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Exploring Cargo Potential of an Airport: Pre-Feasibility Study and Policy Recommendations for Hasan Polatkan Airport

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Abstract

Although air passenger transportation has grown steadily since liberalization movements, it has experienced a sharp decline with the COVID-19 pandemic. However, air cargo transportation has been relatively less affected by this crisis due to the increasing volume of e-commerce and the critical importance of supply chains. Air cargo positively affects the regional economy through the logistics and trade channels it provides. This study aims to investigate Eskişehir Hasan Polatkan Airport's cargo transportation potential and make its pre-feasibility as an air cargo hub. In this context, as a case study, interviews were conducted with stakeholders regarding the cargo potential of Hasan Polatkan Airport, and qualitative data were obtained. The authors qualitatively analyzed the data, and the findings were compiled under two headings: findings on demand and findings on technical/operational requirements. Considering these findings, alternative business models are discussed, and different policy recommendations are provided.

1. Introduction

With the increasing globalization, the importance of air cargo transportation has also been growing. Typically, small, light, compact, high-value-added new products are increasingly being transported by air at an accelerating pace and flexibly (Button and Yuan, 2013; Tuncer and Aydoğan, 2019). Despite a 65.9% decrease in revenue passenger kilometers (RPK) compared to 2019 across the industry due to the Covid-19 impact, the decline in cargo ton kilometers (CTK), supported by various aids and the increase in e-commerce, remained at only 9.1% for the same year (IATA, 2020). In Türkiye, according to the data for 2020, the first year affected by the pandemic, annual passenger traffic decreased by approximately 60% in parallel with the world, while cargo traffic decreased by only 10% (DHMİ, 2021). Air cargo transports only 1% of the volume of world trade but carries 35% of its monetary value (more than 6 trillion US dollars) (IATA, 2021). Air cargo operations contribute to increased income for airports and the surrounding community and increase the utilization rate of airport facilities (Golicic et al., 2003). Therefore, the occurrence of air cargo flights in a city will also increase the prosperity level of that city. However, before deciding to start air cargo operations at a new airport, airports should determine the feasibility of such an initiative. Airports must comprehensively assess the air cargo market to determine whether they can secure a satisfactory market share. In this context, the present study is designed to investigate the potential for air cargo in Eskişehir.

International freight is a fundamental requirement for the development of international trade. Numerous studies provide compelling evidence that air cargo services are a crucial driver of economic growth and international trade in today's dynamic global economy (Yu and Zou, 2022). In studies focusing on specific airports in the air cargo field, there has been a concentration on the general analysis of air cargo centers (Zhang, 2003), demand analysis and modeling (Lo et al., 2015; Magaña et al., 2017; Wadud, 2013), and air cargo tariff and planning (Derigs and Friederichs, 2013). However, no previous study has been conducted to investigate the air cargo potential of a city where regular air cargo flights have not been conducted before, and a pre-feasibility study has been conducted on it.

Research indicates that factors such as the volume of imports and exports, production, and employment opportunities explain the increase in air cargo traffic (Kupfer et al., 2017; Lakew and Tok, 2015). One of the reasons for choosing Eskişehir as a cargo case in this study is primarily due to its significant opportunities in terms of railway, highway, and airway transport. Additionally, with these opportunities, the city is centrally located among Türkiye's highly populated and industrialized cities, such as İstanbul, Ankara, İzmir, Bursa,

Konya, and Antalya. Eskişehir, which has dense road and railway connections and is close to major ports, houses two logistics centers. Unlike the Turkish average, Eskişehir recorded a surplus between 2014 and 2018. Furthermore, Eskişehir monopolizes producing diesel locomotives, aircraft engines, and compressors (coolers). In 2018, the United States was the country with which Eskişehir conducted the most exports and imports. However, most of Eskişehir's significant export partners are European countries. The other countries with which Eskişehir conducts the most imports are France, China, and Germany, respectively.

2. Significance and Literature

Air cargo transportation is not a heavily researched area in the aviation literature. Some argue that cargo transportation at airports is an airline activity and has little impact on the economic performance of the airport; hence, it is not considered important. While air cargo may not be significant for many airports and airlines, for some airports, it constitutes a substantial portion of their revenue. For instance, at the Cincinnati/Northern Kentucky International Airport, cargo airlines operate half of the total flights, and DHL alone contributes to 14% of the airport's operational revenue (Mayer, 2016).

Several factors influence an airport's ability to attract cargo traffic. These factors include airport infrastructure capacity, regional and intercontinental airport network connectivity, service quality, and cost factors. Air cargo transportation is inherently a highly competitive sector. This is because, except for urgent cargo, many types of cargo are insensitive to routing. For a shipper sending cargo from New York to Kuala Lumpur, whether the cargo goes through Tokyo, Hong Kong, or Shanghai is not essential. What matters is that the cargo arrives in Kuala Lumpur on time. Shippers can often choose from multiple routes and carriers when sending their cargo. Therefore, airports compete more in air cargo than passenger transportation (Ohashi et al., 2005).

Air cargo transportation is experiencing rapid growth worldwide for several reasons. Firstly, the production of lightweight but high-value products is increasing. Between 80% and 90% of the international transportation of medical products and microelectronics is carried out by air transportation. Secondly, with the shortening of product life cycles and the adoption of just-in-time manufacturing philosophies, there is a growing need for rapid transportation to ensure products reach markets quickly. Thirdly, air transportation costs have significantly decreased over the past 20 years, particularly with the introduction of wide-body aircraft and cargo carriage in passenger aircraft (Yuan et al., 2010).

On the other hand, the increasing importance of air cargo necessitates airports to plan and develop their air cargo capacities to meet growing demands. This is particularly crucial for regional airports, especially when major airports reach their capacity limits. To effectively enhance air cargo operations, regional airports must understand the specific requirements of their industries and tailor their facilities accordingly. Market Opportunity Analysis (MOA) enables airport management to assess macro-opportunities, identify target industries, and develop marketing strategies to design appropriate air cargo facilities. Each city and airport is unique regarding target industries and customers, so the MOA process should be conducted specifically for each airport (Golicic et al., 2003).

Studies examining airport selection for air cargo transportation have identified several factors evaluating the cargo potential of selected airports. For instance, Zhang (2003) studied Hong Kong International Airport and concluded that airports closer to shippers, with lower total costs and faster cargo throughput, have a greater chance of becoming regional air cargo hubs. Zhang and Zhang (2002) emphasized the importance of customs efficiency in air cargo transportation. Airport fees could be a significant factor in air cargo carriers' choice of airports. However, Zhang (2003) found contrasting findings with the example of Hong Kong. According to this study, although Hong Kong is the world's most expensive airport, airport fees account for only 7% of the total costs for air cargo carriers. Buyck (2002) found that airports open 24/7 and without noise restrictions are much more preferred by air cargo carriers. Bakhitiyorjon and Lee (2017) comprehensively reviewed the literature on factors influencing cargo airlines' airport switching decisions. The findings indicated that constraint-related issues (such as night flight restrictions and customs management) harm the airport-airline relationship, followed by location issues (such as lack of demand between departure-arrival points). Hong and Zhang (2010) used data from 29 airlines from 1998 to 2002 and found that airlines carrying more cargo are more efficient than those carrying less cargo. In a study evaluating the suitability of Venango Regional Airport for air cargo operations, Baker (2020) found limited potential for the airport's current cargo operations. This was primarily attributed to the airport's proximity to existing air cargo hubs and airports. However, the study also highlighted the opportunity for Venango Regional Airport to provide specialized air carrier services based on demand.

This study evaluates the air cargo potential of Eskişehir Hasan Polatkan Airport, which has not been previously examined in the literature. The research results were first converted into a technical report, and then the updated version was published in this study (Şengür et al., 2019). The airport has been assessed in terms of aspects mentioned in the literature, such as noise restrictions, cost, and proximity to cargo centers, and recommendations have been made to contribute to the literature.

3. Materials and Methods

The study employed a case study method. According to Creswell (2007), case studies are conducted using a specific incident as a sampling tool to understand a problem, and they are researches that investigate a problem with one or more situations within a limited system. They are generally considered qualitative research and are an appropriate method for assessing contextual conditions (Yin, 2008). A detailed analysis of the data obtained from the interviews conducted in the study was carried out to provide evidence regarding Eskişehir's air cargo potential. While case studies can be supported with quantitative data, using qualitative data collection techniques is also a strong element of the method.

An in-depth literature review was conducted as part of the case study, and statistical information regarding air cargo transportation to/from Eskişehir and its surroundings was searched. Based on the literature, a survey was prepared. Still, it was understood through preliminary discussions with field experts that obtaining in-depth information from experts would provide more meaningful findings than using a multiple survey method. Therefore, semi-structured and unstructured interviews were preferred in the data collection phase. As a result, 12 participants with high experience in their field were interviewed. In this context, one-on-one interviews were

conducted with MNG Airlines operating in the Turkish domestic air cargo market, BEBKA (West Black Sea Development Agency), Eskişehir Chamber of Industry, Eskişehir Chamber of Commerce, Hasan Polatkan Airport responsible manager, and senior executives of Eskişehir Customs Directorate.

All interviews were conducted by appointment in the managers' offices except an hour of a phone interview with MNG Airlines managers based in İstanbul and exclusively operating air cargo transportation. Additionally, group and individual meetings were held with various public and private stakeholders who may be involved in air cargo operations in Eskişehir. All interviews were conducted in late 2019, just before the COVID-19 pandemic. The list of organizations and representatives interviewed is provided in Table 1 below.

Table 1. Organizations and participants interviewed

Organization	Participants' positions
Bursa Eskişehir Bilecik Development Agency (BEBKA)	- Eskişehir Investment Support Office Coordinator
Eskişehir Chamber of Commerce	- President - Board members responsible for logistics and transportation - A representative of a major logistics company
Eskişehir Chamber of Industry	- Deputy Secretary General
Hasan Polatkan Airport	- Operations Manager - Search and Rescue and Firefighting Unit Manager
Eskişehir Customs Directorate	- Customs Director
CAN International Heavy Transport and Warehousing	- Operator
DHL Express Western Anatolia Agency	- Engagement director
MNG Airlines	- Planning director - MNG Bursa-Yenisehir Airport Cargo Hub Project Manager, UTİKAD Vice President

The qualitative data obtained from the interviews have been analyzed, and subsequently, research results and policy recommendations have been provided, benefitting from statistical cargo-related data of Eskişehir.

4. Case Study on Air Cargo Potential of Eskişehir Hasan Polatkan Airport

4.1. The features of Eskişehir Hasan Polatkan Airport

Opened to traffic on March 29, 1989, under the name of Anadolu Airport, Hasan Polatkan Airport is currently an international airport operated by the Faculty of Aeronautics and Astronautics on behalf of the Rectorate of Eskişehir Technical University. Table 2 shows the technical specifications of Hasan Polatkan Airport.

Table 2. Technical specifications of Hasan Polatkan Airport

ICAO Designator Code	LTBY
IATA Designator Code	AOE
Average Maximum Temperature (1928-2018)	17.4°C
Average Minimum Temperature (1928-2018)	5.3°C
Airport Elevation	2580 ft
Runway Orientation	09/27
Runway Length	3000 m
Runway Width	45 m
Runway Surface	Concrete
Distance from City Center	5 km
Coordinates	AD 39485N-0303114E
Fuel Type/Capacity	JET A-1/38 Ton
Cargo Loading and Unloading Facility	-
Anti-Icing Facility	-
Hangar Area and Maintenance Facility for Visiting Aircraft	-

Source: (ESTÜ, 2021)

The airport effectively manages airport operations, terminal operations, air traffic control services, maintenance hangars, and flight training activities. Additionally, faculty students can gain practical learning experiences in the field by participating in activities aligned with their educational topics. In this regard, the airport provides opportunities for education within the practical application field, aiming to enhance the education process's effectiveness, efficiency, and sustainability.

Figure 1 illustrates Hasan Polatkan Airport's cargo traffic (baggage + cargo + mail) (tons) between 2008 and 2023.

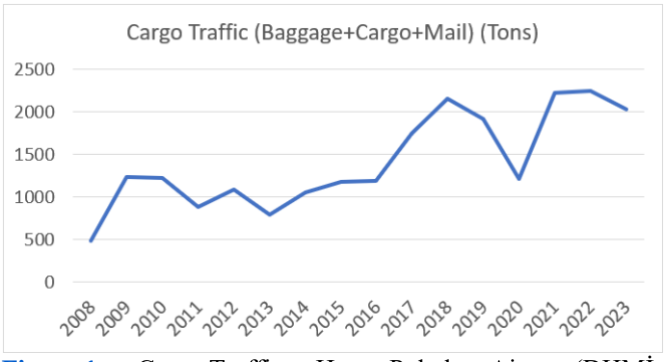

Figure 1. Cargo Traffic at Hasan Polatkan Airport (DHMİ, 2023)

Hasan Polatkan Airport has not had significant cargo traffic in the past. However, cargo traffic moves in parallel with passenger traffic.

4.2. The potential of Eskişehir by numbers

In general, cargo transportation, specifically air cargo, is a function of a country's and region's industrial and commercial volume and the country's key economic, demographic, and social indicators. Local air cargo traffic expectations depend on local manufacturing industries and the types of goods produced (Zhang, 2003). A city's industrial and commercial volume and surroundings are the main input for cargo potential. Eskişehir, which has significant railway, highway,

and air transportation opportunities, is centrally located among Türkiye's most important cities: Ankara, İstanbul, Bursa, İzmir, Konya, and Antalya. Table 3 shows the distances and travel times from Eskişehir to these cities.

Table 3. Distance and travel times of Eskişehir to some important cities

	Ankara	İstanbul	İzmir	Bursa	Antalya	Konya
Distance (km)	233	324	411	155	424	339
Travel Time (hours)	1.5	2.5	5	2	5	2
Transportation Type	By train	By train	By road	By road	By road	By train

In Eskişehir, located close to important ports and with dense road and railway connections, there are two logistics centers: TCDD Hasanbey Logistics Center and Organized Industrial Zone Logistics Center. Various agreements have been made to establish a railway connection between these two centers, but they have not yet been finalized. In Eskişehir, where the railway is heavily used for freight and passenger transportation, approximately one-third of the population earns their living from the industrial sector (see Table 4).

Table 4. Various economic and commerce statistics of Eskişehir

	Value	Year	Source
Employment Rate	42.8%	2020	TÜİK (Turkish Statistical Institute)
Unemployment Rate	13.2%	2020	TÜİK
Number of Establishments	20009	2021	SGK (Social Security Institution)
Number of Active Employees	243.703	2020	SGK
Number of Newly Established Companies	1.783	2015	TOBB (Union of Chambers and Commodity Exchanges of Türkiye)
Number of Closed Companies	567	2015	TOBB
Number of Foreign Capital Companies	95	2016	Ministry of Economy
Number of Investment Incentive Certificates (Quantity)	69	2015	Ministry of Economy
Main Railway Line Passenger Count	3.048.579	2015	TCDD (Turkish State Railways)
Railway Freight Transport (tons)	737.815	2015	TCDD

Source: Compiled from the institutions provided in the source column by the authors

As of 2021, Eskişehir's gross domestic product (GDP) amounted to 81,527,000,000 TL (approximately 9,07 billion $). Figure 2 illustrates the change in Eskişehir's GDP between 2004 and 2017.

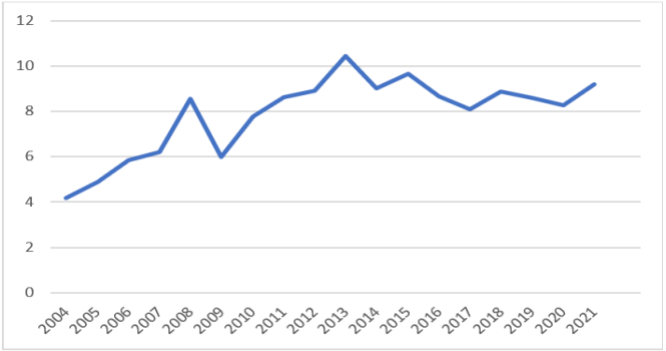

Figure 2. Gross Domestic Product of Eskişehir from 2004 to 2021 (in billion $) Source: TURKSTAT, 2021

Eskişehir's gross domestic product (GDP) has seen an increasing trend based on US dollar currency despite depreciating Turkish Lira. According to the graph, particularly in the years after 2009, a modest increase in growth rate stands out. Figure 3, on the other hand, illustrates the import and export activities of Eskişehir between 2014 and 2018.

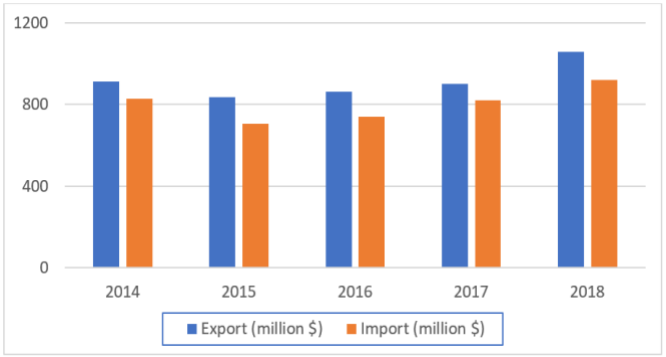

Figure 3. Import and Export Activities of Eskişehir from 2014 to 2018 Source: TURKSTAT, 2019

According to Figure 3, Eskişehir has consistently maintained a trade surplus, unlike the Turkish average in previous years. The proportional increase in the trade surplus in 2018 is noteworthy. On average, $25,000 is transported per container exported from Eskişehir. The transportation cost of a container from Eskişehir to Gemlik Port is approximately 1500 TL, while the transportation cost to European countries is around 2500 € on average.

Figure 4 shows the number of exporting and importing companies in Eskişehir between 2014 and 2018.

In 2014, the number of exporting and importing companies was close to each other. In the following years, however, the difference between the numbers of exporting and importing companies increased in favor of importing companies. By 2018, the number of exporting companies had surpassed that of importing companies.

Figure 4. Number of Exporting and Importing Companies in Eskişehir, 2014-2018 Source: TÜİK, 2019

Figure 5 shows the monthly export and import values of Eskişehir. According to the figure, export values fluctuate throughout the year, reaching their highest levels at the end of the year. On the other hand, the trend of imports appears to be more stable.

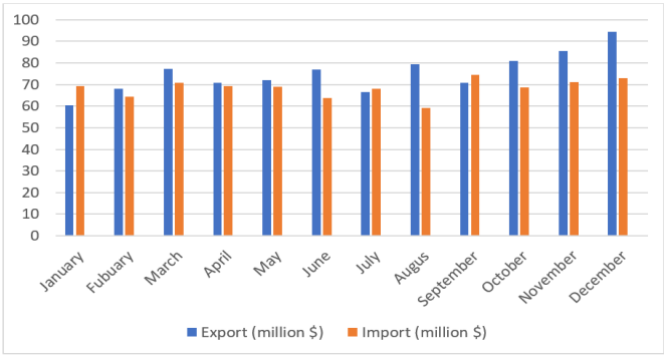

Figure 5. Export and Import Values of Eskişehir by Months Source: TÜİK, 2019

Table 5 shows the national shares of some products produced in Eskişehir. According to the table, Eskişehir monopolizes producing aircraft engines, diesel locomotives, and compressors (refrigeration). It also has significant weight in producing borax, jacks, refrigerators, and clothes dryers.

Table 5. National Shares of Some Products Produced in Eskişehir

Product	Eskişehir's Share in National Production
Aircraft engine	%100
Diesel locomotive	%100
Compressor (refrigerator)	%100
Borax	%73
Jack	%70
Refrigerator	%65
Clothes dryer	%50
Magnesite	%30
Biscuit, cake, cracker	%30
Roof tile	%30
Milk	%20
Truck	%20
Oven	%20
Ceramic floor and wall tiles	%15

Source: Eskişehir Chamber of Industry, 2016

Table 6 shows the distribution of imports by product groups in Eskişehir in 2018. According to the table, the top three product groups that Eskişehir imported the most are boilers, machinery, mechanical appliances, nickel articles, and plastics.

Table 6. Distribution of Imports by Product Groups in Eskişehir (2018)

Product	Import (million $)
Boilers, machinery, mechanical appliances, and equipment, nuclear reactors, and their parts and accessories	202.896
Nickel and articles thereof	119.045
Plastics and products thereof	70.742
Electrical machinery and equipment; sound recording or reproducing apparatus; television image and sound recording or reproducing apparatus and their parts and accessories	64.669
Other base metals (tungsten, molybdenum, tantalum, magnesium, cobalt, bismuth, cadmium, etc.)	59.643
Motor vehicles, tractors, bicycles, motorcycles, and other land vehicles; their parts and accessories	55.300
Vehicles and materials for railways, etc.; their parts and accessories; mechanical traffic signaling devices	47.697
Aluminum and articles thereof	36.261
Optical, photographic, cinematographic, measuring, checking, precision, medical or surgical instruments and apparatus; their parts and accessories	30.754
Tanning or dyeing extracts; tannins and their derivatives; dyes, pigments, and other coloring matter; paints and varnishes; putty and other mastics; inks	29.526

Product	Export (million $)
Defense and aerospace industry	383.081
Iron and non-ferrous metals	97.891
Machinery and components	93.716
Chemicals and chemical products	79.171
Mining products	62.969
Cement, glass, ceramic, and clay products	59.540
Climate control industry	54.158
Grains, pulses, oilseeds, and their products	52.065
Electrical and electronic products	44.135
Ready-made clothing and apparel	40.823

Table 7 shows the distribution of Eskişehir's exports by product groups in 2018. According to the table, the top three product groups that Eskişehir exports the most are the defense and aerospace industry, iron and non-iron metals, and machinery and parts.

Table 7. Eskişehir's Exports by Product Groups (2018)

Product	Export (million $)
Defense and aerospace industry	383.081
Iron and non-ferrous metals	97.891
Machinery and components	93.716
Chemicals and chemical products	79.171
Mining products	62.969
Cement, glass, ceramic, and clay products	59.540
Climate control industry	54.158
Grains, pulses, oilseeds, and their products	52.065
Electrical and electronic products	44.135
Ready-made clothing and apparel	40.823

Source: Eskişehir Chamber of Industry, 2019

Table 8 shows the top ten countries where Eskişehir exported the most in 2018. According to the table, Eskişehir exported the most to the United States in 2018. Germany, France, and Austria, respectively, followed this. Upon examining the table, it is noticeable that most of Eskişehir's significant export partners are European countries.

Table 8. Top 10 countries in terms of export to Eskişehir (2018)

Countries	Export (million $)
USA	359.030
Germany	92.282
France	84.809
Austria	42.152
Spain	31.551
Romania	29.675
Belgium	29.539
Netherlands	24.678
Poland	20.274
United Kingdom	19.122

Source: Eskişehir Chamber of Industry, 2019

Table 9 shows the top 10 countries where Eskişehir imported the most in 2018. According to the table, Eskişehir sourced the highest value of products from the United States in 2018. France, China, and Germany, respectively, followed this.

Table 9. Top 10 countries in terms of import from Eskişehir (2018)

Countries	Import (million $)
USA	259.100
France	76.119
China	75.277
Germany	74.868
Spain	73.554
Italy	54.830
Czech Republic	36.288
United Kingdom	27.873
Netherlands	21.477
Japan	20.903

4.3. Findings Regarding the Cargo Potential of Hasan Polatkan Airport

In this section, findings obtained from stakeholders regarding the potential of Hasan Polatkan Airport to become a cargo hub have been compiled under two main headings:

- Findings related to demand
- Findings related to technical, operational, administrative requirements

Based on these findings, alternative business models have been discussed, and policy recommendations have been provided.

Findings related to demand

In air cargo transportation, small package shipments require urgent and fast delivery due to their characteristics. Therefore, excessive transfers are not desired to minimize time loss. Hence, regular and preferably direct flights are the most basic requirement for small package carriers. For other cargoes, air transportation is often an expensive alternative for transporting many products. Mostly, businesses prefer cheaper alternative routes. Only in cases such as sending samples or urgent part needs does the importance of price decrease, and there may be demand for air cargo. In such cases, cargo senders need to rely on and get used to the existence of regular flights. However, according to the discussions, there is not enough potential in Eskişehir and its vicinity to fill the capacity of a cargo aircraft and make regular flights daily.

The flow of cargo is different from that of passengers. While passengers generally demand a flow where they depart in the morning and return in the evening, cargo companies typically collect cargo until a certain time and send them with scheduled flights at airports with evening flights. The cargo aircraft usually depart after 6 pm. Special vehicles are dispatched for urgent cargoes arriving after 3-4 pm and transported to İstanbul by road. İstanbul is considered the center of cargo in Türkiye, and even cargoes originating from İzmir are sent to İstanbul via scheduled flights. Additionally, 75% of the cargo in Türkiye is distributed to İstanbul and its surroundings.

It has been noted that even if scheduled flights are organized regularly and prove reliable, it may not be easy for businesspeople to change their cargo habits. Despite the seemingly long distance by road, factors such as the short duration of the İstanbul-Eskişehir route by private vehicle, the numerous flights departing from İstanbul, the ability to dispatch vehicles by road at any time, and the affordability of sending from İstanbul may continue to be preferred. Discussions with MNG Airline Managers also support this thesis. MNG Airlines is a Turkish company based in İstanbul that exclusively carries cargo. MNG also manages DHL's activities in Türkiye. They indicate that they provide investment and equipment support to the management of Bursa Yenişehir Airport for flights. Thus, it aims to create cargo potential in Bursa with the initiative and support of city stakeholders. However, despite the provision of warehouses, depots, cargo handling equipment, customs, etc., it is stated that industrialists and traders in Bursa mostly continue to prefer İstanbul over Bursa. Price and habits are shown as the most important reasons for this. MNG Managers state that they will wait for demand to emerge for some time. It is also not certain that demand will emerge. Therefore, although it is possible to withdraw the equipment, there is a risk of investments being idle. Despite having made investments and Bursa's business volume is several times that of Eskişehir, the lack of regular demand for cargo operations in Eskişehir could

also be an indicator. It is not considered very likely that regular cargo flights that do not operate in Bursa will operate in Eskişehir. On the other hand, in the possibility of cargo flights becoming regular in Bursa, when considering that Bursa Yenişehir Airport is close to Eskişehir and Bozüyük, where the industry is developed, it is also possible for demand to shift to Bursa.

Difficulties in directing demand were examined using Şanlıurfa GAP Airport as an example. At Şanlıurfa GAP Airport, an area of 3,800m² with 4 cold storage warehouses totaling 41.5m² has been allocated for air cargo services. Despite providing cooling between +5 and -25 degrees in these warehouses, these facilities cannot provide cargo services. The tender for finding an operator was canceled due to a lack of demand. (Şanlıurfa GAP Airport Feasibility Report, 2016) Şanlıurfa is one of the leading provinces in Türkiye in terms of cut flower and fresh fruit and vegetable exports using air cargo. Despite its export potential and existing facilities, even in this airport, cargo transport is preferred to İstanbul, and air cargo operations are not at the desired level. In this situation, it has been determined that there will not be a short-term potential to sustain cargo operations at Hasan Polatkan Airport solely through cargo aircraft.

Findings related to technical, operational, and administrative requirements

In terms of enough demand, starting cargo operations needs basic technical, operational, and administrative requirements such as procuring personnel, facilities, and equipment for cargo handling and storage requirements. These requirements and their prospective cost sides will be explained below.

Technical and equipment requirements

While basic equipment may be sufficient for baggage loading on a passenger aircraft, various loading equipment is required for cargo operations. Some of the equipment are listed below:

- Container (Boxes produced for transporting goods without damage)
- Pallet, dolly, and pallet dolly (Equipment used for transporting ULDs and pallets)
- High loader (Vehicles used for cargo loading and capable of moving loads up and down. There are two types: a) Main deck high loader and b) Lower deck high loader)
- Forklift (Used for loading or unloading heavy loads onto or from aircraft)

Various factors also influence the number and quality of the necessary equipment:

- Type, size, volume, and cargo weight to be served.
- Type, size, and characteristics of the aircraft to be served.
- Hourly and daily distribution of demand and service.

From the perspective of equipment and tools, it can be observed that cargo handling equipment is also quite expensive. Due to the low potential, the probability of preferring to purchase and keep this equipment at Hasan Polatkan Airport for ground handling operations is low as it would be considered a sunk-cost investment. On the other hand, the University purchases a single high loader, which costs approximately 370,000.00 USD, a single pallet dolly, around 3,500 USD, and a single container dolly, about 2,600 USD (Eski and Tasus, 2018). One high loader and numerous pallet and container dollies are required for each aircraft to be serviced simultaneously. As seen, cargo equipment is expensive and can only guarantee a return on investment and profitability if a high and sustainable demand justifies the investment.

Operational and Facility Requirements

Regarding facilities, a separate apron area is required for handling cargo (unloading, loading, preparation). Discussions have suggested that the West Apron at Hasan Polatkan Airport may suit this purpose. To open up this apron for use, apron lighting needs to be installed. According to international regulations, the current Search and Rescue and Firefighting (ARFF) technical capability is sufficient for cargo operations.

Many airports prefer to build an additional terminal based on cargo volume. A cargo terminal is required for pallet and container loading. When cargo volume does not require an additional terminal, a portion of the passenger terminal can be used as a cargo terminal. The existing terminal at Hasan Polatkan Airport is not always sufficient for passenger operations alone. During peak times, passengers may need to wait outside. In this case, there will be a need for an additional terminal for cargo operations.

Another aspect of facility requirements is the necessity of temporary and permanent storage areas, warehouses, and depots. The requirements for storage areas vary depending on the type of goods to be transported. Especially for perishable cargoes, there should be cold storage warehouses, and sufficient space should be allocated for hazardous materials. On the other hand, especially in international shipments, incoming cargoes are delivered to the warehouse under the supervision of customs officials, and the products are kept in the warehouse while the necessary documents are completed. After these procedures are completed, the cargo becomes ready for pickup by the consignee. However, the readiness of the cargo does not necessarily mean it will be picked up immediately. Storage services must be provided until the consignee retrieves the product. Outbound cargoes are also first received in the warehouse, and customs brokers wait for customs clearance and declaration procedures to be completed. Temporary storage is required until they are ready to be transported under the aircraft.

Therefore, cargo operations at Hasan Polatkan Airport will also necessitate the construction of a storage facility, creating a need for warehouse construction. The construction and operation of warehouses are defined in the relevant articles of the Customs Regulation in Türkiye and Annex 80, titled "Conditions and Required Documents for Opening and Operating Warehouses." Technical specifications and necessary conditions are detailed and quite extensive. Further detailed studies are required regarding the cost of warehouse investment. Annual fees must also be paid for opening and operating warehouses. According to data from 2023, the fee for a general warehouse operating permit is 202,961.40 TL, and an annual fee of 67,646.30 TL is required for operation. The same amounts are also required for temporary storage, place operating permits, and operations. In addition, application file fees, other charges, and commitment letters are required during the opening process (SHGM, 2015). The investment in the cargo business is quite high, and the return on investment takes a long time. Therefore, it is not considered very effective for the University to make this investment and bear the operating costs. The interviewees were also asked for their opinions on carrying out this warehouse investment using the Build-Operate-Transfer method. They mentioned that while there are some projects like this in land transportation, they have not yet been used in aviation in Türkiye. Although it generally seems feasible, it was noted that the return on investment would take a very long time. Due to the low cargo

potential, it would not be an attractive investment for the private sector.

Administrative and human resource requirements

The equipment and requirements for pallet loading at airports where pallet loading is predominant may differ from container or bulk loading requirements. Especially in bulk loading, the need for handling personnel increases, while the need for specialized personnel to use specialized equipment will also increase. On the other hand, storage requirements at airports where live animals are predominant will differ from those where frozen fish or dangerous goods are sent.

A cargo business model requires changes in the administrative structure and managerial staffing in addition to operational personnel. The airport is managed by Eskişehir Technical University, which provides the necessary personnel for landside and airside operations, excluding the tower. However, because the university is subject to public personnel recruitment policies, it may face challenges in assigning skilled operational, administrative, and managerial staff to the airport or hiring new personnel.

Short operating hours have been identified as a utilization issue for some subsidized Turkish airports (Uzgör and Şengür, 2022). Extending operational hours for cargo operations at Hasan Polatkan Airport could introduce further administrative challenges, particularly regarding working hours or additional shifts. Such challenges may bring extra costs to the airport operator.

4.4. Discussion and policy recommendations

Nowadays, airports have become intermodal exchange points for passengers and cargo. Eskişehir Hasan Polatkan Airport is an airport that provides safe and secure services at international standards and has significant potential. It harbors important potential for both Eskişehir and Eskişehir Technical University regarding education and economic and social aspects. As Reynolds-Feighan (1995) and Grubesic and Wei (2013) noted, facilitating air carriers to deliver air services brings significant advantages, including economic growth and enhanced social cohesion. The present study acknowledges their studies regarding the potential benefits of air services while embracing the air cargo perspective. Considering that Eskişehir Hasan Polatkan Airport has not yet fully utilized its passenger potential, the present research has led to three alternative business models for cargo transportation. These are:

- Making the airport ready for general cargo aircraft operations
- Use of the airport as a cargo base by an airline
- Improving passenger-cargo transportation by increasing the number of scheduled flights at the airport

These alternatives have been discussed in detail under the following subheadings.

Alternative 1 – Investment for general cargo operations

Airlines consider various factors when selecting airports for their major cargo operations, including potential demand, physical characteristics of the airport, available facilities, operating costs, ground handling services, personnel costs, and others. Another important factor is the potential position of the airport within the airlines' flight network.

Considering the data mentioned earlier and the findings, it is evident that preparing Hasan Polatkan Airport for the operations of public cargo aircraft and making it attractive for airlines will incur significant infrastructure costs and operational expenses. The investment amount is high, and the return on investment is long-term. It does not seem realistic for the university to cover these costs. While it may be possible to address them through a structure established in collaboration with city stakeholders and the university, it has been found that Eskişehir industrialists and businesspeople do not have such a need for air cargo.

The individuals interviewed indicate that Eskişehir's export-import figures and domestic cargo potential are insufficient to fill a cargo aircraft daily. Statistics also show that products in Eskişehir and its surroundings are not suitable for air cargo as they are not time-sensitive. Products such as heavy machinery parts, white goods, or biscuits are expensive to transport by air. However, there is a need for air cargo in emergencies, such as the urgent delivery of samples or machine parts that prevent production from stopping. Customers must be convinced that a sustainable and reliable service is available even in such cases. Otherwise, they may opt for a more reliable method, such as road transportation to İstanbul, where they know continuous flights.

The competitive dynamics of other transportation systems should also be considered here. Eskişehir Hasanbey Logistics Center is a significant logistics hub because of its railway transportation and road connections. Rail transportation is the most cost-effective and environmentally friendly for carrying industrial products. Therefore, increasing its share in logistics networks is a key goal of global policies and supranational entities like the European Union. The world's logistics understanding is evolving towards integrated intermodal transportation systems that incorporate not only the road but also rail, sea, and even air transportation, with the road being the least used mode, especially for long distances. Cargo transportation via trains between China and Europe has already begun through the "New Silk Road Project," which is expected to shorten the duration and reduce costs for Türkiye, including Eskişehir, along the route. The first train passed through Türkiye recently and crossed the Bosporus to Europe. Therefore, rather than focusing on the competition between transportation modes, it is more beneficial to emphasize their complementarity. The railway can be used more actively and cost-effectively by connecting Hasanbey Logistics Center with Eskişehir Organized Industrial Zone and Gemlik Port, further limiting air cargo's competitiveness on these routes. Consequently, establishing a cargo market in Eskişehir, especially for domestic routes, seems challenging. It also seems difficult to generate sufficient cargo potential to support direct flights to different destinations for long-haul routes. However, initiating cargo flights that feed İstanbul could be considered, although this approach may not be highly preferable due to increased transfer costs.

Even with existing cargo facilities and regular flights at the current airport, there is a belief that shipments can be made faster and more affordably from İstanbul. Therefore, this investment does not seem feasible from the perspective of city stakeholders. While it may be considered to leverage private sector support for constructing and operating cargo warehouses, this option is not particularly attractive regarding private sector investment.

On the other hand, in evaluating this alternative, certain conditions may exist for obtaining investment support as part of a national strategy beyond university, city, or private-sector investments. Türkiye is located in an earthquake-prone zone, and a major earthquake is expected in İstanbul and the surrounding region in the near future. Airports are crucial logistics centers during natural disasters and emergencies, creating social benefits. They are essential for delivering aid teams and humanitarian supplies, restoring normalcy, and managing crises. Therefore, airports in the region are

fundamental elements of urban resilience and disaster preparedness planning. İstanbul has two major airports, and while their terminal buildings are known to be resistant to high-intensity earthquakes, it is impossible to predict the location, intensity, and magnitude of a potential earthquake in İstanbul. Therefore, the possibility of both airports sustaining significant damage in a major earthquake cannot be ruled out. In such a scenario, the relatively nearby and less susceptible to earthquakes Hasan Polatkan Airport could serve as an "Emergency Aid Cargo Hub" for domestic and international flights. Eskişehir could take on this mission for İstanbul and neighboring regions. Moreover, since Eskişehir would likely be among the suitable landing sites for aircraft in the event of a large-scale disaster in İstanbul or another neighboring city, it is important to undertake relevant emergency planning now. In addition to public funds, the possibilities of utilizing international funds for these investments should also be explored. Hatay Airport, which stopped operating after its runway was damaged in the 2023 major earthquake, has demonstrated how important airports can be in the event of a disaster.

In conclusion, this alternative can be implemented through a phased cargo strategy spread over time. Along with other alternatives, Hasan Polatkan Airport can be reassessed in the long term in terms of its strategic strengths and weaknesses for additional investments and cargo services as demand matures.

Alternative 2 – The airport to be used as a cargo hub by an airline

Another alternative is to use the airport as a cargo hub. Cargo airlines typically choose an airport as their central hub for operations. FedEx's hub is located in Memphis, Tennessee. In recent years, DHL has selected Leipzig/Halle Airport in Germany as its hub and has received support from the government to make Germany a cargo hub. Additionally, cargo villages are becoming more widespread. While handling activities such as sorting, consolidation, and short-term cargo storage are usually carried out by airline or cargo handling agents or external carriers, there is a recent trend towards larger cargo terminals or cargo villages with numerous warehouses to accommodate these activities.

Amazon operates Prime Air (Amazon Air), which has 45 aircraft in the United States and serves 20 airports nationwide. Most recently, in September 2019, it was announced that Amazon had chosen Dallas' Fort Worth Alliance Airport, a general aviation and cargo-centric regional airport already used by FedEx, as a regional hub. In terms of cargo flights, this airport holds the distinction of being the first airport adapted to Amazon's business model (built-to-suit). This project is part of the "Alliance Global Logistics Hub" project, and it also includes an intermodal railway center operated by a private company within the complex. This will create a hub to serve Amazon's numerous daily flights and small package distribution. Amazon's main hub is located at the Cincinnati/Northern Kentucky International Airport, which became operational in 2021 (Freightwaves, 2019). With approximately 650,000 full and part-time employees worldwide as of 2018, Amazon is expected to create 300 full-time jobs at Fort Worth Alliance Airport (Freightwaves, 2019).

Public-Private Partnerships (PPPs) have been extensively utilized in Türkiye for new airport and terminal construction and operations (Sengur, 2020). This model could also be explored as an investment and operational strategy for airport cargo operations. Additionally, government subsidies effectively promote an airport within a region and stimulate demand (Uzgör and Şengür, 2022). To make this situation attractive, incentives such as free land and discounted landing fees could make operating as a regional hub for an airline at Eskişehir Hasan Polatkan Airport an appealing alternative. Additionally, businesses like Amazon participate in global distribution and can provide significant opportunities for cities and countries. Connecting Hasanbey Logistics Center to the airport could also be considered in this case. If the physical and technical capabilities are researched and feasible, the airport will become much more valuable in cargo intermodality.

Alternative 3 – Increasing scheduled passenger-cargo flights

Another alternative for developing cargo transportation is to reopen scheduled passenger flights, especially on the Eskişehir-İstanbul route, at Hasan Polatkan Airport, which currently serves the non-scheduled market. Flights conducted at suitable hours for cargo transportation and repeated regularly for a certain period can enable industrial and commercial individuals in Eskişehir to use the cargo compartments under the aircraft for their needs.

Therefore, it is important to make transporting cargo under passenger aircraft sustainable. With continuous and regular flights, industrial and commercial individuals in Eskişehir may be able to change their air cargo habits in the long term. While filling a cargo aircraft may be challenging, filling the belly cargo compartment under a passenger aircraft is relatively easier. Thus, passenger and cargo operations can support each other, increasing the airline's profitability. According to the Ground Handling Regulation, one of the common provisions to be applied in implementing tariff schedules is that, in addition to cargo service fees, ramp fees are also fully charged for aircraft carrying cargo in the passenger cabin (SHGM, 2018). This will lead to an increase in the airport's revenue.

For these reasons, it may be worthwhile to consider making passenger flights more regular than cargo aircraft transportation, connecting Eskişehir to İstanbul with smaller aircraft, and connecting to more distant cities with cross flights. The biggest problems in the Eskişehir-İstanbul flights previously initiated by Turkish Airlines (THY) and terminated due to lack of demand can be cited as aircraft size, flight time, and day. THY's business model is network transportation, and it provides full service. Eskişehir is geographically close to many cities, making it suitable for inexpensive flights without amenities. Encouraging low-cost carriers to open routes with support incentives could be facilitated.

On the other hand, based on participants' views, establishing an airline in Eskişehir to operate with small aircraft is another solution that would support this alternative. The establishment of an "Eskişehir Airline Operations" under the auspices of Eskişehir Technical University, which has been operating the airport for a long time, training human resources for the aviation system for 30 years, and now serves as a model for Public-Private Sector Cooperation, would facilitate regular flights and have a positive impact on economic and social development. Involving the city administration, chambers of commerce and industry, and other stakeholders as partners in this operation would not only share the financial burden and operational risk but also provide support in terms of marketing.

5. Conclusion

All stakeholders involved in establishing and developing the air cargo market in Eskişehir have voluntarily stated that they will support the diversification and growth of the region's cargo and passenger transportation activities. However, in the face of economic uncertainties within Türkiye and globally, as

well as considering Eskişehir's air cargo potential, stakeholders are cautious about financing the airport cargo infrastructure.

Eskişehir's geographical location presents advantages and disadvantages in becoming a cargo center. Located in Central Anatolia, cargo distribution from this center appears advantageous. However, the range of products, services, and commercial activities in the surrounding provinces reduces the likelihood of creating air cargo potential. The investment required for cargo operations is high, and the return on investment takes a long time. Infrastructure and equipment costs are considered to be quite high. Therefore, it has been described as difficult for the university to handle this investment alone. On the other hand, a joint airport cargo investment with other stakeholders does not seem desirable due to low demand. However, a model of being an 'Emergency Aid Cargo Hub' for Hasan Polatkan Airport could provide new opportunities.

It is considered more effective for an airline to invest in Hasan Polatkan Airport and use it as a hub rather than investment by the university or stakeholders. Using Hasan Polatkan Airport as a hub for international flights will provide significant economic and social benefits for the university, the city, and even the country. When the airline invests in facility and equipment infrastructure, it will be easier to introduce services such as customs and ground handling. In this case, ensuring an increase in the university's personnel will be sufficient. Another alternative is to support scheduled, regular, and sustainable passenger transportation. It has been found that mixed flights carrying both passengers and cargo will be preferred in the region. Thus, it is stated that over time, the cargo habits of the region's businesspeople may change in favor of Hasan Polatkan Airport instead of İstanbul.

The tradition of conducting national and international commercial activities through İstanbul necessitates careful consideration of the smooth and efficient handling of air cargo and transfers connected to İstanbul Sabiha Gökçen Airport via road and railway connections. When the logistics center's connection to the Organized Industrial Zone is operational, the railway connection will become much more attractive and preferred due to its cost-effectiveness. However, it should not be forgotten that completing the air cargo infrastructure in Bursa province may negatively affect market potential. Additionally, demand to support cargo flights has not yet materialized at Bursa Yenişehir Airport. Furthermore, when all phases of İstanbul Airport are completed, it should be considered that it will become significantly more prominent in passenger and cargo traffic.

In conclusion, all these findings suggest that growth and investment plans should be carefully made and steps taken cautiously. A more detailed feasibility study should be conducted for the final investment decision, comprehensively addressing the issue's technical, economic, social, and environmental dimensions, and financial plans should be developed. Thus, the correct investment decision can be made by minimizing the risk of idle investment for the city, the university, and the country.

Ethical approval

Not applicable. The qualitative data were collected just before 2020. However, the writing was recently completed.

Conflicts of Interest

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

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