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Sustainability and Operational Efficiency in Air Cargo: Insights from Turkish Cargo's Management Practices

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Abstract

This study examines the concepts of sustainability management and efficiency in air cargo companies. In particular, the impacts of sustainability-focused activities carried out by Turkish Cargo between 2018 and 2023 on operational efficiency were evaluated. Based on THY Inc.'s sustainability reports, we conducted a qualitative analysis by evaluating and interpreting Turkish Cargo's sustainability management and efficiency-focused initiatives. By extracting cargo data from the general reports published by THY Inc. between 2018 and 2023 and Turkish Cargo's sustainable management policies, we determined that the company primarily focuses on sustainable growth, environmental sustainability, social sustainability, and efficiency. We also found that Turkish Cargo aims to achieve efficiency through digitalization and fleet management during this period. This study addresses a gap in existing research by focusing on the evaluation of sustainability management and efficiency concepts in air cargo transportation. Our analysis of Turkish Cargo provides a unique example at both the sectoral and organizational levels by revealing the tangible results of sustainability management. Offering a new perspective on the integration of sustainability management with efficiency, this study contributes to the literature at both theoretical and practical levels.

Keywords: sustainability management, operational efficiency, air cargo

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Hava Kargoda Sürdürülebilirlik ve Operasyonel Verimlilik: Turkish Cargo'nun Yönetim Uygulamalarından Çıkarımlar

Öz

Bu çalışmada hava kargo şirketlerinde sürdürülebilirlik yönetimi ve verimlilik kavramları incelenmektedir. Özellikle, Turkish Cargo tarafından 2018-2023 yılları arasında yürütülen sürdürülebilirlik odaklı faaliyetlerin operasyonel verimliliğe etkileri değerlendirilmiştir. THY A.O.'nun sürdürülebilirlik raporları baz alınarak, Turkish Cargo'nun sürdürülebilirlik yönetimi ve verimlilik odaklı girişimlerini değerlendirip yorumlayarak nitel bir analiz gerçekleştirdik. THY A.O. tarafından 2018-2023 yılları arasında yayınlanan genel raporlardan kargo verilerini ve Turkish Cargo'nun sürdürülebilir yönetim politikalarını çıkararak, şirketin öncelikli olarak sürdürülebilir büyüme, çevresel sürdürülebilirlik, sosyal sürdürülebilirlik ve verimliliğe odaklandığını tespit ettik. Ayrıca, Turkish Cargo'nun bu dönemde dijitalleşme ve filo yönetimi yoluyla verimliliğe ulaşmayı hedeflediğini bulduk. Bu çalışma, hava kargo taşımacılığında sürdürülebilirlik yönetimi ve verimlilik kavramlarının değerlendirilmesine odaklanarak mevcut araştırmalardaki bir boşluğu gidermektedir. Turkish Cargo'ya yönelik analizimiz, sürdürülebilirlik yönetiminin somut sonuçlarını ortaya koyarak hem sektörel hem de kurumsal düzeyde benzersiz bir örnek sunmaktadır. Sürdürülebilirlik yönetiminin verimlilik ile bütünleştirilmesine yönelik yeni bir bakış açısı sunan bu çalışma, literatüre hem teorik hem de pratik düzeyde katkı sağlamaktadır.

Anahtar Kelimeler: sürdürülebilirlik yönetimi, operasyonel verimlilik, hava kargo

1. INTRODUCTION

The concept of sustainability has been adopted by businesses with its economic, environmental, and social dimensions, becoming integrated into management practices (Porter and Derry, 2012). All businesses are making efforts toward sustainability, striving to achieve efficiency through various sustainable management practices.

The aviation industry has become one of the leading sectors demonstrating significant efforts in sustainability, particularly concerning reducing environmental impact and utilizing advanced technology. The sector has made considerable strides in sustainability through efforts such as reducing fuel consumption and advancing digitalization. While these measures have enhanced efficiency on a business level, the industry continues to face challenges in achieving the desired levels of environmental and economic sustainability. Air cargo carriers have encountered substantial difficulties in their sustainability efforts following the COVID-19 crisis (Bartle et al., 2021).

Air cargo transportation, which plays a significant role in today's supply chain, faces increasing demand for the transportation of high-value and time-sensitive products in an internationally competitive environment. This rising demand not only increases air cargo traffic but also escalates the need for infrastructure and resources, thus negatively impacting sustainability.

Although there are numerous studies in the literature on sustainability in the aviation sector, it is seen that the studies that address the concepts of sustainability management and efficiency together are limited. For this reason, it was aimed to make an evaluation in terms of efficiency and sustainability management by conducting a document analysis on the sustainability reports of the air cargo company Turkish Cargo published by THY A.O. between 2018-2023, especially by examining them in terms of cargo data. In this context, the main research question was determined as "How can efficiency be achieved with sustainability management in air cargo companies?"

Most of the studies in the literature touch upon economic, environmental and social dimensions in sustainability management (Dyllick and Hockerts, 2002; Lozano, 2008). This research aims to examine the relationship between sustainability management and productivity in more detail through the example of an air cargo company. It is also expected to provide ideas on the sectoral applicability of sustainability management results. In short, it is thought that this research will contribute to the literature at theoretical and practical levels.

This paper has five sections. In the first section, a general framework of the study is drawn. In the second section, the concepts of sustainability management and efficiency are examined, and studies conducted on this subject in both air cargo companies and other sectors are emphasized. In the third section, the method of the research is explained with its limitations. In the fourth section, the findings of the research are given according to the years of the analyzed documents,

and the themes extracted from the examined documents are discussed separately. In the last section, the results obtained are discussed and directions are given for future studies.

2. BACKGROUND

2.1. Sustainability Management and Efficiency

Sustainability management is an important issue for businesses to achieve success in the long term. Sustainability is an important management approach that requires an integrated perspective in both eliminating environmental impacts and in social and economic terms. Since efficient and effective use of resources will reduce costs in businesses as well as environmental impacts, the concept of efficiency is also of critical importance in sustainability management. When the relevant literature is examined, it is seen that studies focusing on both concepts are increasing day by day. The connections between these two concepts are examined in the literature with different focal points. For example, there are various studies that explain sustainability management conceptually (Elkington and Rowlands, 1999; Dyllick and Hockerts, 2002; Lozano, 2008; Epstein and Buhovac, 2010; Schaltegger and Burritt, 2010). Studies examining these two concepts with a focus on development are also frequently encountered (Peşkircioğlu, 2016; Alagöz, 2007; Demirkıran et al., 2022; Sağbaş and Başbuğ, 2018; Çokmutlu, 2023; Hekimci, 2015; Bozoğlu and Ciğerim, 2022). Additionally, there are many studies in the literature that address sustainability and efficiency at the sectoral level construction (Süzen et al., 2017; Geçer et al., 2019; Han, 2023), fashion (Tatman et al., 2022), finance and banking (López et al., 2007; Gençoğlu and Aytaç, 2016; Arslan, 2019; Yeniçeri and Böcek, 2022; Akdoğan et al., 2023; Özaydın and Bicil, 2023), healthcare (Söğüt, 2023; Çavmak et al., 2024), transportation (Durrani and Forbes, 2004; Iacono and Levinson, 2016; Lee and Yoo, 2016; Wang et al., 2020; Chen et al., 2022; Júnior et al., 2024). The fundamental approaches and focal points of research into these two concepts are explained in this section in light of selected studies.

There are significant academic works that define and explain the concept of sustainability management from various perspectives. In a study that conceptually addresses sustainability (Elkington and Rowlands, 1999), the concept of the "Triple Bottom Line" is defined. In other words, the economic, social and environmental dimensions of sustainability are explained here. Another conceptual study was conducted by Dyllick and Hockerts (2002). In this study, the authors explain the value created by the concept of sustainability management on businesses. Similar to Elkington, they focus on economic, social and environmental sustainability. In another study that addresses sustainability in three dimensions, similar to Elkington, Lozano (2008) examines the integration of businesses into this three-dimensional structure by looking at sustainability management from a broad perspective. In a study that addresses the implementation of sustainability management in businesses (Epstein and Buhovac, 2010), the integration of this concept into businesses is similarly examined. Another study that examines

sustainability management within the accounting context (Schaltegger and Burritt, 2010) explains the use of this management strategy as a decision support mechanism by leaders.

Studies on the conceptual dimensions of sustainability management and efficiency are also frequently found in the literature (Fiksel et al., 2012; Starik and Kanashiro, 2013; Demirkıran et al., 2022; Tüyen, 2020; Polat and Akçakaya, 2022). Fiksel et al. (2012) address the relationship between sustainability and efficiency while developing a framework of sustainability indicators for the U.S. Environmental Protection Agency (EPA). The study focuses particularly on environmental performance and resource efficiency, discussing how industrial processes can be optimized to meet sustainability goals. Starik and Kanashiro (2013), in their research aimed at developing a theory in the field of sustainability management, argue that sustainability needs to be integrated with existing management theories and seek to uncover nearly obvious but often overlooked aspects in this field. This approach aims to create a new management framework that supports businesses in achieving environmental, social, and economic sustainability goals. The study analyzes different components of sustainability management and discusses how these elements can be integrated into management strategies. A key finding is that for sustainability management to be successfully implemented, environmental, social, and economic elements must be integrated into management strategies using a holistic approach. Demirkıran et al. (2022) aim to examine the effects of digitalization and the digital transformation process on efficiency from both theoretical and practical perspectives. The study analyzes variables determining the impact of digitalization on efficiency in Turkey between 2005 and 2020 using artificial neural network architecture. This method reveals the importance rankings of these variables. The findings suggest that efficiency gains can be encouraged by creating and determining the importance levels of the socio-economic environment within the digitalization process, thereby enhancing the potential for inclusive sustainable development.

Sectoral studies examining the concepts of sustainability and efficiency together explore how these two concepts can be integrated and their outcomes across various industries. Matos and Hall (2007) examine sustainable development and efficiency in the oil and gas and agricultural biotechnology sectors. In this study, an assessment is made on the life cycle in the integration of sustainability and efficiency. A different study was conducted on financial markets (López et al., 2007). In the research conducted on businesses in the Dow Jones Sustainability Index, financial performance is examined in the context of sustainability. In a different study including a sustainability review on the construction sector (Süzen et al., 2017), the need to develop sustainable strategies for industrial efficiency improvement in this sector is emphasized. Examining the connection between efficiency and sustainability management, Tseng et al. (2018) focused on the concepts of circular economy and Industry 4.0. In a different study on the health sector, Çavmak et al. (2024) revealed which factors determine sustainability in the services provided in this sector. According to the main result of the research, three categories were determined in terms of social, economic and environmental aspects, and the economic factor was revealed as the most important group. In their study examining sustainability in terms

of the aviation sector, Júnior et al. (2024) determined that the USA and China had low efficiency among 21 different countries they examined.

2.2. Sustainability Management and Efficiency in Air Cargo Operations

In the aviation sector, efficiency and sustainability-focused strategies in cargo operations aim to increase performance. Therefore, the effective use of sustainability-focused strategies aims to minimize environmental impacts. In addition, costs are also reduced. The combination of two important concepts in the sector ensures the effectiveness of sustainable practices. For example, a decrease in fuel consumption and an increase in energy efficiency. Air cargo companies that want to achieve their carbon footprint goals need to implement improvements in this sense to achieve their sustainability goals. When sustainability management is evaluated with a focus on efficiency, it provides cost reductions as it provides efficiency in resource use. It contributes to a reduction in fuel consumption and improvement of cargo operation processes. For these reasons, air cargo companies should address sustainability and efficiency in a holistic manner.

Many academic studies have been conducted on fuel saving, which is a very important issue in the aviation sector. In the relevant literature, there are three main focuses on fuel saving: social, technological, and operational (Sobieralski, 2023).

Chow and Fung (2009), who investigated technical efficiency in Chinese airports, revealed the existence of economies of scale in both passenger and cargo transportation in his main findings. Abeyratne (2013), in the focus of the aviation security conference organized by ICAO, focused on how sustainability and innovation concepts can be used to increase air cargo safety. Carlucci et al. (2018) emphasized the importance of airport size in Italian airports in their study. They concluded in their study that airport size has a significant effect on technical and scale efficiency. Hu et al. (2018), in their study, where they presented a theoretical and practical framework within the scope of air cargo terminal service quality, examined eight basic criteria on sustainability.

The causal relationships between these criteria were assessed through a D-ANP survey answered by 25 industry experts. Various strategies were drafted in response to service quality demands, and a reference framework for air cargo terminal operators was provided. Drljača et al. (2020) aimed to identify the environmental and safety aspects of the Air Cargo Transport Process at the operational level so that process managers could identify critical aspects and prevent potential negative effects on sustainability. Results showed that specific environmental and safety aspects of activities in the Air Cargo Transport Process have a significant impact on the reliability, functionality, profitability, and competitiveness of the entire process. Bartle et al. (2021) address the relevant opportunities and challenges in air cargo management and examine sustainability in light of the severe human and economic costs of the pandemic on a global scale. Suggestions are made for developing a more efficient cargo supply industry that minimizes negative impacts through sustainable development. Baxter (2021) employed a case

study research design to deeply examine the environmental measures and strategies adopted by airlines worldwide to eliminate carbon emissions from air cargo operations. The study period is from 2004 to 2021. The research reveals that airlines carrying cargo worldwide are aware of their environmental impacts and have therefore developed a comprehensive range of measures and strategies to eliminate carbon emissions. Mitchell (2022) provides a comprehensive examination of sustainability initiatives in the aviation industry and their impact on operational efficiency. Kierzkowski et al. (2023) proposed a new management model for scanning air cargo shipments. The aim of the study was to complete the scanning process within the expected time and with the lowest energy consumption.

Wang et al. (2023) examined the pollution damage situation created by air cargo operations in the Chinese economy between 1975 and 2020. The study showed that positive shocks in insurance services and green field investments reduce carbon emissions immediately and in the long term, while negative shocks such as fuel use and insurance access increase carbon damage in the short term. In addition, the contribution of positive and negative shocks related to air transportation in fuel use to carbon damage is revealed. The study emphasizes that air cargo operations should be supported by biofuel energy sources, green field investments and sustainable aviation insurance to achieve the goal of 'green clean' transportation. Beškovnik (2024) discusses the greening of air transportation chains.

The studies in the literature are important studies that evaluate sustainability management from an efficiency perspective in operations carried out in the air cargo sector and examine the effects of these two concepts on processing performance.

3. RESEARCH METHOD

Document analysis method was used as the research method in the study. Document analysis method provides the formation of research outputs through the process of coding the documents determined in accordance with the research purpose, in-depth examination, determination of themes and interpretation of the data (Bowen, 2009). As written documents begin to take their place in every aspect of our daily lives, the need to interpret and make sense of the information contained in these documents also arises. The document analysis method assists in the process of interpretation and interpretation (Davie and Wyatt, 2021). Analyzing documents published by various institutions and organizations on a sectoral basis has gained academic importance, and the data in these documents have provided resources for important studies. For this reason, document analysis is frequently used as a qualitative research method in research in different branches of science (Coffey, 2014). This method is also frequently used in the aviation industry research (Seamster and Kanki, 2017; Snyder and Kanakis, 2017). When using document analysis in research, difficulties in terms of finding sources, data redunancy, risk of bias, validity and security risks, and excessive time requirement are encountered (Bowen, 2009). In the study, the use of reports declared by THY A.O. to international aviation organizations, which are accepted in terms of validity and security, has eliminated the risks of finding sources

and data security. In addition, the evaluation of the last 5-year period in the study has eliminated the difficulties of data redundancy and excessive time requirement.

Within the scope of the research, the sustainability practices and activities of the subsidiary company Turkish Cargo will be examined based on the sustainability reports published by Turkish Airlines Inc. between 2018-2023. In this study, inferences were made about the effectiveness of sustainability management in the context of cargo transportation with the evaluation made on a yearly basis using secondary data. In the study, the absence of a sustainability report based on air cargo companies, which reveals the details of air cargo data more clearly, caused the inability to obtain results through quantitative analysis. For this reason, the cargo data accepted in the secondary category obtained from the reports were evaluated qualitatively and inferences were made. Annual evaluations have created advantages in terms of observing developments. In addition, many details included in the sustainability report have provided an opportunity to have a general perspective. Since official documents published directly by the relevant organization were used as data sources in this study, the data obtained can be considered reliable.

The sustainability report, which is evaluated on an annual basis, allows determining the themes in the sustainability management of the air cargo company and answering the question "How can efficiency be achieved with sustainability management in air cargo companies?".

The evaluations made based on the results obtained from the reports were evaluated in the light of important studies in the literature and the focal points of the sustainability management activities carried out by Turkish Cargo company with its efficiency efforts were tried to be determined.

4. FINDINGS

In the 2018 Turkish Airlines (THY) Sustainability Report, some information related to air cargo sustainability management was obtained (THYSR, 2018).

In the context of sustainable growth, in 2018, Turkish Cargo transported 1,412,423 tons of cargo. It was emphasized that air cargo transportation is on a strong growth trend and that this trend will continue to accelerate with new cargo investments at Istanbul Airport. THY A.O. reported that 12.885 million USD in revenue earned in 2018 was 12.8% from cargo revenue.

In 2018, Turkish Cargo was awarded several accolades, including: Best Air Cargo Carrier in Europe (Asian Freight Logistics and Supply Chain Awards), Most Eco-Friendly Air Cargo Carrier (Asian Freight Logistics and Supply Chain Awards), Air Cargo Carrier of the Year (World Air Cargo Awards), Air Cargo Brand of the Year (Stat Times Awards), and Second Best Air Cargo Brand in Europe (Schiphol Aviation Awards).

In the context of sustainable environmental management, online training contents on environmental and greenhouse gas awareness were developed, and 1,057 cargo personnel

participated in these trainings. It was mentioned that effective waste management projects were tried to be implemented in every level of cargo operations and in every area of office activities. It was also stated that a significant result was obtained in recycling by generating electricity from natural gas in the warehouse trigeneration facility.

As of 2018, the fleet included 22 cargo aircraft. It was noted that with the goal of minimizing environmental impacts in cargo transportation, the Boeing 777F aircraft, which joined the Turkish Cargo fleet in 2017 and continued its deliveries in 2018, compared to older generation cargo aircraft with similar capacity and range, it provided 20% lower emissions, 20% less noise and 15-20% fuel savings.

In the context of social sustainability, it was decided to support Somalia, the only international airline serving the country under threat of famine and hunger in the African continent, by providing aid. Millions of dollars worth of food and relief materials collected via social media were delivered to the people of Somalia using two cargo aircraft. Additionally, it was mentioned that safety programs specific to cargo operations were implemented, and continuous efforts were made to ensure that cargo transportation is conducted in compliance security regulations and standards, and to prevent any form of illegal interference.

The 2019 THY A.O. Sustainability Report provides information on air cargo sustainability management (THYSR, 2019).

In the context of sustainable growth, Turkish Cargo transported 1,543,028 tons of cargo in 2018. It was also noted that investments in Istanbul Airport were aimed at increasing the market share in air cargo transportation. THY A.O. reported that 12.8% of the $13,229 million revenue obtained in 2019 was from cargo.

In 2019, Turkish Cargo received awards for Airline Cargo Brand of the Year (Stat Times Awards), International Air Cargo Market of the Year (Stat Times Awards), Air Cargo Brand of the Year (ICN Awards), Air Cargo Brand of the Year (Air Cargo News Award), and Air Cargo Brand of the Year (Logitrans).

In the context of sustainable environmental management, it was reported that 1,216 employees completed the "Cargo Personnel Environmental Awareness Training" aimed at increasing awareness of environmental impacts from work areas, and 3,965 people completed the "Greenhouse Gas Awareness" remote training. Additionally, the tri-generation facility located at the cargo site continued to produce electricity from natural gas, and the generated electricity met the needs of both the cargo and headquarters facilities. It has been mentioned that efforts are being made to convert the cooling water and flue gas heat generated during the production process into efficiency through absorption coolers.

It was reported that as of 2019, there were 23 cargo aircraft in the fleet. The same efficiency performance was achieved with the Boeing 777F, which started to join fleet in 2018 and continued to be delivered in 2019.

In the context of social sustainability, it was mentioned that a "Competency Development Program" was launched for managers in the General Manager (Cargo) Assistant position, supported by coaching sessions based on competencies and development areas.

The 2020 THY A.O. Sustainability Report provides information on air cargo sustainability management (THYSR, 2020).

The year 2020 was marked as the year when the effects of the COVID-19 pandemic were most intensely felt in the aviation sector, with this impact evident across all operations and data. The Chairman of the Board of THY A.O. emphasized in the sustainability report: "As Turkish Cargo, we played a very active role in vaccine transportation by preparing the necessary infrastructure to ensure the cold chain for COVID-19 vaccines was maintained. We became the first airline to hold IATA CEIV certification in three different categories: health products, live animals, and perishable goods. Turkish Cargo, continuously transporting pharmaceuticals, medical supplies, medical equipment, humanitarian aid, and food around the world, was awarded the Best Air Cargo Brand in Europe in 2020. Additionally, despite all the challenges brought by the pandemic, Turkish Cargo achieved a record revenue of 2.7 billion USD with a 61% increase in total cargo revenue, transporting approximately 1.5 million tons of cargo during this period."

In the context of sustainable growth, Turkish Cargo has had a significant market share in the transportation of medicines, medical supplies, masks, medical equipment, humanitarian aid and food during the pandemic. It has increased its share in the air cargo sector by 4.7%. This increase has brought the company to 6th place in the global air cargo traffic ranking. The goal of being among the top three brands in global air cargo transportation has been formed in this direction. Turkish Cargo aims to be one of the most active air cargo carriers in the sector, especially in vaccine transportation. In 2020, Turkish Cargo transported 1,487,233 tons of cargo. The cargo unit revenues reached a record level of 2.7 billion USD with a 66% increase in 2020. Cargo revenues accounted for 40.4% of total revenues. It was noted that the negative impacts on passenger revenues were offset by cargo revenues. In 2020, the highest volumes of cargo transported were pharmaceuticals, vaccines, medical equipment, and laboratory equipment.

Turkish Cargo was awarded the titles of Fastest Growing Air Cargo Brand of the Year (Stat Times Awards), Best Air Cargo Brand in Europe (Air Cargo News Award), Air Cargo Brand of the Year (Atlas Logistics Awards), Air Cargo Brand of the Year (Payload Asia Awards), and Best Air Cargo Brand in Europe (AFLAS Awards) in 2020.

In terms of environmental sustainability, the Cargo Fast Dispatch Hub Building and the Cargo Loading Equipment Repair Workshop at Istanbul Airport received LEED Green Building certification. Additionally, wooden materials used for securing cargo were converted into wooden transport pallets in the carpenter workshop, resulting in the creation of 101,530 wooden pallets in 2020, thereby preventing waste formation.

As of 2020, it is noted that there were 25 cargo aircraft. Fleet productivity remained at the same level with aircraft delivered in 2018 and 2019.

In the context of social sustainability, audits related to COVID-19 were carried out and the identified non-compliance issues were communicated to the managers. In addition, in 2020, Turkish Cargo became the first air cargo carrier to join the Air Cargo Sustainability Program managed by the International Air Cargo Association (TIACA), which aims to cooperate with other stakeholders in the sector on issues such as carbon footprint, new technologies, process improvement, innovation and training.

The 2021 THY A.O. Sustainability Report provides some insights into air cargo sustainability management (THYSR, 2021).

In the context of sustainable growth, Turkish Cargo transported 1,879,552 tons of cargo in 2021, representing a 26.4% increase. Cargo revenues rose by 48% to reach 4.0 billion USD, with cargo revenues constituting 37.5% of total revenues.

In 2021, Turkish Cargo was awarded the Air Cargo Excellence Award (WOF Expo) and the Best Air Cargo Brand of the Year (Istanbul Economy Summit).

The COVID-19 pandemic significantly impacted the air cargo sector in 2021, with a parallel increase in demand due to the rise in online commerce practices. The rapid development of global online trade has highlighted the need for logistics processes that can be managed remotely, monitored, and executed through digital business processes. Consequently, numerous digital applications have been introduced to manage these processes.

In terms of environmental sustainability, it is noted that the cargo and ECB buildings completed at Istanbul Airport in 2021 utilize heat recovery ventilation systems, achieving thermal efficiency of between 50% and 70%.

It is stated that there are 20 cargo aircraft as of 2021. It has continued to develop its fleet in order to expand its cargo operations. In addition to these aircraft, Turkish Cargo continued its operations with wet-lease leased aircraft in its fleet.

The 2022 THY A.O. Sustainability Report provides some insights into air cargo sustainability management (THYSR, 2022).

In the context of sustainable growth, Turkish Cargo transported 1,678,953 tons of cargo and mail in 2022. Cargo revenues decreased by 7% to 3.7 billion USD, with cargo revenues accounting for 20% of total revenues. The report notes that investor and shareholder demands included issues such as the potential division of THY Cargo. Additionally, it highlights that Turkish Cargo has approached its goal of becoming the world's third-largest air cargo carrier with the SmartIST infrastructure established at Istanbul Airport.

In terms of environmental sustainability, it was stated that the climate control system in the live animal cargo section at the Istanbul Airport center was renewed in 2022 to provide 100% fresh air and heat recovery. It is stated that this situation provides 65% thermal efficiency. This efficiency led to an annual 20% saving in electrical energy consumption.

As of 2022, it is indicated that there were 21 cargo aircraft. The A330-200F and B777-200LRF aircraft added to the Partnership fleet continued to be used throughout 2022. Additionally, wet lease cargo aircraft were rented during 2022 to support cargo operations, alongside the cargo aircraft acquired from manufacturers.

In 2022, Turkish Cargo developed digital tools such as the SmartDock Vehicle Guidance System, Shipment Tracking API System, and Work Order application, contributing to the improvement of processes.

In the context of social sustainability, Turkish Cargo initiated a collaboration to implement a special discounted transportation program for Turkey Exporters Assembly (TIM) members, aimed at encouraging Turkish exporters. Additionally, the Destination of The Week program provided discounted cargo transportation services through agents on routes determined by the Partnership.

The 2023 THY A.O. Sustainability Report provides some insights into air cargo sustainability management (THYSR, 2023).

In the context of sustainable growth, Turkish Cargo transported 1,658,686 tons of cargo and mail in 2023. Although cargo revenue decreased by 30% to 2.6 billion USD, this figure remained 43% higher than pre-pandemic levels. Cargo revenue accounted for 12.3% of total revenue. Turkish Cargo, operating at SmartIST in Istanbul Airport, ranked fourth in global cargo traffic in 2023. The 2033 strategy emphasizes the goal of becoming one of the top 3 cargo carriers by 2028, through capacity expansion at SmartIST, digitalization, a focus on special cargo segments, and the implementation of door-to-door delivery with e-commerce.

In 2023, Turkish Cargo was awarded the Sustainable Air Cargo Brand of the Year (Freightweek Sustainability Awards-Europe 2023) and the Innovative International Air Cargo Brand of the Year (Air Cargo INDIA 2024).

As of 2023, Turkish Cargo operates with 24 cargo aircraft. The A330-200F and B777-200LRF aircraft added to the Partnership fleet continued to be used throughout 2022. Additionally, wet lease cargo aircraft were rented during 2022 to support cargo operations. In 2023, Turkish Airlines added four aircraft to its cargo fleet. Furthermore, the sale of older aircraft in the fleet and the conversion of wide/narrow-body aircraft into cargo aircraft for enhancing efficiency in cargo operations were prioritized in the sustainability management framework for 2023.

Focusing on digitalization and customer satisfaction, Turkish Cargo introduced the WhatsApp chatbot Cargy application in 2023, providing live support services. This feature allowed customers to be instantly informed about changes in cargo statuses.

On February 6, 2023, Turkey experienced devastating earthquakes in 10 provinces. During this period, emergency relief supplies were transported to the affected regions via unscheduled flights. Turkish Cargo aircraft played a crucial role in delivering humanitarian aid, equipment, generators, tents, and other urgent necessities in the aftermath of the disaster. It is reported that 36,000 tons of humanitarian aid materials were delivered to the affected areas during this period.

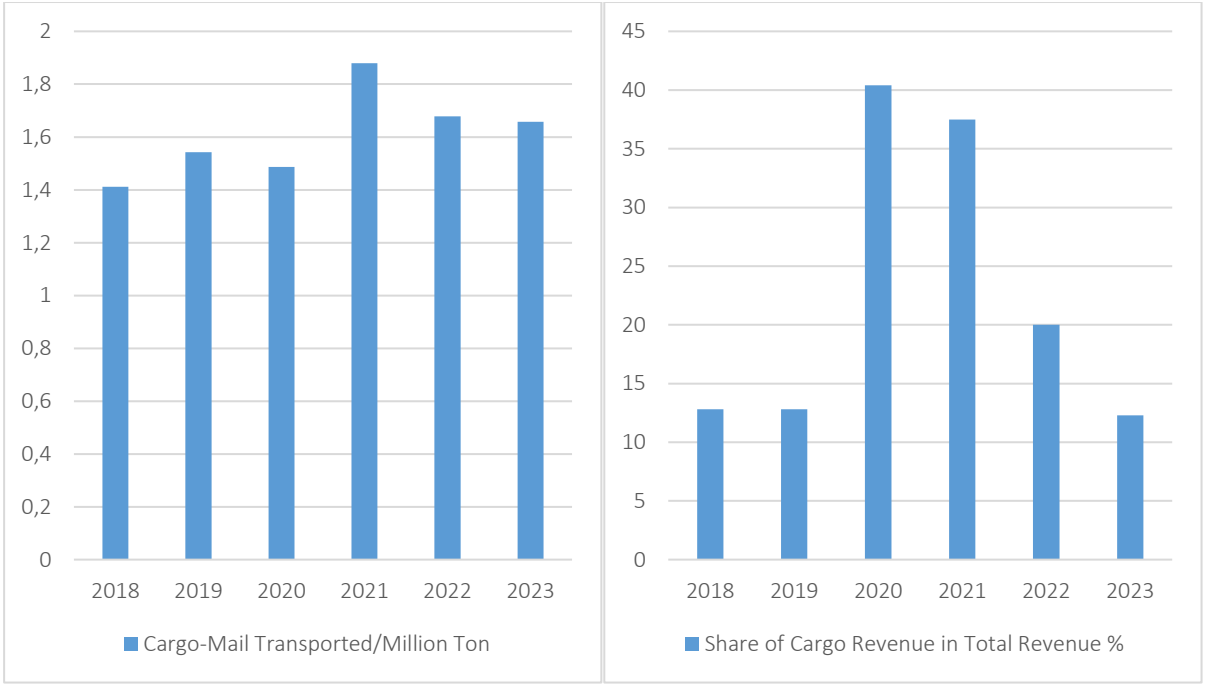
4.1. Efficiency and Sustainability Management in Turkish Cargo

From 2018 to 2023, an examination of the general reports published for Turkish Airlines Inc. reveals a focus on achieving sustainable growth, environmental sustainability, and social sustainability through efficiency. These concepts can be considered as the basic themes of Turkish Kargo's sustainable management. Additionally, it has been determined that Turkish Cargo has aimed to enhance efficiency through digitization and fleet management during this period. This section provides an evaluation of air cargo sustainability management within the context of the reports examined.

4.1.1. Sustainable Growth

Turkish Cargo has increased its market share due to factors such as the growth trend in air cargo transportation, increased demand for medical supplies during the pandemic, the rise in transportation volume resulting from the growth of online commerce during and after the pandemic, the transition to advanced facilities at Istanbul Airport, and the increased cargo handling capacity with the SmartIST infrastructure.

Figure 1. Cargo-Mail transported/million tons and the share of cargo revenue in total revenue % (2018-2023)



Source: THYSR (2018; 2019; 2020; 2021; 2022; 2023)

When examining the volume of cargo transported, a significant increase is observed in 2021 in response to the surge in demand due to the pandemic and the growth in online commerce. Additionally, Figure 1 illustrates the growth trend in the volume of cargo and mail transported. Turkish Cargo, which saw a rise in cargo revenues due to activities conducted during the pandemic and the decline in passenger revenues, has achieved a significant position within total revenues. Although cargo revenues decreased as a proportion of total revenue in 2022 and 2023 due to the recovery and growth in passenger transportation, it can be said that there has been a continued growth momentum in cargo compared to pre-pandemic levels. The pandemic period has had a positive impact on sustainable growth for Turkish Cargo.

The data in the graph reveal that Turkish Cargo's air cargo transportation is on a strong growth trend. In the literature, air cargo transportation is considered to be a growing sector responding to the increasing pace of global trade and the logistical demands required by international trade (Bowen, 2000; Kasarda and Green, 2005; Jelti and Saadani, 2024). Air cargo plays a critical role in the transportation of time-sensitive and high-value products; thus, the growth trend in the sector is closely related to the increase in economic activities and the expansion of global trade (Bartle et al., 2021).

New cargo investments at Istanbul Airport (Utikad, 2024; Özbek, 2024; İstAirport, 2024) are expected to support this growth trend and enable Turkish Cargo to enhance its capacity and gain a competitive advantage. Infrastructure investments will improve the efficiency of cargo

operations, thereby supporting sustainable growth objectives and reinforcing long-term competitive strength.

This figure highlights the strategic importance of air cargo transportation within the company's total revenues. The significant share of cargo revenues in the company's financial performance underscores the contribution of air cargo transportation to economic sustainability. In the literature, diversified revenue sources in the aviation sector are considered a critical factor for enhancing the financial sustainability of businesses (Wensveen, 2015).

4.1.2. Environmental Sustainability

Within Turkish Cargo, environmental sustainability is achieved through measures such as reducing environmental impacts, increasing awareness of greenhouse gases, implementing waste management, preventing resource wastage through recycling, and executing zero waste and recycling initiatives.

The introduction of next-generation aircraft has led to a 20% reduction in emissions, 20% less environmental noise, and 15-20% fuel savings compared to older-generation cargo aircraft. Efficiency has been achieved through the production of electricity from natural gas at cargo facilities, conversion of cooling water and exhaust gas heat from the production process into useful energy with absorption chiller devices, and adherence to green building standards. Efficiency is also supported by recycling wooden materials, managing waste, and preventing resource wastage. Additionally, using heat recovery air conditioning units in building ventilation systems has resulted in 50-70% thermal efficiency and a 20% saving in electrical energy.

Turkish Cargo's award for "Greenest Air Cargo Carrier" in 2018 demonstrates the company's commitment to environmental sustainability. In the literature, environmental sustainability is increasingly recognized as a significant issue in air cargo transportation. Environmental sustainability strategies encompass elements such as ensuring the continuity of natural resources, reducing carbon footprints, implementing energy efficiency practices, and adopting eco-friendly technologies (Güneş and Güneş, 2013; Turgut and Budak, 2022; Çelebi, 2024). The awards received by Turkish Cargo in this domain reflect the effectiveness of its environmental management systems and its adoption of best practices in the industry. Additionally, awards such as "Air Cargo Carrier of the Year" and "Air Cargo Brand of the Year" highlight Turkish Cargo's operational excellence and brand value. Such awards are granted based on factors like customer satisfaction, service quality, and operational efficiency, and the literature emphasizes that operational successes positively impact brand loyalty and customer trust (Zeithaml et al., 1996; Heskett, 1997). The awards received by Turkish Cargo can be considered as elements reinforcing its leadership position in the sector and providing a competitive advantage.

The creation of online training content on environmental and greenhouse gas awareness for 1,057 cargo personnel is a critical step in increasing employees' environmental responsibility awareness. The literature provides strong evidence that environmental education and awareness programs enhance employees' capacity to adopt and implement environmental sustainability practices (Ramus, 2001; Fernández et al., 2003; Daily et al., 2007). Furthermore, the establishment of a trigeneration facility producing electricity from natural gas at the cargo base represents a significant step in improving energy efficiency and reducing environmental impacts. The literature highlights that energy efficiency projects, such as trigeneration systems, have the potential to reduce energy costs and lower carbon emissions for businesses (Chicco and Mancarella, 2009).

4.1.3. Social Sustainability

Turkish Cargo demonstrates its commitment to social sustainability through various projects and policies implemented each year. In 2018, efforts included delivering aid collected via social media to Somalia, implementing safety programs specific to cargo operations, maintaining cargo transportation in compliance with national and international security standards, and taking measures to prevent any form of illegal intervention.

Another aspect of social sustainability can be seen in educational efforts. Examples of such efforts include providing zero waste and greenhouse gas awareness training to cargo personnel and managers, as well as training related to the COVID-19 process in 2020. Turkish Cargo also proved its commitment to sustainability by becoming the first air cargo carrier to join the Air Cargo Sustainability Program conducted by the International Air Cargo Association (TIACA) in 2020.

Turkish Cargo played a significant role in transporting COVID-19 vaccines by preparing the necessary infrastructure to ensure the cold chain was maintained. It demonstrated notable social responsibility by continuously transporting medicines, medical supplies, medical equipment, humanitarian aid, and food across the globe. In 2022, Turkish Cargo’s efforts to incentivize Turkish exporters through a special discounted transportation program were also significant in the context of social sustainability.

In 2023, following the devastating earthquakes on February 6, referred to as the disaster of the century, Turkish Cargo undertook a crucial role by delivering all essential emergency supplies to the affected region from the earliest hours of the disaster, transporting 36,000 tons of humanitarian aid. This activity is considered a significant social assistance effort.

Turkish Airlines' efforts in aid and security measures address two significant aspects of social sustainability: humanitarian aid and operational security. In the literature, large enterprises such as airlines contributing to local and international communities through social responsibility projects are considered a critical factor in supporting social sustainability (Kolk and Van Tulder, 2010; Pomering and Dolnicar, 2009). These two examples illustrate Turkish Airlines' efforts to

achieve its social sustainability goals. Both humanitarian aid and operational security practices can be seen as part of the social responsibility approach and can provide long-term societal benefits.

Turkish Cargo's aid activities and assumed responsibilities, sensitive to both international and national issues, have generated efficiency advantages in various aspects, such as brand awareness, customer satisfaction, and business image.

4.1.4. Digitalization

One of the most important activities in sustainable management, digitalization has been a focus for many years; however, it has gained significant prominence in sustainability reports as of 2022. In 2022, Turkish Cargo implemented several digital tools such as the SmartDock Vehicle Guidance System, Shipment Tracking API System, and Work Order application, which have contributed significantly to process improvements and efficiency. The primary benefits of these tools include enhanced customer satisfaction, time savings, and process improvements. In 2023, the introduction of the WhatsApp chatbot Cargy application indicates that efforts towards digitalization and efficiency have continued positively.

4.1.5. Fleet Management

In sustainability management, fleet management is crucial for reducing environmental harm, ensuring operational continuity, and maintaining transport capacity. In this context, it is observed that Turkish Cargo has been working to increase the number of aircraft in its fleet, while aiming to include aircraft that produce lower emissions, generate less environmental noise, and offer fuel savings. Since 2017, the addition of new-generation Boeing 777F aircraft to the fleet has provided significant efficiency advantages, including 20% less emissions, 20% less environmental noise, and 15-20% fuel savings compared to older generation cargo aircraft.

Table 1. Turkish cargo aircraft numbers

2018	2019	2020	2021	2022	2023
22	23	25	20	21	24

Source: THYSR (2018; 2019; 2020; 2021; 2022; 2023)

As of 2021, in addition to incorporating A330-200F and B777-200LRF aircraft into its fleet, Turkish Cargo continued operations with wet-lease aircraft. As shown in Table 1, the reduction in the number of aircraft in 2021 was due to the retirement of older aircraft and the filling of this gap with leasing operations. By 2022, it can be said that a significant portion of the fleet consisted of new generation aircraft due to the increase in the number of aircraft. In the context of sustainability management for 2023, key issues included the sale of older aircraft in the fleet and the process of converting wide/narrow-body aircraft into cargo aircraft to enhance efficiency in cargo operations. This approach is expected to increase the number of aircraft

available for cargo transportation and enable the efficient utilization of aircraft that might otherwise become idle.

5. DISCUSSION and CONCLUSION

The concept of sustainability has become an important approach adopted by businesses with its economic, environmental and social dimensions. Businesses aim to achieve efficiency with the practices, strategies and policies they implement within the scope of sustainability management. Sustainability management and efficiency have common interests in reducing environmental impacts, preventing resource waste, reducing costs and optimizing processes.

Sustainability and efficiency can be seen as two complementary elements in the air cargo sector. Air cargo businesses aim to reduce emissions, minimize fuel consumption, increase energy efficiency, etc. with the strategies they implement. These strategic approaches also provide businesses with competitive advantage and economic sustainability.

This study investigates how Turkish Cargo achieved efficiency through sustainability-focused activities carried out between 2018 and 2023. It was concluded that the sustainability management strategies implemented by the business had a positive impact on operational efficiency. In the context of sustainability, especially fuel efficiency, reducing carbon emissions and improving operational processes are considered important in terms of the company's sustainability performance.

When Turkish Airlines (THY) 2018-2023 sustainability reports are examined in detail in terms of cargo, it shows that Turkish Cargo's activities in the fields of sustainable growth, environmental and social sustainability come to the fore. During this period, Turkish Cargo increased its market share especially with its investments in Istanbul Airport and achieved a significant growth trend in cargo transportation. As of 2023, Turkish Cargo ranked fourth globally.

In terms of environmental sustainability, Turkish Cargo has given great importance to fleet modernization and has worked to continuously improve the fleet in cargo transportation to reduce environmental noise while providing energy efficiency. In addition, during this process, it has achieved significant environmental sustainability and efficiency by obtaining green building certificates for cargo facilities, recycling waste materials and accelerating digitalization processes.

The field of social sustainability stands out as the area where Turkish Cargo is most successful with the rapid response to events. In addition to health, education and humanitarian aid projects, it has gained a very important image in national and international media especially with the logistic support provided during the COVID-19 pandemic and the 2023 earthquakes. With these processes, Turkish Cargo has proven that it has gained momentum by winning numerous industry awards and achieving sustainability goals.

Turkish Cargo has been focusing on digitalization activities in recent years and has achieved efficient results in terms of customer satisfaction and process improvement with the applications it has developed.

In summary, it can be said that sustainability management is a necessity for all businesses operating in the air cargo sector in general. It can be said that the implementation of sustainable management strategies can provide significant environmental, economic and social benefits, thus ensuring sustainability in terms of efficiency. As a result, it can be said that a strong relationship between sustainability and efficiency will be an important factor in shaping the future success of air cargo businesses.

It has been concluded that the adoption and diversification of sustainable management strategies by air cargo businesses will have a positive impact on businesses in every aspect.

This study was created only from cargo data obtained from THY A.O.'s general sustainability reports. Therefore, a limited evaluation of sustainability management was made. Future research can expand this topic by including detailed data analyses to obtain quantitative results on efficiency performance.

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