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SUSTAINABILITY PRACTICES IN THE AVIATION SECTOR: A STUDY OF TURKEY-BASED AIRLINES

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Abstract: *This study aims to develop a framework for the identification, categorization, and prioritization of sustainability practices in Turkey-based airlines. A comprehensive literature review was conducted to determine the main criteria and sub-criteria of sustainability practices, and The Analytic Hierarchy Process (AHP) was used to determine priorities. The study has identified 3 main criteria and 23 sub-criteria of sustainability practices relevant to airlines. It is found that fuel efficiency with Aviation revenues has the top priority in the Turkey-based airlines under sustainability practices.*

Keywords: *Sustainability, The Analytic Hierarchy Process (AHP), Airlines, Air Transportation*

INTRODUCTION

Aviation is one of the main drivers behind globalization, driving the development of the modern world. A network of airlines, airports, and air traffic management organizations link the major cities and small communities of the world 24 hours a day with increasingly advanced aircraft (ATAG, 2018). Modern air transportation has developed into a hugely complex system in a relatively short time.

The long-term outlook for the industry continues to remain positive due to the fundamental drivers of air travel demand: economic growth and the increasing propensity to travel due to increased trade, globalization, and improved airline services driven by liberalization of air traffic rights between countries (Boeing Annual Report, 2019). Airlines carries over 4 billion people and about \$7 trillion in goods every year to bring more of the world closer (Boeing 2020 Global Environment Report). The development and complexity, however, offer insights into how the industry can address the challenges of sustainability (Critchley, P., & Styger, L. 2013).

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There are certain criteria that force companies to be sustainable. While some of these forces stem from the financial concerns of the companies, some of them have a sense of social responsibility, which is thought to be necessary in the formation of a corporate identity. But when the forces that trigger companies to be sustainable are approached from an economic perspective; companies are commercial organizations and the primary purpose of all commercial organizations is "profit". According to this point of view, companies feel responsible for the prevention of environmental degeneration, respond to changing consumer habits, especially with the innovations they make in production and marketing processes, or want to display a sustainable vision in order not to fall behind other competitors in the global formation; consequently, it aims to maximize profit (Kuşat, N., 2012). Hence, to implement their sustainability strategy, companies are faced with an enormous challenge, that of quantifying the link between corporate actions and environmental, social, and financial performance. (Epstein, M. J., & Roy, M. J., 2007).

Airline companies are not considered different from all other companies. There are criterias that force them to be sustainable, and these criterias in particular; it appears socially, environmentally and economically. There are many factors which could influence the sustainability of airlines (MDPI, 2016). There is a much clearer recognition of the need to consider aviation's contribution to the three pillars of sustainability; economic, social and environment in a more integrated manner (ICAO Journal, 2011)

Passenger airlines in Turkey has grown exponentially in the last decade. The number of aircraft has increased in line with the increasing passenger traffic (Sivil Havacılık Genel Müdürlüğü Faaliyet Raporu (Annual Report of Directorate General of Civil Aviation), 2019).

Table 1. Number of aircrafts owned by airline companies in Turkey

Number of Aircrafts Owned by Airline Companies in Turkey		
	2010	2020
Turkish Airlines	153	324
Pegasus Airlines	27	84
Sun Express Airline	28	53
Onur Air	28	27
AtlasGlobal Airlines	15	16
Corendon Airlines	7	14
Freebird Airlines	7	9
Tailwind Airlines	5	5
TOTAL	270	532

Source: Sivil Havacılık Genel Müdürlüğü Faaliyet Raporu (Annual Report of Directorate General of Civil Aviation)

In Turkey, important steps has been laid to be opened to free competition in the air transport market in the mid-2000s. Airline companies have started to provide access to many points of the world with their modern structures. Airline companies in Turkey also have to be sustainable in the sector where competition is intense, and this situation is in parallel with the State policies.

Turkey, after held in 1992 in Rio the United Nations Conference on Environment and Development, in 1996 has taken the "sustainable development concept" on the agenda. The 2030 Agenda for Sustainable Development, agreed upon by the world leaders at the United Nations (UN) Sustainable Development Summit held in September 2015, was adopted with the signatures of 193 countries. A total of 17 Sustainable Development Goals (SDGs) have been defined under the 2030 Agenda (T.C.Cumhurbaşkanlığı, 2020). Turkey is among the countries that adopt this purpose.

According to Singh et al. (2007), there are a number of frameworks of sustainability assessment that evaluate the performance of companies. The purpose of this study is to investigate sustainable practices in the airline sector in Turkey and to put forward their priorities.

For this purpose, the literature is reviewed and a comprehensive research framework is developed. In doing so, the sustainability reports and annual reports of the airlines are examined too. As we accepted the practices of airline companies as three pillars of sustainability; It seems that there is no sustainability framework for airline companies that they can use to assess in social, environmental, and economic context. Therefore, this study develops a framework for airlines.

The objectives of this study are as follows;

1-To identify the main criteria and sub-criteria of the sustainability dimension of Turkey-based airlines

2-To introduce a comprehensive framework of sustainability practices in airlines

3-To develop an AHP model for airlines to prioritize sustainability practices (Alameeri, A., Sustainability practices in the aviation sector: a study of UAE-based airlines, International Journal of Sustainable Society, January 2017).

DEFINITION OF SUSTAINABILITY

There are several definitions for sustainability. The main idea of them is defined as: The ability of the system to maintain the current state when exposed to external influences. If the current state is not saved, then this state is called unstable (Altuntas, O., et al. As cited in Brundtland GH).

In another definition; "Sustainability is an economic state where the demands placed upon the environment by people and commerce can be met without reducing the capacity of the environment to provide for future generations" (Forsyth, P., 2011).

In business, sustainability means meeting the needs of the present organization and stakeholders such as customers, staff and communities without compromising the needs of future stakeholders (Alameeri, A., et al.,2018). As mentioned before today there is a much clearer recognition of the need to consider aviation's contribution to the three pillars of sustainability; economic, social and environment in a more integrated manner.

The top authority of aviation ICAO is accelerating developments and steadily progressing in a number of initiatives which have the potential to benefit international aviation's contribution across the three pillars of sustainability; Economic, Social, Environmental, focusing on four key areas:

1. State action plans/assistance to States.
2. Sustainable alternative fuels for aviation.
3. Market based measures.

GLOBAL ASPIRATIONAL GOALS

Economic sustainability means that we must use, safeguard, and sustain resources (human and material) to create long-term sustainable values by optimal use, recovery, and recycling. In other words, we must conserve finite natural resources today so that future generations too can cater to their needs (Altuntas, O., et al. as cited in Paschek, F.).

Power of this social sustainability thinking is its inherent ability to view the future in terms of radically new forms and values. This framework articulates an alternative set of arrangements and constructs to urge others to act in concert to affect change (Eizenberg, E. and Jabareen, Y.).

The most important is the awareness and protection of people's health against pollution and other harmful activities of companies and other organizations (Altuntas, O., et al. cited in Adams W.M.).

Concerns about the environmental impacts of air transport are not new; they have been documented for more than four decades (Daley, B., 2016). Environmental sustainability is the rate of extraction of renewable resources, generating pollution, and nonrenewable depletion of resources that can be sustained indefinitely. If they cannot be pursued indefinitely, they are not durable (Altuntas, O., et al. as cited in Paschek, F.).

RESEARCH METHODOLOGY

In this study, a two-phase research methodology has been performed to investigate and prioritise the sustainable practices in the airlines' sector in Turkey. In phase I; criterias and sub-criterias of the sustainable practices in the airlines' sector have been identified through literature review. In Phase II; relative weights of sustainable practices in the airlines' sector were assessed through well-known AHP methodology implementing a questionnaire to industry professionals.

The questionary study, which forms the basis of the AHP analysis, was carried out in Turkey' s scheduled airlines of 50 aircraft and above. The questionnaires were answered by the mid-level manager profile of the Airlines. Participants were clearly explained what they had to do while filling out the questionnaire. The importance of the evaluator's perception on what the company they works for gives weight to was emphasized.

THE ANALYTIC HIERARCHY PROCESS (AHP)

The Analytic Hierarchy Process (AHP) is a basic approach to decision making. It is designed to cope with both the rational and the intuitive to select the best from a number of alternatives evaluated with respect to several criteria.

In this process, the decision maker carries out simple pairwise comparison judgments which are then used to develop overall priorities for ranking the alternatives. The AHP both allows for inconsistency in the judgments and provides a means to improve consistency. (Saaty, 2012).

Paired comparison judgments in the AHP are applied to pairs of homogeneous elements. The fundamental scale of values to represent the intensities of judgments is shown in Table 2. (Saaty, 2012).

Table 2. The Fundamental Scale

Intensity of Importance	Definition	Explanation
1	Equal importance	Two activities contribute equally to the objective
2	Weak	
3	Moderate importance	Experience and judgment slightly favor one activity over another
4	Moderate plus	
5	Strong importance	Experience and judgment strongly favor one activity over another
6	Strong plus	
7	Very strong or demonstrated importance	An activity is favored very strongly over another; its dominance demonstrated in practice
8	Very, very strong	
9	Extreme importance	The evidence favoring one activity over another is of the highest possible order of affirmation

Source: Saaty, (2012)

The simplest form used to structure a decision problem is a hierarchy consisting of three levels: the goal of the decision at the top level, followed by a second level consisting of the criteria by which the alternatives, located in the third level, will be evaluated. Hierarchical decomposition of complex systems appears to be a basic device used by the human mind to cope with diversity (Saaty, 2012).

In this study, the goal of the decision at the top level is to determine the framework of the best practices for major airlines in Turkey in the scope of sustainability. Second level includes criteria and subcriteria, and they are derived from literature review. As the third level, the alternatives regarded as the best practices for major airlines in Turkey in the scope of sustainability are not dealt with.

But the framework of the best practices can be drawn from the importance intensity of the criteri and the subcriteria. In the light of this study, airline companies can obtain the best practices by applying third level of AHP process to their practices at hand to provide sustainability.

The hierarchy for the second levels designed based on 3 main criteria and 23 sub criterias of sustainability shown in Table 3.

Table 3. Sub-criterias of 3 main criteria of sustainability in Airlines

Environment	Environmental legal framework
	Efficient Use of Resources
	Waste/Noise Management
	Combating Climate Change
	Long term environmental strategic focus
Social	Relationship with stakeholder
	Customer Satisfaction/Rights
	Safe and Secure flight
	Society and community wellbeing
	Social Responsibility Projects
	Occupational Safety and health protection
	Employee's Legal Framework and welfare
	Employee Training
	Employment Policy
Innovative Products & Services	
Economics	Aviation revenues
	Non-aviation revenues
	Research and Development Investment
	Sustainable behavior incentives
	Contribution by Public
	Contribution to Public Finance
	Network development
	Fuel Efficiency

After deciding the hierarchy, the next step is to construct a set of pairwise comparison matrices. Each element in an upper level is used to compare the elements in the level immediately below with respect to it. (Saaty, 2008) The nxn matrices consisting of comparisons of the criteria and subcriteria from the Table 2 are constructed. The illustration and properties of the n-element matrices created from the criteria and sub criteria are as follows:

$$A = \begin{bmatrix} 1 & \cdots & a_{1n} \\ \vdots & \ddots & \vdots \\ a_{n1} = 1/a_{1n} & \cdots & 1 \end{bmatrix} \quad (1)$$

$$\forall a_{ij} > 0 \text{ and } a_{ij} = \frac{1}{a_{ji}} \quad (2)$$

where a_{ij} represents the importance of alternative i over alternative j . If criteria j is more important than criteria i , then it is illustrated as $1/a_{ij}$.

Next step is to normalize each matrix by dividing the column entries by corresponding column sums, and then priority vector (weight) is obtained by taking the

average value of every rows in the normalized matrices. After the determination of their priorities, the consistency of the comparison matrices is calculated. In order to determine whether an A matrix formed as a result of binary comparison judgment is consistent or not, it is necessary to calculate the Consistency Index (CI) which is one of many methods. CI is obtained by:

$$CI = \frac{\lambda_{max} - n}{n - 1} \quad (3)$$

where λ_{max} is the largest or principal eigenvalue of the A matrix and n is the number of criteria. In order to evaluate the consistency, the value of "Random Index (RI)" should be known. RI values defined for n-dimensional comparison matrices are given in Table 4.

Average random consistency index (R.I.) (Saaty, 2012)

N	1	2	3	4	5	6	7	8	9	10
Random consistency index (R.I.)	0	0	0.52	0.89	1.11	1.25	1.35	1.40	1.45	1.49

After the CI and RI values are determined, the "Consistency Ratio (CR)" is calculated.

$$CR = \frac{CI}{RI} \quad (4)$$

If the CR obtained is less than 0.10, it is decided that the comparison matrix is consistent.

ANALYSIS AND RESULTS

Air transport has been a vital enabler, as well as beneficiary, of that globalization. Over the past forty years, international trade has expanded eleven-fold, matched by a ten-fold rise in RPKs flown and a fourteen-fold rise in FTKs flown. The 60 percent fall in the real cost of air transport over this period, driven by advances in aircraft technology and in airline operational efficiency, has been an important driver in the expansion of international trade.

Through this mechanism low income countries have seen their economies expand and poverty reduced significantly (ICAO, 2011). It is important to analyze the sustainability practices of developing countries and to draw the global framework of the issue. This is why a study was made on the basis of major airlines in Turkey. This study can take place as a part in the whole analysis of airlines in other developing countries.

The survey, has been made with mid-level managers of the airlines the Turkey based which in civil air transportation, and have 50 and over aircraft. The reason for this is that mid-level managers have experiences, competencies and the idea that their follow-up will be more objective.

In accordance with the hierarchical structure of AHP, criteria and sub-criteria are used in questionnaires to compare them in pairs. However, in comparisons, the method used by Karaman and Akman, (2018) is preferred instead of the classical matrix in order to provide ease of use to the respondents. As a result, the questionnaires given in appendix are prepared and distributed to respondents. In total, 17 managers answered the questionnaires.

Out of the distributed 30 questionnaires, 10 questionnaires were deleted because of incompleteness and missing values. After collecting the questionnaires, the answers

are filled into the classical matrices and individual judgements are aggregated into a single representative judgement for the entire group by using the geometric mean. The matrices are normalized to obtain priority vector (i.e. weight). After getting the weights, Consistency Ratios (CRs) are calculated to find out the consistency. If CRs are less than 0.01 (%10), it points out the consistency. The λ_{max} , CI, CRs are given below the related tables. Relative weight is obtained by multiplying the weight of the subcriterion with the weight of the relevant main criterion. The results are obtained from a customized excel file containing formulas related to AHP.

THE QUESTIONNAIRES RESULTS ARE AS FOLLOWS

It shows that economic concern are perceived as the main driver of Airline activities. Although the weight given to environmental factors is greater than the weight given to social factors, the difference between both factors and economic factors is large. When it comes to economy, the importance of other factors is low. The study reveal economic concerns are major shaping factor in Airline Industry, while placing especially social criteria in reverse.

General	Weight	Ratio
Environmental	0,158	15,8%
Economic	0,714	71,4%
Social	0,127	12,7%
Total	1,000	100%

$$\lambda_{max}=3,001 \text{ CI}=0,000 \text{ CR}=0.001 < 0.10$$

When we examine the sub criteria, we see that the first, second and third priority ranks are in the economic criteria, fuel efficiency with 1.167, aviation revenues with 0.155, and network development with 0.154, respectively.

Environmental	Weight	Relative Weight	Ratio	Rank
Environmental legal framework	0,152	0,024	2,4%	10
Efficient Use of Resources	0,455	0,072	7,2%	4
Waste/Noise Management	0,148	0,023	2,3%	
Combating Climate Change	0,124	0,020	2,0%	
Long term environmental strategic focus	0,122	0,019	1,9%	
TOTAL	1,000	0,158	15,8%	

$$\lambda_{max}=5,019 \text{ CI}=0,005 \text{ CR}=0.004 < 0.10$$

Social	Weight	Relative Weight	Ratio	Rank
Relationship with stakeholder	0,027	0,003	0,3%	
Customer Satisfaction/Rights	0,057	0,007	0,7%	
Safe and Secure flight	0,360	0,046	4,6%	
Society and community wellbeing	0,033	0,004	0,4%	
Social Responsibility Projects	0,031	0,004	0,4%	
Occupational Safety and health protection	0,179	0,023	2,3%	
Employee's Legal Framework and welfare	0,094	0,012	1,2%	
Employee Training	0,086	0,011	1,1%	
Employment Policy	0,084	0,011	1,1%	
Innovative Products & Services	0,049	0,006	0,6%	
TOTAL	1,000	0,127	12,7%	

$$\lambda_{\max}=10,338 \quad CI=0,038 \quad CR=0.025 < 0.10$$

Economic	Weight	Relative Weight	Ratio	Rank
Aviation revenues	0,217	0,155	15,5%	2
Non-aviation revenues	0,073	0,052	5,2%	8
Research and Development Investment	0,086	0,061	6,1%	7
Sustainable behavior incentives	0,088	0,063	6,3%	6
Contribution by Public	0,060	0,043	4,3%	9
Contribution to Public Finance	0,088	0,063	6,3%	5
Network development	0,154	0,110	11,0%	3
Fuel Efficiency	0,233	0,167	16,7%	1
TOTAL	1,000	0,714	71,4%	

$$\lambda_{\max}=8,216 \quad CI=0,031 \quad CR=0.022 < 0.10$$

Interestingly, while social criteria are not included in the top 10 priorities, they are ranked 4th and 10th by environmental sub-criteria; "efficient use of resources" with 0.072 and "environmental legal framework" with 0.024 is set. This study demonstrate; Turkey's major airlines are in effort economically more stable and powerful. For this reason, the study shown that their priority is economic issues.

As in every sector, the economy is an issue that should be prioritized for a company in order to maximize profit. However, given that the survey was conducted during the pandemic period, even middle-level managers and experts may have prioritized the economy more than usual. To understand this, it is recommended to repeat a similar study long after the pandemic ends.

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