Yılmaz et al., 2018).

- **i.** Airport is very close (5 km) to the city center and to the intercity bus terminal (9 km and it takes about 15 min by private car)
- **ii.** Considerable support from Anadolu University to both airlines and airport
- **iii.** Significant experience of Anadolu University about aviation (over 30 years)
- **iv.** The airport is located on campus of Anadolu university, and it is easier to provide any support
- **v.** Cheap shopping
- **vi.** Cheap transfer via taxi, bus etc all transportation modes from city to airport and vice versa
- **vii.** One night free accommodation facility by Anadolu University to all airlines crew
- **viii.** Available handling service from Turkish Airlines
- **ix.** Suitable Tariff (service prices)
- **x.** No-neighbouring competing secondary airport: in city, no another (2nd) airport, but close cities such as Bursa, Ankara, Kutahya has their airports.
- **xi.** User friendly terminal building: base floor and 1st floor
- **xii.** Bank service and post service is also available
- **xiii.** Free otopark for both passenger and also cockpit team and other members of airlines.
- **xiv.** Unlimited internet connection for airport users
- **xv.** Open 7/24 during flights
- **xvi.** No environmental restrictions (noise pollution, etc.)
- **xvii.** Placed in Anadolu University's Campus
- **xviii.** Signs and lightning's and all facilities to good comfortable services are both available and suitable for passengers.

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[6] UNESCO World Heritage Centre (2017) , Tentavive Lists, retrieved from
http://whc.unesco.org/en/tentativelists/?action=listtentative&pattern=eskisehir&state=&theme=&criteria_restrication=d
ate_start=&date_end=&order
[7] https://geniuscommunication.wordpress.com/2015/05/21/kesisen-yollarin-duragi-eskisehir/

The following Table 4 shows the increasing passengers numbers for the 2011-2016 period. This Table is important to showing increasing international traffic. And this numbers presents for only non-scheduled traffic. Completed national Projects show that this airport has considerable capacity in view of scheduled traffic in especially to Europe and Asia.

Table 4: Airport Passengers traffic for the 2011-2016 Period (Anadolu University, 2017)

✈	Domestic passenger	International passenger	Total
2011	12,508	30,530	43,038
2012	2,940	44,288	47,228
2013	1,955	32,445	34,400
2014	2,459	43,413	45,872
2015	2,389	49,536	51,925
2016	1,115	55,946	57,061

Eskisehir city has high demand to flights to/from Europe, especially to Germany (Cologne, Frankfurt, Berlin, Hamburg, Brussels, etc.), France (Paris, Lion). Also, we have determined high potential to connected network flights such as Eskisehir-İzmir-Europe; Eskisehir-Antalya-Europe, Eskisehir-İstanbul-Europe. Anadolu University has completed 3 projects to search sustainable airline demand of Eskisehir-Europe and Europe-Eskisehir (Küçük Yılmaz, 2016). Airport also offers pilot training services.

FINDINGS AND RESULTS

Within the scope of this article, criteria of BOCR were identified in view of ANP process concept. Specifically benefits, costs, opportunities and risks are determined in view of sustainable flight routes based scenarios. Risk management based mentality has placed into research philosophy.

Eskisehir Anadolu University is one of the most distinguished universities in both in Turkey and also World. Also, the socio-economic dynamics of Eskisehir are suitable for aviation. And the fact that, in today's conditions, it is necessary to increasing flights from Eskisehir/to Eskisehir in terms of both need of modern life and need of business life.

Supporting with the purpose of developmental acceleration with proper use of limited sources, making risk management decisions of effective time, cost and opportunity and implementing them are one of the agenda items by executives. In this research, Network design has been considered as managerial problem as MCDM The ANP is a useful way to deal with complex decisions that involve dependence and feedback analyzed in the context of benefits, opportunities, costs and risks. Herewith, modelling of flight network become more an issue cost efficient. According to this project that aims to optimization of Benefit, Cost, Opportunity and Risk, targets sustainable aviation development thanks to cross flight network models both global and national scale. Risk management of flight networks with regard to optimization of benefit, opportunity, risk and cost extensive in

civil aviation development and increasing in accessibility has remarkable qualifications. By coupling up MCDM including in Eskisehir and airport, Optimum network models and their application strategies have been envisaged to use by airlines. This study is consistent with Anadolu University Philosophy as Life Long learning, so in this research presentation statement have designed as "Life Long Learn and Fly!" as following figure.

Figure 3. AOE/ Hasan Polatkan Airport Presentation Statement in Project of Anadolu University (Kucuk Yilmaz, 2017)

Thanks to measured current and potential demand of air transportation in Eskisehir, it is aimed to present that model offers to carry out grid cross flights that contribute city's social and economic development within the scope of BOCR parameters of ANP Methods. Managers will be able to incorporate this suggestion model into decision-making processes in their flight network studies. This will also benefit them in terms of saving time and seizing opportunities. Sustainable flight networks will be developed with the analysis studies they will take into account in the direction of the demands from the sector.

In this research, seeing that Eskisehir-Turkey-Europe Grid Flight Network Offers being developed require in defiance of many criterions, it discussed in detail problem as "MCDM model".

This research may contribute original value to civil aviation sector in especially Turkish Civil Aviation. BOCR list of AOE/ Eskisehir Hasan Polatkan Airport shows that here is a new emerging market to Airlines. Anadolu University may support airlines when they operate into our airport. In our research, we aimed also to increase awareness about Eskisehir Anadolu University's Airport as new optimum market for airlines to improve Turkish Civil Aviation. AOE/ Hasan Polatkan Airport may be a new alternative with full of opportunities in view of place, facilities, security level and city based advantages. These criteria may useful to detailed analysis of destinations. Thus the results of this study shall constitute a guide for both Anadolu University Faculty of Aeronautics and Astronautics and relevant organizations. Besides, increase of labor efficiency, efficient use of organizational capacity and country financial resources shall be also provided. The number of flights in University Airport shall increase and the airport capacity may serve to public benefit in more high level. Anadolu University has considerable facilities and capabilities to improve both high education and also civil aviation of Turkey.

TÜRKİYE'DE BÖLGESEL HAVACILIĞIN GELİŞİMİ İÇİN ÇOK KRİTERLİ KARAR VERME SÜRECİ METODOLOJİSİYLE AĞ TASARIMI MODELLEMESİ: ANADOLU ÜNİVERSİTESİ ÖRNEĞİ

ÖZ

Bölgesel havacılık sektörü Türkiye'de gelişim ivmesi yakalamıştır. Kısıtlı kaynakları doğru bir şekilde kullanarak, risk yönetimi kararlarını etkin zaman, maliyet ve fırsata dönüştürmek ve uygulamak işletme yönetiminin en kritik unsurlarıdır. Bölgesel havacılığın gelişimini sürdürmek için doğru stratejilere ve karar alma süreçlerine ihtiyaç vardır. Türkiye'de bölgesel havacılığın gelişimini sürdürmek için hem doğru stratejilere hem de çok kriterli karar verme süreçlerine ihtiyaç duyulmaktadır. Ayrıca kurumsal risk yönetimi yaklaşımı ile karar verme süreci desteklenmelidir. Kurumsal stratejilere ulaşmak için uygulama risk yönetimi temelli karar verme süreci gereklidir. Havayolu yönetiminde ağ dizaynı pek çok faktörün kurumsal strateji ile birlikte karar alıcılar tarafından dikkate alındığı bir süreçtir. Bu faktörlerin birbirine olan dolaysız ya da dolaylı etkisi de birbiriyle ilişkilerini ortaya çıkarmaktadır. Metodoloji olarak kriterler arasındaki ilişkiler ve etkileşimler nedeniyle ANP yöntemlerine dayanan BOCR kriterleri kullanılmıştır ANP karar verme problemlerinde nitel faktörleri de dikkate alan çok kriterli karar verme tekniğidir. Bu yöntem ayrıca küresel çapta ulusal ve uluslararası endüstride yöneticilerin görüşleri alınarak ve ayrıca detaylı ve güncel literatür incelemesi ile desteklenmiştir. Bu çalışmanın ayrıca, hem Türkiye'nin bölgesel havacılığının gelişimine hem de sosyal ve ekonomik gelişimine katkıda bulunacak çabalara Eskisehir AOE-Hasan Polatkan Havalimanı örneği vasıtasıyla temel teşkil etmesi ve ilham vermesi de hedeflenmiştir.

Anahtar Kelimeler: Havayolu Taşımacılığı, Analitik Ağ Süreci/AAS, BOCR, Kapasite Analizi, Kurumsal Strateji, Uçuş Ağı Modelleme, Çok Kriterli Karar Verme, Bölgesel Havacılık, Risk yönetimi

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