JOURNAL OF AVIATION

PUBLISHING

VOLUME 7
ISSUE 1
MARCH 2023

www.javsci.com
dergipark.gov.tr/jav
e-ISSN 2587-1676

JOURNAL OF AVIATION

edit PUBLISHING

e-ISSN: 2587-1676 J. Aviat. March 7(1), 2023

JOURNAL OF AVIATION

edit PUBLISHING

e-ISSN: 2587-1676

J. Aviat. March 7(1), 2023

JOURNAL OF AVIATION

e-ISSN: 2587-1676 J. Aviat. March 7(1), 2023

JOURNAL INFORMATION

Journal Name	Journal of Aviation
Abbreviation	J. Aviat.
Subjects	Aviation, Aircraft, Aerospace
e-ISSN	2587-1676
Publisher	Edit Publishing; Edit Teknoloji ARGE San. Tic.Ltd. Şti. Diyarbakır, Türkiye
Owner	Vedat Veli Cay
Language	English
Frequency	Tri-annual (March, July, November)
Type of Publication	International, Scientific, Open Access, Double blinded peer review, Widely distributed periodical
Manuscript Submission and Tracking System	JAV uses the submission system of TUBITAK ULAKBIM JournalPark Open Journal Systems - http://dergipark.gov.tr/jav
Licence	Journal is licensed under a Creative Commons Attribution 4.0 International License
Legal Responsibility	Authors are responsible for content of articles that were published in Journal
Indexed and Abstracted in	TÜBİTAK ULAKBİM TR Dizin, Crossref, Directory of Open Access Journal (DOAJ), AGORA, AGRIS (Agricultural Science and Technology Information), WorldCat, Google Scholar, SOBIAD, Scilit, ROAD (Directory of Open Access Scholarly Resources), Neliti, International Citation Index, ROOT Indexing, ResearchBib, Index Copernicus International, ESJI, JournalTOCs, TEELS, ResearchGate, Microsoft Academic
Address	Edit Teknoloji Arge Sanayi ve Ticaret Limited Şirketi Dicle Teknokent Dicle Üniversitesi Kampüsü Yiğit Çavuş Mah. Silvan Yolu Üzeri Kat:2 No:26, Diyarbakır, Türkiye
Contact	Ph.D Vedat Veli Cay Phone: +90 532 567 95 97 E-Mail: journalofaviation@gmail.com - info@editteknoloji.com Web: www.javsci.com - dergipark.gov.tr/jav

JOURNAL OF AVIATION

edit PUBLISHING

e-ISSN: 2587-1676 J. Aviat. March 7(1), 2023

AIM AND SCOPE

Journal of Aviation (JAV) established in 2017. It is a peer–reviewed international journal to be of interest and use to all those concerned with research in various fields of, or closely related to, Aviation science. Journal of Aviation (JAV) aims to provide a highly readable and valuable addition to the literature which will serve as an indispensable reference tool for years to come. The coverage of the journal includes all new theoretical and experimental findings in the fields of Aviation Science or any closely related fields. The journal also encourages the submission of critical review articles covering advances in recent research of such fields as well as technical notes.

The scopes include:

- Accounting
- Acoustics
- Aerospace communications
- Air cargo, logistics, and supply-chain management
- Air pollution
- Air traffic management and control
- Air transport policy, regulation, and law
- Airport planning and management
- Airworthiness, reliability, and safety
- Atmospheric flight mechanics
- Attitude dynamics
- Autonomous and unmanned air vehicles
- Big data and data mining
- Brand management
- Business management and strategy
- Combustion and fuels
- Complex systems
- Design and manufacturing
- Dynamics and control of large flexible space structures
- Economics and finance
- Electrical systems in air vehicles
- Electromagnetism and radar
- Environmental issues
- Flight mechanics
- Flight performance
- Fluid dynamics
- History of aviation
- Human and system interaction
- Human factors
- Information processing
- Innovation in aerospace and astronautical technology
- Maintenance, repair, and overhaul
- Management of route, terminal, airspace, and airport operations
- Maneuvering flight vehicles
- Marketing
- Materials and structures
- Navigation, guidance, and control
- Noise
- Novel and trend technologies in aerospace
- Numerical and computational methods
- Optics
- Orbit determination
- Organizational behavior and commitment
- Propulsion systems
- Robotics and intelligent systems
- Safety management system (SMS)
- Signal and image processing
- Space mission analysis
- Standards, procedures, training, and certification in aviation
- Sustainable technologies and development
- System design and development for air vehicles
- Test, instrumentation, and validation
- Trajectory optimization
- Vehicle conceptual design
- Weather and meteorology

JOURNAL OF AVIATION

edit PUBLISHING

e-ISSN: 2587-1676

J. Aviat. March 7(1), 2023

Abstracting & Indexing

TR Dizin	Index Copernicus	CrossRef	ASOS Inde
Google Scholar	International Scientific Indexing	DRJI	Bielefeld Academic Search Engine BASE
Journal Factor	JIFACTOR	i2or	Rootindexing
Science Library Index	Academic Keys	Eurasian Scientific Journal Index	COSMOS IF
Scientific Indexing Services			

JOURNAL OF AVIATION

edit PUBLISHING

e-ISSN: 2587-1676 J. Aviat. March 7(1), 2023

CONTENTS

-Research Article-

Relationship Between Wingspan and Fuselage Length in Aircraft According to Engine Types ***Seyhun Durmuş***	1
A Framework for Airworthiness Certification of Autonomous Systems Within United States Naval Aviation ***Donald Costello, Rich Adams***	7
A Comparative Research on The Crew Planning Department of Airlines Adopting Different Business Models-Turkish Flag Carrier and A Low-Cost Airline Example ***Duygu Toplu Yaşlıoğlu, İbrahim Zeki Akyurt, Murat Yaşlıoğlu and Teoman Erdağ***	17
A Demographic Research on Compassion Fatigue and Job Satisfaction Levels of Aviation Employees ***Hanifi Sever***	29
The Effect of Technological Stress Dimensions on Employees' Decision-Making Styles and Regulatory Role of Job Insecurity Perception: A Research in The Aviation Sector ***Bekir Alper Yıldırım, Deniz Elber Börü***	39
The Mediating Role of Perceived Organizational Support in the Effect of Abusive Management and Psychological Contract Perception on Job Embeddedness in Air Transport Businesses ***Seçil Ulufer Kansoy***	55
The Effects of The Pandemic Period on The Performance of Airline Pilots in Turkey ***Çakır Atılhan Güzel, Nuran Karaağaoğlu***	64
Cash Management of Multinational Airlines: A Case Study on A Turkish Airline ***Yaşar Köse, Ceyda Aktan***	73
The Effect of Covid-19 on the Financial Performance of Ground Handling: The Example of Çelebi Aviation Holding ***Oğuzcan Kurşuncu, Nisa Seçilmiş***	83
An Investigation and Benchmarking Model for Developing Sustainable Material Use Among Turkish Airport Operators ***Alper Dalkıran***	93
Determination of Location Selection Criteria and Their Importance Levels for Air Cargo Companies: A Case from Turkiye ***Ahmet Türk, V. Alpagut Yavuz***	100
A Profitability Analysis of Air Navigation Service Providers in European Zone: COVID-19 Crisis ***Olcay Ölçen, Serdar Alnıpak***	110
Is Gamification Important for Service Systems Non-Users? A Study on Airline Loyalty Programs ***Osman Seraceddin Sesliokuyucu***	123
An Investigation on Hope and Life Satisfaction of Employees in the Aviation Sector in New Normal Era ***Esra Zeynel***	133
Understanding the Role of Corporate Social Responsibility on Internal Customer Satisfaction for Sustainable Business Strategy; A Qualitative Research in the Aviation Industry ***Çiğdem Boyacılar Çağlar, Abdullah Türk***	141
The Aviation Sector from a Work Psychological Perspective: A Bibliometric Analysis of Graduate-Level Theses Written in Türkiye ***Neşe Çakı***	147
Does Flight Safety Require a Flight Psychologist? ***Selvi Vural***	156

7 (1): 1-6 (2023)

Journal of Aviation

https://dergipark.org.tr/en/pub/jav

e-ISSN 2587-1676

Relationship Between Wingspan and Fuselage Length in Aircraft According to Engine Types

Seyhun Durmuş[1*]

[1*]Balikesir University, Edremit School of Civil Aviation 10300, Edremit, Balikesir, Türkiye. (drmsyhn@gmail.com)

Article Info

Received: 25 August 2022
Revised: 26 December 2022
Accepted: 12 January 2023
Published Online: 26 February 2023

Keywords:
Aircraft design
Wingspan
Fuselage length
Power correlation
Aircraft sizing

Corresponding Author: *Seyhun Durmuş*

RESEARCH ARTICLE

https://doi.org/10.30518/jav.1163494

Abstract

The study aims to explain the size relationship between wingspan and fuselage length, which are the two basic design parameters that a designer is most curious about. Within the scope of the study, the relationship between take-off mass, fuselage length and wingspan of a total of 601 aircraft was questioned for single-piston, twin-piston, turboprop, and jet aircraft types. Power correlations were used for mass-based sizing of wingspan and fuselage length. In mass-based sizing, bad correlations were found for fuselage length for single-piston airplanes and good correlations for turboprops and jets. In terms of wingspan to fuselage length ratio (b/l_{fus}) jets showed a more pronounced trend, ranging from 0.7 to 1.1, while other aircraft types showed different trends, ranging from 0.9 to 1.7. In general, racer, homebuilt, aerobatic, and light transport aircraft have low b/l_{fus} ratios, while motor gliders, firefighters, patrol, and agricultural aircraft have high b/l_{fus} ratios. The study is valuable in that it fills a gap in the literature by considering the relationship between wingspan and fuselage length both with correlations over mass and by revealing statistics according to aircraft types over proportional relationship.

1. Introduction

Wingspan and fuselage length, which are related to the take-off mass of the aircraft, are the main dimensional parameters that affect the parking area occupied by the aircraft in the hangar or apron. ICAO categorized aircraft into 4 main groups based on maximum take-off mass, taking into account wake turbulence category: J (Super) type of aircraft (A380) with a maximum take-off mass of 560 000 kg, H (Heavy) type of 136 000 kg or more (except those specified as J); M (Medium) type of aircraft less than 136 000 kg and more than 7 000 kg; and L (Light) type of aircraft 7000 kg or less (ICAO, 2017). ICAO categorized the wingspan length of aircraft into 6 main groups with aerodrome reference code letters from A to F: A with a wingspan < 15 m, B with 15 m but < 24 m C with 24 m but < 36 m, D with 36 m but < 52 m, E with 52 m but < 65 m, F with 65 m but < 80 m (ICAO, 1988).

Torenbeek (2013) claimed that the ratio of fuselage length to diameter is the basic parameter affecting aircraft total drag with body frontal area and wetted area. Fuselage length of the aircraft is the sum of the nose cone, cabin, and tail cone lengths. Since the fuselage fineness ratio effect the aircraft total drag, the nose length and tail cone length are generally defined on fuselage diameter. The fuselage nose length to diameter ratio is between 1.2-2.5 and tail cone fuselage length to diameter ratio is about 2-5 (Sforza, 2014). Raymer (2018) proposed an approach to estimate fuselage lengths using take-off gross mass. Raymer presented on a power correlation data between the mass and fuselage length for different types of aircraft (sailplanes, homebuilt, general aviation, jets). Liu (2006) claimed that wingspan is proportional to the one-third-power of the weight. Nicolosi et al. (2016) used computational fluid dynamics to predict fuselage drag for regional turboprop aircraft. This study concluded that the fuselage coefficient and lateral rolling moment coefficients should be neglected, and future studies should focus on fuselage shape and wing-fuselage interferences. Anderson and Takahashi (2017) proposed computer aided design and finite element analysis for the structural design of fuselage. Singh et al. (2016) in conceptual design of transport aircraft, a genetic algorithm was used to optimize the fuselage length and wing aspect ratio. According to Wells et al. (2017) for conventional tube with wing designs, fuselage sizing is used to support aircraft weight estimation with the flight optimization system (FLOPS). A slender fuselage does not have a significant effect on the lift distribution in an upswept wing, whereas it produces a greater change in the lift distribution in swept wings (Zlotnic & Diederich, 1952).

There are also studies on original fuselage designs in the literature. The unsymmetrical fuselage models affect the pitching moment coefficient, so unsymmetrical cambered fuselage is difficult to implement (Abubakar et al, 2013). Bejan et al. (2014) found that large or small, aircraft show a proportionality between wingspan and fuselage length, and between fuel load and aircraft size. Also, Bejan et al. (2013) revealed correlations between aircraft mass, speed, engine

mass, range. Ardema et al. (1996) developed a computer program (PDCYL) for analytical estimation of fuselage and wing weight for transport aircraft based on basic structural principles. Bronz (2012) proposed multiplying the wingspan by a coefficient of 0.8 for the estimate of fuselage length of mini-UAV. Kruger et al. (2016) argued that the low fineness ratio provides savings in structural weight as well as reduction in fuel consumption and total drag. Marta (2008) studied on a genetic algorithm for optimization of small regional jet geometry with parameters of fuselage length, fuselage diameter, wingspan, wing chord. Nita and Scholz (Nita & Scholz, 2010) investigated aircraft cabin parameters for optimum slenderness parameter namely fuselage length-to-fuselage diameter using chromosomal algorithm and basic methods. McDavid and Kuhner (2017) studied the effect of fuselage lengths on determination of the tail lever for different tail configurations. The study claimed that the landing angle reserve and length of landing gear legs were for increase of fuselage length (Zhuralev, 2012).

This study aims to fill the gap in the literature by considering the relationship between wingspan and fuselage length with mass-based power correlations and presenting statistics according to aircraft types.

2. Materials and Methods

In this study, take-off gross weight (kg), wingspan (m), and fuselage length (m) data of 601 aircraft were compiled from Jane's All the World's Aircraft (Jackson, 2004). Details by type of aircraft examined are as follows: 285 passenger jets, 163 single piston aircraft, 61 twin piston aircraft, and 92 turboprops.

$$l_{fus} = a m_g{}^{c} \quad (1)$$

Raymer (2018) proposed an approach of estimating fuselage lengths with take-off mass as a method. In this study, Raymer's power correlation methodology was applied to data of 601 aircraft. This method is given in Eq. 1 where m is in kg and l_{fus} is in meter. Similarly, wingspan (b) is calculated as given in Eq. 1.

3. Result and Discussion

In this study, the relationships of fuselage length and wingspan were revealed depending on the take-off mass parameter for single-piston, twin-piston, turboprop, and jet aircraft. Power correlation of fuselage lengths in terms of weight parameter according to 4 aircraft types is given in Fig. 1 on a base 10 logarithmic scale. In terms of fuselage length, the weakest correlations were found in single-piston aircraft, followed by twin-piston aircraft. As seen from the slopes of the curve, in unit weight; the highest fuselage lengths are in jet and turboprop aircraft, and the lowest fuselage lengths are in single pistons. The biggest difference in terms of fuselage length is between the light jets and passenger jets.

The aircraft designs with the lowest and highest values in terms of fuselage length among the examined aircraft, are listed below by aircraft types. In the study, the design data of both civil aircraft and military aircraft were also examined. In the single-piston aircraft examined: Acro Sport has a fuselage length of 5.3 m and that of the An-2 is 12.4 m. In twin-piston aircraft examined: 680 E commander has a fuselage length of 7.38 m and that of the CL-215 is 19.82 m. In the turboprop aircraft examined: King Air has a fuselage length of 10.82 m and that of the Dash 8 is 32.84 m. In jet aircraft examined: Cessna A-37 has a fuselage length of 8.62 m and that of the Boeing 747 is 76.25 m (Jackson, 2004).

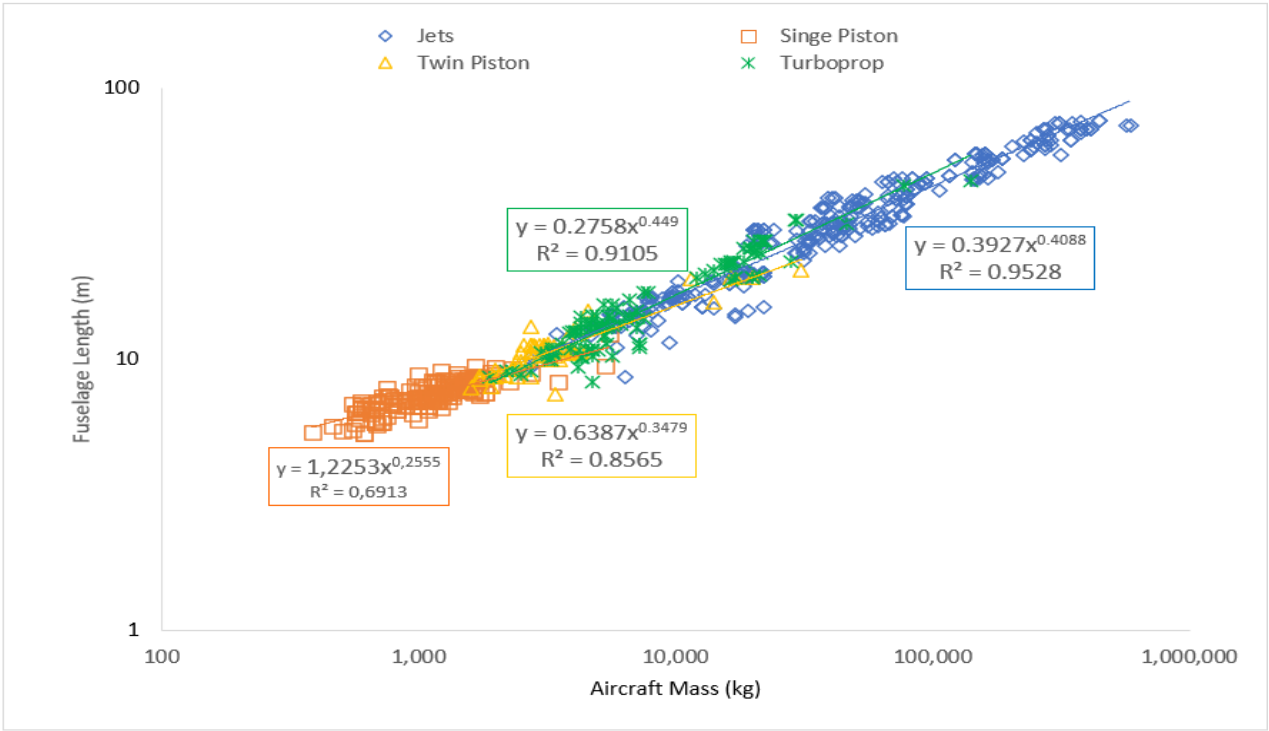


Figure 1. Representation of power correlation between fuselage length and aircraft mass on a base 10 logarithmic scale for different engine types.

According to the statistics presented in Fig. 2, the relationships between wingspan and mass gave an overall high R^2 value, except for single-piston aircraft. As seen from Fig. 2, in terms of wingspan, the weakest correlations were found in single-

piston aircraft. As can be seen from the slopes of the curve, in unit weight; jet have the lowest wingspan with other aircraft types showing similar trends.

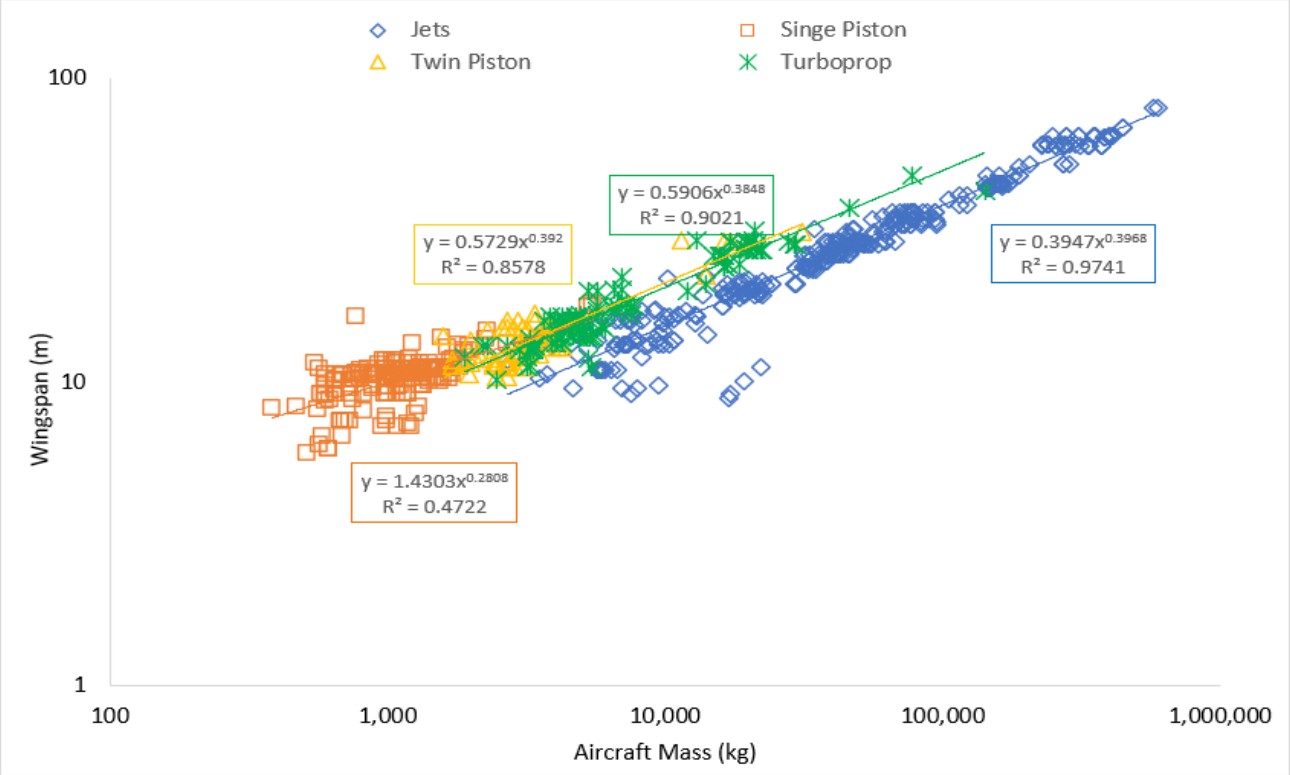


Figure 2. Representation of power correlation between wingspan and aircraft mass on a base 10 logarithmic scale for different engine types.

The coefficient values of power correlation obtained from the statistical data of the fuselage length change according to the weight parameter are shown in Table 1 together with R^2 values. In terms of both fuselage length and wingspan, the worst correlations were found in single-piston aircraft, while the best correlations were found in jets followed by turboprops. Good correlations found in jet and turboprop aircraft show that aircraft have a more uniformly distributed density (more homogeneous payload) along the fuselage than single-pistons.

Table 1. Power correlation between fuselage lengths and wingspan in terms of take-off mass

Fuselage Length Correlations				**Wingspan Correlations**			
$l_{fus} = a\ m_g^C$				$b = a\ m_g^C$			
Aircraft Type	**a**	**c**	**R^2**	**Aircraft Type**	**a**	**c**	**R^2**
Single Pistons	1.22	0.25	0.69	Single Pistons	0.14	0.28	0.41
Twin Pistons	0.64	0.35	0.80	Twin Pistons	0.57	0.39	0.78
Turboprops	0.27	0.45	0.90	Turboprops	0.59	0.38	0.90
Jets	0.39	0.41	0.95	Jets	0.39	0.39	0.94

One of the most curious issues of a designer who wants to size aircraft is how the relationship between wingspan and fuselage length varies according to types of aircraft. Fig. 3 shows the wingspan/fuselage length (b/l_{fus}) ratios of 601 aircraft. Wingspan/fuselage length (b/l_{fus}) ratios are concentrated in different ranges for certain aircraft types. The b/l_{fus} range (min.-max.) is 1.04-2.25 for single piston aircraft, 0.88-2.14 for twin-piston aircraft, 0.86-1.82 for turboprop aircraft and 0.61-1.27 for jets. Considering the mean b/l_{fus} values, single piston aircraft have highest b/l_{fus} ratio and jets have lowest b/l_{fus} ratio.

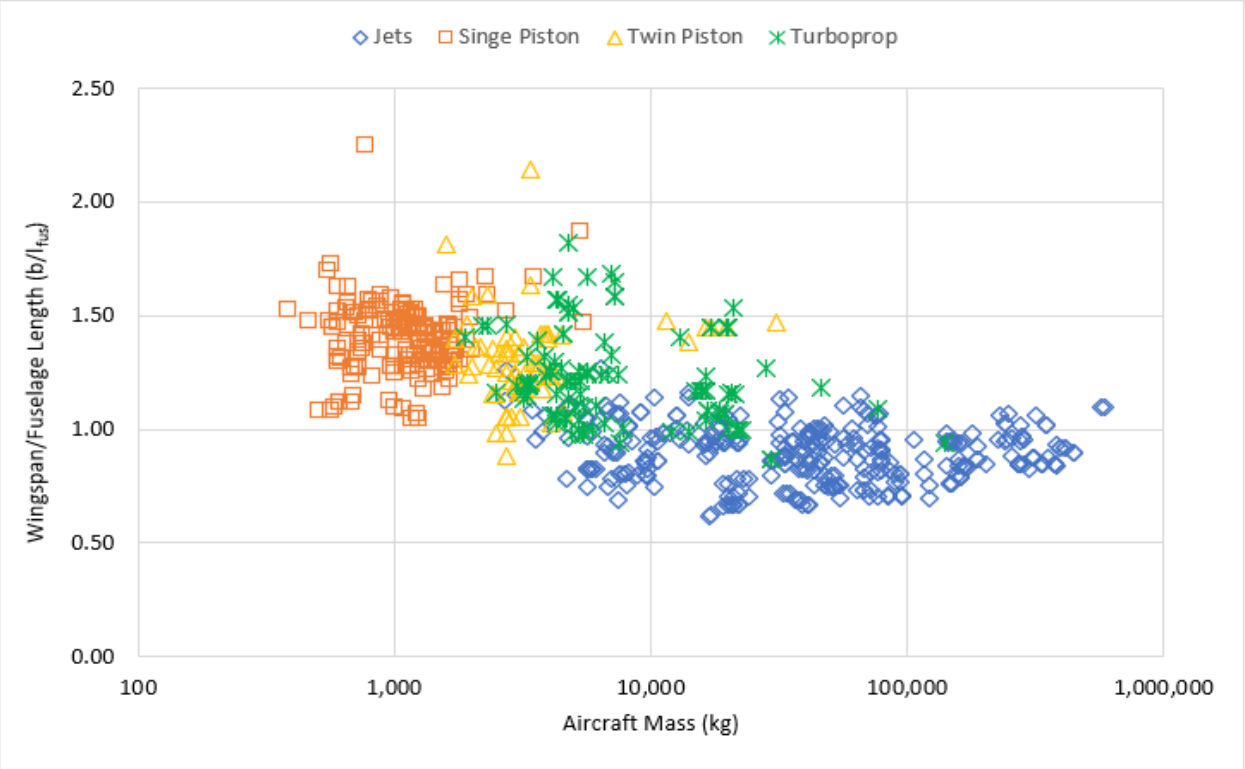
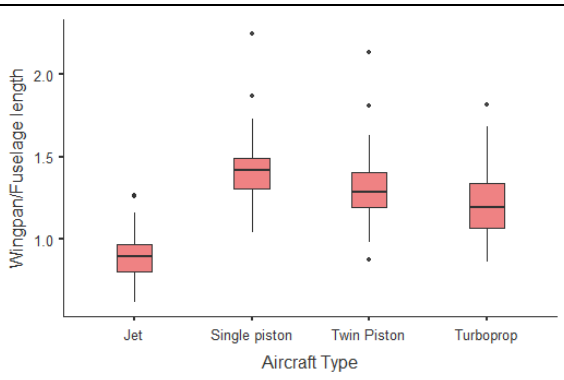


Figure 3. Display of the ratio of wingspan to fuselage length for different type of aircraft



Aircraft Type	N	Mean Wingspan/Fuselage Length	SD
Jet	285	0.896	0.125
Single piston	163	1.400	0.158
Twin Piston	61	1.303	0.196
Turboprop	92	1.217	0.197

Figure 4. Boxplot display of b/l_{fus} frequency distribution with mean and standard deviation values

Fig. 4 shows wingspan/fuselage length (b/l_{fus}) frequency distributions in a boxplot with basic statistics. In terms of wingspan to fuselage length ratio, singe piston props, twin piston, and turboprop aircraft showed similar trends, while jets showed a distinct trend. While the mean b/l_{fus} value of the jet is 0.89, this value is 1.40 for single piston aircraft.

In Fig. 5 extreme aircraft designs are presented according to wingspan/fuselage length ratios. In single-piston aircraft, the air racing aircraft- homebuilt aircraft, military trainers and aerobatics have low b/l_{fus} values, while motor gliders, firefighters and agricultural aircraft have high b/l_{fus} values. In twin-piston aircraft, light transport aircraft have low b/l_{fus} values, while firefighters have high b/l_{fus} values. In turboprop aircraft, the aircraft of regional airliners and executive transport aircraft (P.180 Avanti, Mitsubishi MU-2) have low b/l_{fus} values, while firefighters, patrol aircraft, agricultural and STOL turboprop aircraft have high b/l_{fus} values. In jets, the aircraft of the regional airliners, narrow body jets have low b/l_{fus} values, while business jets and trainer jets have high b/l_{fus} values.

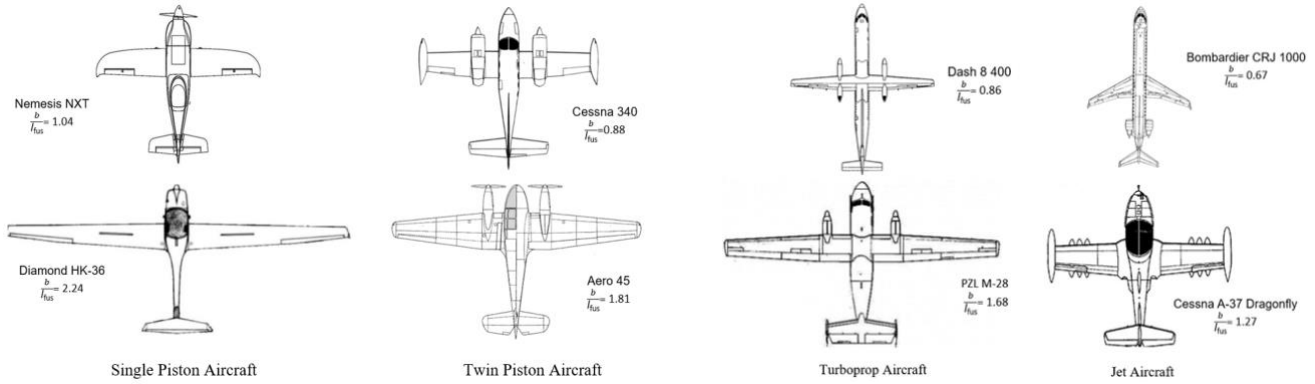


Figure 5. Some extreme examples in terms of b/l_{fus} in different aircraft types

4. Conclusion

When power correlations obtained depending on the mass between both fuselage length and wingspan were examined, high correlations were obtained in turboprops and jets, good correlations in twin pistons and bad correlations were obtained in single pistons. The ratio of wingspan to fuselage length was high in single piston aircraft, while it was low in jets. For single-piston aircraft the b/l_{fus} value is in the range of 1.04-2.25, with a mean value of 1.40. For twin-piston aircraft the b/l_{fus} value is in the range of 0.88-2.14, with a mean value of1.30. For turboprop aircraft b/l_{fus} value is in the range of 0.86-1.82, with a mean value of 1.21. For the jets b/l_{fus} value is in the range of 0.61-1.27, with a mean value of 0.89. In single-piston aircraft, the air racing aircraft, homebuilt aircraft, military trainers, aerobatics, and air taxi aircraft have low b/l_{fus} values, while agricultural aircraft and motor gliders have high b/l_{fus} values. In twin-piston aircraft, the light transport aircraft have low b/l_{fus} values, while firefighters have high b/l_{fus} values. In turboprop aircraft, the regional airliner aircraft and executive transport aircraft have low b/l_{fus} values, while firefighter aircraft, patrol aircraft, agricultural and STOL aircraft high b/l_{fus} values. In jets, the regional airliner jets and narrow body jet airliner have low b/l_{fus} values, while business jets and trainer jets have high b/l_{fus} values. A finding on the recommendation of the reviewer has been added to the results section. In this study, although the size-mass relations are compared according to engine types, the common use of composite materials in commercial jets; The differences in aircraft mass, wingspan and fuselage length of old and new jets may be one of the future studies.

Ethical approval

Not applicable.

Conflicts of Interest

The authors declare that there is no conflict of interest regarding the publication of this paper.

References

Abubakar, M. R., Basuno, B., & Hasan, S. (2013). Aerodynamics Analysis on Unsymmetrical Fuselage Models. In Applied Mechanics and Materials (Vol. 315, pp. 273-277). Trans Tech Publications Ltd.

Anderson, B. K., & Takahashi, T. T. (2017). Conceptual fuselage design with direct CAD modeling. In 17th AIAA aviation technology, integration, and operations conference.

Ardema, M. D., Chambers, M. C., Patron, A. P., Hahn, A. S., Miura, H., & Moore, M. D. (1996). Analytical fuselage and wing weight estimation of transport aircraft.

Bejan, A., Charles, J. D., & Lorente, S. (2014). The evolution of airplanes. Journal of Applied Physics, 116(4), 044901.

Bronz, M. (2012). A contribution to the design of long endurance mini unmanned aerial vehicles (Doctoral dissertation, Institut Supérieur de l'Aéronautique et de l'Espace-ISAE).

ICAO (1988). Annex 14: Aerodromes. International Civil Aviation Organ.

ICAO (2017). Wake turbulence separation in RVSM airspace. Third meeting ATM SG/3-WP/27. Cairo, Egypt.

Kruger, M., Huyssen, R. J., Smith, L., & Meyer, J. P. (2016). Application of a low fineness ratio fuselage to an airliner configuration. In 54th AIAA Aerospace Sciences Meeting (p. 1282).

Liu, T. (2006). Comparative scaling of flapping-and fixed-wing flyers. AIAA Journal, 44(1), 24-33.

Marta, A. C. (2008). Parametric study of a genetic algorithm using a aircraft design optimization problem. Report Stanford University, Department of Aeronautics and Astronautics.

McDavid, J., & Kühner, B. (2017). Empennage Sizing: The Tail Lever Arm as a Percentage of Fuselage Length Determined from Statistics. Digital Library-Projects & Theses-Prof. Dr. Scholz.

Nicolosi, F., Della Vecchia, P., Ciliberti, D., & Cusati, V. (2016). Fuselage aerodynamic prediction methods. Aerospace Science and Technology, 55, 332-343.

Niţă, M., & Scholz, D. (2010). From Preliminary Aircraft Cabin Design to Cabin Optimization-Part Ii. Deutscher Luft-und Raumfahrtkongress DLRK, 2010.

Raymer, D. (2018). Aircraft design: a conceptual approach. American Institute of Aeronautics and Astronautics, Inc

Sforza, P. M. (2014). Commercial airplane design principles. Elsevier.

Singh, V., Sharma, S. K., & Vaibhav, S. (2016). Transport aircraft conceptual design optimization using real coded genetic algorithm. International Journal of Aerospace Engineering, 2016.

Jackson, P. (Ed.). (2004). Jane's All the World's Aircraft. Jane's. In various years.

Torenbeek, E. (2013). Advanced aircraft design: conceptual design, analysis and optimization of subsonic civil airplanes. John Wiley & Sons.

Wells, D. P., Horvath, B. L., & McCullers, L. A. (2017). The flight optimization system weights estimation method.

Zhuravlev, P., & Zhuravlev, V. (2012). Significance of modifications for development of passenger airplanes. Aircraft Engineering and Aerospace Technology.

Zlotnick, M., & Diederich, F. W. (1952). Theoretical Calculation of the Effect of the Fuselage on the Spanwise Lift Distribution on a Wing.

Cite this article: Durmus, S. (2023). Relationship Between Wingspan and Fuselage Length in Aircraft According to Engine Types. Journal of Aviation, 7(1), 1-6.

7 (1): 7-16 (2023)

Journal of Aviation

https://dergipark.org.tr/en/pub/jav

e-ISSN 2587-1676

A Framework for Airworthiness Certification of Autonomous Systems Within United States Naval Aviation

Donald Costello[1*], Richard Adams[2]

[1*] United States Naval Academy, Annapolis, Maryland, United States (dcostell@usna.edu)
[2] Romeo Alpha, L.L.C., Prince Frederick, Maryland, United States (Richard.adams@romeoalphallc.com)

Article Info

Received: 18 August 2022
Revised: 18 December 2022
Accepted: 26 December 2022
Published Online: 26 February 2023

Keywords:
Airworthiness Certification
Certification of Autonomous Systems
Military Unmanned Aviation

Corresponding Author: *Donald Costello*

RESEARCH ARTICLE

https://doi.org/10.30518/jav.1161725

Abstract

A need has been identified to establish a strategy and framework for airworthiness certification of autonomous systems in Naval Aviation. The purpose of this research was to document a two-day virtual summit that was held in June 2021 to develop an initial strategy and framework for airworthiness certification of autonomous functionality in Naval Aviation air systems. The summit was designed to engage the airworthiness community to start the development of a strategy and framework for airworthiness certification of autonomous systems. The summit was attended by representatives from government, industry and academia. Following two full days of discussions, the group came to a consensus on a strategy and framework for airworthiness certification of airborne autonomous functions based on an example use case: an unmanned aircraft performing a drogue aerial refueling task. This paper summarizes the summit and it's outcomes in an effort to stimulate the certification community to develop methods for certifying autonomous behaviour.

1. Introduction

All modern aircraft have some level of automation. However, there is increasing interest in the implementation of autonomous systems and functions in U.S. military air systems. Current certification standards rely on a human to have overall responsibility for the air vehicle. An autonomous system will not have a human in or on the loop when it operates. These systems present unique airworthiness certification challenges, and a need has been identified to establish an airworthiness certification strategy and framework for these systems.

The various branches of the U.S. armed forces have documented processes for airworthiness certification of military air systems (NAVAIR Instruction 13034.1F: Airworthiness and Cybersecurity Safety Policies for Air Vehicles and Aircraft Systems, 2016; NAVAIR Airworthiness and Cybersafe Process Manual, NAVAIR Manual M-13034.1, 2016; Air Force Instruction 62–601: USAF Airworthiness, 2010; Air Force Policy Directive 62–6: USAF Airworthiness, 2019; Army Regulation 70–62: Airworthiness of Aircraft Systems, 2016; MIL-HDBK-516C: Department of Defense Handbook, Airworthiness Certification Criteria, 2014). These processes primarily utilize a set of airworthiness certification criteria, standards and methods of compliance to establish the airworthiness basis for an air system. While the overall airworthiness processes and procedures can be leveraged for air systems implementing autonomous functions, a strategy and framework for airworthiness certification of air systems with autonomous functions needs to be developed to adapt to this emerging capability. Airworthiness certification processes are designed to ensure that an air system is airworthy and safe for its intended mission in its intended operating environment.

As part of the airworthiness process, an air system is evaluated against a set of airworthiness criteria and standards. Operating limitations, normal and emergency procedures, warnings, cautions and notes are established, and safety risks are assessed and accepted at the appropriate level. In general, current airworthiness criteria and standards used to assess airworthiness and safety of flight of air system functions, hardware and software assume deterministic system behavior.

To stimulate discussion and build consensus on a possible path towards an airworthiness certification strategy and framework for autonomous systems, a two-day summit was held in June 2021 entitled June 2021 Summit on Certification of Autonomous Systems Within Naval Aviation. The summit was held in conjunction with the National Airworthiness Council Artificial Intelligence Working Group (NACAIWG). It was attended by representatives from the United States government airworthiness community (United States Navy (USN), United States Air Force (USAF), United States Army (USA), National Aeronautics and Space Administration (NASA), and the Federal Aviation Administration (FAA)), industry (Boeing, Lockheed Martin, Northrop Grumman, and

Aurora Flight Sciences) and academia (Purdue University, University of Maryland, and the United States Naval Academy). Following two full days of discussions, the group came to a consensus on a strategy and framework for airworthiness certification of airborne autonomous functions based on an example use case (an unmanned aircraft performing a drogue aerial refueling task). This paper summarizes the outcomes of the summit.

The contributions of this paper include documentation of the summit itself, and the framework agreed upon by all participants (all of whom were subject matter experts in safe for flight certification from industry, the United States government, and academia). It allowed an open dialog between the government and industry in an open forum. Most engagement with the industry is only with one company at a time. By using a hypothetical use case, every member of the summit was able to openly contribute to the shared goal of developing a framework for the certification of autonomous systems within naval aviation. Ultimately, the results of the summit were briefed and endorsed by the NACAIWG.

2. Background

This section provides a summary of definitions and concepts, relevant instructions, standards and papers related to airworthiness certification, system safety, development assurance, and certification of autonomous function in aviation.

2.1. Definitions and Concepts

Based on a literature review, ASTM F3060-20 (ASTM International: F3060-20 Standard Terminology for Aircraft, 2020). Standard Terminology for Aircraft, was determined to be the most comprehensive source of relevant definitions addressing autonomous systems and functions. The summit adopted the definitions from ASTM F3060-20 to enable a common understanding of relevant definitions. As an industry consensus standard, ASTM F03060-20 provides a set of relevant standardized definitions applicable to the certification of autonomous systems including definitions for automatic, autonomous, artificial intelligence (AI), adaptive system, complex system, deterministic system, non-deterministic system, intelligent agent, machine learning (ML), run-time assurance (RTA) architecture and safety monitor. It also defines the differences between humans in the loop, humans on the loop and humans out of the loop.

Human in-the-loop systems requires a human to interact with the system to be able to perform its intended functions or control actions. Human on loop systems is characterized by functions where a human can give guidance to an automated system that has the authority to perform functions or control actions without human oversight or actions. Human out-of-the-loop systems are characterized by systems in which a human is not able to intervene or provide guidance to an automatic (or autonomous) system. The system has the authority to perform functions and control actions without human oversight or actions.

For automated functions, a system performs actions without the need for human intervention and may provide the capability for a human to monitor and override the system (to include when the system performs off-nominal or to prevent a mishap). These functions typically operate with a human on the loop as a safety monitor. Current unmanned aerial systems (UAS) such as the MQ-4C and MQ-8 function automatically but with air vehicle operator (AVO) supervision. They follow preplanned routes and utilize a deterministic rule-based architecture. In the absence of human intervention, the system will perform its programmed mission automatically.

For autonomous functions, the system is delegated authority by a human to independently determine a new course of action in the absence of a predefined plan and to accomplish goals based on its knowledge and understanding of its situational observation of the operational environment. The system takes actions that are dependent on sensing and interpreting the external environment. Autonomous systems utilizing ML improve their performance by exposure to data without the need to follow explicitly programmed instructions. These systems have the ability and authority to make decisions independently and self-sufficiently without human intervention. Autonomous functions do not preclude the ability of a human to monitor (on the loop) and override the autonomous function if provisions for human monitoring and intervention are considered in the design. However, for the summit, it was assumed that the autonomous functionality being certified would not have a human in or on the loop.

Deterministic behavior is rule-based. For a given input, a deterministic system will exhibit known behavior based on known input conditions and always produce the same output. There is only one potential output for a defined set of inputs. Automated functions are deterministic.

Non-deterministic systems rely on observation to influence the output. There are multiple potential outputs to a single input. The exact behavior of the system cannot be predicted based on input conditions. Autonomous functions are typically non-deterministic.

DoD Directive 3000.09 (Department of Defense Directive 3009.09: Autonomy in Weapons Systems, 2017) establishes guidelines for autonomy in weapon systems used for lethal, non-lethal, kinetic and non-kinetic use. It provides a set of top-level principles that can be used as a basis for establishing principles for the certification of autonomous functions in air systems. Among these are:

- A human is ultimately responsible for the system and its behavior. A human is responsible for deciding to delegate authority to the system to operate with little or no human intervention.
- Autonomous systems should provide operators with feedback on system status and enable operators to activate and deactivate system functions if needed.
- Autonomous systems should be sufficiently robust to minimize behaviors or failures that lead to safety hazards or unintended consequences.
- Autonomous systems should undergo rigorous hardware and software development and testing, including software validation and verification, lab, ground and developmental flight to ensure the system functions as intended with no unintended or unsafe behaviors. They will function as anticipated in realistic operating environments. Regression tests should be conducted after changes to the system to ensure safety critical systems have not been affected.

2.2. Review of Relevant Airworthiness Instructions and Standards

Relevant Department of Defense (DoD) instructions and handbooks related to airworthiness certification were reviewed. These include:

- NAVAIRINST 13034.1: Airworthiness and Cybersecurity Safety Policies (NAVAIR Instruction 13034.1F: Airworthiness and Cybersecurity Safety Policies for Air Vehicles and Aircraft Systems, 2016).
- NAVAIR M-13034.1: NAVAIR Airworthiness and CYBERSAFE Process Manual (NAVAIR Airworthiness and Cybersafe Process Manual, NAVAIR Manual M-13034.1, 2016).
- AFI 62-601: USAF Airworthiness Instruction (Air Force Instruction 62–601: USAF Airworthiness, 2010).
- AFPD 62-6: USAF Airworthiness Policy (Air Force Policy Directive 62–6: USAF Airworthiness, 2019).
- 70-62: Airworthiness of Aircraft Systems (Army Regulation 70–62: Airworthiness of Aircraft Systems, 2016).
- MIL-HDBK-516C: Airworthiness Certification Criteria Guidance for the DoD (MIL-HDBK-516C: Department of Defense Handbook, Airworthiness Certification Criteria, 2014).

These instructions and policies establish the process and procedures for airworthiness certification for the USN, USAF and USA. They address airworthiness certification processes and procedures but do not specifically address certification criteria and standards for autonomous systems. MIL-HDBK-516C (MIL-HDBK-516C: Department of Defense Handbook, Airworthiness Certification Criteria, 2014) is a tri-service handbook that identifies airworthiness certification criteria, standards and methods of compliance to be considered as part of the airworthiness certification process. MIL-HDBK-516C (MIL-HDBK-516C: Department of Defense Handbook, Airworthiness Certification Criteria, 2014) contains criteria addressing software certification, system safety and vehicle control functions but does not specifically address certification of autonomous systems. These top-level criteria would be generally applicable to autonomous systems. In the future, as the DoD gains experience in the certification of autonomous systems, there may be a need to specifically address autonomous systems within the handbook.

2.3. Review of Relevant System Safety and Development Assurance Standards and Best Practices

Military, civil aviation and industry standards and best practices for system safety and development assurance were reviewed. These include:

- MIL-STD-882E: DoD Standard Practice: System Safety (Department of Defense MIL-STD-882E: Department of Defense Standard Practice, System Safety, 2012).
- Joint Software Systems Safety Engineering Handbook (JSSSEH) (Joint Software Systems Safety Engineering Handbook, 2010).
- FAA Advisory Circular 23.1309E: FAA System Safety Analysis and Assessment for Part 23 Airplanes (Advisory Circular 23.1309.E: System Safety Analysis and Assessment for Part 23 Airplanes, 2011).
- European Union Aviation Safety Agency (EASA) Certification Specification 25 Alternate Means of Compliance AMC 25.1309 (Systems and Equipment) is part of the EASA (Certification Specifications for Large Airplanes CS-25, 2007).
- SAE ARP 4761: Guidelines and Methods for Conducting the Safety Assessment Process on Civil Airborne Systems and Equipment (Guidelines and Methods for Conducting the Safety Assessment Process on Civil Airborne Systems and Equipment, 1996).
- SAE ARP 4754: Guidelines for Development of Civil Aircraft and Systems (Guidelines for Development of Civil Aircraft and Systems, 2010).
- DO-178C, Software Considerations in Airborne Systems and Equipment Certification (Certification Specifications for Large Aeroplanes CS-25 Software Considerations in Airborne Systems and Equipment Certification, 2011).

These standards and best practices document the system safety and software system safety/development assurance processes for military and civil systems. They document a systems-engineering approach for decomposing a system into functions implemented by hardware and software, and establish safety objectives for hardware and software. Both civil and military processes share a common theme of functional decomposition of the system, allocation of functions to hardware and software, and setting safety objectives based on the criticality of the function to be performed in hardware or software.

In general, software functions whose failure results in a catastrophic failure (e.g., loss of aircraft) demands a greater level of development and test rigor (or development assurance) than those that do not. MIL-STD-882E (Department of Defense MIL-STD-882E: Department of Defense Standard Practice, System Safety, 2012) and the JSSSEH (Joint Software Systems Safety Engineering Handbook, 2010) identify Level of Rigor (LOR) Tasks that should be performed based on the criticality of the software function to ensure the software is safe for the intended use. Within the DoD safety framework, software safety risks may be identified and accepted by the appropriate authority for software that does not satisfy the LOR tasks.

Civil airworthiness regulations establish a set of safety objectives and development assurance levels that are assigned at the functional level based on hazard classification. Civil airworthiness certification is compliance based. Unlike the DoD, civil system safety processes do not accommodate safety risk acceptance for software that does not satisfy the required development assurance level. The software must be shown to be compliant with the processes and tasks otherwise the air system may not receive civil certification. The processes defined in ARP 4761 (Guidelines and Methods for Conducting the Safety Assessment Process on Civil Airborne Systems and Equipment, 1996), ARP 4754 (Guidelines for Development of Civil Aircraft and Systems, 2010) and DO-178C (Certification Specifications for Large Aeroplanes CS-25 Software Considerations in Airborne Systems and Equipment Certification, 2011) follow the systems engineering process. Functions are decomposed into hardware and software items. Acceptable failure probabilities are assigned to hardware items, and development assurance levels are assigned to software based on hazard classification (e.g., Catastrophic, Hazardous, Major, etc.) to software items. The development assurance level of the software items establishes the development objectives that must be accomplished. A common theme is that the level of rigor (or development assurance) for safety-critical software is determined by the criticality of the function (i.e., hazard severity and probability of occurrence).

2.4. Other Relevant Standards and Papers on Autonomy

A survey of other relevant standards and papers related to the certification of autonomous systems was performed. Several relevant industry standards and papers were identified. These include:

- Concepts of Design Assurance for Neural Networks (CoDANN) (Concepts of Design Assurance for Neural Networks (CoDANN), 2020), March 2020
- CoDANN II (Concepts of Design Assurance for Neural Networks (CoDANN) II, 2021), May 2021
- EASA Artificial Intelligence Roadmap 1.0 (Artificial Intelligence Roadmap 1.0, 2020), February 2020
- EASA Concept Paper: First Usable Guidance for Level 1 Machine Learning Applications (EASA Concept Paper: First Usable Guidance for Level 1 Machine Learning Applications, 2021), April 2021
- ASTM F3060: Standard Terminology for Aircraft (ASTM International: F3060-20 Standard Terminology for Aircraft, 2020), February 2020
- ASTM TR1-EB: Autonomy Design and Operations in Aviation: Terminology and Requirements Framework, 2019 (Autonomy Design and Operations in Aviation: Terminology and Requirements Framework, 2019)
- ASTM TR2-EB: Developmental Pillars of Increased Autonomy for Aircraft Systems (ASTM International: TR2-EB: Developmental Pillars of Increased Autonomy for Aircraft Systems, 2019)
- ASTM F3269-17: Standard Practice for Methods to Bound Flight Behavior of Unmanned Aircraft Systems Containing Complex Functions (ASTM International: F3269-17 Standard Practice Methods to Safely Bound Flight Behavior of Unmanned Aircraft Systems Containing Complex Functions, 2017)
- ASTM F3269: An Industry Standard on Run-Time Assurance for Aircraft Systems (Nagarajan et al., 2021), January 2021
- Leveraging ASTM Industry Standard F3269-17 for Providing Safe Operations of a Highly Autonomous Aircraft (Skoog et al., 2020), 2020
- An ASTM Standard for Bounding Behavior of Adaptive Algorithms for Unmanned Aircraft Operations (Invited) (Cook, 2017), January 2017

As noted above, ASTM F3060 (ASTM International: F3060-20 Standard Terminology for Aircraft, 2020) provides a set of standardized definitions related to autonomous systems, including the distinction between automated systems and autonomous systems. The standard also defines key terms such as ML, intelligent agent, non-deterministic system, safety monitors and run-time assurance architecture. ASTM F3269-17 (ASTM International: F3269-17 Standard Practice Methods to Safely Bound Flight Behavior of Unmanned Aircraft Systems Containing Complex Functions, 2017) provides information on the implementation of run-time assurance/safety monitor architectures for airborne systems. EASA CoDANN (Concepts of Design Assurance for Neural Networks (CoDANN), 2020), CoDANN II (Concepts of Design Assurance for Neural Networks (CoDANN) II, 2021), and the EASA Concept Paper for First Usable Guidance for Level 1 Machine Learning Applications (EASA Concept Paper: First Usable Guidance for Level 1 Machine Learning Applications, 2021) provide detailed background and certification considerations for autonomous systems. They are particularly focused on the challenges posed by the use of neural networks in aviation and in the broader context of allowing ML and more generally artificial intelligence on-board aircraft for safety-critical applications. The EASA Concept Paper for First Usable Guidance for Level 1 ML Applications (EASA Concept Paper: First Usable Guidance for Level 1 Machine Learning Applications, 2021) also provides guidance for learning assurance of autonomous systems and a set of design objectives/tasks for the development of AI/ML functions.

3. Example Use Case: Vision Based Receiver Unmanned Aircraft Autonomous Aerial Refueling

An example use case was selected to facilitate the development of an airworthiness certification strategy based on an example application of AI. The use case focused on an unmanned receiver aircraft autonomous aerial refueling task where the receiver aircraft is equipped with a vision-based ML/neural network sensor that provides aerial refueling drogue location in 3-D space to the receiver aircraft's vehicle management system.

The 2006 NASA/Defense Advanced Research Projects Agency (DARPA) study (Schweikhard, 2006) and the 2015 X-47 program (Photo Release -- X-47B Unmanned Aircraft Demonstrates the First Autonomous Aerial Refueling, 2015) both demonstrated the ability of a UAS to receive fuel through the NATO standard method with limited human interaction. However, both programs were flown under intern flight clearances (IFCs). An IFC requires multiple risk mitigation steps from flight certification officials and is not intended for general fleet use. This work focuses on developing a process for obtaining a permanent flight clearance (PFC) for autonomous behavior. A PFC would allow operations with limited risk mitigation steps in place.

Building on prior work (Schweikhard, 2006; Photo Release -- X-47B Unmanned Aircraft Demonstrates the First Autonomous Aerial Refueling, 2015), we assumed that unmanned receiver aircraft would be capable of navigation to pre-contact position (5 to 20 feet directly aft of the drogue) behind the tanker aircraft. Figure 1 illustrates the pre-contact position behind a wing pod of a KC-135. From this point, the UAS would employ a computer vision-based optical sensor with a neural net to identify and track the drogue through contact. The vision sensor provides drogue location from pre-contact (5-20 feet behind the drogue) to contact (probe tip linking with the coupler). The vehicle management system commands the vehicle position to place the aerial refueling probe tip in the drogue based on the drogue position provided by a computer vision system. Following contact, the vehicle management system will station keep based on a position signal (such as a Differential Global Positioning (DGPS) signal as demonstrated in Reference (Schweikhard, 2006; Photo Release -- X-47B Unmanned Aircraft Demonstrates the First Autonomous Aerial Refueling, 2015)) from the tanker aircraft. Consideration of the use case highlighted some of the challenges in applying traditional design and development assurance techniques to autonomous functions. Figure 2 highlights the drogue, coupler and probe tip on an F/A-18F preparing to refuel from a KC-130 wing pod.

Figure 1. EA-18G Growler at the pre-contact position in 2013 behind a KC-135 ("EA-18G at the Pre-Contact Point Behind a KC-10 over Afghanistan," 2013)

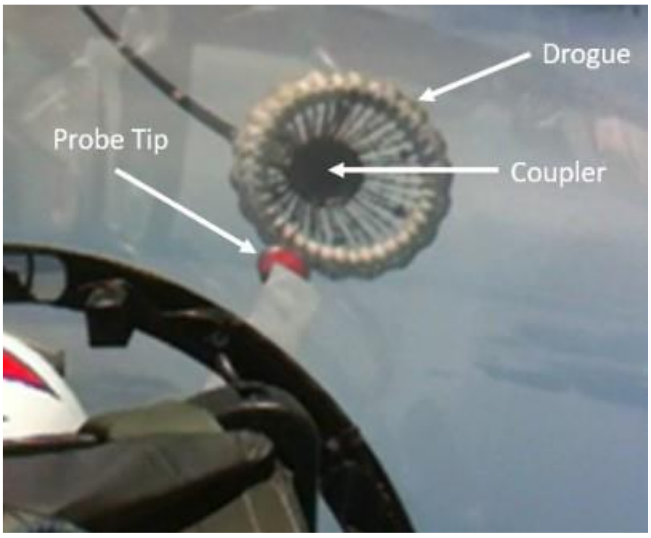


Figure 2. F/A-18F Super Hornet preparing to aerial refuel ("F/A-18F Preparing to Aerial Refuel Over Maryland," 2010)

4. Autonomous Systems Airworthiness Certification Challenges

The emergence of AI/ML functions in airborne systems presents unique airworthiness certification challenges. These challenges include limitations in the application of existing development assurance concepts to AI/ML, system architecture considerations, and the unique challenges associated with machine learning. The design and analysis techniques traditionally applied to deterministic functions may not provide adequate development assurance/safety coverage for AI/ML functions. While the principles of development assurance (utilizing a combination of process assurance and verification coverage criteria, or structured analysis or assessment techniques) may be applied, the non-deterministic nature of AI/ML drives unique design assurance considerations to provide confidence that errors in requirements, design, integration, or interaction effects have been adequately identified and corrected.

Unique challenges associated with certification of AI/ML functions include:

- System Development Assurance: This includes unique considerations for the safety assessment process, definition of requirements for the intended function and architectural considerations.
- Learning Process: This includes the process to train the system, evaluate system performance, and the hardware/software learning environment.
- Data Assurance Process: This includes definition of an end-to-end process to select and manage training data sets throughout the product lifecycle, and considerations regarding training data quality (accuracy, completeness, etc.).
- Training Verification and Data Sets: This includes the development and management of training data and the processes to verify the system functions as intended.

Existing requirement-based hardware and software development and certification processes and standards such as MIL-STD-882E (Department of Defense MIL-STD-882E: Department of Defense Standard Practice, System Safety, 2012), ARP-4761 (Guidelines and Methods for Conducting the Safety Assessment Process on Civil Airborne Systems and Equipment, 1996), ARP-4754 (Guidelines for Development of Civil Aircraft and Systems, 2010), DO-178C (Certification Specifications for Large Aeroplanes CS-25 Software Considerations in Airborne Systems and Equipment Certification, 2011) are well suited to the certification of deterministic systems and functions. These processes and standards utilize formal methods to implement the system engineering process to identify requirements, develop and verify hardware and software functions and items. The process begins with development of functional and performance requirements and, in parallel, decomposition of the system into hardware and software functions. A functional hazard assessment (FHA) is conducted to identify functional failure conditions leading to hazards. Functional failure conditions are assigned a hazard classification that characterizes the probability and severity of the functional failure. As the system is further decomposed into hardware and software items, hazard classifications are assigned to each hardware and software item. For software, a level of rigor or development assurance level is assigned based on criticality of the function/item that establishes the development processes and tasks required to ensure that the function/item performs as intended with an appropriate level of safety. MIL-STD-882E (Department of Defense MIL-STD-882E: Department of Defense Standard Practice, System Safety, 2012), ARP-4761 (Guidelines and Methods for Conducting the Safety Assessment Process on Civil Airborne Systems and Equipment, 1996), ARP-4754 (Guidelines for Development of Civil Aircraft and Systems, 2010), DO-178C (Certification Specifications for Large Aeroplanes CS-25 Software Considerations in Airborne Systems and Equipment Certification, 2011) provide guidelines for the development of software based on the hazard classification/safety criticality of the function. More details on the FHA process can be found in Reference (Guidelines for Development of Civil Aircraft and Systems, 2010).

System architecture is an important consideration in the development of the FHA. Architectural considerations such as redundancy, functional independence, and the degree of human oversight are considered when establishing the criticality and level of rigor/development assurance level for each function/item. MIL-STD-882E (Department of Defense MIL-STD-882E: Department of Defense Standard Practice, System Safety, 2012) implements the concept of software criticality index (SWCI) to establish level rigor tasks for

software development. A SWCI is assigned based on the Software Control Category and severity/consequence of failure. Similarly, DO-178C (Certification Specifications for Large Aeroplanes CS-25 Software Considerations in Airborne Systems and Equipment Certification, 2011) assigns a design assurance level (DAL) to software items based on the functional failure analysis. A set of development objectives are assigned based on the assigned DAL. Use of development assurance methods that utilize a combination of process assurance and verification coverage criteria, or structured analysis or assessment techniques increase confidence that errors in requirements or design, integration, and interaction effects have been adequately identified and mitigated. An overview of the FHA can also be found in Reference (Guidelines for Development of Civil Aircraft and Systems, 2010).

The EASA AI Roadmap (Artificial Intelligence Roadmap 1.0, 2020) notes that traditional development assurance frameworks are not completely adaptable to ML functions. The roadmap identifies several challenges with respect to the trustworthiness of AI/ML functions and the integrity of learning processes.

4.1. Learning Assurance

While the principles of traditional requirement-based development assurance can be applied to autonomous functions using ML, the development assurance process must also consider the unique aspects of the learning function and its implementation during development and fielding. This process is known as a learning assurance. Learning assurance comprises the systematic activities to provide at an adequate level of confidence that the system functions as intended, that errors in the data driven learning process are identified and corrected such that the system satisfies applicable requirements (including safety considerations), and provides sufficient generalization guarantees (EASA Concept Paper (EASA Concept Paper: First Usable Guidance for Level 1 Machine Learning Applications, 2021). The EASA AI Roadmap (Artificial Intelligence Roadmap 1.0, 2020) and the CoDANN phases (Concepts of Design Assurance for Neural Networks (CoDANN), 2020; Concepts of Design Assurance for Neural Networks (CoDANN) II, 2021) identify the challenges associated with learning assurance and provide recommended certification strategies to support certification of autonomous systems implementing ML.

A building block approach was identified that is intended to provide confidence at an appropriate level that an AI/ML function supports the intended functionality safely. The learning assurance 'Process W' developed by EASA addresses the fundamental aspects of this approach. The Learning Assurance Process 'W' is summarized in CoDANN and CoDANN II (Concepts of Design Assurance for Neural Networks (CoDANN), 2020; Concepts of Design Assurance for Neural Networks (CoDANN) II, 2021).

4.2. Architectural Mitigations – Safety Monitors and RTA

Given the challenges with ensuring the trustworthiness of AI/ML functions, architectural considerations such as the implementation of deterministic independent RTA safety monitors can mitigate the inability to fully validate and verify AI/ML functions, ensure behavior is always safe and predictable, and mitigate the risks associated with anomalous/undesired behavior. With this approach, the uncertainty in the AI black box is mitigated by implementing deterministic boundaries and controls around it.

ASTM international committee F38 on Unmanned Aircraft Systems developed ASTM F3269-17 (ASTM International: F3269-17 Standard Practice Methods to Safely Bound Flight Behavior of Unmanned Aircraft Systems Containing Complex Functions, 2017) Standard Practice for Methods to Safety Bound Flight Behavior of Unmanned Aircraft Systems Containing Complex Functions. Acknowledging the challenges in verification of complex functions using conventional software methods, the document was developed to provide industry with a standard practice for certification of UAS containing complex functions. F3269-17 (ASTM International: F3269-17 Standard Practice Methods to Safely Bound Flight Behavior of Unmanned Aircraft Systems Containing Complex Functions, 2017) address a RTA safety monitor architecture concept that implements independent real-time monitoring, prediction, and fail-safe recovery mechanisms that bound the behavior of a complex functions to ensure the safety of a UAS. The RTA architecture implements a deterministic independent safety monitor function that oversees the outputs of the complex function and ensures that the outputs are safe and executable based on a set of predetermined rules that bound acceptable outputs of the complex function. Should the complex function's outputs be determined to be outside of an acceptable range, the safety monitor implements a deterministic response overriding the outputs of the complex system to ensure the air system remains in a safe state.

Independent safety monitors and RTA architectures provide a deterministic layer of protection around the complex function and mitigates the risk of unpredictable/anomalous behavior of the complex function. In addition, safety monitors provide a layer of failure detection that is independent of the complex system being monitored. As they are deterministic, RTA safety monitor architectures can be developed using traditional hardware and software systems engineering processes (e.g., the systems engineering 'V'). Existing functional, hardware and software safety assessment and development assurance processes and standards (e.g., MIL-STD-882E (MIL-STD-882E: Department of Defense Standard Practice, System Safety, 2012), ARP-4761 (Guidelines and Methods for Conducting the Safety Assessment Process on Civil Airborne Systems and Equipment, 1996), ARP-4754 (Guidelines for Development of Civil Aircraft and Systems, 2010), DO-178C (Certification Specifications for Large Aeroplanes CS-25 Software Considerations in Airborne Systems and Equipment Certification, 2011) can be utilized. System and subsystem functional hazard analyses considering system architecture can be used to establish RTA safety monitor safety objectives and mitigations. This includes allocation of functional, performance and safety requirements to the RTA safety monitor function, and use of system and subsystem functional hazard analyses considering system architecture to establish safety objectives and mitigations. Hardware and software safety objectives should be based on the criticality of function using MIL-STD-882E (Department of Defense MIL-STD-882E: Department of Defense Standard Practice, System Safety, 2012) or civil equivalent (ARP-4761 (Guidelines and Methods for Conducting the Safety Assessment Process on Civil Airborne Systems and Equipment, 1996), ARP 4754 (Guidelines for Development of Civil Aircraft and Systems, 2010). Typically, safety monitors

are considered safety critical functions and developed to the appropriate level of rigor/development assurance.

An example implementation of a RTA safety monitor architecture is provided in Figure 3. In this example, an AI/neural net complex function provides outputs to a vehicle management function. A safety monitor is implemented that monitors the inputs to, and outputs from the complex function. Input monitors assure that system inputs are acceptable for use by the complex function (e.g., valid within an acceptable range of expected values, rates of change, etc.). The output side of the safety monitor checks that the outputs of the complex function are with predefined safety boundaries/range of acceptability before being sent to the vehicle management function. In the event that the output of the complex function falls outside of a pre-defined set of safety boundaries, the safety monitor will override the complex function's output, and provide outputs to the vehicle management function that insures the system remains in a safe state. These outputs can range from simple error declaration that flags an error in the complex function to issuance of safe state commands in lieu of those determined by the complex function.

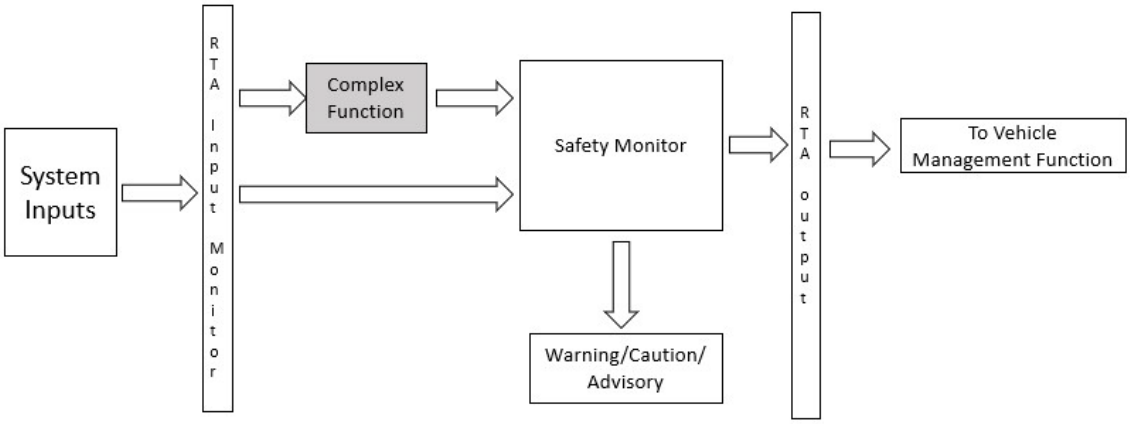


Figure 3. RTA Architecture

5. Materials and Methods

The summit determined that the following concept for aerial refueling could lead to a PFC for a AI/ML function within naval aviation and can be used as a certification strategy and framework:

- Midair Collision Avoidance With the Tanker Aircraft: A 3-D keep-out zone safety boundary shall be established around the tanker aircraft. This keep-out zone serves as a safety boundary to ensure the receiver aircraft does not contact the tanker. Utilizing a DGPS based relative navigation solution, deterministic vehicle management function can be used to position the receiver in the pre-contact position. During the entire tanking evolution, a deterministic safety monitor ensures the receiver aircraft remains in a safe position relative to the tanker.
- Corridor of Autonomy (COA): As part of the RTA architecture the receiver would maintain separation from the tanker and only attempt to make contact with a drogue that is within a defined volume behind the tanker. The summit agreed that the key to obtaining a PFC for autonomous tanking is to establish a COA. The COA would also be considered a flight clearance envelope, where the system will be permitted to exhibit autonomous behavior where a monitor will ensure it will remain within the envelope (Figure 4). The dimensions of the COA are defined relative to the tanker aircraft. It would include the nominal location of the drogue and the nominal location of the optional refueling point (approximately 10 feet forward of the contact position). The COA would include some amount of room for deviations from the nominal positions to allow for perturbations. The UAS would only be allowed to exhibit autonomous behavior if it that behavior would result in the UAS remaining within the COA.
- Transition from Pre-Contact to Contact: Once in the pre-contact position, the vehicle position command transitions from DGPS-based tanker relative position to drogue-relative navigation position using an AI/ML based computer vision sensor. The AI/ML based vision sensor identifies the drogue location and provides relative position commands to the vehicle management function which maneuvers the probe tip into the drogue. This contact point is marked via a relative position to the tanker.
- Fuel Transfer: After the receiver makes contact with the drogue, it will push the drogue in approximately 10 feet (based on DGPS) to allow fuel to transfer. Throughout the tanking evolution safety monitors track the location of the receiver and tanker aircraft to ensure the COA is not breached. This will also continue to mitigate the risk of midair collision.
- Completing the Task: Once the receiver has completed its fuel onload it will return the drogue to the contact point, back out to its pre-contact point, and continue its planned mission.

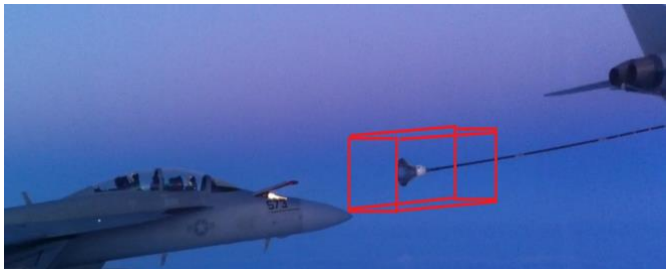


Figure 4. EA-18G Growler at the Pre-Contact Position in 2011 with a Notional COA added to the Image ("EA-18G Completing the Aerial Refueling Task Over Washington State," 2011)

6. Remaining Tasks for Certification

Certification of autonomous systems presents unique challenges. Existing processes and standards form a basic foundation for certification, but are predicated on the use of deterministic systems. Near term practical certification solutions for certification of non-deterministic AI/ML applications are needed. The fundamental work accomplished by ASTM and EASA provides a jumping off point for a development of a tailored development assurance strategy for AI/ML. It is recommended that the NACAIWG develop and document certification, criteria, standards, methods of compliance and processes for AI/ML in DoD air systems. In an effort to help establish a path forward to certification, the NACAIWG is attempting to reach a consensus across the DoD for updates to the relevant guidance documents.

The following key elements should be considered in the development of a tailored certification framework for a specific AI/ML function:

- Implement traditional systems engineering processes (the systems engineering "V"). Utilize existing functional, hardware and software safety assessment and development assurance processes and standards to the maximum extent possible (e.g., MIL-STD-882E (MIL-STD-882E: Department of Defense Standard Practice, System Safety, 2012), ARP-4761 (Guidelines and Methods for Conducting the Safety Assessment Process on Civil Airborne Systems and Equipment, 1996), ARP-4754 (Guidelines for Development of Civil Aircraft and Systems, 2010), DO-178C (Certification Specifications for Large Aeroplanes CS-25 Software Considerations in Airborne Systems and Equipment Certification, 2011)). This includes of system level functional, performance and safety requirements allocation to the AI/ML function. Conduct system and subsystem functional hazard analyses considering system architecture, and establish hardware and software safety requirements and mitigations.
- Leverage the EASA learning process W to develop a development assurance framework for AI/ML functional assurance. Tailor EASA ML development objectives to the proposed system design and architecture. Leverage EASA ML safety assessment objectives, means of compliance and guidance material to establish a framework for AI/ML functional assurance. Implement and adapt the traditional Systems Engineering V with the Learning Assurance W. Guidance and objectives are provided in EASA concept Paper: First Usable Guidance for Level 1 Machine Learning Applications (EASA Concept Paper: First Usable Guidance for Level 1 Machine Learning Applications, 2021).
- Implement an independent, deterministic RTA/safety monitor architecture to mitigate residual risk associated with the uncertainty of the AI/ML function and satisfy system-level safety objectives. This is necessary due to the complexity and nature of AI/ML functions and the challenges associated with ensuring fail-safe behavior of non-deterministic autonomous functions. Because they are deterministic, existing hardware and software systems engineering processes can be used and existing functional, hardware and software safety assessment and development assurance processes and standards (e.g., MIL-STD-882E (MIL-STD-882E: Department of Defense Standard Practice, System Safety, 2012), ARP-4761 (Guidelines and Methods for Conducting the Safety Assessment Process on Civil Airborne Systems and Equipment, 1996), ARP-4754 (Guidelines for Development of Civil Aircraft and Systems, 2010), DO-178C (Certification Specifications for Large Aeroplanes CS-25 Software Considerations in Airborne Systems and Equipment Certification, 2011)) may be utilized. This includes allocation of functional, performance and safety requirements to RTA safety monitor functions, and use of system and subsystem functional hazard analyses considering system architecture to establish safety objectives and mitigations. Hardware and software safety objectives should be based on the criticality of function using MIL-STD-882E (Department of Defense MIL-STD-882E: Department of Defense Standard Practice, System Safety, 2012) or civil equivalent (ARP-4761 (Guidelines and Methods for Conducting the Safety Assessment Process on Civil Airborne Systems and Equipment, 1996), ARP 4754 (Guidelines for Development of Civil Aircraft and Systems, 2010)). Treat safety monitors as safety critical functions. Guidance on the development and implementation of safety monitors and RTA can be found in ASTM F3269-17 (ASTM International: F3269-17 Standard Practice Methods to Safely Bound Flight Behavior of Unmanned Aircraft Systems Containing Complex Functions, 2017).
- Implement provisions for delegation of autonomy to the system as well a human supervision/monitoring/oversight of the autonomous function (human-on-the-loop) as an additional mitigation against unpredictable system behavior or complex failure conditions.
- Utilize an iterative AI/ML development and verification strategy utilizing software simulations, hardware in the loop simulations, and flight test data to train, and verify the AI/ML function.
- Limit ML to the development environment until confidence is gained in the learning function. Once confidence is gained in the integrity of the AI/ML function, consider enabling learning in operational systems.

7. Conclusions and Future Work

The June 2021 summit was a large step in the right direction for certification of autonomous systems in Naval Aviation. By bringing certification officials from the three services and NASA together with industry and academia on a notional use case we were able to have an open and frank dialog on the airworthiness certification issues associated with AI/ML. AI/ML certification guidelines need to be established by the government before we task industry to develop the systems. The results of the summit highlighted the need for standards and guidelines that support the development and certification of autonomous systems.

The results of the summit also provide insight into a potential airworthiness certification framework for AI/ML for a specific use case. We recommend that future summits expand to other use cases. We recommend that a future summit be held with an expanded audience (to include NAVAIR Naval Subject Matter Experts) to further iterate on standards, methods of compliance, validation and verification processes that will be required to certify air systems that incorporate AI/ML functions.

We recommend a future summit to further decompose the unmanned aerial refueling task, with a focus on establishing guidelines, standards and methods of compliance supporting development and certification of autonomous systems. The example use case may be useful in exploring testing, modeling and simulation methods and strategies to support autonomous system certification.

The summit chose to keep the receiver aircraft as a generic system. Not one that is developed by one of the primes (i.e., Boeing, Lockheed Martin, or Northrop Grumman). This enabled free and open discussion among all attendees of the summit. Prior to full certification of the autonomous system the interactions between the autonomous functionality and the air vehicle would need to be vetted through flight clearance officials. This paper only focused on the application capabilities of the system and not the technical aspects. Once a path towards certification has been approved by airworthiness authorities, examining the technical aspects of the interactions would have been to be accomplished before a truly autonomous system can be given a safety of flight certification within United States Naval Aviation.

Ethical approval

Not applicable.

Conflicts of Interest

The authors declare that there is no conflict of interest regarding the publication of this paper.

Acknowledgements

The authors would like to thank the National Airworthiness Council Artificial Intelligence Working Group who helped publicize the summit in multiple venues. They would also like to thank all of the attendees to the June 2021 summit for their willingness to participate and collaborate in an open frank discussion on finding a path forward for certifying an AI within Naval Aviation. It was only through their efforts that the summit was able to produce the results documented in this paper. In particular, they would like to thank Dr. Xu and the University of Maryland for enabling the summit through a virtual bridge available to all attendees.

References

Advisory Circular 23.1309.E: System Safety Analysis and Assessment for Part 23 Airplanes. (2011). United States Department of Transportation: Federal Aviation Administration.

Air Force Instruction 62–601: USAF Airworthiness. (2010). Secretary of the Air Force.

Air Force Policy Directive 62–6: USAF Airworthiness. (2019). Secretary of the Air Force.

Army Regulation 70–62: Airworthiness of Aircraft Systems. (2016). Department of the Army.

Artificial Intelligence Roadmap 1.0. (2020). European Union Aviation Safety Agency.

ASTM International: F3060-20 Standard Terminology for Aircraft. (2020). ASTM International, Conshohocken, PA.

ASTM International: F3269-17 Standard Practice Methods to Safely Bound Flight Behavior of Unmanned Aircraft Systems Containing Complex Functions. (2017). ASTM International.

ASTM International: TR2-EB: Developmental Pillars of Increased Autonomy for Aircraft Systems. (2019). ASTM International.

Autonomy Design and Operations in Aviation: Terminology and Requirements Framework. (2019). ASTM International.

Certification Specifications for Large Aeroplanes CS-25 Software Considerations in Airborne Systems and Equipment Certification. (2011). RTCA Document DO-178C.

Certification Specifications for Large Airplanes CS-25. (2007). European Union Aviation Safety Agency.

Concepts of Design Assurance for Neural Networks (CoDANN). (2020). European Union Aviation Safety Agency.

Concepts of Design Assurance for Neural Networks (CoDANN) II. (2021). European Union Aviation Safety Agency.

Cook, S. P. (2017). An ASTM Standard for Bounding Behavior of Adaptive Algorithms for Unmanned Aircraft Operations (Invited). AIAA Information Systems-AIAA Infotech @ Aerospace.

Department of Defense Directive 3009.09: Autonomy in Weapons Systems. (2017). United States Department of Defense.

Department of Defense MIL-STD-882E: Department of Defense Standard Practice, System Safety. (2012). United States Department of Defense.

EA-18G at the Pre-Contact Point Behind a KC-10 over Afghanistan. (2013). [Photograph]. In from the Private Collection of CDR Costello.

EA-18G Completing the Aerial Refueling Task Over Washington State. (2011). [Photograph]. In from the Private Collection of CDR Costello.

EASA Concept Paper: First Usable Guidance for Level 1 Machine Learning Applications. (2021). European Union Aviation Safety Agency.

F/A-18F Preparing to Aerial Refuel Over Maryland. (2010). [Photograph]. In from the Private Collection of CDR Costello.

Guidelines and Methods for Conducting the Safety Assessment Process on Civil Airborne Systems and

Equipment. (1996). S-18 Aircraft and Sys Dev and Safety Assessment Committee.

Guidelines for Development of Civil Aircraft and Systems. (2010). S-18 Aircraft and Sys Dev and Safety Assessment Committee.

Joint Software Systems Safety Engineering Handbook. (2010). United States Department of Defense.

MIL-HDBK-516C: Department of Defense Handbook, Airworthiness Certification Criteria. (2014). United States Department of Defense.

Nagarajan, P., Kannan, S. K., Torens, C., Vukas, M. E., & Wilber, G. F. (2021). ASTM F3269 - An Industry Standard on Run Time Assurance for Aircraft Systems. AIAA Scitech 2021 Forum.

NAVAIR Airworthiness and Cybersafe Process Manual, NAVAIR Manual M-13034.1. (2016). Naval Air Systems Command.

NAVAIR Instruction 1304.1F: Airworthiness and Cybersecurity Safety Policies for Air Vehicles and Aircraft Systems. (2016). Naval Air Systems Command.

Photo Release -- X-47B Unmanned Aircraft Demonstrates the First Autonomous Aerial Refueling. (2015). Northrop Grumman Newsroom. https://news.northropgrumman.com/news/releases/photo-release-x-47b-unmanned-aircraft-demonstrates-the-first-autonomous-aerial-refueling

Schweikhard, K. (2006). NASA/DARPA Automatic Probe and Drogue Refueling Flight Test. SAE Guidance and Control Subcommittee Meeting.

Skoog, M. A., Hook, L. R., & Ryan, W. (2020). Leveraging ASTM Industry Standard F3269-17 for Providing Safe Operations of a Highly Autonomous Aircraft. 2020 IEEE Aerospace Conference.

Cite this article: Costello, D., Adams, R. (2023). A Framework for Airworthiness Certification of Autonomous Systems Within United States Naval Aviation. Journal of Aviation, 7(1), 7-16.

7 (1): 17-28 (2023)

Journal of Aviation

https://dergipark.org.tr/en/pub/jav

e-ISSN 2587-1676

A Comparative Research on The Crew Planning Department of Airlines Adopting Different Business Models-Turkish Flag Carrier and A Low-Cost Airline Example

Duygu Toplu Yaşlıoğlu[1], İbrahim Zeki Akyurt[2], Muhsin Murat Yaşlıoğlu[3] and Teoman Erdağ[4*]

[1] İstanbul University, Faculty of Business Administration, Business Management and Organization, İstanbul, Türkiye. (duygut@istanbul.edu.tr)
[2] İstanbul University, Faculty of Business Administration, Production/ Turkish Airlines Flight Academy, General Manager, İstanbul, Türkiye. (zekiakyurt@gmail.com)
[3] İstanbul University, Faculty of Business Administration, Business Management and Organization, İstanbul, Türkiye. (murat@yaslioglu.com)
[4*] İstanbul University, Faculty of Business Administration, Business Management and Organization, İstanbul, Türkiye. (teomanerdag1979@gmail.com)

Article Info

Received: 11 September 2022
Revised: 26 December 2022
Accepted: 12 January 2023
Published Online: 26 February 2023

Keywords:
Crew Planning
Turkish Flag Carrier
Low-Cost Airlines
Competitive Strategies
Airline Business Models

Corresponding Author: *Teoman Erdağ*

RESEARCH ARTICLE

https://doi.org/10.30518/jav.1173753

Abstract

Airlines operating in Turkey strive to be international leaders in their segments by adopting different competitive strategies. The crew planning department plays an active role in achieving the goals of an airline. In this study, the crew planning departments of airline companies that adopt two different strategies are compared and the differences they encounter in practice are revealed.

1. Introduction

Airline companies have emerged in the first quarter of the 20th century (Wensveen, 2007), and have gained an important place in the passenger transportation industry by growing continuously (TOBB, 2018). Due to the rapid growth in the industry, the intensity of the competition between airline companies has increased day by day (Küçükönal & Korul, 2012), and reached its highest level at the beginning of the 21st century. At the beginning, there were the major airlines which evolved into FSCs in today's terminology, the regional airlines and the charter airlines. After deregulation, LCCs entered the sector as a new model, but even this model had been pioneered by Southwest (founded in 1967) and built on the charter airline model's focus on cheap tickets. Eventually, increased competition (mainly due to rapidly growing LCCs) in the deregulated era led to major changes in business models. Thus, more competition has caused changes in existing business models and the invention of new ones, and airline companies have started to adopt different business models in order to reduce the severity of competition by segmenting the market (Koch, 2010).

Recently, it is observed that airlines adopting different business models have started to enter into each other's fields of activity (Wit & Zuidberg, 2012). For this reason, especially full-service and low-cost airline companies strive to gain a competitive advantage against each other by controlling "the overtime fees (Hava-İş, 2019), accommodation fees paid to cockpit and cabin crews, the fees paid to the accommodation facilities, and the transfer fees between facilities and the airport (Durmuş & Öztürk, 2014). The Crew Planning Department assumes one of the most important tasks in this regard (Üzülmez & Çalışkan, 2018). In order to perform the most effective flight operations at the lowest cost, the crew Planning department is engaged in two consecutive activities that complement each other: Crew Pairing and Crew Rostering (Barnhart et al., 2003). The crew pairing addresses the problem of finding a flight sequence, while the crew rostering focuses on the problem of determining the cockpit and cabin crews to be assigned to these flight sequences (Tekiner et al., 2009).

According to the business model, the expectations from crew planning departments and their focus points may differ. In the study, semi-structured interviews were carried out with the managers and employees of the crew planning departments

of a low-cost airline company and a full-service provider, which operates as Turkey's flag carrier airline, and the similarities and differences that emerge according to the adopted business model were studied.

2. Conceptual Framework

2.1. Business Models in the Airline Industry

The airline business models that comply with the competitive strategies introduced by Porter, 1980 can generally be discussed in five classes: the full-service provider, low-cost, regional, charter, and air taxi business models (Koch, 2010). In accordance with the differentiation strategy, full-service airline business model offers the highest level of service for different passenger classes (Özkan, 2019). In this business model, high costs are incurred in exchange for carrying passengers with high ticket fees (Mutlu & Sertoğlu, 2018).

The full-service provider airline business model is mostly adopted by large airline companies operating on multiple continents. They have a mixed fleet structure, which usually consists of wide and narrow-body aircraft (Önen, 2018). Due to *Flight and Duty Time Limitations and Rest Requirements* (FTL) instruction and the variety of services offered on-board, they employ more than the minimum number of cockpit and cabin crew members (Steine et al., 2009). This business model has specific features such as maintaining operations in primary airports (Wit & Zuidberg, 2012), operating connected flights using certain airports as a Hub & Spoke center (Erdoğan, 2018) and establishing low-cost airline business subsidiaries.

Low-cost airlines usually provide services only to economy class passengers with a uniform fleet of narrow-body aircraft (Eroğlu, 2015). In accordance with the cost leadership strategy, there is a constant effort to develop mitigating practices on all items of expenses (Dinçer, 2013). Low-cost airline companies prefer secondary airports to procure the services offered by the airport at more affordable rates (Şen & Akpur, 2015). As the flight density of secondary airports is less, the ground times are kept to a minimum to carry out a more frequent number of flights (Erdoğan, 2018). In addition, it is aimed to control the costs by assigning the lowest number of the cockpit crew and cabin crew allowed (Shaw, 2007).

Regional airlines, on the other hand, usually use the focus strategy. They try to avoid the severity of competition by operating flights with regional jets with seats usually less than 100, or turbo props aircrafts to destinations where other airline companies do not operate flights. Some regional airlines can generate revenue by moving passengers from small cities to Hub & Spoke centers on behalf of full-service airline businesses (Bieger & Agosti, 2005). In this business model, since the total number of flights, aircraft, flights, and cabin crew is smaller than in other business models, expense control activities are mostly based on cockpit and cabin crew fees.

Charter airlines adopt a focused cost leadership strategy (Gerede, 2015). In this business model, it is aimed to achieve the maximum number of flights by selling seats to tour operators in blocks (Aldemir, 2018). Agreements are most often concluded before the holiday season (Balta & Altıntaş, n.d.). Since the cockpit and cabin crews to be employed are usually seasonally determined, options such as unpaid leave or dismissal may be on the agenda during periods when the need decreases (Jull, 2016). In general, the demand for charter flights is low compared to other airline business models.

Adopting a focused differentiation strategy, Air Taxi businesses offer a small number of passengers the opportunity to travel with high quality and flexible hours through business jets in their fleet (Wensveen, 2007). The share of business jets leased by passengers who can pay high fares in the airline industry is increasing regularly (Vincent, 2020). There may be sudden changes in the schedules of cockpit and cabin crews as air taxi companies offer flexible flight hours to passengers. Effective flight planning is required to keep these changes under control, which may lead to an increase in overtime and accommodation fees.

Although there are differences in practice according to the adopted business model, the crew planning department is primarily responsible for ensuring that the operations of airline companies are carried out smoothly and at the lowest possible costs.

2.2. Crew Planning Department

Crew planning activity is a complex and dynamic process consisting of various tasks such as calculating flight duty period (FDP), duty period (DP), and rest time of cockpit and cabin crew members (Akyurt & Yaşlıoğlu, 2018), recording professional health controls, annual leave, training, and considering the circumstances that hinder the flight of the members (Akyurt & Yaşlıoğlu, 2018; Ernst et al., 2004). Crew formation activities include cockpit and cabin crew members and may differ depending on the structure of the industry, the size of the company, and the intended purposes.

The cockpit crew members consist of at least one pilot in command and a co-pilot. The pilot in command is a person who is responsible for the entire operation of the aircraft during flight duty and is licensed by an authorized civil aviation organization of the relevant aircraft type (SHGM, 2016). The cabin crew consists of cabin attendants licensed by an authorized civil aviation organization and who have successfully completed the airline's training, at least one of whom is a cabin chief. The cabin chief is appointed from cabin attendants who have at least 1 year of cabin attendant experience and have successfully completed their training and control flights (SHGM, 2019).

The body size of the aircraft, the number of seats, the number of emergency exit doors (SHGM, 2002) and the FTL instruction issued by the civil aviation organizations of the countries can cause significant variations in the formation of cockpit and cabin crews (EASA, 2017). However, the procedures of the airline company, the earned rights by collective bargaining agreements, the existence of connecting flights, aircraft parking capacity of airports, safety, security, and comfort conditions in the accommodation airports, and differences in service according to the business model adopted by the airline may also be effective in this regard.

In addition, the crew planning department has important additional tasks such as rostering cockpit and cabin crew to specific flights they prefer, scheduling annual permits to the dates they request, and balancing the distribution of the number of monthly and annual flights and the number of airports for flights and accommodation. It is aimed to maintain labor peace and increase motivation through these additional tasks (Barnhart et al., 2003).

2.2.1. Crew Pairing

The crew pairing activity usually refers to the scheduling of a series of flight duties that end where they started. When scheduling flight sequences, first of all, the maximum FDP, flight time (FT), and DP determined by civil aviation organizations for crew members are taken into account. FDP

covers a period that begins when a flight crew member reports his/her arrival for flight duty and ends when the aircraft's engines are shut down after the last flight (SHGM, 2018). FT is a period that starts with the first movement of the aircraft for each flight and ends with the shutdown of the engines at the end of the flight (SHGM, 2017). DP refers to the period between the arrival of crew members at the designated time at the place of duty and decommissioning from all duties at the end of the flight (Erkayman, 2013).

The procedures of the airline companies and/or the procedures that can be arranged in favor of the crew members as a result of trade union activities can have an effect on FDP, FT, and DP. There may be differences in the determination of these periods in two airline companies with different operational conditions, as well as the differences in the periods determined for different bases of a single airline company (Hava-İş, 2019a).

Many airlines plan connecting flights for destinations where passengers cannot go directly (Gerede, 2015). Passengers collected at major airports designated as Hub & Spoke centers are distributed to a wide range of flight destinations through connected flights. In order for connected flights to be carried out without delay, it is necessary to plan the flight sequences with extreme caution (Medard & Sawhney, 2007).

Each airport has a certain capacity, and in order for airlines to use airport services, they must have obtained a permit called SLOT prior to the flight (İnan, 2020). SLOT refers to the allocation of the time required to the airline company usually for a fee, for the flight of the aircraft from the relevant airport (Cengiz, 2010). Availability of SLOT dependent on the airport capacity is important, especially in order to meet the additional flight requests of airline companies and to evaluate the feasibility of new lines (Battal et al., 2006).

Crew planning departments work in cooperation with various departments to prevent possible delays by effectively planning the time that aircraft spend on the ground. For example, the maintenance activities of the technical department have an important place in the effective use of the time spent on the ground. Maintenance operations, which are often audited by authorized civil aviation organizations (SHGM, 2008), can be scheduled between flights or when the aircraft is parked during an overnight stay (Gerede, 2017).

Airline companies cannot generate revenue during the time that planes are on the ground. Therefore, the crew planning departments attempt to create flight sequences that allow for the highest number of flights. When creating flight sequences, planners should determine at which airport the aircraft will spend the parking time taking into account the connected flights and where the next flight series will start, check the availability of parking at the relevant airport, coordinate with the technical department should be ensured if there are planned maintenance procedures during the parking period, and ensure the safety and comfort of the crew staying at the airport or in a suitable facility. An extremely complex structure arises when the coordination of these activities is carried out for a large number of aircrafts, flights, and crews. After the completion of the crew pairing activities through the flight sequences, the crew planning department starts the crew rostering, which is also very challenging the second problematic issue.

2.2.2. Crew Rostering

Crew rostering activity refers to the creation of individual programs of the crew members taking into account the criteria of aircraft type, FTL, airline procedures, trade union requirements, and a balanced distribution of duties. In order to create individual programs, the number of crew members required for each type of aircraft must first be determined. The number of crew members varies according to the aircraft size. Civil aviation organizations generally require that at least 1 cabin crew member is on board for every 50 passenger seats and/or each emergency exit door (SHGM, 2002). The minimum number of cabin crew members increases in wide-body aircraft types due to the seat capacity and the high number emergency exit doors. In addition, there must be at least 2 pilots on the passenger aircraft, one of whom is the pilot in command (Lim at al., 2017). However, with the inclusion of flight engineers in the cockpit crew in some types of wide-body aircraft, the number of flight crew members may increase (EASA, 2019).

Another important factor that should be taken into account when determining the number of cockpit and cabin crew members is the FTL instruction. The instruction details many practices, especially on FDP, FT, and DP; such as, duty start times, number of flights, situations and requirements where the maximum duty period can be extended, in-flight and post-flight rest times, transitions between consecutive day and night duties (SHGM, 2018). Factors such as technical disruptions during the flight, the intensity of the airport, deteriorating health condition of the passenger, and adverse weather conditions can cause delays (Serdar, 2019). In such unforeseen circumstances, FDP may be extended and the Extended Maximum Daily FDP chart may be used within certain restrictions. In addition, if certain conditions are met, extended FDP can be applied for flights with a planned departure from the main base. In this case, cockpit and cabin crews should be provided with in-flight rest and at least one additional crew member should be assigned (EASA, 2017).

The rest period allocated for the crew members at the end of the flight should be at least 12 hours or as much as the previous FDP, depending on which one is longer. Outside the main base, this duration is applied as 10 hours or as the previous FDP (SHGM, 2018). If transition from a night flight to an early day flight is planned, then at least one-night rest should be allowed between the two duties, and at least 60 hours of rest should be planned if four or more consecutive night duties are assigned (EASA, 2017). These restrictions increase the number of crews necessary to complete flight sequences.

For the crew planning department, the airline's procedures are important, in addition to the FTL instruction, in the preparation of flight schedules. Scheduling more than the minimum number of cabin crew on certain flights, having cockpit and cabin crew members with different ratings, paid and unpaid leave periods, and special requests can affect the activities of the crew planning department.

If cockpit and cabin crews are unionized, many rules of FTL instruction and operating procedures that form the basis for the preparation of flight schedules can be changed in favor of the personnel (Akyurt & Yaşlıoğlu, 2018). Therefore, the activities of the crew planning department may differ between airline companies depending on whether the personnel are represented by a union or not. Determining the number of annual leaves, crew rostering of extra members for short flights, and FDP, FT, DPs, determined specifically in the collective bargaining agreement, in favor of employees affects crew rostering activities (Hava-İş, 2019).

The appointment of cockpit and cabin crews to the long consecutive duties, night flights, or numerous accommodation

tasks can increase the level of fatigue (SHGM, 2018). If some of the crew members consistently find their flight schedules to be more exhausting than other members, labor peace may be disturbed. This condition, which may create a decrease in the level of job satisfaction and motivation, may cause a decrease in service quality, and have a negative impact on the profitability and sustainability of the airline business (Yangınlar & Kabul, 2020).

The crew planning department performs an important task to ensure labor peace by preparing balanced flight schedules and thus increasing the competitiveness of the airline company. Activities such as granting cockpit and cabin crews the right to choose a certain number of flights, taking into account their preferred annual leave dates, allowing free days on birthdays and anniversaries are among the methods used by crew planning departments to increase job satisfaction and motivation. The crew planning departments carry out crew rostering activities by considering all these factors.

3. Research Purpose, Importance, And Problem

The study aims to contribute to the literature and relevant stakeholders in the industry by comparing the crew planning activities of two airline companies that adopt different competitive strategies in Turkey.

In the literature, there are no studies investigating the differences between the crew planning departments within the scope of the competitive strategies adopted by airline companies. It is important that the crew planning activities that have a significant impact on the profitability and sustainability of airline companies are investigated in-depth for a contribution to the literature.

The majority of the human resources employed in airline companies are cockpit and cabin crews. The research problem is to reveal the crew planning activities applied for the effective use of human resources in airline companies that adopt different competitive strategies.

4. Research Method

The research was conducted at two airlines operating in Turkey in 2019 by adopting qualitative methods. For the purpose of explaining the problem in-depth in the qualitative research method, the information collected from the relevant people is analyzed by creating themes that lead from the specific to the general (Creswell, 2007). The use of the purposive sampling technique together with the qualitative research method makes it possible to obtain more information about the subject being investigated (Curtisa, 2000).

The research participants consisted of managers and employees of the crew planning departments of two airline companies. Firstly, the crew planning department managers of each airline were interviewed within the scope of the research. Based on the information received from the department managers, department employees with at least 3 years of professional experience in the relevant airline were identified and included in the study. The number of participants is a total of 10 individuals, consisting of 5 individuals for each airline, including managers of the crew planning department of the two airlines. Semi-structured interviews were conducted with the participants. The interview technique allows direct access to the feelings and beliefs of the people participating in the research (Patton, 2014). The semi-structured interview technique is often preferred since it provides flexibility for the researcher (Tümüklü, 2000). An in-depth interview is possible with the prepared interview questions that can have a new direction according to the responses given by the participants (Toprakçı & Aksoy, 2019; Ekiz, 2003).

The research questions were prepared by considering an article that two of the authors had previously published about crew planning management and other studies available in the literature, such as DGCA, EASA publications. In addition, while preparing the interview questions, the questions that the authors obtained from the literature in the previous article were developed by taking the suggestions of two airline crew planning managers. The participants of the study were informed about the subject matter, the use of audio recording devices, and their right to get their expressions removed from the recordings if they wish. The participants were informed about their confidentiality by stating that codes will be used in the manuscript, instead of their names, and the interviews were conducted in places where they feel free to express themselves clearly to collect the most data possible. T1, T2, T3, T4, T5 codes were used for the names of individuals working in the crew planning department of the flag carrier airline, and the P1, P2, P3, P4, P5 codes were used instead of the names of employees of the crew planning department of the low-cost airline company.

5. Research Data Analysis, And Findings

By assigning codes to the collected data, their relationships with each other were determined and themes were created accordingly. After the activities of the crew planning departments of the two airlines were addressed separately, the differences between them were analyzed and interpreted.

5.1 Turkish Flag Carrier Crew Scheduling Department

Eighteen codes were identified as a result of the data obtained through semi-structured interviews conducted with the managers and employees of the crew planning department of the full-service airline operating as a flag carrier in Turkey. The codes were found to be grouped under 7 themes: business model, communication and reporting, aircraft type, airline procedures, trade union, fair and equitable distribution of duties, and FTL.

There are three codes that group under the business model theme: the *'separation of senior (experienced) and junior (inexperienced)', 'standby crew', and 'accommodation'.*

- **Separation of senior and junior:** Professional experience and language competencies are considered in the formation of cabin crew with the idea that maintaining the quality of service at the highest possible level will provide a competitive advantage. In addition, cabin and cockpit crews were classified according to the experience criterion in order to increase flight safety. If there is a junior second pilot in the cockpit crew, the pilot in command must be experienced, or vice versa, a senior second pilot is assigned for the pilot who is new as a pilot in command.
- **Standby crew:** Published flight schedules may be changed during the month for many reasons such as cancellation, delay, divert, compassionate and sick leaves. Business model-specific activities such as classifying crews by providing different training according to the type of aircraft and scheduling more people for flights to priority points of importance, such as the prestigious line, make it difficult to plan standby crews.

- **Accommodations:** Accommodations increase the costs incurred by airline companies. Subsistence paid to crew members, hotel, and transfer fees are important expense items. In order to reduce the number of night layovers, short flights are combined when scheduling the flight sequences. Due to the FDP limits, it is seen as an important crew scheduling activity to plan four short flights as a flight sequence and reduce costs instead of resting the crews outside the main base by giving one short flight after two long flights. *"The scheduling of four-legged flights is not welcomed by the crews, but it is a very effective method in terms of reducing costs,"* said participant T2 on this issue. The term leg is used for each take-off.

Two codes were grouped under the theme of communication and reporting: *'communication'* and *'reporting.*

- **Communication:** The preferred method of communication in the flag carrier airline is the use of electronic mail. Although there is no rule that prevents communication by phone, it takes an effort to access. Prior to the face-to-face interviews with the relevant departments for various reasons, an appointment is requested via electronic forms. Permission must be granted by the responsible authorities of the affiliated department in order to conduct interviews on issues related to different departments. The crew scheduling department needs to work in cooperation with various departments. This vertical communication can be an obstacle in situations that require speed.
- **Reporting:** The reporting culture is quite common in the flag carrier airline. It is expected that all conflicts between employees will be reported, especially in cases related to safety. Particularly, to follow the problems experienced among the cabin crew members, it is requested by the cabin crew department to plan face-to-face meetings under the name of office preoccupation. This increases the workload of the crew planning department and may cause flight schedules to be disrupted.

There are two codes that group under the aircraft type theme: *'variety of aircraft types'* and *'rostering by type'*.

- **Variety of aircraft types:** The flag carrier airline has a large number of narrow and wide-body aircraft in its fleet. Considering the types of aircraft with similar usage characteristics as a single type, cockpit crews only be rostered in one aircraft type, whereas cabin crews can be rostered in three aircraft types. For this reason, it is not possible for cabin crews to take part in some of the aircraft types in the fleet. Participant T1 expressed her opinion on this issue: *We have to pay attention to the classes when assigning tasks. For instance, mistakenly rostering a Y-Class cabin chief licensed for an Airbus 330/350, in the place* of *a V-Class cabin chief licensed for a B777/787 will disrupt the operation. Due to this and many similar classifications, our work becomes complicated.*
- **Rostering by type:** Especially when a new aircraft type is added to the fleet, first of all, the lines, the number, and frequency of flights with this aircraft type are taken into account. Within the scope of these criteria, the crew need is determined and type training is planned. In addition, the annual mandatory recurrent training dates of the crews are planned by considering the number of crews required at that period in the aircraft type.

There are three codes that are grouped under the theme of the Airline Procedures: *'income and expense balance'*, *'number of flight legs'*, and *'employee satisfaction'*

- **Balance of income and expenses:** Civil aviation organizations determine only the minimum number of the cockpit crew and cabin crew, but do not state a maximum number. The flag carrier airline schedules the least possible number of crew members for flights without sacrificing quality. On the other hand, in order to maintain operations at the lowest cost, many factors are taken into account, such as which airport the aircraft will spend long parking periods in, connecting flights, and technical requirements. Participant T3 said, *"We don't just perform a grouping process when scheduling flight sequences. The number of connecting flights is very large, which leads to a complex scheduling process. We are expected to perform operations at the least cost, but there are factors that increase the complexity of the process such as airport availability, SLOT permits, and the maintenance time of the aircraft,"* he said, emphasizing the difficulties of the planning work.
- **Number of flight legs:** The FTL instruction specifies how many take-offs can be performed during a flight duty, depending on the type of aircraft, the start time of the duty, and the total duty time. However, to increase safety in the flag carrier airline and not to wear down the human resources at hand, the maximum number of flight legs that are performed within a duty period is limited with four. Participant T1 stated the following regarding this issue: *"The maximum number of flights per crew in our company is 4 legs. While other airlines can plan 5-legged flights for each cockpit and cabin crew, the fact that our application of procedures not allowing us to plan more than 4-legged flights, has a negative impact on costs and increases the number of crew members needed. My opinion is that it has an important contribution in terms of working conditions and safety."*
- **Employee satisfaction:** Employee satisfaction is taken into consideration when crew planning activities are carried out in the flag carrier airline. In this context, it is aimed to share the workload equally in the cockpit and cabin crew rosters.

There are four codes under the trade union theme: *'24-hour rule'*, *'overtime'*, *'rest periods'*, and *'fixed off days'*.

- **24-hour rule:** The 24-hour rule is a restriction that is applied only to the flag carrier airline in Turkey because of trade union rights. According to this rule, the planned duties of crew members can be changed if they are notified at least 24 hours in advance. For example, T1 stated the importance of the issue to them by saying "Since there is a rule that makes it difficult to assign crew members for sudden flight changes, it causes the planning more crew members to standby duties and increasing our workload".
- **Overtime:** Flight crew members are entitled to overtime pay for each hour when they work over 70 flight hours per month, while cabin crew members are entitled to this right when they exceed 80 flight hours per month. Overtime pays should be carefully planned within the scope of expense management when preparing flight schedules. There is great importance attached to this issue since it will be a loss for the airline to enforce overtime work for some people when there are enough crews at hand.
- **Rest periods:** The rest periods in the flag carrier airline differ according to the FTL instruction. According to the

collective bargaining agreement, the minimum rest period to be given at the end of a flight duty is calculated by three different methods. The calculation of the rest period is carried out by considering twice the FT, a minimum of 12 hours, or FDP, whichever is longer.

- **Fixed off days:** According to the FTL instruction, cockpit and cabin crews should be provided with 96 free days per year. Seven off-days in a month should be given, and the remaining 12 off-days should be distributed at available times. Trade union rights require that 8 fixed off-days must be given per month. In addition, 8 fixed off-days should be allocated in the 2+2+2+1+1 form. As participant T5 said, *"Fixed off-days are a restrictive criterion for us. Sometimes we find it difficult to find a crew in case of need, and we cannot assign people, who have finished their rest period, to duty since they are on their fixed free off-days."*

The codes that are grouped under the theme of fair and equitable distribution of duties include *'person-independent pairings'* and *'off-day requests'*. In accordance with the first of these codes, the pairings are made independent of people when planning the flight schedules.

- **Person-independent pairings:** It is emphasized that each crew member is evaluated equally and efforts are made to issue a fair and equitable schedule in which the seniority of crew members in the airline company and/or personal relationships with crew planning department employees are not involved. For example, T3 explained the importance attached by saying, *"The work we do is capable of affecting the people's lives, and therefore we strive to ensure to issue the fairest possible schedule."*
- **Off-day requests:** Cockpit and cabin crews at the flag carrier airline can request eight off-days and four time-offs of 8 hours for the next month between the 1st and 10th day of the current month. In this context, participant T4 said, *"We are making a great effort to fulfill the wishes of the crews when preparing the programs. We have a priority to satisfy requests as much as possible. We try to create a balance on a monthly and sometimes yearly basis by treating everyone equally fairly."*

There are two codes that group under the FTL theme: *'civil aviation authority audits'* and *'new rules'*.

- **Civil aviation authority audits:**The participants stated that the Directorate General of Civil Aviation **(DGCA)** inspects the crew planning activities through an electronic system, that breaking the FTL instruction imposes financial obligations and is important for the performance of department employees.
- **New rules:** On January 1st, 2019, the FTL instruction was issued with significant changes in practice. Being a much more detailed instruction than before has led to an extension of the time for crew planning employees and cockpit and cabin crews to learn and get used to the new rules. In this regard, training documents have been prepared and crew members have been informed with detailed examples. The instruction, which has been in force for a short time, is supported by the operating procedures to adapt it to the operational structure of the airline. Participant T5 said, *"When the FTL instruction has entered into force, we had to provide information for the crew members to adapt.* Yet, we still receive objections regarding inappropriate duty assignments from crew members, and we have to explain to them that we have not made wrong planning according to the new rules.

5.2 Low-Cost Airline Crew Planning Department

Twenty codes were determined as a result of interviews with managers and employees of the crew planning department of the low-cost airline. It was observed that the codes are grouped under 7 themes: business model, safety management, aircraft type, airline procedures, FTL, communication and reporting, fair and equitable distribution of duties.

There are four codes that group under the business model theme: *'turnaround time, 'base', 'accommodation'*, and the *'number of employees'*.

- **Turnaround times:** Turnaround time up to 25 minutes on domestic flights and up to 40 minutes on international flights can be planned in a low-cost airline. These periods are usually 1 hour or more in full-service airline companies. A quick operation cycle is important to increase revenues by scheduling more frequent flights.
- **Base:** Different bases have been established in order to minimize the accommodation and transfer fees paid to the crew members at the low-cost airline. There are six bases: Istanbul (SAW), Antalya (AYT), Izmir (ADB), Ankara (ESB), Adana (ADA), and Lefkoşa (ECN). Cockpit and cabin crews are offered to work at one of these bases provided that they organize their own accommodation, and requests within the quota are met. The crew planning department makes its plans by recalculating the number of captain pilots, co-pilots, cabin chiefs, and cabin attendants on the bases on a monthly basis. Regarding the bases, *"We are trying to plan all the bases from a single center. Bases other than SAW are being run with fewer crew members. This is advantageous both for the company and for us. Not trying to solve the accommodation problem reduces our workload and keeps the business profitable. The major problem that can be experienced at the bases can be experienced in the* planning *of standby crew,"* said participant P2.
- **Accommodation:** When scheduling flight sequences, the low-cost airline works with the unit that makes hotel adjustments. It is important that accommodation planning is carried out at a minimum level in terms of the hotel fees and subsistence paid to crew members, hotel, and transfer fees are important expense items paid. If there is an increase in hotel expenses at the end of the year, more careful planning needs to be done for the next year. On this issue, *"Expense control is quite important in our business. We are expected to keep costs down as much as possible. We are trying not to deviate from the annual forecasts by carrying out constant checks on hotel fees and charges,"* said participant P3.
- **Number of employees:** The low-cost airline business model conducts operations with the fewest possible employees. Therefore, both the number of employees in the crew planning department and the number of cockpit and cabin crew are less than in other business models. On this issue, *"We have a significant workload, we carry out* planning *activities with a small number of people. In addition, the number of crews is kept to a minimum. We are scheduling standby crew with a limited number of crew members at hand, and we have to disrupt all the plans we have made in unexpected situations, such as adverse weather conditions, and the number of aircraft failures greater than expected,"* said the participant P2.

There are three codes that are grouped under the theme of safety management: *'safety department', 'fatigue levels'*, and

'separation of senior and junior'.

- **Safety department:** Employees of low-cost airlines do not have the right to enter into a collective bargaining agreement. Instead, the safety department provides the management with suggestions about the FT, FDP, and DPs of cockpit and cabin crews, as well as rest and off-day periods within the scope of increasing flight safety.
- **Fatigue levels:** The safety department can follow the fatigue levels of the crew members through algorithms and instruct the crew planning department to make the necessary corrections.
- **Separation senior and Junior:** The safety department pays special attention to the separation between senior and junior when forming a cabin crew. Cabin crew classifications were made as cabin chief, 1st cabin attendant (CA1), 2nd cabin attendant (CA2), and 3rd cabin attendant (CA3). The cabin chief is responsible for the front left door, CA1 is responsible for the rear left, CA2 is responsible for the front right, and CA3 is responsible for the rear right door. The safety department aims to establish equality in terms of experience in front of and behind the aircraft with this assignment structure.

There are two codes under the theme of aircraft type: the *'variety of aircraft types'* and *'rostering by type'*.

- **Variety of aircraft types:** Low-cost airlines usually operate with a uniform fleet of aircraft. Thus, it is aimed to reduce training costs, maintenance, and repair costs, as well as to use the crews effectively. The low-cost airline has three types of aircraft: B737, A320, and A321. The cockpit crew is divided into two classes as a Boeing and an Airbus crew. Since A320 aircraft and A321 aircraft are of a similar type, the Airbus crew can take part in both types of aircraft. Since they can be used in three types of aircraft, cabin crews can be utilized quite effectively. Participant P1 said, *"Our workload has increased as when we started scheduling for two different aircraft types. In the first stage, we were able to plan training for a small number of cabin crews, but over time, all cabin crews were certified. As the training of the cockpit crews took longer, we had a difficult process. It is still difficult to find a cockpit crew due to the type differences at some times."*
- **Rostering by type:** The use of more than one type of aircraft in a flight sequence disrupts the unity of the cockpit and cabin crew. In low-cost airline companies, crew rostering activities usually begin with the selection of a cockpit crew, and then they are combined with the cabin crew to ensure that they act together during the duty period. If two aircraft types are used for reasons such as maintenance requirements, fuel-saving on four-legged flights, the pairing of cockpit and cabin crews is disrupted, and the workload of the crew planning department increases.

The codes that are grouped under the airline procedures are *'restriction of residence'*, *'part-time work'*, *'decision authority'*, and the *'10 hours rule'*.

- **Restriction of residence:** Since the low-cost airline does not have a collective bargaining agreement, the most important restriction following the FTL instruction is the airline procedures. It is aimed to control the transfer costs by obliging the SAW base crews to reside on the Anatolian side of Istanbul. Vehicle planning is carried out for the residence addresses of the cockpit and cabin crews for the transportation to and from their duties.
- **Part-time work:** The low-cost airline offers part-time work to cockpit and cabin crews. The crew planning department informs the flight operations and cabin crew departments about the number of crew members needed in respective months. The crew members who are on a part-time contract are employed full-time in one of the months between July and September. The option of working part-time is offered to cockpit crews as a 15-day unpaid leave, and cabin crew as a 7-day unpaid leave.
- **Decision authority:** The crew planning department has the right to have a say in scheduling such as annual leave and holiday leaves. The crew planning department prepares calendars for annual leave scheduling, taking into account the need for cockpit and cabin crews, and allows crew members to make requests for a total of three different time frames. The flag carrier airline, on the other hand, offers a choice of 12 different time frames for the annual leave request.
- **10 hours rule:** Changes in the schedules of cockpit and cabin crews should be notified at least 10 hours before the start of the duty. About this issue, *"We try not to disrupt the programs we issued as much as possible. Disruption of a person's schedule requires us to reschedule many people's schedules. We make changes to the programs in case of necessity for reasons such as additional flights, and health reports. We need to inform about the change we have made at least 10 hours before the flight,"* said participant P5.

The codes that are grouped under the FTL theme include *'civil aviation authority audits'* *'number of flight legs'*, and *'rest requirements'*.

- **Civil aviation authority audits (DGCA AUDITS):** In DCGA audits, detection of practices contrary to the FTL instruction may result in administrative and financial sanctions. In this regard, *"With the implementation of the FTL instruction, the frequency of audits has increased. Remote controls are carried out by means of technology. In case of non-compliance, fines can be imposed on the company or measures can be taken to stop the flight,"* said participant P4, stressing the importance of the issue.
- **Number of flight legs:** Flight sequences are mostly tried to be planned as 4-legged. In order for the crew to reach the main base during the returns from the accommodation airports, 5-legged flight sequences can be scheduled provided that the last leg is off-duty (deadhead crew).
- **Rest requirements:** The in-flight rest requirements have been tightened by the FTL instruction. In order to benefit from the extended maximum FDP right with the additional crew, one of the three rest facilities with different characteristics must be offered. The maximum FDP varies depending on the rest offered. Aircraft in the low-cost airline's fleet can take advantage of the extended maximum FDP only to a certain extent since they provide a limited rest in terms of the number of seats, placement, and reclining angle of the seats.

The codes that are grouped around the communication and reporting theme are the *'communication' and 'reporting'*.

- **Communication:** Communication is carried out in a horizontal direction, intensively. The preferred way of communication is the use of electronic mail. The use of phones is accepted in order to increase the speed of communication in emergencies. The impact of bureaucratic obstacles is attempted to be alleviated

- through horizontal
- communication.
- **Reporting:** The low-cost airline company is given priority to employee satisfaction, and their commitment is tried to be increased by making them feel like family members. For example, the reporting of personal conflicts to the management are not welcome, this may be perceived as disturbing the peace in such family environment. Unlike the flag carrier airline, the reporting culture covers only circumstances related to safety and business development proposals.

The codes that are grouped under the theme of fair and equitable distribution of duties are the *'person-independent pairings'*, and *'leg fee'*.

- **Person-independent pairings:** ID codes are used instead of names when scheduling the programs. After issuing the rosters, they are only changed when a crew member is absent, has a medical report, or if there are any operational reasons. In this case, the interested parties are informed about the reason for the change.
- **Leg fee:** A low-cost airline has a fee item calculated per flight and expressed as a leg fee. Leg fees vary depending on the duration of the flight. The established fees increase by 50% in the summer season. It is important that the flight schedules are planned in a balanced manner in terms of due fares.

5.3 Comparative Analysis of Crew Planning Departments of Flag Carrier Airlines and Low-Cost Airlines

The themes and codes determined for the crew planning departments of the two airlines were created considering the frequency of the statements emphasized by the participants in their responses to the interview questions and the relationships of these themes with each other. Table 1 shows the themes, codes, and repetition frequencies obtained for the flag carrier airline and the low-cost airline.

Table.1 Themes, Codes, And Frequencies of The Flag Carrier Airline And The Low-Cost Airline.

Themes of Flag Carrier Airline	Codes of Flag Carrier Airline	Frequencies
Business Model	Separation of Senior and Junior	3
	Standby Crew	5
	Accommodation	4
Aircraft Type	Variety of Types	4
	Rostering by Type	6
Airline Procedures	Income and Expense Balance	2
	Number of Flight Legs	5
	Employee Satisfaction	3
Communication and Reporting	Communication	4
	Reporting	5
FTL	Civil Aviation Authority Audits	3
	New Rules	4
Trade Union	24-Hour Rule	6
	Rest Periods	2
	Fixed Off Days	3
	Overtime	4
Fair and Equitable Distribution of Duties	Person-Independent Parings	3
	Off-Day Requests	5
Themes of Low-Cost Airline	**Codes of Low-Cost Airline**	**Frequencies**
Business Model	Turnaround Time	5
	Accommodation	4
	Base	5
	Number of Employees	4
Aircraft Type	Variety of Types	4
	Rostering by Type	4
	Restriction of Residence	3
Airline Procedures	Part-Time Work	6
	Decision Authority	5
	10 Hours Rule	4
Communication and Reporting	Communication	3
	Reporting	2
Safety Management	Safety Department	4
	Fatigue Levels	5
FTL	Separation of Senior and Junior	5
	Civil Aviation Authority Audits	4
	Number of Flight Legs	3
	Rest Requirements	6
Fair and Equitable Distribution of Duties	Person-Independent Pairings	3
	Leg Fee	4

As shown in Table 1, the themes of the crew planning departments of the two airlines are similar, but the issues they consider important to achieve their goals differ. The only difference between the themes identified is the fact that low-cost airline employees do not have the right to make a collective bargaining agreement. The fact that similar codes

group under different themes is due to the different priorities caused by the procedures, safety management practices, and business models of the two airlines.

6. Discussion

The studied flag carrier airline and the low-cost airline are the leading airline companies in Turkey. The flag carrier airline ranks first in terms of fleet size, the number of passengers carried, and employed personnel, while the low-cost airline ranks second. The flag carrier airline adopts a full-service provider business model in line with the differentiation strategy, while the low-cost airline adopts the cost leadership strategy.

Competition strategies may cause practices specific to different organizational structures, organizational culture, and business models. Different competition strategies are adopted in order to gain a competitive advantage by dividing the market in the airline industry where competition severity is high. However, airline companies may increase the severity of competition by entering each other's market sections for reasons such as saturation of occupancy rates on the lines they operate. For example, while the flag carrier airline operating in Turkey and the low-cost airline initially offered services to different market segments, today they compete with each other by scheduling simultaneous flights to many destinations.

The fact that full-service airline companies pay attention to expense management as much as low-cost airlines may enable them to gain a competitive advantage against their competitors. The two major items of expenses of airline companies are fuel costs and personnel wages, respectively. The crew planning department strives to ensure that the company achieves the highest efficiency using the resources at its disposal by planning the schedules of cockpit and cabin crews, which have a significant share of personnel wages, as well as scheduling the flight sequences of aircraft in the fleet. For this purpose, crew pairing and crew rostering activities are successively performing to reach the targets.

Cost management may be counted among the issues that are important for the effective execution of flight planning activities. In addition, these flight planning activities should be in compliance with criteria such as the airline's business model, fleet structure, instructions of civil aviation organizations, communication structure, organizational culture, airline procedures, trade union rights, fair and equitable distribution of duties.

Flag carrier airline companies usually strive to differentiate by keeping the quality of service high. Low-cost airlines generally strive to keep the perception of quality lower level than flag carrier airlines and aim to incur the lowest possible costs on all expense items. Therefore, the amount resources allocated by the flag carrier airline to the crew planning department may be more than the low-cost airline. For example, even if the aircraft is similar to the low-cost airline in terms of the number and frequency of flights, the number of the cockpit crew and cabin crew employed in the flag carrier airline is usually higher due to the expectation of a higher quality. In addition, there may be advantages such as the number of accommodated duties planned, the conclusion of accommodation agreements with multiple hotels within the same city, and the faster fulfillment of requests due to the more intensive use of airport facilities. From this point of view, it is possible to conclude that the activities of the crew planning department of the flag carrier airline are less challenging than the activities of the crew planning department of the low-cost airline. Although an FSC might have more resources, its crew scheduling problem is almost always more difficult than that of an LCC because of extensive use of the hub and spoke network structure which is a tool for maximizing connections. However, in the light of the data obtained in the research, it was seen that the crew planning departments of the flag-carrier airline and the low-cost airline prioritized different concepts when attempting to achieve similar goals and had to deal with different challenges in both business models.

Within the scope of the business model of the flag carrier airline crew planning department, attention is paid to the conditions for the coexistence of senior and junior crew members for flights in order to provide high-level quality service in full-service airline companies. The low-cost airline aims to increase safety by identifying the areas where senior and junior cabin crew members are responsible on the plane.

The crew planning department of the low-cost airline tries to keep the number of accommodations of the cockpit and cabin crews to a minimum in accordance with its philosophy of taking mitigating measures on all items of expenses within the scope of its business model. In this way, it is aimed to control the hotel and transfer fees, aircraft parking rentals, and subsistence paid to the crew members. Flag carrier airline considers the same practice within the scope of airline procedures. In addition, the high number of connected flights of full-service airline companies is effective in this decision.

Within the scope of the procedures of the flag carrier airline, short-term flights are combined to reduce the number of accommodations, while on the other hand, as few four-legged flights as possible are planned to ensure safety and not to burden the human resources at hand. In the low-cost airline, on the other hand, the same application is covered within the scope of FTL and safety management. Whereas attempts are made to make the most flights with the least number of crews, changes and interventions are made to the crew planning within the scope of safety management based on the analyses towards fatigue management.

Both airlines emphasized that DCGA inspections have increased under the FTL instruction. It is of approximately the same importance that the work performed is monitored remotely with frequent intervals by an authorized organization. Similarly, the degree of importance attached to planning the most objective flight schedule possible by making pairings independent of people within the scope of fair and equitable duty distribution is similar.

Many of the different practices seen between the flag carrier airline and the low-cost airline's crew planning departments are caused by the trade union activities. Since the majority of the flag carrier airline's staff are trade union members, they are able to conclude a collective bargaining agreement. However, in the low-cost airline there are no collective bargaining rights. Therefore, the rule of notification of a change in duty at least 24 hours before the start of the duty in the flag carrier airline, within the scope of the trade union, is applied in the form of notification at least 10 hours before the start of duty in the low-cost airline in accordance with the procedures.

Although crew planning activities show similarities within the scope of the goals to be achieved, they differ in terms of the reasons for achieving these goals. As a result of the analysis, it was found that there are small differences between the goals of the crew planning departments of the two airlines,

but their practices differentiate from each other on many issues.

7. Limitations and Recommendations for Future Research

The decline in the airline industry after COVID-19 pandemic and the fact that airlines have turned mainly to cargo services in addition to transporting passengers further increases the importance of crew planning. The main reason for this is the growing demand for cargo in addition to the decreasing passenger capacity, and the increasing importance attached by airlines to cargo services, so they are switching to aircraft suitable for carrying larger hulls and cargo. For this reason, the crew planning department also manages the transition process while determining the needs of these new types of aircraft. In addition, crew planning also plays an important role in determining the need for training. In the subsequent research, it is planned to investigate the effect of this structure on the process, which has changed and taken shape after COVID-19 pandemic.

In addition, the fact that the research was carried out only with the crew planning departments of two airlines, and that exclusion of the flight management, cabin crew, and technical departments that constantly interact with the crew planning department constitutes the limitations of the study. Consideration of the mutual relations of the activities of these departments in future research will contribute to the literature and the industry. In this context, as shown in Figure 1 below, a model is proposed for future research.

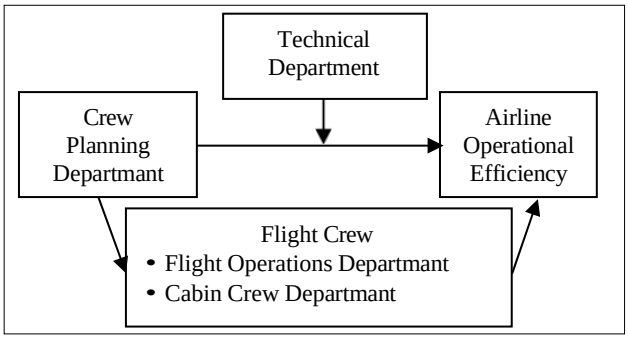


Figure 1. The Proposed Research Model for Future Research

In the proposed model, the mediating role of the flight operations department and the cabin crew department, which are defined as the flight crews, and the regulatory role of the technical department are investigated in the impact of the activities of the crew planning department on the operational efficiency.

Ethical approval

Not applicable.

Conflicts of Interest

The authors declare that there is no conflict of interest regarding the publication of this paper.

References

Akyurt, İ. Z. and Yaşlıoğlu, D. T. (2018). Havacılık Sektöründe Ekip Planlama Yönetimi: Bir Türk Havayolu Örneği. İşletme Araştırmaları Dergisi, 19 (1), 431.

Aldemir, H. Ö. (2018). Analysis of Competition Approach of Charter Airlines in Turkey According to The Miles and Snow's Competitive Typology. Journal of Transportation and Logistics, 3(2), 53-62.

Balta, S. and Altıntaş, V. (n.d.), Seyahat Acentacılığı ve Tur Operatörlüğü. İ. Ünlü (Ed.). T.C. Anadolu Üniversitesi Yayını No: 2589, Eskişehir, Açıköğretim Fakültesi Yayını No: 1558., 52.

Barnhart, D., Cohn, A. M., Johnson, E. L., Klabjan, D., Nemhauser, G. L. and Vance, P. H. (2003). Airline Crew Scheduling. In: Handbook of Transportation Science. R.W. Hall (Ed.). International Series in Operations Research & Management Science, 56, Springer, Boston, MA. Retrieved from: (15) (PDF) Airline Crew Scheduling (researchgate.net), on 17th May, 2021.

Battal, Ü., Yılmaz, H. and Ateş, S. S. (2006). Türkiye'de İç Hatlarda Serbestleşme ve Geleceği. HaSeM'06 Kayseri VI. Havacılık Sempozyumu 12-14 Mayıs 2006, Nevşehir.

Bieger, T. and Agosti, S. (2005). Business Models in The Airline Sector- Evolution and Perspectives. In: Strategic Management in The Aviation Industry. S. Auerbach, H. Baum, and W. Delfmann (Eds.). Kölner Wissenschaftsverlag, Köln, 53.

Cengiz, A. (2010). Avrupa Birliği ve Türkiye'de Slot (Sıra/Zaman) Tahsisi Uygulaması ve Hukuki Değerlendirme. Dokuz Eylül Üniversitesi Hukuk Fakültesi Dergisi, 12 (Özel S.), 1105-1157.

Creswell, J. W. (2007). Qualitative Inquiry and Research Design: Choosing Among Five Approaches Second Edition. Sage Publications, Inc, California, 37.

Curtis, S., Gesler, W., Smith, G. and Washburn, S. (2000). Approaches to Sampling and Case Selection in Qualitative Research: Examples in The Geography of Health. Social Science & Medicine, 50, 1002.

Dinçer, Ö. (2013). Stratejik Yönetim ve İşletme Politikası 9. Baskı. Alfa Yayım, İstanbul, 200.

Durmuş, S. and Öztürk, S. (2014). Havayolu Taşımacılığında Lojistik Maliyetler. KTÜ SBE Sos. Bil. Derg., 8, 205-220.

EASA (2017). EASA FTL 2016: Flight and Duty Time Limitations and Rest Requirements. Annex to Decision 2017/007/R AMC and GM to Part-ORO- Issue 2, Amendment 11. Retrieved from: easa-combined-ftl-2017.pdf (wordpress.com), on 17th May, 2021.

EASA (2019). Type-Certificate Data Sheet for Airbus A300, A310, A300-600. TCDS EASA.A.172 Issue: 4. Retrieved from: Form (europa.eu), on 18th May, 2021

Ekiz, D. (2003). Eğitimde Araştırma Yöntem ve Metotlarına Giriş. Anı Yayıncılık, Ankara.

Erdoğan, D. (2018). Havayolu Taşımacılığında Havaalanı-Havayolu Ilişkisi: Dikey İşbirlikleri, In: Hava Taşımacılığı Yönetimi. Ü. Battal (Ed.). Nisan Yayınevi, Eskişehir. Rterieved from: Airport-AirlineRelationship_preprint.pdf, on 18th May, 2021.

Erkayman, B. (2013). Havayollarında Uçuş Aksaklıkları Problemi için Bir Çözüm Yaklaşımı ve Uygulaması, Sakarya Üniversitesi, Fen Bilimleri Enstitüsü, Sakarya.

Ernst, A. T., Jiang, H., Krishnamoorthy, M. and Sier, D. (2004). Staff Scheduling and Rostering: A Review of Applications, Methods and Models. European Journal of Operational Research, 153 (1), 3-27.

Eroğlu, O. (2015). The Success of Low-Cost Carriers: The Case of Southwest Airlines and Pegasus Airlines.

Gümüşhane Üniversitesi Sosyal Bilimler Enstitüsü Elektronik Dergisi, 6 (12), 185-200.

Gerede, E. (2015). Havayolu Taşımacılığı ve Ekonomik Düzenlemeler Teori ve Türkiye Uygulaması Yayın No: HUD / T-01. Sivil Havacılık Genel Müdürlüğü Yayınları, Ankara. Retrieved from: SHGM_Havayolu_Tasimaciligi_Kitabi.pdf, on 17th May, 2021.

Gerede, E. (2017). Havaaracı Bakım Maliyetlerini Etkileyen Faktörlerin ve Bakımın Havayolu İşletmesinin Gelir ve Giderlerine Etkisinin Araştırılması. Ulusal Havacılık Teknolojisi ve Uygulamaları Kongresi (UHAT 2017), Kasım 2017, İzmir.

Hava-İş (2019). 26. Dönem Toplu İş Sözleşmesi. Retrieved from: thy-ao-26-donem-tis-1555361043.pdf (havais.org.tr), on 16th May, 2021.

Hava-İş (2019a). 26. Dönem İşletme Toplu İş Sözleşmesi Teklifi. Retrieved from: 26donem-toplu-is-sozlesmesi-taslak-1546520734.pdf (havais.org.tr), on 17**th** May, 2021.

İnan, T. T. (2020). Slot Kavramının Havalimanları ve Havayolları Açısından İncelenmesi. International of Journal Management and Social Researches, 7(13), 46-55.

Jull, M. (2016). Employment and Working Conditions in EU Civil Aviation, Briefing, April 2016, European Parliament Research Service, Retrieved from: Working conditions in EU civil aviation (europa.eu),.on 17th May, 2021.

Koch, B. (2010). Aviation Strategy and Business Model. In: Introduction to Aviation Management. A. Wald, C. Fay, R. Gleich (Eds.), LIT Verlag, Berlin, 154.

Küçükönal, H. and Korul, V. (2012). Havayolu İşletmelerinde İnsan Kaynakları Yönetimi. Sosyal Bilimler Dergisi, (24), 89.

Lim, Y., Bassien-Capsa, V., Ramasamy, S., Liu, J. and Sabatini, R. (2017). Commercial Airline Single-Pilot Operations: System Design and Pathways to Certification. IEEE Aerospace and Electronic Systems Magazine, 32, 4-21.

Medard, C. P. and Sawhney, N. (2007). Airline Crew Scheduling from Planning to Operations. European Journal of Operational Research, 183(3), 1013-1027.

Mutlu, S. and Sertoğlu, A. E. (2018). Düşük Maliyetli ve Tam Hizmet Sunan Havayolları Müşterilerinin Hizmet Kalitesi Beklentilerinin Karşılaştırılması. İşletme Araştırmaları Dergisi, 10(1), 528-550.

Önen, V. (2018). Düşük Maliyetli Havayolu Firmaları ile Tam Hizmet Veren Havayolu Firmaları Marka Kişiliklerinin Karşılaştırması: Türk Havayolları- Pegasus Havayolları İncelemesi. İşletme Araştırmaları Dergisi, 10(2), 783-802.

Özkan, T. (2019). Farklılaştırılmışve Düşük Maliyetli Strateji Uygulayan Havayolu İşletmelerinin Müşteri Değeri Yaratma Anlayışlarının İncelenmesi. MAKÜ-BİFD, 2(2), 209-223.

Patton, M. Q. (2014). Nitel Araştırmanın Doğası. In: Nitel Araştırma ve Değerlendirme Yöntemleri 3. Baskı**.** M. Bütün, and S. B. Demir (Eds.). Pegem Akademi, Ankara, 4.

Porter, M. E. (1980). Competitive Strategy Techniques for Analyzing Industries and Competitors. The Free Press, New York.

Serdar, İ. (2019). Uçuşun İptaline ve Uzun Gecikmesine Sebebiyet Veren Olağanüstü Haller"de Sorumluluktan Kurtulma. Dokuz Eylül Üniversitesi Hukuk Fakültesi Dergisi, 21(1), 233-304.

Shaw, S. (2007). Airline Marketing and Management. Ashgate Publishing Company, Burlington.

SHGM (2002). Kabin Personeli Eğitim ve Standardizasyonu (SHT-61.40). Retrieved from: sht61.40.pdf (shgm.gov.tr), on 19th May, 2021).

SHGM (2008). Haberler. Retrieved from: SHGM, Uçak Bakım Denetimlerini Arttırdı. | Sivil Havacılık Genel Müdürlüğü, on 21th May, 2021.

SHGM (2016). Pilotların Kaptan Olarak Atanması ve Kaptan Eğitimine İlişkin Esaslar Rev. 3 (SHT61-103-Rev3). Retrieved from: Microsoft Word - sht61103.doc (shgm.gov.tr), on 17th May, 2021.

SHGM (2017). Uçuş Ekibi Lisanslandırma Talimatı (SHT-FCL). Retrieved form: SHT-FCL.pdf (shgm.gov.tr), 2017, on 12th May, 2021).

SHGM (2018). Uçuş ve Görev Süresi Sınırlamaları ile Dinlenme Gereklilikleri Talimatı (SHT-FTL). Retrieved form: SHT-FTL_Rev02.PDF (shgm.gov.tr), on 16th May, 2021.

SHGM (2019). Kabin Yol Boyu Denetimlerine İlişkin Esas ve UsullerT alimatı (SHT-KABİN YOL BOYU). Retrieved from: SHT-Kabin_Yol_Boyu_Rev.01.pdf (shgm.gov.tr), on 17th May, 2021.

Steine, E. Von D., Ingomer, J. and Junek V. (2009). Effects of EU Liberalisation on Air Transport Employment and Working Conditions Final Report. European Commission Directorate- General for Energy and Transport, Londra.

Şen, L. M. and Akpur, A. (2015). Düşük Maliyetli Bir Havayolu İşletmesinde Uçak İçi Hizmetler Kalite Algısını Ölçmeye Yönelik Bir Araştırma. İşletme Araştırmaları Dergisi, 9(4), 63-83.

Tekiner, H., Birbil, Ş. İ. and Bülbül, K. (2009). Robust Crew Pairing for Managing Extra Flights. Computers & Operations Research, 36(6), 2031-2048.

TOBB (2018). Türkiye Sivil Havacılık Meclisi 2018 Yılı Sektör Raporu. Türkiye Odalar Ve Borsalar Birliği Türkiye Sivil Havacılık Meclisi. Retrieved from: Turkiye Sivil Havacilik Meclisi Sektor Raporu 2018.pdf (tobb.org.tr), on 13th May, 2021.

Toprakçı, G. and Aksoy, B. (2019). Kadın Girişimciliği ve Sosyal Sermaye: Nitel Bir Araştırma. Mehmet Akif Ersoy Üniversitesi Sosyal Bilimler Enstitüsü Dergisi, 11 (27).

Tümüklü, A (2000). Eğitim Bilimi Araştırmalarında Etkin Olarak Kullanılabilecek Nitel Bir Araştırma Tekniği: Görüşme. Kuram ve Uygulamada Eğitim Yönetimi. (24), 547.

Üzülmez, M., Ateş, S. S. and Çalışkan, A. (2018). Havayolu Operasyonlarında Uçucu Ekip Planlama ve Ekip Rotasyon Optimizasyonu: Bir Hava Kargo İşletmesinde Uygulama, Turkish Studies Social Sciences, 13/18, 1343-1356.

Vincent, R. (2020). Business Aviation Market Overview-January 2020. AvBuyer. Retrieved from: Business Aviation Market Overview – January 2020 | AvBuyer, on 22th Apr, 2021.

Wensveen, J. G. (2007). Air Transportation A Management Perspective. Ashgate Publishing Limited, Hampshire.

Wit, J. G., Zuidberg, J. (2012). The Growth Limits of The Low-Cost Carrier Model. Journal of Air Transport Management, 21, 17-23.

Yangınlar, G. and Kabul, N. U. (2020). Sivil Havacılık İşletmesinde Toplam Kalite Yönetiminin Ve Örgüt İkliminin İş Tatmini Üzerindeki Etkisi. Turkish Studies, 15(3), 2073-2092.

Cite this article: Yaslioglu, D.T, Akyurt, İ.Z, Yaslioglu, M.M, Erdag, T. (2023). A Comparative Research on The Crew Planning Department of Airlines Adopting Different Business Models-Turkish Flag Carrier and A Low-Cost Airline Example. Journal of Aviation, 7(1), 17-28.

7 (1): 29-38 (2023)

Journal of Aviation

https://dergipark.org.tr/en/pub/jav

e-ISSN 2587-1676

A Demographic Research on Compassion Fatigue and Job Satisfaction Levels of Aviation Employees

Hanifi Sever[1*]

[1*] Turkish National Police, Aviation Department, UAV Pilot, Ankara, Türkiye. (drhanifisever@gmail.com)

Article Info

Received: 20 September 2022
Revised: 27 December 2022
Accepted: 05 January 2023
Published Online: 26 February 2023

Keywords:
Compassion fatigue
Job satisfaction
Aviation
Airport management

Corresponding Author: *Hanifi Sever*

RESEARCH ARTICLE

https://doi.org/10.30518/jav.1177750

Abstract

Aviation is a high-cost sector dependent on quality, risk and sectoral developments. Aviation businesses include not only flight activities, but can also be expressed with a broad-spectrum organizational structure such as passenger, ground, and airport ramp services. The activities that make up the most important part of the aviation industry, such as the wishes and demands of the passengers or the conditions of the passengers requiring special care, are carried out. Customer satisfaction is the main vision of aviation enterprises struggling under global competition. In addition, security, one of the basic principles of aviation, should not be ignored. For this reason, it can be said that aviation workers work under a multidimensional pressure. It is evaluated that both the various demands of the people receiving the service, the sectoral safety procedures, and the constant physiological effects (pressure, high noise, etc.) affect the compassion fatigue and job satisfaction of aviation employees. In this study, it is aimed to investigate the compassion fatigue and job satisfaction levels of airport employees. Although there are studies on job satisfaction in the aviation industry, there are no studies on compassion fatigue. Therefore, this study is a first in this field. This research applied to 653 employees working at 62 airports operated in Turkey. According to the results of the research, a difference was found between compassion fatigue and the education, age, duty, and income status of aviation workers. It can be stated that the factors that reduce job satisfaction are an important factor in triggering compassion fatigue.

1. Introduction

Aviation can be defined as one of the fastest growing sectors in the global economy and market. In order for global transportation and shipping services to be sustainable, human resources should be evaluated in the best way. Human resource is the most precious treasure that businesses have. It is evaluated that organizations managed with personal empowerment, motivation and knowledge management will be less injured in global competition wars.

In order to achieve sustainable goals strongly, organizations need to use their existing resources appropriately. Human resource is the most precious capital that organizations have. For this reason, the withdrawal of experienced personnel learnt by making large investments from the sector depending on internal and external factors can cause great financial losses for businesses.

In professional organizations, human resources are important for staff turnover. According to studies conducted in various sectors, the incidence of turnover is high for employees with low job satisfaction (Chin, 2018, Gabor, 2018, Lee et al., 2017, Shu et al., 2018).

Aviation, which is the job that requires top security and quality, aims to make people travel safely and quickly. It deals with increasing costs because of high standards. Losing human resources has the feature of increasing the costs of aviation. Therefore, job satisfaction among employees has an important place in staff turnover.

Compassion fatigue can be expressed as pity, loss of sadness because of a situation or numbness (Jenkins & Warren, 2012, Stamm, 2002). According to studies, there is a significant relationship between job satisfaction and compassion fatigue (DePanfilis, (2006), Grant et al., 2019, Li et al., 2014, Slatten et al., 2011, Yang & Kim, 2016). The most common studies on compassion fatigue are those of healthcare workers.

Aviation is an industry where billions of people use terminals to fly from one place to another. It is necessary to consider aviation not only in terms of flight services, but also within the scope of ground services. There is a broad spectral division of labor, such as welcoming passengers at terminals, boarding card and suitcase delivery, electronic guidance systems, boarding and apron transportation services, cleaning and operation. In addition, the management of airport personnel becomes more complex when additional services provided to disabled or elderly passengers are included. The daily population of most terminals can exceed the population of a city. The daily problems faced by the employees who

serve such a vast crowd of people, the endless demands of the passengers and the perfectionist attitudes of their managers can affect the lives of these employees.

Job dissatisfaction and compassion fatigue can cause exhaustion in aviation workers. This can lead to a decrease in the work's quality and an increase in the rate of work turnover. Ignoring people who ask for help in any matter or adopting inappropriate behavior patterns to avoid them.

In this research, it is aimed to compare the job satisfaction and compassion fatigue among airport employees. Although it is possible to find studies in the literature on job satisfaction, there is no research on compassion fatigue in aviation. Therefore, it is important to determine the relationship between compassion fatigue and job satisfaction in aviation, which is one of the most important sectors on a global scale.

2. Job Satisfaction

Job satisfaction refers to the complex attitudes and feelings of employees towards their jobs. It is an emotional phenomenon that gives employees the value, ownership and satisfaction they give to their jobs (Thiagaraj & Thangaswamy, 2017). Job satisfaction can be expressed as the emotional happiness between the expectations and the result (Cranny et al., 1992).

Job satisfaction is associated with specific job factors, personal characteristics, and group relationships. According to the research, these three factors are closely related to each other in terms of job satisfaction. In addition, job satisfaction includes issues related to employee expectations (Mishra, 2013).

When the theoretical studies on job satisfaction are examined, Vroom's study in 1964 contains very important results. Staff turnover, accident, absenteeism and job performance studies drew attention as variables in Vroom's research on job satisfaction.

Within the hedonistic approach, it is necessary for the employees to take pleasure from their work. The satisfaction created by the perception of pleasure is in harmony with the realization of wishes (Davis, 1982).

Researchers approaching job satisfaction from the reward and punishment parabola (Condon & DeSteno, 2011) focused on utility. If benefit is got after a job, satisfaction can occur in the reward parabola. On the other hand, the punishment approach is a factor that negatively affects job satisfaction. Here, reward and punishment are used as reinforcements.

Many studies have been conducted on the relationship between job satisfaction and income. In addition, there are studies stating that there is an important relationship between job satisfaction and the physical characteristics of the working environment and ergonomics (Habibi et al. 2008, May et al., 1997).

The common aspect of research on various occupational groups is that insufficient wages affect job satisfaction negatively (Abdulla, 2009, Carlan, 2007, Chimanikire et al., 2007, Guis, 2014, Harrington et al., 2001, Martin & Schinke, 1998, Ololube, 2006, Papanastasiou & Zembylas, 2005, Schweitzer et al., 2013). The common aspect of research on job satisfaction in the aviation industry is like the results in other industries (Nahar et al., 2017, Jou et al., 2013, Blyton et al., 2001). It is stated that wage inequality matters in job satisfaction.

In 1943, Abraham Maslow developed a five-stage hierarchy of needs theory similar to the creation of man. In the historical process, the need pyramid has been used in many researches and theses. The logic of this theory is that unless simple needs are met, people cannot move on to the next level. As human needs are met, the next step can be taken. Maslow expressed a five-stage category of needs. The first group includes the physical needs of people. It is not possible for the individual who cannot meet his physiological needs, such as eating and drinking, to pass to the second part. Physiological needs are essential elements for human survival. The second step is security. A person who can satisfy his basic needs seeks an environment where he can protect himself against external dangers. The third level is social needs. Within the scope of social needs, people emphasize the feelings of love and belonging. Status needs are at the fourth level. People may need a status in society. After long efforts, professionalism is adopted to gain status and value. As an outcome of these professional occupations, earning income or benefits begins. The last step is the realization phase. A person who meets the needs of the lower level reaches the ideal individual. The stage of reaching prestige in one's ideals can be expressed as realization (Fallatah & Syed, 2018, Shahrawat & Shahrawat, 2017).

Clayton Alderfer, in his in-depth analysis of Maslow's empirical research, argued that the components centered on three basic human needs. These are existence, relatedness, and growth needs. Alferder's ERG theory was created with the initials of these needs. A person among these needs can meet over one need at the same time (Alderfer, 1969). Therefore, he avoided talking about a hierarchy in the order of needs (Caulton, 2012, Schneider & Alderfer, 1973). Existence refers to physical needs. Elements such as accommodation, security, salary, safe working life describe this stage. Building relationships with other people and developing feelings of respect and belonging refers to the second part. It is considered as a need to interact not only with colleagues but also with family or social environment. Growth refers to all the needs that a person can satisfy by using his abilities and intelligence (Botha & Venter, 2016, Poulou & Norwich, 2019, Wanous & Zwany, 1977).

Fredrick Herzberg conducted empirical research aimed at changing hierarchy theory. He calls his argument a theory of hygiene, two-factor theory, rather than a hierarchical structure. It has been determined that employees have satisfaction and dissatisfaction, but removing dissatisfaction in the workplace does not lead people to absolute satisfaction (May & Decker, 1988, Sanjeev & Surya, 2016). This is associated with satisfaction. Removal of unsatisfactory elements does not reveal job satisfaction among employees. The most important factor emerging in this section is the existence of motivation factors (Dartey-Baah & Amoako, 2011, Maidani, 1991).

David McClelland, in his work published in 1961, expressed three important needs that motivate people to be successful: the need for achievement, the need for power, and the need for relationship. (McClelland, 1961). The most important part of the theory is the claim that needs will differ according to people's culture, expectations and education levels. Therefore, people's needs differ according to their perspective on needs. The basis of the approach is that people realize their needs by learning and that the need may increase according to the severity of the need. The need for achievement is an impulse that must be satisfied in order to reach the intended goals as soon as possible. For this impulse, ability, knowledge, and power must be used. The need for power is directly proportional to the masculine development

and knowledge capacity. No success is accidental. Achievement goals that are not supported by power are also difficult to achieve. The last part is the need for relationship. Humans are created with a sense of belonging by nature. It is important to satisfy needs within social relations. It can be easier for people who are in team or group work to achieve success. In addition, team organizations also enrich the power factor (Harrell & Stahl, 1984, Osemeke & Adegboyega, 2017, Royle & Hall, 2012).

Reinforcement theory should be evaluated in parallel with learning and differential reinforcement theories. According to the approach that suggests that behaviors can be developed with the help of reinforcers, a different model of the reward and punishment relationship has been adopted. A behavior can be weakened by negative reinforcement. Positive reinforcement can also reinforce behavior. Rewarding employees after a behavior and gaining income can be expressed as an important motivation. The development of this motivation factor also increases the job satisfaction of the employees (Viken & McFall, 1994, Villere & Hartman, 1991, Wei & Yazdanifard, 2014).

Vroom's expectancy theory states that motivation does not always result in performance for employees. The main backbone of the theory is the attractiveness and utility of the result to be got after an action. If the pleasure to be created by the result of the individual who will try meets the expectation of the person, this action will take place as soon as possible. The volume and severity of gain achieved can provide an increase in effort. If the threshold value of the gain is below the expectation, the person is not expected to exhibit that behavior. Thus, the result of an action may cause satisfaction or dissatisfaction (Badubi, 2017, Zboja et al., 2020).

3. Compassion Fatigue

Compassion is an interpersonal process that creates the urge to feel and notice the pain of another person and to reveal the motivation to help (Dutton et al, 2014). In another definition, compassion is the feeling of pity that is frequently encountered in relationships where the sense of empathy is weak (Wei et. al, 2011). Compassion is one of the human characteristics. In the light of the definitions made in the literature, compassion is the state of pity, sadness and a desire to help a person due to a situation he has experienced. Compassion and empathy are two issues that are dealt with on the same parallel axis (Welp & Brown, 2014).

When the studies are examined, empirical studies on compassion are made on the health sector (Bride et al., 2007, Coetzee & Klopper, 2010, Yoder, 2010). The common aspect of these studies is that the feeling of compassion is negatively affected over time, as healthcare professionals encounter people in need of help every day. This concept has also found a place in the literature as compassion fatigue. Compassion fatigue can be expressed as the increase in burnout levels of employees over time due to reasons such as worthlessness, weariness and dissatisfaction.

Compassion fatigue can be explained by mental, emotional, social, or physical burnout. Workplace change problems of employees who have post-traumatic stress disorder after traumatic events in the profession may increase their burnout. For example, flash bangs left by an employee who has been exposed to violence or an accident that resulted in a serious injury can explain mental burnout. Sometimes, mental burnout is also a component of an emotional trauma. The disrespectful and violent attitudes and behaviors of the people who receive the service against the employees trigger emotional burnout in the employees. Emotional traumas affect the job performance of employees negatively (Devilly et. al, 2009). It can be stated that employees who feel social exclusion are similarly fatigued. Finally, compassion fatigue can be observed in employees who experience physical burnout because of insufficient sleep, long working hours, and lack of exercise (Whitebird et al., 2013).

4. Materials and Methods

Between February 1st, 2020 and April 01st, 2020, research scales and questionnaires were presented to the participants on the internet. There are 62 airports suitable for civil air traffic operating in Turkey. A survey link was sent to the block e-mail addresses of the employees belonging to these airports and on the administrative websites, and they were invited to take part. In addition, it is aimed to increase the accessibility of the survey through social media groups and the mobile phone applications of the employees. In order to determine the universe of the research, it was not possible to reach the State Airports Authority data. For this reason, each participant who responded to the research was accepted by the convenience sampling method. 653 people responded to the data collection tools.

The first part of the data collection tools is the sociodemographic scale. The Minnesota Job Satisfaction Scale used in the second part was developed by Spector (1985) and is a two-dimensional, 5-point Likert-type scale comprising 20 questions in total. Internal satisfaction and external satisfaction make up the dimensions of the scale. Scores to be got because of the scale provide information about job satisfaction. In the last part of the study, the compassion fatigue scale developed by Pommier (2020) was used. This scale is a 7-point Likert type scale and comprises 24 items and six sub-dimensions. The sub-dimensions of the scale are kindness, indifference, common humanity, separation, mindfulness, and disengagement. According to the mean of the scale, it can be stated that as the total scores increase, the level of compassion also increases.

Cronbach's Alpha and confirmatory factor analysis were performed in order to test the structural validity of the measurement tools. In terms of alpha values, the job satisfaction scale was .0819 (81.9%) and the compassion fatigue scale was .0763 (76.3%). When examined in terms of Skewness and Kurtosis, it was understood that the sample showed a normal distribution.

The obtained data was analyzed by t test, one-way Anova test, Levene and regression tests using SPSS (version 20) package program;

H_1a: Job satisfaction differs according to gender.
H_1b: Compassion fatigue differs according to gender.
H_2a: Job satisfaction differs according to marital status.
H_2b: Compassion fatigue differs according to marital status.
H_3a: Job satisfaction differs according to education level.
H_3b: Compassion fatigue differs according to education level.
H_4a: Job satisfaction differs according to age.
H_4b: Compassion fatigue differs according to age.
H_5a: Job satisfaction differs according to the task.
H_5b: Compassion fatigue differs according to task.
H_6a: Job satisfaction differs according to the financial situation.

H_6b: Compassion fatigue differs according to the financial situation.

H_7: Compassion fatigue affects job satisfaction positively.

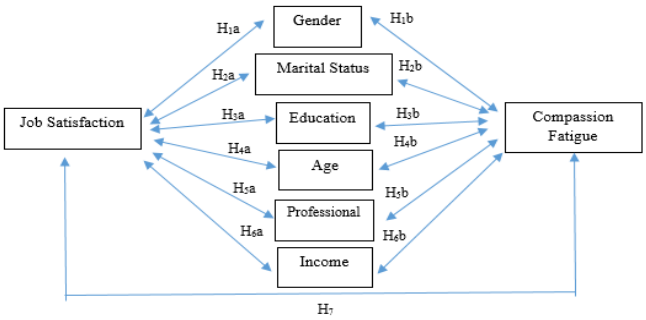


Figure 1. Research model

5. Result and Discussion

653 people working at airports were included in the study. The youngest of the participants in the study is 25 years old, and the oldest is 57 years old.

Table 1. Sociodemographics

Education	**n**	**%**	**Marital Status**	**n**	**%**
High School	197	30.1	Married	355	54.3
Vocational School	154	23.5	Single	298	45.7
University	217	33.2			
+Graduates	85	13.2			
Age	**n**	**%**	**Gender**	**n**	**%**
18-30 years	223	34.1	Female	374	57.2
31-40 years	295	45.1	Male	279	42.8
+41 years	135	20.8			
Status	**n**	**%**	**Income**	**n**	**%**
Handling services	203	31	Excellent	176	26.9
Air traffic control	73	11.1	Good	154	23.5
Electronic services	48	7.3	Not bad	122	18.6
Slot coordination	86	13.1	Bad	78	11.9
Security	243	37.5	Very bad	123	19.1
Total	653	100.0	**Total**	653	100.0

The education level of the participants in the research is high. 57.2% of the sample are women, nearly half (45.1%) are between the ages of 31-40 and half (54.3%) are married. 31% of the employees work in handling services including passenger handling, operations, ramp and freight, passenger service, ticket sales and de-icing services and 37.5% in security services. 50.4% find the salary they receive satisfactory, and 18.6% find it relatively satisfactory.

Table 2. T-test results of sociodemographic variables and scale averages

Gender		**n**	**Mean**	**StD**	**df**	**t**	**p**	**Levene**
Job Satisfaction	Female	374	3.76	0.12	653	4.226	.000	.126
	Male	279	3.04	0.23				
Compassion Fatigue	Female	374	3.17	0.17	653	4.645	.000	.153
	Male	279	3.89	0.12				
Marital Status								
Job Satisfactin	Married	374	3.57	0.11	653	4.945	.000	.192
	Single	279	2.87	0.15				
Compassion Fatigue	Married	374	3.03	0.18	653	4.284	.000	.128
	Single	279	3.68	0.21				

In scale averages, it can be stated that women have higher job satisfaction scores than men (3.76±0.12). It is noteworthy that men have a much higher score than the mean of the compassion fatigue scale (3.89±0.12).

After the t test analysis, it is understood from the Levene test results that the variances between the groups are equally distributed ($p>0.05$). According to Table 2, job satisfaction and compassion fatigue were compared with gender and marital status. According to the t-test results, a statistical difference was found between gender and job satisfaction [$t(653)=4.226$, $p<0.01$)] and compassion fatigue [$t(653)=4.645$, $p<0.01$)].

In this context, it can be stated that the hypotheses "H_1a: Job satisfaction differs according to gender" and "H_1b:

Compassion fatigue differs according to gender" are confirmed.

For marital status, within scale averages, the high satisfaction rate of married people in terms of job satisfaction (3.57±0.11) is remarkable. In terms of compassion fatigue (3.68±0.21), it is seen that singles achieve higher scores.

A statistical difference was found between marital status and job satisfaction [t(653)=4.945, p<0.01)] and compassion fatigue [t(653)=4.284, p<0.01)].

In this context, "H_2a: Job satisfaction differs according to marital status." and "H_2b: Compassion fatigue differs according to marital status." hypotheses can be confirmed.

Table 3. One Way Anova test results

Education		**n**	**F**	**p**	**Levene**
Job Satisfaction	High School	197	3.834	.000	1.912
	College	154			
	University	217			
	+Graduate	85			
Compassion Fatigue	High School	197	3.643	.000	1.843
	College	154			
	University	217			
	+Graduate	85			
Age					
Job Satisfaction	18-30 years	223	3.854	.000	1.945
	31-40 years	295			
	+41 years	135			
Compassion Fatigue	18-30 years	223	3.532	.000	1.853
	31-40 years	295			
	+41 years	135			
Task					
Job Satisfaction	Handling services	203	3.924	.000	2.053
	Air traffic control	73			
	Electronic services	48			
	Slot coordination	86			
	Security	243			
Compassion Fatigue	Handling services	203	3.484	.000	1.553
	Air traffic control	73			
	Electronic services	48			
	Slot coordination	86			
	Security	243			
Income					
Job Satisfaction	Excellent	176	4.642	.000	2.347
	Good	154			
	Not bad	122			
	Bad	78			
	Very bad	123			
Compassion Fatigue	Excellent	176	3.805	.000	1.806
	Good	154			
	Not bad	122			
	Bad	78			
	Very bad	123			

As seen in Table 3, it is understood from the Levene test results that the variances between the groups were equally distributed after the One Way Anova test analysis (p>0.05). A statistical difference was found between education, age, duty and financial situation, job satisfaction and compassion fatigue (p<0.01). In this context, "H_3a: Job satisfaction differs according to educational status.", "H_3b: Compassion fatigue differs according to educational status.", "H_4a: Job satisfaction varies according to age.", "H_4b: Compassion fatigue differs according to age.", "H_5a: Job satisfaction differs according to the task.", "H_5b: Compassion fatigue differs according to the task.", "H6a: Job satisfaction differs according to financial situation.", "H_6b: Compassion fatigue differs according to financial situation. " hypotheses can be confirmed. When the Tukey HSD test was used to find the direction of the difference, there were differences for both scale variables of learning. Accordingly, employees with a master's degree or higher have a very low level of satisfaction. When compared with age, it was shown that the job satisfaction of those younger than 30 years old was not sufficiently satisfied, and similarly, the compassion fatigue of this age group was different. When job satisfaction is examined by occupational status in airports, it is seen that air traffic control officers are highly satisfied, while handling services employees provide the highest score in compassion fatigue. As income increased, job satisfaction increased and compassion fatigue decreased.

The relationship between compassion fatigue and job satisfaction was examined with the help of correlation analysis. According to the correlation analysis, (r= -0.822, p<0.01) value was got. It can be stated that as the intensity of compassion decreases, job satisfaction increases. It can be said that the hypothesis "H_7: Compassion fatigue affects job satisfaction positively" is rejected.

Table 4. Regression Analysis of Job Satisfaction and Compassion Fatigue

	B	P	R^2	Cor R^2	F	Sig. F
Kindness	1.421	.000	.372	.370	141.271	0.000
Indifference	.742					
Common humanity	1.441					
Separation	.953					
Mindfulness	1.558					
Disengagement	1.041					

According to the results of the regression analysis between job satisfaction and compassion fatigue (Table 4), job satisfaction has a statistically significant explanatory effect on compassion fatigue. Life satisfaction explains 37% of compassion fatigue.

According to the findings, the status of the hypotheses is given in Table 5. It is seen that only the H_7 hypothesis was rejected and the rest were accepted.

Table 5. Hypothesis table

Hypothesis	Accept/Reject
H_1a: Job satisfaction differs according to gender.	Accept
H_1b: Compassion fatigue differs according to gender.	Accept
H_2a: Job satisfaction differs according to marital status.	Accept
H_2b: Compassion fatigue differs according to marital status.	Accept
H_3a: Job satisfaction differs according to education level.	Accept
H_3b: Compassion fatigue differs according to education level.	Accept
H_4a: Job satisfaction differs according to age.	Accept
H_4b: Compassion fatigue differs according to age.	Accept
H_5a: Job satisfaction differs according to the task.	Accept
H_5b: Compassion fatigue differs according to task.	Accept
H_6a: Job satisfaction differs according to the financial situation.	Accept
H_6b: Compassion fatigue differs according to the financial situation.	Accept
H_7: Compassion fatigue affects job satisfaction positively.	Reject

According to Vroom (1964), there is a negative relationship between job satisfaction and turnover and absenteeism. On the other hand, presenteeism is also negatively associated with job satisfaction (Côté et al., 2021).

Compassion fatigue can be used in almost all areas of the service sector, although it has found more work in the health sector. In industries that are in constant contact with people, data on compassion fatigue may be more accurate (Waytz, 2016).

Job satisfaction is directly related to wage (Freund, 2005), value of experience (Saber, 2013), physical environment and ergonomics (Ishaque & Shahzad, 2016, Shobe, 2018, Waqas et al., 2014), job insecurity (Sang et al., 2009) personal and job characteristics (Gazioglu & Tansel, 2006), promotion opportunities (Pandey & Asthana, 2017), personality (Furnham et. al., 2002) and job stress (Linn et al., 1985, Voltmer et. al, 2012).

According to the results of the study on organizational culture and job satisfaction conducted with 228 people in Jordanian private aviation companies, it has been revealed that there is a positive and significant relationship between organizational culture and job satisfaction. Some stated that there is a negative relationship between the market, bureaucracy, and hierarchy of the personnel working in airline companies and job satisfaction (Rawashdeh et al., 2015).

In the study on job satisfaction of US Airforce Officers (Sullivan, 1998), it was revealed that pension raises for senior officers were only 15% effective. According to our study, it has been revealed that the effect of salary raises and bonuses on young aviators reduces the intention to leave the job. It has been stated that salary matters in job satisfaction for younger aviators, even though it is not very meaningful for senior aviators in this study.

In the study conducted with 122 people working as air traffic controllers within the Pakistan Civil Aviation Authority, it was stated that the participants had a top level of job satisfaction (Iqbal, 2012). In another study, which is a continuation of the studies in the same unit, it is noteworthy that one of the most important factors reducing job satisfaction of air traffic controllers is job stress (Iqbal & Waseem, 2012).

According to another study conducted in Thailand, it was stated that the job satisfaction levels of the employees who are at the forefront of the aviation industry in contact with customers are much lower than the other employees (Krongboonying & Lin, 2015).

Mehta (2019) conducted a job satisfaction study with 300 people working in civil aviation businesses in India, and a significant relationship was found between gender, marital status, job profile, shift and experience, and job satisfaction.

In another study on personality traits and job satisfaction of aviators, 60 personnel working in a private aviation company were included in the study. Extroversion was found to be more determinant in job satisfaction than other personality traits. In this context, it was stated that extroverted employees achieved higher scores in job satisfaction (Mansour et al, 2021).

In studies on job satisfaction, it is stated that the quality of the job also affects the level of satisfaction (Gazioglu & Tansel, 2006). In this context, in the research conducted on 704 South African aircraft pilots, it was determined that the region to be flown, the content of the flight task, and the license type(s) for the command in flight caused a change in job satisfaction (Hoole & Vermeulen, 2003).

According to the results, job satisfaction of women was measured higher than that of men. In contrast, men have higher compassion fatigue than women. In this context, it can be stated that compassion fatigue among the genders affects job satisfaction negatively. When the same comparison is evaluated in terms of the marital status of the employees, it is seen that the job satisfaction of the married personnel is higher. It is noteworthy that the job satisfaction of single employees is very low. In this context, it is evaluated that the responsibilities

and habits of married employees towards their families have a positive reflection on job satisfaction. On the other hand, it can be stated that the satisfaction levels of single employees are low for various reasons and they have a greater potential for job turnover compared to married employees.

The level of job satisfaction varies according to educational status, age, income, and job status. It has been observed that individuals with high education levels have low job satisfaction levels. In this context, it can be stated that the level of dissatisfaction occurs in the employees due to the difference between the education received and the characteristic or income of the job. On the other hand, it is important to increase job satisfaction as age increases. Junior employees are less afraid of losing their current position because they believe they can easily find another job. A better career prospect is an important variable that affects the satisfaction of young employees. On the other hand, it is considered that the job satisfaction of former employees is high due to reasons such as professional maturity and the necessity to find a job again. The job satisfaction level of air navigation workers is higher than the others. This situation can be explained in two ways. Employees have less contact with people in the air control tower. Therefore, psychological attrition levels may be low. The salary received is much higher than for their peers working in other fields. On the other hand, it is thought that the most important factor reducing job satisfaction of air navigation officers is job stress. When evaluated in parallel with motivation theories, it can be accepted that wage issue is an important hygiene factor. According to the results of this research, the level of job satisfaction increased as the income increased. For this reason, the satisfactory income of employees by adhering to economic policies also increases the level of job satisfaction.

When the level of education, age, income and job status are analyzed with compassion fatigue, it is noteworthy that compassion decreases as the education level increases. The most important issue to be investigated in this section is what the training received is. The roles of those who are trained to do this job, such as aviation, communication and business, and graduates from other departments in the aviation sector should be compared. It is considered that interesting results can be obtained in future research on this subject.

The direction of the difference in compassion fatigue according to the age variable is remarkable. As age progresses, the level of compassion fatigue also increases. This may be closely related to burnout. Addressing compassion fatigue in terms of exhaustion in future studies may provide important results.

When the income status with compassion fatigue is examined, the fatigue level of the employees who describe their income status as insufficient is higher. On the other hand, when the task situation is considered, it is understood that the compassion fatigue of the employees who are in the front line to serve people is high. This result is in line with the job satisfaction results of the Krongboonying & Lin (2015) study.

Another important result got from the study is the organic link between compassion fatigue and job satisfaction. Increasing compassion fatigue negatively affects job satisfaction. Adoption of policies that will reduce the level of fatigue in order to reduce the personnel turnover rate in the enterprises will increase job satisfaction.

6. Conclusion

The aviation industry comprises thousands of businesses aiming to survive in a globally competitive environment. Besides flight services, ground and passenger services are of great importance in the sector. Human capital is the industry's most valuable resource. The endless demands of passengers, who have high expectations in the triangle of safety, quality and comfort, are the biggest cause of fatigue for airport employees.

One of the biggest costs in the aviation industry is the spent-on education. Employees who successfully complete the courses designed and certified under international criteria work in a way that does not allow mistakes. Turnover is just like chaos for the aviation industry because life at the airport continues twenty-four hours a day. Moreover, passengers expect service regardless of whether the employees are new or experienced. In addition, aviation services continue, assuming that the people who provide air control and ground services know their job and are qualified. Unfortunately, the replacement of lost personnel in the aviation industry requires endless processes.

According to the results of this study, job satisfaction and compassion fatigue of female employees differ from males. Women's job satisfaction levels are higher than men's. In addition, men's compassion fatigue level is also higher than women's. In this context, it can be stated that women are more dedicated in terms of airport employees. On the other hand, the situation of male employees regarding job satisfaction needs to be reconsidered. In connection with this result, the level of compassion fatigue among male employees with low job satisfaction is high. Considering the correlation between these two variables, it is evaluated that increasing job satisfaction can reduce compassion fatigue.

The selection of the personnel to be assigned in the airport operations is important. In order not to experience a process that may cause frustration, it is vital to select the appropriate personnel for the appropriate job. According to the results of this research, the satisfaction levels of single, young and highly educated employees are low in aviation ground handling services. On the other hand, it should be noted that the satisfaction level of air control officers is above the average. In this context, it can be stated that employees who are in direct contact with passengers have low job satisfaction and high compassion fatigue. Within the scope of this result, the situation of the personnel who are in contact with people in the airport operations should be closely surveyed. Supporting the personnel with the help of supervisors, reducing working hours, arranging their shifts, making promotions and salary arrangements, and giving priority to motivation-enhancing activities can also increase performance and quality.

This research was carried out at 62 airports operated in Turkey. All the participants work in ground services. In order to better understand the job satisfaction and compassion fatigue of aviation professionals, it is recommended that flight crew may be included in future studies. Revealing the similarities and differences between ground personnel and flight crew in terms of job satisfaction and compassion fatigue may be a suggestion for future studies.

Ethical approval

Not applicable.

Conflicts of Interest

The authors declare that there is no conflict of interest regarding the publication of this paper.

References

Alderfer, C. P. (1969). An empirical test of a new theory of human needs. Organizational behavior and human performance, 4(2), 142-175.

Badubi, R. M. (2017). Theories of motivation and their application in organizations: A risk analysis. International Journal of Innovation and Economic Development, 3(3), 44-51.

Blyton, P., Lucio, M. M., McGurk, J., & Turnbull, P. (2001). Globalization and trade union strategy: Industrial restructuring and human resource management in the international civil aviation industry. International Journal of Human Resource Management, 12(3), 445-463.

Botha, A., & Venter, J. M. P. (2016). The effect of life stages on needs satisfied by credit used, according to Alderfer's existence relatedness growth theory. Risk Governance & Control: Financial Markets & Institutions, 6(4), 324-333.

Bride, B. E., Radey, M., & Figley, C. R. (2007). Measuring compassion fatigue. Clinical social work journal, 35(3), 155-163.

Carlan, P. E. (2007). The search for job satisfaction: A survey of Alabama policing. American Journal of Criminal Justice, 32(1-2), 74-86.

Caulton, J. R. (2012). The development and use of the theory of ERG: A literature review. Emerging Leadership Journeys, 5(1), 2-8.

Chimanikire, P., Mut, E., Gadzirayi, C. T., Muzondo, N., & Mut, B. (2007). Factors affecting job satisfaction among academic professionals in tertiary institutions in Zimbabwe. African Journal of Business Management, 1(6), 166-175.

Chin, C. L. (2018). The influence of job satisfaction on employee turnover intention in the manufacturing industry of Malaysia. Journal of Arts & Social Sciences, 1(2), 53-63.

Coetzee, S. K., & Klopper, H. C. (2010). Compassion fatigue within nursing practice: A concept analysis. Nursing & health sciences, 12(2), 235-243.

Condon, P., & DeSteno, D. (2011). Compassion for one reduces punishment for another. Journal of Experimental Social Psychology, 47(3), 698-701.

Côté, K., Lauzier, M., & Stinglhamber, F. (2021). The relationship between presenteeism and job satisfaction: A mediated moderation model using work engagement and perceived organizational support. European Management Journal, 39(2), 270-278.

Cranny, C.J., Smith, P.C., & Stone, E. (1992). Job Satisfaction: How People Feel About Their Jobs. Wiley Library.

Dartey-Baah, K., & Amoako, G. K. (2011). Application of Frederick Herzberg's Two-Factor theory in assessing and understanding employee motivation at work: a Ghanaian Perspective. European Journal of Business and Management, 3(9), 1-8.

Davis, K. (1988). İşletmede İnsan Davranışı-Örgütsel Davranış, Çev, Kemal Tosun. İstanbul Üniversitesi İşletme Fakültesi Yayını, İstanbul.

DePanfilis, D. (2006). Compassion fatigue, burnout, and compassion satisfaction: Implications for retention of workers. Child Abuse & Neglect, 30(10), 1067-1069.

Devilly, G. J., Wright, R., & Varker, T. (2009). Vicarious trauma, secondary traumatic stress or simply burnout? Effect of trauma therapy on mental health professionals. Australian & New Zealand Journal of Psychiatry, 43(4), 373-385.

Dutton, J. E., Workman, K. M., & Hardin, A. E. (2014). Compassion at work. Annu. Rev. Organ. Psychol. Organ. Behav., 1(1), 277-304.

Fallatah, R. H. M., & Syed, J. (2018). A critical review of Maslow's hierarchy of needs. Employee motivation in Saudi Arabia, 19-59.

Freund, A. (2005). Commitment and job satisfaction as predictors of turnover intentions among welfare workers. Administration in social work, 29(2), 5-21.

Furnham, A., Petrides, K. V., Jackson, C. J., & Cotter, T. (2002). Do personality factors predict job satisfaction? Personality and individual differences, 33(8), 1325-1342.

Gábor, H. V. (2018). Public service motivation (PSM) and job satisfaction in case of Hungarian local public service. Academic and Applied Research in Military and Public Management Science, 17(1), 23-30.

Gazioglu, S., & Tansel, A. (2006). Job satisfaction in Britain: individual and job related factors. Applied economics, 38(10), 1163-1171.

Gius, M. (2014). Using fixed effects to estimate the impact of merit pay on teacher job satisfaction. Journal of Economics & Economic Education Research, 15(1), 17-30.

Grant, H. B., Lavery, C. F., & Decarlo, J. (2019). An exploratory study of police officers: Low compassion satisfaction and compassion fatigue. Frontiers in psychology, 9, 2793., doi: 10.3389/fpsyg.2018.02793

Habibi, E., Amini, N., Porabdian, S., & Rismanchian, M. (2008). Assessment of relationship between Macro Ergonomic conditions and employees work satisfaction Touse-eh and Omran factory. Iran Occupational Health, 5(1), 15-20.

Harrell, A. M., & Stahl, M. J. (1984). McClelland's trichotomy of needs theory and the job satisfaction and work performance of CPA firm professionals. Accounting, Organizations and Society, 9(3-4), 241-252.

Harrington, D., Bean, N., Pintello, D., & Mathews, D. (2001). Job satisfaction and burnout: Predictors of intentions to leave a job in a military setting. Administration in social work, 25(3), 1-16.

Hoole, C., & Vermeulen, L. P. (2003). Job satisfaction among South African aircraft pilots. SA Journal of Industrial Psychology, 29(1), 52-57.

Iqbal, M. (2012). Impact of Job Satisfaction and Job Control on Organizational Commitment: A Case Study of Air Traffic Controllers of Pakistan Civil Aviation Authority. Journal of managerial sciences, 6(2).140-154.

Iqbal, M., & Waseem, M. A. (2012). Impact of job stress on job satisfaction among air traffic controllers of civil aviation authority: An empirical study from Pakistan. International journal of human resource studies, 2(2), 53-70.

Ishaque, A., & Shahzad, K. (2016). Impact of internal marketing on employee behaviors: Mediating role of employee job satisfaction. Abasyn University Journal of Social Sciences, 9(1), 233-250.

Jenkins, B. & Warren, N.A. (2012). Concept Analysis: Compassion Fatigue and Effects Upon Critical Care Nurses, Critical Care Nursing Quarterly, (35), 388-395.

Jou, R. C., Kuo, C. W., & Tang, M. L. (2013). A study of job stress and turnover tendency among air traffic controllers: The mediating effects of job satisfaction. Transportation research part E: logistics and transportation review, 57, 95-104.

Krongboonying, W., & Lin, Y. C. (2015). The moderating effect of perceived supervisor support on the relationship between organizational politics and job satisfaction in aviation industry in Thailand. International Proceedings of Economics Development and Research, 84, 99-107.

Lee, X., Yang, B., & Li, W. (2017). The influence factors of job satisfaction and its relationship with turnover intention: Taking early-career employees as an example. Anales de Psicología/Annals of Psychology, 33(3), 697-707.

Li, A., Early, S. F., Mahrer, N. E., Klaristenfeld, J. L., & Gold, J. I. (2014). Group cohesion and organizational commitment: protective factors for nurse residents' job satisfaction, compassion fatigue, compassion satisfaction, and burnout. Journal of Professional Nursing, 30(1), 89-99.

Linn, L. S., Yager, J., Cope, D., & Leake, B. (1985). Health status, job satisfaction, job stress, and life satisfaction among academic and clinical faculty. Jama, 254(19), 2775-2782.

Mac Clelland, D. C. (1961). Achieving society (Vol. 92051). Simon and Schuster.

Maidani, E. A. (1991). Comparative study of Herzberg's two-factor theory of job satisfaction among public and private sectors. Public personnel management, 20(4), 441-448.

Mansour, D., Bhardwaj, A. B., & Chopra, A. (2021). Relating OCEAN (Big Five) to Job Satisfaction in Aviation, 2021 International Conference on Computational Intelligence and Knowledge Economy (ICCIKE) (285-289). IEEE.

Martin, U., & Schinke, S. P. (1998). Organizational and individual factors influencing job satisfaction and burnout of mental health workers. Social work in health care, 28(2), 51-62.

May, C. R., & Decker, R. H. (1988). Putting Herzberg's Two Factor Theory of Motivation in Perspective. Planning and Changing, 19(3), 141-49.

May, D. R., Schwoerer, C. E., Reed, K., & Potter, P. (1997). Employee reactions to ergonomic job design: The moderating effects of health locus of control and self-efficacy. Journal of Occupational Health Psychology, 2(1), 11.

Mehta, P. (2019). Exploring the linkage between demographic and job satisfaction of employees working in civil aviation industry. Journal of Organisation & Human Behaviour, 8(4).27-33

Mishra, P. K. (2013). Job satisfaction. IOSR journal of humanities and social science, 14(5), 45-54.

Nahar, R., Islam, R., & Ullah, K. T. (2017). Identifying the factors for reducing employee turnover rate in aviation business: Bangladesh context. Australian Academy of Business and Economics Review, 3(1), 39-46.

Ololube, N. P. (2006). Teachers job satisfaction and motivation for school effectiveness: An assessment. Essays in Education, 18(1), 9.

Osemeke, M., & Adegboyega, S. (2017). Critical review and comparism between Maslow, Herzberg, and McClelland's theory of needs. Funai Journal of Accounting, Business and Finance, 1(1), 161-173.

Pandey, P., & Asthana, P. K. (2017). An empirical study of factors influencing job satisfaction. Indian Journal of Commerce and Management Studies, 8(3), 96-105.

Papanastasiou, E. C., & Zembylas, M. (2005). Job satisfaction variance among public and private kindergarten school teachers in Cyprus. International Journal of Educational Research, 43(3), 147-167.

Pommier, E., Neff, K. D., & Tóth-Király, I. (2020). The development and validation of the Compassion Scale. Assessment, 27(1), 21-39.

Poulou, M. S., & Norwich, B. (2019). Adolescent students' psychological needs: Development of an existence, relatedness, and growth needs scale. International Journal of School & Educational Psychology, 7(1), 75-83.

Rawashdeh, A., Al-Saraireh, A., & Obeidat, G. (2015). Does organizational culture matter for job satisfaction in Jordanian private aviation companies? International Journal of Information, Business and Management, 7(2), 107-115.

Royle, M. T., & Hall, A. T. (2012). The relationship between McClelland's theory of needs, feeling individually accountable, and informal accountability for others. International Journal of Management and Marketing Research, 5(1), 21-42.

Saber, D. A. (2013). Generational differences of the frontline nursing workforce in relation to job satisfaction: what does the literature reveal? The health care manager, 32(4), 329-335.

Sang, KJC, Stephen G. Ison, and Andrew RJ Dainty. (2009) The job satisfaction of UK architects and relationships with work-life balance and turnover intentions. Engineering, Construction and Architectural Management, 16(3), 288-300

Sanjeev, M. A., & Surya, A. V. (2016). Two factor theory of motivation and satisfaction: An empirical verification. Annals of Data Science, 3(2), 155-173.

Schneider, B., & Alderfer, C. P. (1973). Three studies of measures of need satisfaction in organizations. Administrative Science Quarterly, 489-505.

Schweitzer, D., Chianello, T., & Kothari, B. (2013). Compensation in social work: Critical for satisfaction and a sustainable profession. Administration in Social Work, 37(2), 147-157.

Shahrawat, A., & Shahrawat, R. (2017). Application of Maslow's hierarchy of needs in a historical context: Case studies of four prominent figures. Psychology, 8(7), 939-954.

Shobe, K. (2018). Productivity driven by job satisfaction, physical work environment, management support and job autonomy. Business and Economics Journal, 9(2), 1-9.

Shu, X., Gong, Y., Xiong, J., & Hu, X. (2018). Job satisfaction, turnover intention and work performance in Chinese family enterprises. Management International/International Management/Gestión Internacional, 22(2), 84-95.

Slatten, L. A., Carson, K. D., & Carson, P. P. (2011). Compassion fatigue and burnout: What managers should know. The Health Care Manager, 30(4), 325-333.

Spector, P. E. (1985). Measurement of human service staff satisfaction: Development of the Job Satisfaction

Survey. American journal of community psychology, 13(6), 693-713.

Stamm, B. H. (2002). Measuring compassion satisfaction as well as fatigue: developing history of the compassion satisfaction and fatigue test, Figley CR, editor. Treating Compassion Fatigue. New York: Brunner-Routledge, 107-119.

Sullivan, D. J. (1998). Job Satisfaction Among United States Navy and Marine Corps Aviation Officers-A Study of the Impact on Career Retention. Naval Postgraduate School Monterey CA., Master Thesis.

Thiagaraj, D., & Thangaswamy, A. (2017). Theoretical concept of job satisfaction-a study. International Journal of Research-Granthaalayah, 5(6), 464-470.

Viken, R. J., & McFall, R. M. (1994). Paradox lost: Implications of contemporary reinforcement theory for behavior therapy. Current Directions in Psychological Science, 3(4), 121-125.

Villere, M. F., & Hartman, S. S. (1991). Reinforcement theory: A practical tool. Leadership & Organization Development Journal.12(2), 27-31.

Voltmer, E., Rosta, J., Siegrist, J., & Aasland, O. G. (2012). Job stress and job satisfaction of physicians in private practice: comparison of German and Norwegian physicians. International archives of occupational and environmental health, 85(7), 819-828.

Vroom, V. H. (1964). Work and motivation. Wiley.

Wanous, J. P., & Zwany, A. (1977). A cross-sectional test of need hierarchy theory. Organizational Behavior and Human Performance, 18(1), 78-97.

Waqas, A., Bashir, U., Sattar, M. F., Abdullah, H. M., Hussain, I., Anjum, W., & Arshad, R. (2014). Factors influencing job satisfaction and its impact on job loyalty. International Journal of Learning and Development, 4(2), 141-161.

Waytz, A. (2016). The Limits of Empathy, Harvard Business Review, 68-73.

Wei, L. T., & Yazdanifard, R. (2014). The impact of positive reinforcement on employees' performance in organizations. American Journal of Industrial and Business Management, 4(1), 9-12

Wei, M., Liao, K. Y. H., Ku, T. Y., & Shaffer, P. A. (2011). Attachment, self-compassion, empathy, and subjective well-being among college students and community adults. Journal of personality, 79(1), 191-221.

Welp, L. R., & Brown, C. M. (2014). Self-compassion, empathy, and helping intentions. The Journal of Positive Psychology, 9(1), 54-65.

Whitebird, R. R., Asche, S. E., Thompson, G. L., Rossom, R., & Heinrich, R. (2013). Stress, burnout, compassion fatigue, and mental health in hospice workers in Minnesota. Journal of palliative medicine, 16(12), 1534-1539.

Yang, Y. H., & Kim, J. K. (2016). Factors influencing turnover intention in clinical nurses: Compassion fatigue, coping, social support, and job satisfaction. Journal of Korean Academy of Nursing Administration, 22(5), 562-569.

Yoder, E. A. (2010). Compassion fatigue in nurses. Applied nursing research, 23(4), 191-197.

Zboja, J. J., Jackson, R. W., & Grimes-Rose, M. (2020). An expectancy theory perspective of volunteerism: the roles of powerlessness, attitude toward charitable organizations, and attitude toward helping others. International Review on Public and Nonprofit Marketing, 17(4), 493-507.

Cite this article: Sever, H. (2023). A Demographic Research on Compassion Fatigue and Job Satisfaction Levels of Aviation Employees. Journal of Aviation, 7(1), 29-38.

7 (1): 39-54 (2023)

Journal of Aviation

https://dergipark.org.tr/en/pub/jav

e-ISSN 2587-1676

The Effect of Technological Stress Dimensions on Employees' Decision-Making Styles and Regulatory Role of Job Insecurity Perception: A Research in The Aviation Sector

Bekir Alper Yıldırım[1*], **Deniz Elber Börü**[2]

[1*]THY. IOCC, Operation Center, Arnavutköy, İstanbul, Türkiye. (bekiralperyildirim@gmail.com)

[2] Marmara University, Business Administration Department, Göztepe, İstambul, Türkiye. (denizbörü@marmara.edu.tr)

Article Info

Received: 20 September 2022
Revised: 27 December 2022
Accepted: 05 January 2023
Published Online: 26 February 2023

Keywords:
Technostress
Decision Making Styles
Perception of Job Insecurity
Aviation Sector
Aircraft Maintenance Technics

Corresponding Author: *Bekir Alper Yıldırım*

RESEARCH ARTICLE

https://doi.org/10.30518/jav.1180461

Abstract

The technological stress factor is more evident in the aviation industry, which uses high and rapidly changing technology, especially for technical employees. The purpose of this research is to determine the effect of technostress levels of aviation industry employees on their decision-making styles and to analysis the regulatory effects of job insecurity perception, which is of great importance for businesses and employees in this effect. The research universe has been determined as the technical personnel in the airline companies operating in Turkey. In all, 402 questionnaires were considered valid and included in the 25th data analysis of SPSS. It was determined that technological stress was statistically significantly related to rational, intuitive, avoidant and instant decision-making. Meanwhile, each decision-making style and the dimensions of job insecurity perception separately have significant moderator roles. Finally, it was revealed that all technostress dimensions, except for the techno-invasion dimension, were statistically significantly correlated with at least one decision-making style. In the research, suggestions were made for the effects of changes in employee's decision-making styles and perceptions of job insecurity as a result of the effects of technostress, and the results were tried to be explained with aviation industry dynamics and theoretical literature.

This article was produced from the author's doctorate thesis.

1. Introduction

Studies analysing and revealing the positive or negative effects of changing and developing new technologies are increasing day by day (Chiappetta, 2017). Developing technology and increase in knowledge cause changes in the business life of employees. Recent studies emphasize that employees are under the influence of technology-based information, and this creates an overload of information and work stress on employees (Kaymaz, 2019). This type of stress originating from developing technology is examined under the concept of technostress as a new phenomenon (Norulkamar et al., 2009). TS (Technostress), a phenomenon that emerged with the integration of computer and artificial intelligence technologies into working life, was defined by the first psychologist Dr. Craig Brod (1984) as *'the inability to cope with new computer technologies as a modern disease of our age and the failure to adapt to these new technologies'*. According to different researchers, technostress is a psychological expression and the mental and physiological arousal due to technology (Arnetz & Wiholm, 1997), the negative impact on the thoughts, behaviors, attitudes and body of the employee who is expected to cope with technology (Weil & Rosen, 1997), It is defined as the difficulty of adapting to new technologies (Brand, 2000). Researchers are focusing more and more on the effects of technostress, especially on employee behaviors and organizations, over concepts and variables. Although technology strengthens businesses with greater productivity, efficiency in the workplace, improved communication, improved mobility and HR (Human Resources), negative consequences that can be considered important for both employers and employees may arise from the use of this technology (Boyer-Davis, 2018).

The aviation sector is one of the sectors where technology develops most rapidly and its applications have a wide impact (Alam, 2016). The advancement of technologies used in an aircraft is a serious stress factor on both pilots and technical personnel. The decisions to be made by the technical personnel in case of aircraft maintenance and breakdowns affect the entire flight operation in particularly and the aviation industry in general. Several leading companies in high-tech industries have begun to reorganize their procedures, approaches to work, and decision support systems using training methods derived from decision analysis. The aviation industry and airlines are supporting related programs to improve decision-making and raise situational awareness about the impact of the decision (Zsambok, 2014). These programs are especially based on regulating the decision-making styles of the employees and determining which factors affect the decision-making styles of the employees. In this process, especially

employees have to cope with intense tension and stress. Therefore, it can be said that the decision-making behaviors of the employees have become more important than ever (Çolakkadıoğlu & Güçray, 2007).

According to (Sverke & Hellgren, 2002), job insecurity is considered a classical job stressor that theoretically operates with two basic mechanisms. The first mechanism is that the need for security is a fundamental motivation to work. The second mechanism is based on the idea that the relationship between employer and employee is partially social. Major organizational changes, such as layoffs, pay cuts, or other threats to job security, provoke negative reactions because they violate an employee's psychological contract against the organization. In this case, the perception of job insecurity is seen as a job stressor for employees and its connection with technological stress is revealed. Employee engagement and lack of job satisfaction affect employee turnover intention and employee turnover rate (Appelbaum et al., 2013). Employees who have more decision-making and decision-making opportunities experience less negative consequences of job insecurity than employees who have less decision-making opportunities. For this reason, it is thought that employees' decision-making behaviors and especially their decision-making styles are associated with job insecurity (Probst, 2005).

Considering the statements before mentioned, it is seen that technological stress is an important factor in the aviation industry. In this research, it has been a matter of curiosity how the dimensions of technological stress have a behavioral effect in the aviation sector and how it causes a change, particularly for employees at the decision stage. In previous studies, the effects of stress on decision-making styles were analysed in different sectors. The aim here is to determine how technology-based stress will affect employees' decision-making styles. Its application in the aviation industry, where technology is intensively high, is also suitable for the investigation of the technological stress factor. Observations and investigations confirm that technology is a stress factor in the aviation industry. At the same time, technological developments affect the decisions of the personnel working in aircraft maintenance, and the decisions of the employees directly affect the costs and flight safety. The question of how the perception of job insecurity, which is an important concept in the aviation industry, plays a regulatory role between these two variables will also be revealed. In addition, the questions of whether technological stress causes a certain effect on decision-making styles and whether its results are differentiated according to decision-making styles can be answered.

2. Conceptual Framework

2.1. Technostress

It is possible to talk about many types of stress and many parameters, mechanisms and environments that trigger it. In management studies, the concept of stress is quite old and is explained under different theoretical assumptions. Administrative stress; for a phenomenon that occurs in the person's environment and is perceived as a demand that must be made by the person, is an environmental factor that emerges as a result of the experience of the difference between the individual's demanded wills and the skills and resources required to meet it (McGrath, 1976). At the organizational level, job stress is based on the stressor-strain approach. Any feature related to work, working life, the nature of the job or new technology is known as stress or situations that cause stress, and the physiological or psychological response to this stress is defined as tension (Hurrel et al., 1998). All approaches are generally based on a transitional approach, which defines stress as a dynamic process between stress and the individual and his/her environment.

Information and communication technologies have changed the functioning of global work environments in particular. In addition, the digital revolution has permanently shaped the nature and future of many jobs and professions. Although technology empowers organizations with greater productivity, productivity in the workplace, improved communication and improved mobility, significant negative consequences may arise from the use of this technology for both employers and employees (Boyer-Davis, 2018). Therefore; studies are carried out to understand and isolate the effects of information and communication technologies on business employees and managers. As a result of these studies, a phenomenon called '**Technostress**' was discovered and people's relations with this phenomenon began to be researched (Boyer-Davis, 2018).

In the organizational sense, technostress is the stress situation that arises due to the use of technological information systems in organizational tasks, and they attributed the reason to modern technological information systems (Ayyagari et al., 2011). When stress related to the workplace is considered, technostress is defined as a negative psychological state related to the use of information systems in the workplace and the use of more advanced systems in future, and thus; this can result in anxiety, mental fatigue, skepticism and inefficiency (Salanova et al., 2007). When business and working environments are examined in general, according to (Ragu-Nathan & Tarafdar, 2008), it has three main characteristics as a technological and working environment. First one is the increasing and enormous dependence of managers on information technology (personal computers, production applications, interfaces, etc.), second is the difference in employee-manager knowledge level caused by the increasing complexity of information technologies and third is modern information technologies changing the working climate and organizational culture as well.

Similar to stress in general, but specifically, the key dimensions of technostress are techno-insecurity, techno-uncertainty, techno-overload, techno-invasion and techno-complexity. Technostress creators (stress situations resulting from the use of high information technologies) can be expressed in accordance with the theory as stress situations (expressing emerging situations) and technostress preventers (mitigating situations). Technostress can occur in many situations which are high levels of role stress, low job satisfaction, organizational commitment, productivity and satisfaction of end users from information systems (Tarafdar et al., 2015). However, recent research has shown that when employees are trained to reframe their stress perceptions from negative to positive, significant improvements in their job performance and health have been observed (Crum et al., 2013).

When the studies with technostress are examined, it is seen that the personality traits of the employees, their performance, their productivity, organizational commitment, types of leadership, organizational citizenship, psychological results, intention to leave, feeling good, organizational support, cultural difference, job character and job insecurity, job

satisfaction, productivity, innovation, organizational environment, and its effects were examined (Salanova et al., 2007; Akhtari et al., 2013; Ayyagari et al., 2011; Tarafdar et al., 2015; Srivastana et al., 2015). This research, on the other hand, saw a gap in the field and was designed to understand how it affects the decision-making styles of employees. The research was designed both to fill a gap in the literature and to analyse the relationship between technostress and decision-making styles, and to see the effect on the decision styles of aviation maintenance personnel working with high technology in the sector.

2.2. Decision-Making Styles

Decision-making is the process of choosing among the solution alternatives in order to reach the most suitable result for the specified situation, after obtaining information about the existing alternatives (Chatoupis, 2007). Psychological effects, stress and other irrational internal events affect human decision-making. Especially the role of emotions in decision-making is very important (Leykin & DeBrubeis, 2010). According to (BarOn, 2007), decision-making can be defined as the setting of goals in order to meet any need, generate possible options, and make the most appropriate choice among alternatives.

When it comes to human performance, abilities can partially explain interpersonal differences. However, styles are just as effective on people's performance as abilities. DMS (Decision-Making Styles) have been equated with cognitive style in many studies. Cognitive (intellectual) style determines the speed of the decision maker's processing and interpretation of information (Hayes & Allinson, 1998).

When decision behavior is examined based on decision theory, more than one sub-behavior style and style that affects this type of behavior is detected. One of the sub-dimensions of decision behavior, the factor that most influences behavior is decision-making styles. In particular, decision-making styles take the first place in the list of factors that have the most impact on the risk perceptions of individuals who make decisions (Yaşar, 2016). The decision-making style can be expressed as the reactionary approach of individuals to a phenomenon in a decision-making process (Ercengiz, 2019). Decision-making style has been defined as a characteristic pattern in individuals' interpretation and response to decision-making tasks. With the help of decision-making styles, it can be understood why a person uses such different decision processes when facing seemingly similar situations (Baiocco et al., 2009).

Scott and Bruce (1995) drew attention to many internal characteristics and individual differences in the factors affecting the decision in their studies on decision-making styles and decision-making of individuals. Decision-making by people in managerial positions is an important part of organizational behavior. However, the decision-making styles of managers and the decisions they make are mostly affected by their perceptions and emotions (Nowzari, 2015). Decision-making styles is defined as *'learned habitual response patterns exhibited by an individual when faced with a decision situation'*. This is not a personality trait, but a tendency based on the habit of reacting in a certain way in the context of a certain decision (Orosova & Bavolar, 2015).

Five decision-making styles were defined as a result of a project based on four different populations and explained in behavioral terms (Scott & Bruce, 1995);

• **Rational DMS**: attributed to the use of reasoning and logical approaches in decision-making;

• **Intuitive DMS:** Defined based on hunches, instinctive experience, and hormonal feelings;

• **Dependent DMS:** It is characterized by waiting for support from others before making a decision and turning to different decision-facilitating tools;

• **Avoidant DMS**: Defined by withdrawing, postponing, withdrawing and negating decision scenarios;

• **Instant DMS:** Characterized by quick, heartfelt and impulsive decision-making. The research was designed to reveal the effects and changes of the dimensions of technostress on these five decision-making styles.

2.3. Perception of Job Insecurity

The concept of J.I. (job insecurity), which has become much more effective than its conceptual importance in the 2000s, has now emerged as ian important problem in the macro plans of countries. For example, in a recent policy document published by the European Union in 2013, job security is defined as a *'basic psychological hazard'*. The reasons for this are stated as economic problems, globalization and increasing competition in the future (Schaufeli, 2016). When analysing the respective literature, many different definitions of job insecurity are encountered. It has been defined by Shoss as 'a perceived threat to the continuity and stability of employment' (Shoss, 2017). In this context, the concept of job insecurity can be considered as two types. Quantitative job insecurity refers to perceived threats to the job as a whole, while qualitative job insecurity refers to perceived threats to job characteristics (deteriorating working conditions, lack of career opportunities and reduced salary development, etc.) (Hellgren et al., 1999).

In another definition, job insecurity refers to an employee's anxiety about losing their current job or about losing an existing feature of the job (Greenhalgh & Rosenblatt, 1984). Job insecurity can be defined as the anxiety of the employee about how long he can stay in his current job in the future and the level of continuity he perceives in his job (Lam et al., 2015). Looking at the other phases of job insecurity, the following situations are thought to be a trigger (Roskies & Louis-Guerin, 1990);

• Termination of Employee's Expectations • Early Retirement Status • Decreased Position • Worsening in Working Conditions

The elements of job insecurity are the uncertainty of the future of the job, the perception of threat and anxiety due to the change of working conditions and the business, and the reasons can be specified as personal characteristics, organizational factors, economic and legal reasons (Orçanlı et al., 2019).

Job insecurity, which is a source of work-related stress, not only causes negative attitudes of employees towards their work and the organizations they work for, but also negatively affects the individual and corporate job performance of employees and can harm the physical and mental health of employees. At the same time, job insecurity plays a role in reducing job satisfaction of employees, increasing the intention to leave (Ouyang et al., 2015) and creating a threat to the macro economy (Orçanlı et al., 2019).

2.4. The Relationship Between Technostress and Decision-Making Styles

The importance of making decisions in risky situations under high and developing technology is increasing day by

day. Defining and managing the stress on the flight crew and technical personnel, especially in the aviation industry, is an important component in terms of flight safety. In airline companies, the stressful situations of people working as flight crew and technical personnel also affect other crew members. The underlying assumption is that stress can lead to errors, poor performance, and poor decisions. At this point, determining what kind of stress the employees are affected by will help with the coping techniques. The effects of stressors have a great impact on the decisions to be made in general for errors and performance.

In the book named *'Decision-Making Under Stress Emerging Themes and Applications'*, which examines decision-making and stress and stress factors in general and focuses specifically on the aviation industry, psychological theories on the decision-making and decision situations of aviation workers in technological conditions, time pressure and risky situations are revealed. The book, which consists of twenty-nine chapters, focuses on stress factors and provides information on what types of stressors are affected by decision-makers and how they can cope. The book presents a wide variety of perspectives and applications from many sectors such as aviation, industry, military and emergency services. It is a fundamental scientific publication for the development of technological stress and its effects on employees in the aviation industry (Flin et al., 1997).

In the study named *'The Relationships Among Coping with Stress, Life Satisfaction, Decision-Making Styles and Decision-Making Styles and Decision Self-Esteem: A study with Turkish University Students'*, the complex relationships of stress, life satisfaction, decision-making styles and self-confidence in decision variables were examined. As a result of the study conducted with 492 university students, it was revealed that stress and coping techniques are related to all decision-making styles (Deniz, 2006).

In a qualitative study called *'Decision-Making Styles and Physiological Correlates of Negative Stress: Is There A Relation?'* conducted with military officials and employees, the relationship between Scout and Bruce's five general decision-making styles and negative stress was identified. As a result of the study, it was observed that negative stress was significantly associated with avoidant decision-making style (Thunholm, 2008).

In a quantitative study called 'Decision-Making Styles, Stress and Gender Among Investigators' among police officers, the relationship between the decision-making styles of investigative police officers and the stress they perceived was examined. Scout and Bruce's decision-making styles scale and perceived stress scale were used in this study, which was conducted with 203 participants. When the results were examined, it was seen that the avoidant and dependent styles were associated with high stress (Salo & Allwood, 2011).

2.5. The Relationship Between Technostress and Perception of Job Insecurity

Job insecurity, which is seen as a stressor in the research, is theoretically accepted as a classical job stressor that operates with two basic mechanisms. The first mechanism is that the need for security is a fundamental motivation to work. The second mechanism is based on the idea that the relationship between employer and employee is partially social (Hellgren & Sverke, 2002). Major organizational changes, such as layoffs, pay cuts, or other threats to job security, provoke negative reactions because they violate an employee's psychological contract with the organization.

When the stress factors in the workplace are examined, it is seen that job insecurity has not yet attracted attention in the field compared to other psycho-social stressors. It can be said that job insecurity, which creates an atmosphere of uncertainty, is an important source of stress among individuals. Studies on the subject reveal that the perception of job insecurity increases the level of stress, anxiety and depression, and physical and mental health complaints of employees (Köse & Baykal, 2018). The economic recession, trade wars and high increases in the restructuring activities of the enterprises in recent years have forced the enterprises to lay off their employees in order to reduce their costs (Hirsch et al., 2006), and this has created a high level of job insecurity and stress in many employees (Sverke et al., 2002).

(Hyoung, 2019)'s study analysing the relationship between psychological contract breach, job insecurity and job stress shows how these variables are related to each other. When Saurabh Sharma's study, which measured the relationship between job insecurity and stress at work in the insurance industry in 2016, is examined, it is seen that the primary goal is to reveal how much job insecurity the employees in the insurance industry perceive regarding their jobs and how much stress their job insecurity causes stress in their jobs. In a study conducted in 2007 among married workers, the role of gender in the relationship between job insecurity and job stress is determined (Gaunt & Benjamin, 2007). Gızılgül Valibayova (2018) examined the effect of job insecurity perception on job stress and job performance in her master's thesis.

When Tuğçe Karayaka's (2018) research *titled 'Working life characteristics, work stress and evaluation of job insecurity of occupational safety experts'* is examined, it is seen that 16% of the research group consisting of occupational safety experts have a high quantitative perception of job insecurity and a high rate of job stress that occurs with it., 8% of them have high level of qualitative job insecurity and high level of job stress. It has been observed that there is a positive relationship between job insecurity and job stress. Another research that tries to reveal the relationship between the concept of technostress and job insecurity is the master's thesis conducted by Oğuzhan Kaymaz (2019). The aim of the study titled *'An Application on the Relationship between Technostress and Job Insecurity'* is to determine the relations that may arise between the technostress that employees in the banking sector may be exposed to and the job insecurity they may experience, and to determine how bank employees will face negative situations by considering the effects of these relations. designated as offering recommendations.

3. Material and Method

3.1. Research Models

In this context, the theories based on the research are (Lazarus & Folkman, 1984) 'Transactional Theory of Stress' and (Koeske & Koeske, 1993) 'Stress-Strain-Outcome'. According to these theories, which are modeled as stress tension and behavioral outcome (Cheung & Cheung, 2013), it can be said that technology that causes stress creates a state of tension in employees and as a behavioral result, it leads to meaningful changes or interactions in decision-making styles. For the modeling of the research (Tarafdar et al., 2008), the technostress and its effects model was analyzed and used. In the related model, technostress-creating factors were

determined, and under the influence of these factors, the reactions of employees in different sectors to different variables were determined and the regulatory factors in this relationship were discussed.

There are many studies in the literature examining the relationships between stress types and decision-making behaviors. Study in psychology and management examining decision-making under uncertainty and stress (Heath, 2018), doctoral thesis investigating natural decision-making and stress determinants (Ergönül, 2018), decision-making models and methods book examining decision-making models and types of decisions under different stressors (Klein et al., 1993) have been an important resource for the study of decision-making styles. It has been a reference source for research in books (Flin et al., 1997) that examine the effect of the stressor on decision-making behavior, especially in the aviation sector. The fact that this research is the first to examine the phenomenon of the dimensions of technological stress on decision-making is also important in terms of its original value. The articles and books of researchers such as the founders of the concept of technostress and working in the modeling of the theory (Ayyagari et al., 2011; Tarafdar et al., 2008; Brod, 1984) were used as guides.

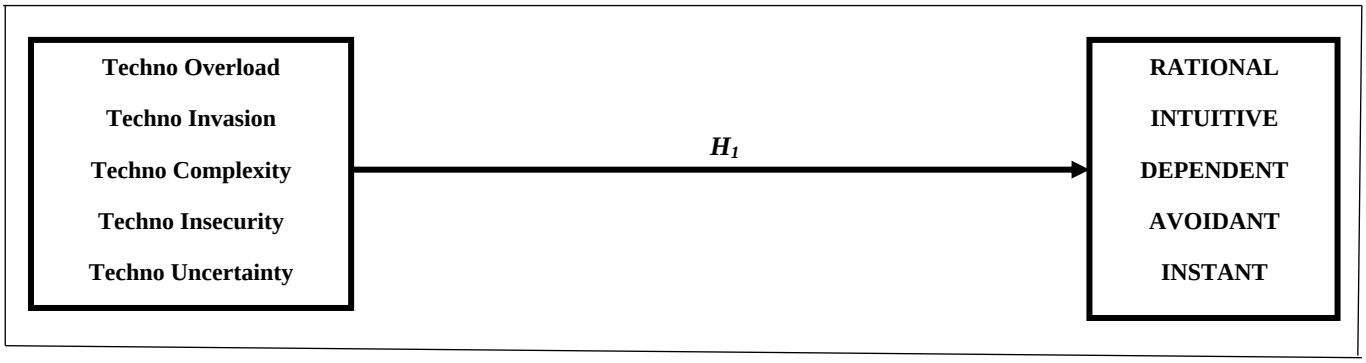


Figure 1. Relationship Model Between Research Sub-Dimensions

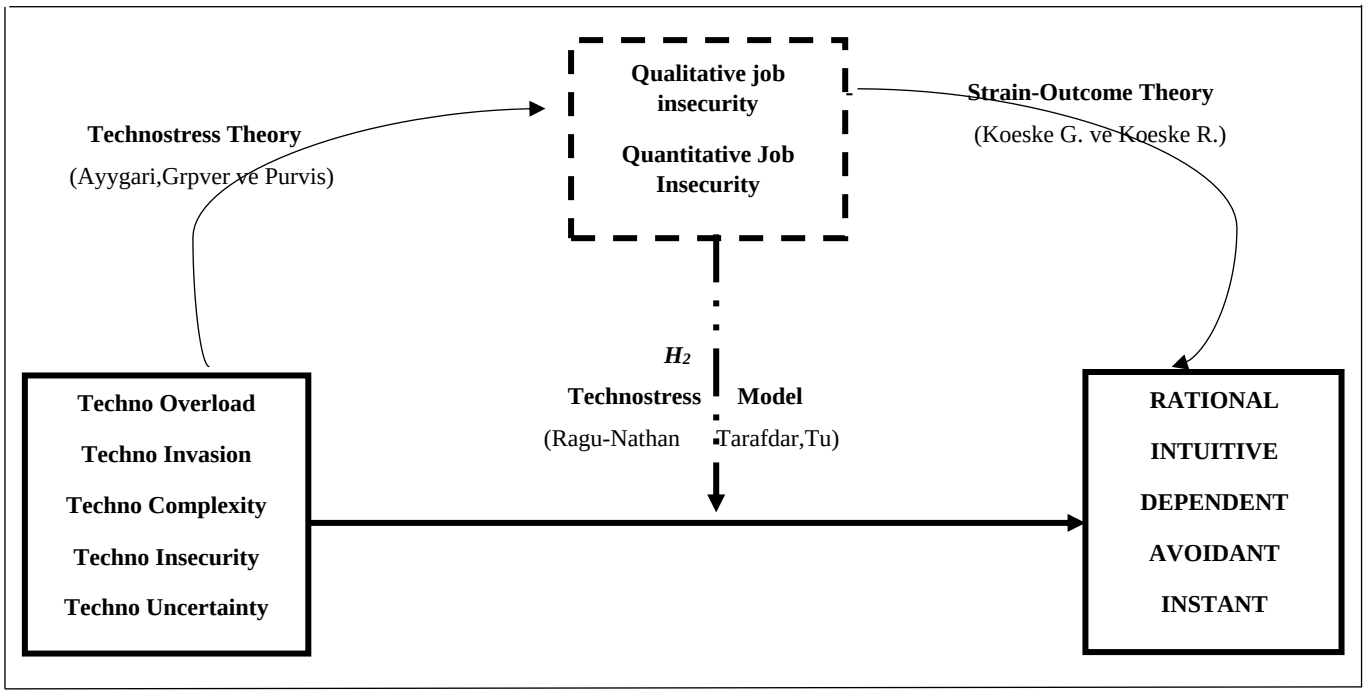


Figure 2. Research and Related Theories Model in the Moderation of Perceptions of Job Insecurity

3.2. Hypotheses

H1: There is a significant relationship between the dimensions of technostress and decision-making styles:

The first hypothesis is that there is a significant relationship between the technostress dimensions and the decision-making styles of the employees. It is thought that the five dimensions of technostress have significant relationships with decision-making styles at different levels. In particular, determining which decision-making style is more affected by which technostress dimension will provide useful evidence for the employees to determine the effect of the stress they are exposed to on the decision style.

H2: The perception of job insecurity has a significant moderator role in the relationship between technostress and decision-making styles:

The second hypothesis is that 'the perception of job insecurity has a significant moderator role in the relationship between technostress and decision-making styles'. It is known that the perception of job insecurity is a significant moderator, especially with the stress factor, as seen in previous studies. In

this research, he thinks that technological stress, especially on decision-making styles, can affect the degree or change its direction.

3.3. Sampling and Data Collection

The research universe consists of technical personnel working in the aircraft maintenance sector in Turkey. The survey method was adopted in the research and the sample was selected from the technical personnel working in the airline companies operating in Turkey and it is seen that the sample selected from the universe is completely homogeneous. The research population was determined as approximately 5500 people. An online questionnaire consisting of a total of 77 questions was created and the prepared questionnaire was sent to the members of UTED (Association of Aircraft Technicians) to collect data in the research, via SMS and online questionnaire link. The number of UTED members is around 4000 and a questionnaire was sent to all members. A total of 529 questionnaires were responded to, and 402 of the questionnaires, which were all filled in and usable, were evaluated and deemed appropriate for data analysis. Research data were analyzed in SPSS 25. Program.

3.4. Measures

The technostress scale was first developed by (Tarafdar et al., 2007) as five dimensions and twenty-three items. The scale is a five-point Likert-type scale measuring technological stress (1= Strongly Disagree, 2= Disagree, 3= Undecided, 4= Agree, 5= Totally Agree). The adaptation of the technostress scale to Turkish was carried out by (Ilgaz et al., 2016) and it was determined that the original structure of the scale was preserved.

The job insecurity perception scale was designed by (Ashford et al. 1989; De Witte & Naswall, 2003; Hellgren et al. 1999) to measure perceived job insecurity and was translated into Turkish by (Şeker, 2011). (Dede, 2017) applied on teachers. The scale is a five-point Likert-type scale measuring the perception of job insecurity (1= Strongly Disagree, 2= Disagree, 3= Undecided, 4= Agree, 5= Totally Agree).

Decision-making style, derived from cognitive psychology, is 'a disposition based on the habit of reacting in a particular way in the context of a particular decision'. Although there are many constructs that describe individual differences in decision-making, Scott & Bruce's (1995) 'General Decision-Making Styles' scale and inventory is the most comprehensive and widely used conceptual approach (Gurtner et al., 2016). The decision-making styles scale includes five sub-dimensions with a total of 25 items. Sub-dimensions of the scale; rational decision making, intuitive decision making, dependent decision making, spontaneous decision making and avoidant decision making. The options of the five-point Likert-type questionnaire, from 1 to 5, are as follows: Strongly Disagree, Disagree, Undecided, Agree, Strongly Agree.

4. Findings and Results

The data set collected through a questionnaire from the primary data sources in the research was analyzed using the SPSS 25 program. In this context, descriptive statistics were calculated and the sample was introduced. In the following stage, factor analyzes were applied to examine the validity and reliability characteristics of the scales used in the study, and then the Cronbach's alpha coefficient was calculated to determine the reliability. By using factor structures discovered as a result of Factor Analysi, factor scores were calculated with the approach of collecting responses. Decision-making styles scale was grouped under KMO: 0.844 and 5 factors and reached 62.447% explanatory power. On the other hand, the scale of perception of job insecurity is KMO: 0.791 and its explanatory value is 72,158% with 2 factors. The 5 dimensions of technostress are KMO:0.847 and the total explanatory value is 64.119%. Using the factor scores obtained, linear regression, multiple regression and hierarchical regression analyzes were applied to the hypothesis tests.

4.1. Testing the Relationship Between Technostress Dimensions and Decision-Making Styles

When the model between the technostress dimensions and rational decision-making was examined, the multicollinearity was checked because there was more than one independent variable in the model and it was seen that there was no (VIF<5.0). Model p=0.000 is seen as significant and 11.2% of the change in rational decision making is explained by the change in the dimensions of technostress.

Table 1. Rational Decision-Making with Technostress Dimensions Hierarchical Regression Analysis Results

Model		Non-standardized Constants		Standardized Constants	t	p	VIF
		B	Std. Error	β			
1	(Constant)	3.081	0.216		14.263	0.000	
	Techno Overload	-0.067	0.036	-0.113	-1.884	0.040*	1.595
	Techno Invasion	-0.013	0.030	-0.026	-0.444	0.657	1.487
	Techno Complexity	0.136	0.039	0.207	3.499	0.001*	1.556
	Techno Insecurity	0.099	0.038	0.146	2.354	0.010*	1.432
	Techno Uncertainty	0.166	0.034	0.242	4.921	0.000*	1.078

a. Dependant Variable: Rational Decision-Making p<0.05* R^2=0.112 F=9.862

When the model is examined, it is seen that 1 unit increase in techno overload causes a 0.113 decrease in rational decision-making, while 1 unit increase in techno complexity causes an increase of 0.207 units in rational decision-making. An increase of 1 unit in the techno uncertainty variable causes

an increase of 0.242 in rational decision-making. A 1-unit increase in techno-insecurity causes an increase of 0.146 in rational decision making. It was understood that the techno invasion (p=0.657) variable did not have a significant effect on rational decision-making.

Table 2. Hierarchical Regression Analysis Results for Heuristic Decision Making with Technostress Dimensions

Model		Non-standardized Constants		Standardized Constants	t	p	VIF
		B	Std. Error	β			
2	(Constant)	3.587	0.346		10.370	0.000	
	Techno Overload	-0.083	0.057	-0.089	-1.462	0.145	1.595
	Techno Invasion	-0.017	0.047	-0.021	-0.362	0.717	1.487
	Techno Complexity	-0.120	0.062	-0.117	-1.939	0.053	1.556
	Techno Insecurity	-0.053	0.061	-0.050	-0.868	0.386	1.432
	Techno Uncertainty	0.145	0.054	0.134	2.671	0.008*	1.078

a. Dependant Variable: Intuitive Decision-Making p<0.05* R^2=0.080 F=6.736

As a result of the multiple regression analysis for the relationship between technostress dimensions and intuitive decision-making, the model was found to be significant (p=0.000). When the model is examined, 8% of the change in intuitive decision-making is explained by the change in the dimensions of technostress. There is no multicollinearity problem in the model. When the model was examined, it was seen that only the relationship between techno uncertainty and intuitive decision making was significant (p=0.008). An increase of 1 unit in the techno uncertainty variable causes an increase of 0.134 units in intuitive decision-making. Techno overload (p=0.145), techno invasion (p=0.717), techno complexity (p=0.053) and techno insecurity (p=0.386) variables have no significant effect on intuitive decision-making. As a result of the multiple regression analysis done to find out the relationship between technostress dimensions and dependent decision-making, the model was found to be significant (p=0.000). When the model is examined, 8.9% of the change in dependent decision-making is explained by the change in the dimensions of technostress. There is no multicollinearity problem in the model.

Table 3. Dependent Decision-Making with Technostress Dimensions Hierarchical Regression Analysis Results

Model		Non-standardized Constants		Standardized Constants	t	p	VIF
		B	Std. Error	β			
3	(Constant)	2.882	0.303		9.515	0.000	
	Techno Overload	0.002	0.050	0.002	0.035	0.972	1.595
	Techno Invasion	0.043	0.041	0.061	1.044	0.297	1.487
	Techno Complexity	0.156	0.054	0.172	2.872	0.004*	1.556
	Techno Insecurity	0.038	0.054	0.041	-0.716	0.475	1.432
	Techno Uncertainty	0.239	0.047	0.252	5.052	0.000*	1.078

a. Dependant Variable: Dependant Decision-Making p<0.05* R^2=0.089 F=7.774

When the model is examined, it is seen that the relationship between techno-complexity and dependent decision-making is significant (p=0.004) and that a 1-unit increase in techno-complexity causes a 0.172-unit decrease in dependent decision-making. The relationship between techno uncertainty variable and dependent decision-making was also significant (p=0.000), and it was understood that 1 unit increase in techno uncertainty caused an increase of 0.252 units in dependent decision-making. On the other hand, techno overload (p=0.972), techno invasion (p=0.297) and techno insecurity (p=0.475) variables did not have a significant relationship with dependent decision-making.

As a result of multiple regression analysis for the relationship between technostress dimensions and instant decision-making, the model was found to be significant (p=0.000). When the model is examined, 12.3% of the change in avoidant decision-making is explained by the change in the dimensions of technostress. There is no multicollinearity problem in the model. When the model is examined, it is seen that the relationship between techno-complexity and instant

decision-making is significant (p=0.000) and that a 1-unit increase in techno-complexity causes a 0.215-unit decrease in instant decision-making.

Table 4. Hierarchical Regression Analysis Results for Immediate Decision-Making with Technostress Dimensions

Model		Non-standardized Constants		Standardized Constants	t	p	VIF
		B	Std. Error	β			
4	(Constant)	3.675	0.277		13.275	0.000	
	Techno Overload	-0.074	0.045	-0.096	-1.616	0.171	1.595
	Techno Invasion	-0.034	0.038	-0.052	-0.905	0.271	1.487
	Techno Complexity	-0.182	0.050	-0.215	-3.670	0.000*	1.556
	Techno Insecurity	-0.076	0.049	-0.088	-1.554	0.632	1.432
	Techno Uncertainty	-0.022	0.043	-0.025	-0.509	0.648	1.078

a. Dependant Variable: Instant Decision-Making p<0.05* R^2=0.123 F=11.118

As a result of the analysis, it was seen that the variables of techno overload (p=0.171), techno invasion (p=0.271), techno uncertainty (p=0.648) and techno insecurity (p=0.632) were not significantly associated with instant decision-making. As a result of the multiple regression analysis for the relationship between technostress dimensions and avoidant decision making, the model was found to be significant (p=0.000). When the model is examined, 17.6% of the change in avoidant decision-making is explained by the change in the dimensions of technostress. There is no multicollinearity problem in the model.

Table 5. Hierarchical Regression Analysis Results for Avoidant Decision-Making with Technostress Dimensions

Model		Non-standardized Constants		Standardized Constants	t	p	VIF
		B	Std. Error	β			
5	(Constant)	4.095	0.325		12.610	0.000	
	Techno Overload	-0.031	0.053	-0.033	-0.575	0.566	1.595
	Techno Invasion	-0.035	0.044	-0.043	-0.778	0.437	1.487
	Techno Complexity	-0.198	0.058	-0.193	-3.393	0.001*	1.556
	Techno Insecurity	-0.260	0.058	-0.246	-4.511	0.000*	1.432
	Techno Uncertainty	-0.001	0.051	-0.001	-0.027	0.979	1.078

a. Dependant Variable: Avoidant Decision-Making p<0.05* R^2=0.176 F=16.902

When the model is examined, it is seen that the relationship between techno-complexity and avoidant decision-making is significant (p=0.001), and a 1-unit increase in techno-complexity causes a 0.193-unit decrease in avoidant decision-making. The relationship between the techno-insecurity variable and avoidant decision-making was also significant (p=0.000), and it was understood that a 1-unit increase in techno-insecurity caused a 0.246-unit decrease in avoidant decision-making. On the other hand, techno overload (p=0.566), techno invasion (p=0.437) and techno uncertainty (p=0.979) variables did not have a significant relationship with avoidant decision-making. As a result of all analysis results, the significant effects of the five dimensions of technostress on the five basic decision-making styles are shown in Figure 3.

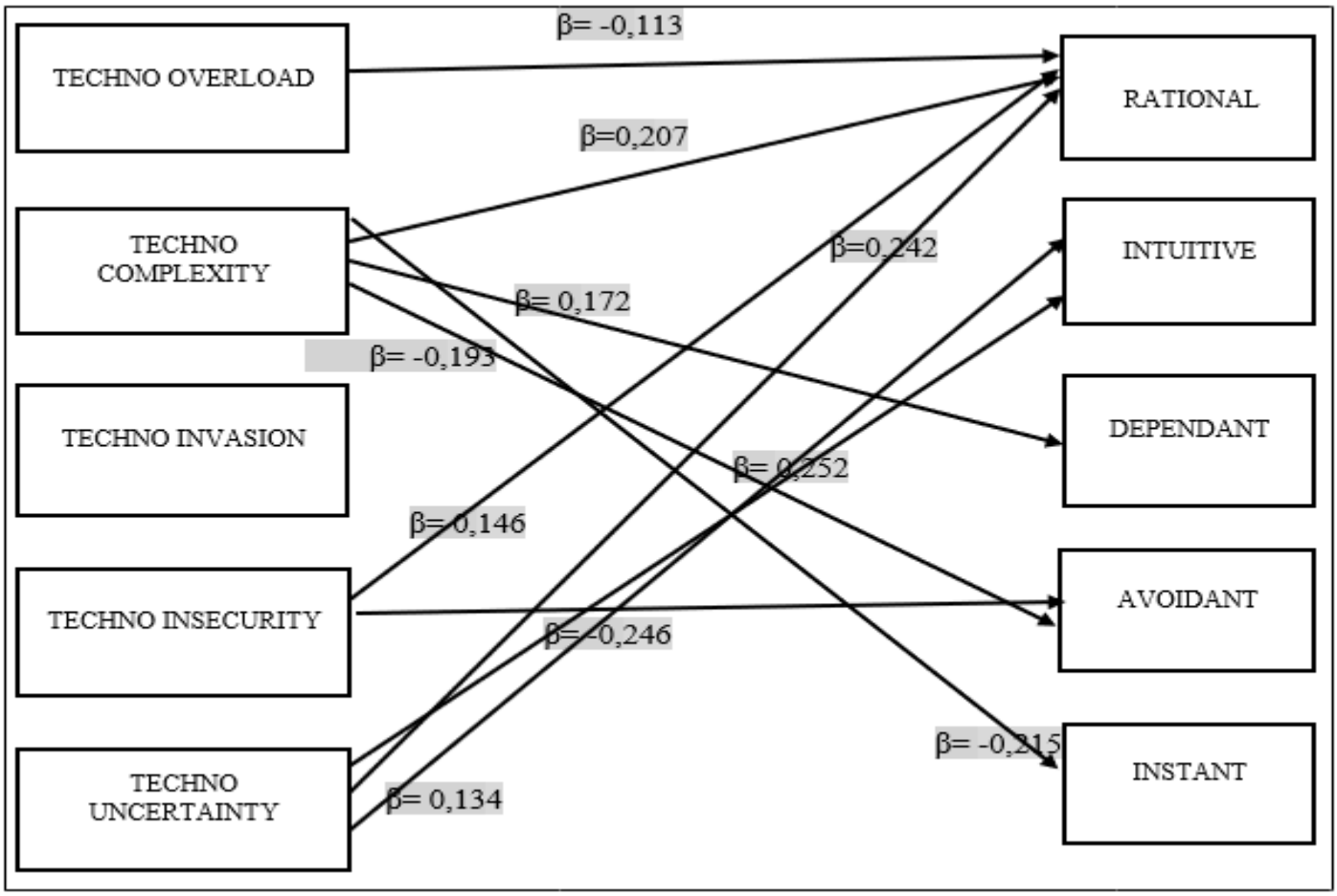


Figure 3. Network Analysis of the Relationship Between Technostress Dimensions and Decision-Making Style

The network relationship between the dimensions of technostress and five decision-making styles is shown above. All dimensions except the techno-invasion dimension seems to have a significant effect on a particular decision-making style. In the table below, the direction of significant relationships is expressed.

Table 6. Technostress and Decision-Making Styles Relationship Direction Network Table

Decision-Making Styles / Technostress	RATIONAL	INTUITIVE	DEPENDANT	AVIODANT	INSTANT
Techno Overload	-				
Techno Complexity	+		+	-	-
Techno Invasion					
Techno Uncertainty	+	+	+		
Techno Insecurity	+			-	

4.2. The Moderating Role of Perception of Job Insecurity in the Relationship Between Technostress and Decision-Making Styles

When the table emerged as a result of the hierarchical regression analysis is examined, it is seen that the perception β=0.136). β=0.108). The perception of qualitative job insecurity has no moderator effect.

of quantitative job insecurity (p=0.041) has a significant moderator effect in the relationship between technostress and rational decision-making, and that technostress has an explanatory effect to (R2=31%) and the effect is lower (from

Table 7. The Moderating Role of Perception of Job Insecurity in the Relationship Between Technostress and Rational Decision-Making Hierarchical Regression Analysis

Model		Non-standardized Constants		Standardized Constants	t	p	R^2
		B	Std. Error	β			
1	(Constant)	4.317	0.031		140.557	0.000	
	Technostress	0.079	0.032	0.136	2.509	0.013	0.20
	Quantitative J.I.	0.033	0.033	0.057	1.012	0.312	
	Technostress* Quantitative J.I.	0.055	0.027	0.108	2.055	0.041*	0.310

a. Dependent Variable: Rational Decision Making J.I.: Job Insecurity * p<0.05

When the table emerged as a result of the hierarchical regression analysis is examined, it is seen that the perception of quantitative job insecurity (p=0.000) has a significant moderator effect in the relationship between technostress and intuitive decision making, and that technostress has an explanatory effect to (R2=6.4%) and the effect (β=-- It was determined that it changed from 0.184 to β=0.181) in the opposite direction.

Table 8. The Moderate Role of Perception of Job Insecurity in the Relationship Between Technostress and Intuitive Decision-Making Hierarchical Regression Analysis

Model		Non-standardized Constants		Standardized Constants	t	p	R^2
		B	Std. Error	β			
2	(Constant)	3.113	0.047		65.543	0.000	0.035
	Technostress	-0.169	0.049	-0.184	-3.453	0.001	
	Quantitative J.I.	0.060	0.051	0.065	1.167	0.244	
	Technostress* Quantitative J.I.	0.145	0.041	0.181	3.518	0.000*	0.064

a. Dependent Variable: Intuitive Decision Making J.I.: Job Insecurity * p<0.05

When the table that emerged as a result of the hierarchical regression analyzes is examined, it is seen that the perception of qualitative job insecurity (p=0.002) has a significant moderator effect in the relationship between technostress and impulsive decision making, and that technostress has increased its explanatory power to (R2=12.9%) and the effect (β=-- It was determined that it decreased from 0.320 to β=0.144).

Table 9. The Moderating Role of Perception of Job Insecurity in the Relationship Between Technostress and Instant Decision-Making Hierarchical Regression Analysis

Model		Non-standardized Constants		Standardized Constants	t	p	R^2
		B	Std. Error	β			
3	(Constant)	2.327	0.036		65.279	0.000	
	Technostress	-0.241	0.036	-0.320	-6.684	0.000	0.099
	Qualitative J.I.	0.069	0.036	0.091	1.918	0.056	
	Technostress* Qualitative J.I.	-0.098	0.032	-0.144	-3.061	0.002*	0.129

a. Dependent Variable: Instant Decision Making J.I.: Job Insecurity * p<0.05

In the analysis, it was determined that the perception of job insecurity does not have a moderator role between technostress and avoidant decision making. At the same time, the moderator role of the perception of job insecurity was not analysed because there was no significant relationship between technostress and dependent decision-making style. In the table below, the meaningful and meaningless moderator roles of the dimensions of job insecurity perception in the relationship between decision-making styles and technostress are indicated.

Table 10. Moderator Role of Perception of Job Insecurity in the Relationship Between Technostress and Decision-Making Styles

MODERATOR \ TS*DMS	TS*RATIONAL DMS	TS*INTUITIVE DMS	TS*INSTANT DMS
QUANTITATIVE J.I.	√	√	
QUALITATIVE J.I.			√

5. Discussion and Conclusion

5.1. Evaluation of the Effects of the Dimensions of Technostress on Decision Making Styles

A significant and negative relationship between techno overload and rational decision-making was determined. The increase in the technological load on the technical personnel leads the employee to do more research in order to understand this new or complex technology and makes the time pressure more felt. This result, which is compatible with the studies of Tarafdar et al., also confirms that technology-intensive workers need more time because they are exposed to multitasking and technological workload at the same time (Tarafdar et al., 2007). Technical personnel have to take the necessary action and make the decision for aircraft maintenance or repair in a limited time frame. At this point, an excessively intense technological situation may cause the personnel to make less rational decisions. Employees may move away from the tendency to make rational and logical decisions, due to this time pressure and technological load. In a study conducted in the aircraft maintenance sector in line with the studies in the literature, he stated that time pressure and increasing technology cause an increase in the workload in the aircraft maintenance sector, a decrease in quality standards, wrong decisions, human factor errors and stress (Çoban, 2019).

A significant and negative relationship was found between techno-insecurity and avoidant decision-making. Techno-insecurity is the fear of employees losing their jobs due to constantly changing and developing technologies, and this is shaped by new behavioral patterns. Especially the new technologies that technical employees are constantly dealing with creates the concern that they will lose their jobs over time or that the people who will replace them may have more control over technology. The increase in such stress level creates a sense of taking more responsibility in employees and causes them to engage in behavioral actions having them to think they can handle technology, they are doing it. In this case, employees make less avoidant decisions and move away from avoidant behavior by taking responsibility.

A significant and positive relationship was found between techno-insecurity and rational decision-making. Technical personnel, who are effected by constantly developing and changing technology, may think that technology can increase much more over time and that some artificial intelligence or advanced technologies can take their place. For this reason, employees try to be more careful and attentive in their decisions and show more rational style that acts according to rules and data. In sectors where technology does not have much effect and technological change is slow, the rational decision-making levels of employees decrease and they may turn to other decision-making styles.

It has been determined that the techno uncertainty factor interacts significantly with more than one decision-making style. Considering that decision-making in fuzzy and uncertain situations is a very difficult and complex process, the effects of different decision-making styles in the environment of technological uncertainty also support our findings in terms of compatibility with the literature. Techno uncertainty has significant and positive effects especially on rational decision-making, intuitive decision-making and dependent decision-making. The significant and positive effect of techno-uncertainty on dependent decision-making, where technostress alone does not have a significant effect, is an important result. Dependent decision-making for employees is an important phenomenon in the aviation industry. Personnel working in aircraft maintenance or any malfunction may frequently refer to the opinions and suggestions of others for jobs that they do not have full knowledge of technology or cannot predict the results of. At this point, the issue of technological uncertainty is seen as a stress factor in the employee and can lead the employee to make decisions more dependent on other employees, especially employees who have a good command of technology. This situation is undesirable for employees at the same level or role. In the organization, the workload remains with a certain group of employees, and employees who follow technology or make better decisions in an environment of technological uncertainty or blurry situations make more effort. On the other hand, fuzzy and uncertain technology makes workers tired. Constant technological changes in the organization push employees to spend time on acquiring more information. In this case, the decisions to be made are delayed and the employees decide more rationally and more investigative. In fact, for many businesses, the employee who makes rational decisions is considered more effective and efficient. However, time pressure and high technology in the aviation industry expect employees to make more effective decisions. In this case, constantly changing and renewed technologies increase the desire of employees not to make mistakes, and this causes them to make more rational decisions. Another relationship between techno-uncertainty and intuitive decision making has been found. Employees in the ever-changing technology do not know which technology to trust in their business decisions. In this case, technological uncertainty can slightly increase intuitive decision making in employees. One of the most important options among decision-making options in uncertain, fuzzy situations and risky positions is to make decisions based on intuition. Therefore, in environments of technological uncertainty, it is normal for employees to act with their intuition and use their intuition in their decisions.

Another relationship between techno-uncertainty and intuitive decision-making has been found. Employees in the ever-changing technology do not know which technology to trust in their business decisions. For example, when an employee who constantly controls aircraft propellers with ultrasound starts to do this with a new technology, microwave, he will not be able to read the results as well as before, and he

will act on his feelings and intuitions instead of his previous experiences in the decisions he will make. In this case, technological uncertainty can slightly increase intuitive decision-making in employees. One of the most important options among decision-making options in uncertain, fuzzy situations and risky positions is to make decisions based on intuition. Therefore, in environments of technological uncertainty, it is normal for employees to act with their intuition and use their intuition in their decisions.

When the study data were analyzed, it was determined that technological complexity had a significant and positive relationship with dependent decision-making. Technical personnel tend to make more dependent decisions when a more complex situation occurs in aircraft technologies and when they are alone with high complexity technologies. The stress factor brought about by complex technology triggers the thought of making mistakes in technical employees and they tend to make more dependent decisions, although they are not sure about their decisions.

The increase in technological complexity in the aviation industry is inevitable. Due to the constantly renewed and more complex technology, employees are no longer able to postpone their decisions and do not leave important decisions for later because techno-complexity is a stress factor on them. This situation shows the harmony of literature and research results in terms of both aviation sector dynamics and avoidant decision-making dynamics. In this case, it can be explained by the desire to minimize the risks of making mistakes due to complex technology.

5.2. Evaluation of the Moderator Role of Perception of Job Insecurity in the Effect of Technostress on Decision-Making Styles

Quantitative job insecurity had a significant moderator effect on the relationship between technostress and rational decision-making, and it was understood that in cases where quantitative job insecurity is high, technostress reduces the positive effect on rational decision-making. While employees make more rational decisions due to technological stress, job insecurity significantly affects this effect and rational decision.

On the other hand, it was determined that quantitative J.I. had a moderator effect on the effect of technostress on intuitive decision making. Quantitative J.I. changed the effect of technological stress on intuitive decision-making from negative to positive. It can be said that quantitative J.I. has a full moderation effect in this relationship. Technological stress leads to increased intuitive decision-making in employees with high quantitative J.I. Employees under technological stress are shy about making decisions based on their past experience and experience because they are faced with a new technological system. At the same time, when faced with high quantitative job insecurity, decision mechanisms change. In many studies (Ünsar & Dinçer; Ilkım & Derin, 2018; Selvi & Sümer, 2018), it has been seen that the perception of job insecurity leads to negative changes in employee performance, job perspective, and emotions. Based on these studies and the concepts in the literature, it can be said that high quantitative job insecurity delays or disables stress-induced corrective behaviors on employees, and it can be thought that this situation adversely affects the behavior of employees who avoid intuitive decision-making due to technology-induced stress. Therefore, it can be said that the perception of quantitative job insecurity played a moderator role in the relationship between technological stress and heuristic decision in the research.

In the study, qualitative J.I. reduced the effect of technostress on intuitive decision-making. At this point, it can be said that it has a partial regulatory effect. Model analysis has shown that as qualitative J.I. increases, employees tends to make more instant decisions. When technical personnel perceive a corporate job insecurity, it can be said that they act not only by the effects of technostress, but also by the effects of corporate job insecurity in their decisions. When the dynamics of the aviation industry are examined, making a quick decision is not a very desirable situation. In studies (Günalan, 2019; Aslan, 2011), employee performance and job engagement decrease as qualitative job insecurity increases. Based on these results, it can be said that although employees tend to make less instant decisions and do their jobs more accurately in the face of technology-related stress, a possible decrease in their performance and organizational commitment in an environment where qualitative job insecurity increases may push them towards instant decisions.

5.3. Contributions and Suggestions

The concept of technostress, which has recently been examined in the field of business administration and organizational behavior, apart from the fields of psychology and sociology, especially its effects on employee performance, job satisfaction, susceptibility to technological innovations, self-efficacy, managerial abilities, organizational commitment, organizational culture, decision making, etc. has been discussed. It has been the subject of research with many variables (Salanova et al., 2007; Akhtari et al., 2013; Ayyagari et al., 2011; Tarafdar et al., 2015; Srivastana et al., 2015). While examining the causes of technological stress and the phenomena associated with it, it was seen that Lazarus' stress theory was theoretically utilized. In this research, taking its theoretical basis from (Lazarus & Folkman, 1984) and (Koeske & Koeske, 1993) stress theories, it was built on the model of technostress and its effect on work/life phenomena (Tarafdar et al., 2011) developed by Tarafdar et al. It is now well established in the literature that technological stress is one of the other types of stress and has important effects on the lives of employees. This research, on the other hand, was carried out in the maintenance department of the aviation industry, where technological stress was investigated before. The effects of technostress on productivity, ergonomics, demographics and time perspective in the aviation industry were examined (Doğan, 2016; Ufuk et al., 2015; Çoban, 2019). In parallel and in harmony with these studies, the effect of stress on decision making, which has been widely researched in the literature, and in this context, the effect of technostress on decision-making in the doctoral thesis research has been examined in a unique framework.

Literature studies show that the direct effect of technological stress on decision-making styles is an under-studied area. Decision-making styles, which are seen as a sub-specialty branch of detailed research on stress and decision-making behavior and have similar characteristics such as personality traits, have actually been discussed with different phenomena in the literature. Studies examining the psychological and sociological aspects of people's decision-making styles (Curşeu & Schruijer, 2012; Leykin & DeBrubeis, 2010) try to understand how the decision-maker makes decisions when faced with factors such as emotional, anxiety and worry, depression, and stress. It is thought that this research will also contribute to this kind of psychology-based research.

The significant and positive effect of the perception of job insecurity with technological stress supports other studies (Jordan et al., 2006; Valibayova, 2018) working on this subject and developing models. It is also thought to make significant contributions to the literature (Cheung et al., 2016; Katungu, 2018; Ouyang et al., 2015) questioning the relationship between decision, emotions and job insecurity. A result supporting the findings of researchers who examined job insecurity as a stress factor and modeled it using the theory of Lazarus & Folkman (1984) was determined. This research shows that the perception of job insecurity is a complete stressor and has a direct effect on technological stress and a moderator and direct effect on decision-making.

It should not be forgotten that decision-making and technostress in the aircraft maintenance industry are two interrelated concepts that affect the performance and work efficiency of aircraft maintenance personnel. In order to combat the problem of new technologies and to get the optimal decision, the quality and quantity of resources such as the number of technicians, necessary equipment and technical documents should be increased, daily, weekly and monthly workload plans should be rearranged, improvements should be made on organizational factors that affect or delay decisions, and decision-management and emotional intelligence training should be given to technicians. Besides, in order for technicians to cope with technostress, the technological workload should be equally distributed to the technicians, basic and refresher training should be given to adapt to new technologies, technical problems and updates should be done in a timely manner, working hours should be rearranged to prevent the physical and psychological negative effects of technostress, and social activities should be emphasized. should be given. The significant and positive interaction between technostress and the perception of job insecurity may suggest that there are mechanisms that can trigger each other or increase the effect of each other relatively. For this reason, studies can be carried out to reduce the perceptions of job insecurity as well as to try to protect employees from technostress. It is known that the aircraft maintenance sector is a field that requires high experience and continuous training, and in this respect, short-term contracts should not be imposed on the personnel. Employees should be informed about employers' long-term employment plans and convinced that they can take part in the care organization's future vision.

As a summary and suggestion;

* The effects model of technostress can now be updated in the light of new research,

* Technostress and decision-making styles research should be conducted for different sectors and a meta-analysis can establish relationships between the results.

* Effects of technological stress can be measured and desired/undesirable situation analysis can be made according to expected decision styles within the scope of prospect theory.

* It can be researched which decision styles are associated with the perception of job insecurity and its regulatory effect can be examined on the basis of sectors within the stress factor.

* Due to the developing technology, changing human life and renewed work/organization environment, a study can be carried out to update the existing technostress scale.

* Businesses should determine the general decision-making styles of the employees and optimize what kind of decision-making personnel will perform better in which departments,

* In order to be affected by technological changes and technological stress at the minimum level, businesses should review their education systems, and the availability of supervised learning and reinforcement learning methods should be increased.

* Aviation supervisors should be more sensitive to employees, especially regarding techno overload, should not leave them alone with the technological load and should take into account the feedback of the personnel on technology.

Ethical Approval

Not applicable

Conflicts of Interest

The authors declare that there is no conflict of interest regarding the publication of this paper.

References

Akhtari, P., Mohseni, M., Naderi, M., Akhtari, A. P., & Torfi, A. (2013, December). The effect of organizational environment on technostress of employees. International Journal of Conceptions on Management and Social Sciences, 1(1), 9-44.

Alam, M. A. (2016). Techno-stress and productivity: survey evidence from the aviation industry. Journal of Air Transport Management, 50, 62-70.

Appelbaum, S., Louis, D., Makarenko, D., Saluja, J., Maleshko, O., & Kulbashian, S. (2013). Participation in decision making: a case study of job satisfaction and commitment. Industrial and Commercial Training , 45(4), 222-229.

Arnetz, B. B., & Wiholm, C. (1997). Technological stress: psychophysiological symptoms in modern offices. Journal of Psychosomatic Research, 43(1), 35-42. September 08.

Ashford, S. J., Lee, C., & Bobko, P. (1989). Content, causes, and consequences of job insecurity: a theory-based measure and substantive test. Academy of Management, 32(4), 803-824. 12 26, http://www.jstor.org/stable/256569?origin=JSTOR-pdf

Aslan, K. (2011). Çalışanlarda iş güvencesizliği ve işini kaybetme kaygısının iş verimi ve iş üretkenliği üzerindeki etkilerinin incelenmesi: bilişim sektöründe bir araştırma. Maltepe Üniversitesi Sosyal Bilimler Enstitüsü , Endüstri ve Örgüt Psikolojisi. İstanbul

Ayyagari, R., Grover, V., & Purvis, R. (2011). Technostres: technological antecedent and implications. MIS Quarterly, 35(4), 831-858.

Baiocco, R., Laghi, F., & D'Alessio, M. (2009, November). Decision-making style among adolescents: relationship with sensation seeking and locus of control. Journal of Adolescence, 32(4), 963-976.

BarOn, J. (2007). Thinking and Deciding (4. Edition b.). Pennsylvania, NewYork: Cambridge University Press.

Bavolar, J., & Orosova, O. (2015, January). Decision-making styles and their associations with decision-making competencies and mental health. Judgment and Decision Making, 10(1), 115-122.

Boyer-Davis, S. (2018). The relationship between technology stress and leadership style: an empirical investigation. (W. I. Mondal, Dü.) Journal of Business and Educational Leadership, 8(1), 48-49.

Brand, S. (2000, June 19). The long now foundation. www.longnow.org: longnow.org/essays/technology-moving-too-fast/

Brod, C. (1984). Technostres: The human cost of computer revolution. Michigan Üniversitesi: Addison-Wesley.

Chatoupis, C. (2007). Decision making in physical education: theoretical perspectives. studies in physical Culture and Tourism, 14(2), 195-204.

Cheung, F., & Cheung, R. Y.-H. (2013). Testing the stressor-strain-outcome model. The Journal of Psychology Interdisciplinary and Applied, *147*(1), 89-103.

Cheung, S. Y., Gong, Y., & Huang, Y.-C. (2016, October). Emotional intelligence, job insecurity, and psychological strain among real estate agents: a test of mediation and moderation models. The International Journal of Human Resource Management, 27(22), 2673-2694.

Chiappetta, M. (2017). The technostress: Definition, symptoms and risk preventation. Senses and Sciences. 4 (1) 358-361.

Crum, A. J., Salovey, P., & Achor, S. (2013). Rethinking stress: The role of mindsets in determining the stress response. Journal of Personality and Social Psychology, 104(4), 716-718.

Curşeu, P. L., & Schruijer, S. G. (2012). Decision styles and rationality: an analysis of the predictive validity of the general decision-making sytle inventory. Educational and Psychological Measurement, 20(10), 1-10.

Çoban, R. (2019). Uçak bakım sektöründe iş yükü ve zaman baskısı üzerine bir örnek olay araştırması. Journal of Aviation, 3(1), 45-60.

Çolakkadıoğlu, O., & Güçray, S. S. (2007). Ergenlerde karar verme ölçeği'ni türkçe'ye uyarlama çalışması. Eğitim Araştırmaları Dergisi, 7(26), 62-71.

Dede, E. (2017). İş güvencesizliği algısının ve örgütsel güven düzeyinin örgütsel vatandaşlık davranışı üzerindeki etkileri: devlet ortaokulu ve özel ortaokul öğretmenleri üzerine bir araştırma. İstanbul Ticaret Üniversitesi Sosyal Bilimler Enstirüsü. İstanbul

Deniz, E. M. (2006). The relationship among coping with stress, life satisfaction, decision making styles and decision self esteem: an investigation with turkish university student. Social Behavior and Personality: An International Journal, 34(9), 1161-1170.

De Witte, H., & Naswall, K. (2003, May). Objective and subjective job insecurity: consequences of temporary work for job satisfaction and organizational commitment in four europan countrie. Economic and Industrial Democracy, 24(2), 149-188.

Doğan, S., & Oğuzhan, Y. S. (2015). Çalışanların duygusal zeka düzeylerinin işten ayrılma niyetlerine etkisi üzerine bir çalışma. Niğde Üniversitesi İktisadi İdari bilimler Fakültesi Dergisi, 8(2), 1-12. http://dergipark.ulakbim.gov.tr/niguiibfd/

Ennis, L. A. (2005, 01 09). The evoluation of technostress. Computers in Libraries, *25*(8), 10-12. 09 21,

Ergönül , İ. (2018). Doğal karar verme yetisinin belirleyicileri. Adli Tıp Enstitüsü. İstanbul: İstanbul Üniversitesi.

Ercengiz, M. (2019). The investigation of the relationship between emotion management skills and decision-making styles with the canonical correlation method. International Online Journal of Educational Sciences, 11(4), 119-130.

Flin, R., Salas, E., Straub, M., & Martin, L. (1997). Decision-making under stress- emerging themes and applications (1. Edition b.). London: Routledge.

Gaunt, R., & Benjamin, O. (2007). Job Insecurity, Stress And Gender. Community, Work & Family, 10(3), 341-355.

Greenhalgh, L., & Rosenblatt, Z. (1984, July). Job insecurity: toward conceptual clarity. Academy of Management Review, 9(3), 438-448.

Gurtner, S., Soyez, K., & Fischer, S. (2016, April). Adapting scott and bruce's general decisionmaking style inventory to patient decision making in provider choice. Medical Decision Making, 1-8.

Günalan, M. (2019). İş güvencesizliğinin örgütsel algılar, ayrılma niyeti ve performansa etkileri üzerine bir literatür incelemesi. International Review of Economics and Management, 7(2), 105-122.

Hayes, J., & Allinson, C. W. (1998). Cognitive style and the theory and practice of individual and collective learning in organizations. Human Relations, 51(7), 847-871. https://link.springer.com/article/10.1023/A:1016978926688

Heath, A. J. (2018). Emotional working memory training, work demands,stress and anxiety in cognitive performance and decision-making under uncertainty. Faculty of Health and Life Sciences, Work and Organizational Psychology. Smaland,İsveç: Linnaeus University.

Hellgren, J., Sverke, M., & Isaksson, K. (1999). A two-dimensional approach to job insecurity:consequences for employee attitudesand well-being. European Journal Of Work And Organizational Psychology, 8(2), 179-195.

Hirsch, P., Soucey, M., & De, M. (2006, August). Organizational restructuring and its consequences: rhetorical and structural. Annual Review of Sociology, 32, 171-189.

Hurrel, J. J., Nelson, D., & Simmons, B. L. (1998, October). Measuring job stressors and strains: where we have been, where we are, and where we need to go. Journal of Occupational Health Psychology, 3(4), 368-389.

Ilkım, N. Ş., & Derin , N. (2018). Algılanan iş güvencesizliği, iş tatmini ve birey-örgüt uyumu kavramları arasındaki ilişkiler. Sosyal Economic Araştırmalar Dergisi, 18(36), 239-250.

Jordan, P., Ashkanasy, N. M., & Lawrence, S. (2010). Job insecurity, emotional intelligence, workplace emotional reactions, and decision-making behaviors. 27th International Congress of Applied Psychology (s. 419-420). Melbourne, VIC, Australia: Australian Psychological Society.

Karakaya, T. (2018). İş güvenliği uzmanlarının çalışma yaşamı özellikleri iş stresi ve iş güvencesizliğinin değerlendirilmesi. Sağlık Bilimleri Enstitüsü. Ankara: Hacettepe Üniversitesi.

Katungu, C. (2018). Emotional intelligence, job insecurity and organizational commitment in organizations in sweden. Department of Psychology. Småland: Linnaeus University.

Kaymaz, O. (2019). Teknostres ve iş güvencesizliği ilişkisine yönelik bir uygulama. Trakya Üniversitesi Sosyal Bilimler Enstitüsü, İşletme. Edirne

Klein, G. A., Orasanu, J., Calderwood, R., & Zsambok, C. E. (1993). Decision making in action: models and methods. New Jersey: Ablex Publishing Corporation.

Koeske, G. F., & Koeske, R. D. (1993). A preliminary test of a stress–strain–outcome model for reconceptualizing the

burnout phenomenon. Journal of Social Service Research , *17*(3/4), 107-135.

Köse, S., & Baykal, B. (2018). İş güvencesizliği algısı ve iş arama davranışı ilişkisi: istanbul ve kocaeli örneği. Sosyal Güvenlik Dergisi, 8(2), 215-228.

Lam, C. F., Liang, J., Ashford, S. J., & Lee, C. (2015). Job insecurity and organizational citizenship behavior: exploring curvilinear and moderated relationship. Journal of Applied Psychology, 100(2), 499-510.

Leykin, J., & DeBrubeis, R. J. (2010, December). Decision-making styles and depressive symptomatology: development of the decision styles questionnaire. Judgment and Decision Making, 5(7), 506-515. http://www.sjdm.org/~baron/journal/10/10119/jdm10119.pdf

Lazarus, R. S., & Folkman, S. (1984). Stress, appraisal and coping. New York, USA: Springer Publishing Company.http://scholar.google.com/scholar_lookup?title=Psychological%20stress%20and%20the%20coping%20process&author=RS.%20Lazarus&publication_year=1966

McGrath, J. E. (1976). Stress and behavior in organizations. (M. Dunnette, Dü.) Chicago, USA: RandMc Nally.

Norulkamar, U., Ahmad, U., Amin, S. M., Khairuzzaman, W., & Ismail, W. (2009). The impact of technostress on organisational commitment among malaysian academic librarians. Singapore Journal of Library & Information Management, 38, 103-110. https://www.researchgate.net/publication/229046696

Nowzari, V. (2015). Relationship between emotional intelligence and decision-making styles among managers at sports organizations in fars province. Indian Journal of Fundamental and Applied Life Sciences, 5(S2), 1302-1310. 11 30. www.cibtech.org/sp.ed/jls/2015/02/jls.htm

Orçanlı, K., Bekmezci, M., & Fırat, Z. M. (2019, Ağustos). İş güvencesizliğinin iş performansına etkisinde örgütsel kimliğin aracılık etkisi. Uluslararası Toplum Araştırmaları Dergisi, 12(Özel Sayı), 1-28.

Orosova, O., & Bavolar, J. (2015). Decision-making styles and their associations with decisionmaking competencies and mental health. Judgment and Decision Making, 10(1), 115-122.

Ouyang, Z., Sang, J., Li, P., & Peng, J. (2015, December). Organizational justice and job insecurity as mediators of the effect of emotional intelligence on job satisfaction: a study from china. Personality and Individual Differences, 76, 147-152.

Nowzari, V. (2015). Relationship between emotional intelligence and decision-making styles among managers at sports organizations in fars province. Indian Journal of Fundamental and Applied Life Sciences, 5(S2), 1302-1310. www.cibtech.org/sp.ed/jls/2015/02/jls.htm

Probst, T. M. (2005). Countering the negative effects of job insecurity through participative decision making: lessons from the demand-control model. Journal of Occupational Health Psychology, 10(4), 320-329.

Ragu-Nathan, T. S., Tarafdar, M., Ragu-Nathan, B. S., & Tu, Q. (2008). The consequences of technostress for end users in organizations: conceptual development and empirical validation. Information Systems Research, 19(4), 417-433.

Roskies, E., & Louis-Guerin, C. (1990, September). Job insecurity in managers: antecedents and consequences. Journal of Organizational Behavior, 11(5), 345-359.

Salanova, M., Cifre, E., Llorenz, S., Grau, L. M., & Nogareda, C. (2007). El tecnoestre´s: concepto, medida y prevencio´n(technostress: concept, measurement and prevention). Nota Te´cnica de Prevencio´n, 730

Salo, I., & Allwood, C. M. (2011, March). Decision-making styles, stress and gender among investigators. Policing: An International Journal, 34(1), 97-119.

Scott, S. G., & Bruce, R. A. (1995, October). Decision-making style: the development and assessment of a new measure. Educational and Psychological Measurement, 55(5), 818-831.

Sharma, S. (2016, December). Job insecurity and stress -a study of private insurance players in amritsar city. International Journal of Management and Applied Science, 2(12), 99-106.

Schaufeli, W. B. (2016). Job insecurity research is still alive and kicking twenty years latter: a commentary. The Australian Psychological Society, 51, 32-35.

Shin, H. C. (2019). The relationship between psychological contract breach and job insecurity or stress in employees engaged in the restaurant business. Sustainability, 11, 1-10.

Shoss, M. K. (2017:1918, February). Job insecurity: an integrative review and agenda for future research. Journal of Management, 43, 1911-1939

Selvi, Ü. Y., & Sümer, N. (2018, Nisan). İş güvencesizliğinin etkileri: temel yaklaşımlar ve olumsuz etkileri düzenleyeci faktörler üzerine bir derleme. The Journal of Human And Work, 5(1), 1- 17.

Srivastana, S. C., Chandra, S., & Shirish, A. (2015). Technostress creators and job outcomes: theorizing the moderating influence of personality traits. 25(4), 355-401.

Sverke, M., & Hellgren, J. (2002). The nature of jop insecurity: understanding employment uncertainty on the brink of a new millennium. Applied Psychology: an International Review, 51(1), 23-43.

Tarafdar, M., Pullins, E. B., & Ragu-Nathan, T. S. (2015, 24 March). Technostress: Negative effect on performance and possible mitigations. Information Systems Journal, 1-50.

Tarafdar, M., Tu, Q., & Ragu_Nathan, T. S. (2011, Eylül). Crossing to the dark side: examining creators, outcomes and inhibitors of technostress. Communications of The Acm, 54(9), 111- 120.

Tarafdar, M., Ragu-Nathan, T. S., Ragu-Nathan, B., & To, Q. (2007). The impact of technostress on productivity. Journal of Management Information Systems Summer, 24(1), 301-328.

Thunholm, P. (2004). Decision-making style: habit, style or both? personality and individual differences, 36(4), 931-944.

Türen, U., Erdem, H., & Kalkın, G. (2015, Ocak). İşyerinde tekno-stres ölçeği: havacılık ve bankacılık sektöründe bir araştırma. (E. Cam, Dü.) Çalışma İlişkileri Dergisi, 6(1), 1-19.

Ünsar, A. S., & Dinçer, D. (2014). Duygusal zekanın işten ayrılma eğilimine etkisi bir alan araştırması. Yalova Sosyal Bilimler Dergisi, 5(7), 55-65.

Valibayova, G. (2018). İş güvencesizli algısının iş stresi ve iş performasına etkisi: araştırma görevlileri üzerine bir çalışma. Samsun: Ondokuz Mayıs Üniversitesi Sosyal Bilimler Enstitüsü.

Wang, Y. (1996). Organizational values and styles of decision-making process: a comparative study of chinese and australian managers. University of Wollongong Thesis Collection. June 27, http://ro.uow.edu.au/theses/1467

Weil, M. M., & Rosen, L. D. (1997). Technostress: coping with technology @work @home @play (Cilt 28 Şub 2011). California: J. Wiley.

Yaşar, O. (2016). Davranışsal Karar Verme Düşünme, Problem Çözme. Ankara: Detay Yayıncılık. https://www.researchgate.net/publication/312893290_Davranissal_Karar_Verme_Dusunme_P roblem_Cozme

Zsambok, C. E. (2014). Naturalistic decision making: where are we now? C. E. Zsambok, & G. Klein içinde, naturalistic decision making (2. Edition b., s. 3-17). NewYork: Psychology Press.

Cite this article: Yıldırım, B.A, Boru, D.E. (2023). The Effect of Technological Stress Dimensions on Employees' Decision-Making Styles and Regulatory Role of Job Insecurity Perception: A Research in The Aviation Sector. Journal of Aviation, 7(1), 39-54.

7 (1): 55-63 (2023)

Journal of Aviation

https://dergipark.org.tr/en/pub/jav

e-ISSN 2587-1676

The Mediating Role of Perceived Organizational Support in the Effect of Abusive Management and Psychological Contract Perception on Job Embeddedness in Air Transport Businesses

Seçil Ulufer Kansoy[1*]

[1*] Kırklareli University, Lüleburgaz Faculty of Aeronautics and Astronautics, Department of Aviation Management, Kırklareli, Türkiye.
seciluluferkansoy@klu.edu.tr

Article Info

Received: 24 October 2022
Revised: 14 December 2022
Accepted: 26 December 2022
Published Online: 26 February 2023

Keywords:
Abusive management
Psychological contract perception
Job embeddedness
Perceived organizational support
Air transport businesses

Corresponding Author: *Seçil Ulufer Kansoy*

RESEARCH ARTICLE

https://doi.org/10.30518/jav.1193896

Abstract

The study attempts to investigate how perceived organizational support mediates the relationship between perceived psychological contract, work embeddedness, and abusive management. Data for the study—which is based on the theories of social exchange and resource conservation—was gathered from Istanbul-based airlines that provide transportation services. The study's sample consisted of 294 individuals. The bootstrap approach and the structural equation model-Amos were used to test the research's hypotheses. Results showed that perceived organizational support mediates the association between perceived psychological contract and work embedding and abusive management. The results also offer a thorough evaluation of how psychological contract perception and abusive management improve job embedding through higher perceived organizational support. This study on airline workers in Turkey is significant because it is the first to address the negative effects of abusive management, the benefits of employees' psychological connections to their workplaces, and the positive effects of employees' perceptions of organizational support on their job embeddedness.

1. Introduction

In today's increasingly competitive environment, it is getting harder for organizations to compete. It is also a fact that the survival of organizations is evaluated in multiple ways. Therefore, in order to reach their predetermined goals, the organizations do not only produce goods and/or services but also act based on the welfare, belonging, well-being and happiness of the employees who are the most valuable capital for the organization. Otherwise, employees will leave the job and the organization, resulting in high costs for organizations (Rubenstein, Eberly, Lee, Mitchell, 2018:1). It is not expected from the organizations in airline transport to bear a new cost item. It is inevitable to state that there are various elements that organizations need to provide for employees to coalesce into their jobs and organizations, that is, to experience organizational identification (Mael ve Ashfort, 1992) and, so to speak, to be embedded in their work.

From the hypothesis that the employees show their efforts as the product of a multi-faceted evaluation while performing their work within an organization, it is ideal for them to feel safe cognitively, physically and emotionally. Otherwise, it is possible for them to get disappointed by or bear a grudge against their organizations, to turn to organization cynicism in other words (Dean, Brandes ve Dharwadkar, 1998). In order to prevent that, organizations need to gain the trust of employees by offering promises they can keep. It can be ensured that the employees stay at the organization through the positive effect of the psychological contract, which is a type of contract, on the perception of the employees. In the studies conducted to seek an answer to the questions Why does an employee stay in his/her organization? or the opposite question Why does an employee leave his/her organization? as emphasized by Mitchell et al. (2001: 1104), the reasons for turnover behavior could not be adequately explained with existing concepts or theories, and the concept of job embeddedness was discussed. It is observed that the concepts that are thought to be effective in job embeddedness in the future, the leader-member exchange (LME) as in the study by Harris, Wheeler and Kacmar (2011), psychological safety, perception of support by Singh, Shaffer and Selvarajan (2018), LME and person-organization fit by Mazıoğlu and Kanbur (2020), perception on organizational support by Afsar and Badir (2016) and Akgündüz and Şanlı (2017), the trust for the manager and the perceived organizational justice by Akgündüz, Güzel and Harman (2016), contextual performance perception by Kesen and Akyüz (2016), are mostly positive concepts. However, it is understood that the possible effect of a negative factor on job embeddedness is not addressed or there are hardly any studies (Holtom, Burton, and Crossley, 2012: 434). Considering the general distribution of the studies, it is

observed that they focus on the health, tourism and accommodation sectors.

Within this context, whether the employees who work in airline transportation companies experience job embeddedness and the perception of the psychological contract, abusive management and organizational support perception, which can be considered as the factors affecting these situations, are evaluated. The lack of studies that deal with the concept of job embeddedness in airline transportation companies and examine it comprehensively together with the other three variables reveals the motivation of the research.

2. Theoretical Framework

2.1. Job Embeddedness

Intellectual capital has evolved into a source of competitive advantage for enterprises in today's knowledge-based economy. Companies now understand how important employee retention and intellectual capital development are to their ability to compete successfully. The choice of employees to remain with or quit their current employer is a crucial factor in work-related studies across all professional activity areas (Khan et al., 2018). Retaining employees is crucial for all industries.

The idea of embeddedness is a theoretical structure attracting the attention of scholars from various disciplines in recent years and means that economic actions and outcomes, just like all social actions and outcomes, are affected by the mutual relationships of the actor and the structure of the general network of relationships (Sandberg, 2003).

Some academics have broadened the concept of embeddedness by including variations like cognitive, cultural, and political embeddedness in response to criticism leveled at Granovetter for his too limited grasp of the concept (Sandberg, 2003). The term embeddedness has been used to refer to the influence of social structure over the economic activities of individuals and other social units in sociology and economics literature in the past. According to Baum and Oliver (1992), the economic players' level of embedding in their social structures will depend on how deeply they participate in relational networks. These social relationships and systems have an impact on and limit how people engaged act economically (Nguyen, 2010). From a sociological perspective, embeddedness is expressed as the forces that provide the connection of individuals with other people, groups and teams. It has also been associated with an individual's intention to stay in or leave an institution (Beduk and Yıldız, 2018). Nevertheless, according to Mitchell et al., the use of embedded structures by sociologists and economists is much broader than they are in terms of units of analysis and dependent variables. While sociologists and economists focus on individuals, groups and organizations in various economic actions, Mitchell et al. focus more narrowly on individuals who stay in their organizations (Nguyen, 2010).

Job embedding represents a broad constellation of effects regarding employee retention. Embedded Figures Test and Kurt Lewin's Field Theory help to understand the core of this structure (Mitchell et al., 2001). Embedded figures are related to the psychological background of the individual and are used in psychological tests. It is difficult to leave the embedded figures and they surround individuals (Dedeoğlu et al., 2016). According to Kurt Lewin's Field theory, there are driving and hindering factors in shaping the behavior that each individual exhibits (Karaduman, 2019).

Many articles and authors have used the terms voluntary turnover or intention to depart to explain the idea of work embeddedness (Birsel et al., 2012). Most of the theoretical underpinnings for psychology research on voluntary turnover are presented by March and Simon (1958), who define voluntary turnover as a reflection of an employee's decision to engage in the activities of his or her business (Lee et al., 2004). To put it another way, when an employee leaves their job voluntarily, they do so to stop their association with the organization (An, 2019). There are numerous causes that lead to people quitting on their own, and numerous research on the employee turnover rate have been done throughout the years.

Traditional research on staff turnover has focused on negative job attitudes (such as low job satisfaction levels) as reasons for turnover. In their important work that they brought to the literature, March and Simon (1958) propose a psychological explanation for employee turnover based on the individual's utility functions. When the outcomes (such as wages or promotion opportunities) are lower than the expectations of the employees, the employee becomes dissatisfied, and this increases his/her desire to move and motivates the employee to leave the organization s/he works for. Employee turnover then becomes a function of the extent of this desirability with the perceived ease of movement, that is the number of perceived job alternatives (Harman et al., 2007).

The ease of mobility refers to perceived job alternatives or actual unemployment rates, but the attractiveness of moving over time refers to work attitudes like job satisfaction or organizational commitment. More specifically, the majority of employee exchange ideas are based on the idea that employees quit their jobs if there are better options accessible to them. Work involving voluntary turnover (employee exchange) is characterized by dissatisfaction, a lack of commitment, and a concentration on standard job alternatives (Lee et al., 2004).

2.2. Perceived Organizational Support

It is of great importance for organizations to support their employees in order to keep up with the innovations of our age. It is only in this way that organizations can survive. Moreover, organizations are not groups of people that come together randomly, they are structures where individuals gather for a common goal, and they need to have certain characteristics, values and roadmap in order to achieve their goals. The existence of all these organizational components in an efficient structure and the support of the organization for the employees who are the locomotive of the organization are essential tasks for organizations aiming at efficiency. The organizations have to make their employees feel valued and necessary while fulfilling this duty. This can be possible by paying attention to their needs and requirements. Employees who feel that they are respected, valued and approved by organizational support may develop a sense of commitment as well as positive personal feelings for their organizations. The organizations can support their employees by giving importance to their suggestions, criticisms, and creative ideas, or they can also support them by appreciating their success, giving job security, or keeping the intra-organizational communication and organizational climate highly positive (Gül, 2010).

The support that employees receive from the organization, the importance attributed to their contribution, the satisfaction of their physiological needs and their happiness are direct indications that they receive support from the organization. Since these indicators occur as a result of mutual interaction, the perceived organizational support of the individual is also

directly related to the realization of this interaction (Eisenberger et al., 1986).

The perceived organizational support for the employees also develops according to what the organization contributes to them, the importance given to their welfare, the support given for creating a social identity, and the reward for their contribution. The employees perceive and directly feel the organizational support when they feel the support of the organization for them (Eisenberger, Cummings, Armeli, & Lynch, 1997).

Çakır (2001) approaches the concept of organizational support from a different perspective. According to Çakır (2001), organizational support begins with caring of employees' ideas. The starting point of organizational support is to develop a helpful approach in the areas needed by the employees both within and outside the workplace and taking the employees into account in this regard. Under such conditions, perceived organizational support of the employees are quite high (Çakır, 2001).

Another factor increasing the perceived organizational support of the employees is listening to the suggestions and complaints of the employees about the organization. Considering the opinions and suggestions of the employees about the organization where they spend a large part of their lives may result in affecting their perceived organizational support at the same rate (Özdevecioğlu, 2003).

The establishment of a reward system is another factor that increases perceived organizational support. Rewarding the employees as a result of their performance and the additional work they perform also significantly increases the perceived organizational support of the employees. In organizations where the reward mechanism works well, employees feel organizational support to a great extent (Eisenberger et al., 1997).

The other approaches that increase the perceived organizational support of the employees are respect, approval and caring. If the employees are aware that they are respected in the organization, feel that they are cared for because of their work and are approved by their superiors, the perceived organizational support of the employee will be significantly higher (Armeli, Eisenberger, Fasolo, & Lynch, 1998).

2.3. Abusive Management

From the definition of Tepper (2000: 178), abusive management, which refers to the perceptions of subordinates regarding the constant hostile behavior of superiors verbally or nonverbally except for physical contact with their subordinates, is the superiors' long-term emotional, cognitive and ultimately psychological maltreatment towards subordinates (Lin, Wang, & Chen, 2013). As a matter of fact, managers who have adopted abusive management style exhibit behaviors such as humiliating employees in a way that insults them in front of others, mocking and mistreating them, intimidating them to lose their job, talking loudly or even shouting at employees in anger for no reason, speaking in a way that violates the private lives of their employees, disturbing employees by giving vicious and hostile looks and not fulfilling their promises to employees. These destructive behaviors that harm the organization over time are defined as ordinary bullying by Ashfoth (1997), as aggressive manager by Schat, Desmarais and Kelloway (2006) and as undermining manager by Duffy, Ganster and Pagon (2002). However, the concept of abusive management has been used predominantly until today (Tepper, 2000).

In abusive management which is also considered an active manifestation of destructive leadership, it is known that, as Ashfoth (1997) states, this type of managers use their power and authority in an oppressive and even arbitrary manner in order to deliberately mistreat their subordinates. Even though these behaviors of the manager who adopts abusive management do not include any tendency and/or attack toward the physical integrity of the employees, they cause damage to the physical and psychological health of the employees over time due to the continuity of these behaviors (Lin et al., 2013; Martinko, Harvey, Brees, and Mackey, 2013). As Tepper (2000) emphasizes, it is respectively observed in managers who have adopted abusive management that a) the manager does not correct or change these behaviors even though s/he is aware of it, b) the employee who is exposed to abusive management maintains the relationship with the manager who exhibits this management style, c) this behavior will be permanent unless the manager who exhibits abusive management ends the relationship with the employee. As a matter of fact, the abusive management becomes more evident because of reasons such as employee's anxiety and fear of losing his job, not being able to object to the manager, feeling powerless against the manager, economic concerns, rush and anxiety due to failure to find a new job (Tepper, 2000).

2.4. Psychological Contract Perception

As defined by Aselage and Eisenberger (2003), the relationship between the employee and the organization is a type of relationship based on mutual exchange in which the employee responds with time, effort and individual elements such as belonging to the organization, in return for the material and moral elements provided to the employee by the organization. This way which is used to define the mutual exchange between the organization and the employees is called the psychological contract (Rosen, Chang, Johnson, & Levy, 2009: 204). The most general and common definitions of psychological contracts are the beliefs of the employees about the terms and conditions of the mutual exchange agreement with the other party (Rousseau, 1989: 123) and an implicit contract that reveals the expectations of the parties about what they will receive from each other and what they will give to each other in the relationship between the individual and the organization (Kotter, 1973: 92). Psychological contracts that go beyond official legal employment contracts include the beliefs of employees about what they consider a right to receive from their employer or what needs to be received personally. In fact, employees believe that the employer makes some kind of promise in a way that guarantees to keep them (Robinson, 1996). Psychological contracts which are considered a kind of employee perception (Rosen et al., 2009) include the ability of the employer to respond through certain resources in response to what the employee puts forward and presents for the organization (Schein, 1980). This relationship that is developed with the exchange of social and emotional resources emerges according to the level of fulfillment of the expectations from the employee towards the organization (Kiewitz, Restubog, Zagenczyk, & Hochwarter, 2009).

Divided into relational and operational (MacNeil, 1995), psychological contracts are formed in three different ways. The first of these is the explicit and/or implicit promises made by the party that has a relationship with the employee during the job interview. Mutual obligations are determined in the communication between colleagues and the manager after the job is started. In this way, the employee creates a contract that

is set individually as well as the official contract. Secondly, employees develop a prediction regarding the obligations they must fulfill by observing the operation and policies in the working environment. As the third and also the last element, it is possible to state that the employer or the organization enables the employees to form a psychological contract by transferring information about performance evaluation methods, rewarding processes and organizational culture (Rousseau, 1990). From these expressions, it is possible that this perception formed in the minds of the employees is an individual evaluation (Coyle-Shapiro, Pereira-Costa, Doden, & Chang, 2019) there can be a perception that the contract is not fulfilled by the employer (Robinson, 1996). This situation that is called the perception of psychological contract violation is defined by Morrison and Robinson (1997: 230) as the failure of the organization to fulfill one or more obligations in the individual's psychological contract in proportion to the individual's contributions to the organization. The assumption by Zuber and Hammon (2002: 43) that there will be emotional loss and even disappointment as a result of not fulfilling the promises given and the expectations of the employee and the trust will be harmed supports the statements of Rousseau (1989; 1990) with the emphasis on the interpersonal and at the organizational level (Thomas and Anderson, 1998).

2.5. Relationships Between Concepts

H1: Abusive management has a negative significant effect on job embeddedness.

There is no study on the concept of abusive management in airline transport companies.

H2: Psychological contract perception has a positive significant effect on job embeddedness.

Elden (2020) analyzes the effect of psychological contract violation on job performance in the employees of airport ground services. A survey was applied to 247 employees of airport ground services in various provinces. As a result of the analysis, a negative and significant relationship was found between psychological contract violation and job performance.

H3: Abusive management has a negative significant effect on perceived organizational support.

There is no study on the concept of abusive management in airline transport companies.

H4: Psyhocological contract perception has a positive significant effect on the perceived organizational support.

There is no study on the concept of abusive management in airline transport companies.

H5: Perceived organizational support has a positive significant effect on the job embeddedness.

Özsavaner (2019) analyzes the effects of organizational justice and perceived organizational support on the subjective well-being of aviation ground services. As a result of the survey conducted on 182 employees at Istanbul Airport of a ground service company with a Class A work license, it was concluded that organizational justice and perceived organizational support had a positive effect on subjective well-being.

In the study on the mediation function of work-life balance in the link between perceived organizational support and organizational commitment, Özgül et al. (2020) evaluate cabin attendants. In the study, 258 cabin attendants participated in a survey. The analysis led to the conclusion that organizational support and organizational commitment dimensions play a partly mediating role.

Aydemir (2021) explores the connection between organizational culture, intrapreneurship behavior, and perceived organizational support in the Turkish aviation sector. This study, which involved 235 employees and a survey, found that organizational culture and perceived organizational support had a substantial impact on a group of airline employees' inclinations to engage in intrapreneurship.

H6: Perceived organizational support has a mediation role in the effect of abusive management on job embeddedness.

There is no study on the concept of abusive management in airline transport companies.

H7: Perceived organizational support has a mediation role in the effect of the psychological contract on job embeddedness.

Elden (2020) analyzes the effect of psychological contract violation on job performance in the employees of airport ground service. A survey was applied to 247 airport ground services employees in various provinces. As a result of the analysis, a negative and significant relationship was found between psychological contract violation and job performance.

3. Methodology

3.1 Research Model

The data of the research were collected from the full-time employees as ground services personnel in the organizations operating within the scope of air transport in Istanbul through surveys. The obtained data were analyzed using SPSS and SEM-AMOS package programs.

3.2. Universe-Sample (Research Group)

The research group is the ground services personnel in aviation organizations.

3.3. Data Collection Tools

During the research process, an online survey form was prepared for the participants. First of all, the consent form was presented to the participants in the form by stating the permission obtained from the ethics committee (The Decision of Social Sciences Ethical Committee dated 27.08.2021 and numbered 2021/9 of Rectorate of Istanbul Aydın University Ethical Committee of Social and Human Sciences) required for the research. The purpose of the research was explained, and it was stated that participation in the research was completely voluntary. Employees of airline companies operating in Istanbul were included in the study. In this state, the universe of the study consists of approximately 45000 people. There are five sections to the survey form. An **information form** for sociodemographic details can be found in the first section (age, gender, marital status, education level, seniority in the institution). The second, third, fourth, and fifth sections, consecutively, provide the scales that were utilized to test the study model.

Job embeddedness scale, Job embeddedness scale which was developed by Crossley et al. (2007) and adapted into Turkish by Kesen and Akyüz (2016), consisting of seven statements and one dimension was used. In the scale, there are statements such as I am too devoted to my job to leave my

institution., I cannot leave this institution easily when I think of what my institution has provided me. The Cronbach's alpha value of the original scale was 0.88, the Cronbach's alpha value of the Turkish version was 0.91, and the Cronbach's alpha value in the study was 0.96.

Perceived organizational support scale, An eight-statement short form of the perceived organizational support scale developed by Eisenberger, Huntington, Hutchison, and Sowa (1986) with 36 statements, abbreviated by Eisenberger et al. (1997) and adapted into Turkish by Dirican (2020) was used. In the scale, there are statements such as My institution really cares about my well-being and welfare., My institution is proud of my achievements at work.. The Cronbach's alpha value of the original scale was 0.93, the Cronbach's alpha value of the Turkish version was 0.92, and the Cronbach's alpha value in the study was 0.93.

Abusive management scale, A five-statement version of the abusive management scale, which was first developed by Tepper (2000) with 15 statements, shortened by Mitchell and Ambrose (2007) and adapted into Turkish by Ülbeği, Mimaroğlu-Özgen and Özgen (2014) was used in the study. In the scale, there are statements such as My manager says my thoughts or feelings are ridiculous., My manager says I am incompetent.. The Cronbach's alpha value of the original scale was 0.89, the Cronbach's alpha value of the Turkish version was 0.97, and the Cronbach's alpha value in the study was 0.91.

Psychological contract perception scale, The five-statement psychological contract perception measure, created by Robinson and Morrison in 2000 and translated into Turkish by Çetinkaya and Özkara in 2015, was utilized. Statements like Almost all the promises made to me during the recruitment process have been met and Promises made to me so far have been properly fulfilled can be found in the scale. The Turkish version's Cronbach's alpha value was 0.94, the original scale's Cronbach's alpha value was 0.92, and the study's Cronbach's alpha value was 0.98.

3.4. Data Analysis

While exploratory factor analysis (CFA) and confirmatory factor analysis (CFA) were performed to test the validity of the scales used in the research, Cronbach's alpha coefficient values were checked to test their reliability. Path analyses were performed on SEM-AMOS to test the hypotheses in the research. The bootstrap method was preferred in testing the mediation role.

4. Result and Discussion

4.1. Findings of the Sample

The sample of the study consists of 294 participants. According to the findings including the socio-demographic characteristics of the participants, 62.2% of the 294 participants were female (n=183) and 37.8% were male (n=111). The smallest age value of the participants is 20, the highest age value is 49, the mean age is 32.83, and the standard deviation is 6.567. Considering their marital status, it is observed that 51% of them are single (n=150) and 49% of them are married (n=144). Their education levels are predominantly associate degree (41.2%) and undergraduate (37.4%). For their seniority in the institution, 7.5% is less than 1 year, 31.6% is 1-5 years, 30.6% is 6-10 years, 19% is 11-15 years, 9.5% is 16-20 years and 1.7% is 21 years or more.

4.2. Findings of Exploratory and Confirmatory Analysis

As Yılmaz and Bilge (2018) state, the measurement model which is a structural model that indicates the relationship between the observed variable(s) and the latent variable(s), includes four variables within the scope of the research. Before testing the hypotheses in the research, the compatibility of the measurement model with the data was checked (Anderson & Gerbing, 1988). For this purpose, CFA was performed with the maximum likelihood method (Jöreskog and Sörbom, 2006). As a result of CFA, it is understood that the fit index values of the measurement model (Cmin/df= 2.038; CFI= 0.972; NFI= 0.947; AGFI= 0.884; RMR= 0.023; RMSEA= 0.060; SRMR= 0.0425) are in the acceptable range (Hu and Bentler, 1998). Besides, as indicated in Table 1, the CFA values of the variables indicate that each factor is loaded separately. It is understood that the standardized factor loads in the expressions of the variables are loaded above 0.60 and the values are between 0.729 and 0.964.

Convergent validity, average variance extracted (AVE) and composite reliability (CR) values of the scales included in the study were examined (Fornell & Larcker, 1981). According to the AVE and CR values in Table 1, it is above the critical threshold values (AVE> 0.50; CR> 0.70) (Bagozzi ve Yi, 1988; Fornell ve Larcker, 1981). Additionally, the fact that each of the statements of the scales had a factor load of more than 0.60 indicates that the scales represent good convergent validity. When the discriminant validity is examined (Table 2), it is seen that the square root of the AVE value for each scale is higher than the correlation value between the variables (Aytaç et al., 2018; Hair et al., 2009). According to this finding, it is understood that the discriminant validity of the scales was ensured (Fornell and Larcker, 1981).

Table 1. Confirmatory Factor Analysis

Statements of the scales	Factor Load	AVE	CR
Job embeddedness		**0.69**	**0.96**
1. I belong to this organization.	0.863		
2. It is hard for me to leave this organization.	0.913		
3. I am too devoted to this organization to leave.	0.907		
4. I feel connected to this organization.	0.869		
5. When I think about what my institution has provided me, I cannot easily leave this institution.	0.922		
6. It is easy for me to leave this organization. (T)	0.914		
7. I am strongly attached to this institution.	0.906		
Cmin/df= 2.357; CFI= 0.993; NFI= 0.988; AGFI= 0.936; RMR= 0.008; RMSEA= 0.068; SRMR= 0.0111			
	Factor Load	**AVE**	**CR**
Perceived organizational support		**0.66**	**0.96**
1. My institution sees my contributions to the institution and cares for me.	0.791		
2. My institution does not see the extra effort I put into the institution. (T)	0.814		
3. My institution does not consider the complaints from me. (T)	0.799		
4. My institution truly cares about my well-being and welfare.	0.833		
5. My organization does not always realize that I am doing my best at work. (T)	0.826		
6. My organization cares about my overall satisfaction at work.	0.823		
7. My institution does not care about me at all. (T)	0.816		
8. My institution is proud of my achievements at work.	0.729		
Cmin/df= 1.343; CFI= 0.998; NFI= 0.991; AGFI= 0.963; RMR= 0.007; RMSEA= 0.034; SRMR= 0.0097			
	Factor Load	**AVE**	**CR**
Abusive Management		**0.68**	**0.91**
1. My manager makes fun of me.	0.946		
2. My manager says my thoughts or feelings are ridiculous.	0.831		
3. My supervisor humiliates me in front of others.	0.766		
4. My manager makes negative comments about me to others.	0.825		
5. My manager says I am incompetent.	0.740		
Cmin/df= 1.830; CFI= 0.996; NFI= 0.996; AGFI= 0.962; RMR= 0.006; RMSEA= 0.053; SRMR= 0.0167			
	Factor Load	**AVE**	**CR**
Psychological contract perception		**0.81**	**0.95**
1. Almost all the promises made to me during the recruitment process were fulfilled.	0.956		
2. Since I was hired, I think that the promises made to me have been fulfilled.	0.964		
3. The promises made to me so far have been perfectly fulfilled.	0.857		
4. Considering my contributions to the place where I work, all the promises made to me have been fulfilled.	0.884		
5. Most of the promises made to me have been kept, as I have fulfilled my duties in my contract.	0.860		
Cmin/df= 1.408; CFI= 0.999; NFI= 0.997; AGFI= 0.971; RMR= 0.003; RMSEA= 0.037; SRMR= 0.0028			
Measurement model (Cmin/df= 2.038; CFI= 0.972; NFI= 0.947; AGFI= 0.884; RMR= 0.023; RMSEA= 0.060; SRMR= 0.0425)			

4.3. Findings of Descriptive Statistics and Correlation Analysis

The mean (X (Av.)), standard deviation (S.) and correlation coefficients for the variables in the research model are given in Table 2.

Table 2. Correlation Analysis

	X (Av.)	S.	1	2	3	4
1. Job embeddedness	3.76	0.722	(0.83)			
2. Perceived organizational support	3.63	0.779	0.825**	(0.81)		
3. Abusive management	1.81	0.481	-0.146*	-0.134*	(0.82)	
4. Psychological contract perception	3.22	1.018	0.680**	0.717**	-0.074	(0.90)

Note: N= 294; X (Mean)= Mean; S.= Standard Deviation; The values in parentheses are the square root of the AVE values of the variables. **p<0.01; *p<0.05

For the values in the table, it is observed that the level of job embeddedness of the participants is higher than the other three variables (Mean= 3.76), the evaluations of abusive management in their organizations are relatively low (Mean= 1.81), and abusive management is in a negatively related to the perceived organizational support and job embeddedness (r=-0.134, p<0.05; r=-0.146, p<0.05, respectively). The psychological contract perception was positively related to the perceived organizational support and job embeddedness (r=0.717, p<0.01; r=0.680, p<0.01, respectively). It was found that the perceived organizational support was positively related to job embeddedness (r=0.825, p<0.01).

4.4. Findings of Hypothesis Test and Mediation Effect

Path analysis was conducted to evaluate the bootstrap method in order to test whether perceived organizational support plays a mediating role in the relationship between abusive management and psychological contract perception and job embeddedness. In the data set showing the normal distribution, the tests related to the hypotheses of the research were made with the AMOS package program. Firstly, the measurement model which includes abusive management, psychological contract perception, perceived organizational support and job embeddedness was tested. When the goodness-of-fit values of the relevant model (Cmin/df=2.038; CFI=0.972; NFI=0.947; AGFI=0.884; RMR=0.023; RMSEA=0.060; SRMR=0.0425) are analyzed, it is understood that the model is confirmed. After the validated measurement model, the hypotheses were tested respectively. According to the results of the structural model, it was found that while abusive management which is one of the independent variables did not have a significant effect (ß=-0,064, S. H.=0,098, p=0,510) on job embeddedness which is a dependent variable, psychological contract perception which is another independent variable had a significant effect (ß=0,480, S. H.=0,035, p<0,01) on job embeddedness that is a dependent variable. According to these findings, while the H1 hypothesis is not supported; H2 hypothesis was supported. In another path diagram within the scope of the research, it was found that abusive management which is one of the independent variables affected the perceived organizational support which is the mediating variable (ß=-0.255, S. H.=0.104, p<0.01), and similarly, psychological contract perception which is another independent variable significantly affected the perceived organizational support, which is the mediating variable, (ß=0.535, S. H.=0.035, p<0.01). According to these findings, H3 and H4 hypotheses were supported. When the effect of perceived organizational support which is the mediating variable on the job embeddedness which is a dependent variable, (ß= 0.795, S. H.= 0.046, p<0.01) is analyzed, it is understood that the effect is significant. Based on the findings obtained, the H5 hypothesis was supported.

Through the inclusion of the perceived organizational support, which is the mediating variable into the model, it was found that the path drawn from abusive management which is one of the independent variables to job embeddedness which is the dependent variable was significant (ß=0.142, S. H.=0.056, p<0.01), and that perceived organizational support and abusive management explained 572.8 of the change in job embeddedness. It is observed that the goodness-of-fit values (Cmin/df=2.175; CFI=0.972; RMR=0.023; RMSEA=0.063; SRMR=0.0465) of the model are in the acceptable range. In the mediation analysis performed with the bootstrap technique, it was found that the indirect effect of abusive management on job embeddedness through the perceived organizational support (ß=-0.129, 95% CI [-0.269; 0.011]) was significant. According to this finding, it is shown that perceived organizational support has a mediating role in the relationship between abusive management and job embeddedness. In this case, hypothesis H6 was supported.

On the other hand, it is understood that the path drawn from psychological contract perception to job embeddedness remained significant (ß=0,537, S. H.=0,035, p<0,01) in the presence of the perceived organizational support which was included in the model with the psychological contract perception which is an independent variable in the study and that the psychological contract perception and job embeddedness explain 73.3% of the change. It is observed that the goodness-of-fit values of the model (Cmin/df=1.962; CFI=0.982; RMR=0.017; RMSEA=0.057; SRMR=0.0211) are in the acceptable range. In the mediation analysis conducted with the bootstrap technique, it was found that the indirect effect of psychological contract perception on job embeddedness through the perceived organizational support (ß=0.529, 95% CI [0.430; 0.626]) was significant. According to this finding, it is shown that perceived organizational support has a mediating role in the relationship between psychological contract perception and job embeddedness. In this case, hypothesis H7 was supported.

Table 3. Path Analysis

	Dependent Variables			
Predictor Variables	**Perceived Organizational Support**		**Job Embeddedness**	
	ß	SH	ß	SH
Abusive Management	-	-	-0.064	0.098
R^2	-	-	0.002	
Abusive Management	-0.255**	0.104	-	-
R^2	0,022		-	
Abusive Management	-	-	0.142***	0.56
Perceived Organizational Support	-	-	0.795***	0.46
R^2	-		0.728	
Indirect Effect			-0.129; %95 GA [-0.269; 0.011]	
Psychological Contract Perception	-	-	0.480	0.035
R^2	-	-	0.483	
Psychological Contract Perception	0.535**	0.035	-	-
R^2	0.527		-	
Psychological Contract Perception	-	-	0.537***	0.35
Perceived Organizational Support	-	-	0.795***	0.46
R^2	-		0.733	
Indirect Effect			0.529; %95 GA [0.430; 0.626]	

5. Discussion and Conclusion

There are various factors that can affect employees in a managerial sense in organizations. These factors can connect employees more to the work and the organization, and on the other hand, they can psychologically and effectively distance them from the organization and work. The information and promises that employees receive from the organization can be a big determinant of whether they will remain in the organization or not. The concepts of abusive management, job embeddedness, perceived organizational support and psychological contract perception in the study are concepts that have a direct impact on the working life of people.

The level of job embeddedness of the participants in the study stands out compared to other factors. According to this result, it can be stated that the participants have no plans to leave the institution they work in for any reason. On the other hand, the opinions of the participants about abusive management for the institution they work in are at a positive level. It can be stated that they have not encountered an abusive management approach in the institution where they work. It is observed that there is a negative relationship between abusive management approach and organizational support and job embeddedness. It can be concluded that if the abusive management approach is applied, the perceptions of organizational support and job embeddedness will decrease. From another perspective, a positive relationship is observed between the perception of psychological contracts and organizational support and job embeddedness. It is stated that if the promises made to employees before starting work are fulfilled, the perceptions of organizational support and job embeddedness will be high.

As a result of regression analysis, while abusive management does not have any effect on job embeddedness, it is observed that the psychological contract has a positive effect. Employees prioritize the fulfillment of the promises made to them before starting the job more than the concept of abusive management. Meeting the expectations built before starting a job stands out for the employees. Elden's study (2020), which produced unfavorable and substantial results, found a link between psychological contract violation and job performance. The outcome shown here backs up the current study.

As a result of regression analysis, it is stated that abusive management has a negative impact on organizational support. It is reasonable that organizational support is gradually decreasing in an organization where there is an abusive management approach. On the other hand, it is observed that the psychological contract has a positive effect. In case the promises made to the employees before entering the job are fulfilled, there will be a positive reflection on the perception of organizational support.

It is observed that if the perception of organizational support increases, it will have a positive effect on job embeddedness. Some organizational justice, organizational support, subjective well-being, and demographic parameters in the study by Özsavaner (2019) in an aviation service company reveal substantial disparities. According to Aydemir's study (2020), organizational cultures and perceived organizational support have a substantial impact on a group of airline sector employees' intrapreneurship behaviors (intentions). Additionally, it was discovered that the three research factors were statistically significant and connected with one another. Employees who feel organizational support are less likely to leave the institution for any reason. If the perception of organizational support persists in the presence of abusive management, this creates a significant situation on job embeddedness. Even if there is abusive management, if the perception of organizational support is established, the reflection on employees will be positive and the possibility of leaving the job will be reduced. Similarly, if the perception of psychological contract is supported by the perception of organizational support, it will be significant on job embeddedness. In such a case, the psychological contract will also support the formation of a positive perception through organizational support.

Ethical Approval

This study protocol received ethical approval from the Istanbul Aydın University's Social Sciences and Humanities (2021/09/06)

Conflicts of Interest

The authors declare that there is no conflict of interest regarding the publication of this paper.

References

Afsar, B. & Badir, Y. F. (2016). Person–organization fit, perceived organizational support, and organizational citizenship behavior: The role of job embeddedness. Journal of Human Resources in Hospitality & Tourism, 15(3), 252-278.

Akgündüz, Y. & Şanlı, S. C. (2017). The effect of employee advocacy and perceived organizational support on job embeddedness and turnover intention in hotels. Journal of Hospitality and Tourism Management, 31, 118-125.

Akgündüz, Y., Güzel, T. and Harman, S. (2016). Yöneticiye güven ve dağıtımsal adalet çalışanların işe gömülmüşlüğünü nasıl etkiler? Ege Akademik Bakış, 16(2), 351-362.

Ashforth B., (1997), Petty tyranny in organizations: A preliminary examination of antecedents and consequences, Canadian Journal of Administrative Sciences, 14: 126-140.

Aydemir, U. (2020). An analysis of the relationship among perceived organizational support, organizational culture, and intrapreneurship behavior: Evidence from Turkish aviation industry. Marmara Üniversitesi, Sosyal Bilimler Enstitüsü,İşletme (İngilizce) Ana Bilim Dalı, Yüksek Lisans Tezi.

Coyle-Shapiro J. A. M., Pereira Costa S., Doden W., Chang C., (2019), Psychological contracts: Past, present, and future, Annual Review of Organizational Psychology and Organizational Behavior, 6, 145-169.

Dean, J. W., Brandes, P. and Dharwadkar, R., (1998). Organizational cynicism. The Academy of Management Review, 23(2), 341-352.

Duffy M. K., Ganster D. C., Pagon M., (2002), Social undermining in the workplace, Academy of management Journal, 45(2), 331-351.

Elden, B. (2020). Psikolojik Sözleşme İhlalinin İş Performansına Etkisi: Havaalanı Yer Hizmet Çalışanları Üzerinde Bir Uygulama. Journal of Organization Psychology and Behavior, 1(1), 68-78.

Harris K. J., Wheeler A. R. & Kacmar K. M. (2011). The mediating role of organizational job embeddedness in the

LMX-outcomes relationships. The Leadership Quarterly, 22, 271-281.

Harris K. J., Wheeler A. R., Kacmar K. M., (2011). The mediating role of organizational job embeddedness in the LMX-outcomes relationships. The Leadership Quarterly, 22, 271-281.

Hobfoll S. E., Halbesleben J., Neveu J.-P., Westman M., (2018). Conservation of resources in the organizational context: The reality of resources and their consequences. Annual Review of Organizational Psychology and Organizational Behavior, 5, 103-128.

Holtom B. C., Burton J. P., Crossley C. D., (2012), How negative affectivity moderates the relationship between shocks, embeddedness, and worker behaviors, Journal of Vocational Behavior, 80, 434–443.

Kesen, M., Akyüz, B., (2016). Duygusal emek ve prososyal motivasyonun işe gömülmüşlüğe etkisi: sağlık çalışanları üzerine bir uygulama. Ç. Ü. Sosyal Bilimler Enstitüsü Dergisi, 25(2), 233-250.

Kiewitz C., Restubog S. L. D., Zagenczyk T., Hochwarter W., (2009), The interactive effects of psychological contract breach and organizational politics on perceived organizational support: Evidence from two longitudinal studies, Journal of management studies, 46(5), 806-834.

Kotter J. P., (1973), The psychological contract: Managing the joining-up process, California Management Review, 15(3), 91-99.

Lin W., Wang L., Chen S., (2013), Abusive supervision and employee well-being: The moderating effect of power distance orientation, Applied Psychology: An International Review, 62, 308-329.

Mael, F. ve Ashforth, B. E. (1992). Alumni and their alma mater: A partial test of the reformulated model of organizational identification. Journal of Organizational Behavior, 13(2), 103-123.

Martinko M. J., Harvey P., Brees J. R., Mackey J., (2013), A review of abusive supervision research, Journal of Organizational Behavior, 34, 120-S137.

Mazıoğlu, V. & Kanbur, E. (2020). Algılanan Örgütsel Desteğin İşe Gömülmüşlük Üzerine Etkisi: Kişi-İş Uyumunun Aracılık Rolü, İşletme Araştırmaları Dergisi, 12 (2), 1639-1654.

Mitchell, T., Holtom, B., Lee, T., Sablynski, C. ve Erez, M. (2001). Why people stay: Using job embeddedness to predict voluntary turnover. Academy of Management Journal, 44(6),1102-1121.

Özgül, B., Erkmen, T., & Karaarslan, E. (2020). Algılanan Örgütsel Destek İle Örgütsel. Business & Management Studies: An International Journa, 8(5), 4364-4412.

Özsavaner, B. B. (2019). Örgütsel Adalet ve Örgütsel Destek Algısının Öznel İyi Oluş Üzerindeki Etkisi: Havacılık Yer Hizmetleri Çalışanları Üzerine Bir Çalışma. Kocaeli Üniversitesi, Sosyal Bilimler Enstitüsü, Havacılık Yönetimi, Yüksek Lisans Tezi.

Robinson S. L., (1996), Trust and breach of the psychological contract, Administrative Science Quarterly, 574-599.

Rosen C. C., Chang C. H., Johnson R. E., Levy P. E., (2009), Perceptions of the organizational context and psychological contract breach: Assessing competing perspectives, Organizational Behavior and Human Decision Processes, 108(2), 202- 217.

Rousseau D. M., (1989), Psychological and implied contracts in organizations, Employee Responsibilities and Rights Journal, 2(2), 121-139.

Rousseau, D. M. (1990). New hire perceptions of their own and their employer's obligations: A study of psychological contracts. Journal of organizational behavior, 11(5), 389-400.

Rubenstein, A. L., Eberly, M. B., Lee, T. W., & Mitchell, T. R. (2018). Surveying the forest: A meta-analysis, moderator investigation, and future-oriented discussion of the antecedents of voluntary employee turnover. Personnel Psychology, 71(1), 23-65.

Schat A. C. H., Desmarais S., Kelloway E. K., (2006), Exposure to workplace aggression from multiple sources: Validation of a measure and test of a model, Unpublished manuscript, McMaster University, Hamilton, Canada, 331-351.

Schein E. H., (1980), Organizational psychology, Englewood Cliffs, NJ: Prentice- Hall.

Singh B., Shaffer M. A. & Selvarajan T. T., (2018). Antecedents of organizational and community embeddedness: The roles of support, psychological safety, and need to belong. Journal of Organizational Behavior, 39(3), 339-354.

Tepper B. J., (2000), Consequences of abusive supervision, Academy of Management Journal, 43, 178-190.

Thomas, H. D. C & Anderson, N. (1998). Changes in Newcomers' Psychological Contracts during Organizational Socialization: A Study of Recruits Entering the British Army, Journal of Organizational Behavior, 19(1), 745-767.

Zuber, T. J. & Hammond, J. B. (2002). The psychological contract: retaining newly employed physicians. Physician executive, 28(3), 40-43.

Cite this article: Ulufer Kansoy, S. (2023). The Mediating Role of Perceived Organizational Support in the Effect of Abusive Management and Psychological Contract Perception on Job Embeddedness in Air Transport Businesses. Journal of Aviation, 7(1), 55-63.

7 (1): 64-72 (2023)

Journal of Aviation

https://dergipark.org.tr/en/pub/jav

e-ISSN 2587-1676

The Effects of The Pandemic Period on The Performance of Airline Pilots in Turkey

Çakır Atılhan Güzel[1], Nuran Karaağaoğlu[2*]

[1]Sunexpress, Ankara, Türkiye. (atilhan.guzel@ozu.edu.tr)
[2] Maltepe University, Vocational School, Department of Marketing and Advertising, İstanbul, Türkiye. (nurankaraagaoglu@maltepe.edu.tr)

Article Info

Received: 16 December 2022
Revised: 14 December 2022
Accepted: 06 December 2022
Published Online: 28 February 2023

Keywords:
Pilot Performance
Flight
Aviation
Effects of Pandemic

Corresponding Author: *Nuran Karaağaoğlu*

RESEARCH ARTICLE

https://doi.org/10.30518/jav.1200222

Abstract

The aviation industry is one of the sectors that have been adversely affected by the pandemic, both materially and morally. In the early stages of the pandemic, air transport came to a standstill for a long time. The airline industry's inability to do business has had some consequences. Pilots, who are the last link of flight safety, which is an indispensable priority of the airline industry, have been the professional group that directly confronts the material and moral consequences of interrupted flights. When the importance of the flight performance of the pilots is evaluated, the effect of these results on the aviation sector has become suitable to increase geometrically. In this study, it is aimed to reveal the extent to which the pilots are affected by the pandemic conditions and the main reasons for these effects. The method of the study was determined as a questionnaire and one-to-one interviews with flight instructors. 148 pilots participated in the survey and 3 flight instructors were interviewed. According to the results, it has been seen that the group most affected by the effects of the pandemic is the inexperienced first officers who have just started to work and have not gained enough experience yet. It has been seen that every time they come to the cockpit, they perform as if they are sitting in that seat for the first time. It was observed that the least affected were experienced captains. However, in general, since flight is a team job, it has been observed that the workload of experienced captains increases due to inexperienced first officers, which negatively affects flight performance. However, it is thought that it is not reflected in the statistics due to the decrease in the number of flights.

1. Introduction

The aviation industry has been moving with a fluctuating graphic model for years. Looking at the events in the last 20 years, the “Twin Towers” attack in the USA is one of the milestones of the aviation community. The resulting economic losses, the fact that the terrorists who carried out the attack had previously received pilot training in the USA, the air traffic stopped for 3 days and the decrease in the number of passengers caused some companies to go bankrupt and some companies to survive with difficulty (Cebeci, 2011). Therefore, many pilots were either re-investigated or unemployed.

One of the epidemic diseases that most affected the aviation industry is the SARS virus, which emerged just after the 9/11 Twin Towers attack. The spread of the uncontrollable SARS virus, which broke out heavily in Canada, was later seen in more than two dozen countries, including North America, South America and Europe. Airline bulletins have been issued by the authorities to raise awareness about SARS precautions since it is mostly transported and dispersed by air. The bulletins describe the precautions that airline personnel should take, how the virus spreads, and how individual protection should be done (CDC, 2005). Like SARS, Ebola and MERS crises also showed their effects in the following years and caused the aviation industry to be disrupted and travel demands to decrease (LePan, 2020). The aviation industry and aviation workers were adversely affected by the falling demands.

The economic crises experienced in the recent past have deeply affected the aviation and commercial air transportation sectors, as well as many other sectors, and even brought them to a standstill from time to time (ICAO, 2021). With the 2008 global crisis, a decrease was observed in the demand for aviation, and people tended to travel with more economical vehicles instead of the aviation sector in this period. In this process, many airline companies in the world either had to close or downsized (John & Franke, 2011). Air transport, which showed a steady growth, experienced a sharp decline in 2008-2009. This decrease was reflected as an economic loss to airline companies. Therefore, it was reflected on the pilots (Argun, 2018).

Germanwings accident that took place in 2015 weighed heavily on Germanwings financially and as a result, they could not get out of this situation. They declared bankruptcy and transferred their aircraft to Eurowings Airline. The financial

burden and loss of prestige brought about by the accident put the airline in a difficult position (Martinez Garbuna, 2020). Nearly 300 pilots of the sinking company were left unemployed. On the other hand, the way the accident occurred became an important example in aviation history and caused some safety changes. Pegasus Airlines came to the fore with 1 run-off event in 2018 and 2 in 2020, and 3 deaths occurred in the last incident. These incidents were not major accidents, but despite this, the company's share values fell. These declines caused both a loss and a loss of prestige for Pegasus Airlines (Tursun & Şahin, 2020).

In total, companies that suffered losses either had to lay off their staff or had to resort to economic restrictions. This had a negative impact on their staff.

Coronavirus epidemic (COVID-19) has been defined by the World Health Organization as an infectious disease caused by the SARS-CoV-2 virus. It has been stated that people infected with the virus will mostly be affected by the respiratory tract, and this effect will result in serious illness or death. It has been announced that the elderly or people of all ages with chronic diseases such as diabetes, diabetes, respiratory and cancer will be more affected by the virus (WHO, 2022). As of January 24, 2022, the number of people infected with COVID-19 infectious disease worldwide was announced as 349.641.119, and the number of people who died from the disease as 5.592.266 (WHO, 2022). In Turkey, serious declines were experienced in the tourism sector, which directly affects aviation. Compared to 2019, revenue from the tourism sector decreased by 52% in 2020. The number of tourists coming to Turkey in 2019 decreased from 52 million to 12 million in 2020 (TC Ministry of Culture and Tourism, 2020). Country borders closed due to the pandemic and travel bans have caused a decrease in flight frequencies (ICAO, 2021). Since the decreasing flights and the intensity of the airline pilots' flight schedules are parallel, the monthly flight hours of the pilots have decreased, even to zero in some months. Due to the decrease in economic income, some airline companies have closed completely, some have laid off their pilots, some have taken unpaid leave, and some have applied the part-time working method. This situation caused job loss stress on the pilots.

All crises in the history of aviation have directly or indirectly affected pilots. Pilots have been affected by the crisis in psychological, economic, employment and performance aspects. From this point of view, it is clear that the COVID-19 pandemic will also affect the performance of pilots.

As a matter of fact, according to a report published by Qantas Airlines, it was stated that an increase was observed in the mistakes made, including experienced pilots, upon the return of the pandemic. The shape of the errors, on the other hand, reveals that although there are simple errors, the pilots are surprisingly rusty. According to the published report, it was understood that the pilots started to make basic mistakes such as trying to move with the parking brake installed or confusing the altitude and speed indicators while in the air (AFB-SBS, 2022). Observing that errors have increased in many procedures, from errors made in pre-flight cockpit preparation to external control errors, Qantas Airlines has stated that many more error events have been reported to ASRS (Pallini, 2020).

So much so that at the very beginning of the pandemic, an Airbus A320 plane belonging to Pakistan Airlines crashed near Karachi Airport. Air traffic, which was closed on the day of the accident due to COVID-19, has been a few days since it opened. When the CVR records were examined, it was revealed that the pilots argued with each other about how they were affected by the pandemic throughout the flight and including the final approach, which is the riskiest part of the flight. They are so distracted by this issue that they approach the airport far above the altitude they should be. Even as they try to fix the altitude, their conversation about the pandemic continues and they forget to turn on the landing gear. The engines that hit the runway are damaged and both engines stall after taking off again (Euronews, 2020). This event has been a harbinger of the damage the pandemic will cause to aviation.

Looking at the number of active aircraft in the fleets of airline companies, a 6% increase was recorded in the number of active cargo aircraft compared to 2020 and 2019, and it rose from 546 to 673 worldwide. However, the number of active passenger jets decreased from 2863 to 1639, with a great decrease of 44.3% in jet-powered passenger aircraft only (ICAO, 2021). Economic losses incurred by airline companies due to these decreases are quite heavy. Looking at Europe in general, airline companies have experienced losses of up to 107 billion USD when compared to 2020 and 2019. Worldwide, this number has reached 372 billion USD (ICAO, 2021). The COVID-19 pandemic, which is considered to be the most severe economic crisis after the Great Depression, has caused the entire aviation industry to shrink by 50% on average (OECD, 2020). The decrease in the number of flights, the shrinkage of the sector and the unemployment of 13% of the flight personnel working in the sector adversely affected the aviation personnel (Sobieralski, 2021).

Safety is always the first priority in aviation. However, it is the experience of the pilots that makes safety the first priority and the training that forms the cornerstone of this experience (Haslbeck, Eichinger & Bengler, 2013). Therefore, airline pilots should establish solid foundation stones in the pilot training phase so that they can manage their professional performance well (Mevlütoğlu, 2022). An Airbus A300-605R flight AA587 was caught in the wing turbulence of the B747 aircraft taking off in front of it and started to swing. The first officer, who had the vertical stabilizer fully maneuvered in opposite directions to get rid of the turbulence, could not withstand the pressure created by the air flow on the vertical stabilizer and caused it to break. The aircraft, whose control was lost as a result of the broken piece, crashed into a residential area (FAA, 2010). In research after the accident, it has been revealed that American Airlines encourage its pilots to use aggressive vertical stabilizer control against turbulence. After this result, American Airlines made changes to their training and tried to correct mistakes. Many such training-related accidents have occurred in the history of aviation (The Flight Channel, 2019).

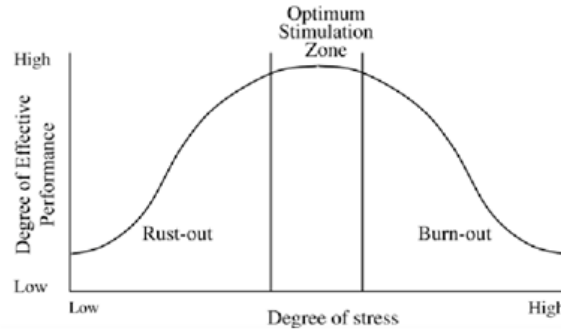


Figure 1. Stress-Performance Graphic

Airline piloting is a professional profession. With the professional infrastructure created as a result of the trainings he received, the pilots can perform the performance management professionally. However, sometimes human factors can come into play and prevent the person from managing his performance. Many other factors such as stress, sleep, private life, economic anxiety are some of the human factors that pilots are exposed to while managing their performance. It is possible to minimize these factors by working efficiently, improving efficiency and providing feedback (Akalın, 2019). Airline pilots are exposed to various stressors due to their work. These stressors may be related to the professional work life of the pilots or, when the human factor is considered, their private lives. In both possibilities, as in Figure 1, pilots who know these thresholds and keep the stress level at an optimum level are managing their performance (Schermerborn, Hunt & Osborn, 1988).

From another point of view, it can be looked at how far the pilots are from the standards and limits set in order to manage their performance. Aircraft always operate within certain limits. Exceeding the specified limits or breaking the standards by exceeding the safety barriers can create dangerous situations. Therefore, standards and limits can be looked at in order to understand the level of flight performance of the aviators and to make the necessary management (Stein, 1984).

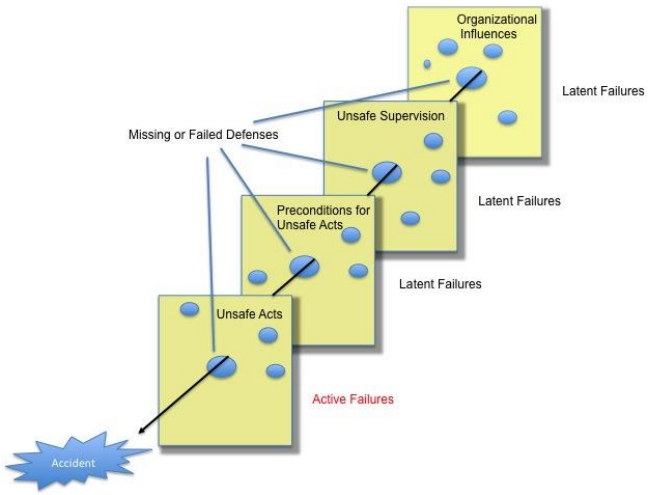


Figure 2. Swiss Cheese Model

The Swiss Cheese model shown in Figure 2 is one of the most effective models used for the resolution of accidents or incidents. According to this model, the cheese rings represent safety barriers. Examples of these barriers are checklists, ground attendants, tower attendants, limits, rules, procedures, and aids that reduce the error rate, such as documents. However, the last link of these barriers is the pilots. Pilots are the last authority to intervene in a problem that will endanger flight safety by overcoming all barriers (Reason, 1991). Therefore, the performance of pilots as the final authority is of vital importance in terms of flight safety.

The performance of pilots in a flight operation is one of the main factors that directly affect flight safety. Considering the human factors, the performance of the pilots; It is directly affected by factors such as lack of communication, lack of theoretical knowledge, complacency, distraction, lack of teamwork, physical and mental fatigue, time pressure, stress, lack of awareness and lack of initiative (FAA Safety, 2022).

In a flight operation, the intensity of the stress created by the flight on the pilots can be considered in direct proportion to the capability of the aircraft, the type of flight operation and the meteorology. According to studies, 19% of fatal accidents are caused by stress. Therefore, stress before and during the flight is an issue that needs to be managed (Soran, 2004). Pilots may have to make instant decisions during the flight. A pilot with a high situational awareness can make an important decision more confidently because he or she follows the previous step, anticipates the next step, and is aware of the events around him. This situation reduces the margin of error of the decisions taken (Kao & Jian Lin, 2010).

One of the factors that cause errors during flight operation is distraction. Mental problems such as absentmindedness, economic situation, family life, personal issues can cause distraction; Factors such as physical changes in working conditions and the use of masks can also cause distraction (FAA Safety, 2022).

Soran (2004) examined that even successful pilots are affected by stressors such as family life, economic conditions, working conditions and ways to cope with them. According to the research, 43% of the stressors mentioned the existence of organizational stress sources (Soran, 2004). Aydın (2019) mentioned that the human factor is effective in aviation and that the human factor should be examined from the perspective of technical and non-technical skills (Aydın, 2019). Erikçi (2020), in his research to determine the correct decision-making processes of pilots, found that the pilots base their sudden decisions on knowledge, experience and self-confidence. On the other hand, he concluded that he benefited from his teammates, operation teams, ATC, procedures and checklists in matters without time restrictions (Erikci, 2020). Kubal Güler (2014) stated in his research that the piloting profession is one of the three most stressful occupational groups and that the resulting stress can cause accidents. The researcher, who examined the preventability of the stress caused by the working conditions of the pilots and the factors that reduce the stress, suggested that it would be beneficial for the pilots to receive psychological counseling in order to prevent them from making the wrong decision under stress (Güler, 2014). Stein (1984), in his research that tried to measure the performance of pilots, found that the performance of pilots was proportional to their experience and workload. He stated that experienced pilots should focus on flying by undertaking less workload, while inexperienced pilots should reduce the workload on the experienced pilot, allowing the experienced pilot to make the right moves (Stein, 1984).

When these studies are evaluated, it is revealed that, together with the reality of COVID-19, airline pilots can be affected by crises today. With this study, it is aimed to examine the size of the effect and to reduce the effect of the next crises.

1.1. The aim of the study

The safety culture in aviation and the effort to optimize flight are the elements that come from the blood-writing of the rules in aviation and always progress cumulatively. Pilots are the final decision mechanism of flight operations in this important sector. It should not be forgotten that the pilots, who are the final decision to be made and the authority to take this decision into action, are human beings, not machines. Although the pilots are professional, when the human factor is involved, some measures need to be taken to prevent their performance from decreasing. However, when the human factors affecting decisions and actions are revealed, problems can be grasped more successfully and accidents or undesirable events can be prevented by making proactive moves (Mannan, 2005).

Pandemic and travel bans have caused a decrease in flight frequencies (ICAO, Operational Impact on Air Transportation, 2021). Since the decreasing flights and the intensity of the airline pilots' flight schedules are parallel, the monthly flight hours of the pilots have decreased, even to zero in some months. It is thought that it would be beneficial for the aviation industry to examine the factors such as how the decrease in flight hours affects the piloting abilities of the pilots and whether the flight experience of the pilots has an effect on the infrequent flight schedule. Decreasing flight frequency has caused economic losses on airline companies. This situation had a direct negative impact on the income of the pilots. It should be examined whether the decreasing economic income has an effect on the job performance of the pilots in a psychological sense. Due to the decrease in economic income, some airline companies have closed completely, some have laid off their pilots, some have taken unpaid leave, and some have applied the part-time working method. This situation caused job loss stress on the pilots. It is of great importance to investigate the effect of this stress on the flight performance of the pilots who continue their work.

In this study, the effects of the effects of the pandemic on the performance of the pilots were investigated. While the effects of the pandemic were taken as the independent variable in the study, the performance of the pilots was evaluated as the dependent variable. The research questions were determined as follows:

- Does the fact that pilots fly less as a result of the decrease in flights due to the pandemic have an effect on the piloting ability?
- Experienced pilots and inexperienced pilots are compared, is there a difference between the levels of being affected by the pandemic?
- Did the economic concerns and job loss stress caused by infrequent flying affect the flight performance of the pilots?
- Did the decrease in flight hours allow the pilots to rest more and get rid of the health problems caused by the flight, or did it cause them to lose their abilities (flying abilities) by getting away from the flight?
- Did flying infrequently increase the workload of pilots, causing disruptions in procedural work and procedural skipping problems?

2. Materials and Methods

This research covers a total of 11.840 civilian pilots working in 10 civilian airline companies operating in Turkey as the main mass (SHGM, 2021). Since it was not possible to reach all of the main mass, it was aimed to participate in the surveys of approximately 300 pilots.

A questionnaire scale was applied to the pilots participating in the study within the scope of the quantitative research. This scale is applied to evaluate the self-perceived performance of the pilots, to measure how their performance has changed compared to the pre-pandemic period, and what the underlying reasons are for these changes. The scale method applied is easy sampling (Büyüköztürk Ş. v., 2010).

For the purpose of evaluating the performance of pilots by the authority within the scope of qualitative research, the results obtained by teacher pilots in simulator lessons, control flights and refresher exams were compared before and after the pandemic. This study was carried out as an interview study with teacher pilots. Data in the form of a voice recording was created and decoded (Büyüköztürk Ş. v., 2010).

2.1. Data and Collection

In this study, which used quantitative and qualitative research methods, data were collected by questionnaire method and interview method. These data cover the pandemic period and are made to measure the overall performance of pilots. For the survey method, related questions were taken from 5 different surveys and a new survey scale of 25 questions was created by adding new questions. The new questionnaire created was called the “Perceived Pilot Performance Scale”. Ethics committee approval was obtained for the new questionnaire scale created.

2.2. Validity and Reliability

Reliability of the scale, which consists of statements about the determination of the problems experienced by the participants during the pandemic period, was determined to be 0.94. The coefficient shows that the scale is reliable enough to be considered quite sufficient (Karagöz, 2016). After the reliability analysis, factor analysis was applied to the scale in order to test the construct validity.

It has been determined that the scale consists of five sub-dimensions. These dimensions were named as psychological impact, impact on flight performance, economic impact, job stress and anxiety, and organizational commitment. The KMO sample adequacy coefficient calculated in the factor analysis was determined as 0.91. The coefficient indicates that n=148 questionnaires will be sufficient to reveal the factor structure. In addition the dimensions, shown in Table 1, obtained according to the result of the Bartletsphericity test, in which the significance of the factor structures were tested, were structurally valid (Barlet'sX 2=1525.11, p=0.01).

Table 1. Evaluation of Dimensions

Dimensions	x ±ss
Psychological Impact	3.33±0.83
Effect on Flight Performance	2.39±0.57
Economic Impact	4.36±0.64
Job Loss Stress	3.44±0.84
Corporate Commitment	3.11±0.56

3. Findings and Discussion

3.1. Demographic Findings

Demographic characteristics of the participants are as in Table 2.

Table 2. General Characteristics of the Participants

		n	%
Gender	Male	128	86.5%
	Woman	20	13.5%
How many years have you been flying?	0-5 Years	78	52.7%
	6-10 Years	45	30.4%
	11-20 Years	12	8.1%
	21 Years and Over	13	8.8%
Task	Captain pilot	38	25.7%
	First Officer	110	74.3%
Age	20-29	42	28.4%
	30-39	68	45.9%
	40-49	25	16.9%
	50-59	13	8.8%
Flight Time	0-1000 Hours	13	8.8%
	1001-2000 Hours	28	18.9%
	2001-3000 Hours	44	29.7%
	3001-4000 Hours	35	23.6%
	4001-5000 Hours	13	8.8%
	5001 Hours and Over	15	10.1%
Institution	Sunexpress	79	53.4%
	Turkish Airlines	46	31.1%
	Pegasus	12	8.1%
	Other	11	7.4%

3.2. Quantitative Research Results

According the Table3, the psychological impact levels of the pilots are different according to their flight experience, and the difference is due to the fact that the pilots flying between 11-20 years are less psychologically affected during the pandemic process. (p=0.02).

It is stated that the psychological impact levels of the pilots are not different according to their seniority levels, and that the captain and first officers were affected psychologically at a similar level during the pandemic process (p=0.74).

It was determined that the psychological impact levels of the pilots were different according to their ages, and the difference was due to the fact that the pilots aged between 50-59 were more psychologically affected during the pandemic process (p=0.01).

It was determined that the psychological impact levels of the pilots were different according to the flight hours, and the difference was due to the fact that the pilots with 4001 hours or more flight experience were more psychologically affected during the pandemic process (p=0.01).

Table 3. Determining the Level of Psychological Impact of COVID-19 on Pilots According to the Characteristics of the Participants

Pilot Features		Psychological Impact	
		X±ss	p
Gender	Male	3.34±0.86	0.68
	Woman	3.25±0.68	
How many years have you been flying?	0-5 Years	3.37±0.86	0.02 *
	6-10 Years	3.43±0.77	
	11-20 Years	3.08±0.71	
	21 Years and Over	3.55±0.99	
Task	Captain pilot	3.38±0.82	0.74
	First Officer	3.31±0.84	
Age	20-29	3.27±0.73	0.01 *
	30-39	3.23±0.90	
	40-49	3.37±0.76	
	50-59	3.98±0.70	
Flight Time	0-1000 Hours	3.12±0.65	0.01 *
	1001-2000 Hours	3.14±0.96	
	2001-3000 Hours	3.37±0.85	
	3001-4000 Hours	3.27±0.83	
	4001-5000 Hours	3.63±0.52	
	5001 Hours and Over	3.63±0.87	
Institution	Sunexpress	3.30±0.82	0.01 *
	Turkish Airlines	3.50±0.86	
	Pegasus	2.82±0.79	
	Other	3.44±0.74	

*Significant difference at 0.05 level

As shown in the Table 4, it can be stated that there is no difference in the level of the effect of the pandemic on the flight performance of the pilots according to the flight years, and the flight performances of the pilots who are experienced in different years are similar during the pandemic process(p=0.23).

It can be stated that the effect of the pandemic on the flight performance is not different according to the seniority of the pilots, and the flight performances of the captain or first officers are similar during the pandemic process. (p=0.56).

Flight performances of the pilots flying between the ages of 50-59 were more affected during the pandemic process (p=0.01).

It can be stated that there is no difference in the level of the effect of the pandemic on the flight performance according to the flight hours of the pilots, and that the flight performances of the pilots who have different flight hours are similar during the pandemic period. (p=0.33).

Table 4. Determining the Level of Effect of COVID-19 on Flight Performance of Pilots According to the Characteristics of the Participants

		Effect on Flight Performance	
		X±ss	p
Gender	Male	2.40±0.59	0.74
	Woman	2.35±0.46	
How many years have you been flying?	0-5 Years	2.37±0.58	0.23
	6-10 Years	2.39±0.49	
	11-20 Years	2.43±0.61	
	21 Years and Over	2.55±0.75	
Task	Captain pilot	2.36±0.59	0.56
	First officer	2.41±0.57	
Age	20-29	2.39±0.51	0.01*
	30-39	2.37±0.60	
	40-49	2.34±0.44	
	50-59	2.63±0.78	
Flight Time	0-1000 Hours	2.37±0.42	0.33
	1001-2000 Hours	2.40±0.63	
	2001-3000 Hours	2.37±0.55	
	3001-4000 Hours	2.37±0.54	
	4001-5000 Hours	2.45±0.61	
	5001 Hours and Over	2.49±0.72	
Institution	Sunexpress	2.32±0.61	0.01*
	Thy	2.63±0.51	
	Pegasus	2.12±0.38	
	Other	2.24±0.34	

*Significant correlation at the 0.05 level

It has been determined that, as stated in Table 5, the economic impact levels of the pandemic are different according to the years of flight of the pilots, and the level of economic impact of the pilots who have served for 21 years or more during the pandemic process is less than the other pilots(p=0.01).

It has been determined that the economic impact levels of the pandemic are different according to the seniority of the pilots, and the economic impact levels of the first officers are higher in the pandemic process(p=0.01).

It has been determined that the economic impact levels of the pandemic are different according to the ages of the pilots, and the economic impact levels of the pilots between the ages of 20-29 are higher in the pandemic process(p=0.03).

It has been determined that the economic impact levels of the pandemic are different according to the flight hours of the pilots, and the economic impact levels of the pilots who have flown 5001 hours or more during the pandemic process are lower in the study (p=0.01).

Table 5. Determining the Level of Economic Impact of COVID-19 on Pilots According to the Characteristics of the Participants

		Economic Impact	
		X±ss	p
Gender	Male	4.36±0.65	0.89
	Woman	4.36±0.58	
How many years have you been flying?	0-5 Years	4.49±0.45	0.01*
	6-10 Years	4.27±0.72	
	11-20 Years	4.27±0.53	
	21 Years and Over	3.90±1.08	
Task	Captain pilot	4.13±0.75	0.01*
	First officer	4.44±0.58	
Age	20-29	4.41±0.52	0.03*
	30-39	4.42±0.60	
	40-49	4.19±0.60	
	50-59	4.15±1.10	
Flight Time	0-1000 Hours	4.54±0.27	0.01*
	1001-2000 Hours	4.47±0.46	
	2001-3000 Hours	4.48±0.51	
	3001-4000 Hours	4.24±0.77	
	4001-5000 Hours	4.35±0.54	
	5001 Hours and Over	3.90±0.97	
Institution	Sunexpress	4.35±0.65	0.01*
	Turkish Airlines	4.49±0.45	
	Pegasus	4.38±0.52	
	Other	3.82±1.04	

*Significant correlation at the 0.05 level

As a result of the regression analysis in the Table 6 below, it is seen that the level of being affected by the flight performance of the pilots is related to the stress of job loss, psychological impact and organizational commitment levels.

Table 6. Regression Analysis

The Dependent Variable	Independent Variables					
	Job Loss Stress (β)	Psychological Impact (β)	Corporate Commitment (β)	F Model	RR ²	DD.W
Effect on Flight Performance(Y)	0.27 t = 12.44 p =0.01	0.24 t = 9.72 p =0.01	-0.22 t =8,181 p =0.01	24.46 (p=0.01)	0.54	1.99

* Regression analysis performed

When the results are examined, the levels of psychological exposure are affected by the increase in the levels of work stress and anxiety and the increase in the level of corporate commitment.

3.3. Qualitative Research Results

Participants were coded as P1, P2 and P3. Each participant works as an instructor pilot in a different airline company and they are experienced captain pilots with competencies in their fields. Participants were selected by non-random purposeful criterion sampling method (Büyüköztürk, Kılıç Çakmak, Akgün, Karadeniz, & Demirel, 2020).

The Effect of Infrequent Flying on Pilot Performance in the Pandemic

As in every job done professionally, doing something infrequently in piloting skills causes a decrease in competence in that job. Decreasing flight frequencies during the pandemic process reduced the flight hours of the pilots and affected their performance.

P1's statements on this subject are as follows; "*At first there was some shyness. Compared to before the pandemic, that warmth, you can see that the mastery of the procedures turns into shyness after a long time. Your friends themselves are already explaining this. Since they do not fly very often, cooling and shyness occur. They say that it is difficult to concentrate and work during the pandemic." "The pilots lost their flight skills. He forgot the procedures. Everything blurred. We are all human, there is the human factor."*

P2 is; "The low *motivation caused by the pandemic was seen in the piloting profession. As teachers, we intervene in a way that does not hinder flight safety." "I repeat, flying is a business again. The training will need to be increased a little more." and "Because we are teachers, we were able to overcome this. But the motivation of the newcomers was to fly. When they couldn't fly, their performance was affected as well."* expressed as.

When the above statements are evaluated together with the quantitative research results, according to the result;

- H1: The effects of the pandemic negatively affected the performance of the pilots,

hypothesis is supported.

The Effect of Flight Experience on Pilot Performance in Pandemic Conditions

Pilots are divided into experience classes according to their flight hours. Inexperienced pilots felt the effect of the break in flight during the pandemic period in their performance due to their lack of experience.

P1 used the following statements about how inexperienced pilots were affected by the pandemic; "*Both the captain and first officers have it, but the copilots have it more. Captains also have stress, though not as much as first officers.","Everyone was affected by the pandemic. But the beginner first officers, the inexperienced first officers, were most affected."*

P2 expressed his thoughts on this issue as follows; "*I can say that they were less impressed by the first officers because the captains had more competencies, but if we do not include the age factor. Flight is a training job. Lack of experience will cause anxiety and poor performance. These are the observed elements. A copilot who has made 2000-3000 ILS approaches is less affected than a beginner copilot."*

P3: "*Experience is very important, but besides experience, it is necessary to know." He emphasized* that inexperience is more affected by pandemic conditions.

When the above statements are evaluated together with the results of the quantitative research, according to the result;

- H1a: The change in institutional commitment caused by the pandemic has varied according to the experiences of the pilots,

hypothesis is supported.

Pandemic on Flight Performance

The pandemic has affected almost every sector economically. The aviation industry and pilots are in the group negatively affected by the pandemic. The resulting economic losses have turned into a source of stress for the pilots and mentally occupied their thoughts even in flight.

Regarding the effect of economic concerns on the performance of pilots, P1 stated the following; First *officers were most affected. They have debts both to the company and abroad. Managing that level of stress and waiting for him to come to the cockpit without commercial concerns is very immaterial. Cockpit chats have also changed. "What are we going to do, captain?", "What will it be?" Unspoken topics began to be discussed. The primary reason for motivation is money. It has to be preserved."*

P2, on the other hand, said the following about the economic concerns of the pilots; "*A pilot with debt will force his economic conditions due to the pandemic", "We are not machines, we have feelings. Being economically affected affects people's performance. We work to live. A person who cannot pay his child's school tuition is affected by surgery, even if he is a doctor. Being a pilot is also affected in flight."*

P3; "*In today's conditions, everything revolves around the economy. Affected rates increased from top to bottom, from instructor pilots to inexperienced copilots. It has been a great burden for our friends who have just started to work. During the flight, the person should be mentally comfortable and focus his brain on the flight. This situation caused problems for the friends and I think that this affected their flight performance."* He supported that the economic anxiety experienced by the pilots had an effect on their flight performance.

When the above statements are evaluated together with the quantitative research results, according to the result;

- $H_{1c:}$ The economic effects of the pandemic affected inexperienced pilots more than experienced pilots.
- $H_{1d:}$ The psychological effect caused by the pandemic has affected the performance of the pilots,

hypotheses are supported.

4. Conclusion and Recommendations

Safety always comes first in aviation. The architect of this ranking is the fact that the rules in aviation are written in blood. Throughout the history of aviation, the study of accidents has become a culture. The source of this culture is to reveal the factors that cause accidents with all its transparency and to prevent it from causing another accident.

An accident that has occurred is examined in all its details. Not only the aircraft, but also all the data that may have an impact on the accident, such as the human factor, the weather, the history of the aircraft and the pilots, are investigated.

According to the statistics kept in the accidents that have occurred until today, around 70-80% of the accidents are caused by the human factor. The source of a malfunction in the aircraft may actually be a human factor. Accident investigation authorities analyze these factors to reveal the cause of the accident and develop new procedures and rules to prevent the same mistakes. However, this is not exactly a proactive approach. In order to reduce the accidents to zero, it is necessary to take a proactive approach and make risk analyzes to reveal and eliminate the factors that may cause the accident before the accident.

Pilots receive numerous trainings to avoid mistakes. Their attention should be on the work they are doing, their minds should not be preoccupied with matters that do not concern flight. It is obvious that a pilot who had an argument with his wife and came to flight depressed cannot give 100% of his potential to the flight. A pilot who has problems with his economic problems cannot fully focus on the flight. Concerned about the future of his job, a pilot comes to the cockpit for fear of making a mistake. Many more such examples can be cited. In short, the pilots, who form the last link of the safety barrier, must be able to leave all the problems outside the door as soon as they enter the cockpit door. But pilots are a human, not a machine.

Looking at the results, it is possible to divide the effects of the pandemic on the performance of pilots into three. The first of these is the low performance caused by the pilots taking a break from flying, the second is the effect of the pilots' experiences on the rate of being affected by the pandemic, and the third is the effect of the economic and mental conditions brought by the pandemic on the performance of the pilots.

For experienced pilots, the negative effect of the pandemic on flight performance was seen as slight. For a pilot who had enough flight experience before the pandemic and whose mentality was imprinted in his engine memory, it took a few flights to return to his old performance in the cockpit after months of deprivation of flight. However, for a pilot who has just started his flight life, has not seen a winter or summer operation yet, and has not had any experience with abnormal situations, it cannot be said that flying is ingrained in the engine's memory. As a result of the break in the pandemic, the skills of inexperienced pilots have atrophied and they have turned into pilots who start over with each flight. This low performance left the experienced one of the two pilots in the cockpit alone and caused one of the firewalls to be disabled. This situation increases the workload of experienced pilots flying with inexperienced pilots. Therefore, inexperienced first officers can be shown as the most risky group. However, this does not change the fact that all pilots are adversely affected by the pandemic in terms of performance.

It is a fact that the aviation industry enters into crises from time to time and the results of these crises negatively affect the performance of pilots. It has an important place in protecting the performance of pilots, preventing accidents and preventing greater material and moral losses. Measures to be taken can be divided into individual and corporate. As a professional, pilots must keep their lifestyle, economy, know-how and piloting skills ready for the worst-case scenario. He should keep himself ready to minimize the effects of the crisis by foreseeing that a new crisis will come after the end of the crisis. On the other hand, companies should always be in a transparent communication with their personnel in order to reduce the question marks in the minds of their employees in times of crisis. They should present the picture in front of them transparently to the employees so that the pilots can reduce their unknown equations. In addition, it can be a comforting factor for pilots to reduce the economic burden on their personnel by establishing economic funds to be used in times of crisis and to be saved at times of high income. With a proactive approach, increasing the number of simulators available, thus ensuring that pilots maintain their skills can also be considered as a solution. Finally, the civil aviation authorities, by organizing seminars and lectures while the pilots are still in the training stage, and explaining how to prepare for the crises that may occur in the future, based on the past events, will help to be prepared for the crises. In addition, during the selection stages of student pilot candidates, new models can be developed to be used in interviews by targeting the selection of candidates with the capacity to manage such long-term crises. Finally, in order to solve the problems when they are young, the units where the pilots can get psychological support (peering pilot) with peace of mind should be expanded, and the support given should be kept confidential in order for the meetings to be productive and sincere.

Regardless of the conditions, it should not be forgotten that the piloting is a professional occupation, and it is always necessary to go forward by closing the gaps. Aviation culture requires putting safety before all personal and corporate interests. In future studies, it can be considered to investigate the factors that negatively affect the performance of pilots in a professional sense and to carry out studies to eliminate these factors.

Ethical Approval

This study protocol received ethical approval from Maltepe University's Ethics Committee by the Decision Number 2021/33-13 (2021/12/06).

Conflicts of Interest

The authors declare that tere is no conflict of interest regarding the publication of this paper.

References

AFB-SBS. (2022, January 5). Qantas pilots making errors after long periods spent grounded by COVID-19, report claims. Retrieved from https://www.sbs.com.au/news/qantas-pilots-making-errors-after-long-periods-spent-grounded-by-covid-19-report-claims/228b019b-39f5-42dd-9e9e-905f7efbf16f on February 5, 2022.

Akalın, Z.D. (2019). Relationships Between Stress Factors and Job Performance on Pilots. Master Thesis. Istanbul: Beykent University Institute of Social Sciences.

Arkun, S. (2018). To The Airline Industry of the 2008 Financial Crisis Reflections and An Application. İSMMMO Mali Çözüm Dergisi, 28(150), 221-231.

Aydın, T. (2019, August). Investigation of Non-Technical Pilot Skills Desired in Airline Pilots. Master Thesis. Eskisehir: Eskisehir Technical University.

Buyukozturk, S. v. (2010). Scientific Study Methods. Ankara: Pegem Academy Publications.

Cebeci, U. (2011, September 11). hurriyet.com. Retrieved from https://www.hurriyet.com.tr/havaciligin-kurallari-11-eylul-le-degisti-18701332.

CDC. (2005, May 3). Guidance for Airline Flight Crews, Cargo and Cleaning Personnel, and Personnel

Interacting with Arriving Passengers. Retrieved from Centers for Disease Control and Prevention: https://www.cdc.gov/sars/travel/airpersonnel.pdf on January 23, 2022.

Erikci, B. (2020). Natural Decision Making: A Study on Pilots. Master Thesis. Istanbul: Bahcesehir University.

Euronews. (2020, June 24). Report on plane crash in Pakistan: Cause of accident 'Covid-19'. Retrieved on 27 January 2022, from tr.euronews.com: https://tr.euronews.com/2020/06/24/pakistan-da-dusen-ucakla-ille-rapor-kaza-why-covid-19.

FAA. (2010). An International Survey of Transport Airplane Pilots' Experiences and Perspectives of Lateral/Directional Control Events and Rudder Issues in Transport Airplanes (Rudder Survey). Washington: Office of Aerospace Medicine.

FAA Safety. (2022). Human Factors.

Haslbeck, A., Eichinger, A., & Bengler, K. (2013). Pilot Decision Making: Modeling Choices in Go-Around Situations. International Symposium on Aviation Psychology (pp. 548-553). Munich: Wright State University.

ICAO. (2021, November 1). Active Fleet Comparisons by Aircraft Types. Retrieved on January 26, 2022 from data.icao.int: https://data.icao.int/coVID-19/aircraft.htm

ICAO. (2021, November 1). Operational Impact on Air Transportation. Retrieved on January 26, 2022 from data.icao.int: https://data.icao.int/coVID-19/operational.htm

ICAO. (2021, November 1). Revenue/Pax/Seat Losses. Retrieved on January 26, 2022 from data.icao.int: https://data.icao.int/coVID-19/economic.htm

IATA. (2006, May 2). The Impact of the 9/11 Terrorist Attacks. Retrieved on January 12, 2022 from iata.org: https://www.iata.org/en/iata-repository/publications/economic-reports/impact-ofsept-11t h-2001-attack/

John, F. & Franke, M. (2011). What comes next after recession? – Airline industry scenarios and potential end games. Journal of Air Transport Management, 19-26.

Kao, LS, & Jian Lin, LW (2010). Situational Awareness. Focus, 2-10.

Kubal Guler, N. (2014). Identification of Psychosocial Risks in Pilots. Master Thesis. Ankara: Ministry of Labor and Social Security, General Directorate of Occupational Health and Safety.

Karagöz, Y. (2016). SPSS 23 and AMOS 23 Applied Statistical Analysis. Ankara: Nobel Academic Publishing.

LePan, N. (2020, March 14). Visualizing the History of Pandemics. Retrieved on January 23, 2022 from Visual Capitalist: https://www.visualcapitalist.com/history-of-pandemics-deadliest/

Mannan, S. (2005). Chapter 14: Human Factors and Human Error.

Martinez Garbuna, D. (2020, April 7). Simple Flying. Retrieved December 29, 2021 from Simple Flying: https://simpleflying.com/germanwings-operations-over/

Mevlutoglu, A. (2022). Simulators in Flight Training. UHUM Special, 17-21.

OECD. (2020, October 15). Tackling Coronavirus (COVID-19): Contributing To a Global Effort. Retrieved on January 27, 2022 from COVID-19 and the aviation industry: Impact and policy responses: https://read.oecd-ilibrary.org/view/?ref=137_137248fyhl0sbu89&title=COVID-19-and-the-aviation-industry

Pallini, T. (2020, June 19). FAA issues warning to airlines after a spike of in-flight incidents due to rusty pilots flying emptier planes than usual due to coronavirus. Retrieved on February 5, 2022 from businessinsider.com: https://www.businessinsider.com/pilot-safety-reports-show-new-dangers-of-pandemic-flying-2020-6?r=US&IR=T

SHGM. (2021). Civil Air- Vehicle Accidents Investigation Regulation.

Sobieralski, J. B. (2020). COVID-19 and airline employment: Insights from historical uncertainty shocks to the industry. Transportation Research Interdisciplinary Perspectives, 5, 100123.

Soran, S. (2004). Stress Factors on Pilots, Their Management and A Field Study on This Subject. Master Thesis. Malatya: İnönü University, Institute of Social Sciences, Department of Business Administration.

Stein, ES (1984). The Measurement of Pilot Performance: A Master-Journeyman Approach. Virginia: US Department of Transportation.

Schermerborn, J., Hunt, J., & Osborn, R. (1988). Managing Organizational Behavior. New York: John Wiley & Sons.

Reason, J. (1991). Human Error. Cambridge: Cambridge University Press.

TR Ministry of Culture and Tourism. (2020). Tourism Income and Expenditures. Retrieved February 8, 2022 from yigm.ktb.gov.tr:https://yigm.ktb.gov.tr/TR201116/turizm-gelirleri-ve-giderleri.html

TheFlightChannel (Managed). (2019). How a Badly Trained Pilot Caused this Airbus to Crash into New York City American Airlines 587 [Motion Picture].

Tursun, M., & Şahin, A. (2020). The Effect of Aircraft Accidents on the Market Value of Airline Companies: Analysis by Case Study Method. Journal of Finance, Economics and Social Studies.

WHO. (2022, January 25). Coronavirus disease (COVID-19). Retrieved January 25, 2022 from who.int: https://www.who.int/healthtopics/coronavirus#tab=tab_1

WHO. (2022, January 25). WHO (COVID-19) Dashboard. Retrieved on January 25, 2022 from WHO.int: https://covid19.who.int/

Cite this article: Atilhan Guzel, C. Karaagaoglu, N. (2023). The Effects of The Pandemic Period on The Performance of Airline Pilots in Turkey. Journal of Aviation, 7(1), 64-72.

7 (1): 73-82 (2023)

Journal of Aviation

https://dergipark.org.tr/en/pub/jav

e-ISSN 2587-1676

Cash Management of Multinational Airlines: A Case Study on A Turkish Airline

Yaşar Köse[1*], Ceyda Aktan[2]

[1*]University of Turkish Aeronautical Association. Ankara, Türkiye. (ykose@thk.edu.tr).
[2] University of Turkish Aeronautical Association. Ankara, Türkiye. (caktan@thk.edu.tr).

Article Info

Received: 11 November 2022
Revised: 10 December 2022
Accepted: 12 December 2022
Published Online: 28 February 2023

Keywords:
Cash Management
Multinational Companies
Airlines
Airline Finance
Netting Systems
Cash Flows

Corresponding Author: *Yaşar Köse*

RESEARCH ARTICLE

https://doi.org/10.30518/jav.1202568

Abstract

Cash is a vital resource for airline companies, which are said to be operating on a multinational level. From executing day-to-day operations to exploiting new investment opportunities, airline companies must maintain an optimal level of cash. The amount of cash level depends on a number of factors such as the company's activity level, the current conjuncture and international markets. In this study, the net cash flows and the changes in the level of cash and cash equivalents account of the flag carrier airline operating in Turkey, which can be considered as an international company, were analyzed using data of 2020, cash flows. In addition, company's relations with the IATA Clearing House were determined, evaluated and interpreted in term of cash management. The fact that there are very few studies in the national and international literature on the analysis, evaluation and interpretation of cash flows in the airline industry makes this study unique.

1. Introduction

The integration of world economy has changed the nature of the firms established as was seen from the rise in the number of multinational companies (MNC). Majority of these MNCs are seen to be located in the United States where in 2017 it was reported that almost 50% of the public companies in the country were MNCs (Erel et al., 2019). Although having similarities, these companies work differently than their national or international counterparts. Whether it is their turnover, sales, production systems or their financial management, MNCs can be referred to as unique entities. A multinational company (MNC) is referred to a company that has subsidiaries, branches or affiliates operating in different countries other than the parent country.

Operating in many different countries means that processes need to be redefined and arranged, as there is a trans-boundary movement of goods and services, issues on the availability of skilled labor and cultural differences influencing management. For this reason, a MNC is only successful if they can be able to continue its operations uninterrupted having dealt with these problems. However, this is not the only problem faced by MNCs. With each expansion in operations, these companies seek to take advantage of locally available resources, and to be able to do this; they need to provide the sufficient amount of funds. It is usually established through a flow of funds from the parent to its subsidiaries or between the subsidiaries themselves. This means that there is a cost involved depending on the frequency and volume of funds that are transferred. It is very important for MNCs to minimize this cost as much as possible to be able to compete with their rivals to stay in the game. The realization of the potential multinational companies provide to world economy, their significance as an actor within they economic system makes it important to carefully understand and manage its financial policies, especially focusing on cash management.

Working from the definition of MNCs, airlines are also referred to as one (Al-Kwifi et al., 2020) because they carry out passenger and freight transportation activities in many different countries outside their home country. They have investments, branches, sales offices and employees and customers from different nations from these countries. In addition, while airline companies want to maximize their company values, they have to comply with the regulations and rules of national and international establishments and organizations such as ICAO (International Civil Aviation Organization), IATA (International Air Transport Association), ECAC (European Civil Aviation Conference), JAA (Joint Aviation Authorities), JAR (Joint Aviation Regulations) which also points out to their multinational level. Airline companies are capital-intensive companies, and they can only meet the large amounts of resources (debt and equity) they need from international financial markets. They need international support and cooperation in issues such as

technology, maintenance-repair, spare parts and expert personnel in order to ensure the sustainability of their flight activities. Therefore, they do not just compete with their international rivals but also play a major role in many partnerships and strategic alliances (Amankwah-Amoah & Debrah, 2011).

The highly competitive airline industry consists of over 1200 different airline companies travelling between more than 3500 different airports. Operating between various countries causes them to give extra care in their financial decisions. Especially after the Covid-19 pandemics, the aviation industry experienced serious problems as governments closed their borders and for a long period of time there were international ban on flights. It was reported that only in the first quarter of 2020, there was a drop of 100 million airline passengers in Europe, which translated into a loss of 2 billion Euros. This loss began to increase exponentially in following few quarters turning this situation to the worst experienced by the aviation industry so far (Deveci et al., 2022). Therefore, airlines have focused on many different financial strategies to overcome this crisis whether it is for cost control, capital budgeting, or working capital management. Among these, airlines, be it legacy carriers or low-cost carriers; have also started paying more attention on their cash management strategies. For this reason, this study aims to analyze the cash management strategies adopted by a multinational airline company through modeling its cash flows and discussing various risk issues through a case study.

The paper can be summarized as follows: Section two describes the cash management of multinational companies in general whereas Section 3 focuses on the cash management specific to an airline company. Section 4 presents an analysis of relevant literature on the topic followed by the Methodology in Section 5. However, Section 5 also provides the detailed purpose of the study explained before the relevant model, as well as a case study and findings. Section 6 concludes the study.

2. Cash Management in Multinational Companies

Journal It is known that an uncertainty experienced by businesses can translate into higher risks for them and therefore pressure them to hold more liquid assets. These assets are resources that can be readily used when needed. Cash is referred to the most liquid of them all and play a vital role in decision-making. However, businesses must hold the optimal amount of cash, as it does not generate additional earnings for the business when held as it is (Melvin & Norrbin, 2013). MNCs face additional challenges in managing these liquid resources they hold as they operate using different currencies. Therefore, it can be said that the purpose of cash management in multinational companies is to minimize their cash holdings while maintaining the smooth functioning of their processes with minimal risk exposure. MNCs treasury, usually runs these set of activities determining the level of cash balances.

Sometimes conflicts can arise while trying to pursue the objectives of international cash management making it even more complex. To give an example, in order to eliminate the possible political risk, a MNC would need to convert all its receipts to the currency used in its home country. While, on one hand, this would minimize political risk, on the other hand, its subsidiaries, affiliates may experience problems. Affiliates of an MNC located in different countries also have obligations to meet their operational requirements and hence, would need to hold some amount in their local currencies for working capital purposes.

The level of cash held by MNC subsidiaries, which are held independently of their working capital management decisions, are partly to ensure normal daily cash payments are provided for and partly to provide protection against unexpected changes in the flow of cash to and from the company. First of these motives are referred to as the transaction motive whereas the latter is the precautionary motive of MNCs (Eitman, et al., 2011). Besides the transaction and precaution motives, da Costa Moraes and Nagano (2014) also mentions about the speculative and bank reciprocity motives for holding cash. In other words, companies holding cash to meet bank requirements as well as to take advantage of the opportunities as they present themselves.

The importance of cash management was seen to have led researchers focus on different aspects of cash management policies for many years. The possible advantages and disadvantages of companies holding cash were among the main area researched in earlier literature (Keynes, 1936; Myers, 1984; Jensen, 1986). More recent studies were referred to as being more focused on the variables affecting the level of cash held by corporations whether these are located in the US or in different countries (Kusnadi & Wei, 2011). Thus, defining the amount of cash resources to be held and the variables influencing it is widely studied yet still uncertain in its application.

There are many directions the funds can flow in a MNC. These can be from the parent to the subsidiary, from the subsidiary to the parent, or between different subsidiaries. In terms of cash flows, and hence, cash management between their subsidiaries, these companies can perform International Cash Clearing and Processing, and wire transfers. The complexity in cash flows and making payments between different businesses, whether they are related or not, have led to a number of different methods to develop. Methods such as; bank transfers, cash pooling and payment network applications all exist to minimize costs related to cross-border payments and to simplify the processes. Regarding wire transfers, the Clearing House Interbank Payment System (CHIPS) and the Society for Worldwide Interbank Financial Telecommunication (SWIFT) are the two main computer-based networks that are seen to be preferred by MNCs to process their transactions and payments in the international arena. CHIPS was established in 1970 and was referred to as the first step in computer-based networks to digitize interbank transactions on an international level. At the time the reason for introducing such a system was to make settlements faster and more efficient by replacing physical checks given by banks with bookkeeping entries that were digitized (Kalra, 2019). Since banks are still the primary financial services provider for MNCs, they use CHIPS to process intercompany payment transfers globally. SWIFT is also a cooperative which functions as a communication system, which aims to provide a secure, fast and cost-efficient transfer of information between financial institutions. While CHIPS acts as an intermediary in financial transactions, SWIFT provides the instructions for the fund transfer (Baker & Aggarwal, 1994). This is one of the differences between the two systems.

There are also certain techniques to optimize the flow of cash for MNCs. One of them is to generate and quicken the cash inflows. Secondly, cash transfers between subsidiaries needs to be carefully managed, especially on leading and lagging strategies. Another way is to focus on currency conversion and hence to employ techniques to minimize the

costs associated with currency conversion. Netting system is one of them. In order to minimize the transaction costs incurred due to fund movements, netting transactions are made between the companies or branches affiliated to MNCs by international finance managers. The cash management netting system is based on the netting of mutual debts and receivables (Yalçıner, 2012). On this basis, the payment obligation and the receivable position between the branches are determined with the help of a matrix. Intra-group payments will be reduced through elimination of counter payments. With netting transactions, both the number of fund transfers and the transaction cost will be reduced.

Usually there are three types of netting systems, which are the bilateral, multilateral, and lastly, the centralized systems for settlement. The first system, bilateral netting, functions between two parties, whether it is between the two subsidiaries or between the parent and subsidiary. However, the multilateral system is more complex and the fund exchange is between parent as well as the subsidiaries. In the centralized system, fund transfers take place through the parent, there is a centralized pool (Srinivasan & Kim, 1986). Among these the multilateral netting system is highly used by MNCs. Considering that there are usually many companies or branches affiliated to the MNC; multilateral netting is carried out between affiliated branches.

MNC subsidiaries or branches can manage their own minimum cash needs and surpluses based on their cash positions in certain periods and the cash inflow and outflow forecasts they obtain, apart from netting out their debt-receivable relations among themselves. For example, these subsidiaries or branches will be able to minimize the financing costs that can arise from fund inflows and outflows by not sending the cash surplus immediately to the parent and instead holding it to meet the cash shortages they may have estimated for the following few days.

In addition, MNC affiliations will decide according to the returns they are earning from the financial markets of the country in which they have the excess cash, and also to the risks they are exposed to (exchange rate risk and rate of return) in relation to the currency. Generally, if the local currency of the country in which it is located is predicted to be valuable in the future relative to the currency of the home country, the excess cash will be held in that local currency. In some cases, the subsidiary will send the excess cash to the parent company, but if cash outflows are not allowed to a foreign country outside the country of operation, rational investment strategies in favor of both the subsidiary and the parent company will need to be followed. For example, by investing in the country of operation the subsidiary company will gain profitability from exporting the goods produced by themselves to other subsidiaries abroad

3. Cash Management in Airline

As previously mentioned, because of its ready to use form, cash becomes a vital tool for businesses to have for their day-to-day operations. Because it is such an important asset, with its alternative uses and costs, it must be ensured that it is neither too little nor too much at any given time, that is, it must be in the optimum amount. Therefore, just as any other business airlines must also appropriately manage their cash holdings. While a strong cash position can allow airlines to finance new aircraft purchases internally and reduce interest costs, a shortage of cash on the other hand can even cause them to file for bankruptcy.

Airline companies, like other companies, hold cash for three main reasons: transaction, precautionary, and speculative motives. For airlines, the transaction motive relates to the use of cash to pay for daily operating expenses such as employee salaries, aircraft fuel and for maintenance. The holding of cash for the transaction motive is proportionally related to the level of business activity of the company, and the larger the airline, the greater the need for cash. Airlines may also hold cash to properly deal with seasonal trends, economic downturns or emergencies (precautionary reason).

The situation is further complicated with the increase in prices of fuel and the economy taking a downturn. For this reason, airline companies need to be prepared for unexpected movements in cash flows and keep an optimum amount of cash in their reserves. This cash that is held for precautionary purposes acts as a protection for the company if faced with financial difficulty. The speculative reason for holding the cash is to be able to utilize profitable investment opportunities. Having cash for the speculative cause is usually not an important factor for airlines with very expensive capital projects, but for airlines faced with short-term profit-making opportunities, it can be a viable factor allowing rapid exploitation. The challenges faced by airline companies in terms of managing their cash can be classified under four headings. These are problems caused by cash shortages, having excess cash, fluctuations in the cash flow and lastly, the exchange rate fluctuations.

In general, cash deposits do not provide a great return to companies, but many airlines view cash as a buffer against possible future bankruptcies, as they are vulnerable to cash flow problems. The industry is large, complex and capital-intensive. An airline may face potential bankruptcy if the cash on hand does not meet its ability to pay current debts, and therefore a shortage of cash is a potential bankruptcy signal. Even under financial distress, cash availability is important in helping a company become stronger and coping with the distress itself. For airlines, the main aim of managing cash is for the company to have a sufficient amount to be able to pay their short-term liabilities and any interest payment that they incur, as well as to use it for investments (Brigham & Houston, 2009). There are methods like forecasting cash or establishing strong relationships with stakeholders or checking credits that can be employed by managers to ensure that a company does not run out of cash.

Not having enough cash is a big problem for all businesses, including airlines, while too much cash can also be a potential problem. Having more cash than necessary for a company's current liabilities and keeping this excess cash idle will reduce the profits that the company can make. However, it is called “cash burn” when a company spends the cash it has earned in the previous period in the current period or when it finances its expenditures with debt due to its lack of cash. According to IATA, more than $77 billion in cash was burned globally in the airline industry in 2020, that is, airline companies consumed their cash reserves to meet their fixed costs during the Covid-19 pandemic (https://www.iata.org/en/pressroom/pr/2021-24-02-01/, Accessed 03.01.2022).

While cash can be used to invest in long-term projects and activities, it is also used to invest in securities as short-term investments. Securities can be defined as types of investments that are short-term can be turned to cash quickly, and most of the time, generate small returns when compared to longer-term financial instruments (Block et al., 2014). The reason for investors to choose marketable securities is to generate some

amount of return from the idle cash. The company can sell marketable securities providing themselves both a high degree of liquidity as well as cash to pay its current debts. Given that a company should not have too little or too much cash, different industries use a wide variety of cash management models to determine the optimal level of cash to hold. These can be referred to as Baumol-Tobin and Miller-Orr models. Among them, the Miller-Orr model is a more realistic model because it assumes that cash inflows and outflows are irregular over time, that the company intervenes in cash inflows and outflows at a specified lower and upper cash level, and also because it optimizes cash holdings and opportunity costs.

An important organization that assists cash management in the airline industry worldwide is the IATA Clearing House (ICH). IATA Clearing Services (ICS) is the department within IATA that deals with financial transactions between airline companies. The main service provided is, however, the ICH. According to IATA, the purpose of ICH is to "provide means for payment of all invoiced items shipped to and from airlines around the world" (IATA, 2014). Between airlines and their Travel Partners there needs to be an efficient closing of accounts and it must be done in the most time effective way as possible. This is probably where IATA Clearing House comes into the picture. They reduce the vast amount of multicurrency transactions taking place into a single transaction, to single payables account. IATA Clearing House uses a netting process to settle majority of the multi-billion transactions. This process enables them to reduce movement of funds to an absolute minimum and at the same time give both credit and currency protection to companies that uses it (IATA, 2014).

IATA Clearing Services are used by more than 475 airlines on a weekly basis, and the amount of these transactions is around $49.5 billion annually (IATA, 2014). The fact that its customer base includes a large number of non-IATA airlines is a sign of ICH's importance. Therefore, they provide the setting to allow airlines to do business with one another, reducing transactions, as mentioned previously. ICH provides a relatively safe and secure environment while reducing costs and providing minimal risk to the individual airline. It would not be exaggerations to say that international air transport would operate much less efficiently and potentially come to a standstill without the service provided by ICH. Airlines in North America primarily use the Airline Clearing House (ACH) for intra-American billing, but agreements between ACH and ICH allow for "intermediate clearing" between the two entities, ensuring smooth transactions. However, a significant majority of the world's scheduled airlines use the IATA Clearing Services system for international flights. In the year 2019, reports indicated that the high number of transactions belonging to airlines and their related companies as well as travel partners were realized successfully at a rate of 99.96% (https://www.iata.org/contentassets/c81222d96c9a4e0bb4ff6ced0126f0bb/iata- annual-review-2020.pdf, Accessed 14.12.2021).

In addition to the clearing house, IATA also provides the services such as IATA Financial Settlement Services (IFSS), Billing and Settlement Plan (BSP), Cargo Account Settlement System (CASS), IATA Currency Clearing Services (ICCS), Simplified Invoicing and Settlement System (SIS), and IATA's Enhancement and Financing (E and F). These services assist in: facilitating payments; simplifying processes such as sales, reporting, and remittance; invoicing and closing of accounts; global cash management; and solving disputes. Let's take the three members of the OneWorld alliance as an example: British Airways, American Airlines and Qantas. Due to extensive international code-sharing and revenue-sharing networks, large amounts of money will need to be exchanged between carriers when passengers book through the British Airways' reservation system but fly on an American or Qantas-operated flight. Subsequent financial transactions will be accumulated by ICH before being sent to the appropriate airline, as opposed to each carrier having to manage and maintain international accounts with each of its partners. Interlining is the purchase of tickets for a flight using more than one airline, unlike intralining, which is the purchase of tickets for more than one connecting flight operated by the same airline. Thus, a passenger in New York can book a trip between New York and London using American Airlines, London to Dubai by British Airways and Dubai to Delhi using Emirates Airlines. The passenger will have a single eligible ticket with several coupons (or more likely an E-ticket these days), one for each sector of their journey. Each of the three airlines involved will willingly accept the reservation as they know they will be paid via ICH to carry the passenger. Thus, without ICH, thousands of bilateral agreements would have to be made between airlines that would not actually be enforceable. The total revenue the passenger pays for the New York-Delhi journey will be split between the airlines involved according to what are known as "proportionating principles", which in itself can be quite complex. Major airlines will have entire departments dealing only with interlining and proportioning.

The key to ICH's success is that airlines pay their bills on time. The inability of even a large airline to meet its obligations on deadlines can quickly cause cash flow problems for the entire industry. If carrier companies in financial difficulties are unable to pay their bills, they are likely to be expelled from the ICH. Often such an issuance is followed by the airline declaring bankruptcy and ceasing operations, as it is extremely difficult for most international carriers to operate without access to ICH. This highlights once again the importance of the ICH system for the efficient functioning of the international aviation network.

In addition to cost savings through net transfer of funds, ICH also simplifies the currency conversion process. While many airlines choose to hold a limited amount of international currency to cover regular expenses incurred abroad, a significant majority of international fund transfers will involve large foreign currency exchanges. However, even with the services provided by ICH, airlines face currency risk to currency fluctuations and valuations.

4. Literature Review

Cash is of great importance for companies to run their operations and ensure the necessary growth over time. Companies that have sufficient cash in their hands will be able to act more flexibly in their management and operational decisions. On the contrary, if there is not enough cash, the profitability of the companies may be affected; they may fail and even face the risk of bankruptcy. Therefore, the correct execution, use and control of cash management is of great importance for businesses today, because the value of the money held decreases over time, and they are faced with changing inflation figures. According to Yılmaz (1999), companies should aim to prevent unnecessary attachment of this cash to assets by keeping cash at the optimum level, and at the same time, they need to raise funds by increasing their non-operating income in order to utilize the cash they have. These are stated as priorities for effective cash management (Yılmaz, 1999).

Manoel and Moraes (2022), in their study, compared the cash policies of MNCs with those of non-MNCs in the Latin American environment (Argentina, Brazil, Chile, Colombia, Mexico and Peru) and found that multinational companies have higher cash levels to take advantage of greater growth opportunities abroad.

However, the level of sufficient cash that companies must hold varies under different circumstances. The sector in which the companies are located, their credibility, supply chain management, buying and selling policies, receivables management, debts in foreign currency and macroeconomic factors are some of the important factors in determining the cash levels of the companies and regulating the cash flow (Galimidi, 2010). There are many studies in the literature on these factors. In their study, Fernandes and Gonenc (2016) investigated the relationship between the cash holdings of companies in 40 different countries and both geographical and industrial diversification, in line with the data covering the years from 1990 to 2011. As a result of the study, a negative relationship was found between both dimensions of diversification (multinational and industrial diversification level) and cash holding at the company level. The results indicate that MNCs can lower the average cash that they hold if they focus on achieving economies of scale when managing their cash holdings and expand/diversify into different areas. In addition, the results show that industrial diversification has a negative impact on cash assets.

When the literature is examined, it is seen that most of the studies on the cash holding tendencies of multinational companies include American multinational companies (Foley et al. 2007; Pinkowitz et al. 2012; Gu 2017, Campbell et al. 2018). In general, it is stated that American multinational companies hold more cash compared to those established in other countries and there is an increase in the amount of cash held over time (Bates et al. 2006; Foley et al. 2007; Gu 2017). Wu et al. (2017), when they conducted research on multinational companies in China, have stated that MNCs hold more cash due to globalization, but as long as sales to foreign countries are similar, it was found that there were no significant differences in cash holdings between multinational and national companies in the country. Ramirez and Tadesse (2009), on the other hand, obtained the opposite result and stated as a result of their studies that multinational companies hold more cash than national companies.

However, it should not be forgotten that the two issues are different from each other, even though the terms between holding cash and cash management are basically the same and there is a connection between them. Companies may have different reasons for holding cash, but the two major reasons can be firstly to use it for making investments or to cover their losses. These reasons will determine the dynamics of the company's cash management (Jiang and Wu 2022). These dynamics may vary depending on whether the companies are national, international or multinational, and there are also objectives adopted by all companies related to cash management.

As Kabakçı (2011) stated, the points desired to be aimed with cash management at the national and international level do not differ from each other. It is based on accelerating the supply of receivables, extending the duration of payments, providing cash transfer between branches according to needs and directing excess cash to investments that will bring profit. The same is true for international and multinational businesses. One of the most important differences between multinational companies and international companies is that they produce and/or provide services in more than one country, as stated in the previous section.

Although international companies need cash management mechanisms to reduce the volume and number of transactions on exchange rate-related transaction costs by considering the cash flows of their subsidiaries, a managerial decision that needs to be taken in multinational enterprises is cash management. It is about whether it will be centralized or not (Ünlü 2010). Doing business in different countries, being subject to different laws and volatility in exchange rates make cash management of multinational enterprises more complicated. However, although it is observed that necessary studies have been carried out to understand this complex structure, it is seen that the literature on the subject is quite limited.

One of the comprehensive studies on the subject was made by Wündisch (1973), and in this study, the techniques used by multinational companies which were developed to minimize the opportunity cost of idle or misplaced cash were mentioned. At the same time, the changes in the attitudes of multinational banks were examined and an Optimum Decision Model was defined for these companies to manage their cash effectively. This proposed Multicurrency model was designed to detect misdirected and/or positioned funds within the system and to minimize idle cash.

Masson (1983), like Wündisch (1973), has focused on cash management activities in multinational companies and developed a model to simulate these activities. In his work, he explains the use of the model on a hypothetical company. The developed model was seen to have focused on concentration banking and total cash position management. These areas primarily include the problems experienced in the movement of cash from a company's subsidiaries or sales points to a central account, as well as effective cash management.

Another study which focuses on the cash management of multinational companies was conducted by von Eije and Westerman (2002). Discussing the effects of liberalization, the use of single currency, as well as how deregulation affected the cash management of multinational companies in the Eurozone, von Eije and Westerman (2002) state that developments in the region facilitate cash transfer and reduce the need to hold local cash. As a result of the study, it is stated that institutional changes in the euro area reduce the imperfections in the market and may eventually trigger centralization and disintermediation. Therefore, it is suggested that the removal of intermediaries after centralization may improve the internal financing function in MNCs. This can ultimately lead to an increase in the value of the multinational company.

In another study by Westerman and von Eije (2005), it was stated that the liberalization of financial markets, low exchange rate volatility and the establishment of the single currency lowered costs relating to transactions and bankruptcies of multinational companies in Europe. They also state that it makes cash transfers in Inner Europe easier and cheaper, and that this makes it possible to centralize cash management activities. Therefore, they stated that centralization and disintermediation at the headquarters of

multinational companies provide cost savings in working capital, bank accounts, funding and bank relations.

Tsamenyi and Skliarova (2005), in their study, have investigated how different or similar cash management practices in multinational companies in Russia and the Commonwealth of Independent States were, as well as observing the differences in their cash management practices. As a result of the study, they stated that there were difficulties in international finance and cash management practices in companies in both Russia and other countries under the Commonwealth of Independent States due to the bureaucracy, banking system and the volatility of the currencies used in these countries.

So and Zhang (2022) investigated the impact of cultural heterogeneity on corporate cash holdings, focusing on multinational companies, and showed that the level of corporate cash holding is positively correlated with the degree of national cultural differences within a multinational company, in general, cultural heterogeneity of multinational management in the context of global operations. stated that it is important to take them into account.

5. Methodology

5.1. Purpose and Scope of the Study

In the study, the aim is to model the cash inflows and outflows from the activities of a multinational airline company that has its headquarters located in Turkey. Also, part of the aim is to evaluate and interpret the risks arising from these cash movements by examining the subject within the framework of a case study.

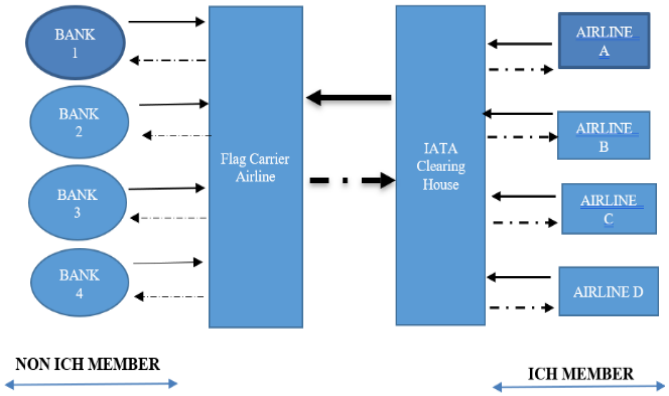


Figure 1. Cash Inflows and Outflows of the International Airline Company
Source: Author's own creation

Turkey's flag carrier airline company examined in the study has representative offices and ticket sales offices in various airports and cities in 128 countries, including Europe, America, Africa, the Middle East, and the Far East regions, apart from Turkey. In addition, it has flights to 330 destinations in the world, and while it receives goods and services such as fuel and maintenance support from these flight points, it also provides direct or indirect similar support to foreign airline companies in Turkey.

5.2. Model

The airline company examined within the scope of the developed model provides cash inflows and outflows with banks via ICH, SWIFT and CHIPS systems. The model is given in Figure-1 below. The solid arrows in the figure show the cash inflow, the dashed lines the cash outflows.

In Figure 1, cash inflows and outflows of an airline operating on a multinational scale is modeled. According to the model, the airline company in question is a member of IATA and benefits from the clearing services offered by the ICH. The cash inflows and outflows shown on the right side of Figure-1 are realized within this scope. On the left side, the cash inflows and cash outflows of the airline company using the CHIPS and SWIFT networks of non-ICH companies and organizations and banks are shown. All these cash inflows and outflows are controlled and managed by the accounting department at the airline company's headquarters.

According to this model, the equations created for an airline company can be stated as follows:

Net Cash Amount=Cash Inflows-Cash Outflows (1)

Cash Inflows = [Entries from ICH + Entries from Other Banks] (2)

Cash Outflows = [Withdrawals from ICH + Payments via Other Banks] (3)

In this study, cash inflows and outflows of a flag carrier airline operating in Turkey, as modeled above, are correlated with the balance sheet and cash flow statement given in the company's 2020 annual report and in Figure 2, comments and evaluations about cash changes are made.

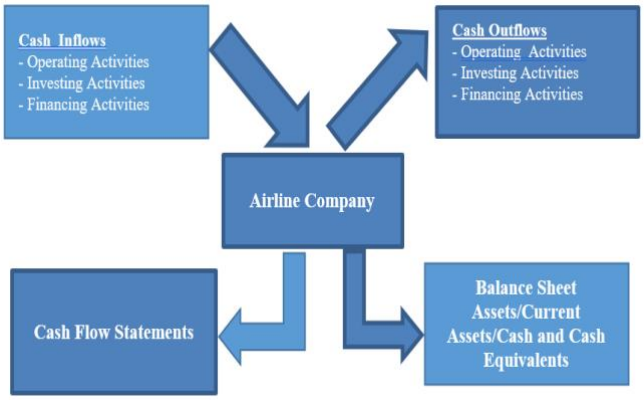


Figure 2. Airline Cash Flows and Financial Statements
Source: Author's own creation

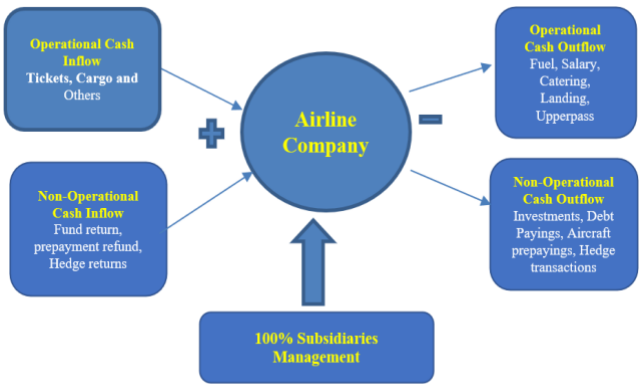


Figure 3. Airline Cash Flows
Source: Author's own creation

Cash inflows and outflows of a company in a certain accounting period are taken from its cash flow statement and can be classified under three sub-headings as operating activities, investment activities and financing activities. The cash inflows and outflows from ICH and banks to the airline company shown in Figure 1 are considered to be cash flows from operating activities, which are the net profit or loss for the period, and changes in working capital. Cash flows from investing activities arise from the purchase or sale of property, plant and equipment (aircraft), cash advances and debts. Cash flows from financing activities are mainly due to loan repayments and rent payments.

Table 1. Cash Flow Statements (Million USD)

Accounts	2020	2019
Begining Balance	2.075	1.636
Cash Flow from Operating Activities	389	2,111
Net Income	(836)	
Cash Flow from Investing Activities	(369)	(1,016)
Cash Flow from Financing Activities	(284)	(656)
Net Change in Cash and Cash Equivalents	(264)	439
Ending Cash and Cash Equivalents Balance	1.811	2,075

Source: Company's 2020 Operating Reports.

Table 2. Balance Sheet 2020 (Related Acconts- Mil. USD)

Assets		Liabilities & Stockholder's Equity	
Current Asset		Liabilities	
		Stockholder's Equity	
Cash and Cash Equivalents	1811	Net Income	(836)

Source: Company's 2020 Operating Reports

5.3. Case Study and Findings

The relevant account items in the cash flow statement and balance sheet for the years 2019 and 2020 are given above. According to the cash flow statement given in Table-1; 438 Million USD was created in 2019, TL -264 million USD was created in 2020, and the cash balance at the end of 2020 was 1,811 million USD. The amount of cash generated decreased by 160 % compared to 2019. While the most important reason for the decrease in the amount of cash created was the Covid-19 pandemic experienced. While a net profit of 788 million USD was recorded for the period in 2019 it was followed by a loss of 836 million USD. in 2020. If the cash flow statement is analyzed in terms of cash inflows and outflows;

Cash Inflows = (from Operating Activities + from Investment Activities + from Financing Activities) = (2,699+784+3,963)= 7446 million USD

Cash Outflows = (from Operating Activities + from Investment Activities + from Financing Activities) = (2,310+1,153+4,247) = 7,710 Million USD

Net Cash Flows = Cash Inflows - Cash Outflows = 7,446 Million USD – 7,710 Million USD = -264 Million USD

Cash inflows and cash outflows in 2020 are given in Table-3 below. According to this table, the difference between cash inflows and outflows was – 234 million USD. In 2020, 53,2% of cash inflows and 55% of cash outflows were from financing activities. While cash inflows are derived from loans provided, cash outflows are from loan repayments and rent (leasing) payments.

It is aimed that the inconsistencies that may occur in the short, medium and long-term cash inflows and outflows of the airline company will not disrupt the operational activity flow. In 2020, the airline company's cash inflows were 7,446 million USD, its outflows were 7,710 million USD and its daily average cash flow (2*7,746+7,710)/360= 65 million USD. Projections related to basic parameters are provided from the units of the company. Parameters that are the basis of cash flow in the airline company are fleet, capacity, flight frequencies, fuel consumption, number of personnel, occupancy rate, unit income, etc. can be specified as. Similarly, basic exchange rates, fuel prices, interest rates, inflation, etc. are used in cash flow forecasting. factors will also be influential. In this way, income, expenses, net cash flow and cash stock are estimated in the light of the above-mentioned parameters. Forecasts can be made in 1 or 1.5 year periods with a monthly frequency. It is aimed to minimize the difference by analyzing the estimation in detail. The minimum liquidity procedure has been accepted at the airline company, and critical thresholds have been determined for the amount of cash. In the event that cash is predicted to fall below the threshold level in the estimation study, necessary actions are taken to procure external resources.

Figure 4 below shows the modeling of the airline company according to the Miller-Orr model, in which the optimal cash balance and the lower and upper limits of the cash level are shown. According to the Miller-Orr model, the minimum cash level (L) is 50 Million USD, the target cash level (Z) as 65 Million USD., and the maximum cash level (H) as 100 Million USD.

The minimum cash level determined by the airline company is determined as, 50 Million USD and when the cash level reaches the upper limit of 100 Million USD, the company will invest in securities of 100-65 = 35 Million USD and reduce the cash level by target or average amount. When the cash level of the company reaches the lower limit of 50 Million USD, the company will sell securities worth TL 15 Million USD (65-50) in order to reach the target capital level and increase the amount of cash at this level.

The airline company examined in the case study followed some strategies for the cash flow problems it experienced during the pandemic period. While foreign airlines received intense government support and reduced their personnel numbers during this period, this company managed to deal with the crisis using its own resources. After the short working practices employed and the agreement reached with the union, 800 million USD were saved in personnel expenses. By reducing the planned advertising and marketing activities, a savings of 100 million USD was also achieved in this period. Approximately 100 million USD was saved due to the simplification of in-flight catering services, strong bargaining with suppliers, and discounts on airport payments. Together with the savings of 100 million US$ in other fixed and operational expenses, a total of approximately 1.1 billion USD was saved within the year. On the other hand, approximately 300 million USD was cut in non-aircraft investment expenditures. As a result of flight cancellations and delays, the financing need for the 2021-2023 period was reduced by 7 billion USD, contributing to short-term cash management planning.

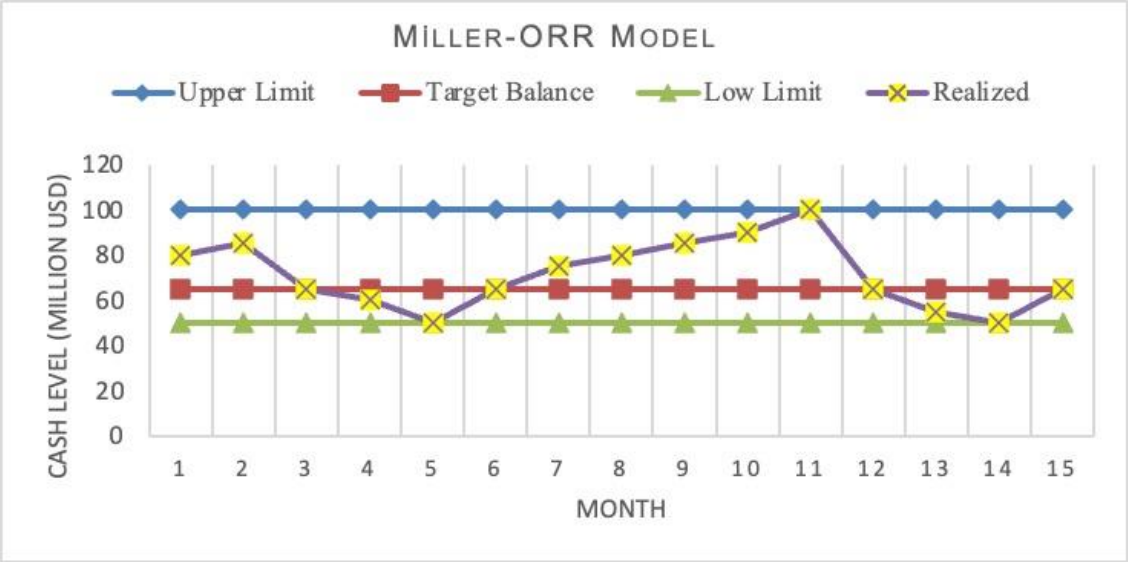


Figure 4. Optimal Cash Balance According to the Miller-Orr Model
Source: Author's own creation

Due to flight cancellations within the scope of the measures taken during the epidemic period, approximately 1 billion USD worth of ticket refunds were made. As a result of the actions taken, the cash level at the end of 2019 was relatively preserved. Cash was generated in passenger operations with dynamic capacity management, higher occupancy compared to competitors and a positive contribution margin. The EBITDA figure, which indicates the cash generation potential of the partnership, was seen to have decreased by 40% in 2020 compared to 2019, and stood at 1.9 billion USD, while the EBITDA margin was realized as 27.7%. Despite the decrease in the EBITDA amount, the aviation industry, which entered

2020 with growth expectations despite the negative commercial and political developments that took effect in 2019 due to the pandemic, faced an unprecedented crisis in its history due to the pandemic.

Despite this, according to IATA expectations, due to the continuing cash burning in the first half of 2021, it is expected that support requests from the markets, banks and governments will continue in order to ensure the income-expenditure balance of airlines throughout the year. Airlines, which need more flexibility in their costs and cannot receive sufficient financial support, are expected to focus on industry consolidation.

In terms of cash flow risk management, the airline pays attention to the establishment and implementation of an effective cash management policy. In order to manage cash flow risk effectively, forward-looking company cash flow estimation studies are carried out on a monthly basis. In addition, in order to ensure the continuity of the company, the minimum level of cash to be kept has also been determined. Current and future cash amounts are monitored according to this level and it is stated that necessary actions are taken to ensure that the minimum cash level is not dropped (THY Annual Report 2020).

6. Conclusion

Cash is vital for airlines operating globally, as it is in other industries. From executing day-to-day operations to exploiting new investment opportunities, airline companies must maintain an optimal level of cash. The amount of the cash level depends on a number of factors such as the company's activity level, alternative rate of return, the current conjuncture and international markets.

There are few common points in previous studies on the topic by Ünlü (2010), Wündisch (1973), Masson (1983), von Eije and Westerman (2002), Westerman and von Eije (2005). These points are first to minimize the cash holding and transaction costs of multinational companies, to keep sufficient amount of cash in the company to evaluate the investment opportunities, to facilitate cash transfer between the multinational company and its sub-units, and to develop appropriate mechanisms and a central and intermediary cash management system. Within the framework of these approaches, in this research, it has been determined that the central system and mechanisms established for cash management in an airline company, which is a multinational company, are compatible with the literature and even this mechanism has been established within the body of IATA all over the world and clearing services are provided to member airline companies.

The IATA Clearing House in the airline sector and technological developments in the banking sector offer airline companies important opportunities that can facilitate and safely carry out their international and national activities. With these opportunities, companies can reduce risks in cash management and operations and increase company values.

The net cash flow and cash levels created by the companies can be monitored in the cash flow statements and balance sheets, and in this way, they can control from which sources the cash flows are obtained and where they are used. They aim is to be able to predict future cash levels for airline companies and to reduce cash flow risk by using methods such as models and forecasting techniques that are used to create a cash budget and determine the cash level.

Due to the Covid-19 pandemic, many airline companies have taken some precautions against cash flow crises. These are precautions such as achieving savings in personnel expenses by reducing the number of personnel, cancellation and postponement of aircraft purchases, cooperation and mergers with other airline companies and government supports are the main measures. However, companies that cannot manage the process and are financially weak should terminate their activities. However, companies that could not manage the process and were financially weak had to terminate their activities or go bankrupt. Today, airline companies both in Turkey and in other countries are considered to be in the recovery process.

In this study, the net cash flows and the changes in the level of cash and cash equivalents account of the flag carrier airline operating in Turkey, which can be considered as an international company, were analyzed 2020. Cash flows and their relations with the IATA Clearing House were determined, evaluated and interpreted. The fact that there are very few studies in the national and international literature on the analysis, evaluation and interpretation of cash flows in the airline industry makes this study unique

Ethical Approval

Not applicable.

Conflicts of Interest

The authors declare that tere is no conflict of interest regarding the publication of this paper.

References

Al-Kwifi, O. S., Farha, A. K. A. and Zaraket, W. S. (2020). Competitive Dynamics Between Multinational Companies and Local Rivals in Emerging Markets. FIIB Business Review, 9(3), 189-204.

Amankwah-Amoah, J. and Debrah, Y. A. (2011). The evolution of alliances in the global airline industry: A review of the African experience. Thunderbird International Business Review, 53(1), 37-50.

Bates, T., Kahle, K. and Stulz, R. (2006). Why do U.S. firms hold so much more cash than they used to? NBER working paper series. Vol. w12534.

Brigham, E. F. and Houston, J. F. (2009). Fundamentals of Financial Management, South-Western Cengage Learning.

Campbell, J. L., Dhaliwal, D. S., Krull, L. K. and Schwab, C. M. (2018). US multinational corporations' foreign cash holdings: An empirical estimate and its valuation consequences. SSRN 2277804.

da Costa, M. B. and Nagano, M. S. (2014). Evolutionary models in cash management policies with multiple assets. Economic Modelling, 39, 1-7.

Deveci, M., Çiftçi, M. E., Akyurt, İ. Z. and Gonzalez, E. D. S. (2022). Impact of COVID-19 pandemic on the Turkish civil aviation industry. Sustainable Operations and Computers, 3, 93-102.

Erel, I., Jang, Y. and Weisbach, M. S. (2020). The corporate finance of multinational firms (No. w26762). National Bureau of Economic Research.

Eitman, K. D., Stonehill, L. A. and Moffett, H. M. (2011). Multinational Business Finance (12th ed). Pearson

Fernandes, N. and Gonenc, H. (2016). Multinationals and cash holdings. Journal of Corporate Finance, 39, 139-154.

Foley, C. F., Hartzell, J. C., Titman, S. and Twite, G. (2007). Why do firms hold so much cash? A tax-based explanation. Journal of financial economics, 86(3), 579-607.

Galimidi, B.V. (2010). İşletmelerde nakit yönetimi ve bu çerçevede bir finansal analiz örneği (Doctoral Dissertation). Ankara University, Ankara, Turkey.

Gu, T. (2017). US multinationals and cash holdings. Journal of Financial Economics, 125(2), 344-368.

Jensen, M. C. (1986). Agency costs of free cash flow, corporate finance and takeovers. Am Econ Rev, 76, 323–329.

Jiang, J. and Wu, S. (2022). The effects of cash-holding motivation on cash management dynamics. Research in International Business and Finance, 59, 101542.

Kabakçı, A. (2011). Çokuluslu işletmelerde merkezi nakit yönetimi ve havuzlama. Dokuz Eylül Üniversitesi Sosyal Bilimler Enstitüsü Dergisi, 13(1), 97-110.

Keynes, J. M. (1936). The General Theory of Employment, Interest, and Money. Macmillan, London.

Kusnadi, Y. and Wei, K. J. (2011). The determinants of corporate cash management policies: Evidence from around the world. Journal of Corporate Finance, 17(3), 725-740.

Manoel, A.S. and Moraes, C.M. (2022). The impact of internationalization degree on cash levels: Evidence from Latin America: International Business Review, 31 (101949), 1-9.

Masson, D. J. (1983). A cash management model for the multinational corporation (Dissertation). Indiana University, USA.

Myers, S. C. (1984). The capital structure puzzle. J Finance, 56, 575–592.

Pinkowitz, L., Stulz, R. M. and Williamson, R. (2012). Multinationals and the high cash holdings puzzle (No. w18120). National Bureau of Economic Research.

Ramirez, A. and Tadesse, S. (2009). Corporate cash holdings, uncertainty avoidance, and the multinationality of firms. International Business Review, 18(4), 387-403.

Srinivasan, V. and Kim, Y. H. (1986). Payments netting in international cash management: a network optimization approach. Journal of International Business Studies, 17(2), 1-20.

So, J. and Zhang, F. (2022). The effect of cultural heterogeneity on cash holdings of multinational businesses, Research in International Business and Finance, 61 (101660),

Tsamenyi, M. and Skliarova, D. (2005). International Cash Management Practices in a Russian Multinational. Managerial Finance, 31(10), 48-64.

Ünlü, Ö. (2010). Çokuluslu işletmelerde nakit yönetimi ve kuramsal bir uygulama (Doctoral Dissertation). Dokuz Eylül University, İzmir, Turkey.

Vasigh, B., Fleming, K. and Humpreys, B. (2015). Foundation of Airline Finance: Methodology and Practice. Routledge: Taylor and Francis Group.

von Eije, H. and Westerman, W. (2002). Multinational cash management and conglomerate discounts in the euro zone. International Business Review, 11(4), 453-464.

Westerman, W. and von Eije, H. (2005). Multinational Cash Management in Europe Towards Centralisation and Disintermediation: The Philips Case. Managerial Finance, 31(10), 65-74.

Wu, W., Yang, Y. and Zhou, S. (2017). Multinational firms and cash holdings: Evidence from China. Finance Research Letters, 20, 184-191.

Wündisch, K. (1973). Centralized cash management systems for the multinational enterprise. Management International Review, 13(6), 43-57.

Yalçıner, K. (2012). Uluslararası Finansman. Detay Yayıncılık, Ankara.

Yilmaz, H. (1999). İşletmelerin Finansal Yönetiminde Nakit Akış Rasyo Analizi. Dokuz Eylül Üniversitesi İktisadi İdari Bilimler Fakültesi Dergisi, 14(1), 185-198.

https://www.iata.org/en/pressroom/pr/2021-24-02-01/ (accessed 03.01.2022).

https://www.iata.org/contentassets/c81222d96c9a4e0bb4ff6ced0126f0bb/iata-annual-review-2020.pdf, (accessed 14.12.2021).

https://investor.turkishairlines.com/documents/finansal-raporlar/tl-thyao-formsrk-aralik_2020.pdf, (accessed 14.12.2021).

Cite this article: Kose, Y. Aktan, C. (2023). Cash Management of Multinational Airlines: A Case Study on A Turkish Airline. Journal of Aviation, 7(1), 73-82.

7 (1): 83-92 (2023)

Journal of Aviation

https://dergipark.org.tr/en/pub/jav

e-ISSN 2587-1676

The Effect of Covid-19 on the Financial Performance of Ground Handling: The Example of Çelebi Aviation Holding

Oğuzcan Kurşuncu [1], Nisa Seçilmiş [2*]

[1]General Directorate of State Airports Authority, Kars, Türkiye. (Oguzcan.KURSUNCU@dhmi.gov.tr)
[2]Gaziantep University, Faculty of Aeronautics and Aerospace, Aviation Management Department, Gaziantep, Türkiye. (nsecilmis@gantep.edu.tr)

Article Info

Received: 15 November 2022
Revised: 28 November 2022
Accepted: 14 December 2022
Published Online: 02 March 2023

Keywords:
Covid-19
Civil aviation
Entropy-Based TOPSIS
Ground handling
Financial performance

Corresponding Author: *Nisa Seçilmiş*

RESEARCH ARTICLE

https://doi.org/10.30518/jav.1205072

Abstract

The aviation industry consists of many interrelated components and there are many factors that affect the functioning of these components. The Covid-19 epidemic, which has recently been exposed to the whole world, has left deep traces in the aviation industry. The narrowing of air transportation due to the effect of the epidemic brought along financial problems for the ground services component, which is responsible for the operational process. The aim of this study is to examine the financial effects of Covid-19 on ground handling services. For this purpose, the data of Çelebi Ground Handling Inc., which was determined as a sample company, between 2009-2020 were tested using the Entropy-Based TOPSIS Method. The criteria were weighted with the Entropy method and then the alternatives were classified with the help of the series created using the TOPSIS method. Five criteria were determined as "net sales, profit before interest, total assets, equity and number of employees". According to the results of the research, while the highest weighted criterion was total assets, 2018 was determined as the most successful year of the company in financial terms. It was observed that negative financial effects occurred in 2020 with the effect of the pandemic, but there were improvements again in 2021 and even a more successful financial performance compared to 2017.

This study was generated from a master's thesis prepared in Gaziantep University, Institude of Social Sciences, Aviation Management Master Program.

1. Introduction

The foundations of the emergence of civil aviation in the world were laid in the early 1900s. However, the separation of civil aviation from military aviation and becoming a sector took place after the Second World War (Aydın, 2021). Air transport is one of the indispensable services of daily life, especially in developed countries, such as health and communication services, and is essential for economic growth and social development. Air transport has an important role not only in developed countries but also in developing countries due to its significant impact on the tourism and trade sector (Aktepe & Şahbaz, 2010). As globalization necessitates access to people and resources, the demand for transportation and air transportation, which is one of the main transportation modes, is increasing (Walker et. al., 2019; Seçilmiş & Korap, 2017). Today, modern airports are considered as important economic units covering all activities related to tourism, entertainment, production, service and logistics sectors as well as providing transfer between air and ground transportation (Akça, 2020).

The aviation industry, which has a global service network and interacts with many sectors, is rapidly taking its share from the positive and negative developments in the world. From the past to the present, many crises have occurred on a global scale, such as the Great Depression of 1929 (Black Thursday), the September 11 Crisis, the 2001 Economic Crisis and finally the Covid-19 Pandemic Crisis. The repercussions of these crises in the aviation industry were rapid and heavy. Many businesses in the aviation industry have downsized, airline companies have decided to reduce or even stop flights.

According to the data of the International Civil Aviation Organization (ICAO), in 2020 compared to 2019; international passenger traffic decreased by 60%, the seat supply of airline companies decreased by 50% and there was a financial loss of approximately 370 billion dollars. In addition, airports lost $115 billion and air navigation service providers $13 billion during the same time period (ICAO, 2022). In Türkiye, when compared to 2019 and 2020, it was determined that domestic air traffic decreased by 31.78%, external air traffic by 60.82%, and total air traffic by 45.15% due to the effect of the pandemic (DHMI, 2021). During the Covid-19 Pandemic, businesses, airports, airlines and ground handling companies in the aviation industry had to make financial and operational adjustments according to the course of the pandemic.

Aviation is perhaps one of the most damaged sectors, as the epidemic directly threatens human health and aviation is a people-oriented service sector. Flights came to a standstill due to the coronavirus, countries closed their borders for indefinite periods and restrictions were imposed on flights even on domestic routes, and as a result of this contraction, all

components in the sector were faced with the financial crisis. Researching these effects separately for each sector component is important in terms of learning from the past and guiding the future. In this study, the ground services side, which acts as a bridge between the airport, the airline and the customer, is selected and the effect on this component is investigated.

Ground handling services are responsible for the following types of services: representation, passenger services, loading and control, reporting, ramp (ramp, cargo and mail, aircraft hygiene, unit loading goods control), aircraft line operations (airline maintenance, aviation fuel and oil), flight operation, transportation, catering, surveillance and data processing management, aircraft private security services and inspection services (Yazgan & Yiğit, 2013). Operationallly, ground handling services can be expressed as the services supplied to passengers, aircraft and cargo at an airport. It is not possible for an aircraft to leave the airport without ground services, and it is not possible for an incoming aircraft to reach the parking lot safely without ground services. Ground handling also covers all activities carried out in the apron area, in the terminal and in the cargo warehouses. Airport service chain is shown in Figure 1. Although fuel, catering and line maintenance services are included in the Standard Ground Handling Services Agreement, these services are not included in the main activities of ground handling services since they are also provided by other specialized companies (Yılmaz, 2015).

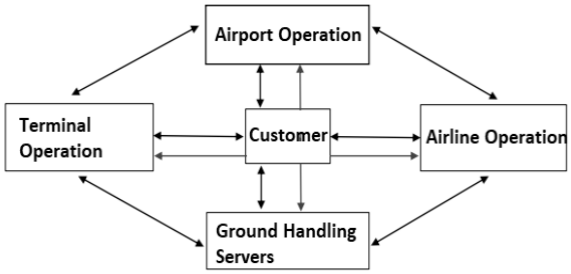


Figure 1. Airport Service Chain (Varışlı, 2015, p. 20)

Ground handling companies may face a number of problems such as flight cancellations or delays due to many different factors such as aircraft mechanical problems, crew diseases, bad weather conditions, legal restrictions, and security procedures while carrying out their operations. These organizations are always obliged to be cautious in every matter and to have the necessary equipment or personnel ready in order to quickly find a solution to any such potential problem (Bazargan & Orhan, 2012). Because possible deficiencies or disruptions play a decisive role in the timely and safe arrival of passengers, luggage and cargo at their destination, that is, they affect the efficiency and success of the transportation process (Schmidberger et al., 2009). Ground handling services, which may not even be noticed until they encounter any problems, are the backbone of flights and constitute one of the most critical links of flight operations.

Namely, a small carelessness or mistake made by ground handling services can harm not only the service company providing this service, but also passengers, airline companies, airports or other components. Ultimately, it can lead to the problem of effective use of both financial and physical resources. In this context, ground handling companies should use their resources correctly and have an effective management approach for both situations in order to maintain their normal activities and be cautious against possible risks.

As mentioned above, the coronavirus outbreak was an unexpected shock, and a process that ground handling companies had to manage with difficulty. In this process, in addition to the health measures brought for passengers and employees, the measures to be taken by companies regarding financial sustainability occupied a very important place in terms of business outcome. Such crises are always likely to occur at the national or global level. For this reason, it is worth investigating how the ground handling services manage this process, how much it is affected financially and what its financial structure is. Analyzing the current situation, determining what kind of measures have been taken and determining what can be done are essential in terms of precaution. In this context, the subject of this research is to find answers to the questions of how the ground services component was affected by the sectoral contraction in the Covid-19 process, whether it was successfully managed, and to make suggestions for possible similar situations.

In order to find an answer to the research question, ground handling companies serving in Türkiye were used. In Türkiye, the activities of airport ground handling services are regulated by the instructions issued by the General Directorate of Civil Aviation, and four organizations currently holding A group operating licenses are serving: Turkish Ground Services Inc., Çelebi Ground Handling Inc., Havaş Ground Handling Inc. and FUGO. Figure 3, shows the % changes in net sales of these organizations before and after the pandemic. Since FUGO has just started to serve, the data of this company is not included. According to the data, Çelebi has been determined as the ground handling company with the lowest rate of change in net sales in 2020, and for this reason, it has been chosen as a sample company in this study.

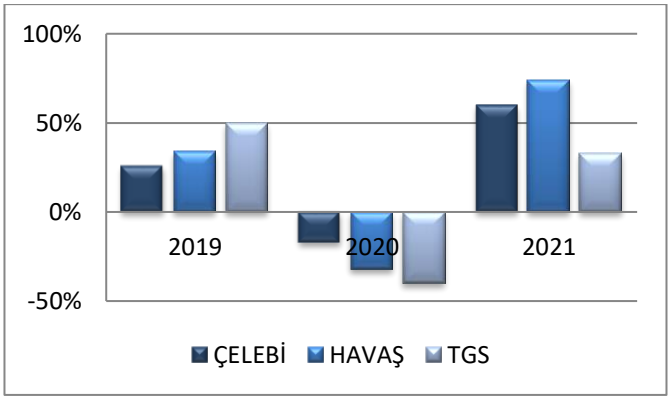


Figure 2. % Change in Net Sales (Fortune Türkiye, 2022; Turkish Airlines, 2022)

In the literature review, it was determined that although many studies were conducted on the effects of Covid-19 on the aviation sector, there was no specific study on the financial impact on ground handling services. It is hoped that the study will contribute to the gap in the literature on this issue. For this purpose, Çelebi Aviation Holding's 2009-2020 data were tested with the Entropy-based TOPSIS method, and the financial structure of this ground handling company was tried to be correlated with the effects of the crisis.

2. Literature Review

It is seen that many academic studies have been carried out in the national and international literature on the effects of the

coronavirus on the aviation sector. In this section, only some of the related studies will be mentioned.

Deveci et al. (2022) examined the effects of the Covid-19 pandemic on air carriers in Turkey. In the study, issues such as financial decisions taken by airlines, flight management, human resources management, hygiene management were presented in terms of differences before and during the pandemic. In the findings of the study, it was mentioned that the sector was seriously affected by the pandemic, it tried to recover with fewer carriers, the salaries of the personnel decreased, the number of passengers decreased, but the cargo flights increased. Köçken et al. (2022) examined the impact of the Covid-19 Pandemic on airports in the study. In the study, data of airports in Türkiye before and during the pandemic were used. Three-Step Data Envelopment Analysis was used to compare these data with the efficiency values. In the light of the information obtained, the performances of the airports were listed. Scheelhaasea et al. (2022), the effects of the Covid-19 Pandemic on a global scale and the measures taken were examined. In the study, the restrictions on the flights of the airline companies, the decisions to stop the flights, the great financial losses experienced by the airport operators and airline companies are included. In addition, in the study, it was emphasized that in order to tolerate these financial losses, governments' providing credit support to these operators more than their repayment capacity may put them in a financially difficult position in the future.

In the study of Dube et al. (2021), potential recovery paths for the global aviation industry from the COVID-19 outbreak were examined. In the study, which used archive and secondary data, it was determined that the epidemic dealt a heavy blow to global aviation, the recovery was slow and airline bankruptcies would increase. In addition, it was mentioned in the study that measures should be taken to protect passengers, reduce costs, increase efficiency, and base on employee health and customer safety. Sucu (2021) examined the impact of Covid-19 and the global crisis it caused on the aviation industry on the basis of Turkish Airlines (THY). In the research, it has been mentioned that perceiving the crisis by senior managers, putting the crisis prevention activities into action, efforts to bring the crisis under control, consist of the steps of communicating with all stakeholders and making efforts to return to the past. In the study, in which THY annual reports, senior management's statements in the written and visual media, and the practices in the crisis management process were examined, it was concluded that THY was successful in the crisis management process. In the study conducted by Annaç Göv & Erbay (2021), they examined the effects of the Covid-19 Outbreak and the views of academics working in the aviation industry on the crisis. The data were provided by 27 Academicians training in the aviation industry in Türkiye, and were analyzed under the Nvivo program. As a result of the study, the importance of cargo transportation was emphasized, and the importance of the aviation industry's readiness after the pandemic process was mentioned. Heiets and Xie (2021) analyzed the losses of the aviation industry by making a brief analysis of the financial effects of the Covid-19 Epidemic on a global scale. In addition, using the PEST analysis, the political, technological, economic and socio-cultural effects of the pandemic on the aviation industry were investigated. In the research, ıt was emphasized that many airlines in the industry will go bankrupt and the rest will merge. In the study conducted by Hopancı et al. (2021), the effects of the Covid-19 epidemic on airports, airline companies and air traffic in the Turkish aviation sector were investigated, and the measures taken to make flights safe were also included. In addition, the predictions made about the recovery process of the aviation sector in the next processes were investigated. In the study, it was determined that airline companies lost 1.7 billion passengers and 6.1 million flights, European aviation suffered a net loss of 56.2 billion Euros and the economic hardship caused 191 thousand direct job losses. Çetin (2021) examined the effects of the Covid-19 Outbreak at the national and international level, and drew attention to the decrease in air traffic, passenger numbers and financial mobility. In the study, it was emphasized that the general recovery in Türkiye will not happen before 2024-2025.

In the study, Akça (2020a) investigated the effects of the Covid-19 Outbreak on Turkish Civil Aviation. The effects of the epidemic were evaluated with its economic aspects, and its financial losses and current situation were analyzed by taking into account the indicators of the aviation sector. In the article prepared by Nizetic (2020), air transport mobility related to Europe (EU) was analyzed for the specific period from January to April 2020. In particular, the impact of COVID-19 on mobility was assessed taking into account the carbon footprint of the two airports in Croatia. The results of the analysis revealed that the pandemic caused more than 89% decrease in the number of flights in the EU, while cargo traffic was not significantly affected. In addition, it was emphasized that there was more than 96% reduction in air transport mobility at selected airports, which is directly related to CO2 emissions falling to a factor of 1.81 for the Zagreb commercial airport and a factor of 3.49 for the seasonal Split airport. Alıcı & Polat (2020) examined the effect of the number of cases and deaths caused by Covid-19 on the stock prices of nine airline companies selected from the countries with the highest number of cases. It was determined that the effects of both variables on stocks were negative, and it was argued that the Covid-19 pandemic was the economic proof of the crisis in airlines.

In the studies, it was determined that the effects of the Covid-19 Pandemic on the aviation sector were evaluated in terms of economic, financial and flight network, and mostly airlines and airports were included. As a result of the studies, the negative effects of the pandemic in every field of the aviation sector were observed. Although there are many studies examining the effects of the Covid-19 Pandemic in the literature, no study has been found that conducts financial analysis of ground handling companies in the aviation sector. This study, which aims to investigate the effects of the pandemic on the financial structure of ground handling services, is therefore expected to make a contribution to the literature.

3. Data and Method of Research

Entropy Based TOPSIS method is frequently preferred in many studies due to its success and high reliability in valuation of financial performance indicators (Altan&Yıldırım, 2019; Perçin&Sönmez, 2018; Sakarya&Aksu, 2020; Akyüz et al., 2019). In addition, it is seen that this method are frequently used in academic studies on the aviation sector (Ömürbek & Balcı, 2017; Ömürbek & Akçakaya, 2018; Bakır & Akan 2018; Kiracı & Asker 2019; Deste & Şimşek, 2019; Ekin & Dinçer, 2020). From this point of view, the Entropy-based TOPSIS method has been preferred in this study, and the data of Çelebi Hava Hizmetleri A.Ş., which is on the Fortune 500 Türkiye list, between the years 2009-2020 has been tested by this method. While deciding on the criteria to be used in this method, studies on the measurement of financial performance

indicators in the literature have been taken into consideration (Perçin&Sönmez, 2018; Işık, 2019; Altan&Yıldırım, 2019; Şahin & Bilgin Sarı, 2019; Ulutaş, 2019; Sakarya&Aksu, 2020). In related studies, it has been observed that criteria such as net sales, change in net sales, profit before interest and taxes, change in profit before ınterest taxes, total assets, equity, exports are mostly included, and among these indicators, the criteria that create undefined data in the analysis are determined and removed from the system. Considering the studies (Ulutaş, 2019; Acer & Kalender, 2020) that emphasize that the number of employees is extremely important when evaluating the performance of companies, this criterion has been included in the analysis as well as financial data. Finally, the financial data and performance indicators to be used in this application have been determined as follows: net sales, profit before interest, total assets, equity and number of employees. The number of employees has been chosen because it provides information about the operational intensity of the company during and before the Covid-19 Pandemic. Other financial data is data that helps to control investments in the light of this data that comes to the fore in a company's financial planning. In this study, all the data belonging to the company in the formation of the decision matrix have been taken from the Fortune 500 Türkiye website.

3.1. Entropy Method

The entropy method is one of the methods used as methods of simultaneous prioritization of reality used to make sense of the lowest certainty or highest uncertainty for a problem. In addition, the method reduces human-induced errors to zero, and as the method gets smaller, the degree of irregularity decreases (Karavardar & Çilek, 2020). The concept of ENTROPY, known as the criterion of disorder and dispersion in thermodynamics, was expressed by Clausius in 1865. The entropy method is used to calculate the sub-criteria weight. The entropy method is a method that can obtain criterion weights by using the values in the decision matrix. Shannon defined the concept of Entropy as the measurement of uncertainty in information. In other words, the concept of Entropy is an effective method used to explain the maximum uncertainty or minimum certainty about an event of interest. The steps of the entropy method are given below (Wu et al., 2011).

Normalization of Decision Matrices:

$$r_{ij} = \frac{x_{ij}}{\sum_1^j x_{ij}} \tag{1}$$

i: alternative value
j: criterion value
rij: Normalized value

Calculating Entropy Values:

$$e_j = -k \sum_{j=1}^{m} r_{ij} \ln(r_{ij}) \tag{2}$$

k: Entropy coefficient
rij: Normalized value
ej: Entropy value

Calculation of Weight Values:

$$W_j = \frac{1 - e_j}{\sum_1^m (1 - e_j)} \tag{3}$$

wj : Weight value
ej: Entropy value

3.2. TOPSIS Method

TOPSIS (Technique for Order Prefence by Similarity Solution), one of the multi-criteria decision making methods, was developed by Hwang and Yoon (1981). This method is based on the fact that the chosen alternative is the closest to the ideal solution and the farthest from the negative ideal solution. For example; The positive ideal solution includes the points with the highest cost and the lowest cost, while the negative ideal solution includes the points where the cost is the highest and the benefit is the lowest. Analysis findings are obtained by ordering the alternatives from the best to the worst according to their distance from these calculated points, in other words, finding the optimum preference. The steps of the TOPSIS method are as follows (Hwang & Yoon, 1981; Chen et al., 2015).

Preparing the Data Row and Creating the Decision Matrices:

The m factor series of the decision problem, which will be the subject of comparison, are determined.

$$\underset{i=1,2,3,\ldots,m}{x_i\big(x_i(j),\ldots,x_i(n)\big)} \quad \underset{j=1,2,3,\ldots,n}{} \tag{4}$$

Decision Matrix:

$$x = \begin{bmatrix} x_1(1)x_1(2) & \cdots & x_1(n) \\ \vdots & \ddots & \vdots \\ x_m(1)x_m(2) & \cdots & x_m(n) \end{bmatrix} \tag{5}$$

Generating Normalized Decision Matrices:

$$n_{ij} = \frac{a_{ij}}{\sqrt{\sum_{i=1}^m a_{ij}^2}} \tag{6}$$

Here, nij is the normalized value of the ith alternative according to the jth criterion.

Generating Weighted Decision Matrices:

In this step, the normalized values are multiplied by the criterion weights.

$$v_{ij} = r_{ij}.w_{ij} \tag{7}$$

Determination of Positive Ideal (A+) and Negative Ideal (A-) Solutions:

In this step, the maximum and minimum values in each column of the weighted matrix are determined. If the criterion is the benefit criterion, the maximum of the criterion values in the positive ideal solution and the minimum one for the cost criterion are taken. Similarly, if the criterion is the benefit criterion, the minimum criterion value is taken in the negative ideal solution, and the maximum one is the cost criterion (Ece, 2019).

$$A^+ = \{(max_i v_{ij} | j \in J), (min_i v_{ij} | j \in J)\} \tag{8}$$

$$A^+ = \{(min_i v_{ij} | j \in J), (max_i v_{ij} | j \in J)\} \quad (9)$$

Measuring Distance Between Alternatives:

The distance of each alternative from the ideal solution is calculated.

$$S_i^+ = \sqrt{\sum_{j=1}^{n} (v_{ij} - v_j^+)^2} \quad (10)$$

$$S_i^- = \sqrt{\sum_{j=1}^{n} (v_{ij} - v_j^-)^2} \quad (11)$$

Calculating Relative Closeness to the Ideal Solution:

Here, it takes a value between $0 \leq C_j^*+ \leq 1$, and C_i*=1 represents the absolute closeness of the relevant decision point to the ideal solution, and Ci*=0 the absolute closeness of the relevant decision point to the negative ideal solution.

$$C_i^* = \frac{S_i^-}{S_i^- + S_i^+} \quad (12)$$

4. Findings

4.1. Entropy solution

The first step of the implementation part is the creation of the decision matrix. While creating the decision matrix, the following financial data and performance indicators were used: Net Sales, Profit Before Interest and Tax, Total Assets, Equity, Number of Employees. The relevant decision matrix is shown in Table 1.

Table 1. Decision Matrix

Year	Net Sales	Profit Before Interest and Tax	Total Asset	Equity	Number of Employees
2009	311.090.568	69.515.602	327.569.517	120.096.539	7.283
2010	347.005.479	71.626.629	359.281.835	128.509.168	3.495
2011	472.753.336	55.945.576	537.163.444	50.482.222	4.207
2012	537.002.487	60.428.482	485.550.616	64.074.156	4.374
2013	507.871.288	72.048.211	515.256.419	46.841.298	10.343
2014	621.449.684	113.031.144	573.244.822	106.453.496	10.508
2015	732.278.323	161.638.141	678.550.555	144.285.259	11.648
2016	709.524.691	92.561.288	689.822.528	101.696.764	12.278
2017	917.789.663	178.250.059	836.042.186	168.855.174	12.657
2018	1.334.270.054	380.496.218	1.522.060.041	353.087.514	13.031
2019	1.877.885.568	378.302.240	2.219.589.632	572.436.992	13.475
2020	1.541.501.101	328.925.275	2.762.169.402	446.297.475	10.009

In table 2., it is seen that there are criteria in different units and the normalization process is performed to standardize the criteria between 0 and 1. These values were found by dividing the values in the decision matrix by their column sum.

Table 2. Normalized Decision Matrix

Year	Net Sales	Profit Before Interest and Tax	Total Assets	Equity	Number of Employees
2009	0.047926184	0.055367035	0.050205749	0.093505341	0.08108078
2010	0.053459186	0.057048403	0.055066216	0.100055287	0.038909423
2011	0.072831728	0.044558928	0.082329679	0.039304691	0.046836035
2012	0.082729864	0.048129424	0.074419112	0.049887165	0.048695226
2013	0.078241951	0.05738418	0.078972045	0.036469923	0.115147399
2014	0.095739682	0.090025824	0.08785978	0.082883075	0.116984325
2015	0.11281379	0.128739799	0.103999723	0.112338311	0.12967581
2016	0.109308397	0.073722214	0.105727349	0.079179556	0.136689526
2017	0.141393411	0.14197068	0.128138066	0.131468074	0.140908888
2018	0.205555807	0.303053514	0.233282282	0.274908576	0.145072586
2019	0.289304464	0.301306078	0.340190874	0.445690748	0.150015586
2020	0.237481536	0.261978847	0.423350699	0.347480436	0.111429017

In Table 3, the values of the expression in the inner part of the formula used to calculate the Entropy value for each criterion found were obtained by multiplying the relevant cell value with the logarithm value of the relevant value. By following the steps below, the formula in the Entropy method was completed, the weight values were found and the weight values of the criteria were reached.

Table 3. Entropy Values for Criteria

Year	Net Sales	Profit Before Interest and Tax	Total Assets	Equity	Number of Employee
2009	-0.145604219	-0.160219515	-0.150196811	-0.221583041	-0.203700001
2010	-0.156573231	-0.163378365	-0.159649013	-0.230330509	-0.126320174
2011	-0.190790256	-0.138620273	-0.205579152	-0.127206151	-0.143369899
2012	-0.206177267	-0.14601801	-0.193344014	-0.149561297	-0.14716546
2013	-0.199356526	-0.164003219	-0.200483278	-0.120761667	-0.248895967
2014	-0.224617015	-0.216751459	-0.21367614	-0.206405744	-0.251015059
2015	-0.246161573	-0.263911692	-0.235389545	-0.245598546	-0.264891074
2016	-0.241963106	-0.192227069	-0.237557901	-0.200802295	-0.272018056
2017	-0.276595081	-0.277145894	-0.263278487	-0.266747571	-0.276130945
2018	-0.325197039	-0.361799188	-0.339543773	-0.354994032	-0.280065684
2019	-0.358817278	-0.361455407	-0.366810274	-0.360176045	-0.284581979
2020	-0.341418988	-0.350918443	-0.363892942	-0.367303123	-0.244516214

The constant k in the formula is found with the formula 1/ ln (m), where m is the number of decision alternatives.

k=1/ln(m) 0.402429604

ej 1.172386729 1.125373677 1.178877819 1.147515953 1.10373181

ej: Entropy value. Entropy values were found for each criterion. Here, the negative value of the constant k is calculated by multiplying the column sum of the values in Table 3. In other words, the sum of -k value * net sales column and the entropy value of the first criterion were found and the other column operations were calculated in this way.

Dj -0.172386729 -0.125373677 -0.178877819 -0.147515953 -0.10373181

dj: Degree of differentiation. In this value, the degree of differentiation was found by subtracting the Entropy value from 1.

Table 2. Calculation of Weight Values

	Net Sales	**Profit Before Interest and Tax**	**Total Assets**	**Equity**	**Number of Employees**
Wj	0.236832049	0.172243564	0.245749776	0.202663543	0.142511068

Calculation of Weight Values is shown in Table 4. It is the last step of the entropy method. It is found by dividing the relevant column differentiation value for each column by the sum of the degrees of differentiation of all criteria. As a result of this process, the importance weights of the criteria were determined. The order is as follows: Total Assets>Net Sales>Equity>Profit Before Interest and Tax>Number Of Employees.

4.2 TOPSIS solution

The first step of the TOPSIS method is to create the decision matrix. Decision matrix and weight values have been given before, so they are not given again in this section.

Table 5. Generating the Normalized Decision Matrix

Year	**Net Sales**	**Profit Before Interest and Tax**	**Total Assets**	**Equity**	**Number of Employees**
2009	0.138633182	0.140169454	0.142197157	0.247497331	0.238063067
2010	0.154638163	0.144426074	0.1559634	0.264834243	0.114242815
2011	0.210675945	0.112807206	0.233181388	0.104034765	0.137516315
2012	0.239307685	0.121846421	0.210776381	0.132045292	0.142975128
2013	0.226325772	0.145276141	0.2236716	0.096531476	0.338086819
2014	0.276940403	0.227913062	0.24884423	0.219381477	0.343480257
2015	0.326329644	0.325922948	0.294557201	0.297345925	0.380744008
2016	0.316189805	0.186638176	0.299450338	0.209578709	0.401337133
2017	0.409000191	0.359418788	0.362923948	0.347980093	0.413725696
2018	0.594598881	0.767222689	0.660722686	0.727649755	0.425950821
2019	0.645434368	0.610294797	0.697515844	0.772771907	0.413015517
2020	0.47078994	0.471194268	0.657911555	0.521855342	0.294840024

Generating the Normalized Decision Matrix is shown in Table 5. It was obtained by dividing each value in the decision matrix by the square root of the sum of the squares of the elements in the relevant column.

Table 6. Weighted Normalized Decision Matrix

Year	Net Sales	Profit Before Interest and Tax	Total Assets	Equity	Number of Employees
2009	0.032832781	0.024143286	0.03494492	0.050158686	0.033926622
2010	0.036623273	0.024876462	0.038327971	0.053672246	0.016280866
2011	0.049894816	0.019430315	0.057304274	0.021084054	0.019597597
2012	0.056675729	0.020987262	0.051798248	0.026760767	0.020375538
2013	0.053601196	0.02502288	0.054967246	0.019563411	0.048181114
2014	0.065588363	0.039256558	0.061153414	0.044460627	0.048949738
2015	0.077285318	0.05613813	0.072387366	0.060261179	0.054260235
2016	0.074883879	0.032147225	0.073589853	0.042473964	0.057194983
2017	0.096864353	0.061907573	0.089188479	0.070522879	0.058960491
2018	0.140820071	0.13214917	0.162372452	0.147468077	0.060702706
2019	0.152859544	0.105119351	0.171414362	0.156612693	0.058859282
2020	0.111498146	0.08116018	0.161681617	0.105761053	0.042017967

Weighted Normalized Decision Matrix is shown in Table 6.

In step 4, ideal and negative ideal solutions were determined. Identified Ideal and Negative Ideal Solutions are given in Table 7. In the table, "A+" denotes positive ideal solution value and "A-" denotes negative ideal solution value.

Table 7. Determination of Ideal and Negative Ideal Solution

	Net Sales	Profit Before Interest and Tax	Total Assets	Equity	Number of Employees
A+	0.152859544	0.13214917	0.171414362	0.156612693	0.016280866
A-	0.032832781	0.019430315	0.03494492	0.019563411	0.060702706

Table 8. Distances to Ideal and Negative Ideal Solutions

Year	Sİ+	Sİ-
2009	0.237359289	0.040929716
2010	0.230926456	0.056499433
2011	0.233896132	0.049829671
2012	0.229770755	0.05032919
2013	0.233855349	0.031941943
2014	0.205056368	0.053952728
2015	0.178945619	0.080145133
2016	0.20087768	0.062933641
2017	0.155123969	0.106988906
2018	0.047787331	0.238671689
2019	0.050433448	0.243225918
2020	0.087485178	0.183014858

Table 9. Distances/ Relative Closeness to Ideal Solution

Year	Cİ*
2009	0.147076295
2010	0.196570439
2011	0.175626153
2012	0.179682971
2013	0.120174071
2014	0.208304377
2015	0.309332279
2016	0.238555497
2017	0.408178752
2018	0.833179172
2019	0.828258676
2020	0.676579792

The distances of the alternatives from the ideal solution and the negative ideal solution were found and shown in Table 8.

Distances/ Relative Closeness to the Ideal Solution were calculated with the formula CI*=SI- / (SI++SI-) and the values found are given in the Table 9. The relative closeness of each alternative to the ideal solution, from largest to smallest, was determined as follows: 2018>2019>2020 >2017>2015>2016>2014>2010>2012>2011>2009>2013.

According to the results of the application; In the analysis report of the data set made with the Entropy Method, the financial indicator that the company attaches the most importance to is total assets; it is followed by net sales, equity and profit before interest and tax, and it is a performance indicator with the lowest weight in the number of employees. On the other hand, according to the success ranking results of the selected criteria made with the help of TOPSIS method; It has been determined that the most successful year in the 12-year period between 2009-2020 was 2018, there was a

decrease in 2020 due to the pandemic, and the most unsuccessful period was 2013.

5. Conclusion

The aviation industry, which has an important place on a global scale, contains many different business lines. All these stakeholders are extremely important in the flawless execution of the operations of the transportation service. Ground handling services are one of the important components that establish the connection between airline companies and airports and play a key role in the management of the flight.

Due to the global networking feature of the aviation industry, the measures taken to prevent the transmission of the Covit-19 virus have also brought about common measures on a global scale. National and international organizations have brought some prohibitions and restrictions both to protect human health and to help the aviation industry survive this pandemic with the least damage. As a result of the measures taken, many countries closed international air traffic and even restricted domestic flights and seat capacities. Although it did not affect the cargo transportation much, the passenger transportation capacity decreased considerably. As a result, large and small-scale airline companies, airport operators and ground handling services companies were also adversely affected, and the aviation industry suffered serious losses.

The Covid-19 pandemic has been one of the factors that most affected the aviation industry among the crises that have occurred to date, and this has caused the aviation industry to shrink financially. Financial indicators are important in terms of planning, decision making and sustainability of companies. In this study, it was aimed to reveal how the financial performance of ground handling services was affected by the Covid-19 Pandemic, and to measure this, the financial data of Çelebi Ground Handling, one of the ground handling companies in Türkiye, between 2008 and 2020 were used. Five selected criteria (net sales, profit before ınterest and tax, total assets, equity and number of employees) were tested with Entropy-based TOPSIS method.

The importance weights of the criteria calculated by the entropy method are as follows: Total Asset>Net Sales>Equity> Profit Before Interest and Taxes>Number of Employees. According to the results obtained with the TOPSIS method, the success order of the years is as follows: 2018> 2019> 2020> 2017> 2015> 2016> 2014> 2010> 2012> 2011> 2009> 2013. Among the years compared, 2018 was the most successful year, while 2013 was the most unsuccessful. Accordingly, it was concluded that the company was affected by the Covid-19 Pandemic, but its financial success rate recovered rapidly, even exceeding its performance in 2017. Considering all these results, it can be said that the company was affected by the pandemic process, but successfully managed this process.

In addition to these determinations, we see that the exemplary company also received agile decisions in crisis management in this process. Namely; Çelebi Ground Handling Inc. management stopped all non-emergency expenditures, postponed investments and directed its employees to paid and unpaid leave as of March 2020. In order to reduce fixed costs, the supports provided by the governments of the countries in which the Group operates were evaluated, necessary applications were made and various supports were utilized. In addition, waivers, discounts or postponements were made in license and lease payments with airport operators and country aviation authorities. The Group Management closely followed the cash flow in order to preserve the strength of its liquidity position (Çelebi, 2021).

The findings of the study are proof that the pandemic has negatively affected the ground handling industry financially. Based on the weighted criteria evaluation results made on the sample organization, it can be thought that supporting a strong asset structure with net sales and strong equity is a way to get out of crisis periods easily. In addition to the proportional distribution in the financial structure, it is also very important to make and implement decisions quickly and correctly in order to get out of the crisis. One way to facilitate this is to include the concept of prudence in company planning. The future plans of ground handling companies should include measures against possible crises as well as growth targets. According to the magnitude of the effects of these crises or the type of crisis (economic, health, terrorism, etc.) it is necessary to have different precautionary packages in different categories in order to minimize the damage that may occur. Thanks to this readiness, the struggle in terms of personnel, operational and financial aspects can be facilitated and faster and more accurate management can be achieved.

The limitations of this study are as follows; the inability to include all the financial data desired to be used in the analysis because it contains undefined data, using only one ground handling company's data, data is limited to the years available in the reports. In addition, the short-term effects of the pandemic cannot be observed because the data are accessed as annual figures.

For future studies, it is recommended to include the balance sheet and income statement ratios used in this study, as well as the ratios of financial statements such as cash flow, change in equity, into the analysis. Another suggestion is to expand the study by using data and/or different methods from different companies serving in the national arena or in other countries. Comparing the financial effects of the previous crises and the effects of the Covid-19 pandemic is thought to be another dimension in terms of the fact that the ground handling component has a wider place in the academic literature.

Ethical approval

Not applicable.

Conflicts of Interest

The authors declare that there is no conflict of interest regarding the publication of this paper.

References

Acer, A. & Kalender, S. (2020). Antrepoların Performansının Entropi ve TOPSIS Yöntemiyle Değerlendirilmesi. Dumlupınar Üniversitesi Sosyal Bilimler Dergisi, (65), 1-20.

Akça, M. (2020). Havalimanı Şehri Modeli. International Journal of Management and Administration, 179.

Akça, M. (2020a). Covid-19'un Havacılık Sektörüne Etkisi. Avrasya Sosyal ve Ekonomi Araştırmaları Dergisi, 7(4), 45-64.

Akyüz, İ., Aydemir, B., Bayram, B.Ç., & Akyüz, K.C. (2019). The Comparison of Financial Performance of the Forest Products Enterprises Using the Entropy-Based TOPSIS Method: A Case of Artvin. Journal of Bartin Faculty of Forestry, 21(1), 136-146.

Altan, İ. M., & Yıldırım, M. (2019). An Analysis and Evaluation of the Financial Performance of the Insurance Sector with Entropy-Weighted TOPSIS Method. Journal of the Human and Social Science Researches, 8(1), 345-358.

Alıcı, A. & Polat, L. (2020). Economic Effect of Coronavirus (COVID-19) Outbreak on Airline Businesses. Turkish Studies, 15(6), 49 - 61.

Aktepe, C., & Şahbaz, R. P. (2010). Türkiye'nin En Büyük Beş Havayolu İşletmesinin Marka Değeri Unsurları Açısından İncelenmesi ve Ankara İli Uygulaması. Cumhuriyet Üniversitesi İktisadi ve İdari Bilimler Dergisi, 70.

Annaç Göv, S. & Erbay, N. (2021). The Effects of the Covid-19 Pandemic on the Aviation Industry and Strategies: Opinions of Turkish Aviation Academics. EUropean Journal of Managerial Research, 5(9), 326-341.

Aydın, A. (2021). ARIMA Modeli ile Covid-19 Salgınının Türkiye Hava Taşımacılığı Sektörü Üzerindeki Etkilerinin Analizi. Ardahan Üniversitesi İktisadi ve İdari Bilimler Fakültesi Dergisi, 119.

Bakır, M., & Akan, Ş. (2018). Havaalanlarında Hizmet Kalitesinin Entropi ve TOPSİS Yöntemleri ile Değerlendirilmesi: Avrupa'nın En Yoğun Havaalanları Üzerine Bir Uygulama. Elektronik Sosyal Bilimler Dergisi, 17(66), 632-651.

Bazargan, M., & Orhan, İ. (2012). Havayolu operasyonları ve planlaması (1 ed.). Eskişehir: Anadolu Üniversitesi Sivil Havacılık Araştırma ve Uygulama Merkezi.

Chen, W., Feng, D., & Chu, X. (2015). Study of Poverty Alleviation Effects for Chinese Fourteen Contiguous Destitute Areas Based on Entropy Method. International Journal of Economics and Finance, 7(4), 89-98.

Çelebi. (2021). Çelebi Hava Servisi Anonim Şirketi 2021 Faaliyet Raporu.

Çetin, D. T. (2021). Covid-19'da Bir Yıl Sonra Sivil Havacılık Sektörünün Operasyonel ve Finansal Durumu: 2021-2025 Tahminleri. In Ekonomi ve Yönetim Bilimleri Çalışmaları (pp. 129-145). Livre de Lyon.

Deste, M., & Şimşek, A. İ. (2019). Havayolu Şirketlerinin Lojistik Performanslarının Entropi ve TOPSİS Yöntemleri Kullanılarak Karşılaştırılması. Yönetim ve Ekonomi Araştırmaları Dergisi, 17(1), 395-411.

Deveci, M., Çiftçi, M.E., Akyurt, İ.Z., & Gonzalez, E.D.R.S. (2021). Impact of COVID-19 pandemic on the Turkish civil aviation industry. Sustainable Operations and Computers, 3, pp. 93-102.

DHMİ. (2021). 2020 Havayolu Sektör Raporu. Ankara: DHMİ.

Dube, K., Nhamo, G., & Chikodzi, D., (2021). COVID-19 Pandemic And Prospects For Recovery Of The Global Aviation Industry. Journal of Air Transport Management, 92, pp.1-12.

Ece, N. (2019). Holding Şirketlerinin Finanssal Performans Sıralamasının Entropi Tabanlı TOPSİS Yöntemleri ile İncelenmesi. Finans Ekonomi ve Sosyal Araştırmalar Dergisi, 4(1), 63-73.

Ekin, E., & Dinçer, S. E. (2020). Havacılık Sektöründe Yedek Parça Envanter Problemlerine Simülasyon Ve Çok Kriterli Karar Verme Yöntemleri İle Hibrit Bir Çözüm Yaklaşımı. Sosyal Bilimler Araştırma Dergisi, 9(4), 28-52.

Fortune Türkiye. (2022). Fortune Türkiye 500. [Retrieved date:02.11.2022]. https://www.fortuneturkey.com/fortune500?yil=2020&fcode=celebi-hava-servisi-as-F269096

Heiets, I., & Xie, Y. (2021). The Impact of the COVID-19 Pandemic on the Aviation Industry. Journal of Aviation, 5(2), 111-126.

Hopancı, B., Akdeniz, H. & Şahin, Ö. (2021). Covid-19 Pandemisinin Havacılık Sektörü Üzerine. Mühendis ve Makina Araştırma Dergisi, 62(704), 446-467.

Hwang, C.-L., & Yoon, K. (1981). Methods for Multiple Attribute Decision Making. New York: Springer-Verlag.

ICAO. (2022). 2020 Passenger Totals Drop 60 Percent as COVID-19 Assault on International Mobility Continues. [Retrieved date: 13.05.2022]. https://www.icao.int/Newsroom/Pages/2020-passenger-totals-drop-60-percent-as-COVID19-assault-on-international-mobility-continues.aspx

Işık, Ö. (2019). Entropi ve TOPSİS Yöntemleriyle Finansal Performans İle Pay Senedi Getirileri Arasındaki İlişkinin İncelenmesi, Kent Akademisi, 12 (37), 200-213.

Karavardar, A., & Çilek, A. (2020). Banka Tercihini Belirleyen Kriterlerin ENTROPİ Yöntemi İle Ağırlıklandırılması: Giresun İli Örneği. İşletme Araştırmaları Dergisi, 12(4), 3482-3492.

Kiracı, K. & Asker, V. (2019).). Hava Aracı Leasing Şirketlerinin Performans Analizi: Entropi Temelli TOPSİS Uygulaması. Uluslararası İktisadi ve İdari İncelemeler Dergisi, 14(1), 17-28.

Köçken, K., Timor, M., & Karakaplan, M. (2022). COVID-19 Pandemisi Öncesinde ve Pandemi Döneminde Türkiye'deki Havalimanı Etkinliklerinin Üç Aşamalı Veri Zarflama Analizi İle Belirlenmesi. European Journal of Science and Technology(35), 643-652.

Nizetic, S. (2020). Impact of coronavirus (COVID-19) pandemic on air transport mobility, energy, and environment: A case study. International Journal of Energy Research, 44(13), 10953-10961.

Ömürbek, N.,& Akçakaya, E. (2018). Forbes 2000 Listesinde Yer alan Havacılık Sektöründeki Şirketlerin Entropi, Maut, Copras ve Saw Yöntemleri ile Analizi. Süleyman Demirel Üniversitesi İktisadi ve İdari Bilimler Fakültesi Dergisi, 23(1), 257-278.

Ömürbek, N., & Balcı, H. F. (2017). Entropi Temelli COPRAS Yöntemi ile Avrupa Birliği Ülkeleri ve Türkiye'nin Havayolu Taşımacılığının Değerlendirilmesi. Süleyman Demirel Üniversitesi Vizyoner Dergisi, 8(18), 13-25.

Perçin, S., & Sönmez, Ö. (2018). Measuring Performance of Turkish Insurance Companies by Using Integrated Entropy Weight and Topsis Methods. IJEAS, 18, pp. 565-582.

Sakarya, Ş., & Aksu, M. (2020). Financial Performance Ranking of Transportation Companies with TOPSIS Based on Improved Entropy Method. Optimum Journal of Economics and Management Sciences, 7(1), 21-40.

Scheelhaasea, J., Ennena, D., Frieskeb, B., Lütjensc, K., Maertensa, S., & Woznya, F. (2022). How To Support The Economic Recovery Of Aviation After COVID-19?. Transportation Research Procedia, 62, 767-773.

Schmidberger, S., Bals, L., Hartmann, E., & Jahns, C. (2009). Ground Handling Services at European Hub Airports:Development of a Performance Measurement System for Benchmarking. International Journal of Production Economics, 117, 104-116.

Seçilmiş, N., & Korap, L. (2017). A New Look At The Relationship Between Aviation Demand And Economic

Growth: Structural Model Estimation For The Case Of Turkey. Journal of International Social Research, 10(49), 661-667.

Sucu, M. (2021). Crisis Management in the Aviation Sector During the COVID-19 Pandemic: A Case Study for Turkish Airlines (THY). Journal of Business Research-Turk, 13(3), pp. 2863-2884.

Şahin, A. & Bilgin Sarı, E. (2019). Entropi Tabanlı Topsis Ve Vikor Yöntemleriyle Bıst-İmalat İşletmelerinin Finansal Ve Borsa Performanslarının Karşılaştırılması. Journal of Accounting and Taxation Studies, 12 (2), 255-270.

Turkish Airlines. (2022). Financial Reports. [Retrieved date: 01.11.2022]. https://investor.turkishairlines.com/tr/mali-ve-operasyonel-veriler/finansal-raporlar?page=3&year= -&term=-

Ulutaş, A. (2019). Entropi Tabanlı Edas Yöntemi İle Lojistik Firmalarının Performans Analizi. Uluslararası İktisadi ve İdari İncelemeler Dergisi, (23), 53-66.

Varışlı, A. (2015). Havalimanı Yer Hizmetlerinde Çalışanlarında İş Tatmini. Yüksek Lisans Tezi, 20. Gazi Üniversitesi Sosyal Bilimler Enstitüsü.

Walker, T., Bergantino, A. S., Sprung, N., & Loiacono, L. (2019). Sustainable Aviation. Cham: Springer Nature Switzerland.

Wu, J., Sun, J., Liang, L., & Zha, Y. (2011). Determination Of Weights For Ultimate Cross Efficiency Using Shannon Entropy. Expert Systems with Applications, 38(5), 5162-5165.

Yazgan, A. E., & Yiğit, S. (2013). Türk Sivil Havacılık Sektörünün Uluslararası Rekabetöilik Düzeyinin Analizi. Sosyal ve Ekonomik Araştırmalar Dergisi, 13(25), 421-445.

Yılmaz, E. (2015). Havayolu Taşımacılığında Yer Hizmetlerinin Önemi ve Yer Hizmetleri İnsan Kaynağının Analizi: Esenboğa Havalimanı Örneği. Türk Hava Kurumu Üniversitesi, Sosyal Bilimler Enstitüsü, Yüksek Lisans Tezi.

Cite this article: Kursuncu, O. Secilmis, N. (2023). The Effect of Covid-19 on the Financial Performance of Ground Handling: The Example of Çelebi Aviation Holding. Journal of Aviation, 7(1), 83-92.

7 (1): 93-99 (2023)

Journal of Aviation

https://dergipark.org.tr/en/pub/jav

e-ISSN 2587-1676

An Investigation and Benchmarking Model for Developing Sustainable Material Use Among Turkish Airport Operators

Alper Dalkıran

Suleyman Demirel University, School of Aviation, Keciborlu, Isparta, Türkiye. (alperdalkiran@sdu.edu.tr)

Article Info

Received: 13 December 2022
Revised: 31 January 2023
Accepted: 19 February 2023
Published Online: 02 March 2023

Keywords:
Sustainability
Materials Sustainability
Airport Sustainability
Airport Benchmarking
Aviation Sustainability

Corresponding Author: *Alper Dalkıran*

RESEARCH ARTICLE

https://doi.org/10.30518/jav.1218291

Abstract

Sustainable material use refers to the capacity of a material to be utilized in a way that does not deplete the Earth's natural resources or harm the ecosystem. This lowering might entail employing renewable or recyclable materials and reducing the overall quantity of material utilized in airport services. Renewable materials, recyclable materials, biodegradable materials, reusable materials, low-impact materials (low-emission materials), natural materials, and non-toxic materials are sustainable materials used in airports. There are 58 civil airports operated in Turkiye. The public information on the airport operators' websites can assess sustainable material use in these airports. Mentioned 58 airports are operated under ten different airport groups. This study offered a novel scoring system called CACS which stands for Clarity, Accessibility, Continuity, and Suitability, to retrieve sustainable material use from sustainability reports of airport operators. The model proposed in this paper will help the readers benchmark a group of airports not present in the literature. The results show that İGA airport is the highest score among the ten airports, followed by TAV airports at 820.6 and 256.3, respectively. The top five airports encapsulate 97.44% after the Normalization of passenger counts of Turkiye. Airport operators' sustainable material usage and other sustainability benchmarking on numerous domains based on sustainability reporting systems would draw the public and increase awareness, allowing operator firms and airport authorities to concentrate on creating a more livable future.

1. Introduction

Sustainable material use refers to the ability of a material to be used in a way that does not deplete the Earth's natural resources or harm the environment. This diminishing can involve using renewable or recyclable materials and reducing the overall amount of material used in airport services. The goal of sustainable materials is to create a closed-loop system where materials are used, recovered, and then used again rather than discarded and contributing to waste and pollution.

Investigating and developing the airport's energy management system is another part of sustainable material usage. Although energy consumption is another aspect of sustainability, the approach must encompass all aspects. The objective is to design a strategy for sustainability to close the gaps. Sustainable strategy plans are critical and identify significant actions to improve sustainability (Bujok et al., 2020; Mathiyazhagan et al., 2019).

Life Cycle Assessment (LCA) is another domain of the material sustainability approach. Material sustainability should assess the disposal and lifetime effects on the environment and economy. Calado et al. (2018) have investigated to find optimal materials for production. Alternative transportation methods can be grouped under sustainability but may relate to the sustainability of the materials; therefore, this must be assessed carefully. The mitigation of raw material used was assessed for alternative transportation research (Wang et al., 2020). Building Information Modelling (BIM) and LCA is effective tool combination for making design decisions for environmental and health consequences of building goods and materials. BIM-LCA integration to aid designers in making sustainable material and product selection decisions from inception. Studies have revealed excellent effects of optimization of sustainable design solutions based on simulations (Asare et al., 2020).

1.1 Material Use and Airport Sustainability

Using sustainable materials in airports can be summarized under renewable materials, recyclable materials, bio-degradable materials, reusable materials, low-impact materials (low-emission materials), natural materials, and non-toxic materials. The Sustainable Airport Manual, being developed by the Chicago Department of Aviation, mentions sustainable materials in the life cycle of an airport development as planning, design and construction, operations and maintenance, and relations with the terminal occupants' sections (Rhee, 2020). The same document has sections describing materials starting with green procurement policy, recyclable materials for conserving resources, waste

management, material reuse, local procurement, certified wood use, maintenance, and low-emission materials.

Çelik and Görgülü (2021) stated that airports have seized the significance of sustainability after the new millennium and drawn an environmentally friendly corporate profile to both reduce the impacts of aviation operations and deal with the pressure. Authors have brought attention to material, building reuse, construction waste recycling, local material use, rapidly renewable material use, and certified wood use as LEED (Leadership in Energy and Environmental Design) certification advises. Nonetheless, terminal sustainable development is crucial for construction material reuse by realizing eco-friendly approaches (Ashley and Lemay, 2008).

However, several airport terminal building evaluation methods are present worldwide. Kacar et al. (2022) evaluated LEED, BREEAM (Building Research Establishment Environmental Assessment Method), and Green Airport Green Company certification methods over seven different certification systems by differential benefits for management staff.

Many studies have dealt with pavement covered by sustainable material use for airports in the design and construction or operation and maintenance phases. Green pavement rehabilitation has been studied by Karadelis et al. (2007), who found that their method will be a solution for sustainable pavement repair. Magnoni et al. (2016) have shared recycling practices for airport pavement construction. Another study has focused on utilizing sustainable runway rehabilitation methods and reviewing the performance results (Moulton et al., 2016). Asphalt pavement performance on friction and material reuse by adding in the mixture has been studied by White (2019). Dyer et al. (2022) have brought the public's attention to the significance of cheaper and sustainable alternative pavement technologies used in railroads, airports, and ships. The literature also has articles focusing on structurally optimized sustainable solutions for airport pedestrian bridge construction methods (Sarkisian et al., 2019).

The abovementioned articles have assessed the airport material used in construction from an architectural point of view. Additionally, there is an economic aspect of material sustainability. There is a diverse effect of using raw materials on the epidemic and pandemic situations. Easily reproducible materials for the disinfection of germs can be possible by supporting reusable materials in airports (Shishkin et al. 2021).

A different study has revealed that acknowledging sustainability reporting is vital from the customers' point of view, and some indicators are critical for the airport industry's sustainability aspects (Karagiannis et al., 2019). However, this study marks sustainable material use as the less significant driver for the airport industry. These remarkable results are the examination of sustainability reports of the world's most used airports. A similar study has focused on the sustainable airport phenomenon for Rome International Airport and the relationship between innovative architectures and materials to achieve Nearly Zero Energy Building design (NZEB) (Falvo et al. 2015). Another approach can be proper planning of airline activities that help to reduce material use by the airline cost reductions (Orhan et al., 2010).

A distinct aspect of sustainable material use is waste management in airports. There is a study financial benefits of recycling the utilization of solid waste in airports (Li et al., 2018). The factors driving the passengers' support for environmental sustainability in aviation have been studied on biofuels, materials, and sustainable manufacturing (Winter et al., 2019). A seperate study highlights that producing aviation fuel from sustainable waste by Fischer-Tropsch synthesis can be a decisive recycling advantage in airports (Sanchez et al., 2022).

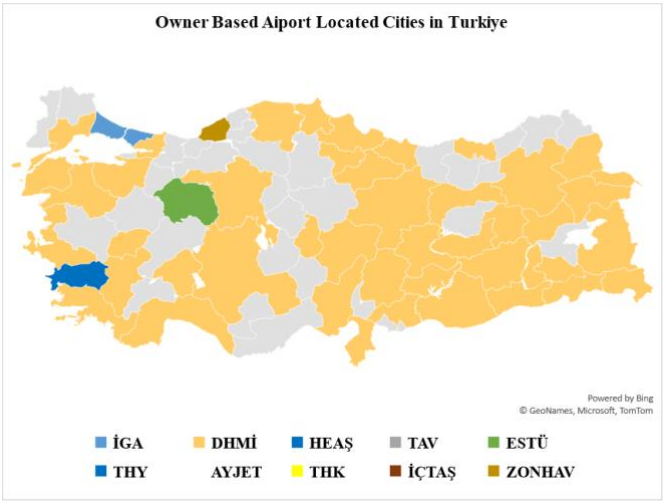
There are many studies in the literature dealing with different aspects of when the topic is sustainable material use in any industry. Nevertheless, airport sustainable material use may be the most condensed form of sustainable material use; unless it has been fully measured. The enormous gap in the literature is that it does not have a gauge to measure how the operators and authorities handle their airports or terminals' sustainable material use. In this study, a proposed approach lets any reader assess sustainability reports to gauge the performance of sustainable material use.

2. Method

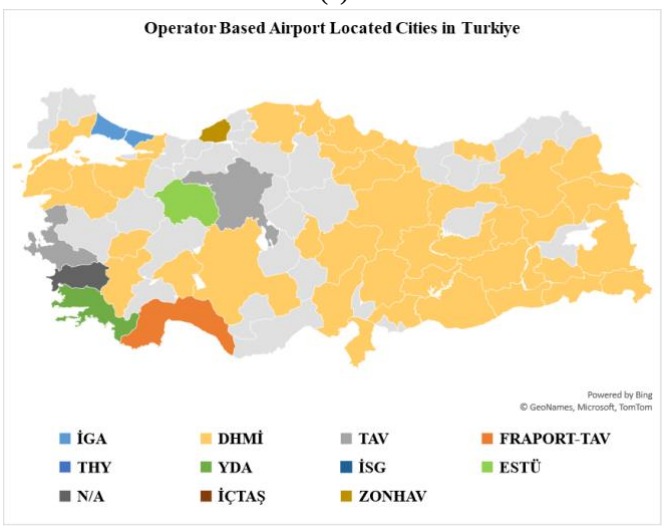
There are 58 civil airports operated in Turkiye as per DHMİ records (DHMİ, 2022a). Figure 1. (a) and Figure 1. (b) demonstrate the Owner-Based Aiport Located Cities in Turkiye and Operator-Based Aiport Located Cities in Turkiye, respectively. Most airports are owned and operated by the DHMİ (DHMİ stands for State Airports Authority). The others are IGA (Istanbul Grand Airport), İSG (İstanbul Sabiha Gokcen), TAV (TAV Airports), Fraport-TAV (Frankfurt Airpot and TAV Airports Venture), YDA (YDA Airports), ESTÜ (Eskisehir Technical University Airport), İÇTAŞ (IC İÇTAŞ), and ZONHAV (Zonguladak Airport Operator) can be found in the DHMİ and SHGM pages. Ordu-Giresun Airport, owned by DHMİ, started operations on 14 May 2022, and the operational figures were reported in the statistics section of DHMİ (DHMİ, 2022a).

There is a distributional difference between the count of owned airports and the total passenger figures served in the airports. Figure 2 (a) and Figure 2 (b) show the differences in this manner—the vast majority of airports, with 74% for DHMİ side. The following airport owners are 6.9% for TAV and 1.72% each for İGA, İSG, YDA, THY, ESTÜ, İÇTAŞ, and ZONHAV. However, the total served passenger figure is slightly changed. The biggest group or airport operator is İGA after the opening at the end of 2018, with 33.78% of total Turkiye air traffic. The following airport operators are Fraport-TAV, İSG, DHMİ, TAV, and YDA, with figures of 16.5%, 16.43%, 15.9%, 14.83%, and 2.43%, respectively. The total of the minor operators covers 0.13% for İÇTAŞ, ESTÜ, THY, and ZONHAV.

These distributional differences define how the problem of developing materials sustainability for airports. The number of airport owners and served passenger count numbers are not aligned. However, how the numbers need to approach to solve is quite challenging. The aviation industry has been changed by unprecedented pandemic news caused by the city of Wuhan, China. Ironically, the virus that started the pandemic has spread throughout the aviation industry and worldwide. The statistics are not reliable, starting with 2020 to the end of 2021. The aviation industry has started to use reliable measurements by the start of 2022. However, the figures are judged and compared by the numbers of 2019 (IATA, 2022). The approach has to be assessed with the approach of catching the series by the average point of 2019 and 2022.



(a)



(b)

Figure 1. Airport distribution among the cities of Turkiye (a) Owner locations, (b) Operator locations (SHGM, 2022a; SHGM, 2022b; DHMİ, 2022b).

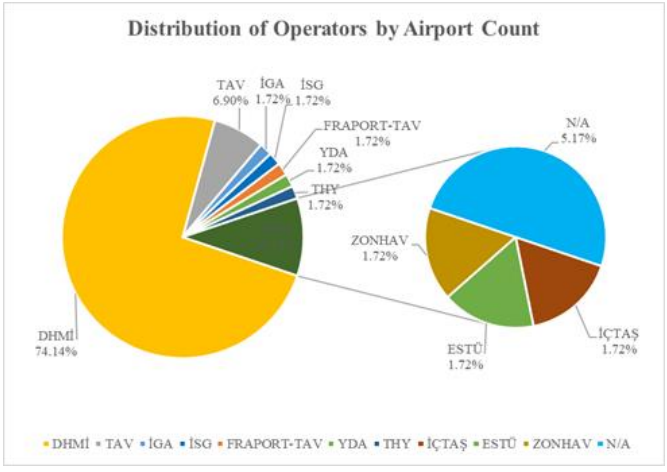
However, the airports of Turkiye cannot be analyzed because of the significant airport change; Istanbul Ataturk Airport has moved to New Istanbul Airport (DHMİ, 2022c; TRT Haber, 2019). This colossal movement action has affected many passenger preferences; airline operations have been affected accordingly. Due to the most significant airport movement and global pandemic effects, it is mandatory to use both 2018 and 2022 data to assess airline distribution.

The research method is based on examining sustainability reports on airport operators. The reason for choosing airport operators is to working methodology of rental and built-operate-transfer agreements in Turkiye. The operator is responsible for the terminal operation and sustainability activities of the airport premises.

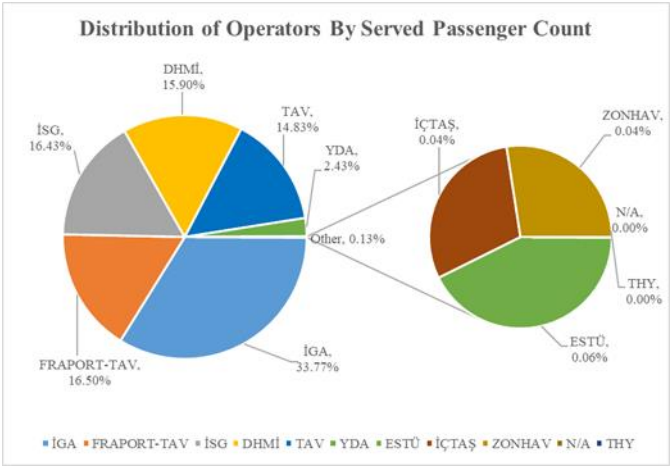
Some studies have assessed sustainability reporting for companies, whether the reporting overlaps with the GRI (Global Reporting Initiative) or not. Karagiannis et al. have studied over 33 reports on the busiest airports of 193, corresponding to 17% of commitment to sustainability issues worldwide (2019). They have described the word “material” as the “importance or applicability” in their study. This applicability study grounds to assessing by a frequency analysis of indices and 2 step approach for identification and prioritization. However, they have not revealed their precise analysis of scoring. Table 1 is a proposed CACS analysis base on gauging for sustainable material use by assessing Clarity, Accessibility, Continuity, and Suitability.

This analysis is to weigh the amount of sustainable material used throughout the airport operation life cycle. The airport operational life cycle starts with the planning phase of airport design and construction; then, it continues throughout the operation and maintenance period with the airport occupants. Figure 3 represents the methodological approach for benchmarking. There is a need to define a normalization approach for the problem to express a comparable magnitude as a gauge for sustainable material use by summarizing public information and reports, and benchmarking calculations were followed through the calculation.

The benchmarking step is multiplying the Clarity, Accessibility, Continuity, and Suitability scores with the normalization index. Normalization is vital to the comprehensibility of the benchmarking grade of the airport’s sustainable material consumption. Normalization can be used yearly to assess the differences throughout the years.



(a)



(b)

Figure 2. Airport operator distributions over Turkiye (a) Counts of operators, (b) Served passenger counts (DHMİ, 2022a).

Figure 3. Methodological approach to solving the problem

Table 1.: Proposed CACS (Clarity, Accessibility, Continuity, Suitability) approach for assessing Sustainable Material Use (SBU)

Gauge	Clarity	Accessibility	Continuity	Suitability
1	SBU is not clearly described	The airport operator web site (web) does not mention any sustainability reporting	The airport operator (AO)has not published any sustainability report	There is no SBU information present in the published report
2	SBU described as a value or significant indicator	There are a value mentioned on the web that sustainable values	AO has announced to publish of a sustainability report	There is only one mention of SBU
3	SBU policy is defined, but no other information is founded	There is more explanation than the values on the web, also approaching and vision plans	AO was published only once years ago	SBU was mentioned more than once
4	SBU policy was defined, and the planning phase announced	There are more explanations than the values on the web have, also specific targets on short-term	AO has published once but announced to publish of the forthcoming version(s)	SBU has been mentioned in many areas but not measured
5	SBU policy defined, and plans mentioned in long-term	Airport operator web site have sustainability reporting/pages but are hard to find	AO has published the reports irregularly for the years	SBU measured
6	SBU policy defined, plans on middle-term were announced or defined	It is possible to find out sustainability reports/pages on the web not easy to find	AO has published the reports irregularly for the years but excuses published in missing years	SBU measured and tracked
7	SBU policy was defined, and short-term and middle-term targets defined	It is possible to find out sustainability reports/pages on the web	AO publishes regularly but stopped because of the pandemic or another force-major	SBU is measured and tracked in many domains
8	SBU policy was defined, short-term and middle-term targets have been defined, announced	It is possible to find out sustainability reports/pages on the web easily	AO publishes regularly but stopped because of the pandemic or another force major, but excuses published on the web	SBU has published as a section
9	Sustainable material use policy defined, plans on short-term and middle-term targets have been defined, latest figures support improvement	Sustainability reporting is present and is offered as a section on the web	AO regularly publishes for years	SBU has published as the main section

Benchmarking grade G_r can be calculated by the below approach:

$$Gr = \frac{i_C\ i_A\ i_P\ i_S\ N}{100} \quad (1)$$

where i_C is the clarity index, i_A is the accessibility index, i_P is the continuity index, and i_S is represents the suitability index. Also, Gr is the grade for the result for the airport, and N represents the normalization value for the airport.

Normalization (N) is used to alter the impact of each development to carry to higher numbers to encourage operators for better applications. The N value represents the share of the commercial passenger count through Turkish airspace. The annual statistics from DHMİ and SHGM were used to calculate the Normalization value. The underlying reason for using N value is to see the actual effect of each sustainable material use development by the passenger share of commercial air traffic served. The score will be more prominent if the share is extensive with each activity.

2.1. Assumptions and Limitations

This study assumpts 'airport owners' and 'airport operators' as two different entities in the airport industry. Although industrial acknowledgment for some definitions of terminal operations is not the same for airport operations, the leading airport owner DHMİ's approach to sustainability points out that the airport operators are the terminal operators. Terminal operators are responsible for the development, building, and investment per the contract. Therefore, DHMİ must be understood as the 'airport owners' category where there is a terminal operator.

Due to the global pandemic adverse effects on the aviation industry, airline metrics have become inconsistent. Therefore, 2020 and 2021 figures were not used for Normalization. On the other hand, the leading airport move in 2019 figures is also unsuitable for this year.

On the other hand, the primary research limitation is publicly announced sustainability reports. There is a worldwide 17% commitment to sustainability reporting per the airport sustainability reporting study (Karagiannis et al., 2019). The Turkish Airports sustainability reporting is based on published reports on the airport operator websites.

This research analyzes sustainability reports' substance and benchmarks public sources. The reports' integrity and impartiality were crucial. The CACS approach created a grade scheme and assessment technique to examine and label the sections of report material carefully. This methodology lets readers assess all sustainability reports subjectively and quantitatively.

The primary constraint of this study was the wide variety of sustainability techniques and definitions. In fact, many reports have neither a section on the usage of sustainably sourced materials nor any discussion of this topic. The second issue involved the consistency of the reporting schedule. In addition, the non-recyclable or non-sustainable material consumption should have been included in the reports. Covid-19, for instance, influenced and compelled airports to use more hygienic materials than reused ones. This specific change also was not discovered in any report. On the other hand, 2022 and 2019 statistics have been used to correlate the difference and consistency of the numbers.

3. Result and Discussion

The methodologic approach item three corresponds to the interrogation of the sustainable material use by the public information throughout the airport operator websites. This task involves searching the airport operator websites, finding the required information, and matching in the scaling step. The reporting information is broadly available for İGA, Fraport-TAV, and TAV airports. The sustainability-related information is present, but no published reports are available for İSG and DHMİ airports. YDA, ESTÜ, and İÇTAŞ airports do not mention any sustainability on their sites, but there are management statements like waste management and targets like zero waste strategy. The airport operator sites for ZONHAV and THY are not reachable. Since no public information is present, their grades have been calculated as a zero, which can be seen in Table 2, Figure 4, and Figure 5.

The results revealed that the CACS score and Normalization are defined in the results in Table 2. Due to the CACS score defined by multiplication, the sustainable material use adaptation score increases rapidly, and the differentiation shows itself broadly.

The graphs shown in Figure 4 and Figure 5 are the results of the CACS benchmarking grade by assessing all aspects as Clarity, Accessibility, Continuity, and Suitability from public reports. Each standpoint developed to a higher level has matched the actions annotated in the airport operators' sustainability reports. CACS indexes i_C the clarity index, i_A the accessibility index, i_P the continuity index, and i_S the suitability index matches with the levels of identical value. Those values and the normalization value of N, which is the share number of total commercial air passenger, represents the grade of airport operator or authority. The vertical scale selected is logarithmic because the normalization value creates incremental growth.

The score for İGA airport is the highest score while comparing the Normalization with other airports. The normalization scores for other big airports are around 15%. The biggest airport operator and prominent airport owner in Turkiye is DHMİ. The DHMİ small airports' total normalization figure is around 15% too. The total for those airport operators in the top five lines reaches 97.44%. Low CACS scores for Fraport-TAV, İSG, and DHMİ are low because their sustainability reports were not published.

Table 2.: Sustainable material use benchmarking scores for airport operators

Airport Operator	Clarity	Accessibility	Continuity	Suitability	Normalization	Grade
	i_C	i_A	i_P	i_S	N	Gr
İGA (İGA Airport, 2022)	9	9	5	6	33.77	820.6
Fraport-TAV (Fraport TAV, 2022)	5	8	1	1	16.50	6.6
İSG (ISG, 2022)	2	5	1	1	16.43	1.6
DHMİ (DHMİ, 2022)	2	3	1	2	15.90	1.9
TAV (TAV Airports, 2022)	9	8	6	4	14.83	256.3
YDA (YDA Dalaman, 2022)	2	2	1	1	2.43	0.1
ESTÜ (ESTÜ HPA, 2022)	2	4	1	1	0.06	0.0
İÇTAŞ	1	1	1	1	0.04	0.0
ZONHAV	1	1	1	1	0.04	0.0
THY	1	1	1	1	0.00	0.0

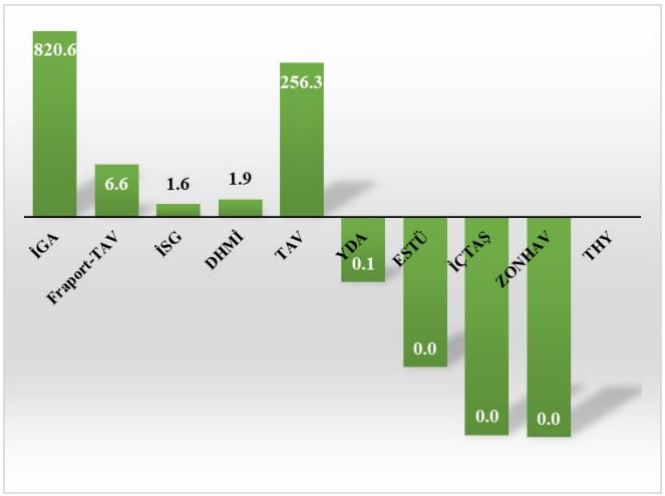


Figure 4. Normalized benchmarking scores among airport operators

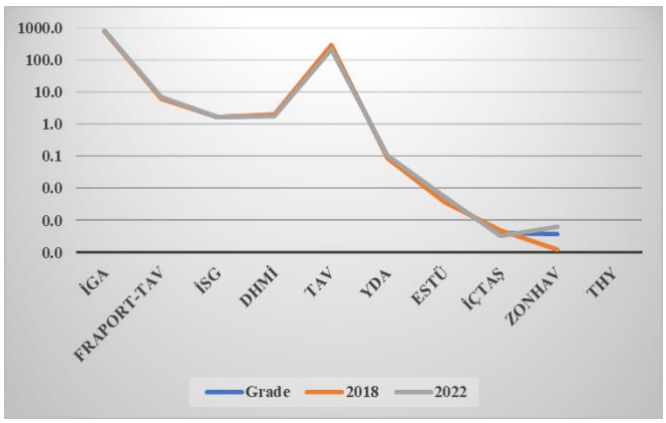


Figure 5. Normalized benchmarking scores among airport operators

The DHMİ has published many annual reports, documents, and statistics, also descriptions on their website, the sustainability reporting is not present. Therefore, their CACS score is as low as the other two airport operators, Fraport-TAV and İSG.

The second highest score was TAV airports which operate four airports in Turkiye. Their normalization score is the lowest in the top five airport operator groups; however, because of their sustainability commitment. İGA and TAV are the most appropriate approaches to sustainability reporting and development for sustainable material use. However, İGA has higher scores in suitability than TAV airports. Figure 4 shows the top five airport operators and other minor airports on a logarithmic scale in a more meaningful way because of the CACS score and Normalization in an exponential manner.

On the other hand, 2018 and 2022 passenger statistics can be slightly different from the normalized results shown in Figure 5. However, as seen in the graphic in logarithmic scales, the differences between the Normalization and 2018 and 2022 figures are almost the same. The changes appear because of the tourist popularity differences and local political results in the neighborhood countries.

The literature has checked for comparing this study with a possible match for sustainable material use in airports. The results of Çelik and Görgülü (2021) listed Adnan Menderes Airport by the LEED criteria of Construction Waste Management, Recycled Materials, Local Material use as 2 points out of 2, and Reuse of Materials as 1 point out of 2. Çelik and Görgülü's measurements are in line with the TAV airports' second position in this study's benchmark. Congruently, the same methodologic approach has been found in the paper of Karagiannis et al. (2019) that benchmarks all airports around the world. There are not any Turkish airport operators assessed in that study; however, the Materials and Sustainability have not been taken seriously by the international airport community as ~%10. Conversely, the same study revealed that Waste Management is recognized as more than %60 important on other indicators.

4. Conclusion

The use of sustainable materials is important because it helps to conserve natural resources and reduce our impact on the environment. The materials used in airports daily, such as plastic, paper, napkins, and materials for any maintenance activity and airport project building phase, affect sustainability. Sustainable material use is one of the most significant parameters in this era.

On the other hand, setting and designing benchmarking systems is crucial for triggering sustainable development in economic, social, and environmental domains. Sustainable material use should start with the definition of a policy statement and the activities of recyclable materials procurement for conserving resources, waste management to reduce environmental impact, reusing of materials to extend the materials life cycle, local procurement alternatives for economic benefits, certified wood use for nature conservation, better maintenance applications for reducing raw materials, and low-emission materials for indoor environmental quality.

Benchmarking systems offered for airport operator sustainability on multiple domains as defined in sustainability reporting systems will attract the public and improve awareness, letting operator companies and airport authorities focus on a more livable future. This study has offered an alternative to benchmarking on sustainability reports to assess sustainable material use under the airport operators of Turkiye.

Acronyms

BIM : Building Information Modelling
BREEAM: Building Research Establishment Environmental Assessment Method
CACS : Clarity, Accessibility, Continuity, and Suitability
DHMİ : Devlet Hava Meydanları İşletmesi, Turkish State Airport Authority
ESTÜ : Eskisehir Technical University Airport
İÇTAŞ : IC İÇTAŞ airports
İGA : İstanbul Grand Airprot
İSG : İstanbul Sabiha Gokcen airport
LCA : Life Cycle Assessment
LEED : Leadership in Energy and Environmental Design
NZEB : Nearly Zero Energy Building
TAV : Tepe Akfen Venture airport
THY : Türk Hava Yolları, Turkish Airlines
TRT : Turkish Radio and Television company
YDA : YDA Airports
ZONHAV: Zonguladak Airport Operator

Ethical approval

Not applicable.

Conflicts of Interest

The authors declare that there is no conflict of interest regarding the publication of this paper.

References

Asare, K. A., Ruikar, K. D., Zanni, M., & Soetanto, R. (2020). BIM-based LCA and energy analysis for optimised sustainable building design in Ghana. SN Applied Sciences, 2(11), 1-20.

Ashley, E., & Lemay, L. (2008). Concrete's contribution to sustainable development. Journal of Green Building, 3(4), 37-49.

Bujok, P., Bjørn-Thygesen, F., & Xydis, G. (2022). Developing a sustainable energy strategy for Midtjyllands Airport, Denmark. International Journal of Sustainable Transportation, 1-25.

Calado, E. A., Leite, M., & Silva, A. (2018). Selecting composite materials considering cost and environmental impact in the early phases of aircraft structure design. Journal of Cleaner Production, 186, 113-122.

Çelik, F., & Görgülü, T. Ş. (2021). Examination of Sustainability in Airport Terminal Buildings within the Framework of LEED Certificate. *Megaron*, *16*(2), 336-349.

Dyer, P. P., & de Lima, M. G. (2022). Waste foundry sand in hot mix asphalt: A review. Construction and Building Materials, 359, 129342.

Falvo, M. C., Santi, F., Acri, R., & Manzan, E. (2015, June). Sustainable airports and NZEB: The real case of Rome International Airport. In 2015 IEEE 15th International Conference on Environment and Electrical Engineering (EEEIC) (pp. 1492-1497).

Kacar, B., Turhan, E., Dalkiran, A., & Karakoc, T. H. (2022). Green Airport building certification comparison: a

practical approach for Airport Management. International Journal of Green Energy, 1-14.

Karadelis, J. N., Koutselas, K., Khan, A., Jiebin, Z., Moscicka, K., & Plachta, A. (2007). Sustainable,"green" solutions for concrete pavement rehabilitation-a feasibility (pilot) study. In Proceedings of the 1st International Conference on Sustainable Construction Materials and Technologies (pp. 417-425). Coventry University. https://core.ac.uk/download/pdf/228145702.pdf

Karagiannis, I., Vouros, P., Skouloudis, A., & Evangelinos, K. (2019). Sustainability reporting, materiality, and accountability assessment in the airport industry. Business Strategy and the Environment, 28(7), 1370-1405.

Li, B., Zhang, W., Wang, J., & Yi, W. (2018, May). Research on recycling and utilization of solid waste in Civil Airport. In IOP Conference Series: Earth and Environmental Science (Vol. 153, No. 6, p. 062039). IOP Publishing.

Magnoni, M., Toraldo, E., Giustozzi, F., & Crispino, M. (2016). Recycling practices for airport pavement construction: Valorisation of on-site materials. Construction and Building Materials, 112, 59-68.

Mathiyazhagan, K., Gnanavelbabu, A., & Prabhuraj, B. L. (2018). A sustainable assessment model for material selection in construction industries perspective using hybrid MCDM approaches. Journal of Advances in Management Research.

Montoya Sánchez, N., Link, F., Chauhan, G., Halmenschlager, C., El-Sayed, H. E., Sehdev, R., ... & de Klerk, A. (2022). Conversion of waste to sustainable aviation fuel via Fischer–Tropsch synthesis: Front-end design decisions. Energy Science & Engineering.

Moulton, S., Decker, C., Falvey, J., & Diebold, J. (2015). Innovative and Sustainable Runway Rehabilitation at Niagara Falls International Airport. In Airfield and

Orhan, İ., Kapanoğlu, M. and Karakoç, T. (2010). Planning and scheduling of airline operations. Pamukkale University Journal of Engineering Sciences, Vol. 16 No. 2, pp. 343-354.

Rhee, J. L. (2020). Sustainable Airport Manual (4th ed.). Chicago Department of Aviation, https://www.flychicago.com/SiteCollectionDocuments/Community/Environment/SAM/Full_SAM_v4.0.pdf

Shishkin, A., Goel, G., Baronins, J., Ozolins, J., Hoskins, C., & Goel, S. (2021). Using circular economy principles to recycle materials in guiding the design of a wet scrubber-reactor for indoor air disinfection from coronavirus and other pathogens. Environmental technology & innovation, 22, 101429.

Wang, S., Wang, H., Xie, P., & Chen, X. (2020). Life-cycle assessment of carbon footprint of bike-share and bus systems in campus transit. Sustainability, 13(1), 158.

White, G. (2019). Quantifying the impact of reclaimed asphalt pavement on airport asphalt surfaces. Construction and Building Materials, 197, 757-765.

DHMİ (2022). Çevre Şube Müdürlüğü. Devlet Havameydanları İşletmesi Genel Müdürlüğü. Retrieved December 8, 2022, from https://www.dhmi.gov.tr/Sayfalar/Isletme/CevreSubeMudurlugu.aspx

DHMİ (2022b). Airport Web Pages. Directorate General of Airport Authority (DHMİ). Retrieved 8 December 2022, from https://www.dhmi.gov.tr/Sayfalar/Havalimani Listesi.aspx

DHMİ (2022c). Proje Detayı. Retrieved 8 December 2022, from https://www.dhmi.gov.tr/Sayfalar/ProjelerDetay.aspx?q=51

ISG (2022). Environmental Management System. Istanbul Sabiha Gokcen Airport. Retrieved 8 December 2022, from https://www.sabihagokcen.aero/corporate-info/others-corporate/integrated-management-systems-policy/environmental-management-system

SHGM (2022). Airport Certifications. Directorate General of Civil Aviation (SHGM). Retrieved 8 December 2022, from https://web.shgm.gov.tr/documents/sivilhavacilik/files/pdf/havaalanlari/Ek-2.pdf

SHGM (2022). Airport Operators. Directorate General of Civil Aviation (SHGM). Retrieved 8 December 2022, from https://web.shgm.gov.tr/documents/sivilhavacilik/files/havacilik_isletmeleri/havaalanlari/ti-010322.pdf

SHGM (2022a). Airport Owners. Directorate General of Civil Aviation (SHGM). Retrieved 8 December 2022, from https://web.shgm.gov.tr/documents/sivilhavacilik/files/pdf/havaalanlari/Havaalani_Isletme_Bilgileri_150222.xlsx

YDA Dalaman (2022). Our Vision. Retrieved 8 December 2022, from https://www.dalamanairport.aero/en/our-vision-mission/

TRT Haber (2019). Atatürk Havalimanı'nın taşınması 45 saat sürecek. TRTHaber. Retrieved December 8, 2022, from https://www.trthaber.com/haber/turkiye/ataturk-havalimaninin-tasinmasi-45-saat-surecek-410702.html

ESTÜ HPA (2022). Eskişehir Teknik Üniversitesi Hasan Polatkan Havaalanı. Retrieved December 8, 2022, from https://hph.eskisehir.edu.tr/tr/Icerik/Detay/atik-yonetimi

Fraport TAV (2019). Sustainability and Management Systems. Retrieved 8 December 2022, from https://www3.antalya-airport.aero/sustainability-and-management-systems/sustainability

IATA (2022, 6 October). Peak travel season ends on a high note in August. Retrieved 8 December 2022, from https://www.iata.org/en/pressroom/2022-releases/2022-10-06-02/

IGA (2019). Sustainability Approach. Retrieved 8 December 2022, from https://www.igairport.aero/sites/sustainability/en

TAV Airports (2022). Sustainability Report. Retrieved 8 December 2022, from https://tavhavalimanlari.com.tr/en- EN/press-room/publications/pages/sustainability-report

DHMİ (2022a). Statistics. Devlet Hava Meydanları İşletmesi. Retrieved December 8, 2022, from https://www.dhmi.gov.tr/Sayfalar/EN/Statistics.aspx

Cite this article: Dalkiran, A. (2023). An Investigation and Benchmarking Model for Developing Sustainable Material Use Among Turkish Airport Operators. Journal of Aviation, 7(1), 93-99.

7 (1): 100-109 (2023)

Journal of Aviation

https://dergipark.org.tr/en/pub/jav

e-ISSN 2587-1676

Determination of Location Selection Criteria and Their Importance Levels for Air Cargo Companies: A Case from Turkiye

Ahmet Türk [1], **V. Alpagut Yavuz** [2*]

[1] Hatay Mustafa Kemal University, Social Sciences Institute, Hatay, Türkiye. (aahmet.turk@hotmail.com).
[2*] Hatay Mustafa Kemal University, Business Administration Department, Hatay, Türkiye. (vyavuz@mku.edu.tr).

Article Info

Received: 18 January 2023
Revised: 04 February 2023
Accepted: 15 February 2023
Published Online: 02 March 2023

Keywords:
Air Cargo Transportation
Location Selection
Cargo Hub
Delphi
G-AHP

Corresponding Author: *V. Alpagut Yavuz*

RESEARCH ARTICLE

https://doi.org/10.30518/jav.1238680

Abstract

Air cargo transportation attracts increasing attention among other alternative transportation models in developing countries due to its ability to provide the fastest transportation service to distant locations. A cargo hub, where air cargo companies perform their cargo operations, plays a critical role, especially in service time and cost. In choosing a site for their operations, understanding the importance of many seemingly independent factors/criteria such as airport system and infrastructure, proximity to production and consumption sources, and transportation connections play a critical role in balancing time and cost. Hence, the study aims to determine the location selection criteria of the cargo hub as the operation site of air cargo companies and to rank their importance. For this purpose, the opinions of experts in university and managers of big air cargo companies in Turkiye were collected. In the first stage of the study, the criteria were determined and categorized into four categories by using the Delphi method. In the second stage, the importance levels of the criteria were determined using the G-AHP method. The research findings highlighted "transportation diversity of the region", "proximity to important production resources", and "the structure of existing warehouses" as the most important criteria among others. The importance levels of location selection criteria categories ranked as "Supply, Equipment and Costs", "Transportation Connections", "Consumer" and "External Factors". In summary, findings show that the most important factor affecting the location selection decision is related to the suitability of the airport's infrastructure for cargo operations.

1. Introduction

Air cargo transportation has become the fundamental element of the global supply chain with the rapid increase of e-commerce in recent years. The growing interest in the air cargo sector is driven by the global widespread integration of just-in-time (JIT) production and distribution systems, as well as a more open trading regime in international air cargo services offered by air cargo carriers (Yılmaz, 2022: 44) Air cargo volume, which showed a continuous increase except for the global crises in 2009 and 2019-2020, reached 65.5 million tons in 2021 (Statista, 2022). Air cargo has increased its importance in the aviation industry, especially with the role it plays in the distribution of health materials and drugs during the global pandemic process. According to IATA (2022) data, by contributing more than one-third of airline company revenues in 2021, it created an alternative to the decreasing passenger revenues in this period and started to gain importance in company strategies.

Similar developments are observed in Turkiye as well. Thanks to the liberalization in air transportation implemented since 2003, rapid development has occurred in air cargo transportation in Turkiye and the cargo capacity of 302,737 tons in 2003 reached 2,593,450 tons in 2021 with an increase of 757% (GDCA, 2021: 38). According to the FTK (Freight Ton Kilometers) ranking in the latest statistics published by ICAO (2021), Turkiye has continued to rise in the sector over the years, reaching the 8th rank. Estimates are that this growth will continue.

In addition to the advantages of air cargo transportation such as speed, reliability and less exposure to weather conditions, there are disadvantages such as the reflection of operational fees on prices and physical barriers (Yılmaz, 2022: 44). In air cargo transportation, cost minimization is an important factor that each air cargo company develops strategies for, in order to compete. Thus, the relationship and balance between time and cost should be analyzed very carefully. Cargo Hubs (CH), which are closely related to the concepts of time and cost, are known as special facilities that operate as assembly and distribution locations, reduce the number of connections on the network, offer companies the opportunity to benefit from economies of scale and provide access to more locations. These facilities can affect the existence and indirectly the future of the airline company with its advantages such as infrastructure and superstructure installation and facilities, the capacity of the airport, equipment features, proximity to important transportation locations, and production sites.

The network structure that brings the flights departing from various airports together at the airport that is the geographical

common point or center of these airports within a certain time period and distributes them from the central point to the surrounding airports in the same way is known as the hub and spoke flight network (Gerede, 2019: 120). The hub and spoke network structure is, in principle, a comprehensive plan designed to ensure that all routes achieve the most efficient system performance (Hsu & Wang, 2013: 258). In this structure, a centrally located institution or facility serves as a collection and distribution point in terms of the importance and capability of its location. The central point where collection and distribution activities take place is known as the CH. In order to take advantage of CHs and to benefit from economies of scale, flows from origin to destination do not use direct/intermediary connection lines and are collected at CHs and sent to destinations via CHs.

The choice of CH location, which is decisive for the performance of cargo transportation activities to be carried out by air cargo companies, has a significant impact on the sustainability of the cargo company, and therefore meticulous and comprehensive research for the selection of the cargo hub is of vital value for this selection process. Through selecting cargo hubs correctly, connection lines are reduced, costs are decreased to lower levels and access to more locations is obtained (Aygün, 2014: 8). Determining the criteria that air cargo companies should consider and evaluate in the selection of CH is a priority issue for making sound decisions.

CH selection is a multi-criteria decision problem, which is described as site/location selection in the literature. Location selection is an important issue that is generally handled within the framework of airport location determination in air transport due to the scope of its consequences and effects. (Martel & Aouni, 1992; Erkan & Elsharida, 2019; Pinto et al., 2020). In studies conducted on this subject in Turkiye; Oktal (1998) proposed a model for the objective evaluation of airport location selection, which has a subjective nature, using numerical data. Akça (2017) conducted a qualitative and quantitative study to develop a scale that allows air traffic controllers to evaluate the suitability of airport locations. Ertunc & Çay (2020) carried out an application study to determine the most suitable areas for airport construction in the provinces of Bayburt and Gümüşhane.

The only study in the literature on the factors considered in air cargo location selection was conducted by Gardiner, Ison, & Humphreys (2005). This is a survey study conducted by 118 non-integrated air carriers in 2005. In this study, they determined that nine factors play an important role in choosing the airport for the cargo activities of the companies. In order of importance, these factors are; night operations, minimizing total costs, airport cargo reputation, local origin-destination demand, the influence of intermediary air cargo agents, airport access, customs clearance times, financial incentives provided by the airport, and shipping time of trucks to main markets. Carrying out operations at night hours and minimizing costs were at the top of the list as extremely important factors. In addition, it has been determined that cost minimization has a great effect regardless of geographical location. Determining the importance of financial incentives as another sub-factor in the airport selection process shows how critical cost management is (Gardiner, Ison, & Humphreys, 2005: 395-396).

A similar study on the subject in Turkiye is the study in which Düztepeliler (2003) examined the home base selection criteria of airline companies and the home base selection criteria of Turkish Airlines for Atatürk Airport. In this study; the question, "According to which criteria was Istanbul Atatürk Airport selected as the home base?" was asked. The answer given was, "No criteria were evaluated for the selection, and Istanbul has become suitable due to the social, cultural, and economic reasons that occur naturally. Although it is suitable for international flights, it is not suitable for domestic flights since it's not a geographical center for Turkiye. This situation can be explained by the fact that the regional development in Turkiye shows great differences and in parallel to this, economic activities are concentrated in a small number of centers (Marmara region and Istanbul). As a result, the absence or very few alternatives in site selection makes detailed analyzes unnecessary for decision-making. However, it is clear from the data that this situation will change rapidly. According to the data of the General Directorate of Civil Aviation for 2021 (2021); Freight traffic consisting of cargo, mail, and baggage increased by 39.8% in domestic cargo transportation in 2021 compared to 2020, while international transportation increased by 34.9%. The increase in air transport traffic along with the increasing number of airports in domestic lines in recent years will create an increasing demand for domestic air cargo transport, causing location selection to be an important decision problem. At this stage, studies to determine the location selection criteria for air cargo companies in Turkiye can provide important contributions.

So far, studies on air cargo in Turkiye has focused on fuel, cargo, fleet planning, and transportation. In these studies; Özger & Oktal (2013) carried out an application study with a new approach proposed for the solution of base layout problems. Derici, Derici, & Karaduman (2015) examined customer preferences in special cargoes. Küçük, Mukanbay & Öztürk (2016) proposed a model for aircraft selection in hazardous goods transportation. Özdoğan (2016) examined the adaptation of modern technology applications in air cargo transit operations.

Considering the studies conducted, it is clear that the CH location selection of air cargo companies has not been sufficiently studied, therefore, this study aims to answer the questions of which criteria should be taken into consideration when selecting the CH location of air cargo companies and how much these criteria should be taken into consideration according to their degree of importance.

Although there are not enough studies on airline cargo companies in the literature, most of these studies focus on fuel, cargo, fleet planning and transportation issues, while very few studies focus on the CH. The difference of this study from the other studies is that the criteria and importance levels taken into account in the site selection process have been investigated by taking into account the views of the academic and industry. From this perspective, the aim of this study is to determine which criteria air cargo carriers take into account when determining the CH airports where they will carry out their operational activities in Turkiye and to classify their importance levels.

2. Materials and Methods

The study consists of two stages. In the first stage, interviews were conducted with experts who are competent on the subject, and a list of criteria that air cargo carriers can consider in CH location selection was created. For the criteria list, the Delphi questionnaire was applied to the academicians who are experts in their fields, and the criteria list that the experts agreed upon was determined. In the second stage, the questionnaire containing pairwise comparisons developed to

determine the importance of these criteria was evaluated by the managers of the companies operating in the air cargo industry. In the last stage, the evaluations of the company managers have analyzed with the Gray-AHP (G-AHP) method, and the ranking of the criteria according to their importance was determined.

In the first stage of the study, 7 academicians with at least 5 years of academic experience with field knowledge and expertise in aviation participated the study. They were asked to determine, within the scope of their expertise, which criteria air cargo companies should evaluate in the decision of CH location selection. In the second stage of the study, the criteria determined by the experts were evaluated by the companies operating in Istanbul IGA airport and Istanbul Sabiha Gökçen airport, which have the highest concentration of central CH activity in Turkiye to find an answer to the question "Which criterion is more or less important than the others in CH location selection". In this context, managers of 5 companies that serve in two different areas (air cargo operators carrying cargo and doing combined transportation) participated this stage.

To create the Delphi questionnaire used in the first stage of the study, the list of criteria covering the topics that can be considered in general was listed by taking into account the relevant literature and expert opinions. Accordingly, the criteria are listed as follows; "Road distance, Railway distance, Seaway distance, Proximity to important consumption sources, Proximity to key production locations, Number of neighboring cities, Structure of warehouses, Airport infrastructure and superstructure, Geographical location, Demographic density, Airport environment Climatic conditions, Airport operating costs".

Then, this list of criteria was sent to academics who are experts in the field to determine the suitability of the criteria, and they were asked to evaluate each criterion in the list by choosing one of the answers as "appropriate, partially appropriate, and unsuitable". Also, it was asked whether there were any suggestions for changes regarding the criteria titles and if there were new criteria suggestions if any. As a result of these evaluations, the list of criteria to be used in the Delphi questionnaire was finalized.

Then, the Delphi questionnaire was created by using the criteria list. The questionnaire containing these criteria was sent back to the independent academic group. At the end of this round the answers given to the questionnaires were evaluated. For this purpose, the 7-point Likert scale evaluations ranging from "strongly disagree" to "strongly agree" for each criterion were coded using numbers from 1 to 7, respectively, and necessary statistics were calculated. The consensus was evaluated by taking into account statistical parameters. Based on this evaluation, it was determined that the experts agreed on the criteria.

As a result of the Delphi study; "proximity to major consumption locations", "the volume of economic activity (industry, trade, import and export) of the region", "population of the nearby region", "nearest airport distance", "transportation diversity of the region", "airport infrastructure and superstructure", "proximity to key production locations", "structure of existing warehouses", "airport operating costs", "geographical location and structure", and "climatic conditions in the airport region" were determined as the criteria for CH location selection. Then, the criteria were grouped under four main criteria categories, taking into account the scope of the criteria.

In the last stage, pairwise comparisons questions were prepared by using the determined criteria to form the AHP questionnaire. In the questionnaire, firstly, four criterion categories were evaluated in six pairwise comparison questions. Then, three criteria in the "Consumer" category were evaluated using three comparison questions. Similarly, the three criteria under the "Transportation Connections" category are in three comparisons; The three criteria under the "Supply, Infrastructure, and Costs" category are in three comparisons; Two criteria under the "External Factors" category were evaluated in one comparison.

The answers given by the air cargo company managers to the survey questions were analyzed by applying the G-AHP steps using the Excel software and the criteria weights were calculated. For the G-AHP calculations, at first the geometric averages of the answers of the five participants were calculated to combine all the evaluations and then using the single evaluation representing the mean group judgement were analyzed.

2.1. Methods

There are many Multi Criteria Decision Making (MCDM) methods used to assist decision makers in location selection problems in the literature. MCDM methods include approaches that help the decision maker to make the most appropriate decision, taking into account the effect of multiple and independent factors (Ömürbek, Üstündağ & Helvacıoğlu, 2013: 105).

Some of the popular methods are; Analytical Hierarchy Process-AHP (Rezaian & Jozi, 2016; Vasileiou, Loukogeorgaki & Vagiona, 2017), Preference Sorting Technique by Ideal Solution Similarity-TOPSIS (Sánchez-Lozano, García-Cascales & Lamata, 2016; Chauhan & Singh, 2016), ELECTRE (Dortaj, Maghsoudy, Doulati & Eskandari, 2020), VIKOR (VlseKriterijuska Optimizacija I Komoromisno Resenje) (Tavakkoli, Mousavi & Heydar, 2011), and a multi-method hybrid (Ishizaka, Nemery & Lidouh, 2013) MCDM method.

There are also studies using various methods related to the location selection problem in Turkiye. Aydın, Öznehir & Akçalı (2009) discussed the modeling of the site selection of a hospital planned to be established in Ankara with AHP. Şahin & Altın (2016) conducted an assignment model study for the location selection problem of temporary settlement areas of tent cities to be used after a possible earthquake in Isparta province. Kasak & Erdal (2019) conducted a study using the MOORA method to select the most suitable location for the penitentiary among alternative lands in Sivas province. Balkan (2020) handled the power plant location problem using the ELECTRE method that will provide the best benefit to producers and consumers. Başkurt & Aydın (2020) evaluated criteria using GIS in determining the appropriate location for the establishment of nuclear power plants. Supçiller & Bayramoğlu (2020) examined the wind farm location selection problem with intermittent gray number-based A-GIA and gray EDAS methods. İnağ & Arıkan (2020) solved the problem of site selection of waste collection centers belonging to Çankaya District Municipality using an integrated model with DEMATEL-ANP and mathematical programming methods. Baki (2021) has proposed an approach by applying the Fuzzy COPRAS technique in the analysis of location alternatives of a private hospital.

In this study, methods that allow quantitative and qualitative evaluations were used. For this purpose, Delphi method was used to determine the criteria related to the subject

by applying different perspectives of academicians who are experts in their fields. Then, with the G-AHP method using AHP and Gray numbers, the importance levels of the criteria were determined by the representatives of the air cargo industry and the criteria were ranked in order of importance.

2.1.1. Delphi Method

It is a technique in which expert opinions about any problem are obtained systematically. It is mainly used to determine the opinions or judgements about a problem or subject and create consensus among the participating experts or those who represent the target audience (Şahin, 2001: 215-216).

This technique, which was developed by Norman Dalkey & Olf Helmer (1963: 458) for military use within Rand Corporation in the 1950s, is also a planning tool used to predict future trends (Green, 2014: 1).

The Delphi Technique (Linstone & Turoff, 1975: 11), is applied to address complex problems in various fields such as health, technology, environment, and transportation, offer solutions for these problems, making inferences about the future and making decisions (Linstone & Turoff, 1975: 11). It is considered a mixed method because it contains both qualitative and quantitative methods.

According to Dalkey, the Delphi technique has three basic features, these are; confidentiality in participation, statistical analysis of group evaluations, and controlled feedback practices (Şahin, 2001: 216).

Confidentiality in participation is seen as the key to Delphi's success. Accordingly, it is kept confidential to whom the ideas put forward during the research belong. Thus, it is ensured that ideas come to the fore rather than individuals. In this way, the unconditional approval of the views of people who are known and respected in the group is prevented.

Statistical analysis of group assessments refers to the statistical analysis of data after each Delphi questionnaire has been administered. Participants should know well what the statistics used in these analyzes mean.

For controlled feedback, sequential questionnaires are used in the Delphi method. After the statistical analyzes of the surveys are completed, the results, in other words, representing the general tendencies of those who answered the survey, are presented to the participants with the same survey questionnaire. In this way, individuals compare their thoughts with different views and approaches using the results presented to them. The questionnaire used in Delphi studies contains a set of statements, either quantitative or qualitative. A single or different scale can be used for these expressions. The statements to be made in the questionnaire can be determined by the researchers, the participants, or both groups together.

Delphi method can be very functional when air cargo companies need expert opinions on CH location selection. Another point that makes the Delphi method functional is that it provides the researcher with a free range of motion. This technique, which leaves the decision to the researcher on issues such as the number of Delphi rounds, the size of the expert group, the selection criteria, and the rate of agreement, has thus become a method that can be used in many areas. Based on all these reasons, Delphi was used in this study to determine the location selection criteria of air cargo companies.

2.1.2. Analytic Hierarchy Process

Analytical Hierarchy Process (AHP) is a multi-criteria decision-making technique that evaluates decision elements in order of hierarchy by pairwise comparison. Qualitative factors are more important than other factors in AHP. However, it is a technique that has the feature of combining qualitative and quantitative factors in evaluation of the alternatives or criteria (Ömürbek, Üstündağ & Helvacıoğlu, 2013: 105).

AHP was developed by Thomas L. Saaty in 1977 to solve complex decision-making problems involving many criteria. AHP aims to solve the problem with its hierarchical analysis and applicability consisting of objectives, criteria, sub-criteria, and options. It is a method with high benefits, dynamism, and a solution to complex decision-making problems (Denizhan, Yalçıner & Berber, 2017: 65)

The main strength of AHP involving many decision-makers is that it processes highly complex and hard decisions more systematically. Constrained logic and constrained conceptual processes make it nearly impossible for decision-makers to incorporate all factors into complex decisions. Decision makers can usually only take into account a subset of decisions, without perceiving the relationship weights and interrelationships of important factors. AHP aims to rationalize complex decision processes by systematizing and synthesizing all possible information for decision making (Handfield et al., 2002: 75-76).

AHP offers an effective and highly understandable approach that allows the integration of qualitative and quantitative factors for decision making. The pairwise comparisons used in the method are an appropriate approach in terms of human perception when making a subjective evaluation (Gülenç & Aydın, 2010: 98).

AHP is used to evaluate factors that are independent of each other at various levels in hierarchical structures (Anık, 2007: 13). In AHP, the problem is structured hierarchically. There is a purpose at the top of the hierarchy and the structure is completed with criteria and alternatives at the bottom, respectively (Felek, Yuluğkural, & Aladağ, 2007: 7).

In order to determine all the criteria that affect the decision process, the opinions of the experts on the subject are used or a survey study is conducted (Dağdeviren, Akay & Kurt, 2004: 132). A decision hierarchy is constructed based on these findings. In the next step, pairwise comparison matrices are created and the decision maker is asked to make pairwise comparisons. Afterward, it is checked whether the comparisons are consistent and if not, the decision maker is requested to reconsider and correct his decision. Then, the relative weights (eigenvector values) are calculated from the pairwise comparison matrices (Aslan, 2005: 5).

Many site selection studies using the AHP method have been identified in the literature. Aydın (2009) evaluated the most appropriate site selection criteria for a hospital to be established in Ankara using the AHP method. In his study, İmren (2011) determined the criteria that have an impact on the process of choosing the most suitable business location in the furniture industry using AHP. Ömürbek et al. (2013) tried to determine the areas where animal husbandry can be made in the province of Isparta using the AHP method. In their study, Uslu, Kızıloğlu, İşlenen & Kahya (2017) proposed a new solution approach in which GIS-based AHP and TOPSIS methods are used together to determine the appropriate site for a newly established primary school. Zaralı, Yazgan & Delice (2018) proposed an integrated approach by combining AHP and VIKOR methods for the Logistics Center planned to be built in Kayseri. Ertunç & Çay (2020) tried to identify suitable

areas for airport construction in the provinces of Bayburt and Gümüşhane by using GIS and AHP. Kara, Masri & Kaya (2022) evaluated the validity of the solutions by comparing the results obtained from different methods in determining the location where a supplier company operating in the maritime sector will establish a new branch by using AHP, ARAS, and fuzzy TOPSIS methods integrated. Terme, Çiçek & Kiraz (2022) handled the facility location problem for an industry with Fuzzy AHP and Fuzzy VIKOR methods.

As seen in the above studies, apart from the classical AHP method fuzzy logic and similar approaches are used in the AHP method to evaluate judgments that do not contain certainty and indecision. Within the scope of this study, the uncertainty in the judgments of the evaluators was evaluated using gray numbers based on Gray Relational Analysis in the AHP method.

2.1.3. Gray Relational Analysis

Gray Relational Analysis (GRA) is one of the techniques developed by Ju Long Deng in 1982 and based on the gray system theory (Deng, 1989). GRA is a decision-aid method by allowing the ranking and evaluation of the elements of a system and has been applied in many areas including social and economic systems.

A system containing known and unknown data is called a gray system. Fuzzy mathematics usually deals with situations where experts express uncertainty through the membership function (Zareinejad, 2014: 275). Gray Systems Theory is preferred in cases where the number of experts and experience level is low, the data are insufficient or there are few samples and it is not possible to extract the membership function (Zareinejad, 2014: 275).

In this study, Gray numbers on a scale of 5 given in Table 1 were used for the numerical values corresponding to the relative linguistic evaluations of the options.

Table 1. Linguistic variables used in the AHP questionnaire

Linguistic variables	Abbreviation symbol	Corresponding Gray numbers
Extreme Importance	EMAIL	[8, 10]
Very Strong Importance	VSI	[6, 8]
Strong Importance	SI	[4, 6]
Medium Importance	MI	[2, 4]
Equivalent Importance	EI	[12]

Source: Zareinejad, 2014: 282

Zareinejad's (2014) steps described below are used in calculating the gray relational scores of alternative options;

Step 1: Gray scores (G_{ij}) for option i and criterion j can be calculated using Equation 1.

$$Gij = \frac{1}{k}\left[G_{ij}^{1} + G_{ij....}^{2} + G_{ij}^{k}\right] \quad (1)$$

Where, G_{kij} indicates that the k decision maker evaluates the j option in terms of the i criterion. This valuation is shown as a gray number $G_{kij} = [* G_{kij}, * G_{kij}]$.

Step 2: Construct a gray decision matrix of G_{ij} with linguistic variables defined based on gray numbers (Table 1).

Step 3: To evaluate m options over n criteria, the decision matrix is normalized according to whether the criteria type is profit or cost, as shown in Equation 2.

$$K = \begin{bmatrix} G_{11} & \cdots & G_{1n} \\ \vdots & \ddots & \vdots \\ G_{m1} & \cdots & G_{mn} \end{bmatrix} \quad (2)$$

a) If the variables are profit (the more the better) Equation 3 is used:

$$G_{ij}^{+} = \left[\frac{{}_{*}G_{ij}}{G_{j}^{maks}}, \frac{{}^{*}G_{ij}}{G_{j}^{maks}}\right] \quad G_{j}^{maks} = maks_{1\le i\le m}\{{}^{*}G_{ij}\} \quad (3)$$

b) If the variables are in the form of costs (the less the better) Equation 4 is used:

$$G_{ij}^{-} = \left[\frac{G_{j}^{min}}{{}^{*}G_{ij}}, \frac{G_{j}^{min}}{{}_{*}G_{ij}}\right] \quad G_{j}^{min} = min_{1\le i\le m}\{{}_{*}G_{ij}\} \quad (4)$$

Step 4: Identifying the reference or ideal option based on the type of problem to make the assessment.

Step 5: Calculation of the relative gray coefficient.

The relative gray coefficient between reference options, taking into account the criterion i denoted by $£_{0i(j)}$, is calculated using Equation 5:

$$£_{0i(j)} = \frac{min_i\, min_j\{D_{0i(j)}\} + \rho maks_i\, maks_j\{D_{0i(j)}\}}{D_{0i(j)} + \rho maks_i\, maks_j\{D_{0i(j)}\}} \quad (5)$$

$$1 \le i \le m,\ \ 1 \le j \le n$$

Where $D_{0i(j)}$ is the Minkowski distance between the reference options considering the j criterion. The technical coefficient (ρ) between the reference options is usually 0.5.

Step 6: In calculating the relative gray score, the relative gray score of an option i considering the reference choice is calculated using Equation 6:

$$\gamma_{0i} = \sum_{j=1}^{n} \frac{1}{n} £_{0i(j)} \quad (6)$$

2.1.4. G-AHP

The main steps of using the G-AHP approach are as follows (Zareinejad, 2014: 279-281):

Step 1: Defining the problem: In the first step, the purpose of the problem, decision criteria, and decision alternatives are defined.

Step 2: Establishing the hierarchical structure: The hierarchical structure of the problem is created based on the defined purpose, criteria and alternatives of the problem.

Step 3: Creation of the pairwise comparison matrix: This stage involves creating the pairwise comparisons and pairwise comparison matrix in each row of the hierarchy to respond to the fulfillment of the objective or meet their requirements. Each element of this matrix is a gray number (Equation 7).

$$K = \begin{bmatrix} G_{11} & \cdots & G_{1n} \\ \vdots & \ddots & \vdots \\ G_{m1} & \cdots & G_{mn} \end{bmatrix} = \begin{bmatrix} [{}_{*}G_{11}, {}^{*}G_{11}] & \cdots & [{}_{*}G_{1n}, {}^{*}G_{1n}] \\ \vdots & \ddots & \vdots \\ [{}_{*}G_{m1}, {}^{*}G_{m1}] & \cdots & [{}_{*}G_{mn}, {}^{*}G_{mn}] \end{bmatrix} \quad (7)$$

Step 4: Normalizing the pairwise comparison matrix (Equations 8,9,10):

$$K*=\begin{bmatrix} G*_{11} & \cdots & G*_{1n} \\ \vdots & \ddots & \vdots \\ G*_{m1} & \cdots & G*_{mn} \end{bmatrix}$$

$$=\begin{bmatrix} [{}_*G*_{11}, {}^*G*_{11}] & \cdots & [{}_*G*_{1n}, {}^*G*_{1n}] \\ \vdots & \ddots & \vdots \\ [{}_*G*_{m1}, {}^*G*_{m1}] & \cdots & [{}_*G*_{mn}, {}^*G*_{mn}] \end{bmatrix} \quad (8)$$

$${}_*G*_{ij}=\left[\frac{2({}_*G_{ij})}{\sum_{i=1}^{m}{}_*G_{ij}+\sum_{i=1}^{m}{}^*G_{ij}}\right] \quad (9)$$

$${}^*G*_{ij}=\left[\frac{2({}^*G_{ij})}{\sum_{i=1}^{m}{}_*G_{ij}+\sum_{i=1}^{m}{}^*G_{ij}}\right] \quad (10)$$

3. Result and Discussion

As a result of the Delphi questionnaire, the criteria agreed upon by the experts were gathered in four main categories, taking into account the subject of each criterion. These criteria categories are as follows;

Consumer: This category includes "proximity to major consumption locations", "the volume of economic activity (industry, trade, import, and export) of the region", and "population of the nearby region".

Transportation Connections: This category includes "nearest airport distance", "transportation diversity of the region", and "airport infrastructure and superstructure".

Supply, Infrastructure, and Costs: This category includes "proximity to key production locations", "structure of existing warehouses", and "airport operating costs".

External Factors: This category includes "geographical location and structure" and "climatic conditions in the airport region".

Table 2. Pairwise Comparisons of Criteria Categories

	Consumer	Transportation Connections	Supply, Infrastructure, and Costs	External Factors
Consumer		(SI, EI)	(MI)	(VSI, SI, SI)
Transportation Connections	(SI, VSI, VSI, VSI)		(VSI, SI, EI, EI)	(EMI, VSI, SI, EI, EI)
Supply, Infrastructure, and Costs	(SI, SI, VSI, EMI, EMI)	(SI, VSI)		(VSI, VSI, VSI, SI, EI, EI)
External Factors	(MI, SI, VSI)	(MI)		

Pairwise comparison questions were asked using the AHP questionnaire for the four criteria categories and sub-criteria determined. In the first questionnaire, four criterion categories were evaluated in six pairwise comparison questions. Then, three criteria in the Consumer category were evaluated using three comparison questions. Similarly, the three criteria under the Transportation Connections are in three comparisons; The three criteria under the Supply, Infrastructure, and Costs criteria are in three comparisons; Two criteria under the External Factors were evaluated in comparison. The participant evaluations for the main criteria category are given in Table 2 as an example. Similarly, pairwise comparisons of sub-criteria were recorded for each group.

Table 3. Gray Matrix of Criteria Categories

	Consumer	Transportation Connections	Supply, Infrastructure, and Costs	External Factors
Consumer	[1,000; 1,000]	[0.331; 0.490]	[0.203; 0.294]	[0.891; 1,348]
Transportation Connections	[2,040; 3.026]	[1,000; 1,000]	[0.891; 1.414]	[1.906; 3.141]
Supply, Infrastructure, and Costs	[3.397; 4,932]	[0.707; 1.123]	[1,000; 1,000]	[3.086; 4.804]
External Factors	[0.742; 1.123]	[0.318; 0.525]	[0.208; 0.324]	[1,000; 1,000]

All the answers given to the survey questions were analyzed by applying the G-AHP steps using the Excel software and the criteria weights were calculated. At first, the geometric mean of the answers of the five participants were calculated for combining the opinions and obtaining the group evaluation. For this purpose, the gray matrix was created by using the calculations defined in the 3rd step of the method. As an example, Table 3 presents the pairwise comparison gray matrix evaluations for the criteria categories.

Then, the calculations in the 4th step of the method were applied and the normalized gray matrix was obtained. Table 4 shows the normalized gray matrix generated for the criteria categories.

Table 4. Normalized Gray Matrix of Criteria Categories

	Consumer	Transportation Connections	Supply, Infrastructure, and Costs	External Factors
Consumer	[0.116; 0.116]	[0.120; 0.179]	[0.076; 0.110]	[0.104; 0.157]
Transportation Connections	[0.236; 0.351]	[0.364; 0.364]	[0.334; 0.530]	[0.222; 0.366]
Supply, Infrastructure, and Costs	[0.394; 0.572]	[0.257; 0.409]	[0.375; 0.375]	[0.359; 0.559]
External Factors	[0.086; 0.130]	[0.116; 0.191]	[0.078; 0.122]	[0.116; 0.116]

Finally, the gray significance levels of the criteria were calculated by applying the calculations defined in the 5th step of the method. Table 5 shows the gray importance levels calculated for the criteria categories.

Table 5. Gray Importance Levels of Criteria Categories

	Gray Importance Levels	Crisp Importance Levels
Consumer	[0.104; 0.140]	0.122
Transportation Connections	[0.289; 0.403]	0.346
Supply, Infrastructure, and Costs	[0.346; 0.479]	0.413
External Factors	[0.099; 0.140]	0.119

All the steps described above were first applied to all group comparisons, starting with combining the geometric averages of the answers of the five participants to reach the evaluation of the criteria under each group among themselves. Thus, the importance levels of the criteria under each main criterion group were calculated. The overall importance levels of all criteria were calculated by multiplying the importance levels of the main criteria groups with the within-group importance levels of each criterion. The results obtained after these procedures are presented in Table 6.

Table 6. G-AHP Questionnaire Results

Groups	Grey Importance	Crisp Importance	Faktörler	Grey Importance	Crisp Importance	Internal Ranking	Normalized Weights	Global Ranking
Consumer	[0.104; 0.140]	0.122	Proximity to major consumption	[0.349; 0.486]	0.417	**1**	0.051	8
			The volume of economic activity of the region	[0.285; 0.429]	0.357	2	0.044	9
			Population of the nearby region	[0.186; 0.266]	0.226	3	0.028	11
Transportation Connections	[0.289; 0.403]	0.346	Nearest airport distance	[0.142; 0.197]	0.169	3	0.059	6
			Transportation diversity of the region	[0.528; 0.724]	0.626	**1**	0.217	**1**
			Airport infrastructure and superstructure	[0.170; 0.240]	0.205	2	0.071	5
Supply, Infrastructure and Costs	[0.346; 0.479]	0.412	Proximity to key production locations	[0.410; 0.585]	0.498	**1**	0.205	2
			Structure of existing warehouses	[0.300; 0.424]	0.362	2	0.149	3
			Airport operating costs	[0.115; 0.165]	0.140	3	0.058	7
External Factors	[0.099; 0.140]	0.119	Geographical location and structure	[0.387; 0.521]	0.681	**1**	0.081	4
			Climatic conditions in the airport region	[0.181; 0.244]	0.320	2	0.038	10

The data presented in Table 6 show the importance levels of the main criteria categories, the importance levels of the sub-criteria within each category, and the importance levels of all 11 criteria in comparison to each other. According to these results;

Based on the crisp importance levels of the four main categories; “Supply, Infrastructure and Costs” is the factor with the highest importance among the categories with 41.2%, “External Factors” category stands out as the factor with the least important among all criteria categories with 11.9%.

The importance levels of the criteria within each category shows that; the most important sub-criterion among the main criteria category “Consumer” is “proximity to major consumption locations” with 41.7%. In this group, “population of the nearby region” criterion is the least important one with 22.6% compared to the other two criteria

The sub-criterion, which has the highest degree of importance in the "Transportation Connections" category, is the "transportation diversity of the region" criterion with a rate of 62.6%. Among this group, the one that has less importance compared to the other two criteria with a rate of 16.9% is the "nearest airport distance" criterion.

Within the “Supply, Infrastructure and Costs” category, the most important sub-criterion is “proximity to key production locations” with 49.8%. The "airport operating costs" criterion is the one that has less importance compared to the other two criteria with a rate of 14% in this category.

The “geographical location and structure” criterion has the highest degree of importance with a rate of 68% in the “External Factors” category. The criterion with less importance is "climatic conditions in the airport region" with a rate of 32%.

According to the normalized weights of 11 sub-criteria of 4 main categories; it is seen that the most important criterion among all is “transportation diversity of the region” with a rate of 21.7%. On the other hand, the criterion with the least important among all criteria was evaluated as “population of the nearby region” with a rate of 2.8%.

Within the scope of the findings, “Supply, Infrastructure and Costs” and “Transportation Connections” criteria emerge as criteria that should be emphasized when choosing CH locations for air cargo companies. For air cargo businesses, some of the 11 sub-criteria under the 4 main criteria determined in this study are generally similar to the criteria considered in the selection of the location of the businesses. These criteria are as follows; “transportation diversity of the region”, “the volume of economic activity of the region”, “proximity to key production locations”, “proximity to major consumption locations”, “geographical location and structure”, “population of the nearby region”. In contrast, the criteria: “structure of existing warehouses”, “airport infrastructure and superstructure”, “nearest airport distance”, “airport operating costs”, “climatic conditions in the airport region” are specific to air cargo transportation. Among the 11 sub-criteria determined within the scope of the study, the "transportation diversity of the region", "proximity to key production locations" and "structure of existing warehouses" criteria are the three criteria with the highest level of importance, and that air cargo companies should pay the most attention when choosing CH location.

A similar study found in the literature on the location selection decision of air cargo companies belongs to Gardiner et al. (2005). The most important criterion determined in this study was "performing the operations at night hours and minimizing the costs" at the selected location. When the findings of this study are compared with their findings; it is seen that there is a parallelism between the criteria of "airport operating costs" and "minimizing the total costs", and the criteria of "transportation diversity of the region" and "access to the airport". However, the importance of these criteria varies in each study. The main difference between the two studies is their study is done within the scope of location selection at the global level. Whereas, this study constrains the location selection decision within one country which is Turkiye. This focus contains valuable insights for application, since the geographical structure of Turkiye contains great diversity, and the regional production and consumption levels are different due to the uneven distribution of demographics. From this point of view, the criteria of “proximity to production sources” and “geographical conditions” differ from the findings in the literature, and in this respect, they offer a contribution to the literature. From another point of view, as an explanation it can be stated that Turkiye’s significant regional development differences are the reason why these criteria come to the fore.

4. Conclusion

The air cargo transportation has many advantages compare to the other transportation modes with its defining features such as speed, security, safety, and transportation service to the distant locations. In particular, companies that prefer the collect-distribute network system, aiming to achieve their activities most efficiently and embracing profit maximization, need a comprehensive analysis for airports with a collect-distribute network system. Collect-distribute network structure has strategic importance for air cargo companies. Factors that are closely linked to the company's existence, are the efficiency of operations and cost management, and determine the company's strategy and decisions. With this priority, this study was conducted for the determination of the CH location criteria and importance levels of air cargo companies in Turkiye. The main limitation of the study is that the number of air cargo companies participating in the study does not allow the results to be quantitatively representative of the entire industry. On the other hand, it can be said qualitatively that the companies for which data is collected in practice are the most important companies operating in Turkiye and that other companies follow their practices, providing sufficient information on sector representation.

The most important criterion for air cargo companies in choosing a location is that the airport should be structurally suitable for cargo operations. Thus, it can be stated that airport equipment is at the forefront of the issues that companies performing air cargo operations in Turkiye. In this study, both production and consumption balance came to the fore as criteria close to each other with the industrialization rate. From this point of view, it can be deduced that the companies that will choose a location as an air cargo company in Turkiye should make a location selection considering the industrialization and agricultural geography.

The results of the research highlight the operational suitability of airport conditions in the location selection decision of air cargo companies. From this point of view, the equipment and operations of the new airports to be built should increase the diversity of services and support the convenience of cargo operations. Since this is the first exploratory study on this subject in Turkiye, it would be beneficial for the sector to examine the site selection criteria and priorities for air cargo operations by repeating the study with a wider participation in future studies with an increase in the number of airports that allow air cargo operations.

Ethical approval

Ethical approval for this study was obtained from Social Sciences and Humanities Scientific Research and Publication Ethics Board at Hatay Mustafa Kemal University (07/03/2022-No.24).

Conflicts of Interest

The authors declare that there is no conflict of interest regarding the publication of this paper.

Acknowledgment

This article was adapted from a master's thesis completed at the Social Sciences Institute of Hatay Mustafa Kemal University.

References

Akca, M. (2017). Assessment of airport location suitability: a qualitative to quantitative study. International Journal of Economic Research, 3 (3), 328-332.

Anık, Z. (2007). Comparison and evaluation of object-oriented programming languages with Analytical Hierarchy and Analytical Network Processes. Unpublished Master Thesis, Gazi University, Ankara.

Aslan, N. (2005). Analytical Network Process. Unpublished Master Thesis, Yıldız Technical University, Istanbul.

Aydın, O. (2009). Hospital site selection for Ankara with fuzzy AHP. Journal of Dokuz Eylül University Faculty of Economics and Administrative Sciences, 24 (2), 87-104.

Aydın, Ö., Öznehir, S. & Akçalı, E. (2009). Modeling the optimal hospital location selection for Ankara with the Analytical Hierarchy Process. Journal of the Faculty of Economics and Administrative Sciences of Süleyman Demirel University, 14 (2), 69-86.

Aygün, S. (2014). Main distribution base location problems and a real main distribution base location selection problem for a public institution. Unpublished Master's Thesis, Turkish Military Academy, Ankara.

Baki, R. (2021). Application of Fuzzy COPRAS technique for site selection of a private hospital. BEÜ Journal of Science, 10 (4), 1506-1514.

Balkan, D. (2020). Realization of energy facility location selection with the ELECTRE method in the Industry 4.0 process. Niğde Ömer Halisdemir University Journal of Engineering Sciences, 9 (1), 238-253.

Başkurt, Z. M. & Aydin, C. C. (2020). Evaluation of location criteria for nuclear power plants with geographic information systems. Turkish Journal of Geographic Information Systems, 2 (1), 37-48.

Chauhan, A. & Singh, A. (2016). A hybrid multi-criteria decision-making method approach for selecting a sustainable location of healthcare waste disposal facility. Journal of Cleaner Production, 139, 1001-1010.

Dağdeviren., M., Akay, D. & Kurt, M. (2004). Analytical hierarchy process and application in the job evaluation process. Gazi University, Journal of Engineering and Architecture Faculty, 19 (2), 131-138.

Dalkey, N. & Helmer, O. (1963). An experimental application of the DELPHI Method to the use of experts. Management Science, 9(3), 351-515.

Deng, J. (1989). Introduction to Grey System Theory. The Journal of Grey System, 1 (1), 1–24.

Denizhan., B., Yalçıner Y., A. and Berber, Ş. (2017). Green supplier selection practice using Analytical Hierarchy Process and Fuzzy Analytical Hierarchy Process methods. Nevşehir Journal of Science and Technology, 6 (1), 63-78.

Derici, M., Derici, S. & Karaduman, I. (2015). Carriage of special quality cargo by air and customer preferences. ABMYO Journal, 37, 67-81.

Dortaj, A., Maghsoudy, S., Doulati A., F. & Eskandari Z. (2020). A hybrid multi-criteria decision-making method for site selection of subsurface dams in the semi-arid region of Iran. Groundwater for Sustainable Development, 10, 100284.

Düztepeliler, Z. (2003). Analyzing the home base selection criteria of airline companies and Turkish Airlines's home base selection criteria for Ataturk Airport. Unpublished Master's Thesis, Anadolu University, Eskisehir.

Erkan, T. E., & Elsharida, W. M. (2019). Overview of Airport Location Selection Methods. 14(7), 6.

Ertunç, E. & Çay, T. (2020). Use of geographic information systems (GIS) and analytical hierarchy process (AHP) in airport location selection. Konya Journal of Engineering Sciences, 8 (2), 200-210.

Felek S., Yuluğkural Y. & Aladağ Z. (2007). Comparison of AHP and ANP methods in estimating market share in mobile communications industry. Journal of Industrial Engineering of the Chamber of Mechanical Engineers, 18 (1), 6-22.

Gardiner, J., Ison, S. & Humphreys, I. (2005). Factors influencing cargo airlines' choice of airport: An international survey. Journal of Air Transport Management, 11 (6), 393-399.

General Directorate of Civil Aviation-GDCA (2021). Annual report 2021. Ankara: General Directorate of Civil Aviation.

Gerede, E. (2019). Havayolu İşletmelerinin Ağ Yapıları. In E. Gerede & Demirci A. E. (Eds.), Havayolu Yönetimi (pp. 116-147). Eskişehir: Anadolu Üniversitesi Yay.

Green, R. A. (2014). The Delphi Technique in educational research. SAGE Open, 4 (2), 1- 8.

Gülenç, I. F. & Aydin B., G. (2010). A model proposal for investment decisions: AHP method. Kocaeli University Faculty of Economics and Administrative Sciences, 9 (34), 97-107.

Handfield, R. B., Walton, S. V, Sroufe, R. & Melynyk, SA (2002). Applying environmental criteria to supplier assessment: a study in the application of the analytical hierarchy process. European Journal of Operational Research, 141, 70-87.

Hsu, C.-I. & Wang, C.-C. (2013). "Reliability analysis of network design for a hub-and-spoke air cargo network". International Journal of Logistics Research and Applications, 16 (4), 257-276.

IATA (2022). IATA's Annual Review. Retrieved September 10, 2022, from https://www.iata.org/en/publications/annual-review/

ICAO (2021) The World of Air Transport in 2020—Presentation of 2020 Air Transport statistical results. Retrieved January 13, 2022, from https://www.icao.int/annual-report-2020/Pages/the-world-of-air-transport-in-2020-statistical-results.aspx

Imren, E. (2011). Establishment site selection with the Analytical Hierarchy Process (AHP) in the furniture industry. Unpublished Master Thesis, Istanbul University, Istanbul.

Inag, T. & Arikan, M. (2020). An integrated approach with DEMATEL-ANP and mathematical programming methods for solid waste collection center location selection: An application in Ankara. Journal of Erciyes University Institute of Science and Technology, 36 (1), 33-46.

Ishizaka, A., Nemery, P. & Lidouh, K. (2013). Location selection for the construction of a casino in the Greater London region: A triple multi-criteria approach. Tourism Management, 34, 211-220.

Kara, A., Masri, A. & Kaya, G. K. (2022). New branch location selection with AHP, ARAS and Fuzzy TOPSIS: an example of a supplier company in the maritime industry. Pamukkale University Journal of Engineering Sciences, 28(1), 148-159.

Kaşak, AE & Erdal, M. (2019). Choosing a location for the penitentiary institution with the MOORA multi-criteria decision-making method: The case of Sivas province. Bayburt University Journal of Science, 2 (1), 34-42.

Küçük, Ö., Mukanbay, R. G. & Öztürk, E. (2016). Aircraft selection modeling for the air cargo company that transports dangerous goods. International Journal of Economics and Administrative Sciences, 2 (1), 37-51.

Linstone, H. A, & Turoff, M. (1975). The Delphi method: techniques and applications. Addison-Wesley Publishing Company, Reading.

Martel, J., & Aouni, B. (1992). Multicriteria method for site selection example of an airport for New Quebec. Info, 30(2), 97–117.

Oktal, H. (1998). Airport location model proposal with the help of geographic information systems. Unpublished PhD Thesis, Anadolu University, Eskişehir.

Ömürbek, N., Üstündağ, S. & Helvacıoğlu, Ö. C. (2013). Use of Analytical Hierarchy Process (AHP) in site selection: An application in Isparta region. Journal of Management Sciences, 11 (21), 101-116.

Özdogan, S. (2016). Transition to contemporary practices in air cargo transit operations. Customs and Trade Journal, 7, 93-95.

Özger, A. & Oktal, H. (2013). A new approach to the single assignment main distribution base layout problem and air cargo application. Pamukkale University Journal of Engineering Sciences, 19 (2), 68-75.

Pinto, A., Da, S., Carlos, M., Borille, G. M. R., Guterres, M. X., Arraut, E. M., Peres, M. S., & Dos, S. (2020). Towards an objective decision-making framework for regional airport site selection. Journal of Air Transport Management, 89 (C). https://doi.org/10.1016/j.jairtraman.2020.101888

Rezaian, S. & Jozi, SA (2016) Application of multi criteria decision-making technique in site selection of wind farm-a case study of northwestern Iran. Journal of the Indian Society of Remote Sensing, 44, 803-809.

Şahin, A. E. (2001). Delphi technique and its use in educational research. Hacettepe University Faculty of Education Journal, 20, 215-220.

Şahin, Y. & Altın, FG (2016). An assignment model for the tent city site selection problem: Isparta example. Mehmet Akif Ersoy University Journal of Social Sciences Institute, 8 (16), 323-336.

Sánchez-Lozano, J. M., García-Cascales, M. S. & Lamata, M. T. (2016). Comparative TOPSIS-ELECTRE TRI methods for optimal sites for photovoltaic solar farms. Case study in Spain. Journal of Cleaner Production, 127, 387-398.

Statista (2022). Worldwide air cargo traffic from 2004 to 2022. Retrieved November 13, 2022, from https://www.statista.com/statistics/564668/worldwide-air-cargo-traffic/

Supciller, A. A. & Bayramoglu, S. (2020). Wind farm location selection using Intermittent Gray Number Based A-Gia and Gray Edas methods. Journal of Gazi University Faculty of Engineering and Architecture, 35 (4), 1847-1860.

Tavakkoli, M. R., Mousavi, S. M. & Heydar, M., (2011). An integrated AHP-VIKOR methodology for plant location selection, International Journal of Engineering-Transactions B: Applications, 24(2), 127-137.

Terme, B., Cicek, I. & Cherry, A. (2022). Facility location selection with Integrated Fuzzy AHP and Fuzzy VIKOR methods. Çukurova University Journal of Engineering Faculty, 37(2), 383-398.

Uslu, A., Kızıloğlu, K., Functioning, SK & Kahya, E. (2017). AHP-TOPSIS approach based on geographic information system in school location selection: Ankara province example. Journal of Polytechnic, 20(4), 933-943.

Vasileiou, M., Loukogeorgaki, E. & Vagiona, DG (2017). GIS-based multi-criteria decision analysis for site selection of hybrid offshore wind and wave energy systems in Greece, Renewable and Sustainable Energy Reviews, 73, 745-757.

Yılmaz, H. (2022). Special cargos in air cargo transport. In Murat Düzgün (Eds) Priority Issues in Air Cargo Transportation, Third Part (pp-43-63). Ankara: Nobel Akademik Yayıncılık.

Zaralı, F., Yazgan, H. R. & Delice, Y. (2018). Logistics center location selection with the integrated approach of AHP and VIKOR: The case of Kayseri province. Journal of Erciyes University Institute of Science and Technology, 34 (3), 1-9.

Zareinejad, M. (2014). Performance evaluation of service quality in higher education institutions using modified servqual approach with Gray Analytic Hierarchy Process (G-AHP) and multilevel gray evaluation. Iberoamerican Journal of Industrial Engineering, 6 (11), 271-293.

Cite this article: Turk, A. Yavuz, V.A. (2023). Determination of Location Selection Criteria and Their Importance Levels for Air Cargo Companies: A Case from Turkiye. Journal of Aviation, 7(1), 100-109.

7 (1): 110-122 (2023)

Journal of Aviation

https://dergipark.org.tr/en/pub/jav

e-ISSN 2587-1676

A Profitability Analysis of Air Navigation Service Providers in European Zone: COVID-19 Crisis

Olcay Ölçen[1], **Serdar Alnıpak**[2*]

[1] Department of Civil Aviation Management, Nişantasi University, Maslak, Sarıyer, İstanbul, Türkiye. (olcay.olcen@nisantasi.edu.tr)
[2*]Department of International Trade and Logistics, Nişantasi University, Maslak, Sarıyer, İstanbul, Türkiye. (serdar.alnipak@nisantasi.edu.tr)

Article Info

Received: 10 January 2023
Revised: 22 February 2023
Accepted: 27 February 2023
Published Online: 02 March 2023

Keywords:
Civil Aviation Industry
Air Navigation Service Providers
Aviation Finance
Quantitative Techniques
Logistics Management

Corresponding Author: *Serdar Alnıpak*

RESEARCH ARTICLE

https://doi.org/10.30518/jav.1231880

Abstract

The civil aviation sector is important for the logistics system. Besides, Air Navigation Service Providers (ANSP) are one of the main parts of the total civil aviation system. This study is about their profitability structure and assessment of performance. Out of the general and classical ratios such as ROA and ROE, authors utilized 13 different profitability ratios to understand the general picture of ANSP in the context of profitability performance by using GRA and MABAC methods. Analysis were made for 34 airport service providers from different countries with annual data between 2017 and 2020. The findings show that COVID-19 crisis has got a deep impact on ANSP's profitability structures in general and by firms. Besides it is seen that the most profitable companies are Turkish, Georgian and Estonian ANSP.

1. Introduction

Participants in the civil aviation industry have got a lot of legal responsibilities towards different parties. From the context of the operational side, they should strictly and soundly follow the rules and regulations of international organizations such as ICAO (International Civil Aviation Organization), Eurocontrol, FAA (Federal Aviation Administration), ACI (Airport Council International) and national regulators. Otherwise, they should be transparent and accountable towards international, regional and national financial institutions. Financial profitability can be defined as the power of ensuring profit for a company in a sustainable manner. The financial statements of a company may give us a lot of insights about the financial structure of a company, also profitability.

In this paper, we aim to make a comprehensive analysis of profitability in air navigation service providers before, after and during the Covid-19 period. For this purpose, we determined 13 different profitability ratios in the first step of the analysis. In the determination process, we utilize EBITDA (Earnings Before Interest, Taxes, Depreciation and Amortization)-based ratios as it is discussed in the literature review section. And also, we form of sample including almost all of the Airport Navigation Service Providers in Europe. In the related section detailed information about sampling was given. We utilize GRA (Grey Relational Analysis) and MABAC (Multi-Attributive Border Approximation Area Comparison) methodologies. The rest of the present study proceeds as follows: Section 2 reviews the literature on the related topic, Section 3 involves the ratios used in the analysis, definitions and data structure, Section 4 introduces the methodology and provides details on the data and variables, Section 5 explains the findings and the last section presents discussions, conclusions and suggestions.

2. Literature Review

In this section the definitions and development of profitability ratios for different industries are explained. Particularly the importance, causes and distinction of EBITDA and EBIT (Earnings Before Interest and Taxes) for the aviation industry are discussed. Detailed information on Air Navigation Service Providers will be given in the last section.

According to financial statements analysis, there are several types such as liquidity, financial structure and profitability analysis. Profitability analysis shows the power of companies to generate profits at certain times by making use of costs, income, income, assets and all kinds of components in the statutory financial statements. In the following paragraphs, we try to analyze the importance of some financial profitability ratios in different industries and countries. In terms of different ratios, Hermawan & Mulyawan (2014) discussed the importance of ROA (Return on Asset), ROE

(Return on Equity) and net profit margin as profitability measures to measure the relationship between profitability and corporate social responsibility. ROA is the focal point of Javaid et al. (2011) analysis of banking profitability in Pakistan and Adelopo et al.'s (2017) in the West African States. Alarussi & Gao (2021) utilized ROA and EPS (Earnings Per Share) ratios as the profitability measures in their analysis. EPS and ROE are selected also by Alarussi & Alhaderi (2018) to determine profitability elements in Malaysia's financial industry. Tenas & Serrat (2018) used ROA to analyse profitability determinants in hospital companies in Spain. Malik (2011) stated the importance of ROA in the analysis of Pakistan insurance companies' profitability. In Sultan's Analysis (2014) Profit Margin (PM), Return on Assets (ROA), Return on Equity (ROE), Capital turnover ratio and Expense ratio are the main determinants of the Baghdad Soft-Drink Industry in Iraq. Pervan & Mlikota (2013) explained the profitability with variables such as EBITDA in the Croatian Food and Beverage Industry. Shaida et al. (2018) realized a profitability analysis of Palm Oil Companies in Malaysia that includes ROA as the main profitability variable. When the main profitability metrics are examined, it is seen that ROA, ROE and EBITDA are the main ones.

According to the analysis of Zeli & Mariani (2009) ROE, ROI (Return on Investment) and ROS (Return on Sales), asset turnover, fixed assets on total assets, leverage, profit margin, and profit on total assets are the main ratios in productivity analysis of Italian companies between the years of 1998-2002. Saleem & Rehman (2011) utilized the ratios of ROA, ROE and ROI to determine and measure the liquidity of Pakistan oil and gas companies, this analysis showed the importance of these ratios in also different financial analyses. Singh & Mogla (2010) utilized Operating Profit Margin (OPM), Net Asset Turnover Ratio (ATR), Net Profit Margin (NPM), Return on Capital Employed (ROCE), and Return on Net Worth (RONW) ratios as a part of their analyses. Scott & Arias (2011) argued the importance of ROA (Return on Asset) for banking profitability.

It is openly stated in the paper of Bezerra & Gomes's (2018), airport and airport performance analysis should include a lot of dimensions such as efficiency, service, safety, security, commercial, environmental, social, competition, economic-financial and operational measures. In economic and financial analysis, operation cost, revenue and expenditure structures, investments, debt, EBITDA, Cash Flow, Profit/Loss, ROA, ROE, ROI and operating margin are some of important measures. Richardson et al. (2014) showed the importance of Net Working Capital (Operating Liquidity) and Debt Ratio in the lease agreements of US hub airports. Ison et al. (2011) developed a framework showing the importance of Doganis's REVEX ratio (Operating Income/Operating Expenditure) to identify controlling airport costs and revenues. Hooper & Hensher (1997) stated that cost efficiency, cost-effectiveness and service effectiveness of airports should be considered for the airport financial performance analyses. Assaf (2009) highlighted the importance of capital investments for efficiency analysis of airports. Raghavan & Yu (2021) defined some clear insights related to operating metrics, leverage metrics and liquidity metrics for airports and their importance in analyzing airport performance. Vogel (2011) argued the importance of some financial ratios in privatized airports utilizing EBIT (Earnings Before Interest and Taxes) value.

Otherwise ANSP (Air Navigation Service Providers) finance their activities by charging airlines to use their airspace. In order to gain more profit, they should implement optimum usage policies in their airspace (Castelli et al., 2013). Tomova (2017) defined different business-making strategies in the ANSP industry according to different requirements of miscellaneous customers (airlines, airports, airports operators, civil aviation authorities and ministries) and develops an economic model. This model provides insights into the mechanisms through which regulation can drive air traffic management performance improvements, as well as its limitations. According to Blondiau et al. (2016), efficient politics in air traffic management provide increases in the revenue of ANSP. Bilokatch et al. (2014) and Dempsey-Brench & Volta (2018) criticized the cost-efficient politics in the European ANSP network. Adler et al. (2020) emphasized the importance of stakeholder policies, shareholder policies and economic structure of ANSP in terms of performance. Button & McDougall (2006) pointed out institutional and structural changes in ANSP Organizations and make conclusions about them. Grebensek & Magister (2012) measured the difference between ANSP due to seasonal traffic variability. With the explanations of Tomova (2016), it can clearly be understood that the role of commercial revenues can change with new paradigms.

2.1. The distinction between EBIT and EBITDA and other ratios

In a financial analysis, there are several types of revenue according to the literature. Especially, the main differences between EBIT and EBITDA can change depending on the industrial context. A criticism can be intensified here, for example, after stating their importance, Adiloğlu & Vuran (2017) explained that EBITDA can be more suitable for manufacturing companies versus service companies. Wandroski et al. (2016) used the net profit ratio to calculate the main distinctive variables such as ROA and EBITDA margin. Lukason (2015) utilized EBIT for European micro-level manufacturing companies. Andres (2008) utilized EBIT and EBITDA measures to understand founding-family ownership structures. When he realizes his analysis, he utilized especially these two distinctive values to calculate Return on Asset ratio. Lopez et al. (2018) utilized also EBITDA measures to calculate ROA in the profitability structures of cheese-producing companies in Spain. According to analyses of Bouwens et al. (2019), EBITDA-reporting firms are generally smaller, more leveraged, more capital intensive, less profitable and have longer operating cycles than non-EBITDA reporting firms.

3. The specific ratios in the analysis and data

There are five different groups of ratios in the analysis. The groups and related ratios can be seen in Table 1. To reach a comprehensive methodology, we utilize the values of EBITDA. When the financial statements of ANSP in Europe are analyzed, it is seen that depreciation and amortization values are relatively high in the certain period between 2017-2022 (www.eurocontrol, 2022). On the other side, that period is so catastrophic due to the COVID-19 crisis. Furthermore, the utilization of assets, debts, expenditures and activities to yield more returns and profits is part of this comprehensive analysis according to the general condition of the European ANSP's network.

The first group of ratios can be defined as expenditure analysis ratios. This group shows how the air navigation service providers utilized their capital or operational expenditures to retain profit and returns between the years of 2017 and 2022. The second group of ratios shows how their assets are utilized to yield more returns between related years. Differences between assets are of great importance due to the industrial nature of ANSP and their different structures. The third group of analyze ratios described the utilization of debts in order to take returns. As the analysis period is a catastrophic one, long- and short-term differences in debt should gain more insight. The ability to turn them into financial returns is a special ability especially for this term. In the fifth section, there are specific ratios related to the use of their investments and these values show the situations of ANSP. There are 36 European ANSP which were analyzed and data was taken from EUROCONTROL's ANSP website

Table 1. The Ratios Used in The Analysis

	RATIOS	
1.	**OPEX (Operational Expenditure) / CAPEX (Capital Expenditure) ANALYSES**	
	Profit/Opex	Profit per operational expenditure (POPEX)
	Profit/Capex	Profit per capital expenditure (PAPEX)
A.	POPEX/PAPEX	The ratio of POPEX to PAPEX
	Return on OPEX	Return (EBITDA) per operational expenditure (ROPEX)
	Return on CAPEX	Return (EBITDA) per capital expenditure (RAPEX)
B.	ROPEX/RAPEX	The ratio ROPEX to RAPEX
C.	OPEX/CAPEX	Operational expenditure per capital expenditure
2.	**ASSET ANALYSES**	
D.	ROA-1-	Return (EBITDA) on Fixed assets
E.	ROA-2-	Return (EBITDA) on Current assets
F.	ROA-3-	Return (EBITDA) on Total assets
3.	**DEBT ANALYSES**	
G.	ROD-1-	Return (EBITDA) on Short-Term Debts
H.	ROD-2-	Return (EBITDA) on Long-Term Debts
I.	ROD-3-	Return (EBITDA) on Total Debts
4.	**STOCK RETURN ANALYSES**	
J.	ROE-1	RETURN(EBITDA) on equity
K.	FCF/SE	Free cash flow/Shareholder equity
5.	**OPERATIONAL ANALYSES**	
L.	RONOA	Return (EBITDA) per an operational activity
M.	RONIA	Return (EBITDA) per an investment activity

4. Methodology

4.1. MABAC (Multi Attributive Border Approximation Area Comparison) Method

MABAC method which was developed by Pamučar & Ćirović (2015), evaluations are made by measuring the distance of the criteria functions of each alternative to the boundary approximation area (Ayçin & Çakın, 2019: 334). The method consists of seven steps. The first step is to form the decision matrix (X) as in Equation (1). m is number of alternatives and, n is number of criteria in this expression. Alternatives are shown with the vector as $A_i = (x_{i1}, x_{i2}, \dots x_{in})$ while x_{ij} is the value of decision unit i according to criteria j ($i = 1,2, \dots, m; j = 1,2, \dots, n$).

$$X = \begin{bmatrix} x_{11} & x_{12} & \dots & x_{1n} \\ x_{21} & x_{22} & \dots & x_{2n} \\ \dots & \dots & \dots & \dots \\ x_{m1} & x_{m2} & \dots & x_{mn} \end{bmatrix} \quad (1)$$

In the second step of the method, the matrix (X) is normalized. The normalized decision matrix (N) is stated in Equation (2).

$$N = \begin{bmatrix} t_{11} & t_{12} & \dots & t_{1n} \\ t_{21} & t_{22} & \dots & t_{2n} \\ \dots & \dots & \dots & \dots \\ t_{m1} & t_{m2} & \dots & t_{mn} \end{bmatrix} \quad (2)$$

For normalization processes, Equation (3) is used for beneficial criteria and Equation (4) is used for non beneficial

criteria. The x_i^+ in the equations represents the maximal and x_i^- the minimal values of the observed criteria by alternatives.

$$t_{ij} = \frac{x_{ij}-x_i^-}{x_i^+-x_i^-} \quad (3)$$

$$t_{ij} = \frac{x_{ij}-x_i^+}{x_i^--x_i^+} \quad (4)$$

In the third step of the method, the N matrix is weighted by using Equation (5). As a result of this process, the V matrix is obtained. w_i are the weight values of the relevant criteria.

$$v_{ij} = w_i * t_{ij} + w_i \quad (5)$$

The next step is to obtain the bordering approximative areas matrix (G). Equation (6) is used to calculate the matrix elements (g_i). In this expression, m represents the total number of alternatives. G matrix is as in Equation (7). n represents the total number of criteria.

$$g_i = \left(\prod_{j=1}^{m} v_{ij}\right)^{1/m} \quad (6)$$

$$G = (g_1, g_2, \dots . g_n) \quad (7)$$

The fifth step is the calculation of the distance matrix (Q) elements (q_{ij}) to the boundary approximative areas of the decision alternatives with Equation (8).

$$Q = V - G = \begin{bmatrix} q_{11} & q_{12} & \dots & q_{1n} \\ q_{21} & q_{22} & \dots & q_{2n} \\ \dots & \dots & \dots & \dots \\ q_{m1} & q_{m2} & \dots & q_{mn} \end{bmatrix} \quad (8)$$

With the values obtained in the fifth step, the status of each decision alternative (A_i) are determined according to the boundary approximative areas. In this context, alternatives can belong to the bordering approximative area (G), the upper bordering approximative area (G^+), or lower bordering approximative area (G^-). The values of the best alternative according to the criteria should mostly be found in (G^+). These areas are shown in Figure 1. Equation (9) is used to determine which area the alternative belongs to (Pamučar & Ćirović, 2015; Bozanic et al., 2016).

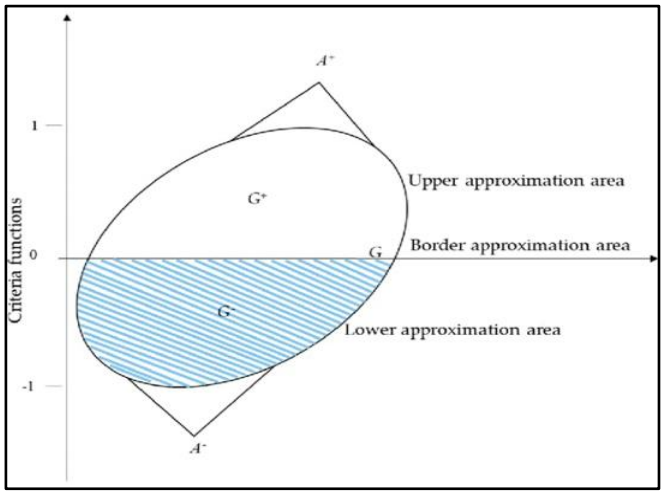


Figure 1. Representation of Bordering Approximative Areas

$$A_i \in \begin{cases} G^+ \; if \; q_{ij} > g_i \\ G \; if \; q_{ij} = g_i \\ G^- \; if \; q_{ij} < g_i \end{cases} \quad (9)$$

The final step of the MABAC method is the ranking of decision alternatives. This ranking is made according to Equation (10) (Vesković, 2018; Demir et al., 2021).

$$S_i = \sum_{j=1}^{n} q_{ij}, \; j = 1,2, \dots, n, \; i = 1,2, \dots m \quad (10)$$

4.2. Gray Relational Analysis (GRA) Method

Gray Relational Analysis (GRA) developed on the basis of GST is a ranking and classification technique (Wen, 2004; Yıldırım, 2014). This method is used as a reference to determine the degree of effect between factors and this degree is called as gray relational degree (Üstünışık, 2007). Similarities or differences between the analyzed elements are obtained by this measurement. The steps of the method are as follows.

The first step of the method is to form the decision matrix (X). This matrix with (mxn) dimension where the total number of alternatives is m and the number of criteria is n is as represented in Equation (11). x_{ij} is the value of decision unit i according to criteria j.

$$X = \begin{bmatrix} x_1(1) & x_1(2) & \dots & x_1(n) \\ x_2(1) & x_2(2) & \dots & x_2(n) \\ \dots & \dots & \dots & \dots \\ x_m(1) & x_m(2) & \dots & x_m(n) \end{bmatrix} i = 1,2, \dots, m; \; j = 1,2, \dots, n \quad (11)$$

In the second step, the reference series ($x_0 = (x_0(j))$ (difference values)) and the comparison matrix are determined. $x_0(j)$ is defined as the maximal value of the normalized criteria. The reference series is added to the first row of (X) to form the comparison matrix.

The third step is to normalize the X matrix. Different equations are used depending on whether the criteria is beneficial or non beneficial. Equation (12) is used for beneficial and Equation (13) is used for non beneficial criteria. In addition, Equation (14) is used if the values in the matrix contribute positively to the purpose according to the determined optimal value ($x_{ob}(j)$).

$$x_i^* = \frac{x_i(j)-min_j x_i(j)}{max_j x_i(j)-min_j x_i(j)} \quad (12)$$

$$x_i^* = \frac{max_j x_i(j)-x_i(j)}{max_j x_i(j)-min_j x_i(j)} \quad (13)$$

$$x_i^* = \frac{|x_i(j)-x_{ob}(j)|}{max_j x_i(j)-x_{ob}(j)} \quad (14)$$

The normalized decision matrix (X^*) is represented as Equation (15).

$$X^* = \begin{bmatrix} x_1^*(1) & x_1^*(2) & \dots & x_1^*(n) \\ x_2^*(1) & x_2^*(2) & \dots & x_2^*(n) \\ \dots & \dots & \dots & \dots \\ x_m^*(1) & x_m^*(2) & \dots & x_m^*(n) \end{bmatrix} \quad (15)$$

The next step is to form the absolute value matrix ($\triangle_{oi}$). The absolute value of the difference between x_0 and x_i^* is used to form this matrix. These calculations are made by means of

Equation (16) and the relevant matrix is formed as in Equation (17).

$$\triangle_{oi}(j)=|x_o(j)^* - x_i^*(j)| \quad i = 1,2,\dots,m;\ j = 1,2,\dots,n \qquad (16)$$

$$\triangle_{oi}=\begin{bmatrix} \triangle_{o1}(1) & \triangle_{o1}(2) & \dots & \triangle_{o1}(n) \\ \triangle_{o2}(1) & \triangle_{o2}(2) & \dots & \triangle_{o2}(n) \\ \dots & \dots & \dots & \dots \\ \triangle_{om}(1) & \triangle_{om}(2) & \dots & \triangle_{om}(n) \end{bmatrix} \qquad (17)$$

The fifth step is to calculate the gray relational coefficient matrix as stated in Equation (18). $\triangle_{max}$ represents the maximal value change in the sequence and calculated by $max_i max_j \triangle_{oi}(j)$. Besides $\triangle_{min}$ represents the minimal value change in the array and calculated by $min_i min_j \triangle_{oi}(j)$. ζ is expressed as the distinguishing coefficient and takes values in the range of 0-1. This coefficient, which is used as 0.5 in studies conducted in different fields in the literature, is used to expand or narrow the range of the gray correlation coefficient value. (Güneysu et al., 2015).

$$\gamma_{oi}(j) = \frac{\triangle_{min}+\zeta\triangle_{max}}{\triangle_{oi}(j)+\zeta\triangle_{max}} \qquad (18)$$

The last step of the method is to calculate gray relational grades. If the criteria weights (w_i) are equal, the gray relational grades are calculated by Equation (19), if different, by Equation (20). Each alternative is ranked according to these values and the first one is evaluated as the most suitable alternative (Demir et al., 2021).

$$\Gamma_{oi} = \frac{1}{n}\sum_{j=1}^{n}\gamma_{oi}(j) \qquad (19)$$

$$\Gamma_{oi} = \sum_{j=1}^{n}\left[w_i(j) * \gamma_{oi}(j)\right] \qquad (20)$$

5. Findings

In this analysis, we try to make a profitability analysis of 34 airport service providers from different countries in Europe. The period in which the analyzes were made covers the years between 2017 and 2020. It is also aimed to make a comprehensive analysis of impacts of COVID-19 with 13 different profitability ratios respecting airport service providers' profitability. The ratios of the relevant companies in the relevant years were evaluated together and as a single data set. The weights (w_i) of the criteria are accepted as equal. The data of decision units and the results of the analysis can be seen in Table 2 and Table 3 respectively.

Table 2. Annual Profitability Ratios of Decision Units

	2017												
ANSP	**POPEX/PAPEX**	**ROA-1-**	**ROA-2-**	**ROA-3-**	**ROE-1-**	**ROD-1-**	**ROD-2-**	**ROD-3-**	**RO- net operating activities**	**RO- net investing activities**	**OPEX/ CAPEX**	**Return on OPEX/Return on Capex**	**free cash flow/Shareholder Equity**
Albcontrol	0.39	0.18	0.57	0.14	0.17	1.31	1.78	0.76	1.03	-1.09	2.54	0.39	0.01
ANS CR	0.22	0.21	0.33	0.13	0.15	0.98	6.49	0.85	1.04	-1.34	4.57	0.22	0.03
Fintraffic	0.08	0.58	0.65	0.31	0.79	0.71	1.75	0.50	1.26	-1.51	13.02	0.08	0.36
ARMATS	0.08	0.66	0.75	0.35	0.41	3.91	6.48	2.44	1.18	-17.89	13.08	0.08	0.32
Austro Control	0.11	0.11	0.45	0.09	0.51	1.78	0.11	0.11	0.66	-0.57	9.09	0.11	0.48
Avinor Flysikring	0.17	0.00	0.01	0.00	0.03	0.01	0.00	0.00	0.02	-0.02	5.94	0.17	-0.12
BULATSA	0.16	0.23	0.25	0.12	0.15	0.67	3.62	0.57	1.74	-2.13	6.15	0.16	0.02
Croatia Control	0.15	0.42	0.32	0.18	0.30	1.69	0.61	0.45	1.12	-2.58	6.78	0.15	0.16
DFS	0.11	0.18	0.10	0.06	- 0.21	0.51	0.05	0.05	0.53	-1.28	9.20	0.11	- 0.23
DHMI	0.63	0.30	1.53	0.25	0.32	1.56	4.85	1.18	1.80	-2.29	1.58	0.63	0.04
DSNA	0.14	0.28	0.37	0.16	0.43	5.16	0.26	0.25	0.79	-1.13	7.32	0.14	0.16
EANS	0.37	0.45	1.98	0.37	0.70	1.77	1.36	0.77	1.11	-2.31	2.69	0.37	0.28
ENAIRE	0.13	0.71	0.71	0.35	0.45	3.46	3.00	1.61	0.53	0.32	7.92	0.13	0.77
ENAV	0.19	0.20	0.43	0.14	0.24	0.77	0.53	0.31	1.41	-2.71	5.18	0.19	0.07
HungaroControl	0.14	0.36	0.44	0.20	0.24	1.36	6.31	1.12	1.17	-1.88	7.03	0.14	0.13
IAA	0.09	0.48	0.18	0.13	0.23	1.31	0.39	0.30	0.70	-0.52	11.14	0.09	0.26
LFV	0.08	0.18	0.07	0.05	0.57	0.60	0.06	0.06	0.50	-1.93	12.30	0.08	0.85
LGS	0.25	0.32	0.61	0.21	0.23	2.52	16.81	2.19	1.01	-1.40	3.95	0.25	0.07

LPS	0.04	0.18	0.19	0.09	0.13	0.53	1.02	0.35	1.00	-12.6	26.28	0.04	0.09
LVNL	0.12	0.31	0.44	0.18	0.43	0.74	0.53	0.31	0.93	-1.92	8.46	0.12	0.24
MATS	0.13	0.42	0.27	0.17	0.20	2.97	1.62	1.05	1.37	-2.15	7.94	0.13	0.08
M-NAV	0.05	0.51	0.29	0.19	0.21	3.50	4.58	1.98	1.12	-5.77	19.57	0.05	0.15
MOLDATSA	0.02	0.26	0.27	0.13	0.16	3.00	1.17	0.84	4.02	-0.98	45.35	0.02	0.02
NATS	0.29	0.21	0.60	0.15	0.33	1.08	0.39	0.29	0.87	-1.58	3.46	0.29	0.18
NAV Portugal	0.10	0.15	0.10	0.06	0.19	0.25	0.14	0.09	0.46	-1.28	10.26	0.10	0.26
NAVIAIR	0.11	0.12	0.45	0.09	0.15	0.61	0.38	0.23	0.71	-1.10	9.04	0.11	0.10
Oro Navigacija	0.42	0.12	0.26	0.08	0.09	1.03	2.22	0.70	0.77	-1.39	2.37	0.42	-0.10
PANSA	0.22	0.17	0.32	0.11	0.21	0.63	0.40	0.24	1.18	-1.11	4.50	0.22	-0.01
ROMATSA	0.06	- 0.17	- 0.15	-0.08	- 0.21	- 0.29	- 0.24	- 0.13	5.97	1.86	17.59	0.06	-0.15
Sakaeronavigatsia	0.58	0.23	1.02	0.19	0.21	3.99	4.98	2.22	0.97	-1.06	1.73	0.58	0.02
Skyguide	0.18	0.11	0.19	0.07	0.14	0.39	0.21	0.14	1.91	-0.64	5.59	0.18	- 0.15
Slovenia Control	0.05	0.28	1.10	0.23	0.40	0.98	1.12	0.52	1.24	-4.79	18.72	0.05	0.24
SMATSA	0.22	0.15	0.54	0.11	0.15	0.93	1.23	0.53	1.08	-1.19	4.50	0.22	0.01
UkSATSE	0.12	0.10	0.15	0.06	0.06	1.43	3.05	0.97	0.46	-1.06	8.62	0.12	0.08

2018

ANSP	**POPEX/PAPEX**	**ROA-1-**	**ROA-2-**	**ROA-3-**	**ROE-1-**	**ROD-1-**	**ROD-2-**	**ROD-3-**	**RO- net operating activities**	**RO- net investing activities**	**OPEX/CAPEX**	**Return on OPEX/Return**	**free cash flow/Shareholder Equity**
Albcontrol	0.23	0.19	0.53	0.14	0.16	1.15	5.24	0.94	1.06	-1.67	4.39	0.23	0.06
ANS CR	0.34	0.21	0.41	0.14	0.16	1.38	5.10	1.09	1.14	-0.89	2.91	0.34	-0.04
Fintraffic	0.03	0.56	0.33	0.21	0.56	0.52	0.90	0.33	0.73	-5.04	34.44	0.03	0.65
ARMATS	0.16	0.62	0.62	0.31	0.36	3.57	6.53	2.31	1.30	-6.39	6.30	0.16	0.21
Austro Control	0.11	0.09	0.35	0.07	0.45	1.18	0.09	0.09	0.64	-0.72	8.72	0.11	0.37
Avinor Flysikring	0.13	0.18	0.37	0.12	1.09	0.52	0.18	0.13	1.49	-1.49	7.63	0.13	- 0.03
BULATSA	0.10	0.28	0.27	0.14	0.16	1.40	2.30	0.87	1.56	-3.62	10.31	0.10	0.06
Croatia Control	0.24	0.45	0.32	0.19	0.32	1.58	0.63	0.45	1.03	2.86	4.18	0.24	0.12
DFS	0.09	0.15	0.09	0.06	- 0.19	0.39	0.05	0.04	-0.69	-1.12	10.69	0.09	0.42
DHMI	0.51	0.42	1.10	0.30	0.43	1.54	3.18	1.04	1.51	-3.27	1.94	0.51	0.15
DSNA	0.15	0.24	0.40	0.15	0.34	6.00	0.28	0.27	0.84	-0.91	6.72	0.15	0.03
EANS	0.48	0.43	1.70	0.34	0.59	1.91	1.40	0.81	1.07	-1.47	2.08	0.48	0.15
ENAIRE	0.13	0.58	0.56	0.29	0.38	2.36	2.32	1.17	0.46	0.44	7.63	0.13	0.72
ENAV	0.20	0.22	0.38	0.14	0.25	0.83	0.49	0.31	0.93	-2.36	5.05	0.20	0.16
HungaroControl	0.15	0.29	0.44	0.17	0.21	1.35	6.40	1.11	1.13	-1.32	6.75	0.15	0.10
IAA	0.22	0.36	0.17	0.12	0.20	1.10	0.38	0.28	0.89	-1.07	4.61	0.22	0.08
LFV	0.11	0.10	0.04	0.03	0.36	0.31	0.04	0.03	0.42	-0.82	8.90	0.11	0.42
LGS	0.24	0.30	0.52	0.19	0.21	2.16	20.90	1.96	0.99	-1.32	4.18	0.24	0.05
LPS	0.07	0.19	0.20	0.10	0.13	0.58	1.01	0.37	1.07	-2.12	14.22	0.07	0.06
LVNL	0.30	0.10	0.19	0.07	0.18	0.27	0.16	0.10	0.54	-0.31	3.35	0.30	-0.26

MATS	0.19	0.13	0.16	0.07	0.09	0.96	0.54	0.35	0.65	-0.56	5.34	0.19	0.03
M-NAV	0.04	0.56	0.25	0.17	0.19	3.26	3.62	1.72	1.24	-6.89	24.84	0.04	0.13
MOLDATSA	0.12	0.20	0.20	0.10	0.12	1.55	0.86	0.55	- 5.28	2.22	8.34	0.12	- 0.12
NATS	0.25	0.19	0.59	0.14	0.34	0.81	0.37	0.25	0.89	- 1.22	4.02	0.25	0.18
NAV Portugal	0.12	0.20	0.14	0.08	0.27	0.23	0.25	0.12	0.67	-1.39	8.45	0.12	0.21
NAVIAIR	0.11	0.12	0.39	0.09	0.15	0.58	0.39	0.23	1.07	-0.76	8.85	0.11	0.03
Oro Navigacija	0.35	0.16	0.33	0.11	0.13	0.74	1.87	0.53	0.74	-1.48	2.88	0.35	0.03
PANSA	0.23	0.20	0.37	0.13	0.23	1.02	0.42	0.30	1.24	-1.31	4.33	0.23	0.01
ROMATSA	0.04	0.16	0.13	0.07	0.21	0.21	0.24	0.11	1.55	-3.04	24.83	0.04	0.05
Sakaeronavigatsia	0.51	0.20	0.83	0.16	0.17	4.11	5.58	2.37	0.90	-1.11	1.94	0.51	0.04
Skyguide	0.18	0.23	0.40	0.14	0.29	1.04	0.39	0.28	2.55	-1.37	5.55	0.18	-0.10
Slovenia Control	0.06	0.31	0.98	0.24	0.38	1.04	1.72	0.65	1.21	-4.23	16.33	0.06	0.22
SMATSA	0.22	0.11	0.52	0.09	0.11	0.94	0.73	0.41	1.83	-0.90	4.48	0.22	-0.06
UkSATSE	0.09	0.18	0.32	0.12	0.12	3.25	3.33	1.64	1.98	-2.89	10.77	0.09	0.02

2019

ANSP	POPEX/PAPEX	ROA-1-	ROA-2-	ROA-3-	ROE-1-	ROD-1-	ROD-2-	ROD-3-	RO- net operating activities	RO- net investing activities	OPEX/CAPEX	Return on OPEX/Return	free cash flow/Shareholder Equity
Albcontrol	0.26	0.18	0.55	0.14	0.15	1.51	75.38	1.48	2.59	-0.94	3.81	0.26	-0.06
ANS CR	0.26	0.14	0.33	0.10	0.12	0.65	4.86	0.57	0.90	-0.80	3.91	0.26	-0.02
Fintraffic	0.08	0.57	0.22	0.16	0.44	0.39	0.68	0.25	0.54	-0.76	13.28	0.08	0.56
ARMATS	0.06	0.55	0.44	0.25	0.28	2.99	5.83	1.98	1.24	-18.9	16.01	0.06	0.20
Austro Control	0.11	0.06	0.28	0.05	0.34	1.03	0.06	0.06	0.67	-0.56	9.28	0.11	0.17
Avinor Flysikring	0.22	0.01	0.05	0.01	0.11	0.05	0.02	0.01	0.08	-0.08	4.61	0.22	0.07
BULATSA	0.14	0.21	0.19	0.10	0.12	0.87	1.73	0.58	0.77	-1.42	6.97	0.14	0.07
Croatia Control	0.18	0.43	0.27	0.16	0.29	1.43	0.51	0.37	0.94	-1.01	5.43	0.18	0.18
DFS	0.11	0.07	0.04	0.03	- 0.04	0.13	0.02	0.02	0.77	-0.50	9.16	0.11	0.03
DHMI	0.51	0.47	0.91	0.31	0.43	1.55	4.05	1.12	2.39	-3.28	1.96	0.51	0.05
DSNA	0.13	0.18	0.78	0.14	0.29	5.22	0.30	0.28	0.91	-0.91	7.97	0.13	0.01
EANS	0.23	0.36	0.71	0.24	0.53	2.00	0.56	0.44	1.01	-2.66	4.33	0.23	0.29
ENAIRE	0.14	0.29	0.44	0.18	0.23	1.41	1.40	0.70	0.30	0.34	7.07	0.14	0.67
ENAV	0.19	0.21	0.35	0.13	0.25	0.73	0.47	0.29	0.82	-3.01	5.26	0.19	0.20
HungaroControl	0.20	0.23	0.30	0.13	0.19	1.44	0.58	0.42	1.08	-1.21	4.99	0.20	0.08
IAA	0.16	0.31	0.15	0.10	0.20	0.71	0.28	0.20	0.78	-1.15	6.34	0.16	0.15
LFV	0.17	0.05	0.03	0.02	0.24	0.18	0.02	0.02	0.25	-0.33	5.82	0.17	0.24
LGS	0.37	0.21	0.57	0.15	0.18	1.91	2.11	1.00	0.97	-0.74	2.71	0.37	-0.06
LPS	0.10	0.15	0.19	0.08	0.11	0.55	0.98	0.35	1.38	-1.22	9.84	0.10	-0.01
LVNL	0.28	0.05	- 0.21	-0.04	- 0.19	- 0.14	- 0.07	- 0.05	0.82	0.20	3.63	0.28	-1.15
MATS	0.13	0.24	0.28	0.13	0.33	1.61	0.25	0.21	1.31	-3.79	7.59	0.13	0.17
M-NAV	0.16	0.15	0.08	0.05	0.07	0.57	0.58	0.29	0.83	-0.49	6.17	0.16	-0.05

MOLDATSA	0.05	0.24	0.23	0.12	0.14	3.58	0.91	0.73	0.34	-3.99	19.76	0.05	0.37
NATS	0.24	0.16	0.34	0.11	0.28	0.95	0.21	0.17	1.17	-1.74	4.13	0.24	0.07
NAV Portugal	0.12	0.12	0.17	0.07	0.22	0.26	0.17	0.10	-0.58	-0.91	8.45	0.12	-0.63
NAVIAIR	0.11	0.09	0.25	0.06	0.11	0.42	0.26	0.16	0.86	-0.74	9.11	0.11	0.02
Oro Navigacija	0.10	0.17	0.28	0.11	0.15	0.68	0.69	0.34	1.56	-3.58	9.63	0.10	0.05
PANSA	0.27	0.14	0.27	0.09	0.18	0.69	0.25	0.19	0.90	-0.86	3.71	0.27	-0.01
ROMATSA	0.05	0.12	0.13	0.06	0.16	0.32	0.16	0.11	-1.02	-1.57	20.80	0.05	-0.25
Sakaeronavigatsia	0.47	0.10	0.62	0.09	0.09	1.96	3.09	1.20	0.95	-0.58	2.15	0.47	- 0.06
Skyguide	0.17	0.16	0.28	0.10	0.21	0.68	0.26	0.19	0.55	-1.02	5.82	0.17	0.19
Slovenia Control	0.19	0.33	0.86	0.24	0.37	1.14	1.73	0.69	1.23	-1.45	5.25	0.19	0.04
SMATSA	0.25	0.09	0.42	0.07	0.10	0.69	0.49	0.29	1.00	-0.67	4.03	0.25	-0.05
UkSATSE	0.09	0.22	- 0.82	-0.17	- 0.19	- 3.06	- 7.30	- 2.15	1.55	2.48	11.72	0.09	-0.20

2020

ANSP	POPEX/PAPEX	ROA-1-	ROA-2-	ROA-3-	ROE-1-	ROD-1-	ROD-2-	ROD-3-	RO- net operating activities	RO- net investing activities	OPEX/CAPEX	Return on OPEX/Return	free cash flow/Shareholder Equity
Albcontrol	0.10	0.06	0.16	0.04	0.05	0.41	2.13	0.34	0.87	-0.28	10.27	0.10	0.03
ANS CR	0.26	- 0.19	- 0.49	-0.14	- 0.21	- 1.23	- 0.58	- 0.39	1.22	1.34	3.79	0.26	-0.33
Fintraffic	0.03	- 0.78	- 0.59	-0.33	- 1.48	- 0.52	- 2.68	- 0.43	0.58	6.60	34.88	0.03	-2.76
ARMATS	0.23	- 0.16	- 0.33	-0.11	- 0.12	- 2.40	- 2.02	- 1.10	0.50	1.13	4.30	0.23	-0.35
Austro Control	0.11	- 0.07	- 0.65	-0.07	- 0.99	- 0.67	- 0.08	- 0.07	1.09	1.46	8.77	0.11	-1.45
Avinor Flysikring	0.27	- 0.09	- 0.18	-0.06	- 0.43	- 0.29	- 0.10	- 0.07	0.84	1.10	3.64	0.27	-1.28
BULATSA	0.18	0.09	0.21	0.06	0.08	0.53	1.99	0.42	-0.52	-0.91	5.44	0.18	-0.23
Croatia Control	0.16	- 0.03	- 0.05	-0.02	- 0.03	- 0.15	- 0.07	- 0.05	0.09	-0.64	6.34	0.16	-0.46
DFS	0.07	0.01	0.01	0.01	- 0.01	0.04	0.00	0.00	-0.04	-0.21	13.78	0.07	0.22
DHMI	0.26	0.07	0.15	0.05	0.08	0.14	0.68	0.12	5.61	-0.84	3.84	0.26	-0.08
DSNA	0.13	0.10	0.36	0.08	0.29	4.66	0.11	0.10	-0.24	-0.93	7.82	0.13	-1.51
EANS	0.14	- 0.04	- 0.09	-0.03	- 0.08	- 0.11	- 0.06	- 0.04	0.37	0.40	7.05	0.14	- 0.41
ENAIRE	0.15	- 0.42	- 1.09	-0.30	- 0.45	- 2.03	- 1.70	- 0.93	2.69	-0.60	6.47	0.15	-0.33
ENAV	0.15	0.11	0.31	0.08	0.17	0.42	0.26	0.16	- 1.02	-3.73	6.61	0.15	-0.25
HungaroControl	0.29	- 0.25	- 0.43	-0.16	- 0.28	- 1.07	- 0.58	- 0.37	1.15	-0.90	3.45	0.29	- 0.44
IAA	0.10	0.09	0.05	0.03	0.06	0.24	0.08	0.06	-0.30	0.12	10.39	0.10	-0.27
LFV	0.24	0.18	0.16	0.08	1.51	0.74	0.10	0.09	0.51	-1.14	4.20	0.24	2.03
LGS	0.18	- 0.12	- 0.28	-0.08	- 0.11	- 0.56	- 1.13	- 0.37	6.42	2.03	5.63	0.18	- 0.12
LPS	0.20	- 0.27	- 0.46	-0.17	- 0.22	- 1.65	- 1.60	- 0.81	1.36	1.61	5.12	0.20	-0.29
LVNL	0.21	- 0.26	- 0.86	-0.20	2.27	- 1.26	- 0.21	- 0.18	0.53	1.65	4.70	0.21	5.69
MATS	0.04	- 0.03	- 0.07	-0.02	- 0.07	- 0.21	- 0.04	- 0.03	0.75	-0.36	25.88	0.04	-0.12
M-NAV	0.07	- 0.57	- 0.60	-0.29	- 0.36	- 7.26	- 1.88	- 1.49	1.11	5.27	13.44	0.07	- 0.40
MOLDATSA	0.04	- 0.40	- 0.57	-0.24	- 0.25	- 5.34	- 8.98	- 3.35	1.45	9.70	24.28	0.04	-0.20
NATS	0.13	0.12	0.51	0.10	0.34	0.61	0.18	0.14	-0.78	-13.73	7.81	0.13	-0.56
NAV Portugal	0.19	- 0.01	- 0.05	-0.01	- 0.02	- 0.02	- 0.02	- 0.01	0.03	0.07	5.37	0.19	- 1.16

NAVIAIR	0.08	0.06	0.13	0.04	0.07	0.23	0.15	0.09	-0.25	0.98	12.09	0.08	-0.34
Oro Navigacija	0.09	- 0.04	- 0.08	-0.03	- 0.04	- 0.19	- 0.15	- 0.08	0.22	0.95	11.21	0.09	- 0.20
PANSA	0.21	0.01	0.03	0.01	0.01	0.03	0.01	0.01	-0.05	-0.06	4.79	0.21	- 0.39
ROMATSA	0.07	0.05	0.03	0.02	0.05	0.10	0.03	0.02	-0.05	-0.33	14.58	0.07	-1.21
Sakaeronavigatsia	0.04	- 0.09	- 0.23	-0.06	- 0.09	- 0.69	- 0.31	- 0.21	1.97	4.64	22.78	0.04	-0.06
Skyguide	0.14	- 0.22	- 0.40	-0.14	- 0.30	- 0.32	- 1.70	- 0.27	0.86	1.82	7.22	0.14	- 0.52
Slovenia Control	0.08	- 0.40	- 2.06	-0.33	- 0.99	- 0.88	- 1.19	- 0.50	0.94	4.39	11.92	0.08	-1.29
SMATSA	0.30	- 0.18	- 1.13	-0.16	- 0.31	- 1.29	- 0.42	- 0.32	1.79	1.41	3.39	0.30	-0.40
UkSATSE	0.06	- 0.25	- 2.15	-0.22	- 0.28	- 3.55	- 1.41	- 1.01	1.74	8.40	18.16	0.06	-0.20

Table 3. Profitability Performance Values According to MABAC and GRA Method

MABAC			GRA		
RANKINGS	**DMU**	**PERFORMANCE VALUES**	**RANKINGS**	**DMU**	**PERFORMANCE VALUES**
1	DHMI-2017	0.6205	1	DHMI-2017	0.6345
2	Sakaeronavigatsia-2017	0.6095	2	Sakaeronavigatsia-2017	0.6185
3	EANS-2018	0.6002	3	EANS-2018	0.6059
4	DHMI-2019	0.5957	4	EANS-2017	0.6015
5	DHMI-2018	0.5894	5	Sakaeronavigatsia-2018	0.5969
6	Sakaeronavigatsia-2018	0.5885	6	DHMI-2019	0.5961
7	EANS-2017	0.5832	7	DHMI-2018	0.5910
8	Albcontrol-2019	0.5658	8	ENAIRE-2017	0.5881
9	ENAIRE-2017	0.5438	9	ARMATS-2017	0.5835
10	LGS-2017	0.5335	10	ARMATS-2018	0.5769
11	ARMATS-2018	0.5310	11	Albcontrol-2019	0.5726
12	Sakaeronavigatsia-2019	0.5276	12	MOLDATSA-2017	0.5627
13	LGS-2018	0.5236	13	LGS-2017	0.5518
14	MOLDATSA-2017	0.5201	14	ENAIRE-2018	0.5500
15	LGS-2019	0.5141	15	Fintraffic-2017	0.5416
16	ENAIRE-2018	0.5126	16	LGS-2018	0.5410
17	Albcontrol-2017	0.5101	17	M-NAV-2017	0.5402
18	ANS CR-2018	0.5055	18	Sakaeronavigatsia-2019	0.5391
19	ARMATS-2017	0.5052	19	M-NAV-2018	0.5379
20	EANS-2019	0.4999	20	ARMATS-2019	0.5370
21	Croatia Control-2018	0.4993	21	LVNL-2020	0.5331
22	Fintraffic-2017	0.4986	22	Fintraffic-2018	0.5291
23	Oro Navigacija-2017	0.4943	23	DSNA-2018	0.5285
24	M-NAV-2017	0.4922	24	LGS-2019	0.5283
25	Slovenia Control-2019	0.4905	25	Croatia Control-2018	0.5266
26	M-NAV-2018	0.4905	26	EANS-2019	0.5262
27	LFV-2020	0.4884	27	Albcontrol-2017	0.5243
28	Fintraffic-2018	0.4867	28	Slovenia Control-2019	0.5227
29	NATS-2017	0.4828	29	ANS CR-2018	0.5220
30	Oro Navigacija-2018	0.4798	30	DSNA-2017	0.5216
31	DSNA-2018	0.4791	31	DSNA-2019	0.5213
32	HungaroControl-2017	0.4783	32	MATS-2017	0.5184
33	DSNA-2017	0.4762	33	Slovenia Control-2018	0.5159
34	MATS-2017	0.4758	34	HungaroControl-2017	0.5156
35	Albcontrol-2018	0.4745	35	Oro Navigacija-2017	0.5147
36	DSNA-2019	0.4734	36	Slovenia Control-2017	0.5144
37	HungaroControl-2018	0.4732	37	UkSATSE-2018	0.5143
38	Slovenia Control-2018	0.4717	38	LFV-2020	0.5130
39	NATS-2018	0.4705	39	HungaroControl-2018	0.5108
40	Croatia Control-2019	0.4705	40	Fintraffic-2019	0.5099
41	Slovenia Control-2017	0.4699	41	DHMI-2020	0.5096
42	ANS CR-2017	0.4681	42	Croatia Control-2019	0.5090
43	ENAIRE-2019	0.4675	43	NATS-2017	0.5085
44	DHMI-2020	0.4672	44	Croatia Control-2017	0.5084
45	UkSATSE-2018	0.4666	45	ENAIRE-2019	0.5075
46	ARMATS-2019	0.4660	46	Albcontrol-2018	0.5061
47	Croatia Control-2017	0.4657	47	Oro Navigacija-2018	0.5049
48	Skyguide-2018	0.4627	48	NATS-2018	0.5023
49	PANSA-2018	0.4618	49	IAA-2017	0.5021
50	ANS CR-2019	0.4613	50	ANS CR-2017	0.5018

51	IAA-2018	0.4599	51	Skyguide-2018	0.5017
52	Fintraffic-2019	0.4597	52	MOLDATSA-2019	0.5016
53	SMATSA-2017	0.4592	53	LVNL-2017	0.4995
54	HungaroControl-2019	0.4586	54	IAA-2018	0.4992
55	SMATSA-2018	0.4566	55	HungaroControl-2019	0.4980
56	NATS-2019	0.4563	56	PANSA-2018	0.4980
57	PANSA-2019	0.4548	57	Avinor Flysikring-2018	0.4970
58	LVNL-2017	0.4537	58	BULATSA-2018	0.4970
59	Avinor Flysikring-2018	0.4529	59	SMATSA-2017	0.4970
60	ENAV-2017	0.4523	60	ANS CR-2019	0.4956
61	ENAV-2018	0.4523	61	SMATSA-2018	0.4954
62	PANSA-2017	0.4519	62	LGS-2020	0.4940
63	LVNL-2020	0.4519	63	ENAV-2017	0.4939
64	IAA-2017	0.4508	64	DSNA-2020	0.4939
65	MOLDATSA-2019	0.4504	65	ENAV-2018	0.4937
66	SMATSA-2019	0.4495	66	NATS-2019	0.4934
67	BULATSA-2017	0.4495	67	BULATSA-2017	0.4934
68	LVNL-2018	0.4485	68	PANSA-2017	0.4922
69	BULATSA-2018	0.4474	69	PANSA-2019	0.4919
70	ENAV-2019	0.4463	70	MATS-2019	0.4911
71	MATS-2019	0.4422	71	ENAV-2019	0.4904
72	Austro Control-2017	0.4413	72	Austro Control-2017	0.4901
73	IAA-2019	0.4401	73	SMATSA-2019	0.4899
74	BULATSA-2019	0.4373	74	IAA-2019	0.4892
75	Skyguide-2019	0.4359	75	ROMATSA-2017	0.4884
76	MATS-2018	0.4343	76	LVNL-2018	0.4880
77	Skyguide-2017	0.4330	77	BULATSA-2019	0.4877
78	Austro Control-2018	0.4308	78	UkSATSE-2017	0.4852
79	UkSATSE-2017	0.4294	79	Skyguide-2019	0.4848
80	NAVIAIR-2018	0.4275	80	MATS-2018	0.4838
81	DSNA-2020	0.4271	81	Austro Control-2018	0.4835
82	ROMATSA-2018	0.4269	82	Skyguide-2017	0.4833
83	Oro Navigacija-2019	0.4266	83	NAVIAIR-2018	0.4827
84	NAVIAIR-2017	0.4256	84	ROMATSA-2018	0.4825
85	LPS-2018	0.4253	85	Oro Navigacija-2019	0.4825
86	LFV-2017	0.4249	86	LPS-2018	0.4823
87	LPS-2019	0.4243	87	NAVIAIR-2017	0.4817
88	M-NAV-2019	0.4241	88	MOLDATSA-2018	0.4814
89	NAV Portugal-2018	0.4224	89	LPS-2019	0.4812
90	Austro Control-2019	0.4201	90	LFV-2017	0.4801
91	BULATSA-2020	0.4201	91	M-NAV-2019	0.4792
92	NAVIAIR-2019	0.4152	92	NAV Portugal-2018	0.4791
93	Avinor Flysikring-2019	0.4138	93	Austro Control-2019	0.4780
94	LGS-2020	0.4133	94	BULATSA-2020	0.4766
95	Albcontrol-2020	0.4130	95	LPS-2017	0.4762
96	LFV-2019	0.4124	96	NAVIAIR-2019	0.4757
97	NAV Portugal-2017	0.4124	97	Albcontrol-2020	0.4747
98	LFV-2018	0.4117	98	NAV Portugal-2017	0.4740
99	LPS-2017	0.4078	99	LFV-2018	0.4726
100	ROMATSA-2017	0.4043	100	Sakaeronavigatsia-2020	0.4725
101	ENAV-2020	0.4042	101	LFV-2019	0.4713
102	MOLDATSA-2018	0.4040	102	Avinor Flysikring-2019	0.4711
103	PANSA-2020	0.4034	103	DFS-2017	0.4707
104	DFS-2017	0.4031	104	ROMATSA-2019	0.4705
105	ROMATSA-2019	0.4022	105	NAV Portugal-2019	0.4698
106	NAV Portugal-2019	0.4018	106	ENAV-2020	0.4695
107	LVNL-2019	0.4000	107	NAVIAIR-2020	0.4687
108	DFS-2019	0.3997	108	DFS-2018	0.4679
109	DFS-2018	0.3982	109	DFS-2019	0.4675
110	NAVIAIR-2020	0.3981	110	PANSA-2020	0.4669
111	Avinor Flysikring-2017	0.3978	111	IAA-2020	0.4664
112	Sakaeronavigatsia-2020	0.3960	112	MATS-2020	0.4660
113	IAA-2020	0.3951	113	LVNL-2019	0.4657
114	MATS-2020	0.3938	114	Avinor Flysikring-2017	0.4648
115	Avinor Flysikring-2020	0.3904	115	NATS-2020	0.4635
116	DFS-2020	0.3900	116	DFS-2020	0.4630
117	NAV Portugal-2020	0.3879	117	Avinor Flysikring-2020	0.4627
118	Croatia Control-2020	0.3834	118	NAV Portugal-2020	0.4612
119	EANS-2020	0.3831	119	ROMATSA-2020	0.4611
120	NATS-2020	0.3826	120	EANS-2020	0.4592
121	ROMATSA-2020	0.3819	121	Oro Navigacija-2020	0.4588

122	Oro Navigacija-2020	0.3796	122	Croatia Control-2020	0.4582
123	ANS CR-2020	0.3752	123	ANS CR-2020	0.4549
124	SMATSA-2020	0.3702	124	SMATSA-2020	0.4549
125	HungaroControl-2020	0.3690	125	HungaroControl-2020	0.4511
126	ARMATS-2020	0.3551	126	MOLDATSA-2020	0.4482
127	Skyguide-2020	0.3502	127	UkSATSE-2020	0.4474
128	LPS-2020	0.3458	128	Skyguide-2020	0.4470
129	Austro Control-2020	0.3385	129	Fintraffic-2020	0.4467
130	UkSATSE-2020	0.3043	130	ARMATS-2020	0.4454
131	UkSATSE-2019	0.2994	131	Austro Control-2020	0.4445
132	ENAIRE-2020	0.2983	132	LPS-2020	0.4436
133	MOLDATSA-2020	0.2852	133	UkSATSE-2019	0.4294
134	Fintraffic-2020	0.2801	134	ENAIRE-2020	0.4281
135	Slovenia Control-2020	0.2639	135	Slovenia Control-2020	0.4241
136	M-NAV-2020	0.2609	136	M-NAV-2020	0.4229

According to the results shown in Table 3, DHMI-2017, Sakaeronavigatsia-2017 and EANS-2018 were in the first three ranks in both of the analysis methods. Besides, the same 8 decision units take place within first-ten decision units according to both of the analysis methods. For these reasons, the results are parallel in MABAC and GRA methodologies. In addition, the companies with the worst three performances according to the MABAC methodology are Fintraffic-2020, Slovenia Control-2020 and M-NAV-2020, while the companies with the worst three performances according to the GRA methodology are ENAIRE-2020, Slovenia Control-2020 and M-NAV-2020. Nevertheless, the average performance values of first-ten decision units and annually average profitability performance values were shown in Table 4. The average performance values are the geometric means of the values obtained according to the two methods.

Table 4. Top 10 Decision Units and Average Profitability Performance Values by Years

DMU	Average Performance Values
DHMI-2017	0.6275
Sakaeronavigatsia-2017	0.6140
EANS-2018	0.6030
DHMI-2019	0.5959
Sakaeronavigatsia-2018	0.5927
EANS-2017	0.5924
DHMI-2018	0.5902
Albcontrol-2019	0.5692
ENAIRE-2017	0.5659
ARMATS-2018	0.5539
2017	**0.4963**
2018	**0.4928**
2019	**0.4739**
2020	**0.4191**

According to Table 4, the annual values decreased constantly in the period between 2017 and 2020. Comparing the year 2017 (when the highest performance was experienced) and 2020 (when the effects of COVID-19 were experienced the most) the decrease was around 16%.

6. Conclusion

As in the dependent organizations of aviation industry, the most interesting one is Air Navigation Service Providers (ANSP). Their financial structures which are compulsive to understand and important for effectiveness of air transportation and logistics systems. EBITDA is used in this analysis, depending on the high values of amortization and depreciation in the financial tables of ANSP. In general, this study is the first comprehensive analysis on profitability measures of ANSP, also it is the first one in terms of using 13 different criteria regarding profitability. Two different methods are utilized, and it is found possibility of making comparative analysis. To the best knowledge of the authors, this is the first study that investigates the profitability performances of European ANSP in this context.

Findings show that DHMI-2017, Sakaeronavigatsia-2017 and EANS-2018 were in the first three ranks in both of the analysis methods. Besides it has been observed that the overall profitability performances decrease every year between 2017-2020. Besides, it is seen that COVID-19 has deeply affected ANSP industry as other industries. It is also seen in the analyzes that 2020, when the effects of COVID-19 were most intense, was the year with the lowest performance. Compared to 2017, a 16% decrease was observed. The findings show that quality, efficiency, and effectiveness of the airspace management and ANSP' financial management in these countries for the period of 2017-2020 are decent. Also, the density and strategical importance of these countries' airspaces in that period may be other reasons.

The foremost limitation of this study is the inaccessibility and timespan of all relevant data for the companies, another one is that there is no comprehensive literature about ANSP financial management. The findings of the research are quite normal when focusing on the developing structure of Turkish aviation and the importance of Turkish airspace (Toydemir & Mutlu, 2019). Also, the importance of Georgian Airspace and Sakaeronavigatsia emerged in this period. The performance of EANS suggests that more studies should be conducted on Estonian Baltic aviation industry. In addition, the authors consider expanding this study to cover a longer period.

Ethical approval

Not applicable.

Conflicts of Interest

The authors declare that there is no conflict of interest regarding the publication of this paper.

References

Adelopo, I., Lloydking, R., and Tauringana, V. (2018). Determinants of bank profitability before, during, and after the financial crisis. International Journal of Managerial Finance, 61, 1-14.

Adiloglu, B., and Vuran, B. (2017). The importance of EBIT-EBITDA disclosure in annual reports: A comparison from Turkey. International Journal of Social Sciences and Education Research, 3(2), 397-405.

Adler, N., Delhaye, E., Kivel, A., and Proost, S. (2020). Motivating air navigation service provider performance. Transportation Research Part A: Policy and Practice, 132, 1053-1069.

Alarussi, A. S., and Alhaderi, S. M. (2018). Factors affecting profitability in Malaysia. Journal of Economic Studies, 45(3), 1-21.

Alarussi, A. S., and Gao, X. (2021). Determinants of profitability in Chinese companies. International Journal of Emerging Markets. 17(2),120-141.

Andres, C. (2008). Large shareholders and firm performance—An empirical examination of founding-family ownership. Journal of Corporate Finance, 14(4), 431-445.

Arias, J. C. (2011). Banking profitability determinants. Business Intelligence Journal, 4(2), 209-230.

Assaf, A. (2009). Accounting for size in efficiency comparisons of airports. Journal of Air Transport Management, 15(5), 256-258.

Ayçin, E., and Çakın, E. (2019). Ülkelerin İnovasyon Performanslarının Ölçümünde Entropi ve MABAC Çok Kriterli Karar Verme Yöntemlerinin Bütünleşik Olarak Kullanılması. Akdeniz İİBF Dergisi, 19(2), 326-351.

Bezerra, G. C., and Gomes, C. F. (2018). Performance measurement practices in airports: Multidimensionality and utilization patterns. Journal of Air Transport Management, 70, 113-125.

Bilotkach, V., Gitto, S., Jovanović, R., Mueller, J., and Pels, E. (2015). Cost-efficiency benchmarking of European air navigation service providers. Transportation Research Part A: Policy and Practice, 77, 50-60.

Blondiau, T., Delhaye, E., Proost, S., and Adler, N. (2016). ACCHANGE: Building economic models to analyse the performance of air navigation service providers. Journal of Air Transport Management, 56, 19-27.

Bouwens, J., De Kok, T., and Verriest, A. (2019). The prevalence and validity of EBITDA as a performance measure. Comptabilite Controle Audit, 25(1), 55-105.

Bozanic, D., Pamucar, D. and Karovic, S. (2016). Use of the fuzzy AHP-MABAC hybrid model in ranking potential locations for preparing laying-up positions. Military Technical Courier, 64(3), 705-729.

Button, K., and McDougall, G. (2006). Institutional and structure changes in air navigation service-providing organizations. Journal of Air Transport Management, 12(5), 236-252.

Castelli, L., Labbé, M., and Violin, A. (2013). A network pricing formulation for the revenue maximization of European air navigation service providers. Transportation Research Part C: Emerging Technologies, 33, 214-226.

Creixans Tenas, J., and Arimany-Serrat, N. (2018). Influential variables on the profitability of hospital companies. Intangible Capital, 14(1), 171-185.

Demir, G., Özyalçın, A.T. and Bircan, H. (2021). Çok Kriterli Karar Verme Yöntemleri ve ÇKKV Yazılımı ile Problem Çözüm. Nobel Akademik Yayıncılık, 1. Baskı, Ankara.

Dempsey-Brench, Z., and Volta, N. (2018). A cost-efficiency analysis of European air navigation service providers. Transportation Research Part A: Policy and Practice, 111, 11-23.

EUROCONTROL (2022). https://ansperformance.eu/economics/ finance/, Access time: 24.12.2022.

Fernández-López, S., Rodeiro-Pazos, D., and Rey-Ares, L. (2020). Effects of working capital management on firms' profitability: evidence from cheese-producing companies. Agribusiness, 36(4), 770-791.

Grebenšek, A., and Magister, T. (2012). Effect of seasonal traffic variability on the performance of air navigation service providers. Journal of Air Transport Management, 25, 22-25.

Güneysu, Y., Er, B. and Ar, İ. (2015). Türkiye'deki Ticari Bankaların Performanslarının AHS ve GIA Yöntemleri ile İncelenmesi. Karadeniz Teknik Üniversitesi Sosyal Bilimler Enstitüsü Sosyal Bilimler Dergisi, 5(9), 71-93.

Hafizuddin-Syah, B. A. M., Shahida, S., and Fuad, S. H. (2018). Sustainability certifications and financial profitability: An analysis on palm oil companies in Malaysia. Jurnal Pengurusan, 54(2018), 143-154.

Hermawan, M., and Mulyawan, S. (2014). Profitability and corporate social responsibility: An analysis of Indonesia's listed company. Asia Pacific Journal of Accounting and Finance, 3(1).

Hooper, P. G., and Hensher, D. A. (1997). Measuring total factor productivity of airports—an index number approach. Transportation Research Part E: Logistics and Transportation Review, 33(4), 249-259.

Ison, S., Francis, G., Humphreys, I., and Page, R. (2011). UK regional airport commercialisation and privatisation: 25 years on. Journal of Transport Geography, 19(6), 1341-1349.

Javaid S, Anwar J, Zaman K, and Ghafoor A (2011). Determinants of Bank Profitability in Pakistan: Internal Factor Analysis, J. Yasar Univ, 23(6), 3794-3804.

Lukason, O., Laitinen, E. K., and Suvas, A. (2016). Failure processes of young manufacturing micro firms in Europe. Management Decision, 54(8), 1966-1985.

Malik, H. (2011). Determinants of insurance companies' profitability: an analysis of insurance sector of Pakistan. Academic research international, 1(3), 315.

Pamučar, D. and Ćirovic, G. (2015). The selection of transport and handling resources in logistics centers using Multi-Attributive Border Approximation Area Comparison (MABAC). Expert Systems with Applications, 42(6), 3016-3028.

Peris, R. W., Contani, E., Savoia, J. R. F., and Bergmann, D. R. (2017). Does better corporate governance increase operational performance? Corporate Governance: The International Journal of Business in Society.

Pervan, M., and Mlikota, M. (2013). What determines the profitability of companies: case of Croatian food and beverage industry. Economic research-Ekonomska istraživanja, 26(1), 277-286.

Raghavan, S., and Yu, C. (2021). Evaluating financial performance of commercial service airports in the United States. Journal of Air Transport Management, 96, 102111.

Richardson, C., Budd, L., and Pitfield, D. (2014). The impact of airline lease agreements on the financial performance of US hub airports. Journal of Air Transport Management, 40, 1-15.

Saleem, Q., and Rehman, R. U. (2011). Impacts of liquidity ratios on profitability. Interdisciplinary journal of research in business, 1(7), 95-98.

Shahida, S., Ba M, H.S., and Fuad, S. H. (2019). Does MSPO certification matter for profitability of Malaysian palm oil companies? International Journal of Economics & Management, 13(2).

Singh, F., and Mogla, M. (2010). Profitability Analysis of Acquiring Companies. IUP Journal of Applied Finance, 16(5), 72-83.

Sultan, A. S. (2014). Financial statements analysis-measurement of performance and profitability: applied study of baghdad soft-drink industry. Research Journal of Finance and Accounting, 5(4), 49-56.

Tomová, A. (2016). Are commercial revenues important to today's European air navigation service providers? Journal of Air Transport Management, 54, 80-87.

Tomová, A. (2017). Two businesses of air navigation service providers: The case study of NATS. Transportation Research Procedia, 28, 99-105.

Toydemir, Ö. and Mutlu, A.A. (2019). The Dance of Change In Turkısh Aırspace. https://skybrary.aero/sites/default/files/bookshelf/4522.pdf, Access date: 30.12.2022.

Üstünışık, N. Z. (2007). Türkiye'deki İller ve Bölgeler Bazında Sosyo Ekonomik Gelişmişlik Sıralaması Araştırması: Gri İlişkisel Analiz Yöntemi ve Uygulaması. Yayınlanmamış Yüksek Lisans Tezi, Ankara, Gazi Üniversitesi Fen Bilimleri Enstitüsü, Ankara.

Vesković, S, Stević, Z., Stojić, G., Vasiljević, M. and Milinković, S. (2018). Evaluation of The Railway Management Model by Using A New Integrated Model DELPHI-SWARA-MABAC. Decision Making: Applications in Management and Engineering, 1(2), 34-50.

Vogel, H. A. (2011). Do privatized airports add financial value? Research in Transportation Business & Management, 1(1), 15-24.

Wen, K.L., (2004). Grey Systems: Modeling and Prediction. Yan's Scientific Research Institute, USA.

Yıldırım, F.B. (2014). Gri İlişkisel Analiz, Yıldırım, F.B. ve Önder, E (Ed.). Operasyonel, Yönetsel ve Stratejik Problemlerin Çözümünde Çok Kriterli Karar Verme Yöntemleri. Dora Yayınları, 1. Baskı, Bursa.

Zeli, A., and Mariani, P. (2009). Productivity and profitability analysis of large Italian companies: 1998–2002. International Review of Economics, 56(2), 175-188.

Zhaoxuan, L. I. U., Kaiquan, C. A. I., and Yanbo, Z. H. U. (2021). Civil unmanned aircraft system operation in national airspace: A survey from Air Navigation Service Provider perspective. Chinese Journal of Aeronautics, 34(3), 200-224.

Cite this article: Alnıpak, S. Olcen, O. (2023). A Profitability Analysis of Air Navigation Service Providers in European Zone: COVID-19 Crisis. Journal of Aviation, 7(1), 110-122.

7 (1): 123-132 (2023)

Journal of Aviation

https://dergipark.org.tr/en/pub/jav

e-ISSN 2587-1676

Is Gamification Important for Service Systems Non-Users? A Study on Airline Loyalty Programs

Osman S. Sesliokuyucu[1*]

[1*] Süleyman Demirel University, Aviation Management Department, 32700, Keçiborlu, Isparta, Türkiye. (osmansesliokuyucu@sdu.edu.tr)

Article Info

Received: 19 January 2023
Revised: 15 February 2023
Accepted: 02 March 2023
Published Online: 03 March 2023

Keywords:
Service system
Gamification
Social influence
Consumer innovativeness
Behavioral intention

Corresponding Author: *Osman S. Sesliokuyucu*

RESEARCH ARTICLE

https://doi.org/10.30518/jav.1239127

Abstract

Increasing use of social communication networks and mobile technology have caused the airline-passenger relationship to shift from traditional methods to more modern and technological infrastructure processes. The airline loyalty programs provide that permit more focused marketing, tailored services, and more accessibility for both members and non-members. Consumers are motivated by prizes, competition, and social engagement in gamified loyalty programmes. Gamification, which is effective in improving the results of innovation practices and their acceptance by consumers, plays an active role in this interaction. In this direction, the study aims to reveal the factors that affect the service system non-users behavioral intentions based on airline loyalty programs and its relationship between social influence, consumer innovativeness, and gamification. The research data were collected from air passengers who use air transportation at least once time and have no loyalty program membership. Data obtained from passengers were analyzed using the PLS-SEM model. The findings show that gamification processes will improve the participation process of new passengers, and in this direction, new consumer profiles can be added to the portfolio of service systems. In addition, it has revealed that gamification and social influence are effective on behavioral intention and gamification has a mediating role in the relationship between consumer innovativeness and behavioral intention.

1. Introduction

In the aviation business, information and communication technologies (ICTs) are essential for the functioning of airline service systems and passenger relationship management. Airlines can effectively handle flight scheduling, ticketing, baggage handling, and consumer services, among other activities, owing to these technologies. In addition, it enables real-time communication between ground employees and pilots, ensuring that passengers travel safely and on schedule. Airlines may collect and analyze consumer data using these technologies, which helps them better target their services and marketing to specific passengers and enhance their overall consumer experience (Polat, 2021). ICTs integration in the aviation industry has, all things considered, substantially increased productivity and consumer happiness, making it an essential part of contemporary air travel.

The development of airline loyalty programs, which aim to reward and retain consumers through a range of perks and advantages, has been significantly influenced by ICTs. Airlines can now gather and analyze data on consumer behavior and preferences, allowing them to customize their loyalty programs to better serve their consumers' needs and preferences. ICTs have made it possible for airlines to focus their marketing efforts more effectively on loyalty programs, which has improved consumer involvement and engagement (Lacey & Sneath, 2006). The ability to redeem rewards online or through mobile applications is just one example of how ICTs have allowed airlines to provide more convenient and individualized services to loyalty program participants (Ahn et al., 2015). Non-members have also been impacted by loyalty schemes. The exposure of loyalty program perks on social media sites might make non-members feel FOMO (fear of missing out), which can encourage them to sign up for the program. Airline loyalty programs' choices for membership and participation may make the program more appealing to non-members (Meyer-Waarden, 2008; Leenheer et al., 2007).

Airline loyalty programs have permitted more focused marketing, tailored services, and greater accessibility for both members and non-members. Consumers are motivated by prizes, competition, and social engagement in gamified loyalty programs. Gamification, the "application of game features and design concepts in non-game situations," has drawn more attention as a means of inspiring and energizing users of service systems (Deterding et al., 2011). Uncertainty exists over the efficiency of gamification in inspiring and involving non-users or those who are yet to accept or use a service system. Using ICT-based gamification approaches in airline passenger interactions has the potential to boost loyalty and the consumer experience. Gamification is the use of game-like components to engage and inspire people to complete desired tasks. These components included points, prizes, and challenges. Airlines may provide consumers with a more pleasurable and engaging travel experience by introducing

gamification into their interaction with passengers, which will eventually enhance consumer satisfaction and loyalty (Pasca et al., 2021).

In order to boost user engagement and involvement, gamification has been widely used in a variety of industries, including business, education, health, and government (Wanick & Bui, 2019; Rodrigues et al., 2019). By boosting non-users' motivation, enjoyment, and perception of the system's utility, gamification can have a beneficial effect on non-users of service systems and raise their desire to use them (Koivisto & Hamari, 2014). Gamification also increases a system's readiness to communicate with and share information with non-users (Yang et al., 2017). Gamification techniques encourage cooperation and social engagement among non-users, which may be strong motivations for some people (Deterding et al., 2011). This is important for service systems that rely on user-generated content or that require user cooperation to achieve a common objective. In summary, gamification is an effective way to engage and motivate non-users of a service system by providing a sense of purpose, competition, social interactions, and fun. It can also increase non-users' intentions to use the system and their willingness to share information and collaborate with others.

Self-Determination Theory (SDT) is relevant for understanding the effects of gamification on non-users of service systems (Suh et al., 2018). It is a psychological theory that explains how people's basic psychological needs for autonomy, competence, and relatedness influence their behavior, well-being, and motivation (Ryan & Deci, 2002). According to the SDT, people are more likely to be genuinely driven and enjoy a feeling of well-being when their fundamental psychological needs are met through their experiences and activities. On the other hand, if these fundamental wants are not addressed, people can become more extrinsically driven and feel out of control. An emerging field of study is the use of SDT for the gamification of service systems. Numerous areas, including education (Gagné & Deci, 2005), sports (Standage et al., 2005), and health care, have all been the subject of SDT research (Osei-Frimpong, 2017). In the context of service systems, gamification components such as badges and points can increase feelings of competence, relatedness, and autonomy (Richter et al., 2015).

This research suggests that SDT could be a useful framework for understanding the effects of gamification on non-users of service systems. The original value of this study is to reveal why gamification processes, which have been previously discussed in terms of different contexts and areas in the literature, are important for people who are not users of service systems. In addition, this study is expected to contribute to the literature in this field (in the aviation context). Organizations can motivate and engage non-users by designing service systems that support people's basic psychological needs such as autonomy, competence, and relatedness through gamification elements. In this context, this study examines the impact of gamification (especially airline loyalty programs), social influence, and consumer innovativeness on the behavioral intentions of non-users of service systems.

2. Conceptual Framework

2.1. Gamification and Non-users of Service Systems

According to extensive research in the field of psychology, gamification, the application of game design principles in contexts other than games, may have a variety of advantages, especially for behavior modification (Lin et al., 2018). The use of gamification to improve engagement and the adoption of service systems by non-users has been a prominent topic of research in this field (Lee, 2019).

For non-users of a service system, gamification may be crucial for a number of reasons (Novak et al., 2018; Xiao et al., 2021; Guo et al., 2022):

- ***Motivation:*** Gamification may provide users with a sense of success and purpose, which is especially useful for attracting non-users who may lack a clear driving force to utilize the system.
- ***Competition:*** Gamification may add a competitive component to the system, which can be a strong incentive for certain individuals.
- ***Social interaction:*** Gamification has the potential to encourage social engagement and teamwork, which may appeal to non-users who do not necessarily feel connected to the service system.
- ***Fun:*** Gamification helps to increase consumer satisfaction with the service system, which can be a major motivator for becoming less frequent users more active.

Based on SDT, three fundamental psychological needs—autonomy, competence, and relatedness—can affect why someone chooses to engage in a certain activity (Ryan & Deci, 2002). By giving users the ability to customize their experiences, offer clear goals and feedback, and foster a feeling of social connection through competition or cooperation, gamification can be utilized to meet these demands. The application of gamification to a service system improves user engagement and adherence to treatment regimens (Pramana et al., 2018). Gamification processes are effective tools for promoting sustainable behaviors, such as recycling or energy conservation (Douglas & Brauer, 2021), as well as increasing recycling rates and decreasing waste production (Santti et al., 2020). The literature suggests that gamification has the potential to increase the engagement and adoption of service systems, particularly among non-users, by addressing psychological needs and providing clear goals, feedback, and incentives.

In the context of service systems, SDT can be used to understand the motivations and behaviors of non-users or individuals who have not yet adopted or utilized a service (Lee, 2019). Literature has shown that people's basic psychological needs can influence their decision to use or not use a service system (Sheldon, 2005). A service system may be more likely to draw and retain non-users if it is built to fulfill people's fundamental psychological requirements for autonomy, competence, and relatedness.

2.2. Social Influence, Gamification & Behavioral Intention

Social influence is one of the main elements that affect how well gamification works. Social influence significantly affects how people behave and make decisions, especially in the setting of service systems (Li, 2013). The idea of social influence relates to how other people affect a person's attitudes, beliefs, and behavior (Abrahamse & Steg, 2013). Social influence is a powerful asset that may be used to inspire and include people in service systems, even those who do not. One strategy utilized to boost involvement among non-users is the gamification of service systems.

Gamification may increase social influence in various ways, including by promoting social contacts, establishing social norms, and providing social comparison data (Suh et al., 2018). For instance, gamified workout software may allow users to create exercise groups with their friends or display how their progress stacks up against their friends. These social

pressures might encourage users to continue using the app and succeed in their objectives (Pei-Shan & Hsi-Peng, 2014). The first hypothesis of this study is provided below.

H_1: Social influence influences service system non-users' gamification usage in a positive and significant way.

Additionally, social influence is a key idea in comprehending how consumers decide whether to use service systems. According to the notion of social influence, people are greatly affected by the behavior and attitudes of others around them (Hu et al., 2019). This can occur through various forms of social influence such as normative influence (conformity to group norms), informational influence (reliance on information from others), and interpersonal influence (direct persuasion from others). Friends and family members who use a certain service system can have a beneficial influence on a non-intentional user to utilize that system (Fischer-Preßler et al., 2022). Consequently, the second hypothesis is as follows:

H_2: Social influence influences service system non-users' behavioral intention in a positive and significant way.

2.3. Consumer Innovativeness, Gamification & Behavioral Intention

Consumer innovativeness is the willingness of consumers' willingness to try novel products, services, and concepts (Al-Jundi et al., 2019). It has been demonstrated that the idea of consumer innovativeness has a significant role in the acceptance and usage of new technologies and service systems. For consumers of service systems who are not users, consumer innovativeness is a key indicator of engagement in the gamification process (Chauhan et al., 2022). Consumer innovativeness often determines whether current non-users will start using the service system often (Dawi & Jalil, 2019). Even in the absence of monetary compensation, it serves as a significant predictor of involvement in service systems (Baswani et al., 2021). Therefore, this study proposes the following hypothesis:

H_3: Consumer innovativeness influences service system non-users' gamification usage in a positive and significant way.

Additionally, among non-users of service systems, consumer innovativeness is a highly significant predictor of behavioral intention. Innovative consumers are often more inquisitive, daring, and open-minded, which increases their likelihood of engaging in novel activities (Japutra & Hossain, 2021). They also frequently exhibit greater readiness to take chances and try new things, which raises the possibility that they will be open to experimenting with novel service models. Innovation increases the probability that people will frequently use a service (Kaur et al., 2020). Consumer innovativeness increases the possibility that non-users will become regular users of service systems, which has a significant impact on their behavioral intentions (Singh et al., 2022). Based on these justifications, the following theory is proposed.

H_4: Consumer innovativeness influences service system non-users' behavioral intention in a positive and significant way.

2.4. Gamification and Behavioral Intention

Gamification incorporating aspects such as feedback, competition, and choice can improve consumer demand (autonomy, competence, and relatedness) and boost consumers' behavioral intention to use a service system (Yang et al., 2017). Consumers' perceptions of competence and relatedness were dramatically boosted by gamification components, such as feedback and competition, which increased their propensity to utilize the service system (Suh et al., 2017; Tobon et al., 2020). Additionally, giving consumers a choice in gamified service systems boosted their perception of their independence, which raised their inclination to utilize the service (Zainuddin et al., 2020; Xu et al., 2022). The use of gamification can lead to certain behaviors, such as better learning outcomes or more knowledge (Lee, 2019). Gamification has been shown to have behavioral effects on users' pro-social behavior and continued service usage (Hamari & Koivisto, 2015a; 2015b; Harwood & Garry, 2015; Rai & Beck, 2017; Mulcahy et al., 2020; Whittaker et al., 2021). In this situation, service system non-users can experience the same consequences and motivator sources. To increase the behavioral intention of non-users to use a service system, it may be more beneficial to offer clear feedback and possibilities for competition and choice:

H_5: Gamification influences service system non-users' behavioral intention in a positive and significant way.

2.5. Gamification as a Mediator

Users' perceptions of other users' perceptions of the service's use are likely to be reflected in their social influence. By receiving "likes" and "comments," individuals can receive feedback on how well they live up to the expectations of other users (Hamari & Koivisto, 2013). Gamification is an effective technique for modifying the link between social influence and behavioral intentions by enhancing non-users' perceptions of behavioral control. Consumers are more inclined to engage in behavior when they believe that they have greater control over it. By increasing task transparency and providing users with visible feedback on progress, gamification components, such as points, badges, and leaderboards, can boost users' perceptions of behavioral control (Hamari, 2017; Alhammad & Moreno, 2020). Gamification may boost consumer motivation and engagement by encouraging social interaction between users and non-users. By enhancing the behavioral control, motivation, and social connections of service system non-users, gamification can serve as a mediator between social influence and behavioral intentions:

H_6: Gamification has a mediating role between social influence and behavioral intention.

The experience is made more enjoyable and engaging in game design components, such as challenges and prizes, which can motivate users to interact with the service system (Liu et al., 2011; Xu et al., 2013). When a service system incorporates gamification, consumers are encouraged to buy more services, which increases their behavioral intent to keep using the system (Hamari & Koivisto, 2015b; Hsu & Chen, 2021). In conclusion, by encouraging a sense of exploration and discovery, gamification can serve as a mediator between consumer innovativeness and the behavioral intention of service system non-users:

H_7: Gamification has a mediating role between consumer innovativeness and behavioral intention.

3. Materials and Methods

In this study, a questionnaire was developed from the literature to test the hypotheses that examine the relationship between social influence, consumer innovativeness, gamification, and behavioral intention for service system non-users. The research dataset was collected from air passengers who used air transportation at least once and had no loyalty program membership.There were two sections in the questionnaire. The first segment contained questions created using a 5-point Likert scale to assess the study's components, while the second section contained inquiries meant to ascertain the participants'

demographic details. Reliable measures were chosen after a thorough literature study to verify that the construct in the questionnaire was content-valid. Additionally, academics and travelers examined the content of the questions.

The conceptual model of the study is shown in Figure 1.

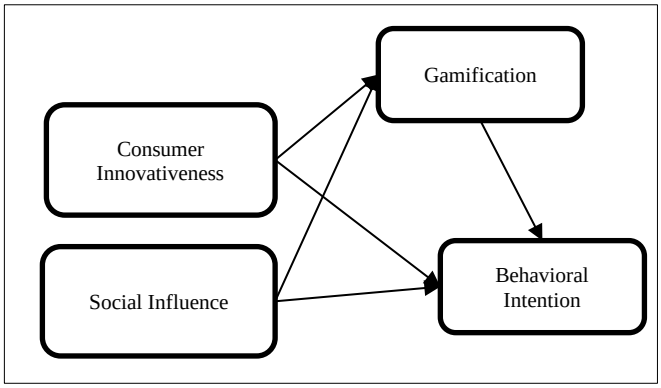


Figure 1. Conceptual Model

The questionnaire items were adapted from the literature:

- Social influence (3 items): Venkatesh et al., 2012,
- Consumer innovativeness (3 items); San Martín & Herrero, 2012,
- Gamification (3 items); Baptista & Oliveira, 2017,
- Behavioral intention (3 items); Venkatesh et al., 2012.

Data were gathered from an online survey of airline passengers from Turkey who had no loyalty program membership. The participants were primarily asked about their flight frequencies and airline preferences, and it was determined that they had previously performed at least one flight. For the next question, the target audience was assessed by asking whether they had any airline loyalty program membership. IP limitation was used to stop participants from completing numerous questions on the same computer. In total, there were 172 returns. There were 126 questionnaires left after incomplete and coherent questionnaires were removed for processing.

Participants' demographic statistics (gender, age, education, occupation, airline travel frequency, and airline choice) are presented in Table 1.

By clearly defining scale items, keeping questions short, labeling each point on the response scale to remove any potential for ambiguity, and using both positively and negatively worded measures to account for acquiescence and dis-acquiescence biases, procedural remedies were used to improve the scale items. Harman's single-factor methodology was applied to assess common method bias. The cut-off point for using Harman's single-factor test was that 50% of the variation was explained by the biggest factor (Podsakoff et al., 2003). All the scales that comprised the elements of the measurement model were compelled to create a single dimension using factor analysis (R^2=33,2%). The application of a one-factor solution demonstrated a lack of a common method bias (Arica et. al., 2022). The relationships between the variables in the study model were examined using the PLS-SEM approach (Ringle et al., 2015). Reliability was assessed using composite reliability (CR), Cronbach's alpha, and rho A. For these, a cutoff value of 0.7. Expectation constructions are a sub-item of the consumer innovativeness variable. "I am often the first to try new services among the people around me." was removed because the factor loading was lower (Table 2).

Table 1. Participants Demographic Statistics

	F	%		F	%
Gender			**Occupation**		
Male	60	48	Public	26	20.6
Female	66	52	Private	11	8.7
Total	126	100	Student	84	66.7
Age			Other	5	4.0
18-25	83	65.9	Total	126	100
26-32	18	14.3	**Travel Frequency**		
33-40	14	11.1	Once a Year	49	38.9
41-48	4	3.2	>2 times a year	53	42.1
>over 49	7	5.6	Once a month	4	3.2
Total	126	100	>2 times a month	2	1.6
Education			Once a week	18	14.3
Associate	33	26.2	Total	126	100
Bachelor's	78	61.9	**Airline Choice**		
Master	7	5.6	THY	73	57.9
PhD	8	6.3	Pegasus	29	23.0
Total	126	100	SunExpress	10	7.9
			AnadoluJet	14	11.1
			Total	126	100

Table 2. Measurement model statistics

Construct	Items	Loadings	α	rho_A	CR	AVE
Consumer Innovativeness	CIN1	0,874	.864	.864	.864	.761
	CIN2	0,871				
Social Influence	SOI1	0,865	.857	.860	.857	.668
	SOI2	0,822				
	SOI3	0,761				
Gamification	GAM1	0,831	.821	.850	.830	.624
	GAM2	0,627				
	GAM3	0,888				
Behavioral Intention	BI1	0,824	.914	.917	.914	.779
	BI2	0,881				
	BI3	0,940				

The average variance extracted (AVE) with a threshold of 0.5 explains convergent validity (Hair et al., 2014). By examining the heterotrait-monotrait ratio (HTMT), which has been referred to as a prognosis for factor correlations, discriminant validity is evaluated. According to Monte Carlo simulations conducted by Voorhees et al. (2016), HTMT outperforms more conventional measures of discriminant validity, and its value should be below the threshold of 0,9 (Henseler et al., 2015). Discriminant validity was guaranteed by all HTMT ratios (Table 3).

Table 3. Heterotrait-Monotrait Ratio (HTMT)

	Behavioral Intention	Gamification	Social Influence
Gamification	0.731		
Social Influence	0.700	0.666	
Consumer Innovativeness	0.520	0.670	0.459

4.2. Hypothesis Testing

Gamification, social impact, and consumer innovativeness variables all had variance inflation factor (VIF) values below the cut-off of 5. (Hair et al., 2017). As a result, Table 4 does not achieve the threshold level of the predictor constructs.

Table 4. Inner VIF values of the structural model

	Gamification	Behavioral Intention
Behavioral Intention		-----
Gamification	-----	2.588
Social Influence	1.267	1.811
Consumer Innovativeness	1.267	1.811

Following factor analysis and goodness of fit testing, the path coefficient with 5000 bootstrapping was used to examine the direct and indirect effects in the structural model. The direct and indirect effects of consumer innovativeness and social influence on behavioral intention via gamification are presented in Table 5.

Mediation takes place when a third mediator variable steps between two related constructs. Changes in the exogenous construct in the PLS path model result in changes in the mediator variable, which then result in changes in the endogenous construct. Therefore, a mediator variable controls the connection between the two constructs (Hair et al. 2017). A bootstrapping process of the particular indirect effects was used to examine the mediating impact of gamification on the relationship between consumer innovativeness and behavioral intention and social influence and behavioral intention. This was done in accordance with the method provided by Zhao et al. (2010) for identifying mediation effects.

The direct effects of consumer innovativeness (H_1; β=0.457, $p<0.001$), and social influence (H_3; β=0.458, $p<0.001$) on gamification were also significant and positive. While the direct effect of social influence (H_2; β= 0.389, $p<0.05$) on gamification were significant and positive, the relationship between consumer innovativeness on behavioral intention wasn't significant (H_4; β= 0.059, $p>0.05$). The direct effect of gamification (H_5; β= 0.415, $p<0.05$) on behavioral intention was significant and positive. Subsequently, the indirect effect of consumer innovativeness on behavioral intention through gamification is also positive and significant (H_7; β= 0.197, $p <0.05$). However, gamification had no mediation effect between social and behavioral intention relationships (H_6: β= 0.196, $p>0.005$). The results are presented in Table 5. The indirect effect of the gamification variable indicated that, the relational effect between consumer innovativeness and behavioral intention stems partially from the direct effect and partially from the indirect effect. This means that the gamification variable mediates the relationship between innovativeness and behavioral intention of consumers. Therefore, H_7 hypothesis is supported, but H_6 hypothesis isn't.

The structural model of the study is shown in Figure 2.

Table 5. Direct and indirect effects and hypothesis tests

Paths	Paths Coef.	STDEV	t Stats	f^2	p Val.	Conclusion
Social Influence -> Gamification (H_1)	0.457	0.112	4.086	0.266	0.000	Supported
Social Influence -> Behavioral Intention (H_2)	0.389	0.053	2.513	0.195	0.012	Supported
Consumer Innovativeness -> Gamification (H_3)	0.458	0.055	4.115	0.269	0.000	Supported
Consumer Innovativeness -> Behavioral Intention (H_4)	0.059	0.054	0.447	0.016	0.655	Not supported
Gamification -> Behavioral Intention (H_5)	0.415	0.049	2.401	0.141	0.017	Supported
Social Influence-> Gamification->Behavioral Intention (H_6)	0.196	0.104	1.833		0.067	Not supported
Consumer Innovativeness -> Gamification->Behavioral Intention (H_7)	0.191	0.090	2.123		0.034	Supported
$R^2_{Gamification}$=0.461; $R^2_{Behavioral\ Intention}$=0.503						

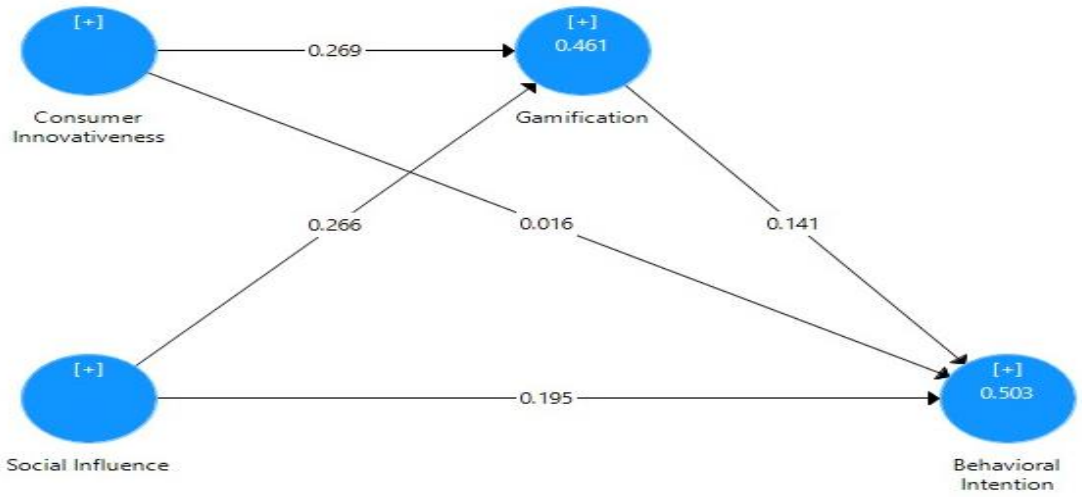


Figure 2. Structural Model

4. Conclusion

In this research, the relationships between service system non-users' behavioral intention to use the systems, and social influence, consumer innovativeness, and gamification have been analyzed within the context of airline passengers who did not have any membership in airline loyalty programs. Four different results were obtained within the context of this investigation.

First, the relationship between gamification and social influence and consumer innovativeness was tested. The analyses showed that social influence and consumer innovativeness affect the effectiveness of the gamification process for non-users. Based on social influence, those who do not utilize a service system or have not yet integrated it may be affected by the actions and attitudes of people who use the system, even in the absence of concrete benefits. As mentioned in the literature, social influence also contributes to non-users' experience of service systems by contributing to the operation of mechanics, which speeds up the processes of communicating the norms within the service systems to other community members and sharing and accepting them through game mechanics (Hamari & Eranti, 2011; Hamari & Koivisto, 2015a). Gamification practices, which lead to an increase in social interactions in the context of service systems, support value co-creation processes by enabling new members to participate in the system (Hamari & Koivisto, 2015a; Sesliokuyucu & Polat, 2021). On the other hand, consumer innovativeness enables people to identify and fulfill their needs and wants, match their activities with their beliefs, feel competent and independent, and interact with others. When exposed to novel sensations, experiences, messages, or things in their environment, consumers' cognitive and decision-making processes respond differently depending on how innovative the service is (San Martín & Herrero, 2012; Arica et al., 2022). It is a significant predictor of unplanned purchases (Floh & Madlberger, 2013; Yu et al., 2022). Consumers who are not innovators are more cautious and goal-focused when selecting new services than innovator consumers. Because they are aware of potential drawbacks and the loss that might follow from service risk, prevention-focused customers tend to avoid the risks connected with a service and its new qualities (Crowe & Higgins, 1997; Jin, 2016). As a result, consumer innovativeness could affect gamification process adoption and reduce the perceived risk of service system non-users while simultaneously raising their goal-focused behavior for the gamified service.

Second, the findings reveal that while social influence significantly affects behavioral intention, consumer

innovativeness does not. Social influence could be an effective tool to increase non-users of service systems' behavioral intention by affecting social comparison, and social validation. If consumers think that one or more significant referents agree that they should, then they can engage in a certain action (Yang et al., 2017). Consumers who have not yet used the service system can adopt new service systems by referencing close environments, and thus, the likelihood of non-users becoming regular users of the service system. Based on the literature another important and effective tool for behavioral intention is consumer innovativeness (e.g., Kim et al., 2017; Kamboj & Sharma, 2022). However, in this study consumer innovativeness had no significant effect on service system non-users' behavioral intentions. Depending on the service system's unique environment, the significance of consumer innovation may change. Consumer innovation may be less significant than practical factors in shaping behavioral intention in the case of service systems that are necessary for everyday living, such as transportation or healthcare. Except for customer innovativeness, other characteristics may be more significant predictors of behavioral intention among non-users. For instance, the determination of behavioral intention may be more significantly influenced by personal traits like age, wealth, and education. Since the service system is customized to the requirements and interests of the target audience, consumer innovativeness may not be a significant component in identifying behavioral intention in some service systems, such as an app created for older people.

Third, gamification has the potential to affect consumers' behavioral intention to utilize a service in the future or how likely they are to do so. The findings showed that gamification has a significant effect on the behavioral intentions of service system non-users. This result is in agreement with those of previous studies (García-Jurado et al., 2018; Uhm et al., 2022). Incorporating aspects such as feedback, competition, and choice can improve customer demand (autonomy, competence, and relatedness) and boost consumers' behavioral intention to use a service system. Consumers' perceptions of competence and relatedness were dramatically increased by gamification components, such as feedback and competition, which enhanced their propensity to utilize the service system. Additionally, giving customers a choice in gamified service systems boosted their perception of their own independence, which raised their inclination to utilize the service.

Finally, the study examined the mediating effect of gamification on the relationship between social influence and behavioral intention, consumer innovativeness, and behavioral intention. As a result, while the results showed that gamification mediates the relationship between service system non-users' consumer innovativeness and behavioral intention, it has no mediating effect on the relationship between social influence and behavioral intention. Gamification mediates the relationship between consumer innovativeness and behavioral intention by increasing non-users' motivation to engage in the service system. Challenges and incentives are examples of game design components that may enhance experience and motivate consumers to interact with the service system. Additionally, gamification can boost perceptions of behavioral control, which, in turn might affect behavioral intentions. By allowing consumers explicit feedback on their progress and increasing task transparency, game design components like points, badges, and leaderboards can improve users' perceptions of their ability to manage their behavior. Users are more inclined to engage in an activity when they believe that they have greater control over it (Hamari & Koivisto, 2015b; Hsu & Chen, 2021). In addition, gamification can mediate the relationship between social influence and behavioral intention in the presence of social interactions. However, the results showed that gamification had no mediating effect on this relationship. This result can be explained by the service system used in the study. These conclusions might be attributed to the fact that airline loyalty programs, such as leaderboards, are often created on an individual basis and do not include gamification aspects for comparison. Although social influence has a direct impact on gamification and intention to use, it is projected that because gamification procedures are not employed more efficiently, gamification does not mediate the link between social influence and behavioral intention. Loyalty programs permit more social benchmarking, which may help include most consumers in the airline service system.

This study's results have several practical implications. Gamification can significantly increase new passenger engagement, resulting in the inclusion of new consumer profiles. Managers can use this to increase their market share, bring in more revenue, and retain existing customers. Additionally, managers should concentrate on offering creative and entertaining gamification strategies to clients to influence their intentions to use the service favorably, as gamification mediates the relationship between consumer innovativeness and behavioral intention. They should also use social influence by enticing consumers to post about their gamification successes and experiences on social media to draw on new consumers and foster consumer loyalty. Integrating gamification techniques and social influence into the consumer service system can be a successful way to boost consumer engagement and loyalty and expand the market.

This study has several limitations. The major flaw of this research is that it only considers gamification from the standpoint of airline loyalty programs. The outcomes of various service systems may differ. In contrast, this research assessed people who did not use the service system. Future research could assess the impact of gamification on both users and non-users. As the data for this study were gathered from Türkiye, more data collection is necessary to make comparisons between various nations as well as to increase the scope of the sample in terms of age groups or cultural settings, which will help the findings be more broadly applicable. The results of this study were based on the information gathered through a survey. By adopting longitudinal and time-series research methods that provide further causal evidence, future research may supplement the findings of this investigation. Future research should use qualitative techniques to gain deeper insight and comprehension.

Ethical approval

The survey study was carried out with the approval number 2021/113-5 of Süleyman Demirel University Ethics Commission.

Conflicts of Interest

The author declares no conflicts of interest regarding the publication of this paper.

References

Abrahamse, W., & Steg, L. (2013). Social influence approaches to encourage resource conservation: A meta-

analysis. Global environmental change, 23(6), 1773-1785.

Ahn, Y. J., Kim, I., & Hyun, S. S. (2015). Critical in-flight and ground-service factors influencing brand prestige and relationships between brand prestige, well-being perceptions, and brand loyalty: First-class passengers. Journal of Travel & Tourism Marketing, 32(sup1), S114-S138.

Alhammad, M. M., & Moreno, A. M. (2020). Challenges of gamification in software process improvement. Journal of Software: Evolution and Process, 32(6), e2231.

Al-Jundi, S. A., Shuhaiber, A., & Augustine, R. (2019). Effect of consumer innovativeness on new product purchase intentions through learning process and perceived value. Cogent Business & Management, 6(1), 1698849.

Arica, R., Cobanoglu, C., Cakir, O., Corbaci, A., Hsu, M. J., & Della Corte, V. (2022). Travel experience sharing on social media: effects of the importance attached to content sharing and what factors inhibit and facilitate it. International Journal of Contemporary Hospitality Management. Vol. 34 No. 4, pp. 1566-1586.

Baptista, G., & Oliveira, T. (2017). Why so serious? Gamification impact in the acceptance of mobile banking services. Internet Research, 27(1), 118-139.

Baswani, S., Townsend, A. M., & Luse, A. (2021). Company-Sponsored Online Co-Creation and Financial Incentives: The Impact of Intrinsic Motivation on Participation Intention. International Journal of Electronic Commerce, 25(4), 394-415.

Chauhan, V., Yadav, R., & Choudhary, V. (2022). Adoption of electronic banking services in India: an extension of UTAUT2 model. Journal of Financial Services Marketing, 27(1), 27-40.

Crowe, E., & Higgins, E. T. (1997). Regulatory focus and strategic inclinations: Promotion and prevention in decision-making. Organizational behavior and human decision processes, 69(2), 117-132.

Dawi, N. M., & Jalil, N. A. (2019, November). Integrated model for smartwatch adoption. In Proceedings of the International Conference on Advanced Information Science and System (pp. 1-7).

Deterding, S., Dixon, D., Khaled, R., & Nacke, L. (2011, September). From game design elements to gamefulness: defining" gamification". In Proceedings of the 15th international academic MindTrek conference: Envisioning future media environments (pp. 9-15).

Douglas, B. D., & Brauer, M. (2021). Gamification to prevent climate change: A review of games and apps for sustainability. Current Opinion in Psychology, 42, 89-94.

Fischer-Preßler, D., Bonaretti, D., & Fischbach, K. (2022). A Protection-Motivation Perspective to Explain Intention to Use and Continue to Use Mobile Warning Systems. Business & Information Systems Engineering, 64(2), 167-182.

Floh, A., & Madlberger, M. (2013). The role of atmospheric cues in online impulse-buying behavior. Electronic Commerce Research and Applications, 12(6), 425-439.

Gagné, M., & Deci, E. L. (2005). Self-determination theory and work motivation. Journal of Organizational behavior, 26(4), 331-362.

García-Jurado, A., Castro-González, P., Torres-Jiménez, M., & Leal-Rodríguez, A. L. (2018). Evaluating the role of gamification and flow in e-consumers: millennials versus generation X. Kybernetes: The International Journal of Systems & Cybernetics, 48(6), 1278-1300.

Gómez, B. G., Arranz, A. G., & Cillán, J. G. (2006). The role of loyalty programs in behavioral and affective loyalty. Journal of Consumer Marketing, 387, 396.

Guo, Y., Peeta, S., Agrawal, S., & Benedyk, I. (2022). Impacts of Pokémon GO on route and mode choice decisions: exploring the potential for integrating augmented reality, gamification, and social components in mobile apps to influence travel decisions. Transportation, 49(2), 395-444.

Hair Jr, J. F., Sarstedt, M., Ringle, C. M., & Gudergan, S. P. (2017). Advanced issues in partial least squares structural equation modeling. saGe publications.

Hair, J. F., Gabriel, M., & Patel, V. (2014). AMOS covariance-based structural equation modeling (CB-SEM): Guidelines on its application as a marketing research tool. Brazilian Journal of Marketing, 13(2).

Hamari, J. (2017). Do badges increase user activity? A field experiment on the effects of gamification. Computers in human behavior, 71, 469-478.

Hamari, J., & Eranti, V. (2011, September). Framework for Designing and Evaluating Game Achievements. In Digra conference (Vol. 10, No. 1.224, p. 9966).

Hamari, J., & Koivisto, J. (2015a). "Working out for likes": An empirical study on social influence in exercise gamification. Computers in Human Behavior, 50, 333-347.

Hamari, J., & Koivisto, J. (2015b). Why do people use gamification services? International journal of information management, 35(4), 419-431.

Hamari, J., & Koivisto, J. (2013). Social motivations to use gamification: an empirical study of gamifying exercise. In Proceedings of the 21st European Conference on Information Systems (pp. 5-8).

Harwood, T., & Garry, T. (2015). An investigation into gamification as a customer engagement experience environment. Journal of Services Marketing, 29(6-7), 533-546.

Henseler, J., Ringle, C. M., & Sarstedt, M. (2015). A new criterion for assessing discriminant validity in variance-based structural equation modeling. Journal of the academy of marketing science, 43(1), 115-135.

Hsu, C. L., & Chen, M. C. (2021). Advocating recycling and encouraging environmentally friendly habits through gamification: An empirical investigation. Technology in Society, 66, 101621.

Hu, X., Chen, X., & Davison, R. M. (2019). Social support, source credibility, social influence, and impulsive purchase behavior in social commerce. International Journal of Electronic Commerce, 23(3), 297-327.

Japutra, A., & Hossain, M. I. (2021). Tourists' mindsets and choice of adventurous holiday activities. Current Issues in Tourism, 24(15), 2078-2087.

Jin, C. H. (2016). The effects of mental simulations, innovativeness on intention to adopt brand application. Computers in Human Behavior, 54, 682-690.

Kamboj, S., & Sharma, M. (2022). Social media adoption behaviour: Consumer innovativeness and participation intention. International Journal of Consumer Studies, 1–22.

Kaur, P., Dhir, A., Singh, N., Sahu, G., & Almotairi, M. (2020). An innovation resistance theory perspective on mobile

payment solutions. Journal of Retailing and Consumer Services, 55, 102059.

Kim, Y., Kim, S., & Rogol, E. (2017). The effects of consumer innovativeness on sport team applications acceptance and usage. Journal of Sport Management, 31(3), 241-255.

Koivisto, J., & Hamari, J. (2014). Demographic differences in perceived benefits from gamification. Computers in Human Behavior, 35, 179-188.

Lacey, R., & Sneath, J. Z. (2006). Customer loyalty programs: are they fair to consumers? Journal of consumer marketing, 23(7), 458-464.

Lee, B. C. (2019). The effect of gamification on psychological and behavioral outcomes: Implications for cruise tourism destinations. Sustainability, 11(11), 3002.

Leenheer, J., Van Heerde, H. J., Bijmolt, T. H., & Smidts, A. (2007). Do loyalty programs really enhance behavioral loyalty? An empirical analysis accounting for self-selecting members. International Journal of Research in Marketing, 24(1), 31-47.

Li, C. Y. (2013). Persuasive messages on information system acceptance: A theoretical extension of elaboration likelihood model and social influence theory. Computers in human behavior, 29(1), 264-275.

Lin, Y., Tudor-Sfetea, C., Siddiqui, S., Sherwani, Y., Ahmed, M., & Eisingerich, A. B. (2018). Effective behavioral changes through a digital mHealth app: Exploring the impact of hedonic well-being, psychological empowerment and inspiration. JMIR mHealth and uHealth, 6(6), e10024.

Liu, Y., Alexandrova, T., & Nakajima, T. (2011, December). Gamifying intelligent environments. In Proceedings of the 2011 international ACM workshop on Ubiquitous meta user interfaces (pp. 7-12).

Meyer-Waarden, L. (2008). The influence of loyalty programme membership on customer purchase behaviour. European Journal of Marketing, 42(1/2), 87-114.

Mulcahy, R., Russell-Bennett, R., & Iacobucci, D. (2020). Designing gamified apps for sustainable consumption: A field study. Journal of Business Research, 106, 377-387.

Novak, J., Melenhorst, M., Micheel, I., Pasini, C., Fraternali, P., & Rizzoli, A. E. (2018). Integrating behavioural change and gamified incentive modelling for stimulating water saving. Environmental Modelling & Software, 102, 120-137.

Osei-Frimpong, K. (2017). Patient participatory behaviours in healthcare service delivery: Self-determination theory (SDT) perspective. Journal of Service Theory and Practice.

Pasca, M. G., Renzi, M. F., Di Pietro, L., & Guglielmetti Mugion, R. (2021). Gamification in tourism and hospitality research in the era of digital platforms: a systematic literature review. Journal of Service Theory and Practice, 31(5), 691-737.

Pei-Shan, W., & Hsi-Peng, L. (2014). Why do people play mobile social games? An examination of network externalities and of uses and gratifications. Internet research: Electronic networking applications and policy, 24(3), 313-331.

Podsakoff, P. M., MacKenzie, S. B., Lee, J. Y., & Podsakoff, N. P. (2003). Common method biases in behavioral research: a critical review of the literature and recommended remedies. Journal of applied psychology, 88(5), 879.

Polat, İ. (2021). Value Co-Creation and Passenger Loyalty in the Context of the DART Model: The Mediating Role of Perceived Service Newness. Journal of Aviation, 5(2), 219-229.

Pramana, G., Parmanto, B., Lomas, J., Lindhiem, O., Kendall, P. C., & Silk, J. (2018). Using mobile health gamification to facilitate cognitive behavioral therapy skills practice in child anxiety treatment: open clinical trial. JMIR serious games, 6(2), e8902.

Rai, V., & Beck, A. L. (2017). Play and learn: Serious games in breaking informational barriers in residential solar energy adoption in the United States. Energy research & social science, 27, 70-77.

Richter, G., Raban, D. R., & Rafaeli, S. (2015). Studying gamification: The effect of rewards and incentives on motivation. In Gamification in education and business (pp. 21-46). Springer, Cham.

Ringle, C., Da Silva, D., & Bido, D. (2015). Structural equation modeling with the SmartPLS. Bido, D., da Silva, D., & Ringle, C.(2014). Structural Equation Modeling with the Smartpls. Brazilian Journal Of Marketing, 13(2).

Rodrigues, L. F., Oliveira, A., & Rodrigues, H. (2019). Main gamification concepts: a systematic mapping study. Heliyon, 5(7), e01993.

Ryan, R. M., & Deci, E. L. (2002). Overview of self-determination theory: An organismic dialectical perspective. Handbook of self-determination research, 2, 3-33.

San Martín, H., & Herrero, Á. (2012). Influence of the user's psychological factors on the online purchase intention in rural tourism: Integrating innovativeness to the UTAUT framework. Tourism management, 33(2), 341-350.

Santti, U., Happonen, A., & Auvinen, H. (2020, May). Digitalization boosted recycling: Gamification as an inspiration for young adults to do enhanced waste sorting. In AIP Conference Proceedings (Vol. 2233, No. 1, p. 050014). AIP Publishing LLC.

Sesliokuyucu, O. S., & Polat, İ. (2021). Hizmet Sistemlerinde Ortak Değer Yaratma: Hizmet Yeniliğinin Şekillendirilmesinde Oyunlaştırma. In: Dijital Dönüşümü İşletme Biliminin Gözlükleriyle Anlamak, Nobel Akademik Yayıncılık, 241-256.

Sheldon, K. M. (2005). Positive value change during college: Normative trends and individual differences. Journal of Research in Personality, 39(2), 209-223.

Singh, N., Misra, R., Singh, S., Rana, N. P., & Khorana, S. (2022). Assessing the factors that influence the adoption of healthcare wearables by the older population using an extended PMT model. Technology in Society, 71, 102126.

Standage, M., Duda, J. L., & Pensgaard, A. M. (2005). The effect of competitive outcome and task-involving, ego-involving, and cooperative structures on the psychological well-being of individuals engaged in a co-ordination task: A self-determination approach. Motivation and emotion, 29(1), 41-68.

Suh, A., Cheung, C. M., Ahuja, M., & Wagner, C. (2017). Gamification in the workplace: The central role of the aesthetic experience. Journal of Management Information Systems, 34(1), 268-305.

Suh, A., Wagner, C., & Liu, L. (2018). Enhancing user engagement through gamification. Journal of Computer Information Systems, 58(3), 204-213.

Tobon, S., Ruiz-Alba, J. L., & García-Madariaga, J. (2020). Gamification and online consumer decisions: is the game over? Decision Support Systems, 128, 113167.

Uhm, J. P., Kim, S., & Lee, H. W. (2022). Stimulating Suspense in Gamified Virtual Reality Sports: Effect on Flow, Fun, and Behavioral Intention. International Journal of Human–Computer Interaction, 1-13.

Venkatesh, V., Thong, J. Y., & Xu, X. (2012). Consumer acceptance and use of information technology: extending the unified theory of acceptance and use of technology. MIS quarterly, 157-178.

Voorhees, C. M., Brady, M. K., Calantone, R., & Ramirez, E. (2016). Discriminant validity testing in marketing: an analysis, causes for concern, and proposed remedies. Journal of the academy of marketing science, 44(1), 119-134.

Wanick, V., & Bui, H. (2019). Gamification in Management: a systematic review and research directions. International Journal of Serious Games, 6(2), 57-74.

Whittaker, L., Mulcahy, R., & Russell-Bennett, R. (2021). 'Go with the Flow'for Gamification and Sustainability Marketing. International Journal of Information Management, 61, 1-13.

Xiao, R., Wu, Z., Buruk, O. T., & Hamari, J. (2021). Enhance User Engagement using Gamified Internet of Things. Hawaii International Conference on System Sciences.

Xu, F., Weber, J., & Buhalis, D. (2013). Gamification in tourism. In Information and communication technologies in tourism 2014 (pp. 525-537). Springer, Cham.

Xu, L., Shi, H., Shen, M., Ni, Y., Zhang, X., Pang, Y., ... & Li, F. (2022). The Effects of mHealth-Based Gamification Interventions on Participation in Physical Activity: Systematic Review. JMIR mHealth and uHealth, 10(2), e27794.

Yang, Y., Asaad, Y., & Dwivedi, Y. (2017). Examining the impact of gamification on intention of engagement and brand attitude in the marketing context. Computers in Human Behavior, 73, 459-469.

Yu, C., Cheah, J. H., & Liu, Y. (2022). To stream or not to stream? Exploring factors influencing impulsive consumption through gastronomy livestreaming. International Journal of Contemporary Hospitality Management.

Zainuddin, Z., Chu, S. K. W., Shujahat, M., & Perera, C. J. (2020). The impact of gamification on learning and instruction: A systematic review of empirical evidence. Educational Research Review, 30, 100326.

Zhao, X., Lynch Jr, J. G., & Chen, Q. (2010). Reconsidering Baron and Kenny: Myths and truths about mediation analysis. Journal of consumer research, 37(2), 197-206.

Cite this article: Sesliokuyucu, O.S. (2023). Is Gamification Important for Service Systems Non-Users? A Study on Airline Loyalty Programs. Journal of Aviation, 7(1), 123-132.

7 (1): 133-140 (2023)

Journal of Aviation

https://dergipark.org.tr/en/pub/jav

e-ISSN 2587-1676

An Investigation on Hope and Life Satisfaction of Employees in the Aviation Sector in New Normal Era

Esra Zeynel[1*]

[1*]Isparta University of Applied Sciences, International Trade and Business Departmant, Isparta, Türkiye. (esrazeynel@isparta.edu.tr)

Article Info

Received: 29 January 2023
Revised: 19 February 2023
Accepted: 14 March 2023
Published Online: 03 March 2023

Keywords:
Aviation Sector
Hope
Life Satisfaction
New Normal Era
COVID-19 Pandemic

Corresponding Author: *Esra Zeynel*

RESEARCH ARTICLE

https://doi.org/10.30518/jav.1244041

Abstract

The aim of the study is to examine the level of hope and life satisfaction of the workforce negatively affected by the COVID-19 pandemic in the post-pandemic period and to measure the effect of hope on life satisfaction. This period, when the COVID-19 restrictions were lifted and individuals returned to the workplace, is described as the new normal era. It is wondered whether life satisfaction increases as the hope of the employees increases. Because hope is a driving force for individuals to reach their goals. There is a need to be hopeful in order to cope with challenges and uncertainty. Therefore, It is considered that the current study will provide contribution to organizational behaviour. In addition, it is predicted that the results of the hope and life satisfaction levels of aviation sector employees who have working challenges will give an idea to the sector managers. The research was carried out at three airports operating in Turkey. The data were obtained from 245 people working at these airports by means of a survey according to the convenience sampling method. The research is based on the quantitative data analysis method. According to the findings of the study, the hope and life satisfaction levels of aviation sector employees were above the average in the post-pandemic period. According to the correlational relationships, gender had a significant and negative relationship with life satisfaction and hope, respectively. While age had a significant and positive relationship with life satisfaction; age did not have a significant relationship with hope. Moreover, there was a significant and positive relationship between hope and life satisfaction and hope predicted life satisfaction significantly and positively.

1. Introduction

Hope and life satisfaction are associated with positive attitudes. Individuals who achieve their goals are happier (Snyder, 2002). Happy people may be more successful in business life, because they find working more enjoyable and are more willing to work. This positive attitude contributes to the increase of work performance and work efficiency. Therefore, the level of hope of employees is important for organizations. The Covid-19 pandemic reminded individuals of the concepts of risk and uncertainty. The World Health Organization defined the coronavirus outbreak on March 11, 2020 as a "COVID-19 Pandemic" (World Health Organization [WHO], 2020). Since then, governments have imposed restrictions in many areas. Due to the pandemic and restrictions, the health concerns of individuals, their distance from other people and the decrease in communication, major economic crises in businesses, changes in working systems have had negative effects. The changes brought about by the pandemic have led to stress, anxiety and depression (Luthans & Broad, 2022). Individuals' expectations for the future have decreased, and their power to cope with difficulties has decreased. Therefore, it has become more important than ever to be hopeful. In addition, being isolated from many things in life, being away from loved ones and being isolated, feeling of loneliness and not being able to go out reduced the enjoyment of life. With the decrease of the Covid-19 pandemic, several restrictions began to be lifted and individuals began to return to their normal working patterns. However, since the COVID-19 pandemic has had great effects on daily life, businesses and institutions in many countries in the world, it was thought that it was not possible to go back to the past completely and a new era had begun. This period has been called the "new normal". The aviation sector has been one of the sectors most affected by the pandemic. In this process, all stakeholders of the aviation industry and labour force in the aviation industry were adversely affected (International Air Transport Association [IATA], 2020). With the removal of restrictions in the post-pandemic period, the hope and life satisfaction levels of aviation workers are examined in the study. The data were collected from aviation workers measuring their perceptions of hope and life satisfaction. Levels of hope and life satisfaction were determined by analyzes. Also, regression analysis was performed to examine the effect of hope on life satisfaction during this period. In accordance with the expectations, it was concluded that hope affected life satisfaction in a meaningful

and positive way. Hope is an important driving force that enables individuals to strive to achieve their goals and to cope with difficulties. Snyder et al., (1991) defined the concept as "hope is a positive motivational state that is based on an interactively derived sense of successful (a) agency (goal-directed energy), and (b) pathways (planning to meet goals)" (Snyder, 2002). According to this definition hope is the perceived ability to acquire pathways to desired goals and to motivate oneself through thinking to use those pathways (Snyder, 2002).

These two basic elements that create hope have an important role in Snyder's theory. The first is the individual capacity to find successful ways to achieve goals. The other concept is the motivational factor, because it is important for individuals to be confident in identifying the right paths to achieve their goals (Snyder, 2002). The motivational factor in hope theory is the perception that one has the capacity to use one's own ways to achieve desired goals. Snyder defined this concept as "agent". Hopeful thinking reflects the belief that one can find paths to desired goals and be motivated to use those paths. Therefore, having high hopes plays an important role in coping with the difficulties faced by the employees in business life. Considering that the aviation industry has many challenges, it is important that aviation employees have a high level of hope. People with high hopes engage in self-talk like "I'll find a way to get this done!" They are also more flexible in finding new ways to achieve their goals. More importantly, they challenge and struggle more with problems (Snyder et al., 1998). Snyder's theory of hope is a cognitive theory. According to Snyder (2002), hope is primarily a way of thinking, but it is also a process in which emotions contribute significantly. Although emotions contribute, the basis of hope is thought.

The concept of hope is similar to several concepts. These concepts are optimism, self-efficacy, problem solving and self-esteem. However, these concepts have similarities as well as differences with hope. Gallagher & Lopez (2009) stated that hope and optimism are related to subjective well-being. Alarcon et al. (2013) conducted a meta-analysis stating that hope and optimism are more appropriate as two separate phenomena.

Hope is a subject of positive psychology. It has effects on human psychology. For example, it is positively associated with eustress, self-efficacy and its predictor of life satisfaction (O'Sullivan, 2011). In addition, hope is associated with subjective well-being, life satisfaction, career and career development, and job satisfaction (Luthans & Jensen, 2002; Juntunen & Wettersten, 2006). In addition, life satisfaction is a concept closely related to happiness. Happier people may tend to be more successful in various areas of life. Especially in workplaces where interpersonal interaction is important, life satisfaction and the accompanying positive attitude can affect performance and productivity. Duckworth et al. (2009) stated that teachers with higher life satisfaction have better performance in student achievement than their peers.

It is known that individuals with high hope levels also have high life satisfaction. It has been stated in the studies in the literature that hope and life satisfaction are related (O'Sullivan, 2011). Bronk et al. (2009) stated that, identified purpose subscale and the searching for purpose subscale were also significantly positively correlated with Satisfaction with life scale, the pathways subscale and the agency subscale. Oliver et al. (2017) proved that dispositional hope, perceived health, and social support were the strongest predictors of life satisfaction. Bailey et al. (2007) stated that the agency is the strongest predictor of life satisfaction. Accordingly, individuals' belief that goals can be achieved in general leads to greater well-being over belief in their ability to produce means to overcome obstacles. Also, as an important contribution, Littman-Ovadia & Raas-Rothschild (2018) found that life satisfaction for Airline pilots was most associated with character strengths such as hope, curiosity, pleasure, honesty and gratitude.

2. Materials and Methods

2.1. The Universe and Sample of the Research

The research was conducted at 3 airports operating in the provinces of Istanbul (2) and Izmir (1) in Turkey. The data of the research were obtained from the employees in the aviation sector according to the convenience sampling method between February 2022 and March 2022. There are many challenges in the aviation industry in terms of employees. In addition, it has been one of the most affected sectors both economically and in terms of the psychology of employees during the pandemic period. For this reason, the level of hope and life satisfaction of employees in this sector was examined in the period when the new normalization started right after the pandemic. In addition, the effect of hope on life satisfaction was investigated. 252 people participated in the research. 7 of the questionnaires were not included in the study, because they were answered incompletely. Therefore, data obtained from 245 individuals were included in the analysis.

2.2. Data Collection Tools and Analysis of Data

Research data were obtained for hope, life satisfaction, working shifts and demographic information in the post-pandemic period. For this purpose, measurement tools for all variables were brought together in a questionnaire form. The State Hope Scale, developed by Snyder et al. (1996) and validated in Turkish by Bekmezci et. al., (2021), was used in the study. The scale is an eight-point likert. In this study, it was used to as a five-point likert scale measure the participants' perceptions of hope (1 = absolutely false, 5 = absolutely true). The Life Satisfaction Scale developed by Diener et al. (1985) and validated in Turkish by Bekmezci & Mert (2018) was used. The scale is a seven-point likert. In this study, the statements in the Life Satisfaction Scale were measured with a five-point likert (1= strongly disagree, 5 = strongly agree) in the research. Detailed information about the characteristics of the scales is presented at the analysis stage. Permission was obtained from the researchers to use the Turkish scales

2.3. Research Model and Hypotheses

One of the main purposes of the research is to measure the hope and life satisfaction levels of those working in the aviation industry during the post-pandemic period also called the new normal. For this purpose, the averages of hope and life satisfaction were measured.

The second main aim of the research is to investigate the effect of hope on life satisfaction. However, in this effect model, gender and age were considered as control variables. For this reason, correlation analysis was performed first to see the relationships between the variables. Then, a regression analysis model was established between hope and life satisfaction, and firstly, gender and age were included in the model as control variables. For this purpose, a hierarchical

regression model was established. Therefore, the following hypotheses have been formed accordingly.

H1: There is a significant relationship between gender and life satisfaction.

H2: There is a significant relationship between age and life satisfaction.

H3: There is a significant relationship between hope and life satisfaction.

H4: Hope has a significant and positive effect on life satisfaction.

3. Result and Discussion

In this stage, the descriptive findings of the sociodemographic information of the participants, the levels of hope and life satisfaction, and the findings of the model based on the effect of hope on life satisfaction are presented. Analyzes were performed with SPSS 23.0 and AMOS 23.0 programs.

3.1. Descriptive Statistics

Research data were obtained from 245 participants. Participants were asked about gender, age, education, sector, department and their working shifts during the post-pandemic period. Descriptive analysis findings regarding this information are shown in Table 1.

Table 1. Descriptive Statistics of the Sociodemographic Variables

		N	%
Gender			
	Male	130	53.1
	Female	115	46.9
	Total	245	100.0
Age			
	19-24	54	22.0
	25-34	101	41.2
	35-44	68	27.8
	45-54	20	8.2
	55+	2	.8
	Total	245	100.0
Education			
	High School Graduate Degree	32	13.1
	Bachelor's Degree	163	66.5
	Master/Doctoral Degree	50	20.4
	Total	245	100.0
Department			
	Cabin Services	39	15.9
	Passenger Services	35	14.3
	Operation/Ground Services	77	31.4
	Aircraft Maintenance/Technical	71	29.0
	Human Resources	7	2.9
	Occupational health and Safety	8	3.3
	Purchasing/Administrative Affairs	2	.8
	Other	6	2.4
	Total	245	100.0
Sector			
	Public	28	11.4
	Special	217	88.6
	Total	245	100.0
Managerial Position			
	Non-manager	155	63.3
	Lower/middle level manager	70	28.6
	Top manager	20	8.2
	Total	245	100.0

According to the results, 53.1% of the participants were male and 46.9% were female. The majority of the participants were in the 25-30 age range (% 41,2). In terms of education, most of the participants were university graduates (% 66,5). 15.9% of the participants were in cabin services, 14.3% were in passenger services, 31.4% were in operations / ground

services, 29.0% were in aircraft maintenance / technique, 2.9% were in human resources department, 3.3% were in occupational health and safety, 0.8% were in purchasing and administrative affairs and 2.4% in the other group. 11.4% of the participants were in the public sector and 86.6% were in the private sector. 63.3% of the participants did not have a managerial position. 28.6% were in the lower and middle management group. 8.2% held a senior management position (Table 1).

Table 2. Working Shift in the Post Pandemic Era

Working Shift in the Post Pandemic Era	N	%
I was compulsorily working from home, I was working at the workplace before	4	1.6
I chose to work from home, I could work from my workplace if I wished	8	3.3
I work from home, I have worked from home for certain times before	4	1.6
I work from home, but I've already worked from home before	7	2.9
I work at workplace	222	90.6
Total	245	100.0

Participants were asked about their ways of working from the workplace or from home during the post-pandemic period. Accordingly, the answers given by the participants are as seen in the table below (Table 2). Most of the participants, 90.6% stated that they worked at the workplace during this period.

3.2. Measurement Validity

Structural equation measurement model analysis was performed to test the construct validity of the hope and life satisfaction scales. Amos 23.0 program was used for this analysis. Measurement validity results are shown with path diagram in Figure 1 and model fit indices in Table 3. Interpretation of the results is given below the table. The path diagram of the measurement model is shown above (Figure 1).

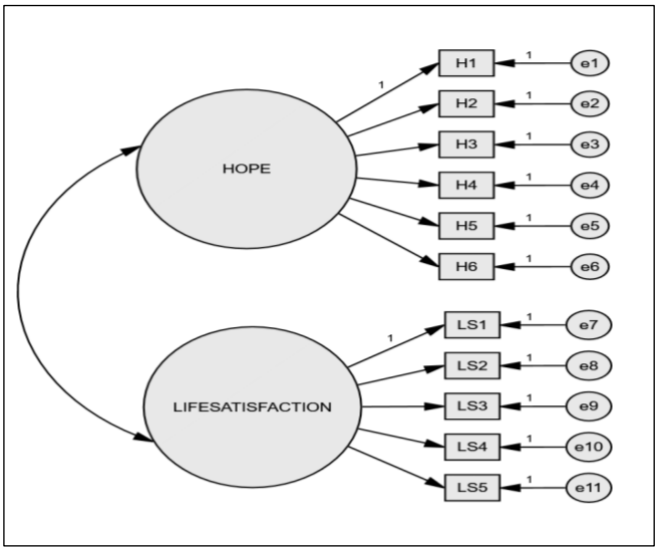


Figure 1. Path Diagram of the Measurement Model

Figure 1 shows the path diagram regarding the measurement validity of hope and life satisfaction variables. The measurement model is a model that tests the relationships between items representing hope and hope, the relationships between items representing life satisfaction and life satisfaction, as well as the relationship and validity between hope and life satisfaction. Hope consists of 6 items. It was validated that each item represents the hope dimension. The hope scale was originally two-dimensional, but in this study, it was aimed to include hope in the research as one-dimensional. Therefore, one-dimensional measurement validity was tested. Bekmezci et al. They tested hope as one-dimensional, first level and secondary level. They stated that the secondary level analysis had indicated better fit. However, they stated that the one-dimensional structure was also within acceptable limits. In this study, one-dimensional measurement validity was ensured. Life satisfaction consists of 5 items and has been validated unidimensionally.

Table 3. Model Fit Summary

	Observed Values of the Model	Goodness of Fit Indices	Acceptable Indices
p value	.000 (*p<.05)*	*p* >.05 (insignificant)	
χ^2 /df (CMIN/ df)	2.445 (105.142 /43)	χ^2 /df < 3	3 ≤ χ^2 /df < 5
GFI	.92	.95<GFI≤1.00	.90<GFI≤.95
AGFI	.89,1	.90<AGFI≤1.00	.85<AGFI≤.90
NFI	.93,4	.95<NFI≤1.00	.90<NFI ≤.95
CFI	.96	.95≤CFI≤ 1.00	.90<CFI<.95
RMSEA	.07,7	0≤RMSEA<.05	.05≤ RMSEA<.08
RMR	.05,5	< .05	.05≤ RMR<.08

CMIN (χ^2): Chi-squared test indicates the difference between observed and expected covariance matrices df: degree of freedom GFI: Goodness of fit index AGFI: Adjusted goodness of fit index NFI: Normed fit index CFI: Comparative fit index RMSEA: The root means square error of approximation RMR: Root means square residual

The Table 3 shows the goodness of fit indices of the model and the values of goodness of fit related to the findings of the study was created by the author. Tablo was created using the sources of Hair et al., 2010, Tabachnick & Fidell, 2007, Kline, 2011, Byrne, 2012. Chi-square (χ^2) is the most fundamental measure used to test the fit of the model (Hair et al., 2010). An appropriate model is expected to be meaningless (p > .05), but in large samples χ^2 is usually significant (p < .05) (Tabachnick & Fidell, 2007). The increase in sample size makes it difficult to find a meaningless p-value. The statistical test or the p-value obtained is less insignificant as the sample size increases or the number of observed variables increases (Hair et. al., 2010). Therefore, one of the proposed methods is the ratio of χ^2 to the degrees of freedom. A ratio of 3 or less is associated with models with good fit (Hair et al., 2010). In this study, the p value of χ2 is significant (43, N=245) = 105.142 *p* < .05, but χ2/df = 2.445 indicates good fit in the model. Therefore, the evaluation was continued with other indices. Along with chi-square, there are different indices to evaluate the goodness of fit of the model. The Goodness of fit index GFI is one of the first attempts to produce a fit statistic that is less sensitive to

sample size. GFI takes values between 0 and 1. The closer to 1 it represents a better fit. A value greater than .90 typically indicates a good fit (Hair et al., 2010). Adjusted goodness of fit index (AGFI) is the GFI value freed from the degrees of freedom (Yaşlıoğlu, 2017). In this study, GFI = 0.92 showed good fit, AGFI = .89,1 showed acceptable fit. The normed fit index (NFI) takes a value between 0 and 1, and a value of 1 represents the perfect model (Hair et. al., 2010). An NFI value greater than .95 in the model indicates good fit (Tabachnick & Fidell, 2007). In the study, NFI = .93 value was found within acceptable limits. Comparative fit index CFI is a widely used index. Although, CFI values above .90 was usually associated with good fit (Hair et.al., 2010), Hu & Bentler (1999) suggested that CFI values of .95 indicates a better fit (Byrne, 2012). However, Hu & Bentler (1999) stated that a CFI value of .95 and above with a SRMR value of .08 and below together indicate acceptable fit (Kline, 2011). CFI = .96 and RMR = .05,5 values in this study showed that the model had good fit. Also, the lower the Root mean square residual (RMR) and the Standardized root mean square residual (SRMR) values, the better the fit. High values are indicative of poor fit (Hair et. al., 2010). Generally, .08 and below are the desired values for RMR (Hu & Bentler, 1999, as cited in Tabachnick & Fidell, 2007). Low RMSEA values according to model degrees of freedom indicate good fit. Previous discussions were that this value should be .05 or .08 (Hair et. Al., 2010). MacCallum et al. 1996 stated that RMSEA values ranging from .08 to .10 showed mediocre fit, and those greater than .10 showed poor fit (Byrne, 2012). An important advantage of RMSEA is that a confidence interval can be created that gives the range of RMSEA values for a given confidence level. Thus, the RMSEA value can be reported as 95% good fit between .03 and .08 (Hair et. al., 2010). Moreover, the hope scale (α=89.8) and life satisfaction scale (α=87.5) were reliable.

Table 4. Path Coefficients

Paths			Coefficients		S.E.	p
			S.E.	U.E.		
Hope 6	<-	HOPE	.804	1.000		
Hope 5	<-	HOPE	.850	.927	.062	***
Hope 4	<-	HOPE	.753	.833	.065	***
Hope 3	<-	HOPE	.802	.964	.069	***
Hope 2	<-	HOPE	.726	.969	.079	***
Hope 1	<-	HOPE	.700	.873	.075	***
LF 5	<-	LF	.713	1.000		
LF 4	<-	LF	.739	.858	.080	***
LF 3	<-	LF	.773	.951	.084	***
LF 2	<-	LF	.796	.933	.081	***
LF 1	<-	LF	.794	.951	.082	***

Hope, LF = Life Satisfaction S.E. = Standardized Effects
U.E.=Unstandardized Effects ***p < .05

Table 4 shows the standardized path coefficients (factor loadings) for the relationships between the variables. As a result of the analysis, values were found to be significantly above .70 (p< .05). Findings on Hope showed that the lowest path coefficient was between item 1 and hope (.70), while the highest path coefficient was between item 5 and hope (.85). Findings on life satisfaction showed that the lowest path coefficient was between item 5 and life satisfaction (.71,3) while the highest path coefficient was between item 2 and life satisfaction (.79,6).

Table 5. Normality Test of Hope Data

	Statistic	S.E.
N	245	
Mean	3.8680	.05525
S.D	.86487	
Minimum	1.00	
Maximum	5.00	
Skewness	-.547	.156
Kurtosis	.087	.310
Normality Test of Life Satisfaction Data		
N	245	
Mean	3.4335	.05915
S.D.	.92578	
Minimum	1.00	
Maximum	5.00	
Skewness	-.350	.156
Kurtosis	-.197	.310

Table 5 shows the findings of the descriptive statistics. In order to evaluate whether the hope and life satisfaction data were in accordance with the normal distribution, skewness and kurtosis were controlled. It was observed that the data related to the variables were in accordance with the normal distribution (between +1.0, -1.0) (Gürbüz & Şahin, 2016).

Table 6. Descriptives of the Scale Items

Scale Item	N	Min.	Max.	Mean	S. E.
Hope					
If I should find myself in a jam, I could think of many ways to get out of it	245	1.00	5.00	3.877	1.102
At the present time, I am energetically pursuing my goals	245	1.00	5.00	3.812	1.179
There are lots of ways around any problem that I am facing now	245	1.00	5.00	3.849	1.062
Right now, I see myself as being successful	245	1.00	5.00	3.914	.977
I can think of many ways to reach my current goals	245	1.00	5.00	3.955	.963
At this time, I am meeting the goals that I have set for myself	245	1.00	5.00	3.800	1.099
Life Satisfaction					
In most ways my life is close to my ideal	245	1.00	5.00	3.640	1.102
The conditions of my life are excellent	245	1.00	5.00	3.330	1.079
I am satisfied with my life	245	1.00	5.00	3.608	1.131
So far I have gotten the important things I want in life.	245	1.00	5.00	3.534	1.069
If I could live my life over, I would change almost nothing.	245	1.00	5.00	3.053	1.290
Valid N (listwise)	245				

Before proceeding the relationship analysis, the descriptive values of the items measuring hope and life satisfaction were

examined. According to results, it was seen that the answers measuring the perception of hope had a higher mean than life satisfaction. It was seen that the items "Right now, I see myself as being successful" and "I can think of many ways to reach my current goals" that make up hope had higher scores than the others. It was observed that the item "If I could live my life over, I would change almost nothing" which measures the perception of life satisfaction, scored lower than the other items (Table 6).

3.2. Relational Analyzes

3.2.1. The Correlation Analysis

Correlation analysis was performed to measure the relationships between the variables. Correlation coefficients in Table 7.

Table 7. Correlation Coefficients

		1 (pearson korelasyon)	1 (sig.)	2 (pearson korelasyon)	2(sig.)
1	Life Satisfaction	1,000	.	.657**	.000
2	Hope	.657**	.000	1.000	.
3	Gender	-.247**	.000	-.109*	.045
4	Age	.307**	.000	.043	.253

**p<.01
*p<.05

There was a significant and positive correlation between life satisfaction and hope (r = .657, p<0.01). Since gender and age variables would be included as control variables in the regression analysis, the correlational relationship between these variables with life satisfaction and hope was also examined. Accordingly, there was a significant and negative relationship between gender's life satisfaction (r= -.247, p<.01) and hope (r= -.109, p<.05). There was a significant and positive relationship between age and life satisfaction (r= .309, p<.01). However, no significant relationship was found between age and hope.

3.2.2. The Regression Analysis

The effect of the level of hope of aviation workers on the level of life satisfaction was examined. Two models were created to determine to what extent hope explains life satisfaction when the gender and age of the employees are controlled.

Table 8. The Results of Hierarchical Regression Analysis

Model Summary										
Model	R	R^2	Ad.R^2	S. E.	Change Statistics					D.W
					R^2	F	df1	df2	Sig.	
1	.350	.122	.115	.8708	.122	16.86	2	242	.000	
2	.721	.520	.514	.6452	.398	199.81	1	241	.000	1.871

According to hierarchical regression analysis, Model 1 includes gender and age. In the second model, there is the hope variable together with the gender and age variables. The R^2 (R Square) value showed that the gender and age variables entered in the first model explained a 12.2% change in life satisfaction, which is the dependent variable. However, the independent variable hope in the second model explained a 51.4% change in life satisfaction. Therefore, it was observed that hope explained the variance in life satisfaction 39.8% more than gender and age. The significance of the model indicates how well the model explains the variance in life satisfaction. Accordingly, both regression models are statistically significant ($p < .05$). Hierarchical regression analysis results showed that the independent variables in the first model contributed significantly to the model (F = 16,863, $p < .05$). (F = 199,816, $p < .05$) (Table 8).

Table 9. Significance of the Model

Anova						
Model		**Sum of Squares**	**df**	**Mean Square**	**F**	**Sig.**
1	Regression	25.579	2	127.90	16.86	.000
	Residual	183.546	242	.758		
	Total	209.126	244			
2	Regression	108.778	3	36.25	87.08	.000
	Residual	100.347	241	.416		
	Total	209.126	244			

Table 9 shows the anova test results of hierarchical regression analysis in which life satisfaction is the dependent variable, age and gender are the independent variables in the model 1, and hope is the independent variable in the model 2. The model as a whole was significant according to the results of anova test (p = .000).

Tablo 10. Hierarchical Regression Coefficients

		B	S.E.	Beta	T	Sig.	Tolerance	VIF
1	(Constant)	3.323	.257		12.94	.000		
	Gender	-.323	.116	-.175	-2.78	.006	.922	1.084
	Age	.261	.063	.258	4.11	.000	.922	1.084
2	(Constant)	.534	.274		1.94	.053		
	Gender	-.200	.086	-.108	-2.31	.022	.913	1.095
	Age	.252	.047	.250	5.37	.000	.922	1.084
	Hope	.679	.048	.635	14.13	.000	.988	1.012

In the first group, gender (β= - .175, p < .05) and age (β= .258, p < .05), among the independent variables entered into the model, had a significant effect on life satisfaction. In the second model, the independent variables of gender (β= - .108, p < .05), age (β= .250, p < .05) and hope (β= .635, p < .05) had a significant effect on life satisfaction.

For multiple collinearity problems in the independent variables, VIF and Tolerance values were checked. The tolerance values were greater than the critical values [for Model 1, (1- 0.122 = 0.878)] and [for Model 2, (1- 0.520 = 0.480)]. There was no collinearity problem (Gürbüz & Şahin, 2016; 284) Life satisfaction= .534 - .10,8 (gender) + .25 (age) + .67,9 (hope).

4. Conclusion

In this study, the hope and life satisfaction levels of the employees in the aviation sector during the post-pandemic period, which is also referred to as the new normal, were examined and the effect of hope on life satisfaction was investigated. The new normal is a situation after a crisis, economic, social, and behavioral characteristics when differ from the situation that existed before the crisis began (Wikipedia, 2020). The term has been used in relation to the COVID-19 Pandemic. The average of the participants' perception of hope was at a high level (mean = 3.8, $p < .05$) and the average of the perception of life satisfaction was lower than hope, but moderate (mean = 3, $p < .05$). This level of hope after the pandemic may be due to the removal of restrictions and the return to normal business life. The anxiety and fear experienced during the pandemic period may have been replaced by the perception that not everything is bad. The opinions of the participants could be obtained by a qualitative interview on this subject, but since the study was a quantitative study in which data were obtained by the survey method, only averages were obtained.

Regression analysis on hope and life satisfaction consisted of two models. The R^2 (R Square) value showed that the gender and age variables entered in the first model explained a 12.2% change in life satisfaction, which is the dependent variable. In the first group, gender (β= - .175, $p < .05$) and age (β= .258, $p < .05$), among the independent variables entered into the model, had a significant effect on life satisfaction. However, the independent variable hope in the second model explained a 51.4% change in life satisfaction. Therefore, it was observed that hope explained the variance in life satisfaction 39.8% more than gender and age. The significance of the model indicates how well the model explains the variance in life satisfaction. Accordingly, both regression models are statistically significant (p < .05). Hierarchical regression analysis results showed that the independent variables in the first model contributed significantly to the model (F = 16,863, $p < .05$). (F = 199,816, $p < .05$). In the second model, the independent variables of gender (β= - .108, p < .05), age (β= .250, p < .05) and hope (β= .635, p < .05) had a significant effect on life satisfaction.

Hope empowers individuals to reach their goals and enables them to produce new ways. It also enables them to struggle with difficulty (Snyder, 2002). Therefore, it is important to be hopeful in order to deal with uncertainty. Hope strengthens having positive expectations for the future. Individuals need it. Especially after the worries, difficulties and uncertainties created by the pandemic in private and business life, employees need more positive thinking. Hope positively affects life satisfaction. This result obtained in this study is compatible with the literature (O'Sullivan, 2011; Bronk et al., 2009; Oliver et al., 2017; Bailey et al., 2007). Life satisfaction is related to happiness. Happy individuals are also more successful at work. Occupational motivation and performance will be high. Therefore, it is beneficial for the managers of the organization to consider the life satisfaction levels of the employees. For this reason, workplace behaviors and organizational policies should be arranged in such a way as to make positive contributions to the hope and life satisfaction levels of the employees. Employees should be given more reassurance. Help them cope with uncertainty. In this sense, organizational behavior issues such as organizational support and trust in the manager come to the fore in this regard. The aviation sector has been one of the sectors most affected by the pandemic. Economic losses, working from home and remotely, and various difficulties experienced by female employees should be taken into consideration. Job security for employees, measures against crises, women. Positive discrimination for employees is seen as policies that can be applied. In addition, since the aviation sector has the feature of international communication, it has created more concern about a global pandemic. For this reason, it will be an important approach to strengthen health policies, continue hygiene measures for employees and ensure this is sustainable. All these factors may affect the hope and life satisfaction of the employees in the aviation sector. The research has some limitations. The data were obtained by the survey method. This method reveals the results of participants' perceptions of attitudes. However, as a result of some findings, the reasons for the opinions

Ethical approval

Approved by the Ethics committee, with the decision of Isparta University of Applied Sciences Ethics Commission, dated 11.02.2022 and numbered 87/03.

Conflicts of Interest

The author declares that there is no conflict of interest regarding the publication of this paper.

References

Alarcon, G.M., Bowling, N.A., & Khazon, S. (2013). Great expectations: A meta-analytic examination of optimism and hope, Personality and Individual Differences, 54(7), 821–827.

Bailey, T.C., Eng, W., Frisch, M.B., & Snyder, C.R. (2007). Hope and optimism as related to life satisfaction. The Journal of Positive Psychology, 2(3), 168-175.

Bekmezci, M., Köksal, K. & Mert, İ.S. (2021). Durumluk umut ölçeğinin Türkçe uyarlaması: yaşam tatmini üzerine bir inceleme [Adaptation of the state hope scale: a study on life satisfaction]. Journal of Management and Economics Research, 19(2), 17-39.

Bekmezci, M. & Mert, İ.S. (2018). Yaşam tatmini ölçeğinin Türkçe geçerlilik ve güvenirlilik çalışması [Turkish validity and reliability study of life satisfaction scale]. Toros Üniversitesi İİSBF Sosyal Bilimler Dergisi, 5(8), 166-177.

Byrne, B.M. (2012). Structural equation modeling with mplus: Basic concepts, applications, and programming. Routledge, New York.

Cotton Bronk, K., Hill, P.L., Lapsley, D.K., Talib, T. L., & Finch, H. (2009). Purpose, hope, and life satisfaction in three age groups. The Journal of Positive Psychology, 4(6), 500-510.

Duckworth, A.L., Quinn, P.D., & Seligman, M.E.P. (2009). Positive predictors of teacher effectiveness. Journal of Positive Psychology, 4, 540-547.

Gallagher, M.W., & Lopez, S.J. (2009). Positive expectancies and mental health: Identifying the unique contributions of hope and optimism. The Journal of Positive Psychology, 4(6), 548-556.

Gürbüz, S. & Şahin, F. (2016). Sosyal bilimlerde araştırma yöntemleri, felsefe-yöntem-analiz (3. baskı). Seçkin Yayıncılık, Ankara.

Hair, J.F., Black, W.C., Babin, B.J, & Anderson, R.E. (2010). Multivariate Data Analysis (7th ed.). Pearson, New York.

International Air Transport Association (IATA). (2020, November). Annual review 2020. 76th Annual General Meeting.https://www.iata.org/contentassets/c81222d96c9a4e0bb4ff6ced0126f0bb/iata-annual-review-2020.pdf

Juntunen, C.L., & Wettersten, K.B. (2006). Work hope: Development and initial validation of a measure. Journal of Counseling Psychology, 53(1), 94–106.

Kline, R.B. (2011). Principles and practice of structural equation modeling (3rd ed.). Guilford Press, New York.

Littman - Ovadia, H., & Raas - Rothschild, E. (2018). Character strengths of airline pilots: explaining life and job satisfaction and predicting CRM performance. Psychology, 9(8), 2083-2102.

Luthans, F., & Jensen, S.M. (2002). Hope: A New Positive Strength for Human Resource Development. Human Resource Development Review, 1(3), 304-322.

Luthans, F., & Broad, J.D. (2022). Positive psychological capital to help combat the mental health fallout from the pandemic and VUCA environment. Organizational Dynamics, 51(2), 1-13.

Marques, S.C., Lopez, S.J. & Mitchell, J. (2013). The Role of Hope, Spirituality and Religious Practice in Adolescents' Life Satisfaction: Longitudinal Findings. Journal of Happiness Studies, 14, 251–261.

New Normal (2020, July). In Wikipedia. https://en.wikipedia.org/wiki/New_normal

Oliver, A., Tomas, J. M., & Montoro-Rodriguez, J. (2017). Dispositional hope and life satisfaction among older adults attending lifelong learning programs. Archives of Gerontology and Geriatrics, 72, 80-85.

O'Sullivan, G. (2011). The relationship between hope, stress, self-efficacy, and life satisfaction among undergraduates. Social Indicators Research, 101(1), 155-172.

Snyder, C.R. (2002). Hope theory: rainbows in the mind. Psychological Inquiry, 13(4), 249-275.

Snyder, C.R., Lapointe, A.B., Jeffrey Crowson, J., & Early, S. (1998). Preferences of high - and low-hope people for self-referential input. Cognition & Emotion, 12, 807–823.

Tabachnick, B.G., & Fidell, L.S. (2007). Using multivariate statistics (5th ed.). Pearson Education.

World Health Organization (WHO). (2020, March). Coronavirus disease (COVID-19) pandemic. https://www.who.int/europe/emergencies/situations/covid-19.

Yaşlıoğlu, M.M. (2017). Sosyal bilimlerde faktör analizi ve geçerlilik: Keşfedici ve doğrulayıcı faktör analizlerinin kullanılması [Factor analysis and validity in social sciences: Application of exploratory and confirmatory factor analyses]. İstanbul Üniversitesi İşletme Fakültesi Dergisi, 46, 74-85.

Cite this article: Zeynel, E. (2023). An Investigation on Hope and Life Satisfaction of Employees in the Aviation Sector in New Normal Era. Journal of Aviation, 7(1), 133-140.

7 (1): 141-146 (2023)

Journal of Aviation

https://dergipark.org.tr/en/pub/jav

e-ISSN 2587-1676

Understanding the Role of Corporate Social Responsibility on Internal Customer Satisfaction for Sustainable Business Strategy; A Qualitative Research in the Aviation Industry

Çiğdem Çağlar [1], Abdullah Türk [2*]

[1] İstanbul Gelişim University, Vocational School, Civil Aviation Cabin Services, İstanbul, Türkiye. (cboyacilar@gelisim.edu.tr)
[2*] İstanbul Bilgi University, Aviation Management Department, İstanbul, Türkiye. (abdullah.turk@bilgi.edu.tr)

Article Info

Received: 03 February 2023
Revised: 22 February 2023
Accepted: 27 February 2023
Published Online: 03 March 2023

Keywords:
Corporate Social Responsibility
Internal Customer Satisfaction
Aviation Management
Strategic Management
Sustainability

Corresponding Author: *Abdullah Türk*

RESEARCH ARTICLE

https://doi.org/10.30518/jav.1246801

Abstract

In industrial life, where competition is increasingly intense in the globalization process, the efforts of companies to gain an advantage differ. In the 21st century, where competition over economic output and growth and profitability alone does not make a difference, corporate social responsibility projects and strategies to compete by gaining social legitimacy comes to the fore. The inimitable aspect of Human Resources, which is the most valuable resource for a business, has led to the need for deep and different studies on the importance of internal customers. These early-recognizing businesses take measures to retain talented employees, making a difference in competition with internal resources. Social responsibilities, which are the responsibilities of organizations to their employees, their environment, and consumers, form the basis of competition and sustainable strategies today. Based on this basis, the research focusing on the role of corporate social responsibility projects on internal customer satisfaction in the aviation industry wants to reveal organization-based outputs. This qualitative research aims to open a social window to competitive advantage with corporate social responsibility strategies; It is concerned to create an important value to understand the role of the institutions that produce and manage sustainability projects that are sensitive to the environment and society. In this context, qualitative research was conducted with 24 middle and senior managers working at the management level of airline companies operating in Turkey. Within the scope of the research, 7 open-ended questions were asked. All collected data were analyzed using the Maxqda 20 program. Content analysis, which is one of the qualitative research methods, was used in the research and the connection relationship of the parts obtained as a result of the analysis was conveyed according to the direction of configuration.

1. Introduction

Under today's increasingly competitive conditions, businesses have to be a few steps ahead of their competitors and be different from their competitors with the competitive strategies they create by identifying new approaches. To achieve this differentiation, it should give importance to both the external stakeholders of the enterprise and the employees, who are the building blocks, namely its internal stakeholders. With the effect of globalization, people have become able to obtain information about businesses and social issues very quickly. Positive or negative news and feedback about the business are extremely important for the future of businesses. A business not only has responsibilities to society and the environment but also has responsibilities to all stakeholders it has direct and/or indirect relationships. Obligations to these stakeholders constitute the concept of corporate social responsibility. Today, it is known that it is an indispensable phenomenon for businesses to be successful in the long run. The hidden power of businesses is their employees. Labor has become the most important weapon to compete. It is an undeniable fact that the satisfaction of employees, in other words, internal customers, will be reflected in all operational processes in these competitive conditions. Businesses try to influence internal customers with the projects they do in interaction with the external environment.

In the conceptual framework of the study, corporate social responsibility and internal customer satisfaction were investigated. Then, the concept of corporate social responsibility in aviation enterprises was examined. With the MAXQDA qualitative analysis program in the methodology, it has been revealed how and how the employees of aviation enterprises are affected by the corporate social responsibility studies carried out in the institutions they work in.

2. Conceptual Framework

2.1. Corporate Social Responsibility

Today, businesses have become an indispensable element in society. Since it has become so important in all phases of our lives, businesses have to undertake some responsibilities for society (Dinçer, 2013, p. 186). With the effect of globalization, the expectations of external stakeholders have changed and businesses have had to keep up with these changes. In addition to the wishes of shareholders, customers, employees, and institutions, businesses have faced the fact that they are faced with environmental and social demands from a much broader perspective and have started to carry out their activities in this direction. (Sökmen, 2013, p. 340). From this point of view, besides their economic activities, businesses should strive for a better society and environment and fulfill their social responsibilities.

When considered in terms of strategic management, corporate social responsibility should add value to the organization and its brands as part of the business strategy in the long run. With this added value, corporate social responsibility should provide financial and moral returns to the company and thus lead the company to profitability. It has to support sustainable development in terms of both the society and all stakeholders with the improvement projects. This support can develop the concept of social responsibility in the enterprise (Aydede, 2007, p. 25). Corporate social responsibility is that the business takes into account the expectations of society voluntarily, not obligatory, and takes into account its stakeholders, such as the social and ecological environment, consumers, employees, and the state, in addition to its owners and shareholders, and attaches importance to human values beyond economic values (Yalman and Çonkar, 2020, p.402).

Businesses are a function of their environment. For this reason, businesses should regulate their relations with their environment to maintain the continuity and profitability of the business. While arranging these relations, the enterprise has some responsibilities toward its internal and external stakeholders.

Employees, also called internal customers, are the most basic stakeholders of businesses. In an environment where employees are unhappy, efficiency and success cannot be expected from anyone in the business. For this reason, the primary duty of a business should be to make its employees happy. To create a positive working environment for employees, to be equal in personnel selection, to ensure job security, to improve working conditions, to provide training and career opportunities to its employees, to apply for a fair wage and promotion, to inform employees about business activities and other employees, to give authority and responsibility, should allow them to express their opinions freely. The enterprise that fulfills these responsibilities will add qualified personnel to the enterprise, and thus, the personnel turnover rate will decrease in an enterprise with happy personnel (Bayraktaroğlu, İlter, and Tanyeri, 2009, p. 11).

2.2. Internal Customer

The reason for the existence of the enterprises is the customers and to use the competitive advantage, they must understand the demands and demands of the customers well and act accordingly (Torlak and Altunışık, 2012, p. 139). All individuals who benefit from a product or service, whether or not a certain price is paid, should be considered customers (Çolakoğlu and Gürdoğan, 2017, p. 25). For a business to be successful, it has to meet the needs, wants, and demands of its customers. Therefore, businesses attach importance to customer satisfaction and loyalty. (Cecily, 2022, p. 250)

Businesses have to sell the products or services they produce to maintain their continuity and profitability. The emergence of this buying behavior is directly related to the satisfaction of the customers. For this reason, businesses should be customer-oriented to ensure customer satisfaction, be closely interested in the interests and tastes of customers, and know what is valuable and important for customers. Businesses that determine the focal points of the customers and what the customer requests and demands are can satisfy the customers more (Türk, 2004, p. 274). The purpose of all personnel in the business is to produce products or services that will meet the demands of customers. The fact that everyone, from the owner of the business to the personnel at the lowest level of the business, performs their duties and responsibilities by establishing good communication is an indication that they serve this purpose. These personnel, who are in contact with each other within the enterprise and fulfill their duties and responsibilities, are called internal customers (Taşkın, 2000, p. 23). Internal customers are people who have direct effects on the success or failure of businesses. Internal customers make a direct positive contribution to business success (Akdemir, 2014, p. 22).

The enterprises aim to increase the loyalty of these customers to the business by ensuring the happiness of their external customers, thus increasing their profits, but while doing this, they have to get the maximum support of the employees. The happiness of the employees will be reflected in the business as profit. For this, it is necessary to try to find ways to make the employees happy (Nakip and Çoban, 2007, p. 209).

2.3. Internal Customer Satisfaction

The most important source of information for businesses to continue their activities is the employees of the business. Employees who have elbow contact with the customer in all processes of marketing have a lot of information about the customer and they are much more successful than the management staff of the business in knowing the customer well (Acuner, 2001, p. 62). While evaluating in this context, the employees of the enterprise should be benefited and they should be made to feel that they have an important role in ensuring the continuity of the business. Just as a lost customer has huge costs for the business, each lost employee also causes huge costs for the business.

In internal customer satisfaction, there should be sincerity in the connections between employees and management. Intimacy should be ensured with the family atmosphere created in the working environment, all necessary information should be given to the employees in a timely and complete manner, there should be no walls between the managers and the employees, and environments, where they can talk about all kinds of problems, should be prepared. Employees should see themselves as members of the family and tend to share a problem that has gone wrong rather than hide it. Thus, employee satisfaction should be ensured (Toksarı, 2012, p. 166).

Internal customers are also highly affected by corporate social responsibility efforts. Employees who donate their time and talents with implemented responsibility projects are very happy with the benefits these projects provide for people and

the environment. Volunteering for the community and the support of the business encourages individuals to "contribute through their unique skills and creative abilities". This incentive positively affects employees who are internal customers. Employees' morale and motivation increase with these projects (Kotler and Nancy Lee, 2017, p. 171-172).

2.4. Corporate Social Responsibility in Aviation Businesses

The aviation industry is one of the fastest-growing industries in the world. With the advancement of aviation, the focus has changed as private airports have been built, and state-owned airports have also been privatized and become more commercial venues in line with increasing demand. Thus, it has created negative externalities. Due to this negative externality in the aviation sector, regulators have taken some precautions and created mechanisms at different levels. In addition, businesses have shaped their activities under the influence of regulators and corporate social responsibility (Corporate Social Responsibility and Environmental Management, 2006, p. 245).

Relationships between corporate social responsibility criteria in aviation enterprises are handled within the scope of 10 alternative programs (Journal Of Air Transport Management, 2008, p. 191):

- Fuel and resource efficiency,
- Environmental Protection,
- Security, transportation, and service process design,
- Financial transparency,
- Improvement of relations with employees and well-being of employees,
- Leisure activities with communities,
- Support for voluntary social work,
- Charitable offerings,
- Considering consumer interests and rights,
- Providing flights at reasonable and affordable prices.

With the help of corporate social responsibility in aviation enterprises, the reputation of the enterprise increases and they strengthen their appearance in the social environment. The corporate image of businesses increases. For example, with a corporate social responsibility project carried out by THY, it becomes a company that knows its responsibilities in the eyes of the public and has a reputation in society, which makes the company profitable, efficient, and superior to its competitors.

At the same time, they can manage risk management more clearly with the help of corporate social responsibility. Since Corporate Social Responsibility carries businesses to a more respected position in society, it is avoided to make a final judgment about the business in case of any risk, and it provides the business with time to manage the risk.

It leads to job satisfaction among employees. Working in businesses that have solid foundations and are respected by society is very important to employees.

It tries to define new market opportunities by encouraging innovation and creating a new perspective for the employees within the organization. It tries to help create more effective business processes and maintain competitive power.

3. Methods and Findings

In this study, a qualitative research technique was used as a research method. Although there are many definitions of qualitative research, the most general definition is; It is the holistic presentation of the data collected by techniques such as observation, interview, and document review. Qualitative research is a technique that gives very important results in social sciences despite its difficulties.

The nature of this technique is not based on statistical or empirical calculations (Brink, 1991). For this reason, as Sandelowski and Barroso (2002) stated since the epistemological diversity in qualitative methods is too wide to be represented by a single criterion, it is necessary to avoid looking for general criteria such as validity and reliability for qualitative research. Instead, it is recommended to evaluate the quality of each study separately with a more rhetorical approach. From this point of view, it can be concluded that the quality of qualitative research cannot be determined by following the "predicted formulas", therefore, good qualitative research depends on the scientific worldview and these preferences may change over time. Although measuring quality in qualitative research is a controversial issue, it does not seem possible to determine a precise criterion that increases quality in qualitative research (Arastaman et al., 2018). One of the main distinctions here is that quantitative research generalizes according to the positivist approach, while qualitative research focuses only on the qualitative characteristics of the group in which the research is conducted.

At this point, questioning the information produced is a technique in which the method cannot be singular and the finding and theory are independent of the method. The more productive and versatile social sciences facilitate efficient interaction and play a more active role in interdisciplinary research (Tanyaş, 2014, p. 11). The data obtained by the interview method in the research were made using the content analysis technique developed by Strauss and Corbin (1990). Thanks to the content analysis technique, the data were coded and separated into themes. The main subject in content analysis; is to select and categorize a small number of words that are critical for the subject out of a large number of words in the answers given to open-ended questions (Miles and Huberman, 2015, p. 58). Interview answers were reviewed in the MAXQDA Pro 2020 program. The purpose of using this program is to obtain systematic and meaningful results by putting the data obtained in the focus group interviews on a solid basis in the sample. The answers are made meaningful by establishing a connection between all the answers given. (Türk A., 2021, p. 31)

Interviews with employees working in airline companies operating in Turkey and management positions were transferred to the MAXQDA Pro 2020 Qualitative Data Analysis program. In line with the opinions of expert analysts, coding was done using the code key and the analysis was defined in the program. The interview results were arranged as texts and read in detail for coding, and the meanings of each interview text such as words, sentences, or paragraphs were analyzed and coded. As a result of the coding process, "Trust", "Organizational Reputation", "Organizational Socialization", "Support", "Participation", "Satisfaction" and "Organizational Justice" codes emerged. The resulting codes were analyzed in the MAXQDA program.

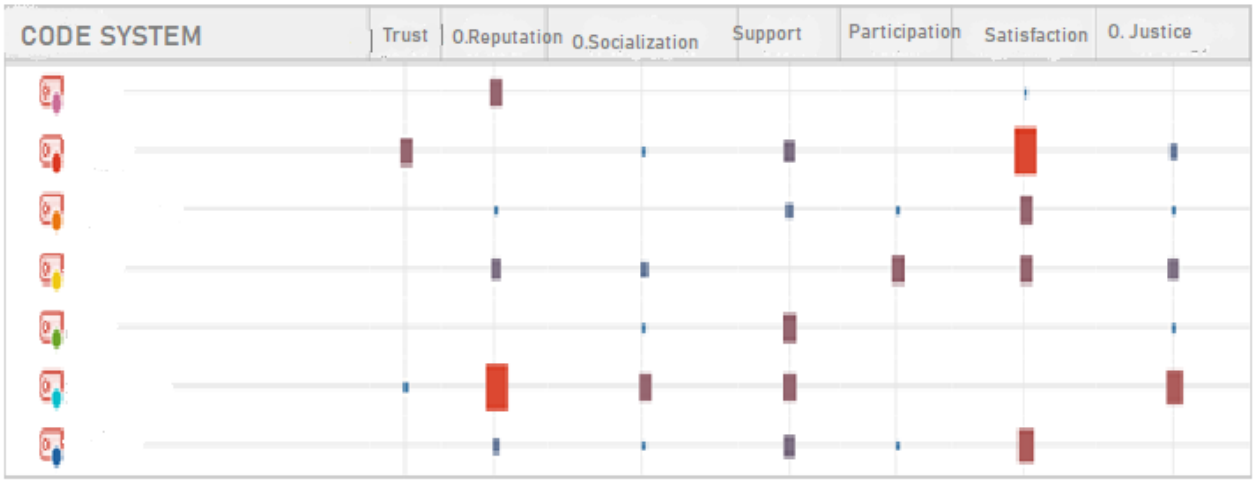


Figure 1. Code Relationships Scanner

To determine the relationship between the codes given through the MAXQDA 20 program, the frequency of the codes used together in the same sentence or paragraph was analyzed. As a result of the analysis, the matrix in Figure 1 was obtained. The interaction between the code relations scanner and different codes is quantitatively transferred. At this point, the aim is to interpret the relationship between the codes qualitatively and quantitatively. Relationship ties revealed the elements used by the airline managers included in the study in their evaluations. According to this matrix; "Organizational Reputation" and "Satisfaction" 20 times, "Organizational Justice" and "Satisfaction" 14 times, "Organizational Reputation" and "Trust" 11 times, "Organizational Socialization" and "Satisfaction" 11 times, "Support" and "Satisfaction" 11 times" 10 times, "Support" and "Participation" were used together 11 times, "Organizational Reputation" and "Support" 7 times. In this context, at the point of ensuring corporate social responsibility and internal customer satisfaction of airline managers operating in Turkey; It can be said that the fulfillment of the responsibilities of the institutions towards the environment and their stakeholders creates the organizational reputation when evaluated from an external perspective, and as a result, it can be said that the internal customers, namely the employees, are satisfied. It can be said that another factor that creates satisfaction in the internal customer is the fair attitude within the scope of corporate social responsibility premises. Another point is that the fulfillment of corporate social responsibility and external responsibilities can be said to be effective in creating satisfaction by creating the confidence that the institution will fulfill its responsibilities to its employees. In addition to these effective relations, the codes that are less in relation with each other in terms of effect; "Organizational Reputation" and "Organizational Socialization", "Trust" and "Satisfaction", "Organizational Socialization" and "Participation", "Organizational Justice" and "Participation".

Another data obtained with the MAXQDA program; was a code-based frequency analysis which is illustrated in Figure 2. Code-based frequency analysis; It is to show how much it emphasizes each code assigned to the answers quoted in the answer text. The response texts of the airline managers operating in Turkey were analyzed. When the data obtained from the research is examined, it has been determined that different rates are concentrated on 7 codes. It is seen that 92% of the people included in the research emphasize "Organizational Reputation", 88% "Satisfaction", 68% "Organizational Justice", 60% "Support" and 44% "Trust".

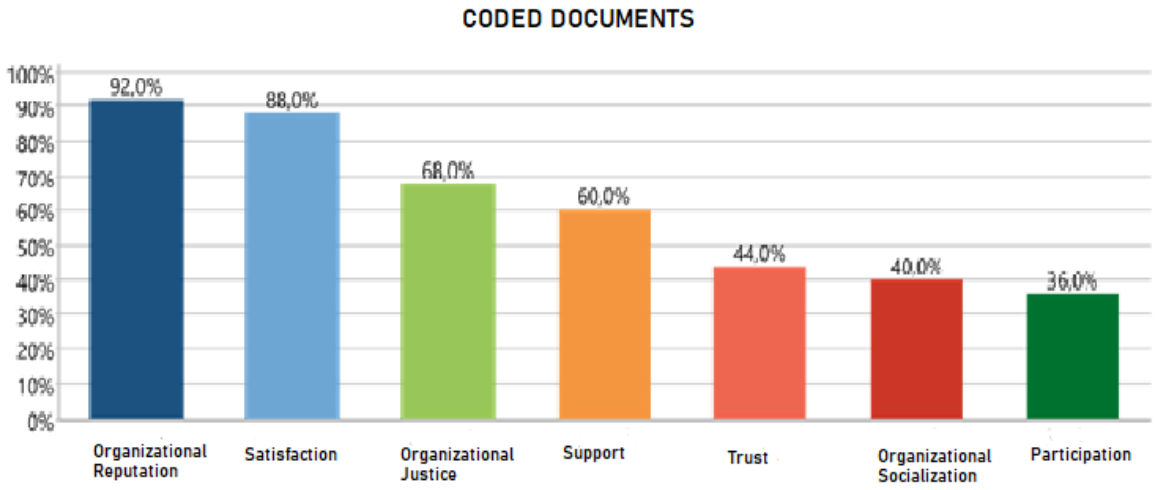


Figure 2. Code-Based Frequency Analysis

In addition, the most important feature of the analysis; can be said that it is to reveal the tricks of the work they are doing by making use of the expertise of the focus group employees with whom the interviews were conducted. With this perspective; It means that the key point in ensuring corporate social responsibility and internal customer satisfaction of airline managers is based on organizational reputation and satisfaction. Another data obtained as a result of the analysis made with the MAXQDA program; is a single case model analysis. The model is based on the evaluation of the answer texts obtained as a result of the interviews as a single text. In another saying; The aim is to reveal a single structured code relationship by evaluating the texts as a single source. In this context, all of the codes assigned while coding were evaluated as if they were obtained from a single text, and the general point of view of the interviewed group was revealed. While code-based frequency analysis evaluates each document one by one, the single case model is the evaluation of all documents. The single-case model is presented in Figure 3.

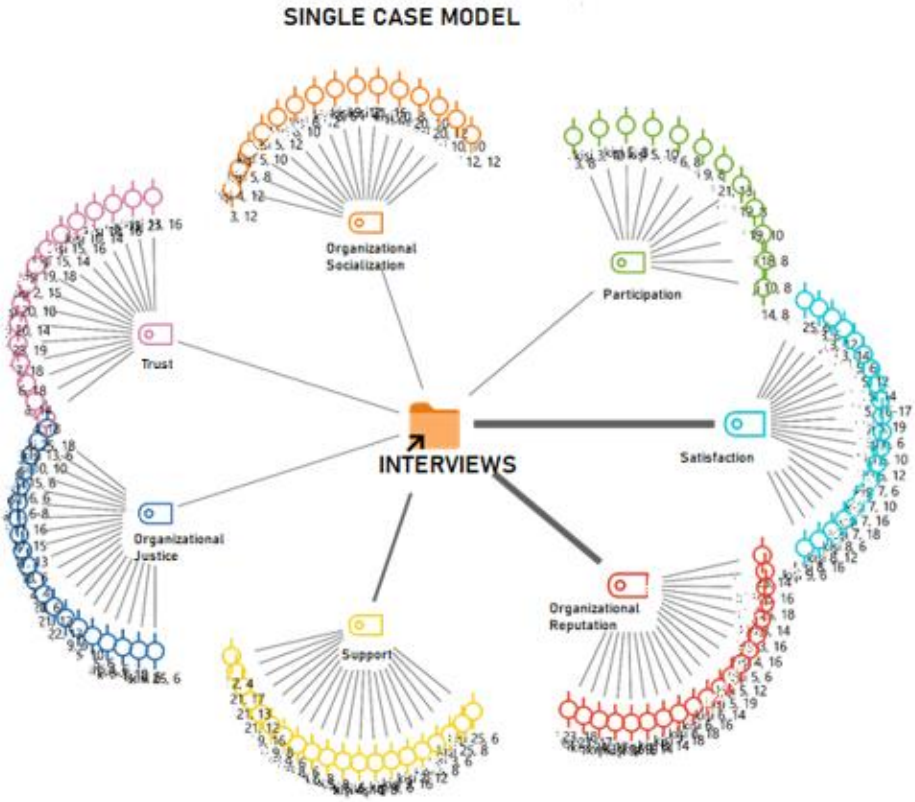


Figure 3. Single Case Model

Figure 4. Word Cloud

By creating a word cloud, the analysis of the relationship between corporate social responsibility and internal customer satisfaction was revealed with the most used words in the texts. The size and thickness of the words quoted in Figure 4 mean that the related words are used more frequently by the interviewed airline managers. In this context, while conveying the relationship between corporate social responsibility and internal customer satisfaction; It can be seen that factors such as employee satisfaction, corporate attitudes, and behaviors, responsibilities towards the environment and stakeholders, corporate reputation, communication, and support take place. This is the group interviewed; It supports that corporate social responsibility has an inclusive perspective of all elements included in its general responsibilities.

4. Conclusion

The fact that people are more sensitive and access information faster thanks to technology reveals that businesses should be more sensitive about their responsibilities. Under these conditions, developing and renewing the responsibility strategies of the enterprises is to understand the external and internal environment of the enterprise well and act accordingly. In this context, it is understood that corporate social responsibility provides positive benefits to businesses from both internal and external perspectives of their businesses to fulfill their legal responsibilities towards their customers, their environment, their employees, and their legal responsibilities. In the research, it has been determined that the fulfillment of the responsibilities of the enterprises will add value to the brand value and put the enterprises in a more successful position thanks to the image they will gain from both their internal and external environment. The first practical results of the research show that the level of "reputation", "respectability", which is the value that institutions see by their

external customers, has an important place in fulfilling their responsibilities.

The hidden power of businesses is their employees. Human, the most important building block of businesses, plays a key role in businesses. Of course, the company's reputation increase is also reflected in the internal customer. It is seen that the increase in satisfaction resulting from working in a valuable company from the outside is significant. The important role of labor in competition is even more vital in the aviation industry. It requires technical knowledge and skills, where it is difficult to find and maintain competent employees under competitive conditions. Therefore, businesses have to care about their employees, in other words, the satisfaction of their internal customers. The satisfaction of the internal customer is very important not only for the staff to stay in the company but also for the entire operation of the business.

Other practical results of this study; Employees believe that the business they work in is not just a mechanical place and that it is supported as a result of organizational socialization and that justice among employees will be ensured by participating in all business decisions make. As a result of this study; It is recommended that airline companies include their corporate social responsibility studies in their strategic plans and that other businesses in the aviation sector for the academic community contribute to the literature in understanding the importance of the subject by supporting them with quantitative data.

Ethical approval

This study protocol received ethical approval from the Istanbul Gelişim University's Ethics committee chairman, dated 09.09.2021 and numbered 2021-28.

Conflicts of Interest

The authors declare that there is no conflict of interest regarding the publication of this paper.

References

Acuner, T. V. (2001). Toplam Hizmet Kalitesi Yönetimi ve Müşteri Memnuniyetini Sağlamadaki Rolü. Pazarlama Dünyası, 61-64.

Akdemir, A. (2014). Yeni Ekonomide ve Yeni Dünyada İşletmecilik. Kocaeli: Umuttepe Yayınları.

Akım, F. (2004). Sağlık Alanında Gerçekleştirilen Sosyal Sorumluluk Kampanyalarının Bireyde Farkındalık ve Davranış Değişikliği Yaratma Etkisi:"Kalbini Sev Kırmızı Giy Kampanyası"Üzerine Bir Değerlendirme. İstanbul Üniversitesi İletişim Fakültesi Dergisi, 8.

Arastaman, G., Fidan, İ. Ö., & Fidan, T. (2018). Nitel araştırmada geçerlik ve güvenirlik: Kuramsal bir inceleme. Van Yüzüncü Yıl Üniversitesi Eğitim Fakültesi Dergisi, 15(1), 37-75.

Aydede, C. (2007). Yükselen Trend Kurumsal Sosyal Sorumluluk. İstanbul.

Bayraktaroğlu, G., İlter, B., ve Tanyeri, M. (2009). Kurumsal Sosyal Sorumluluk-Pazarlamada Yeni Bir Paradigmaya Doğru. İstanbul.

Brink, P. J. (1991). Issues of reliability and validity. In J. M. Morse (Ed.), Qualitative nursing research: A contemporary dialogue (pp. 164-186). Newbury Park, CA: Sage.

Cecily, S. (2022). Factors Influencing Customer Satisfaction as Well as Internal Processes: A Research Study. International Research Journal of Modernization in Engineering Technology and Science, 250-255

Corporate Social Responsibility and Environmental Management. (2006). Corporate Social Responsibility and Environmental Management Volume 13, issue 5, 245-260.

Çolakoğlu, O.E. ve Gürdoğan, A. (2017). Çağdaş Yönetim Teknikleri. Çağdaş Yönetim Teknikleri (s. 20-300). Ankara: Detay Yayıncılık.

Dinçer, Ö. (2013). Stratejik Yönetim ve İşletme Politikası. İstanbul: Beta Basım.

Journal Of Air Transport Management. (2008). Journal Of Air Transport Management Volume 14 ıssue 4, 188-196.

Kalder. (2020, 10 16). EFQM Mükemmellik Modeli. 11 11, 2011org tarihinde Kalder: http://www.kalder.org/efqm_mukemmellik_modeli

Kotler, P. and Lee N. (2017). Kurumsal Sosyal Sorumluluk. (S. Kaçamak, Çev.) İstanbul: Yaylacık Matbaa.

Maxqda. (2022, Haziran). Maxqda The Art Of Data Analysis. https://www.maxqda.com/ adresinden alındı

Miles, M.B. and Huberman, A.M. (2015). Nitel Veri Analizi. Ankara: Pegem Akademi Yayıncılık.

Nakip, M. ve Çoban, S. (2007). Yıldırma (Mobbing) olgusunun içsel pazarlama ile ilişkisi. Nevşehir' de bulunan bankalar örneği. Atatürk Üniversitesi İİBF Dergisi, 307-321.

Sökmen, A. (2013). Örgütsel Davranış. Ankara: Detay Yayıncılık.

Sandelowski, M., & Barroso, J. (2002). Reading qualitative studies. International Journal of Qualitative Methods, 1, (1), 74-108

Tanyaş, B. (2014, Nisan). Nitel Araştırma Yöntemlerine Giriş: Genel İlkeler ve Psikolojideki Uygulamalar. Eleştirel Psikoloji Bülteni.

Taşkın, E. (2000). Müşteri İlişkileri Eğitimi. İstanbul: Papatya Yayıncılık.

Toksarı, M. (2012). İçsel pazarlama uygulamaları bağlamında iç müşterinin çalıştığı işyerinden tatmin olma düzeyi ile demografik özellikleri arasındaki farkların tespitine yönelik bir çalışma. Erciyes Üniversitesi Sosyal Bilimler Enstitüsü, 155-183.

Torlak, Ö. ve Altunışık, R. (2012). Pazarlama Stratejileri. İstanbul: Beta.

Türk, M. (2004). Perakendeci İşletmelerde Personelin Fiziksel Özelliklerinin Müşteri. Fırat Üniversitesi Sosyal Bilimler Dergisi, 274-275.

Türk, A. (2018). Değişim ve Örgüt Kültürünün Çalışan Performansı ile İlişkisi: Sivil Havacılık Sektöründe Bir Uygulama. İstanbul.

Yalman, Y. ve Çonkar, M.K. (2020). Türkiye'de, İşletmelerin Çalişanlarina Yönelik Kurumsal Sosyal Sorumluluk Faaliyetlerinin Kurumsal İtibara Etkisi. Uluslararası Ekonomi, İşletme ve Politika Dergisi,383-408

Cite this article: Çağlar, Ç. ve Turk, A. (2023). Location selection criteria of air cargo firms and their importance levels: A case from Turkey. Journal of Aviation, 7(1), 141-146.

7 (1): 147-155 (2023)

Journal of Aviation

https://dergipark.org.tr/en/pub/jav

e-ISSN 2587-1676

The Aviation Sector from a Work Psychological Perspective: A Bibliometric Analysis of Graduate-Level Theses Written in Türkiye

Neşe Çakı[1*]

[1*]İstanbul University, Labor Economics and Industrial Relations Department, 34093, Fatih, İstanbul, Türkiye. (nese.caki@istanbul.edu.tr).

Article Info

Received: 22 January 2023
Revised: 20 February 2023
Accepted: 08 March 2023
Published Online: 09 March 2023

Keywords:
Aviation
National thesis center
Work pychology

Corresponding Author: *Neşe Çakı*

RESEARCH ARTICLE

https://doi.org/10.30518/jav.1240522

Abstract

When aviation studies from past to present are examined, it has been observed that human-oriented studies have increased gradually after it was determined that airplane accidents are caused by human error rather than technical problems. Because work psychology is a discipline that examines the attitudes and behaviors of employees in work life, includes issues related to theimprovement of current working conditions and the correction of negative conditions, and will contribute to the minimization of human errors, this research will examine the theses written within the scope of work psychology in the aviation sector by excluding the technical parts in theaviation field. For this purpose, in the National Thesis Center of the Council of Higher Education in Türkiye, between 2003 and 2023, some keywords related to the field were searched and it was determined in which years, on which subjects, where, about whom the research was conducted, and which type of research was used. As a result of the analysis, it has been determined that there has been a great interest in “human”-oriented studies in aviation in Türkiye in the last 20 years, but the number of theses has increased more than in the past after 2019, mostly in Beykent, Anadolu and Gelişim universities and social sciences institutes, and in business and civil aviation management departments, using quantitative research methods. Moreover, “organizational commitment”, “stress”, “burnout”, “communication” and “safety management” subjects were mostly studied at the master's level and “performance”, “organizational commitment”, “personality”, “competence” and “management style” were mostly studied at the doctoral level and the most studied sample group types were employees in the aviation sector generally as well as pilots.

1. Introduction

Airline is more preferred for passenger and cargo transportation as it is faster, more comfortable and safer than other transportation methods (Janic,2000). The development of technology and economy, the increase in international trade with the effect of globalization and the increase in tourism activities have positively affected the travel. These developments have led to the improvement of the aviation sector and the spread of scientific research on this subject. Although there is a lot of research at the national and international level in the field of aviation, "human"-oriented studies are based on a very recent past. The reason for such a tendency is that the technical equipment is stronger with the increasein technological opportunities, so human errors are highlighted as the cause of the plane crashes. The discipline of work psychology, which examines attitudes and behaviors in business life, is used inorder to reduce the human errors or to behave safely beforehand.

In this study, the theses written in the aviation sector with the perspective of work psychology in the national thesis center of the Council of Higher Education in Türkiye between 2003-2023 by scanning the concepts of "aviation", "flight", "cockpit", "pilot", "cabin crew", “air traffic” "aviation safety" were found. They were classified in terms of year of publication, university, institute, department, higher education level, sample group, type of research, and topics studied. The findings were turned into tables with numerical data.

In the first part of the study, the aviation sector was evaluated with a work psychological perspective in general. In the next part, the bibliometric analysis method was used, and the theses were classified by making a general within the framework of the determined concepts in the national thesis center. Finally, the findings were evaluated in the conclusion part.

2. Aviation Sector from a Work Psychological Perspective

People generally use air transport more frequently than other means of transport because it is fast, safe and comfortable. Therefore, the aviation sector, which has developed rapidly since the 20th century, has become a significant position in the transportation sector (Sun, 2019; Taşlıgil,1997). The sector is also very important for national economic growth and regional development by employment because the fast- growing, capital-intensive, and fragile structure (Tsiotas, Erdem and Çubukçu,2020). For instance, employment expectation in the global level is to reach approximately 100 million people in 2034 in the aviation sector. Türkiye has some opportunities in terms of civil aviation sector such as being a tourism country, geographical features and location, having a widespread air network throughout the country, having a young workforce potential and these affects national income and employment directly and indirectly (Macit and Macit,2017). As a matter of fact, according to Civil Aviation Annual Report, while approximately 65.000 employees were employed in the sector in 2003, this number reached 245.876 in 2020 (SHGM,2021). Around millions of people work in the aviation sector directly and indirectly such as airport operators, flight and cabin crews; executives; ground services, check-in, training, maintenance staff; engineers and designers of civil aircraft, engines and components; air traffic controllers; retail, car rental, customs and immigration, freight forwarders; catering and fuel suppliers; aircraft suppliers, manufacturers of goods sold in airports, and a variety of business support roles like call centers, IT and accountancy (ATAG,2023).

The aviation sector includes many different occupational groups, as well as there is little to no tolerance for mistakes due to the fact that even the smallest of mistakes could endanger the lives of personnel and passengers. The aviation system is a complex one and it is comprised of dimensions including the human, technological, organizational, and societal interactions (Høyland and Aase,2009). With the development of technology, the causes of civil and military flight crashes are "human" with a high rate of 70-80%, because while errors caused by technical problems have decreased radically in the last 40 years, human errors have decreased at a lower rate (Wiegmann and Shappell, 2001). Human mistakes can be divided into two types in aviation sector. One of the mistakes is that instructions for flight operations are deliberately not adhered to; another is related to the incorrect assessment of situations encountered suddenly during the flight and the decisions taken following the incorrect assessment. Both are very noticeable mistakes (Rezchikov et al.,2016) and such mistakes can be reduced by applying work psychology.

Today, pilots piloting large planes carrying hundreds of people and cabin crew must be evaluated in detail in terms of both the physical and psychological problems. Currently, instead of physical demands, mental and emotional demands have become prominent in work life for many employees (Jonge and Kompier,1997). As a result, work psychology has come to the fore to understand and predict the reasons for the thoughts, attitudes and behaviors of those working in the aviation sector. As a matter of fact, aviation psychology, which began with personality tests used by psychologists in selecting pilots for military service during the First World War, receives support from work psychology in order to improve the welfare of employees in aviation, reduce human-induced errors, and improve the performance of employees (Birsel, 2022; Kümbül Güler,2015). For the same purpose, Crew Resource Management (CRM) programs has been developed to provide the effective use of all resources, including human, knowledge, conditions, software and hardware inside and outside the plane, to conduct flight safely. Thanks to CRM skills (cognitive and interpersonal) such as problem identification, task prioritization, workload management, teamwork, communication, leadership; potential human errors that cause accidents are reduced (Terzioğlu,2010).

Moreover, work psychology topics such as employee attitudes and behaviors, relations between employees, cooperation, effective communication, teamwork, work-life balance, motivation, job satisfaction, anxiety, stress, burnout, bullying in the workplace, management and leadership styles, and so on, affect flight safety as they affect employees positively or negatively. In addition, although the rules about flight safety are clear and the senior management is primarily responsible, practical studies such as establishing and disseminating safety awareness in employees, determining risks, taking necessary precautions, as well as determining policies for these issues are within the discipline of work psychology (Birsel, 2022; Taşçıoğlu, 2018).

3. Analysis of Graduate Theses Written in the Aviation Sector from a Work Psychological Perspective at the Council of Higher Education National Thesis Center between 2003-2023

3.1. Purpose of the research

When the graduate level theses in the aviation sector are examined, it is seen that there are studies in fields such as engineering, medicine, law, international relations, economy, tourism, history, meteorology and so on. However, because it has recently been suggested that human errors are the most common cause of aircraft accidents, the purpose of this study is to examine the graduate level theses written with the perspective of work psychology, which is a discipline that examines the causes of "human errors", how solutions can be found and how to improve employee well-being. This research involves those theses in the National Thesis Center in Türkiye which examine the aviation sector from the perspective of work psychology between 2003 and 2023, with the aim of making classifications by examining them in terms of variables such as the year they were published; the university, institute, and department from which they come; the research methods utilized; the research topics studied, sample group selected, higher education level graduated, and finally, to monitor the changes, transformations, and development of the theses written on these concepts during this process and to guide future studies.

3.2. Research questions

For the purpose of the research, the following research questions were determined, and the studies in the National Thesis Center in Türkiye were classified on the basis of the following questions.

1) What is the distribution of theses written from a work psychological perspective in the aviationsector according to the years in which they were published?
2) What is the distribution of theses written from a work psychological perspective in the aviationsector according

to the universities at which they were published?

3) How is the distribution of theses written from a work psychological perspective in the aviationsector according to the institutes at which they were published?

4) What is the distribution of theses written from a work psychological perspective in the aviationsector according to the departments in which they were published?

5) What is the distribution of theses written from a work psychological perspective in the aviationsector according to the higher education level (master's, doctoral)?

6) What is the distribution of theses written from a work psychological perspective in the aviationsector according to the topics of work psychology examined?

7) How is the distribution of theses written from a work psychological perspective in the aviationsector according to the sample group examined?

8) What is the distribution of theses written from a work psychological perspective in the aviation sector by research type?

3.3. Methods

In this research, graduate level theses (MA and PhD) written in Türkiye between the years 2003-2023 in the aviation sector from the perspective of work psychology were examined using the bibliometric analysis method. Bibliometric analysis is one of the research methods used when examining the current state, change and development of the literature in a particular field. In the study, the concepts of "aviation", "flight", "cockpit", "pilot", "cabin crew", "air traffic" and "aviation safety" were scanned among the allowed theses in the National Thesis Center of the Council of Higher Education between 2003 and 2023. A scan was made among determined 1250 theses, and then 49 doctoral theses and 195 master's theses written with the perspective of work psychology, a total of 244 graduate theses and 2 medical specialization theses were reached. However, it was seen that some theses intersect in the search, in this case, the same theses were removed in order to avoid repetition and the certain number was reached. When the intersecting theses were sorted out, a total of 236 theses were evaluated over 46 doctorate, 188 master's and 2 medical specialization theses.

3.4. Findings

3.4.1. Distribution of theses written from a work psychological perspective in the aviation sector by year of publication

When the theses written on the aviation sector from the perspective of work psychology in the NationalThesis Center between 2003 and 2023 are examined according to the years they were published, it wasobserved that the year with most studies published was 2019, followed by 2020, 2021 and 2022, respectively, and there was only one study in 2003 and in 2005. In other words, it can be said that the number of theses on related topics has started to increase in recent years.

Table 1. Publication years

Publication Years	Frequency	Publication Years	Frequency
2003	1	2013	5
2004	6	2014	7
2005	1	2015	8
2006	3	2016	12
2007	4	2017	19
2008	3	2018	22
2009	2	2019	38
2010	3	2020	34
2011	3	2021	33
2012	4	2022	28
		TOTAL	**236**

3.4.2. Distribution of theses written from a work psychological perspective in the aviation sector by universities

As can be seen in the table 2, when the distribution of theses written with from a perspective of work psychology in the aviation sector is examined according to the universities at which they are published, it can be seen that they are mostly written at Beykent University, followed by Anadolu University, Gelişim University, Arel University, Istanbul University, Turkish Aeronautical Association University, Aydın University, and Kocaeli University.

Table 2. Universities

Universities	Frequency	Universities	Frequency
Beykent University	25	Ondokuz Mayıs University	2
Anadolu University	21	Sabahattin Zaim University	2
Gelişim University	13	Selçuk University	2
Arel University	12	Ufuk University	2
İstanbul University	12	Nişantaşı University	2
Turkish Aeronautical Association University	12	Yıldız Technical University	2
Aydın University	10	Ankara University	1
Kocaeli University	10	Bartın University	1
Eskişehir Technical University	7	Bilim University	1
Gazi University	7	Çağ University	1
Marmara University	7	Çankaya University	1
Bahçeşehir University	6	Dicle University	1
İnönü University	6	Gedik University	1
Middle East Technical University	6	Haliç University	1
Dumlupınar University	4	İzmir Kâtip Çelebi University	1
Maltepe University	4	Kadir Has University	1
Akdeniz University	3	National Defence University	1
Gebze Technical University	3	Kırklareli University	1
İbn Haldun University	3	Niğde University	1
Işık University	3	Çanakkale Onsekiz Mart University	1
İstanbul Technical University	3	Pamukkale University	1
İstanbul Ticaret University	3	Rumeli University	1
Sakarya University	3	Süleyman Demirel University	1
Ankara Yıldırım Beyazıt University	2	Uşak University	1
Atılım University	2	Mersin University	1
Manisa Celal Bayar University	2	Medipol University	1
Hacettepe University	2	Üsküdar University	1
Hatay Mustafa Kemal University	2	Erciyes University	1
Muğla Sıtkı Koçman University	3	Health Sciences University	1
Yeditepe University	3	**TOTAL**	**236**
Okan University	2		

3.4.3. Distribution of theses written from a work psychological perspective in the aviation sector according to the institutions where they were published

Table 3. Institutions

Institutions	Frequency
Institute of Social Sciences	162
Institute of Graduate Studies	46
The Graduate School of Natural and Applied Sciences	19
Graduate School of Health Sciences	3
Defense Institute of Health Sciences	2
Institute of Educational Sciences	2
Graduate School of Informatics	1
Institute for Defence Sciences	1
TOTAL	**236**

When the distribution of the theses written from the perspective of occupational psychology in the aviation sector in the National Thesis Center between 2003 and 2023 is examined according to the institutes at which they are published, it is seen that the institute with the most studies is the Institute of Social Sciences, followed by the Institute of Graduate Studies, and then by the Graduate School of Natural and Applied Sciences. The least the institutes with the fewest studies are the Graduate School of Informatics and the Institute of Defense Sciences, with one study each.

3.4.4. Distribution of theses written from a work psychological perspective in the aviation sector according to the departments in which they are published

When the distribution of the theses written from the perspective of work psychology in the aviation sector in the National Thesis Center between 2003 and 2023 is examined according to the departments in which they are published, it is seen that the most work is in the business department, followed by the civil aviation management, the business management, the aviation management, the psychology, the labor economics and industrial relations departments, respectively.

Table 4. Departments

Departments	Frequency	Departments	Frequency
Business	102	Electrical and Electronics Engineering	1
Civil Aviation Management	19	Maritime Transportation Engineering	1
Business Administration	15	Cognitive Science	1
Aviation Management	12	Industrial Design	1
Psychology	11	Educational Sciences	1
Labour Economics and Industrial Relations	10	Education Management and Supervision	1
Human Resources Management	7	Motion and Training Sciences	1
Air Traffic Control	5	Physical Education and Sports	1
Industrial Engineering	4	Economics	1
Environmental and Technical Research of Accidents	4	Business (English)	1
Air Transport Management	3	Public Relations and Publicity Department	1
Pilotage	3	Marketing	1
Communication	3	Sociology	1
International Trade and Logistics	3	Psychological Counseling and Guidance	1
Computer Engineering	2	Family Counseling and Education	1
Aerospace Engineering	2	Recreation	1
Human Resources and Organizational Change	2	Defense Management	1
Public Relations	2	Science of Strategy	1
Occupational Health and Safety	2	Transportation and Logistics	1
Tourism Management	2	International Business	1
Nutrition and Dietetics	1	International Quality Management	1
Computer Education and Instructional Technology	1	TOTAL	236

3.4.5. Distribution of theses written from a work psychological perspective in the aviation sector by higher education level

As can be seen in the table 5, when the distribution of theses written from the perspective of work psychology in the aviation sector in the National Thesis Center between 2003 and 2023 is examined according to the level of higher education, it has been determined that 188 master's theses,46 doctoral theses and 2 specialization in medicine theses have been written.

Table 5. Level of Education

Degree of education	Frequency
M.A.	188
PhD	46
Thesis in Medicine	2

3.4.6. Distribution of theses written from a work psychological perspective in the aviation sector according to the sample group examined

Table 6. Sample Group

Sample Group	Frequency
Employees in the aviation sector	76
Pilots - Army aviation pilots (air forces command fighter pilots -land forces command)	44
Air traffic controller	19
Airline cabin crew	18
Airlines flight crew	17
Ground services workers	16
Flight and maintenance technicians/ Technical personnel in the aviation sector / Technicians working in commercial aircraft maintenance jobs	9
Theoretical studies and studies with model proposals	9
Employees at the management level of airline companies	7
Associate, undergraduate and graduate students in aviation departments	5
Employees operating in the sportive aviation sectors	4
Flight training students and instructor pilots	3
Company officers serving the aviation sector	3
Civil aviation general directorate employees	2
Customers in the civil aviation sector	2
Flight dispatcher	1
Flight training organizations operating in the civil aviation sector	1
TOTAL	**236**

When the theses were evaluated in terms of sample group, it was difficult to distinguish the target group and to obtain certain numbers, as some of the studies were more general, while others were quite specific in this regard. According to results, it has been determined that employees working in the aviation sector, civil and military pilots, air traffic controllers, airline cabin crew, airline flight crew and aviation ground services workers were selected as sample groups.

3.4.7. Distribution of theses written from a work psychological perspective in the aviation sector by research type

When the table is examined to determine the research type of theses, it is seen that out of 236 theses, 203 are quantitative research, 17 are qualitative research, 8 are mixed research comprising of both qualitative and quantitative research, and the remaining 8 are theoretical research. In this case, it is seen that between the years 2003 and 2023, the quantitative research type was utilized, and mostly through the use of questionnaires as data collection tool, followed by the qualitative research type utilizing interviews, and then the mixed research type, which includes both types of research at the minimum level. In the field of aviation, which is more suitable for field work, it can be seen that theoretical studies are clearly in the minority.

Table 7. Research Type

Research Type	Frequency
Quantitative	203
Qualitative	17
Mixed research	8
Theoretical	8
TOTAL	236

3.4.8. Distribution of theses written from a work psychological perspective in the aviation sector according to the research subjects

3.4.8.1. M.A. Theses

Table 8. Subjects (Master of Theses)

Subjects (Master of Theses)	Frequency	Subjects (Master of Theses)	Frequency
Organizational commitment-occupational commitment-loyalty	26	Experience	2
Stress	18	Mental workload	2
Burnout	16	Risk taking levels-risk management	2
Communication-Communication skills- Communication problems	9	Positive organizational behavior	2
Safety management in aviation - Flight safety - Unsafe behavior	9	Organizational support	2
Emotional intelligence	7	Organizational attractiveness	2
Anxiety	6	Professional adaptation	2
Motivation	6	Person-organization fit	2
SCL90 (somatization, depression, interpersonal sensitivity, phobic anxiety) hopelessness	4	Spare time-perception of boredom	1
Decision-making	4	Time management	1
Life satisfaction	4	Problem solving	1
Worklife balance	4	Digital Literacy	1
Fatigue / Fatigue risk management	4	Self-Assertion	1
Organizational justice	4	Alertness	1
Turnover intention	4	Psychological Ownership	1
Self-efficacy	3	Caution	1
Happiness-wellbeing	3	Over workload	1
Recruitment	3	Psychosocial risk factors	1
Work engagement	3	Pilots'soft skills	1
Organizational citizenship	3	Air traffic management	1
Organizational silence	3	Corporate risk management	1
Organizational culture-Organizational climate	3	Interaction between Human and Machine	1
Psychological harassement	3	Machine learning techniques	1
Shift – normal work	3	Occupational competence	1
Working conditions and rights	3	Management support	1
Personality traits / Temperament characteristics	2	Job crafting	1
Ego analysis	2	Intrapreneurship	1
Perception of crisis management	2	Psychological contract	1
Psychological capital	2	Perception of job insecurity	1
Situational awareness	2	Intention to stay	1

Between the years 2003 and 2023, the master's theses in the field of aviation from the perspective of work psychology were examined in terms of the subjects covered at the National Thesis Center. According to the analysis result, it was

determined that the most studied topics were organizational commitment, stress, burnout, communication, safety-security, emotional intelligence, anxiety, motivation and so on.

3.4.8.2. PhD Theses

Between the years 2003 and 2023, the doctoral theses in the field of aviation from the perspective of work psychology were examined in terms of the subjects covered at the National Thesis Center. According to analysis results; it was determined that the most studied topics include: performance, organizational commitment, personality, manager-leadership styles, competence, culture, job satisfaction, intention to leave and so on.

Table 9. Subjects (PhD of Theses)

Subjects (Philosophy of Doctorate)	Frequency	Subjects (Philosophy of Doctorate)	Frequency
Performance	10	Nomophobia	1
Personality	7	Political skills	1
Organizational commitment	7	Organizational learning ability	1
Intellectual competence – competence	6	Innovative behavior	1
Management style-leadership	6	Risk perception	1
Organizational culture – culture	5	Technostress	1
Job satisfaction	4	Perception of job insecurity	1
Intention to leave	4	Psychological empowerment	1
Agility	3	Positive psychological capital	1
Motivation	3	Job control	1
Decision-making	3	Employees' conformity to the organizational rules	1
Communication	3	Work engagement	1
Emotional intelligence	2	Burnout	1
Managerial support	2	Workplace relationships quality	1
Organizational justice	2	Organizational socialization	1
Organizational trust	2	Emotional labour	1
Organizational citizenship	2	Job demands	1
Innovation strategies-innovative organizational climate	2	Psychological contract	1
Working conditions	2	Intrapreneurship	1
Gender	1		

3.4.8.3. Theses in Medicine

When the specialization theses in medicine are examined, the topics identified include: human limit, education and performance subjects.

Table 10. Subjects (Dissertation in Medicine)

Dissertation in Medicine	Frequency
Performance	1
Human Limit	1
Education	1

4. Discussions and Conclusion

Since the 1980s, globalization has increased, and with it there has been an increase in trade at the international level, development in the field of tourism, as well as a revival of the economy and advancements in technology, all of which have contributed to the development of the transportation sector quantitatively and qualitatively. Also, flying is often preferred because it is faster, more comfortable and more reliable relative to other forms of transportation. Along with these developments, more personnel were required as the number of passengers and trips increased. At the same time, employed personnel should be employees who have the technical knowledge to use the developing technology, possess excellent communication skills and be able to work efficiently by adapting to the organization because when the recent studies are examined, it is observed that plane crashes are generally caused by human errors rather than technical problems.

As a matter of fact, while it was seen that technical issues were mostly studied in the first studies in the field of aviation, psychology-based scientific studies became important with the increase in human errors. In this context, work psychology, which is a discipline that examines the attitudes and behaviors of employees in business life, investigates the causes and tries to find solutions to problems, comes to the fore. For this purpose, the theses written on the aviation sector were examined from the perspective of work psychology in this study. In order to determine the theses written in this field, a comprehensive search of the keywords "aviation", "flight", "cockpit", "pilot", "cabin crew", "air traffic" and "aviation safety" was made in the National Thesis Center of the Council of Higher Education for the years between 2003 and 2023 (inclusive). One thousand two hundred fifty (1250) theses accepted for publication were located in this search. When the field of aviation was examined from many different perspectives among these theses, it was determined that there were 246 theses related to work psychology were in line with

the purpose of the research. However, when the concepts of "aviation", "cockpit", "pilot", "flight", "aviation safety" were scanned, it was determined that 8 theses were similar, so some theses were eliminated. Therefore, this study encompassed 236 theses. They were classified according to the year of publication; the universities, institutes, departments at/in which they were published; the level of higher education at which they were written; the topics in work psychology on which they were written; the sample groups which were studied, and research type.

According to the publication years of the theses, it was seen that the most studies were published in 2019, then in 2020, 2021 and 2022, respectively. In other words, it has been seen that the number of theses on related work psychology has begun to increase in recent years. One possible reason for this may be that while technical problems decrease with the development of technology, human errors come to the fore and the number of human-oriented studies has increased as a result. Secondly, according to the universities at which they are published is examined, it is seen that they are mostly written in Beykent University, Anadolu University, Gelişim University, Arel University, Istanbul University, Turkish Aeronautical University, Aydın University and Kocaeli University. The fact that these universities have programs specifically related to aviation can be shown as the reason for the high number of studies. Thirdly, according to the departments is examined, it is seen that they are mostly studied in the departments of business followed by the departments of civil aviation management, business administration, aviation management, psychology, labor economics and industrial relations, respectively. The fact that business departments are older than civil aviation departments and have organizational behavior discipline has caused this department to come to the fore. Since the subjects are related to the attitudes and behaviors of individuals in work life, the psychology department may be behind in terms of the theses written when compared to other departments. In the department of labor economics and industrial relations, the existence of the disciplines of work psychology and human resources increases the number of relevant studies in these departments. Fourthly, according to the institutions is examined, it is seen that the institute with the most studies is the institute of social sciences because above-mentioned departments are affiliated with this institutions. Fifthly, according to the level of higher education is examined, it has been determined that 188 master's theses, 46 doctoral theses and 2 specialization in medicine theses have been written. It can be said that the reason for the high number of master's theses is that the master's education is more common and relatively short-term, a limited number of people receive doctoral education, and the doctorate program in the field of aviation in Türkiye is limited. Sixthly, when master's and doctoral theses are examined in terms of work psychology; it has been seen that "organizational commitment, stress, burnout, communication, safety management, performance, personality, competence and management style" were the most studied subjects. As life safety is always at the forefront in the transportation sector, "safety management, communication, management style, personality and competence" subjects are very important. Due to difficult working conditions, excessive workload and high levels of responsibility, "stress and burnout" topics are also important. "Organizational commitment" is also necessary for employees to continue working in this sector and "performance" as in every sector are among the subjects expected to be studied. Seventhly, when the theses were evaluated in terms of sample group, it was difficult to distinguish the target group and to obtain certain numbers, as it the studies were sometimes general and other times quite specific. In general, those working in the aviation sector, civil and military pilots, air traffic controllers, airline cabin workers, airline flight crewand aviation ground services workers were selected as sample groups. Finally, when the type of research was examined, it was determined that most of the theses utilized quantitative research methods. Although quantitative studies are good for collecting more data in the field, more qualitative studies are necessary to gain in-depth knowledge of the field. At the same time, the mixed research type is the most useful research type in terms of outputs quantitatively and qualitatively.

As a result, it was determined that number of studies increased after 2019. Although it was seen that lots of research were conducted in different departments, institutes and universities, more spesific departments related with aviation psychology should be opened. Additionaly, despite quantitative research type was used in most of the theses, qualitative and mixed research types should be preferred in terms of getting more detailed and in-depth information about aviation sector. Finally, organizational commitment, stress, burnout, performance and personality were very common topics studied so researchers should studied on more original topics. Moreover, as a result of this study, it will be primarily determined how much research has been done on which subject and which occupational groups are selected as the sample group, and at the same time, subjects and occupations that have been studied less or not will be a guide for future studies. Moreover, thanks to these researches, managers in the aviation sector can learn the reasons for the attitudes and behaviors of the employees, how to ensure harmony between work life and employee, and how to improve the well-being of the employee to prevent accidents.

Ethical approval

Not applicable.

Conflicts of Interest

The authors declare that there is no conflict of interest regarding the publication of this paper.

References

Air Transport Action Group (ATAG), 2023, Employment, Retrieved from https://aviationbenefits.org/economic-growth/supporting-employment/, 17 January 2023.

Birsel, M. (2022) Havacılık Psikolojisi: Kapsamı ve Havacılık Psikologlarının Sorumlulukları. In Havacılık Psikolojisi: Kavramlar, Araştırmalar, Uygulamalar. (Edt.Pınar Ünsal ve Seda Çeken). İstanbul Üniversitesi Yayınevi, İstanbul. 1-33.

Høyland, K. & Aase, K. (2009) Does Change Challenge Safety? Complexity in the Civil Aviation Transport System. In Safety, Reliability and Risk Analysis: Theory, Methods and Applications. (Edt. Sebastian Martorell, Carlos Guedes Soares, Julie Barnett). Taylor & Francis Group, London.

Janic, M. (2000). An Assessment of Risk and Safety in Civil Aviation. Journal of Air Transport Management, 6(1), 43-50.

Jonge, J. & Kompier, M.A.J. (1997). A Critical Examination

of the Demand-Control-Support Model from a Work Psychological Perspective. International Journal of Stress Management, 4(4), 235-258.

Kümbül Güler, B. (2015). Geçmişten Günümüze Çalışma Psikolojisi. Karatahta İş Yazıları, 3, 1-25.

Macit, D. ve Macit, A. (2017). Türkiye'de Sivil Havacılık Sektöründe İstihdamın Mevcut Durumu, Sorunları ve Sorunların Çözümüne Yönelik Öneriler. Journal of Emerging Economies and Policy,2(2), 74-85.

Rezchikov, A., Dolinia, O., Kushnikov, V., Ivaschenko, V., Kachur, K., Bogomolov, A. & Filimonyuk, Y (2016). The Problem of a Human Factor in Aviation Transport Systems. Indian Journal of Science and Technology, 9(46),1-6.

SHGM, (2021). Sivil Havacılık Genel Müdürlüğü Faaliyet Raporu 2021, Retrieved from https://web.shgm.gov.tr/documents/sivilhavacilik/files/kurumsal/faaliyet/2021.pdf, 18 January 2023.

Sun, M. (2019). Sivil Havacılık Sektörünün Tarihsel Gelişimi ve Ekonomik Krizlerin Havacılık Sektörüne Etkileri, Tokat Gaziosmanpaşa Üniversitesi, Sosyal Bilimler Enstitüsü, Yüksek Lisans Tezi.

Taşçıoğlu, C. (2018) Çalışma Psikolojisi. Journal of Economy Culture and Society, 57, 275-279.

Taşlıgil, N. (1997). Türkiye'de Hava Ulaşımının Gelişimi. Öneri Dergisi, 2(7), 89–97.

Terzioğlu, M. (2010). Ekip Kaynak Yönetimi (Crew Resource Management), Cinius Yayınları, Birinci Baskı, İstanbul.

Tsiotas, D., Erdem, U.& Cubukcu, K.M. (2020). Outlining the historical framework of the aviation sector in Turkey: A spatiotemporal approach. Regional Statistics, 10(2), 117–141.

Wiegmann, D.A. & Shappell, S.A., (2001). A Human Error Analysis of Commercial Aviation Accidents Using the Human Factors Analysis and Classification System (HFACS), Final Report, Office of Aviation Medicine Washington D.C. 20591.

Cite this article: Cakı, N. (2023). The Aviation Sector from a Work Psychological Perspective: A Bibliometric Analysis of Graduate-Level Theses Written in Türkiye, Journal of Aviation, 7(1), 147-155.

7 (1): 156-160 (2023)

Journal of Aviation

https://dergipark.org.tr/en/pub/jav

e-ISSN 2587-1676

Why Are Flight Psychologists Important to Flight Safety?

Selvi Vural[1*]

[1*]Recep Tayyip Erdogan University, Transportation Services Department, Rize, Türkiye. (gocmenselvi@gmail.com)

Article Info

Received: 17 December 2022
Revised: 01 March 2023
Accepted: 15 March 2023
Published Online: 16 March 2023

Keywords:
Flight Safety
Flight Psychologist
Aviation Psychology
Flight Crews

Corresponding Author: *Selvi Vural*

RESEARCH ARTICLE

https://doi.org/10.30518/jav.1220425

Abstract

The developments in aircraft technologies both in our country and around the world cause a serious increase in both the aircraft fleets and ticket sales, as well as the number of airline companies, their employees and passengers. These developments in the aviation industry necessitate flight safety and highlight the importance of the human factor (flight crew) by reducing the causality of technical factors in ensuring safety. Studies within this scope show that the main causal factor (65-70%) in aircraft crashes is the flight crew. There are many factors such as physiological, psychological, personal and psychosocial at the basis of the unsuccessful performance of the flight crew. However, the number of studies in the literature that draw attention to the psychological elements of the flight crew is very few. In fact, it is known that the psychological well-being of the flight crew is important for the success of the flight operations, but the airline companies do not have any evaluation obligation regarding this. On the contrary, some negative consequences may be encountered due to the freedom in this matter. In particular, the fact that human factor causation is at a much higher level than previously thought in plane crashes increases the importance of flight psychologists for airline companies today. Therefore, in this study, it is aimed to reveal the importance of flight psychologists on flight safety in civil aviation. In this context, interviews were held with the flight crews of two airlines (private-public). The findings show that flight psychologists are important and necessary in airline companies in order to be able to perform safe flights with healthier flight crews.

This article was presented as a paper at the 2nd International Congress on Aviation Management.

1. Introduction

Today, developments in aircraft technologies both in our country and around the world cause a serious increase in the number of aircraft fleets and ticket sales, as well as in the number of airline companies, therefore their employees and passengers (Lasi et al., 2014). However, these developments in the aviation industry also necessitate flight safety. For this reason, it is striking that the primary purpose of the enterprises operating in the sector is to ensure flight safety (Jausan et al., 2017). As a matter of fact, technological developments reduce the causality of technical factors (such as engine, navigation, approach and landing systems) in ensuring flight safety, and highlight the importance of the human factor in the aviation industry to a greater extent (Foushee, 1984; CAP 720, 2002).

Of course, captain pilots may be the first to come to mind when the word "human factor" is mentioned but considering the importance and inevitable necessity of teamwork in the aviation industry, it is understood that both the cockpit and the entire cabin crew are meant (Jensen ve Benel, 1997; CAP 737, 2006). In other words, it is thought that not a single person - the pilot - is responsible for ensuring flight safety, but all flight assistants before, during and after the flight. Therefore, a safe, successful and trouble-free flight requires a rich perspective on the subject. In addition, even team members who are complex by human nature and serve the same purpose may have different wishes, needs and expectations. The individual competencies and competences, weaknesses, information asymmetries, attention, understanding and perception levels, intelligence and reasoning powers, personalities, emotions, stress and fatigue, experiences and health conditions of each of them can be different from each other, all of which are of great importance in terms of the success or failure of a flight is important (Wilhem & Roth, 1997; Sias, 2005; Clark & Rock, 2016).

When the studies focusing on the human factor in the aviation sector are examined, it is thought that it is necessary to focus on accidents that occur due to failure rather than successful flight operations in terms of flight safety. Because it is stated that there are mostly errors caused by the flight crew in aircraft accidents that occur. Researchers examined civil aircraft crashes up to the 1980s and found that more than 70% of them were caused by flight crew errors. In addition, in the studies covering a period of 16 years after 1980, the British Civil Aviation Organization analyzed 75% of fatal plane crashes and revealed that the flight crew was the main causal factor in 67% of them. From a more comprehensive point of view, it is pointed out that the main causal factor in plane crashes both in our country and around the world is 65% to 70% of the flight crew (Helmreich & Foushee 1993).

There are many reasons (physiological, psychological, personal, psychosocial) based on the unsuccessful

performance of the flight crew, which makes the flight operations unsuccessful and even causes various accidents-destructions. However, in the literature, psychological (situational awareness, family conflict, addiction, somatization, mental confusion, inattention, depression, anxiety, panic disorder, phobic reaction, motivation, exhaustion, fatigue, stress, perception, cognitive processes, decision making, etc.) The number of studies that draw attention to these factors is relatively few compared to the others (Jensen, 1997). In fact, it is known that the psychological well-being of the flight crew is important for the success of the flight operations, but the airline companies are not obliged to make any assessments about it, on the contrary, some negative results may be encountered due to the freedom in this matter.

Flight 9525 of Germanwings airlines in 2015 is the best example and explanatory of this situation. In this flight, which is one of the scheduled flights of the airline between Germany and Barcelona, co-pilot Andreas Lubitz deliberately crashed the plane into the Alps (France), causing a very important accident in the history of aviation and in the recent past. As a result of the accident, no passengers or flight crew survived, and it was stated that the reason was psychological problems of the pilot. Many data were obtained about the pilot's psychological health (such as depression diagnosis, hospitalizations, ongoing psychotherapy process, drugs used) and these were included in the accident report. Ultimately, this accident had great repercussions in terms of flight safety in the aviation industry and once again revealed the importance and follow-up of psychological health (BEA, 2016).

At this point, the place and importance of aviation psychology and flight psychologists in the air transport sector is understood. The focus of psychology is on the human factor and its behaviors. When it comes to aviation psychology, the first thing that comes to mind is a branch of science that examines the behavior of company employees (individuals or crews providing flight services) operating in the air transport sector. Aviation psychology is the application of psychological principles and techniques to aviation-related problems or situations (Martinussen & Hunter, 2010). According to Jensen (1997), aviation psychology is a multidisciplinary field (such as ergonomics, engineering, psychology, organizational psychology, human resources, organizational behavior), and it helps to reveal the behaviors of employees in the aviation field and the root causes of these behaviors. In particular, the fact that human factor causation is at a much higher level than previously thought in plane crashes increases the importance of aviation psychology and flight psychologists for airline companies today. In 1919, British Air Force Dr. According to Oliver Gotch, the psychology of flight is very important in aviation, so the situation should be given more importance than studies in other fields.

Flight psychologists are essentially experts or clinical psychologists who work in areas such as individuals' stress and fears, team resource management, psychomotor assessments, peer support programs and post-accident psychological support processes. These individuals have graduated from a course approved by the General Directorate of Civil Aviation (SHGM, 2020). However, the first studies on aviation psychiatry and psychology were made by neuropsychiatrists. In the following years, experts who took a course in aviation psychology, namely flight psychologists, started to support the studies carried out only by flight doctors for many years. In this context, aerospace medicine specialists and flight physicians are involved in the psychiatric evaluation for the selection of flight personnel and their subsequent health examinations. However, the physiological and psychological effects of flight on the human organism and the health problems that may arise in flight or prevent flight, flight personnel morale, motivation, mission performance and flight safety, etc. flight psychologists are involved in keeping it at the highest level or in supporting actions for it (Çetingüç, 2018).

Success in the aviation industry today; It requires addressing both physiological and psychological problems of the cockpit crew, cabin crew and even passengers. Businesses operating in the field of air transport should pay attention to the importance and necessity of a detailed examination of the origins of psychology and psychological problems in this field, especially considering the pilot's suicide dive into the Alps in 2015 due to psychological problems. As a matter of fact, the importance of this issue in military aviation has been known since ancient times and has been meticulously emphasized. It is thought that flight psychologists, who are permanent employees of the air force, may also be important elements of flight safety in civil aviation (ATA, 2021). In the light of this information, while carrying out civil aviation activities, especially flight safety is emphasized, but the role of flight psychologists in ensuring flight safety and the issues that necessitate their existence are not mentioned. For this reason, it is believed that this research, which was carried out to reveal the importance of flight psychologists on flight safety in civil aviation, will fill an important gap in the literature.

Qualitative research method was used in the research. Qualitative research method was preferred in the research because it covers the processes for revealing perceptions and events in a holistic way (Cropley, 2021). In the research, two different study groups were studied in order to reveal holistic and different attitudes. The first working group consists of the flight crew (captain pilot and cabin crew) of a private airline company. The second working group is the flight crew of a public airline company. The main reason why the research was conducted with the employees of both public and private airline companies is to determine whether the perspectives of the two groups on the subject differ.

Within the scope of the research, face-to-face interviews were conducted with the participants (flight crews). Research data were obtained through semi-structured questionnaires asked to participants in these interviews. Semi-structured questionnaires allow the participants to ask the planned questions, as well as different questions that are not planned according to the course of the interview but related to the subject at the time of the interview. Thus, in-depth and versatile data on the subject can be obtained. Within the scope of the research, interviews were held with a total of 13 participants, including 5 cabin crew, 4 cabin supervisor and 4 captain pilot, between September and November 2022.

In the first stage of the data collection process, a preliminary interview was held with 3 cabin crew and 2 captain pilots, who were easy to access, and an appointment was requested by giving information about the research topic. The interviewed participants responded positively to this request and made an appointment to meet. Interviews with the participants were held in the offices of the institutions they work for. Face-to-face interviews were recorded with the consent of the participants, both in audio and in writing. The interview with a participant took 45 minutes on average. The recordings made later were transcribed in writing. In the research, face-to-face interviews were conducted with 13 participants through semi-structured questionnaires. The data were obtained as a result of face-to-face interviews through semi-structured questionnaires in accordance with the purpose of the research. Before the interview, the participants were informed about the research topic.

This research is within the scope of exploratory research type. The research was carried out using the case study

approach, one of the exploratory research qualitative research designs. Identifying and discovering what happens in the real environment in case studies is possible by systematically collecting and analyzing data. In this framework, easily accessible case sampling method was used. The interviews conducted in the research were recorded in written and audio form. At the same time, after each interview, the participants were presented with the spoken and transferred information, and feedback was received on whether the transferred information was understood correctly. Thus, subjective inferences are avoided. By receiving feedback from the participants about the interviews, the principle of confirmability, which is one of the credibility indicators of qualitative research, was met.

In order for the research results to reveal the truth in a holistic way, interviews were conducted with both public and private sector employees (comprising cabin crew, cabin chief and captain pilot). Thus, the reliability of the internal validity of the research was increased by triangulating the data sources. At the same time, in order to increase the reliability of the research, more than one researcher took part in the analysis of the data, and an independent expert who is an expert in qualitative research and has publications on this subject analyzed the same data. Discussions continued until consistency was achieved on the themes. What is the importance of flight psychologists in terms of flight safety? The participants' views on the question were carried out with descriptive and content analyzes.

2. Result and Discussion

The first group of the research consists of the employees (participants) of the private airline company. Within the scope of the first group, 6 participants were interviewed. The second group of the research consists of the employees (participants) of the public airline company. The number of participants interviewed within the scope of the second group is 7. Of the 13 participants interviewed, 8 (62%) were male and 5 (38%) were female. While 8 of the participants (62%) were undergraduates, 5 (38%) were graduates. The average age is 38. Participants, who have an average of 16 years of experience in the sector, have been working in their current businesses for an average of 12 years.

Content analysis was applied to the discourses obtained as a result of the interviews with the participants, and as a result of the analysis, it was determined that they were gathered under three different themes showing that flight safety requires a flight psychologist. The first theme was named as “Flight Safety-Flight Psychologist Requirement in Airlines”. The second theme was named “Flight Safety in Airline Companies - The Role of Flight Crew” and the third theme was named “Flight Crew Attitude towards the Requirement of a Flight Psychologist”.

Table 1: Professional Characteristics of the Interviewed Participants

Participant Number/No	Gender	Education	Age	Sector	Working Time In The Industry (Year)	Working Time In Business (Year)	Position
Participant 1	Female	Master Degree	35	Public	15	15	Cabin Crew
Participant 2	Female	Degree	31	Private	9	7	Cabin Crew
Participant 3	Male	Degree	42	Private	21	20	Cabin Supervisor
Participant 4	Erkek	Master Degree	27	Public	6	6	Cabin Crew
Participant 5	Female	Master Degree	38	Private	16	13	Cabin Crew
Participant 6	Female	Degree	50	Public	28	23	Cabin Supervisor
Participant 7	Male	Master Degree	32	Public	8	7	Captain Pilot
Participant 8	Male	Degree	45	Private	25	17	Cabin Supervisor
Participant 9	Female	Degree	46	Private	27	19	Cabin Supervisor
Participant 10	Male	Degree	50	Public	29	8	Captain Pilot
Participant 11	Male	Master Degree	31	Private	6	4	Co-Pilot
Participant 12	Male	Degree	34	Private	11	11	Cabin Crew
Participant 13	Male	Degree	36	Public	5	5	Co-Pilot

The discourses of the participants on “Flight Safety-Flight Psychologist Requirement in Airline Companies” were analyzed by subjecting them to content analysis, and as a result of the analysis, it was determined that the opinion of the flight psychologist as a requirement for flight safety was clearly stated. Supporting citations on the subject are given below.

“….Until recently I didn’t have a retirement plan…I need peace of mind now…I am a passionate person, I love my job, but how have I neglected myself until now…that big man who used to fly planes when I was little, now has big dreams and can’t go back to his childhood… exhaustion and stress are killing me …don't get up now and call it a doctor or something.. I haven't even seen my children for two weeks.. the doctor comes to me, it's even late…”(Participant No:10, Male, Captain Pilot)

“…if there was a flight psychologist in the company, maybe the results of things could have been much different… It reflects too much on the decisions I will make.. you don't hear them calling during the flight... I am in a very depressed state of absent-mindedness and carelessness... I am just where I need to be physically at that moment…” (Participant No:8, Male, Cabin Supervisor)

“…One of our teammates resigned recently... Apart from all that, the psychological disorders he experienced over time and some behavior had gotten him to this stage.. then I sat and thought about it for a long time. I know a lot of people like you and even witness it closely… Occupational deformation… It would be great to create time and opportunity not to experience this, but how?” (Participant No:2, Female, Cabin Attendant)

“…I didn't know that what I was experiencing was panic disorder until a while ago… It was affecting me negatively in every way on the flight, at home. The situation… the company brought us together with the flight psychologist service, albeit from outside… Awareness is very important… Being hugged by the door with an emergency warning every time I go to sleep

or being suffocated by being out of breath… It was very painful to experience the pain in my mind that I did not feel physically." (Participant No:5, Female, Cabin Attendant)

The discourses of the participants on "Flight Safety in Airline Companies - The Role of the Flight Crew" were analyzed by subjecting them to content analysis, and as a result of the analysis, it was determined that the flight crew played an important role in ensuring flight safety. Supporting citations on the subject are given below.

"…one day, a passenger was taken to the plane with a drink and alcohol in his hand, other passengers complained a lot about this situation (insulting, swearing). Our supervisor came and said to him, sit calmly now, please, soon we will hand you over to the airport police and you will be billed for the ticket price of all the passengers on the plane. I said it saves lives…"(Participant No:12, Male, Cabin Attendant)

"…everyone working in the service industry knows that there is an effort to please others… which means increased responsibilities and workload. You need to concentrate on your work well and avoid behaviors that will put both yourself and others at risk. Therefore, whatever needs to be done in this process is carried out on time and completely. The flight crew is the heart of this work." (Participant No:9, Female, Cabin Supervisor)

"…the flight crew takes part in all phases of the flight, fully and fully staff… Therefore, ensuring the operation depends on the coordination and success of the crew… In one case, the timely awareness of a friend from the cabin crew and reporting the situation prevented a major problem. we all (passenger and crew) could be adversely affected." (Participant No:13, Male, Co-Pilot)

The statements of the participants about the "Attitude of the Flight Crew Towards the Necessity of a Flight Psychologist" were analyzed by subjecting them to content analysis, and as a result of the analysis, it was determined that the flight crew had a positive attitude towards the necessity of flight psychologists in ensuring flight safety. Supporting citations on the subject are given below.

"….After stressful, tired and tense years in the air force, it seems much more comfortable to do this job today, but the truth of the matter is not.. people are people everywhere, but sometimes they think that the only problem is lack of sleep or tiredness… being able to take healthy flights. It is also necessary for a person to feel healthy and supported in every sense in order to…"(Participant No:11, Male, Co-Pilot)

"…The primary goal and great responsibility for all of us is to make safe and successful flights… a problem experienced by one of our crew can reflect on all of us from time to time and cause negativities… which you cannot say is his personal problem because teamwork is inevitable for us, it is best for us to eliminate the problem and let the company do this. making an effort on the subject…"(Participant No:3, Male, Cabin Supervisor)

"…A safe flight requires a healthy body and a healthy mind…the company recently offered us a psychological support service, but to what extent we have benefited…no one has time and energy for this, in fact, a vicious circle…however, success is in our hands in safety and satisfaction…what is it? If you sow it, you will reap it... then it's a simple distraction, lack of communication, panic, carelessness... is it your fault... Nothing is done so that these things don't happen or anyone causes them, which I would love to do. (Participant No:6, Female, Cabin Supervisor)

3. Conclusion

Research findings: It shows that flight safety requires the presence of flight psychologists in airline companies, flight (cockpit-cabin) crew plays an important role in ensuring flight safety and they have a positive attitude towards the necessity of flight psychologists in airlines. In this context, in similar studies, it is seen that only the cockpit crew, not the cabin crew, are included in the research in ensuring flight safety, but this situation reveals a distinctive feature of this research as it is necessary to include them in the research in which both play an important role in ensuring flight safety.

Particularly, it is understood that the participants expect from the airline companies and desire their support in terms of eliminating the psychological problems, discomforts or professional deformation and realizing safe flights. As it can be understood from the statements, it is clear that the employees need psychological support, but although there is a flight psychologist service provided to them, the external support is not at a satisfactory and sufficient level. Their expectation is that the company tells them unconditionally and that you are important to me, and that it provides or incorporates this service for the success and well-being of the company.

In addition, the high level of responsibility of the employees increases this need because they give themselves a great and important role in ensuring flight safety. In this context, the findings are in line with studies that emphasize that the flight crew plays a major role in ensuring flight safety in airline companies (Hochschild, 1983; Chute and Wiener, 1996; Murphy, 2001). In addition, the positive changes and results in the lives of employees who benefit from flight psychologist service can give us hope and be convincing about the necessity of airline companies to have a flight psychologist.

As a result, healthy and safe flights are important for both airline companies and the aviation community. For this reason, in order to avoid all kinds of negativity, it is necessary to listen to people, their psychological health as well as their physical health, their needs, problems, demands and expectations. As they say, the flight crew is the heart of the flight. It gives life to flight, adds vitality, catches the flow and dynamism, beats under all conditions, does not give up-resistance, and contains sensitivities…

Ethical approval

Not applicable.

Conflicts of Interest

The authors declare that there is no conflict of interest regarding the publication of this paper.

References

Ata, N. (2021). Türkiye'de Havacılık Psikiyatrisi ve Psikolojisi, Lokman Hekim Dergisi, 11 (1): 160-172.

Bureau d'Enquêtes et d'Analysespour la sécurité de l'aviation civile (BEA). (2016). Final Report -Accident on 24 March 2015 at Prads-Haute-Bléone (Alpes-de-Haute-Provence, France) to the Airbus A320-211 registered D-AIPX operated by Germanwings, (Accessible 10 December 2022 - https://www.bea.aero/uploads/tx_elydbrapports/BEA2015-0125.en-LR.pdf)

CAA, CAP 720. (2002). Flight Crew Training: Cockpit Resource Management (CRM) and Line-Oriented Flight Training (LOFT), ICAO, 217AN/132.

CAA, CAP 737. (2006). Crew Resource Management (CRM) Training, Guidance for Flight Crew, CRM Instructors (CRMIS) and CRM Instructor-Examiners (CRMIES).

Çetingüç M. (2018). Uçuş psikologları, Havacılık Tıbbı Bülteni 32:1022-3.

Chute, R.D. and E.L. Wiener. (1996). Cockpit-Cabin Communication: II. Shall We Tell the Pilots? The International Journal of Aviation Psychology, 6(3), 211–231.

Clark, G. I. and Rock, A. J. (2016). Processes contributing to the maintenance of flying phobia: A narrative review, Frontiers in Psychology, 7(754), 1-21.

Cropley, A.J. (2021). Qualitative research methods: A practice-oriented introduction for students of psychology and education, 3 rd updated, revised, and enlarged edition.

Foushee, H. C. (1984). Dyads and triads at 35,000 feet: Factors affecting group process and aircrew performance, American Psychologist, 39(8), 885.

Helmreich, R.L. and Foushee, H.C. (1993). Why Crew Resource Management? Empirical and Theoretical Bases of Human Factors Training in Aviation, in E.L. Wiener, R.L. Helmreich, B.G. Kanki (Eds.), Cockpit Resource Management, AcademicPress, San Diego, 3-41.

Hochschild, A.R. (1983). The Managed Heart: Commercialization of Human Feeling. London: University of California Press.

Jausan, M. Silva, J. and Sabatini, R. (2017). A holistic approach to evaluating the effect of safety barriers on the performance of safety reporting systems in aviation organisations, Journal of Air Transport Management, 63, 95-107.

Jensen, R.S. (1993). The Boundaries of Aviation Psychology, Human Factors, Aeronautical Decision Making, Situation Awareness, and Crew Resource Management, The International Journal of Aviation Psychology, 7, 4, 259-267.

Lasi, H. Fettke, P. Kemper, H. G. Feld, T. and Hoffmann, M. (2014). Industry 4.0, Business & Information Systems Engineering, 6(4), 239-242.

Martinussen, M. and Hunter, D.R. (2010). Aviation Psychology and Human Factors, CRC Press, Taylor and Francis Group, LLC.

Murphy, A. (2001). The Flight Attendant Dilemma: An Analysis of Communication and Sensemaking During In-Flight Emergencies, Journal of Applied Communication Research, S.29(1), 30-53.

Sias, P.M. (2005). Workplace relationship quality and employee information experiences, Communication Studies, 56(4), 375-395.

Sivil Havacılık Genel Müdürlüğü (SHGM). (2020). Havacılık Sağlık Talimatı (SHT-MED), Ankara.

Wilhelm, F.H. and Roth, W. T. (1997). Clinical characteristics of flight phobia, Journal of Anxiety Disorders, 11(3), 241-261.

Cite this article: Vural, S. (2023). Why Are Flight Psychologists Important to Flight Safety? Journal of Aviation, 7(1), 156-160.