ISTANBUL AIRPORT & THE ROLE OF AIR CARGO TRANSPORTATION IN GLOBAL TRADE : A REGIONAL PLANNING PERSPECTIVE

A THESIS SUBMITTED TO
THE GRADUATE SCHOOL OF NATURAL AND APPLIED SCIENCES
OF
MIDDLE EAST TECHNICAL UNIVERSITY

BY

ONUR KÖPRÜLÜ

IN PARTIAL FULFILLMENT OF THE REQUIREMENTS
FOR
THE DEGREE OF MASTER OF SCIENCE
IN
REGIONAL PLANNING IN CITY AND REGIONAL PLANNING

DECEMBER 2019

Approval of the thesis:

ISTANBUL AIRPORT & THE ROLE OF AIR CARGO TRANSPORTATION IN GLOBAL TRADE : A REGIONAL PLANNING PERSPECTIVE

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ABSTRACT

ISTANBUL AIRPORT & THE ROLE OF AIR CARGO TRANSPORTATION IN GLOBAL TRADE : A REGIONAL PLANNING PERSPECTIVE

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Master of Science, Regional Planning in City and Regional Planning
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December 2019, 205 pages

Growing trade trends along with globalization increases the importance of logistics activities and logistics sector day by day. In recent years, development scenarios which mainly focus on production organizations have begun to big change in accordance with rapid changes in information technology. Nowadays goods and services are being to design in any geographical region of the world, produce in a different geographical region and demand from elsewhere of the world.

Therefore, it can be said that logistics sector became one of the important drivers of global trade. Especially in the last 25 years the logistics sector has gained substantial value. We can obviously see that the logistics sector which has become one of the fastest growing and the biggest sectors has significant impacts on the economic level of countries in this time period. Hence many countries (especially developed countries) invest in logistics sector to take advantage of the enormous potential of this sector.

It can be said that Turkey also has an important position in the world in terms of the logistics sector and also Istanbul which has the highest cargo volume in Turkey is suitable for such a development scenario. According to 2016 data, Istanbul Atatürk Airport ranks 34th in the World Cargo Traffic Rankings which led by Hong Kong, Memphis (USA) and Shanghai Pudong (China) airports. Although today we have approximately 20% cargo volume of the leaders on the list we can said that we have a significant potential in terms of air logistic sector and over time we can become a global air logistics hub with large investments in infrastructure such as the third airport in Istanbul. Therefore, the main objective in this thesis is to investigate whether logistics hub oriented development can be in Istanbul and to reveal the air cargo potential of Istanbul.

Keywords: Air Cargo, Air Freight, Multi-modal transportation, Logistics Hubs, Istanbul

ÖZ

İSTANBUL HAVALİMANI VE KÜRESEL TİCARETTE HAVA KARGO TAŞIMACILIĞININ ROLU : BÖLGE PLANLAMA PERSPEKTİFİ

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Tez Danışmanı: Prof. Dr. Melih Pınarcıoğlu

Aralık 2019, 205 sayfa

Küreselleşen Dünya'da artan ticaret eğilimleri lojistik faaliyetlerin ve lojistik sektörünün önemini her geçen gün arttırmaktadır. Son yıllarda, ağırlıklı olarak üretim organizasyonlarına odaklanan kalkınma senaryoları, bilgi teknolojisindeki hızlı değişikliklerin etkisiyle büyük değişimler yaşamaya başlamıştır.Üretimin artık tek bir fabrikada değil farklı yerlerde gerçekleştirilmesi nedeniyle taşımacılık artık farklı mekânlar ve iş basamakları arasında gerçekleştirilmeye çalışılan bütünleştirici bir süreç haline gelmiştir.

Bu nedenlerle lojistik sektörünün küresel ticaretin önemli itici güçlerinden biri olduğu söylenebilir.Özellikle son 25 yılda lojistik sektörü önemli bir değer kazanmıştır. Günümüzde en hızlı büyüyen ve en büyük sektörlerden biri haline gelen lojistik sektörünün ülke ekonomilerine de önemli etkileri olmaktadır. Bu nedenle gelişmiş ülkeler başta olmak üzere bir çok ülke, bu sektörün potansiyelinden yararlanmak için lojistik sektörüne yatırım yapmaktadır.

Türkiye'nin, halihazırda lojistik sektörü açısından dünyada önemli bir destinasyon olduğu ve Türkiye'nin en yüksek kargo hacmine sahip olan Istanbul'un böyle lojistik odaklı bir gelişme senaryosu için uygun olduğu söylenebilir. 2016 verilerine göre, İstanbul Atatürk Havalimanı, Hong Kong, Memphis (ABD) ve Shanghai Pudong (Çin) havalimanlarının liderliğindeki Dünya Kargo Trafik Sıralamasında 34. sırada yer almaktadır. Günümüzde listedeki lider havalimanlarının yaklaşık %20'si oranında bir kargo hacmine sahip olsa da, hava kargo açısından önemli bir potansiyele sahip olunduğu ve zaman içerisinde yeni havalimanı gibi büyük yatırımlarla Istanbul'un küresel bir lojistik merkezi haline gelebileceği söylenebilir. Dolayısıyla bu tez de lojistik merkez odaklı kalkınmanın Istanbul'da olup olamayacağını araştırmak ve Istanbul'un kargo potansiyelini ortaya çıkarmak başlıca hedef olarak belirlenmiştir.

Anahtar Kelimeler: Hava Kargo, Çok Türlü Taşımacılık, Lojistik Merkez, Istanbul

To my family...

ACKNOWLEDGEMENTS

First of all, I would like to express my deepest gratitude to my supervisor Prof. Dr. Melih PINARCIOĞLU for his professional guidance and valuable suggestions throughout the preparation of this thesis. I am grateful for his guiding, helpful and encouraging attitude since the first day I had the opportunity to meet him thanks to the Regional Planning Graduate Program. I also owe special thanks to him for providing me the opportunity to work for very valuable projects including "Systems and Development Planning of Turkish Airports" project at YTM-MATPUM where I achieved important gains for this thesis.

I also thank to my honorable jury members; Prof. Dr. Emine YETİŞKUL ŞENBİL and Assist. Prof. Meriç GÖKDALAY for their valuable contributions, advices and encouragements to this thesis.

I would like to thank my esteemed teachers at METU for their contributions to my personal development.I would especially like to thank Prof. Dr. Ayda ERAYDIN who I deeply respected her professional knowledge.

I also thanks to my all friends and colleagues at YTM-MATPUM for supporting me to complete this thesis.

Finally, my deepest thanks and gratitude is for the most valuable three people in my life; my mother Fatma KÖPRÜLÜ, my father Adnan KÖPRÜLÜ and my sister Pınar KÖPRÜLÜ. I could never be the person who I am now without the presence of these precious people who always provide me full support in my entire life. I feel very special for being a part of this family. I've added a new one to my achievements throughout my life and I'm proud to give you this honor.

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LIST OF ABBREVIATIONS

ACI	: Airports Council International
DHMİ	: General Directorate of State Airports Authority
EU	: European Union
G	: Globalization
GDP	: Gross Domestic Product
JIT	: Just in Time
LCC	: Low Cost Carrier
OECD	:The Organisation for Economic Co-operation and Development
Paris-CDG	: Paris Charles de Gaulle Airport
SS	: Significance Score
SWOT	: Strengths, Weaknesses, Opportunities, Threats
T	: Technology
TCDD	: The State Railways of the Republic of Turkey
TurkStat	: Turkish Statistical Institute
UK	: United Kingdom
ULD	: Unit Load Device
US	: Uncertainty Score
USA	: The United States of America

YTM-MATPUM :Research and Implementation Center for Built Environment and Design

CHAPTER 1

INTRODUCTION

1.1. Aim

Several researches describe airports as places that stimulate the overall economy, create job opportunities, increase competitiveness of a city or a region at international level. With the impact of the logistics sector developing with globalization, some airports in the world have become a logistics hub. Nowadays these logistics hubs have become important locations that direct global trade, increase accessibility and connectivity to goods and services, increase countries' export potential, and collect and distribute goods on a global scale.

Given those features, this research aims to examine whether Istanbul could be a global hub in terms of the air logistics sector. To achieve this aim, main question and sub-questions of the thesis are determined as

Main Question:

Could Istanbul be a global hub in terms of the air logistics sector ?

Sub Questions:

- Is production potential in Istanbul suitable for air logistics ?
- Is the existing logistics structure in Istanbul suitable for development of air logistics ?
- Could Istanbul be a significant transit point for air logistics ?
- What are the factors that can shape the future of air cargo transportation?

1.2. Justification

Growing trade trends along with globalization increases the importance of logistics activities and logistics sector day by day. In recent years, development scenarios which mainly focus on production organizations have begun to big change in accordance with rapid changes in information technology. Nowadays goods and services are being to design in any geographical region of the world, produce in a different geographical region and demand from elsewhere of the world.

Therefore, it can be said that logistics sector became one of the important drivers of global trade. Especially in the last 25 years the logistics sector has gained substantial value. We can obviously see that the logistics sector which has become one of the fastest growing and the biggest sectors has significant impacts on the economic level of countries in this time period. Hence many countries (especially developed countries) invest in logistics sector to take advantage of the enormous potential of this sector.

The clustering approach of logistics activities in specific areas, also called logistics hubs is becoming increasingly widespread and the efficiency of the logistics sector is increasing day by day. In particular, logistics hub-oriented development trends are widely seen in the air cargo sector. When the existing airports are examined in terms of air logistics, it is seen that the major airports which stand out with such features as having the highest cargo volumes, becoming global air logistics hubs and making a significant contribution to the country's economy have relation with logistics hubs.

Hence, it can be said that the relationship with the logistics hubs has effects on air logistics sector, the airports which own these relations have a high competitive power in terms of the logistics sector and the air logistics sector will become to a more important position over time through the increasing logistics hub trend. It can also be said that the logistics hub oriented development approach is an important issue that can play a big role in the development of the regions.

Turkey also has an important position in the world in terms of the logistics sector and also Istanbul which has the highest cargo volume in Turkey is suitable for such a development scenario. According to 2016 data, Istanbul Atatürk Airport ranks 34th in the World Cargo Traffic Rankings which led by Hong Kong, Memphis (USA) and Shanghai Pudong (China) airports. Although today we have approximately 20% cargo volume of the leaders on the list we can said that we have a significant potential in terms of air logistic sector and over time we can become a global air logistics hub with large investments in infrastructure such as the third airport in Istanbul.

1.3. Methodology

In this thesis, it is mainly examined whether Istanbul could be a global hub in terms of the air logistics sector. The main research question and sub-questions were determined to investigate this issue. These are shown in table below.

Table 1.1. *Main and Sub Research Questions of the Thesis*

Main Question	**Sub Questions**
Could Istanbul be a global hub in terms of the air logistics sector ?	Is production potential in Istanbul suitable for air logistics ?
	Is the existing logistics structure in Istanbul suitable for development of air logistics ?
	Could Istanbul be a significant transit point for air logistics ?
	What are the factors that can shape the future of air cargo transportation?

To investigate the answers of these research questions, a mixed method including both quantitative and qualitative research methods was used. The thesis consists of 4 steps depending on the methods used.

Literature Review

A theoretical background about subjects and studies, which are related to air cargo transportation for discussions, was obtained by conducting a literature review about the research subject. Within the scope of the literature review, the role of aviation in

global trade, historical evolution of air cargo, importance of airports in terms of cargo transportation, share of air cargo transportation in global competition and current situation of cargo transportation in Turkey was investigated. In addition, detailed information about the global trends in cargo transportation has been obtained by literature review of the variables that may affect the future of air cargo transportation.

Air Cargo Potential Index

An index study was conducted to analyze whether existing logistics infrastructure facilities in Turkey are suitable for the development of air cargo transportation and analyze the development potential of the air cargo sector by provinces. In the light of literature researches, 9 cargo indicators which form the basis of the index study and it can direct the development of the air cargo sector in a region have been identified.

Table 1.2. *Cargo Indicators That Can Direct the Development of Air Cargo Sector*

Cargo Indicators	
K_1	Import/Export Point (Over $750.000.000 or not) (2017)
K_2	Possibility of Multimodal Transportation
K_3	Integration with Logistic Hub (Yes/No)
K_4	Integration with Free Zone (Yes/No)
K_5	Airway Transportation Export Value ($) (2017)
K_6	Airway Transportation Import Value ($) (2017)
K_7	Annual Cargo Traffic of Airport located in the province (tonnes) (2017)
K_8	Possibility of Cargo Terminal at Airport located in the province (Yes/No)
K_9	Possibility of providing Air Cargo Service at the airport located in the province

Table 1.3. *Formulations of Index Study*

$0{,}5\ x\ (Cargo\ Potential\ Score + Air\ Cargo\ Potential\ Score) = Result\ Index\ Score$
$Cargo\ Potential\ Score = \ 0{,}25\ x\ (K_1 + K_2 + K_3 + K_4)$
$Air\ Cargo\ Potential\ Score = \ 0{,}2\ x\ (K_5 + K_6 + K_7 + K_8 + K_9)$
$Result\ Index\ Score$ $= 0{,}5\ x\ (0{,}25\ x\ (K_1 + K_2 + K_3 + K_4) + (0{,}2\ x\ (K_5 + K_6 + K_7 + K_8 + K_9))$

The formulations in the table 1.3 was used for the index. Accordingly, the index has been calculated in three stages as “Cargo Potential Score”, “Air Cargo Potential

Score" and "Result Index Score". Cargo potential scores for 81 provinces were calculated by using K_1, K_2, K_3 ve K_4 indexes. Air cargo potential scores for 81 provinces were calculated by using K_5, K_6, K_7, K_8 ve K_9 indexes. Lastly the results index scores were calculated for 81 provinces by taking the average of the values obtained in the 1st and 2nd stage. In other words, the results index scores were calculated by evaluating both the air cargo potentials and other cargo potentials of the province and using all the parameters in the table 1.2.

Comparison Study

A comparison study was conducted to analyze whether Istanbul Airport can be a significant transit point in terms of global air logistics. Firstly, top 20 airports in the world according to cargo traffic rankings is determined. In the light of the top 20 airport list, airports that are in close proximity to Turkey and which may be competing in terms of cargo transportation were identified. Comparison study between Istanbul Airport and its competitors was carried out in three stages. In the first stage, the annual cargo traffic data of the airports in the last 10 years has been compiled and a trend analysis was conducted by using the obtained data. In the second stage, the index results of Istanbul Airport and its competitors, which were compiled from connectivity index studies made by ACI and OAG, were discussed. In the third stage, detailed information was gathered on the cargo structure of Istanbul Airport and its competing airports and 14 variables were identified in order to compare the airports. Then, obtained data were discussed by comparison. Determined variables are shown in the following table.

Table 1.4. *Variables and its abbreviations that used to compare airports*

Abbreviations	**Variables**
S1	Annual cargo handling capacity (tonnes)
S2	Cargo terminal area (m^2)
S3	Annual cargo traffic in 2018 (tonnes)
S4	ACI World Cargo Ranking Position
S5	Average annual growth rate of last ten years
S6	ACI Hub Connectivity Ranking Position
S7	Integration with free zone
S8	Various infrastructure possibilities by product groups
S9	Cold chain transportation possibilities
S10	7/24 Cargo operation capability
S11	Accessibility to the cargo terminal of cargo vehicles such as trucks
S12	Possibility of railway connection that can carry cargo
S13	Integration with seaway transportation
S14	Possibility of multimodal transportation

Scenario Development

A scenario study was conducted to develop possible cargo development scenarios in future. Obtained data from the focus group meetings attended by representatives from the sector in "Systems and Development Planning of Turkish Airports" project was analyzed from the perspective of cargo transportation and base data were obtained for the possible cargo development scenarios. According to the focus group meetings results of the project, there are 41 variables that could affect the aviation sector in the following years and these variables were evaluated by the author in terms of air cargo transportation. According to this evaluation, 32 variables that can guide the development of the air cargo sector were identified from the 41 variables that could affect aviation sector. Then a literature research has been conducted about these 32 variables that might affect the scenario development process and uncertainty scores between 1-5 has been determined for each variable by analyzing the probability of occurrence of these variables in the following years (1: Most Certain - 5: Most Uncertain). The variables having both high significance score (> 3.18) and high uncertainty score (≥ 3) from the variables that may affect development of cargo transportation are included in the process of determination of the scenario axes. The

variables included in the process of determining the scenario axes are grouped under two main axes: Globalization and Technology. 4 scenarios were created by evaluating all combinations of the two scenario axes. Scenarios vary depending on whether technology and globalization axes are positive or negative. The scenarios are; Golden Age of Air Cargo Transportation (G + T +), Competitive World (G + T -), Self-Enclosed Growth (G - T +) and Crisis Scenario (G - T -).

1.4. Content

This thesis consists of eight chapters including introduction and conclusion chapters. In the first chapter, which named as introduction, information about aim, justification, context and methodology of the thesis are given. In the second chapter, a literature study on the subject is given. In the literature study, the subjects and studies related to air cargo transportation are included under the headings Globalization and Global Trade, Logistics Revolution and Airports, Air Cargo Transportation as a Global Competition Tool and Airport Concepts. In the third chapter, current situation analysis of air cargo transportation in Turkey and in Istanbul are given. In the chapters between 4 to 7, the detailed researches, which conducted in the light of the main thesis research question and sub-questions, that constitutes the main body of the thesis are discussed. In the chapter 4, it was investigated whether there is a production or consumption potential suitable for the development of air cargo transportation in Istanbul and the obtained data were evaluated in terms of air cargo transportation. In the chapter 5, an air cargo potential index study conducted to determine the most appropriate area for air cargo transportation in Turkey. Indicators used in the index study and the data obtained as a result of the index was explained in detail. In the chapter 6, it has been investigated whether Istanbul Airport can be a significant transit point in terms of global air logistics. Brief explanations were made about the potential rival airports that could be effective in achieving this goal of Istanbul Airport and then a comparison was made between Istanbul Airport and its rivals. In the chapter 7, a scenario study was conducted for air cargo transportation. Within the scope of the scenario study, the Systems and Development Planning of Turkish Airports Project by YTM-MATPUM

was analyzed and data of the focus group meetings held as part of the project were evaluated from an air cargo perspective. Accordingly, 4 possible scenarios for air cargo transportation were produced. Finally, in the conclusion chapter, a general evaluation on the findings of the research was made. In addition, the relationship between Istanbul Airport and regional development has been discussed from regional planning perspective.

CHAPTER 2

THEORETICAL FRAMEWORK OF THE THESIS

2.1. Globalization and Global Trade

According to The International Monetary Fund's (IMF), Globalization is the increasing economic interdependence of international countries during the increasing volume and multiplicity of cross-border transactions in goods and services, freer international capital flows and additional rapid and common technology spread (Kherbash & Mocan, 2015). Also Donald G. Janelle and Michel Beuthe defines globalization as the increasing geographical scale of economic, social, and political interactions (Janelle & Beuthe, 1997).

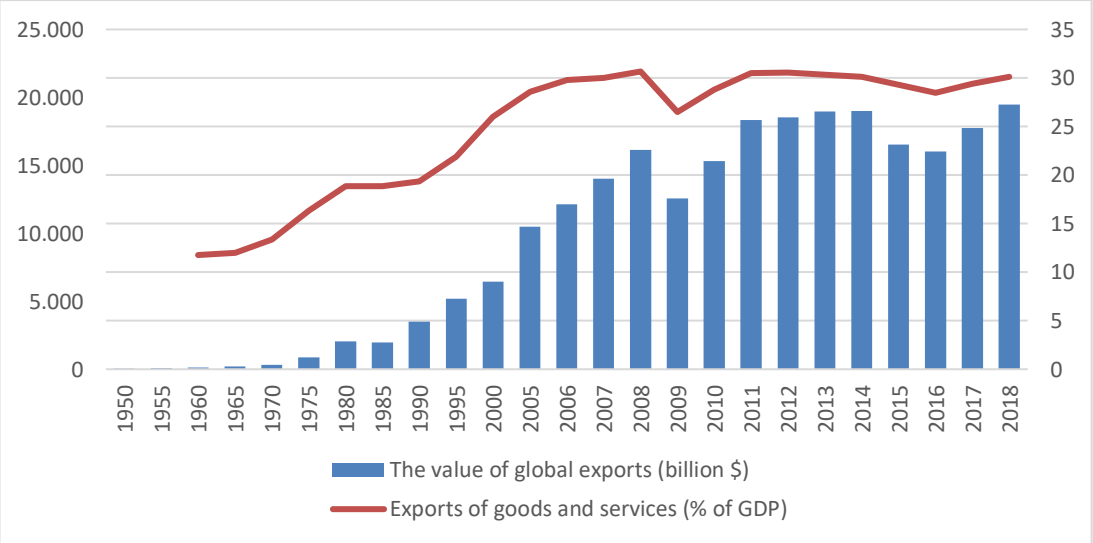


Figure 2.1. Economic Indicators of Global Trade (*This figure is created by the author through using World Bank and Statista.com database)*

The value of global exports and the value of exported goods & services as share of GDP are shown in the figure above. The figure was compiled through using the World Bank and Statista.com database. Accordingly, it can be said that global trade has

grown remarkably over the last decades. In 2018, the global trade value of goods exported throughout the world amounted to approximately $19.5 trillion. In addition, it can also be said that global trade has grown proportionately with GDP. According to World Bank, the ratio of exported goods and services to GDP was approximately 30% in 2018. The increasing trends in the graph are also a reflection of the increase in globalization.

Earlier surge of globalization seems to be highly concentrated among developed nations. However, the contribution of emerging market economies in international trade has been increasing significantly in past few years (Naz & Ahmad, 2018). The best example of this is the increasing market share of Asian countries in global trade especially in recent years. Turkey who shown as one of the emerging economies have target to have a significant share in global trade. The most important indicators of Turkey's efforts to play a key role in global trade are important investments in the defense industry and the aviation industry. Therefore, it will be useful to analyze the dynamics of globalization well.

It can be said that globalization is a very comprehensive concept and it is driven by many factors. One of the most important dynamics of globalization is technological developments. Advancement in technologies both facilitate and improve global trade. Technological developments are discussed under two headings: transportation and communication technologies. Especially since the 18th century, transportation developments have had an impact on globalization. Global trade between cities near the ports has gained momentum thanks to the sea / water transportation that emerged in the 18th century. In the 19th century, Railways / railroad transportation emerged and goods have started to be carried on land via railroads. In addition, new trade routes and industrial cities emerged thanks to that development. In the 20th century, automobiles & highways emerged and private car ownership increased. It also increased the mobility of people & goods. Lastly, developments of air transportation in the 21st century is seen as one of the major transport developments that will affect globalization. The demand for excessive mobility and connectivity has also emerged

due to that development. In addition, airport cities have emerged where airport oriented developments are at the forefront.

Table 2.1. *Effects of Transportation Developments on Globalization*

Transportation Developments	Effects on Globalization
18th century: Sea / water transportation	- Global trade among cities located near ports.
19th century: Railways / railroad transportation	- Goods have started to be carried on land via railroads. - Emergence of new trade routes, industrial cities.
20th century: Automobile & Highways	- Increasing private car ownership. - Increasing mobility of people & goods.
21st century: Air transportation	- Excessive mobility and connectivity demand. - Emergence of airport cities (Aerotropolis approach).

Production and dissemination of containers is one of the important examples of developments in transportation technologies. International trade has gained momentum and also transportation has come to the forefront in global trade thanks to the container system which facilitates the exchange of goods and significantly reduces transportation costs. Similarly, the introduction of universal barcode has increased the movement and flow of goods worldwide (Naz & Ahmad, 2018). It is also an important factor that transport vehicles can perform transportation activities at a lower cost in line with the developments in fuel technologies over time. The importance of air cargo technology which providing fast and safe transportation in global trade is increasing day by day due to prominence of the time factor.

Especially since the 20th century, communication developments have had an impact on globalization. Emergence of internet in the 20th century, increased individual computer ownership. It also increased accessibility to goods. Today, global trade has begun to change shape partially due to the widespread use of individual computers and increased access to the Internet. In the 21st century, a concept called e-commerce emerged thanks to internet technology and it is becoming more widespread with each

passing day. Opportunities for marketing goods & services increased thanks to e-commerce. It can be seen clearly on the producer and consumer scale. From a manufacturer's point of view, the manufacturer can now have the opportunity to market his product or service to the other side of the world via the e-commerce. The consumer may likewise purchase a product or service which produced on the other side of the world. Furthermore, the development of e-commerce has a multiplier effect in many sectors such as logistics. Increased access to goods via e-commerce accelerated shopping and the transportation of goods has come to the fore. In light of the above we obviously see that advancement in technology is one of the most important drivers of globalization.

Table 2.2. *Effects of Communication Developments on Globalization*

Communication Developments	**Effects on Globalization**
20th century: Emergence of internet	- Increasing individual computer ownership - Increasing accessibility
21st century: Emergence of e-commerce	- Reshaping of global trade - Increasing opportunities for marketting goods & services - Multiplier effect in sectors such as logistics - Golden era of accessibility

Lower transport and communication cost can only be exploited through lower trade barriers. Policies aimed at reduction in trade barriers lead to trade liberalization. In addition, deregulation and outward looking reforms are considered to be an important source of globalization (Naz & Ahmad, 2018). Therefore, it can be said that government policies could be driving factor of global trade. Today, we see that trade barriers between countries can create a global economic crisis and it can affect global trade significantly.

Nowadays, the trend of creating hub and spoke networks to provide more efficient consolidation and traffic distribution ,especially by establishing direct point-to-point connections between major global cities, is increasingly spreading (Janelle & Beuthe, 1997).The Hub and spoke trend means in the simplest way to clustering of transport

activities in specific centers and actualizing an efficient distribution between those centers. The spread of this trend is evident in air passenger and in both ground and air-freight transportation. Cities serviced by direct connections are likely to gain appreciable accessibility advantages over other places within national and international urban hierarchies (Janelle & Beuthe, 1997).

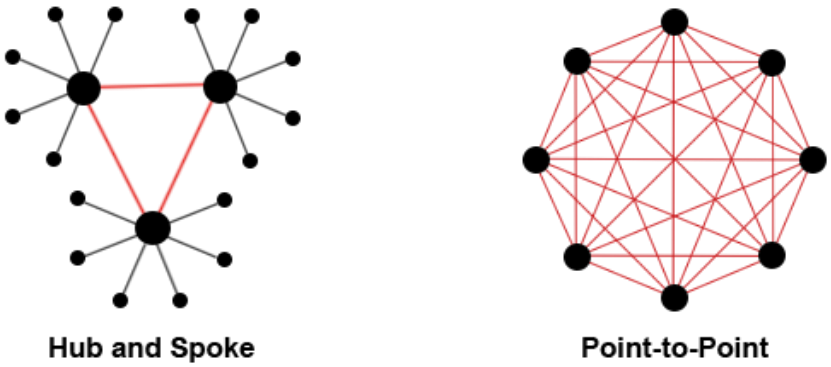


Figure 2.2. Hub and Spoke & Point-to-Point Diagram (*This figure is created by the author)*

Although maritime transport is different from other types of transport, it can be given as a good example of this hub and spoke approach. The scale advantages of large hubs for international marine traffic and the increasing sizes of ships cause concentration of shipping activity in specific ports. Therefore, most of maritime transport takes place among mega cities with such ports. Mega cities with such ports are prominent in global trade with the wide opportunity of maritime transport. Likewise, it can be said that mega cities, which can be a global hub where international transportation is concentrated, have high accessibility and low transportation costs advantages. In the following period, it is predicted that global trade will be realized more among the cities which become global hubs. Therefore, cities seek to extend their competitive presence from regional and national setting to the international domain (Janelle & Beuthe, 1997).

The hub and spoke approach also enables decreasing transportation costs of the exchange of goods and services between the two countries through using a 3rd country with advanced infrastructure facilities as a transfer point. Especially the countries with

advanced communication and transportation infrastructure are trying to be an important hub that directs global trade. One of the best examples of this is concentration of the international commercial activities in and around Amsterdam Schiphol Airport in the Netherlands. For example, goods belonging to a product group can be supplied as raw materials from more than one point in the world and processed in Amsterdam and marketed elsewhere in the world. In addition, goods belonging to any product group with export potential can also be supplied in processed form from more than one point in the world, and can provide aggregation of these goods at a single point to export at low costs. In other words, countries are trying to gain more benefit from global trade by creating a suitable area for global trade in their countries as well as trying to marketing what they can produce in their own countries.

Considering that important countries such as Germany, the Netherlands, France, the United Kingdom and the United States have given great importance and made huge investments in recent years, the importance of having a hub which capable to direct global trade is increasing day by day. It should be aware that Turkey likely to be one of the most important global trade hubs in the world through using the geographical location advantages. Considering that Istanbul is already a major destination for global trade, Turkey economy will provide more benefits from global trade through developing of global trade enabling infrastructures.

2.2. Logistics Revolution and Airports

The dynamics of globalization reshaping transport-related business organizations while increasing the volume and depth of trade and business relations. Especially the cargo industry has changed significantly in the last 25 years due to the rapid technological changes. In this process, while the world economy become more global, the market and production organizations developed. New logistics and supply chain concepts have evolved due to reduced fuel and labor costs and zero stock production (Just In Time - JIT) and Destination Assembly Manufacturing trends (ACRP, 2015). New business organizations, which aiming to meet global consumer demand cheaply,

efficiently and effectively, emphasize approaches that evaluate transport within the value added chain rather than evaluate it alone.

The concept of cargo is no longer sufficient to describe the transport sector in a comprehensive way. Cause of emerging new business functions on the agenda, sector is tried to be defined by names such as logistics, integrative logistics or supply chain management. The integral integrity of suppliers, manufacturers, transporters and end-of-sale services is emphasized in such approaches. Basically, the management of each part of the value-added chain in a co-ordinated, common knowledge and technology base, producing fluid solutions instead of stationary (supplying the required goods immediately instead of storing goods can be given as an example here) are seen as the main issues of the new transportation defined as supply chain management.

Since production is now carried out in different locations rather than in a single factory, transportation has now become an integrative process that strives to be carried out between different locations and work steps. In addition, due to increased short shelf life of the new products and the increase in the value of the goods shipped, the demand for rapid transportation and control is increasing as well as transparency in logistics processes (ACRP, 2015). The importance of air logistics is increasing day by day thanks to it is faster, more reliable and the risk factor is at minimum values compared to its alternatives. In line with these developments, it is foreseen that the logistics sector will become one of the fastest growing sectors in the world and that air logistics will be at the forefront in terms of time management.

In the "World Air Cargo Forecast" titled study which conducted by Boeing in 2016-2017, it is estimated that the amount of cargo carried by air transportation will increase by two times in the next 20 years and the number of aircraft will increase by 70%. According to the study, there is a strong relationship between air cargo and national income; therefore, these estimates are based on the assumption that the world economy will grow by 2.9%. According to the estimation, the world cargo growth rate was around 4.2%. Due to this structure that develops day by day in business and trade life,

special importance is given to cargo transportation in master planning. In the master plans to support cargo transport, large areas are reserved for the logistics sector when making land use plans around the airport (Boeing, 2017c).

For airports and master plans that will give importance to the cargo issue, the first consideration should be the size of the demand and the market. Based on this classification, five separate cargo airports can be identified. The first group, called "global transparks", defines the main logistics hubs of the global economy. Airports such as Dubai and Schiphol are included among such global cargo centers, where re-export is intense within the logistics operations. In the second group, there are airports which do not play a key role at the global point but cargo activities are very intense and are generally supported by industrial parks and free trade zones. Cargo is the main function of the airport in such airports and this type of airports are mostly located in the US. Alliance Airport, Fort Worth, Pratt and Caldwell airports are examples of this type.

Airports that operate on the basis of cargo only and which are regional hubs are considered as "regional hub cargo airports" by in this classification. The most notable of these airports is East Midland Airport in England, which has only 300 thousand tons of cargo volume per year. The niche market airports are generally airports that do not have a national and international centrality but compete with marketing strategies. The airports in this group provide agreements with cargo carriers for special services and as a result of these agreements, they specialize in certain subjects in cargo. Manston in the UK and Liege Airport in Belgium are examples of this type. Lastly, the airports that absorb the excess capacity of air traffic in large cities serve as capacity relaxing airports. Such airports are located at the secondary level next to the primary airports in the cargo.

Differences in airports in terms of market and demand, such as infrastructure, multimodal connections and obstacles to air transport, shape the overall quality of cargo airports. An airport should have sufficient infrastructure if it wants to be a

transpark cargo airport in a global sense. The airport should have meaningful answers in the main categories such as the density of transport companies, sufficient land around the airport for logistics services, multimodal connections and especially high speed train connections, night traffic and noise restrictions.

When we look at the world, the first and basic product group of air cargo demand consists of products that are sensitive to time and temperature that need to be carried urgently and non-durable products. The first category where the cost of transport is insignificant and price flexibility is zero includes medicinal products, hazardous materials, live animals. In the second category where speed, flight frequency gains importance instead of urgency there are products such as fruits, vegetables and cut flowers as both groups have a high risk, business processes such as transportation management, insurance and storage are very important in order to reduce this risk.

Undoubtedly, the most important means of transportation in these two product groups is air cargo transportation. In the durable product group, air cargo is becoming more and more important in the globalized world among alternative transport routes. The development potential of air cargo is mainly in this product group. This product group mainly includes petroleum and petroleum products, textiles and apparel, electronics and computers, mechanical parts and supplies. Distance is the most important factor in this type of product group. As long as distances increase and geographically complex in the global production process, air cargo transportation will be a preferred mode of transport for durable products. Air cargo, which have competitors in close distance such as road, sea and rail transportation, seems to be unrivaled because it shortens delivery time over long distances. Therefore, the spatial size of the global economy is drawn by air-cargo transport. World trade, which grows and deepens spatially with the participation of more and more countries, increases the demand for air cargo in the durable product segment.

In short, as long as production flexibility, international trade intensity and delivery speed determine the demand, air cargo will remain unrivaled in durable products over

long distances. The basic criterion for durable products in short distances is weight. As air cargo pricing is based on weight rather than volume, air cargo transportation becomes more economical for large volume and low weight durable products. Another important point is the transportation of durable and high value products. Air cargo is preferred for the transportation of high value goods which also have high risk such as jewelry, antique goods, banknotes and gold.

In the light of all this information, it can be said that airports that want to increase cargo volume have to analyze the product and market opportunities very well in their development strategies. Apart from the product and market matrix, other points to be considered in development strategies can be summarized as follows based on the air cargo studies conducted by Airbus and Boeing. Other points to be considered in development strategies can be summarized as follows based on the air cargo studies conducted by Airbus and Boeing.

- Underbelly cargo is expected to lose its price advantage due to increased security measures in the coming years; therefore, a significant improvement is expected in cargo aircraft transport (cargo aircraft transport is expected to increase by 4.5%, Underbelly cargo by 4.9% and the market share of Underbelly cargo will increase in a 20-year perspective).

- In the next twenty years air cargo growth rates are expected to be very high in Asia and especially China, which is the center of world manufacturing industry production in recent years. This rate is 6.2% in China and 5% in Asia (Boeing, 2017c).

- In addition to this remarkable advantage in Asia, a very interesting movement is envisaged in the African market. A national income growth of up to 15% is expected especially in oil producing African countries (Angola, Equatorial Guinea, Chad). Likewise, there is a growth expectation of around 10% based on agricultural products in Mozambique, Ethiopia and Tanzania. In addition, as China has an increasing influence on Africa every day, it is foreseen that strong manufacturing industry will be developed in Africa under the control of China. In this case, in the next twenty years, high cargo transportation based on very high growth rates may be introduced in some African countries.

- The proportion of large aircraft which are 80 tons and over is expected to increase from 14% to 26% in the next twenty years. Medium-sized aircraft are expected to increase from 47% to 49% and small aircraft less than 30 tons are not expected to decrease. In parallel with the growth in aircraft volumes, it is foreseen that multi-modal transports such as airplane-train, airplane-truck or airplane-ship will be more on the agenda. Smaller airplanes will still be important where geographical conditions are limited, so it is not expected that a decline in small aircrafts in the coming years (Boeing, 2017c)(Airbus, 2014).

2.3. Air Cargo Transportation as a Global Competition Tool

Due to the increasing trade trends in the globalizing world and the rapid technological developments in recent years, the importance of logistics activities and logistics sector is increasing day by day. Today, the logistics sector, which has become one of the fastest growing and largest sectors, has significant effects on the national economies. With the impact of globalization and rapid technological developments in recent years, urbanization rates have increased and societies' unique value judgments and cultures have also changed and societies have started to resemble each other. In line with these developments, it can be said that significant changes have occurred in people's demands and the effects of this change have been seen on the logistics sector. As a reflection of the increase in urbanization rates, urban regions have increased significantly over the years and the concept of competition, which has gained importance with globalization, has been reflected in these regions as well. As a result, nowadays these regions compete with each other.

In recent years, development scenarios which mainly focus on production organizations have begun to big change in accordance with rapid changes in information technology. Nowadays goods and services are being to design in any geographical region of the world, produce in a different geographical region and demand from elsewhere of the world. In line with these developments, investments to produce these products are not enough today and the procurement processes of the produced products have come to the forefront. While the scarcity of resources is in the forefront in the economy in the past, the situation has changed in recent years and have

emerged markets where there are many cheap and high quality products, product diversity has been provided and competition is increasing. The importance of supply chain management increased due to developments such as increased product diversity, increased short shelf life of products and increased value of goods. Furthermore, the importance of logistics, which is a factor that significantly reduces the transportation costs when properly constructed within the supply chain system, is also increasing day by day.

Together with the global competition and these developments in production organizations directly affect the logistics sector. It even enables countries to make a difference in global competition and the logistics sector to become the most important actor in this process. Considering the importance of logistics in interregional competition, mega cities, which are increasing in number every day, can be seen as an opportunity for the development of the sector. It is not a coincidence that the investments in the logistics sector have increased by developed countries in recent years with some effects such as the lifting of international borders, production becomes portable thanks to developing technology, the prominence of the competition factor. Therefore, the logistics sector is seen by many countries as a strategic and promising sector with high development potential and investments in the logistics sector are increasing day by day.

The scattered location of logistics activities significantly increases the costs and makes the infrastructure investments necessary for the development of the sector difficult. It is becoming increasingly impossible to produce and sell this product in the global market at high logistics costs without sufficient logistics infrastructure. In addition, there occur negative effects such as traffic and air pollution of using vehicles like trucks in logistics activities. It can also decrease the quality of life of individuals. For this reason, logistic activities should be carried out efficiently and these activities should be clustered outside of the urban area in order to minimize the harm to the environment.

The clustering approach of logistics activities in specific areas, also called logistics hubs is becoming increasingly widespread and the efficiency of the logistics sector is increasing day by day. These logistics hubs contribute directly to the competitiveness at the regional level if integrated with a wide range of transport modes and planned in a comprehensive way. When the existing airports are examined in terms of air logistics, it is seen that the major airports which stand out with such features as having the highest cargo volumes, becoming global air logistics hubs and making a significant contribution to the country's economy have a relationship with logistics hubs. Hence, it can be said that the relationship with the logistics hubs has effects on air logistics sector, the airports which own these relations have a high competitive power in terms of the logistics sector and the air logistics sector will become to a more important position over time through the increasing logistics hub trend. It can also be said that the logistics hub oriented development approach is an important issue that can play a big role in the development of the regions.

Although air logistics still has a small role in the entire logistics sector, it is irreplaceable due to its large efficiency in international trade and modern logistics operations and its role in the transport of small valuable goods. Within the influence of the globalization process, while consumers want to have fast delivery opportunities, and also producers expect fast, safe, secure, high reliability and frequent transportation services to meet the demands of the consumers. For these reasons, air logistics is a very important factor in terms of competition in the global market. Furthermore, the trends such as the flow of products from the manufacturer to the consumer at maximum speed, Zero-Stock Production (JIT) and Mounting at Destination emphasize the importance of air logistics.

Especially in order to compete in cargo operations with sea logistics, which is the most important competitor and has the most cost-effective advantages today, air logistics has to reduce its costs to the levels of alternatives. Market share in the logistics sector is gradually increasing due to the fact that it is faster, more reliable than the alternatives, and the transportation risk factor is at minimum values. In line with the

increasing investments in the sector, transportation costs are reduced in the air logistics sector and competitiveness of sector is increasing.

Since the end of the 1990s, with the introduction of more dynamic and more integrated multi-cargo systems at airports, speed and capacity in logistics operations has increased significantly. Having multi modal connections has become an important factor in the competitiveness of airports due to the emergence of integrated transport companies (FedEx, UPS, DHL), "door-to-door" delivery models and logistic hub trends in recent years. With the increasing importance of time factor and logistics supply management, tendencies to adapt to different geographical features depending on the destination location in logistics operations and to decrease logistics costs by evaluating transportation alternatives according to the route have emerged. Fuel prices, which have experienced significant fluctuations in recent years, have a major impact on gaining importance of multi modal transportation.

One of the most important factors considered in the evaluation process is the infrastructure facilities of airports which play an important role in ensuring that cargo products reach their destination in a timely and robust manner and that customers can easily access their cargo opportunities. Logistic costs are reduced to minimum levels thanks to multi modal transportation connections at hub airports where cargo operations are intensified. And it also gains a significant competitive advantage against alternative airports through developed infrastructure facilities.

Another important issue for the competition in terms of air logistics is the aircraft technology used. 3 types of aircraft are used for air cargo transportation: wide-body, narrow-body and narrow-body turbo-prop. Most of the aircrafts currently in use as cargo aircrafts are transformed passenger aircraft due to the expiry of their life as passenger aircrafts. Other cargo planes used are usually large-bodied aircraft manufactured by Boeing and Airbus. In particular, converted aircraft have significant disadvantages than alternatives such as low fuel efficiency, low capacity compared to large-body aircraft, and frequent repair problems depending on aircraft age.

In addition, using the aircrafts produced for passenger transportation as cargo aircraft, transportation costs have increased significantly due to increasing oil prices and environmental reasons today. It can also be said that this type of aircraft has lost efficiency in terms of logistics sector. For these reasons, aircraft fleets began to be modernized by companies seeking to increase their competitiveness. Thus, new types of aircraft with high fuel efficiency, high range and high carrying capacity, minimum environmental impact, hosting new technologies have started to use.

Another important factor that increases air logistics costs at airports is the damage to the transportation vehicles (ULDs) which used for the carriage of cargo on airplanes during cargo operations. Repairs and loss of time due to incorrect loading of these vehicles can increase transportation costs considerably. In addition, the unloaded weight of these transport vehicles significantly reduces the capacity of cargo aircraft. With the increase in the use of wide-body aircraft, ULD management in logistics operations has begun to play an important role in achieving high efficiency. Nowadays, innovation studies are being carried out to produce transport vehicles (ULDs) that are lighter, more robust and reduce transport risks.

The Trade Protection approach adopted by the European countries, which emerged with the 2008 crisis, has devastating effects on world trade. According to the World Trade Organization (WTO), world trade, which has been declining due to trade restrictions between countries, is expected to capture a new growth trend through free trade agreements between countries (IATA, 2015). Particularly, the limitation rules for air cargo and the increasing safety measures due to these rules lead to delays in transportation processes and speed factor, which is the most important advantage of air logistics, cannot be used effectively. Based on these examples, it can be said that the legal regulations also have a direct impact on the competition of air logistics.

Increased safety measures applied in transport processes are one of the important factors that increase the transport time of the product. Innovations that reduce these time losses are increasing day by day. However, the ratio of airports hosting these

technologies which requiring high investment costs is low. Due to insufficient infrastructure, the possibility of damage to the transported cargo increases as well as delays in the procurement processes and increase in transportation costs. Therefore, investments in security infrastructures are important for the competition of airports.

Certainly, airports have the most important role in achieving a significant development in the air logistics sector. Significant budget is allocated for the development of airports in developed countries that are aware of this. Economic, industrial and commercial structure of the region have great importance for carrying out air logistics activities in a region. Likewise, infrastructure of airports has also great importance too. Not only improving infrastructure of airports is vital but also air cargo terminals should also be able to learn to think of themselves as a logistics hub rather than just seeing an airport, use the opportunities, and be able to become an international connection point by enabling other modes of transport.

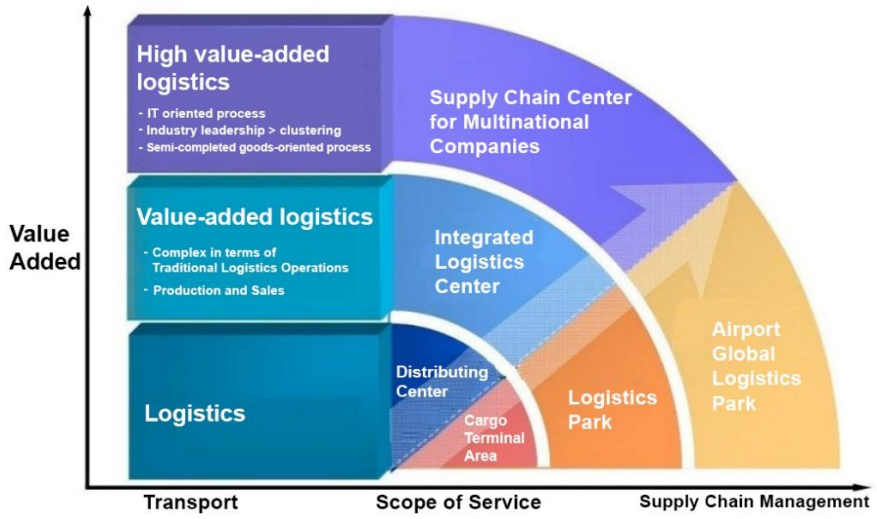


Figure 2.3. Increased Value Added Chart From Cargo Terminal to Logistics Center (Yavaş, 2013).

According to a study on air freight logistics hubs in Hong Kong and China, these hubs, rather than being a terminal for air transport activities only, will be important logistics and production hubs that meet the requirements of 21st century e-commerce and new information systems and are highly dependent on time sensitivity and personalized products (Sit, 2004). It is also thought that a similar impact of the first few decades of

the invention of the container in the 1960s could be captured by this new approach of cargo transport deployed close to the growing industrial and commercial markets. Therefore, air cargo-based logistics hubs have the potential to be a center that can trigger regional development by blending new technological developments such as trade, emergency transportation services, "JIT" philosophy and products produced in many regions globally (Yavaş, 2013).

Another important issue is the possibility that destructive innovations will have a negative impact on air cargo volumes. One of the developments that need to be taken into consideration is that innovations such as 3D printer may cause a decrease in cargo demand. In addition, passenger transport with fast and sustained growth rates has an impact on air cargo. With the effect of decreasing flight prices, it is easier for individuals to travel to other countries for touristic purposes. The approach of individuals to purchase products that are produced in that country and can be obtained at affordable costs and to bring them to their own country by adding to their own baggage has emerged. This trend, also called "buy & carry", may have a negative impact on air cargo.

To summarize, the logistics sector is seen as one of the strategic sectors that directly contribute to the competitiveness of the countries. Despite the rapid development trends in recent years, it is still considered that its potential is not being used sufficiently but its potential is increasing with the effect of technological developments. Therefore, investing in the logistics sector should be seen as an important opportunity for countries that want to gain an advantage in global competition. It is foreseen that the air logistics sector, which has gained significant momentum with the clustering approaches and multi modal transportation concepts gaining importance in recent years and whose value has increased with speed advantage, may have larger leaps in the coming years. It also be said that development potential of air cargo transportation is higher than alternative logistics sectors. Countries may have significant returns in the long term through evaluate these opportunities in the global competition and develop their infrastructure facilities.

Furthermore, the SWOT analysis performed by IATA to show different aspects of air logistics can be seen in the following table.

Table 2.3. *SWOT Analysis of Air Cargo (IATA, 2015)*

Strengths	**Weaknesses**
- Speed - Safety - Security - Reliability - To be the most convenient mode of transportation for the countries that do not have a sea shore - To be most suitable for long-distance transport compared to alternatives	- Lack of airport capacity - Lack of wage competition - Non-environmentalist perception - Inadequate investment in modernization, adaptation and innovation - Having a complex structure - Excessive security restrictions
Opportunities	**Threats**
- Growth in e-commerce activities and increased demand for fast delivery - Free trade agreements - Liberalization of the market - Growth in economy and trade - Globalization of production, distribution, procurement processes - New logistics trends - Investments to increase capacity - Increase in urbanization rates	- Fires that may occur during cargo transportation - Irregular supply chain management - Competition with alternative modes of transport - Fluctuations in gasoline prices - Terrorist actions and insufficient security requirements - Increased restrictions on airfreight processes - Trade protection - Inadequate airport infrastructure - Night restrictions for logistics activities

Three different strategies are applied in terms of cargo airport in the world according to the characteristics of the airport and the city-region where they are located. One of these strategies is to organize global airports in mega aviation cities as a global cargo transpark. Global airports such as Schiphol, Frankfurt, Charles de Gaulle, Seoul Incheon, which are trying to build the main logistic centers of the global economy, are the airports that best reflect this trend. Istanbul Atatürk Airport has become a partial global transpark due to lack of capacity. Istanbul Airport can be made one of the most important global cargo transpark in the world with appropriate interventions.

Table 2.4. *Top 20 Airports in The World According to Cargo Traffic Ranking (2018)*

PLACE	ICAO CODE	NAME	COUNTRY	CARGO TRAFFIC (TON)
1	VHHH	Hong Kong International Airport	Hong Kong	5.120.811
2	KMEM	Memphis International Airport	U.S.A.	4.470.196
3	ZSPD	Shanghai Pudong International Airport	China	3.768.573
4	RKSI	Seoul Incheon International Airport	Republic of Korea	2.952.123
5	PANC	Ted Stevens Anchorage International Airport	U.S.A.	2.806.743
6	OMDB	Dubai International Airport	United Arab Emirates	2.641.383
7	KSDF	Louisville International Airport	U.S.A.	2.623.019
8	RCTP	Taiwan Taoyuan International Airport	Taiwan	2.322.823
9	RJAA	Narita International Airport	Japan	2.261.008
10	KLAX	Los Angeles International Airport	U.S.A.	2.209.850
11	OTHH	Hamad (New Doha) International Airport	Qatar	2.198.308
12	WSSS	Singapore Changi Airport	Singapore	2.195.000
13	EDDF	Frankfurt Airport	Germany	2.176.387
14	LFPG	Charles de Gaulle Airport	France	2.156.327
15	KMIA	Miami International Airport	U.S.A.	2.129.658
16	ZBAA	Beijing Capital International Airport	China	2.074.005
17	ZGGG	Guangzhou Baiyun International Airport	China	1.890.561
18	KORD	Chicago O'Hare International Airport	U.S.A.	1.868.880
19	EGLL	Londra Heathrow Airport	United Kingdom	1.771.342
20	EHAM	Schiphol Amsterdam Airport	Netherlands	1.737.984
	LTBA	**İstanbul Atatürk Airport**	**Turkey**	**1.281.186**

* Compiled from ACI (Airports Council International), and DHMİ database

According to the table above which shows the world's 20 largest airports in terms of annual cargo traffic in 2018, Istanbul Atatürk Airport could not rank in the top 20 with 1.281.186 tons. According to these data, Istanbul Atatürk Airport is far behind the

important global transpark airports in the sector such as Hong Kong, Incheon and Frankfurt.

Another strategy is to become a global logistics center through a strong logistics company. The best example of this is the relationship between FedEx and Memphis logistics companies. With the new cargo facilities created as a result of FedEx's deployment in Memphis, Memphis Airport has become a worldwide connection hub. 95% of the total cargo of Memphis Airport, which has been number one in world cargo transportation for many years, is transported by FedEx. The Airport Master Plan is also prepared according to FedEx's development forecasts. In the future, a similar development can be seen in the air logistics industry in Turkey.

The third strategy is the regional planning approaches developed in cities and airports where these two strategies cannot be implemented. Such planning is carried out at regional airports which are not global hubs. Due to the limited or lack of "re-export" activities in such airports, the cargo business volume cannot be as much as at global transpark airports. This type of planning, which is compatible with the economic dynamics of the city or the region, can affect the mutual relationship between air cargo and production. In order to expand and improve cargo operations at regional airports, airport services are diversified and studies are carried out for different product segments. However, these studies have not yet reached the level of making specialized terminals as in the case of transparks. In these airports, studies are carried out in accordance with the regional economy and cargo development in harmony with the urban dynamics is tried to be directed. Munich, Vienna, Brussels, Eastern Midland, Lyon Saint Exupery, Nice, Helsinki, Liege airports are examples of such regional cargo airports.

Vienna Airport serves as the warehouse of Eastern European countries and contribute regional development through trying to improve the exportation of the companies in the region. While the Lyon region, where Lyon Saint Exupery Airport is located, implemented the Lyon Logistics development program, logistics parks and business

parks were built around the airport. In the “Zavantern-Machelen-Vilvoorde” area, where Brussels Airport is located, there are industrial, logistics and business parks focused on air cargo. Helsinki Airport continues its efforts in this area by creating “Helsinki Aviapolis” which includes advanced technology, telecommunication and logistics parks. The business and logistics parks around Munich Airport are supported by advanced fairgrounds. Copenhagen Airport - “Orestaden Advanced Technology Business Logistics Center” and Nice Airport – “Sofia Antipolis Science and Technology Park” stand out as very important partnerships in terms of cargo. One of the most striking examples of regional airports is the East Midland Airport in the UK, with only 300,000 tons of cargo per year. These airports, which generally do not have a national and international central structure but compete with their marketing strategies, make agreements with cargo carriers for special services and as a result of these agreements they specialize in certain subjects in air cargo.

Munich, which had a small airport until 1992, is an important example. Munich, saw the airport and air cargo activities as a regional development tool in the Bavarian Development Plans and established a new airport and entered a very rapid growth process (Burghouwt, 2007). The development strategy in the Bavarian region is based on the fastest and most cost-effective relationship with global business actors. That strategy aims to develop an advanced technology-based economy based on chemicals, pharmaceuticals, machinery, computers, electronics, telecommunications, medical and optical instruments, motor vehicles, advertising and media, design and architecture, logistics, law, consulting, finance and insurance services. The airport also makes a significant contribution to the participation of goods produced in this knowledge economy into the global trade cycle as soon as possible.

For the present only Istanbul Airport from Turkey is likely to be a global cargo transpark. However, there are many airports in Turkey that specializes in different variety of cargo. Izmir Adnan Menderes, Ankara Esenboga and Antalya airports can be important cargo airports in different sectors within their regional area. Furthermore,

this kind of development may occur at airports in Turkey's industrial area or in the border airports.

Table 2.5. *Turkey Airports Cargo Transportation Data (2018) (DHMİ)*

Place	ICAO Code	Airport Name	Annual Cargo Traffic (ton)	Percentage
1	LTBA	İstanbul Atatürk	1.281.186	92,3%
2	LTFJ	İstanbul Sabiha Gökçen	70.411	5,1%
3	LTBJ	Adnan Menderes	11.889	0,9%
4	LTAC	Esenboğa International	10.683	0,8%
5	LTAI	Antalya	6.157	0,4%
6	LTAF	Adana	3.177	0,2%
		Other Airports	5.121	0,4%
TOTAL			**1.388.623**	**100%**

According to 2018 data of DHMI, there are cargo activities in 47 of the total 56 airports in Turkey. Only 13 of these 47 airports have cargo terminal area. As seen in the table above, 6 airports in Turkey draw attention in terms of cargo traffic. It is remarkable that Istanbul Atatürk Airport has 92,3% of Turkey total cargo traffic. Istanbul Atatürk Airport also ranks first in terms of both domestic and international cargo transportation in Turkey.

2.4. Airport Concepts

Among several factors that have an impact on urban form, transport infrastructure has always been one of the strongest determinants of urban spatial patterns. Transportation systems provide some of the crucial necessities of the urban areas such as connectivity, accessibility, and interaction. Almost each century has witnessed a predominant or newly developed transportation technology that shaped the era. For example, starting from the very early civilizations, sea transportation was one of the earliest technologies that has been discovered and used for carrying goods and people over places. Accordingly, the greatest cities of the history located near ports where

they have access to other places through sea transport. After the development of railroad technologies, masses of people and goods have started to be carried on land via trains. Its impact on urban spatial patterns can be observed as the emergence of satellite cities. Especially in industrial cities, new towns started to emerge around railroad stops where masses of workers were transported from their homes to the working areas on daily basis. Then, development of automobile technologies caused the spread of highways all over the places. When automobile became the predominant way of commuting, the flexibility provided by the private car ownership urged people to choose their living places far from the city centers and suburbs started to emerge as the new spatial forms. In the 21st century, globalization has become the primary trend that affected many aspects of life. Countries have become much more dependent on each other, especially for economic reasons. Movement of people, products, knowledge, and money is also become more freely and faster than ever through globalization. Thus, accessibility and connectivity have become key characteristics that affect the competitiveness of cities or regions in that era. Air transportation and airports have become as the main providers of this accessibility and connectivity. Today, airports have also become a distinctive and identifiable economic zone that drives global trade and influences the development of urban areas.

The evolution of the airport area into a distinctive and identifiable economic zone accelerated from the early 1960s with the arrival of jet aircraft as the trigger (Freestone & Baker, 2011). Emergence of commercial jet aircrafts in the 1970s accelerated the transportation of goods among different regions of the globe (Naz & Ahmad, 2018). From the 1970s and throughout the 1980s, airports started to be managed as private businesses (several were privatized) to counter the natural cyclical business constrains or to maximize profits, airport managers started rapidly to diversify their revenue sources. This trend led to significant transformations in the aviation world and in its commercial strategy and operations potentiating the emergence of modern aviation infrastructures. In the later part of the 1980s and through the 1990s, globalization accentuated the transformation of the airport as a potential centerpiece of an entire

region while passengers, goods and services moving around the world through air transportation are steadily increasing, contributing more and more to reinforce the actual importance of airports. In the 1990s, globalization also reinforced the tendency of companies to locate their operations near airports where in the recent world economy, companies are more connected than ever and a product's quality and price are not enough for business success. In late 1990s, with the advent of internet and e-commerce, products started to be delivered more quickly and companies need to be flexible to attend the consumer's needs and demands in every part of the globe (Correia & Silva, 2015).

At the beginning of the 20th century, airports were seen as a component of the transportation system, which should be installed in the outskirts of cities, to avoid potential threats such as air pollution and operational hazards to the host cities (Correia & Silva, 2015). At the end of the 20th century, it was realized that airports with international accessibility have become important attraction centers that direct urban development. According to Robert Freestone, airports are no longer places where planes just take off and land but have evolved into major business enterprises with spatial impacts and functional implications that extend deep into metropolitan areas. He also states that airports have become vital functional nodes in the world economy and the jousting for regional, national, and international competitiveness (Freestone, 2009). Similarly, Marcos Daniel states that major airports became an influence for urban development and growth, a centerpiece on regional development and planning due to its territorial, social and economic impacts (Correia & Silva, 2015). American urban economist-sociologist John Kasarda is also argued that advances in transport technologies are shaping urban space. He also states that airports are shaping urban space in the 21st century much as highways did in the 20th century, railroads in the 19th century, and seaports in the 18th century (Freestone & Baker, 2011). Therefore, it can be said that the importance of airports has increased significantly in the 20th century and that airports have become an important component of urban areas through the effects of globalization.

Consequently, with the increasing importance of the aviation sector, airport-oriented development trends that affects the spatial patterns of urban areas have emerged. Literature on this issue mainly has been focused on understanding the interactions of airports with the urban core and other parts of metropolitan places or regions. In addition, a great attention has been given to understand the spatial forms developing around this huge infrastructures (airports). "Airport Regions" (Roeseler, 1971), “Airport City & Aerotropolis” (Kasarda, 2000), “Airport Corridor” (Schaafsma, 2003), and “Airea” (Schlaak, 2010) are the major concepts which were developed to understand and define the spatial forms that emerged as a result of airport driven development. In the following part, aviation concepts based on airport oriented development are explained in detail.

Airport Regions

Airport Regions Concept is generated by Roeseler in 1971. It basically defines the airport and a buffer area of 100 miles in diameter surrounding the airport. The buffer area subdivided into several land use control zones;

- Industrial uses, including airport and river transportation oriented industrial uses,
- Airport related restricted commercial uses, including: offices, hotels and motels, restaurants and minor retail establishments within office or hotel buildings,
- High-density residential uses,
- Retail commercial uses,
- Medium-density residential uses,
- Agricultural and low-density residential uses, and
- Agricultural and conservation uses.

According to the concept, there are different restrictions on each land use zones. The land use zones are detailed in the following table.

Table 2.6. *Zones of Airport Region Concept (Roeseler, 1971)*

Name of the zone	Description of the zone
Industrial Zone	With the exception of incompatible uses, any industrial use may be established in this zone which can meet the specifications, performance standards and urban design criteria prescribed. Among in compatible uses are: low intensity uses; unsightly uses; all forms of residential and commercial uses, except certain industry related services; etc.
Airport Related Restricted Commercial Zone	This zone represents a carefully selected group of land uses which, in the judgment of informed persons, constitutes services commonly desired by the traveling public at or near major air terminals. Common retail uses will be excluded as principal uses, but may be authorized as accessory uses within large office or hotel buildings.
High-Density Residential Zone	This is intended to be a high-rise apartment zone with a possible minimum building height of six stories. Its application will be limited, but should be effective. Proposed maximum density will be 35 dwelling units per gross acre with credits for open space.
Retail Commercial Zone	This is a somewhat conventional retail business area tending to be more exclusive than the ordinary district in view of severe design restrictions relating to structures and to outdoor advertising.
Medium-Density Residential Uses	This zone will be used sparingly. It will permit all forms of dwelling units under four stories. Townhouses, cluster developments and mobile home parks are included. Densities will not exceed 10 dwellings per acre, with credits for open space.
Agricultural and Low-Density Residential Zone	This zone will govern areas which will permanently remain as uncontrolled, but guided open space. It will permit all customary agricultural uses and rural non-farm residences on tracts of land not less than 40 acres in area and fully self-sufficient as regards water and sewer service.
Agricultural and Conservation Zone	This classification is to be used primarily in the floodplains and in areas characterized by steep slopes or other natural features making urban or rural non-farm development undesirable. Residential uses are prohibited. It is not anticipated that this zone be changed, except in situations where flood conditions, for example, have been removed by public improvements.

Airport City & Aerotropolis

Aerotropolis Concept is generated by Kasarda in 2000. It basically defines an airport and surrounding high density urban area. In other words, Kasarda defines the airport boundaries (inside the fence) as airport city, while the buffer zone surrounding the airport (outside the fence) is defined as aerotropolis (Kasarda, 2008). Airport city area includes terminals, aprons, runways, multimodal facilities, offices, hotels, cargo, retail and consumer services. Aerotropolis area includes industrial parks, freight forwarding, logistics and distribution services, business parks, shopping centers, entertainment areas, meeting areas, lodging areas. The components of Aerotropolis Concept are given in the figure below.

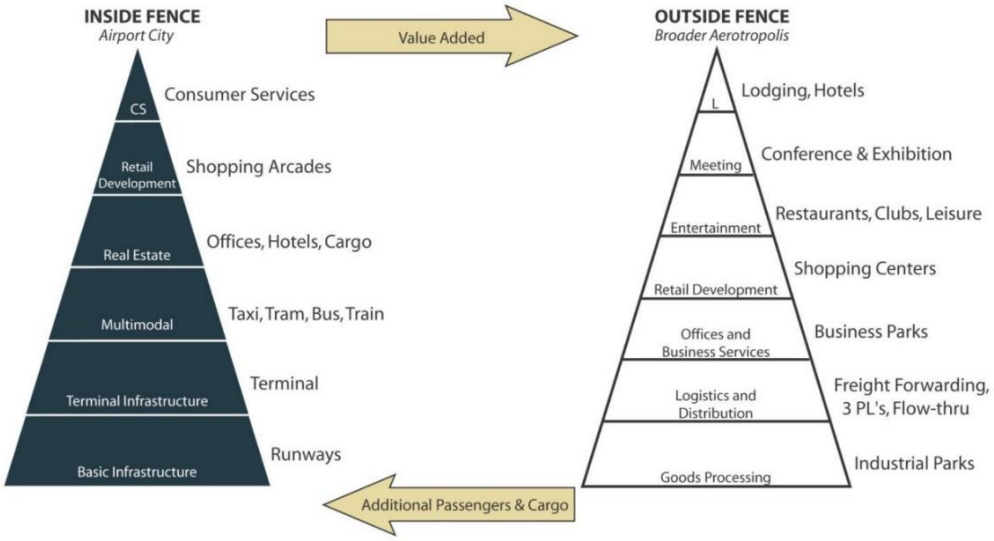


Figure 2.4. The components of Aerotropolis Concept *(Kasarda, 2008)*

The Aerotropolis model is grounded in the fact that in addition to their core aeronautical infrastructure and services, major airports have developed significant nonaeronautical facilities, services and revenue streams. At the same time they extend their commercial reach and economic impact well beyond airport boundaries (Kasarda, 2008).

According to Kasarda, there are four basic drivers of Airport Cities;

1. Airports need to create new non-aeronautical revenue sources, both to compete and to better serve their traditional aviation functions.
2. The commercial sector's pursuit of affordable, accessible land.
3. Increased gateway passengers and cargo traffic generated by airports.
4. Airports serving as a catalyst and magnet for landside business development. The most common airside and landside airport city commercial activities include: duty free shops, restaurant and specialty retail, cultural and entertainment attractions, hotels and accommodation, banks and currency exchanges, business office complexes, convention and exhibition centers, leisure, recreation and fitness, logistics and distribution, perishables and cold storage, catering and other food services, Free Trade Zones and Customs Free Zones, golf courses, factory outlet stores, personal and family services such as health and child day care.

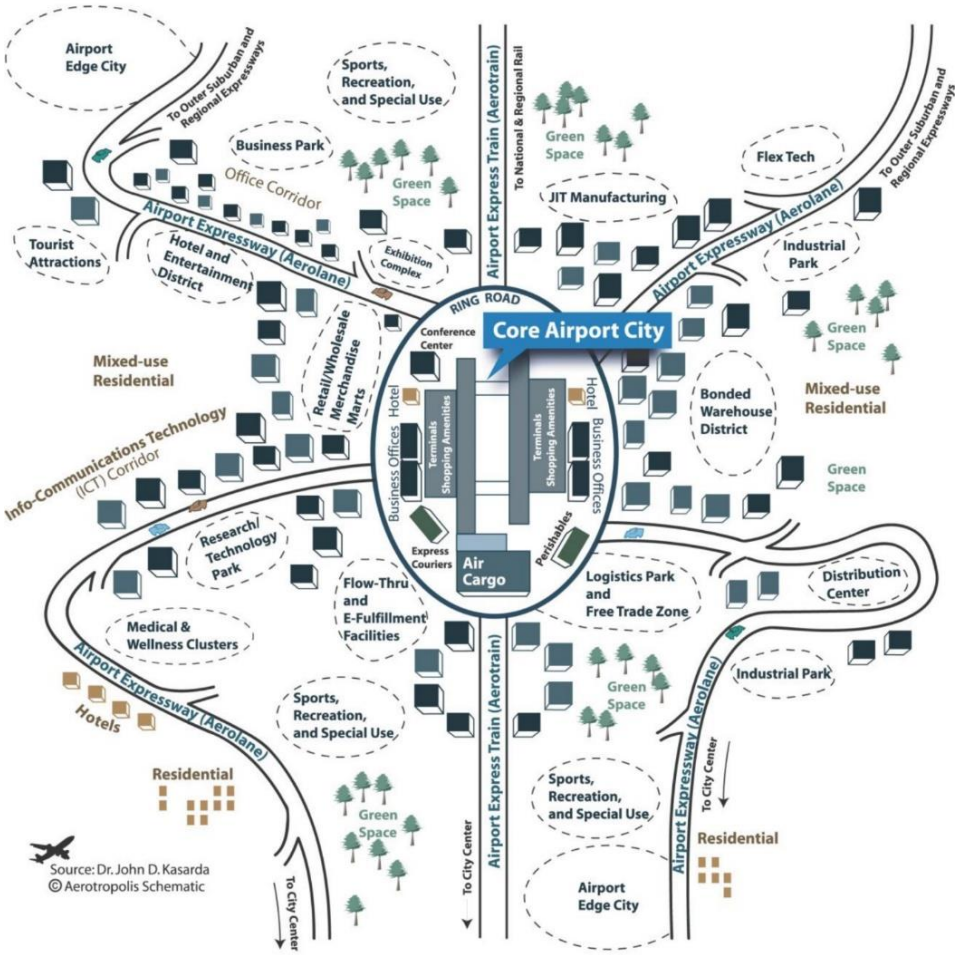


Figure 2.5. The scheme of the Aerotropolis Concept *(Kasarda, 2008)*

Airport Corridor

Airport Corridor Concept is generated by Schaafsma in 2003. It basically defines an urban development area emerged between the airport and the city along the main transportation routes. Airport corridor is a cluster with various production and service centers, such as technology production, logistics, food industry, offices, trade and retail. This type of the development is one of the rapidly growing and can be considered also as a linear type of the city (Krylova, 2016). In other words, it creates an urban conurbation between the Airport City and the host city through the developing of residential, commercial, industrial, logistical and leisure areas, structured along highways or railways (Correia & Silva, 2015).

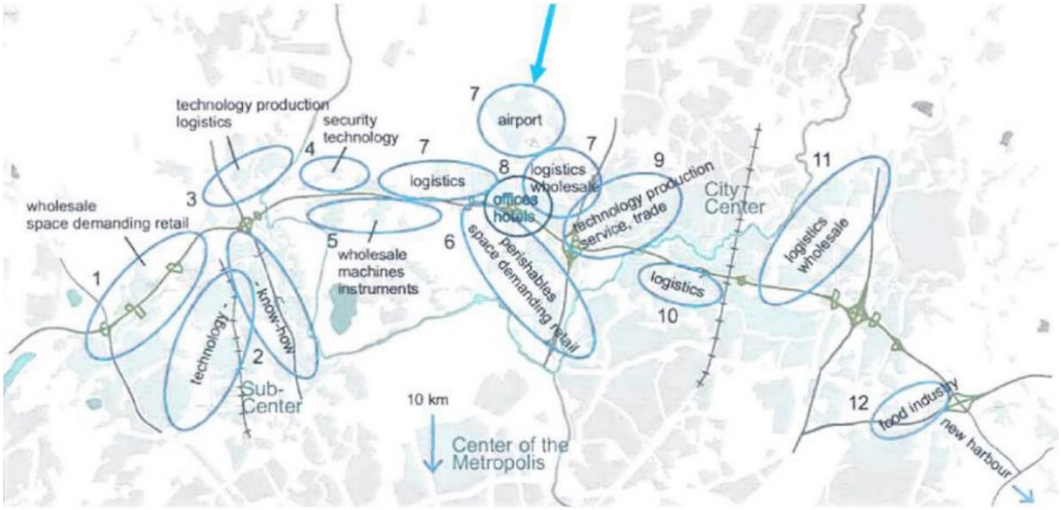


Figure 2.6. The scheme of the Airport Corridor Concept *(Krylova, 2016)*

Airea

Airea Concept is generated by Schlaak in 2010. The Airea basically consist of various fragmented islands of development within a certain space of opportunity in relation to the airport (Schlaack, 2010). In other words, Airea is a fragmented and dispersed developed area around the airport in a polycentric and metropolitan way (Correia & Silva, 2015). In addition, Freestone and Baker define “Airea” as discrete spatial clusters of airport-related development (Freestone & Baker, 2011).

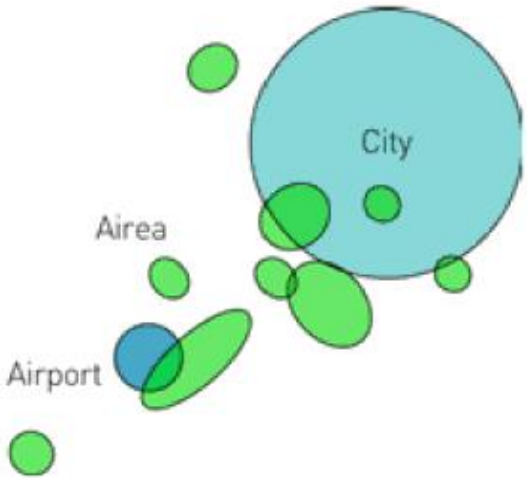


Figure 2.7. The scheme of the Airea Concept *(Schlaack, 2010)*

Schlaak explains this concept by giving an example. Firstly, he states that the actual spaces in the region, which show an interaction in direct airport relation by influencing the airport and being influenced by the airport need to be defined. Research criteria on that account are the proximity and accessibility regarding isochrone or distance, the development status by time and the marketing strategy regarding the airport. The component spaces together form the Airea and could each be ranked by their airport relation, airport focus and evaluated by their relation to each other (Schlaack, 2010).

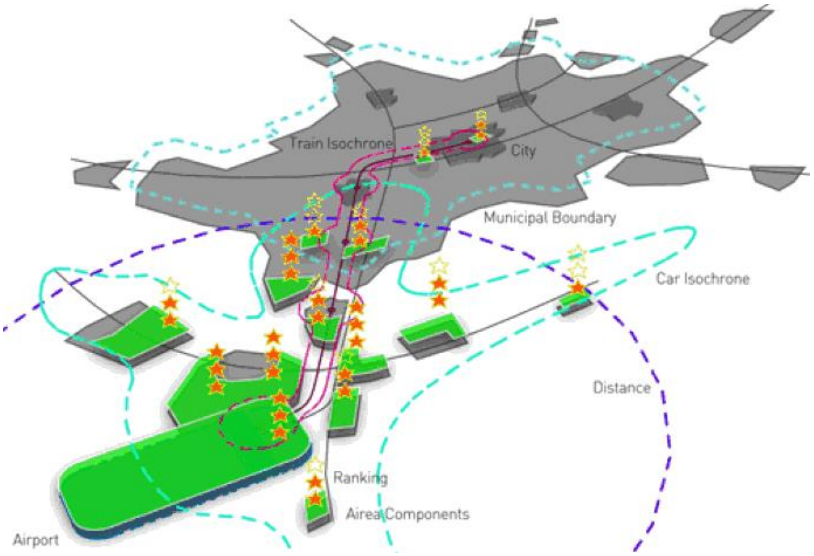


Figure 2.8. Schematic definition and ranking of Airea components *(Schlaack, 2010)*

Secondly, the component parts of the Airea are analyzed by program, physical form and stakeholder constellation in order to reveal inherent characteristics of the component parts in comparison to each other and to the other case studies and to further specifically characterize the overarching Airea. Thirdly, the interaction and interrelation of the Airea components to the city and to the airport, between each other and to their immediate vicinity are explored in order to characterize different types of interaction in the Airea. in the last step overarching types of interaction between airport and city are defined and a typology of interaction is developed. In this regard the aforesaid types of interaction of airport and city like the symbiotic, the competitive, the parasitic or the isolated become evident (Schlaack, 2010).

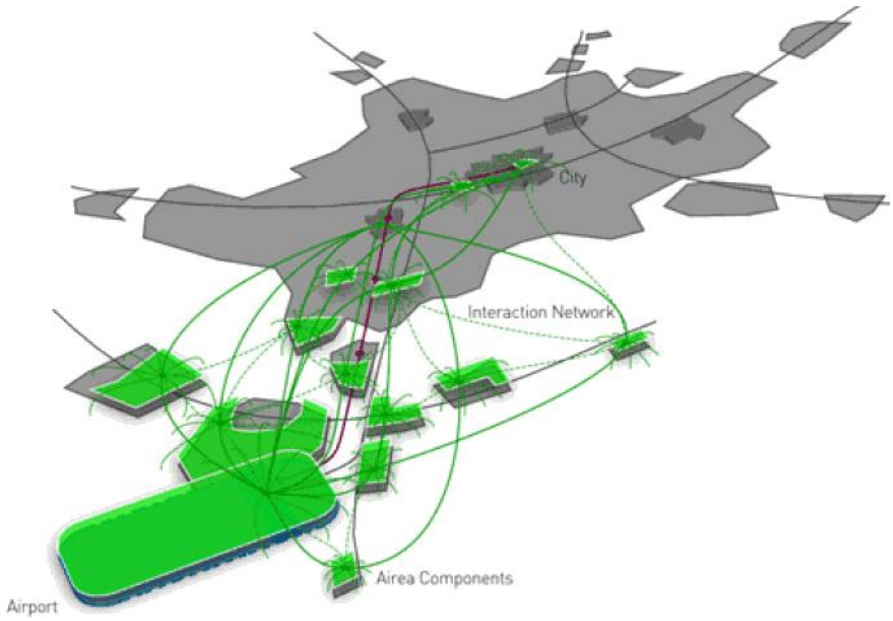


Figure 2.9. Schematic interaction and interrelation of Airea components *(Schlaack, 2010)*

CHAPTER 3

CURRENT STATUS OF CARGO TRANSPORTATION IN TURKEY AND ISTANBUL

3.1. Air Cargo in Turkey

In recent years, development scenarios which mainly focus on production organizations have begun to big change in accordance with rapid changes in information technology. Nowadays goods and services are being to design in any geographical region of the world, produce in a different geographical region and demand from elsewhere of the world (Gümüş, 2014). In parallel with these developments, only production-based regional development scenarios have become inadequate and the logistics activities have come to the forefront. In other words, the logistics sector has become an important variable in regional development scenarios in recent years.

Especially in the last 25 years the logistics sector has gained substantial value. We can obviously see that the logistics sector which has become one of the fastest growing and the biggest sectors has significant impacts on the economic level of countries in this time period. Hence many countries (especially developed countries) invest in logistics sector to take advantage of the enormous potential of this sector. Similar to these countries, logistics sector is regarded as one of the strategic sectors for Turkey in recent years. The sections dedicated to the logistics activities in important studies such as the regional plans in recent years and the national logistics master plan work in progress are among the main examples showing the importance given to the sector.

The geographical location of the region, whether the existing infrastructure is sufficient for logistics activities and qualification of future investments are the main components of the development of the logistic activities in a region. In addition to the

production capacity and diversity of a region, it is also important that there are physical areas where logistics activities can take place in that region. Interaction between these physical areas is also crucial for development of the logistic activities.

Today, there are important mega cities where logistic activities are concentrated. It is seen that the main element of the concentration of these activities in these megacities is the logistics infrastructure investments in these regions. One of the common features of these mega-cities is that there are commercial areas that serve as a gateway from their countries to foreign markets where international trade activities can take place. An international airport or an international port can be given as examples of such physical areas.

Considering in terms of air cargo transportation, it can be said that the main element of the development of air cargo activities in an area is the presence of an airport with internationally operating logistics facilities. However, just having such a physical space is not enough to improve air cargo transportation in that area. Additionally, the proximity of airport to the products that can be transported, capable of responding to different needs arising from product range, whether integrated with alternative transport methods, whether there is a free zone to host international trade activities in the province, whether there is a logistics hub approach that can increase the efficiency of logistics activities are important elements for the development of air cargo activities. In addition to having the required physical areas for the development of the logistics sector, strategies for the realization of the interaction between these areas are also vital.

In terms of cargo transportation in Turkey, although road and maritime cargo transportation comes to the forefront, improvements are also seen in air and rail transportation. According to the 2018 data, the total amount of road freight in Turkey is approximately 510 million tons, the total cargo amount in ports is 460 million tons and the total cargo amount in railways is approximately 50 million tons. The total cargo amount in airports is around 1.4 million tons.

Table 3.1. *Turkey Cargo Statistics (thousand tons)*

Year	Railway	Seaway	Airway	Roadway
2013	51.481,4	384.930,8	738,4	435.938,3
2014	55.810,2	383.120,6	845,5	456.596,0
2015	49.789,4	416.036,7	904,8	480.346,6
2016	49.913,6	430.201,2	1.032,9	491.339,4
2017	N/A	471.173,9	1.256,2	506.080,0
2018	N/A	460.153,6	1.388,6	509.788,0

*Compiled from Ministry of Transport and Infrastructure database

Air cargo transportation in Turkey has a higher growth rate compared to alternative transportation modes and there are many indicators that Turkey has tremendous potential for air cargo development. Turkey's sectoral depth and wealth, current development line, geographical location, having an efficient logistics structure, having significant logistics investments, being one of the important centers of attraction in its region, producing compatible products with air cargo transport are the indicators which can be given as example for that idea. Having important international cargo ports and airports in terms of cargo activity are also important indicators. Based on these it can be said that there is significant development potential in terms of air cargo sector in Turkey. Therefore, it is useful to examine the figure below which shows Turkey's logistics structure.

Figure 3.1. Turkey Logistics Map (*This figure is created by the author through using YTM-MATPUM database)*

Especially in recent years, there are important factors that could guide the development of air logistics sector in Turkey. One of these factors is logistics hub approach and it has begun to experience in Turkey in the 2000s. The number of logistics hubs in Turkey have increased significantly in the last 10 years. As it can be seen from the following table, 21 logistics hubs planned to made in Turkey. 8 of 21 logistics hubs started to operate and 6 of 21 logistics hubs are still under construction. 7 of 21 logistics hubs are in the tender / project / expropriation phase. Efforts to increase efficiency by intensifying logistics activities in these hubs are increasing day by day. The biggest deficiency of logistics hub approach in Turkey in terms of air logistics is to over focus on rail and seaway transport. While the links between the ports and railways are strengthened, the links between these areas and airports are not given sufficient importance. Considering the investments made for alternatives of air cargo transportation in Turkey, it becomes increasingly difficult for air cargo transportation to survive in this competition. Therefore, significant leaps can be experienced in air logistics sector through strengthening the links between logistics hubs and airports.

Table 3.2. *Logistic centers in Turkey and their operational status (TCDD)*

PLACE	LOGISTICS HUB NAME	LOCATION	OPERATIONAL STATUS
1	Halkalı	İstanbul	1
2	Köseköy	İzmit	1
3	Gökköy	Balıkesir	1
4	Hasanbey	Eskişehir	1
5	Uşak	Uşak	1
6	Kaklık	Denizli	1
7	Gelemen	Samsun	1
8	Türkoğlu	Kahramanmaraş	1
9	Bozüyük	Bilecik	2
10	Kemalpaşa	İzmir	2
11	Kayacık	Konya	2
12	Yenice	Mersin	2
13	Palandöken	Erzurum	2
14	Kars	Kars	2
15	Yeşilbayır	İstanbul	3
16	Karaman	Karaman	3
17	Boğazköprü	Kayseri	3

Table 3.2. continued

18	Sivas	Sivas	3
19	Mardin	Mardin	3
20	Tatvan	Bitlis	3
21	Habur	Şırnak	3

Operational status 1 refers to "logistics centers in operation", 2 refers to "logistics centers under construction", 3 refers to "logistics centers in tender/project/expropriation stage".

Another important factor that can direct the development of the air logistics sector is the free zones. There are 21 free zones which providing a modern investment area to companies wishing to turn to foreign trade in Turkey. Proximity to these free zones may increase air cargo activities at the airports. Considering there are small number of free zones that play an important role in international commercial activities, it can be said that the airports close to these free zones has an important advantage in terms of international air cargo transportation.

Table 3.3. *Free zones in Turkey and establishment years*

PLACE	FREE ZONE NAME	LOCATION	ESTABLISHMENT YEARS
1	Mersin	Mersin	1985
2	Antalya	Antalya	1985
3	Ege	İzmir	1987
4	İstanbul Atatürk Airport	İstanbul/Yeşilköy	1990
5	Trabzon	Trabzon	1990
6	İst. Trakya	İstanbul/Çatalca	1990
7	Adana yumurtalık	Adana	1992
8	İst Endüstri ve Ticaret	İstanbul/Tuzla	1992
9	Mardin	Mardin	1994
10	Samsun	Samsun	1995
11	Avrupa	Tekirdağ/Çorlu	1996
12	Rize	Rize	1997
13	Kayseri	Kayseri	1997
14	İzmir	İzmir	1997
15	Gaziantep	Gaziantep	1998
16	Tübitak-MAM	Kocaeli/Gebze	1999
17	Denizli	Denizli	2000
18	Bursa	Bursa	2000
19	Kocaeli	Kocaeli	2000
20	Sakarya İpekyolu	Sakarya	2007
21	Filyos	Zonguldak	2011

* Compiled from the website of the Ministry of Economy.

Another factor that can improve air cargo transportation is the approach to reduce the transportation costs by using more than one transportation method in the transportation process of a product called multi-modal transportation. Establishing a strong connection between air transport and alternative transport methods such as road, rail or maritime transport is seen as an important method to reduce transport costs. Multi-modal transportation methods are widely used in Turkey but there is no strong link between air cargo transportation and other alternative transport methods. Therefore, strong alternative transportation mode connections such as road, rail and maritime are needed to improve multimodal transport activities at airports in Turkey.

For example, trucks commonly used in road transport should be provided access to the airport cargo terminal and the cargo transported by road should be quickly transferred to the airline transport system. Similarly, containers arriving by sea should be transferred to the airway transport system by establishing rail connection between the port and the airport. In particular, the integration with the logistic hubs, where all transport types will be united in one center and selecting the most appropriate transportation method for the cargo to be transported, will have a direct positive impact on this strategy.

Table 3.4. *Turkey Airports Cargo Transportation Data (2018) (DHMİ)*

Place	ICAO Code	Airport Name	Cargo Traffic	Percentage
1	LTBA	İstanbul Atatürk	1.281.186	92,3%
2	LTFJ	İstanbul Sabiha Gökçen	70.411	5,1%
3	LTBJ	Adnan Menderes	11.889	0,9%
4	LTAC	Esenboğa International	10.683	0,8%
5	LTAI	Antalya	6.157	0,4%
6	LTAF	Adana	3.177	0,2%
		Other Airports	5.121	0,4%
TOTAL			**1.388.623**	**100%**

According to 2018 data of DHMI, there are cargo activities in 47 of the total 56 airports in Turkey. Only 13 of these 47 airports have cargo terminal area. As seen in the table above, 6 airports in Turkey draw attention in terms of annual cargo traffic. It is remarkable that Istanbul Atatürk Airport has 92,3% of Turkey total cargo traffic.

Istanbul Atatürk Airport also ranks first in terms of both domestic and international cargo transportation in Turkey. Airports in Turkey are classified in terms of domestic and international cargo through using the classification method proposed by the FAA (FAA divides the airports into four groups as big hub, middle hub, small hub and non-priority center according to their percentages in the total annual air cargo volume of the country. It is classified as "large hub" for areas 1% and above, "medium hub" for 0.25-1.00%, "small hub" for 0.05-0.25%, and "non-priority center" for 0.05% and below).

Figure 3.2. Airports Classification in terms of domestic cargo transportation by using FAA method (*This figure is created by the author through using YTM-MATPUM database)*

*1 refers to large hub, 2 refers to medium hub, 3 refers to small hub.

According to the classification in terms of domestic cargo transportation calculated for the country airports by the method proposed by FAA, Istanbul Atatürk, Istanbul Sabiha Gokcen, Ankara Esenboga, Izmir Adnan Menderes, Antalya, Adana, Gaziantep and Trabzon airports are classified as "big hub". Diyarbakır, Denizli Çardak, Kayseri, Samsun Çarşamba, Malatya and Van Ferit Melen airports are classified as "middle hub". Batman, Erzurum, Kahramanmaraş, Muğla Milas-Bodrum, Konya, Şanlıurfa GAP, Muğla Dalaman, Elazığ, Adıyaman, Hatay, Muş, Erzincan and Mardin airports are classified as "small hub".

Figure 3.3. Airports classification in terms of international cargo transportation by using FAA method (*This figure is created by the author through using YTM-MATPUM database)*

*1 refers to large hub, 2 refers to medium hub, 3 refers to small hub.

According to the classification in terms of international cargo transportation calculated for the country airports by the method proposed by FAA, Istanbul Atatürk and Istanbul Sabiha Gokcen airports are classified as "big hub". İzmir Adnan Menderes airport is classified as "middle hub". Ankara Esenboğa, Antalya and Adana airports are classified as "small hub". The cargo terminals to be constructed at Istanbul Airport and Çukurova Airport are not taken into consideration in evaluation due to insufficient information.

One of the factors that can contribute to the development of air cargo activities in a region is the capacity volume of airports. Capacity calculations differ according to the technology used in the cargo terminal (manually / average technology / high technology). The cargo terminal capacities of airports in Turkey was calculated using the calculation method proposed by IATA (Depending on the level of automation, IATA generally uses 5 tonnes/m² for manual operations, 10 tonnes/m² for average technology use and 17 tonnes/m² for high-tech/fully automated systems).

Table 3.5. *Airports having cargo terminal in Turkey and its capacities (tonnes)*

PLACE	AIRPORT NAME	CARGO TERMINAL AREA (M^2)*	MANUALLY	AVERAGE TECHNOLOGY	HIGH TECH / FULLY AUTOMATED
1	İstanbul Atatürk	66.212	331.059	662.117	1.125.599
2	Ankara Esenboğa	12.237	61.184	122.369	208.027
3	İzmir Adnan Menderes	10.603	53.015	106.030	180.251
4	Adana Şakirpaşa	9.500	47.500	95.000	161.500
5	Bursa Yenişehir	9.460	47.300	94.600	160.820
6	İstanbul Sabiha Gökçen	8.900	44.500	89.000	151.300
7	Antalya	7.382	36.910	73.820	125.494
8	Tekirdağ Çorlu	4.350	21.750	43.500	73.950
9	Samsun Çarşamba	4.110	20.550	41.100	69.870
10	Şanlıurfa Gap	3.260	16.300	32.600	55.420
11	Isparta Süleyman Demirel	1.500	7.500	15.000	25.500
12	Gaziantep	1000	5.000	10.000	17.000
13	Konya	345	1.723	3.445	5.857

*Compiled from YTM-MATPUM database

As can be seen from the table above, Istanbul Atatürk Airport has a significant capacity with its 66.212 m^2 cargo terminal area. Ankara Esenboga, Izmir Adnan Menderes, Adana Sakirpasa, Bursa Yenisehir, Istanbul Sabiha Gokcen and Antalya Airports also stand out in terms of capacity with their cargo terminal areas of 7.000 m^2 and above. Due to the level of technology used in these airports is not fully known, net capacity measurement could not be made. In addition, it is important to consider that the insufficient capacity problem can be solved by improving the technology level used at the airport instead of making additional terminals in the existing terminal shortage.

3.2. Air Cargo in Istanbul

In terms of cargo transportation in Istanbul, although road and maritime freight transportation comes to the forefront, improvements are also seen in air and rail transportation. According to the 2018 data, the total amount of road freight in Istanbul is approximately 75 million tons, the total cargo amount in ports is 44 million tons and the total cargo amount in railways is approximately 0.6 million tons. The total cargo amount in Istanbul Atatürk and Istanbul Sabiha Gökçen Airport is around 1.4 million tons.

Table 3.6. *Istanbul City Cargo Statistics (thousand tons)*

Year	Railway	Seaway*	Airway **	Roadway
2013	506,2	51.117,8	666,7	58.445,4
2014	14,7	52.015,2	768,9	62.382,2
2015	13,3	46.883,5	841,6	64.206,4
2016	558,6	42.507,8	981,2	62.748,9
2017	N/A	46.286,3	1.202,9	69.923,7
2018	N/A	44.213,2	1.351,6	74.595,8

* Seaway is the total amount of Istanbul Ambarlı, Silivri, Şile and Tuzla ports.

** The total cargo data of Istanbul Atatürk and Istanbul Sabiha Gökçen airports.

*** Compiled from Ministry of Transport and Infrastructure database.

Air cargo transportation in Istanbul has a higher growth rate compared to alternative transportation modes and there are many indicators that Istanbul has tremendous potential for air cargo development. Istanbul's sectoral depth and wealth, current development line, presence of surrounding provinces with high economic performance, hosting the vast majority of logistics activities in Turkey, having an efficient logistics structure, being the most important center of attraction in Turkey are the indicators which can be given as example for that idea. Based on these it can be said that there is significant development potential in terms of air cargo sector in Istanbul.

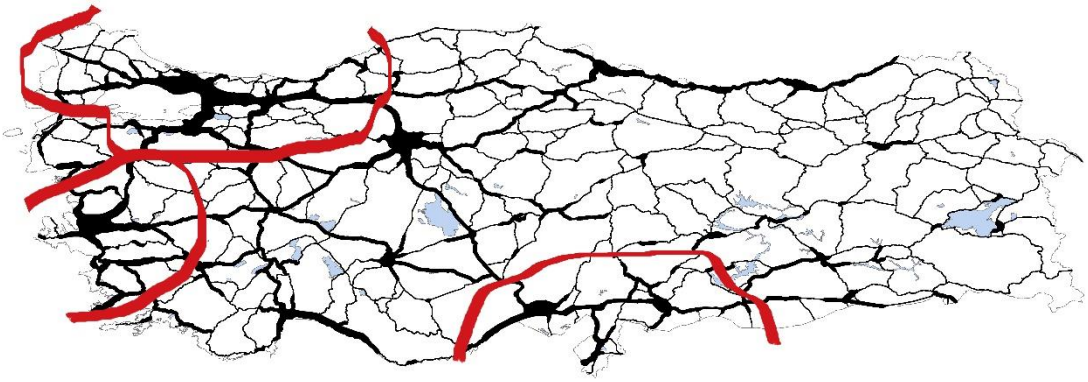


Figure 3.4. Turkey Road Volume Map and City Regions (YTM-MATPUM)

As it is seen from the above figure, Istanbul region is one of the most important city-region in Turkey. In addition to this region, when the D-30 road is opened, a new city region may be occurred between Izmir and Istanbul. Therefore, it can be foreseen that Istanbul and its region will remain as one of the most important city regions where transportation is concentrated. Istanbul is an important logistics region thanks to the advantages of being in a strategically important location. Therefore, logistics strategies to be implemented in Istanbul and its region are of great importance for the development of the region.

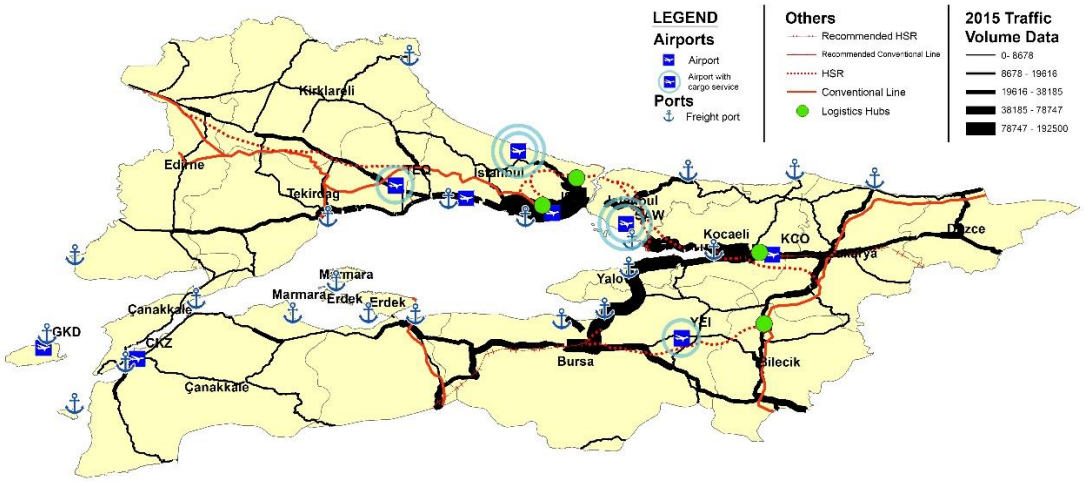


Figure 3.5. Istanbul and Its Regions Map (*This figure is created by the author through using YTM-MATPUM database)*

As can be seen from the traffic volume data in the figure 3.5, it can be said that Istanbul is a center which has strong connections with its neighbors. When the cargo transportation in the region is examined, it is seen that maritime transportation comes to forward. Logistics activities are concentrated in the region due to having important freight ports serving internationally and airports that are important in terms of cargo activity. As it can be seen from the following table, 4 of 21 logistics center which planned to made in Turkey are located in Istanbul and its region. İstanbul Halkalı and Kocaeli Köseköy logistics centers started to operate and Bilecik Bozüyük Logistics Center is still under construction. Istanbul Yeşilbayır Logistics Center is in the tender / project / expropriation phase.

Table 3.7. *Logistic centers in Istanbul region and their operational status (TCDD)*

PLACE	LOGISTICS CENTER NAME	LOCATION	OPERATIONAL STATUS
1	Halkalı	İstanbul	1
2	Köseköy	Kocaeli	1
3	Bozüyük	Bilecik	2
4	Yeşilbayır	İstanbul	3

Operational Status 1 refers to "logistics centers in operation", 2 refers to "logistics centers under construction", 3 refers to "logistics centers in tender/project/expropriation stage".

Today, air cargo transportation is the most important transportation mode in the region after maritime transport. It shows that air cargo activities are concentrated in the region. It is foreseen that significant improvements will be experienced in the air cargo transportation along with the Bozüyük and Yeşilbayır Logistics Centers and the 3rd airport, which are planned to be built.

Table 3.8. *Free zones in Istanbul region and establishment years*

PLACE	FREE ZONE NAME	LOCATION	ESTABLISHMENT YEARS
1	İstanbul Atatürk Airport	İstanbul/Yeşilköy	1990
2	İst. Trakya	İstanbul/Çatalca	1990
3	İst Endüstri ve Ticaret	İstanbul/Tuzla	1992
4	Avrupa	Tekirdağ /Ergene/Çorlu	1996
5	Tübitak-MAM	Kocaeli/Gebze	1999

Table 3.8. continued

6	Bursa	Bursa	2000
7	Kocaeli	Kocaeli	2000
8	Sakarya İpekyolu	Sakarya	2007

* Compiled from the website of the Ministry of Economy.

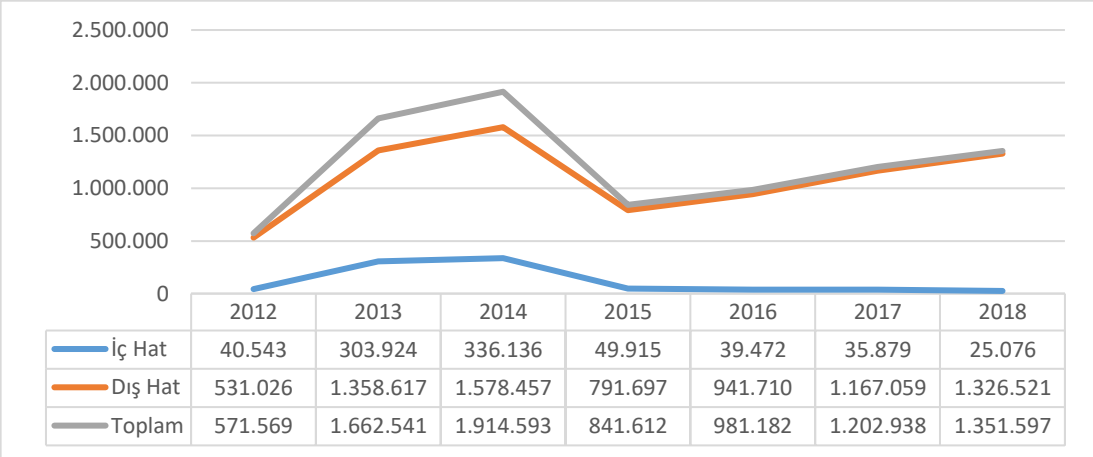
8 of 21 free zones which providing a modern investment area to companies wishing to turn to foreign trade are located in Istanbul and its region. It also contributes to the intensification of international trade in the region. Istanbul Atatürk, Istanbul Sabiha Gokcen, Tekirdag Çorlu and Bursa airports are located in the region. It can be said that these airports have an advantageous position in terms of international air cargo transportation due to their proximity to free zones. In addition, there is a free zone at Istanbul Atatürk Airport that separates it from the others. It should also be taken into consideration that having a free zone in airport area is a facilitator factor in terms of international air cargo operations at the airport.

Table 3.9. *Airports providing cargo service in Istanbul and its region*

PLACE	AIRPORT NAME	CARGO TERMINAL AREA (M^2)*	2018 ANNUAL CARGO TRAFFIC (TONS)
1	İstanbul Atatürk	66.212	1.281.186
2	İstanbul Sabiha Gökçen	8.900	70.411
3	Bursa Yenişehir	9.460	123
4	Tekirdağ Çorlu	4.350	704

*Compiled from DHMI database

As can be seen from the table above, there are 4 airports providing cargo services in Istanbul and its region. it is seen that Istanbul Atatürk Airport hosts a large proportion of air cargo activities in the region thanks to its cargo terminal area and other infrastructure facilities. Although Istanbul Sabiha Gokcen Airport does not have as much air cargo traffic as Atatürk Airport, it is one of the most important airports in the country in terms of air cargo. Bursa Yenişehir and Tekirdağ Çorlu airports, despite their high cargo terminal capacities, have low volumes in terms of air cargo traffic. It is foreseen that air cargo activities will increase significantly with the commencement of cargo activities at the Istanbul Airport under construction in Istanbul, where air cargo operations are currently the most intense in country.

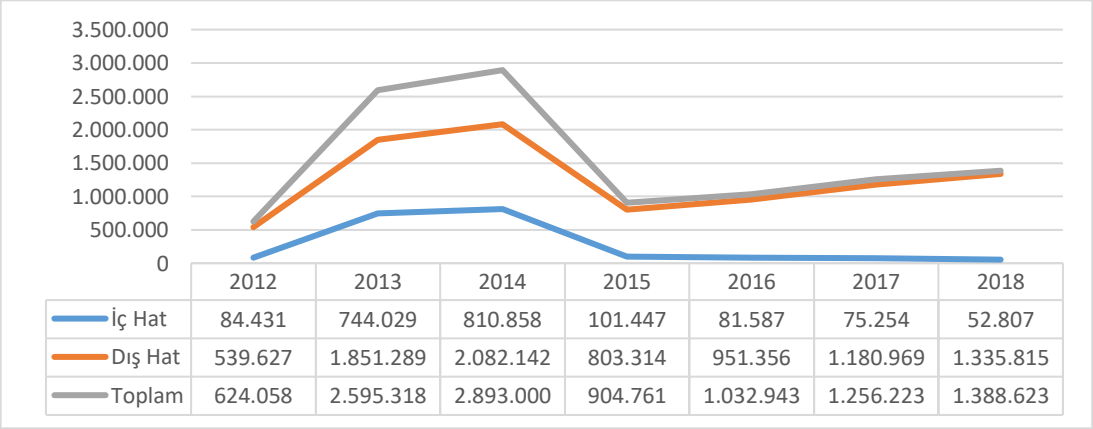


	2012	2013	2014	2015	2016	2017	2018
İç Hat	40.543	303.924	336.136	49.915	39.472	35.879	25.076
Dış Hat	531.026	1.358.617	1.578.457	791.697	941.710	1.167.059	1.326.521
Toplam	571.569	1.662.541	1.914.593	841.612	981.182	1.202.938	1.351.597

Figure 3.6. Air Cargo Statistics of Istanbul by Years (tons)

*Compiled from Istanbul Atatürk and Istanbul Sabiha Gokcen airports database

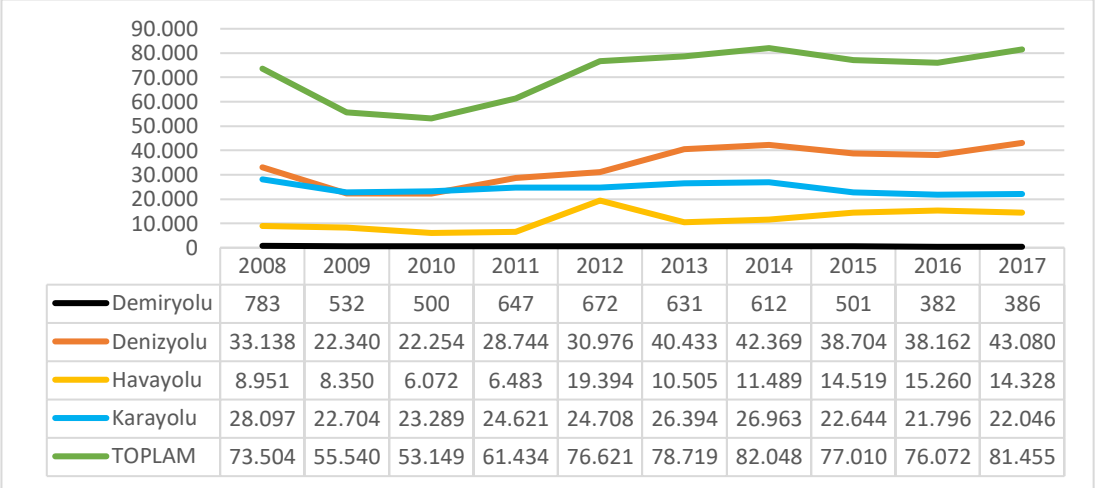
As can be seen from the graph above, Istanbul Air cargo has achieved a significant growth curve in both domestic air cargo and international air cargo between 2012-2014 but experienced a rapid decline between 2014-2015. Although Istanbul air cargo has seen a significant decrease in the domestic line since 2015, it has started to grow again in the international line. Another point that can be deducted from graph is that air cargo has started to lose its competitive advantage in the domestic line but it started to increase the competitive advantage in the international line in recent years. In addition, it is seen that from the graph below this trend is not only experienced in Istanbul but also it experienced throughout the country.



	2012	2013	2014	2015	2016	2017	2018
İç Hat	84.431	744.029	810.858	101.447	81.587	75.254	52.807
Dış Hat	539.627	1.851.289	2.082.142	803.314	951.356	1.180.969	1.335.815
Toplam	624.058	2.595.318	2.893.000	904.761	1.032.943	1.256.223	1.388.623

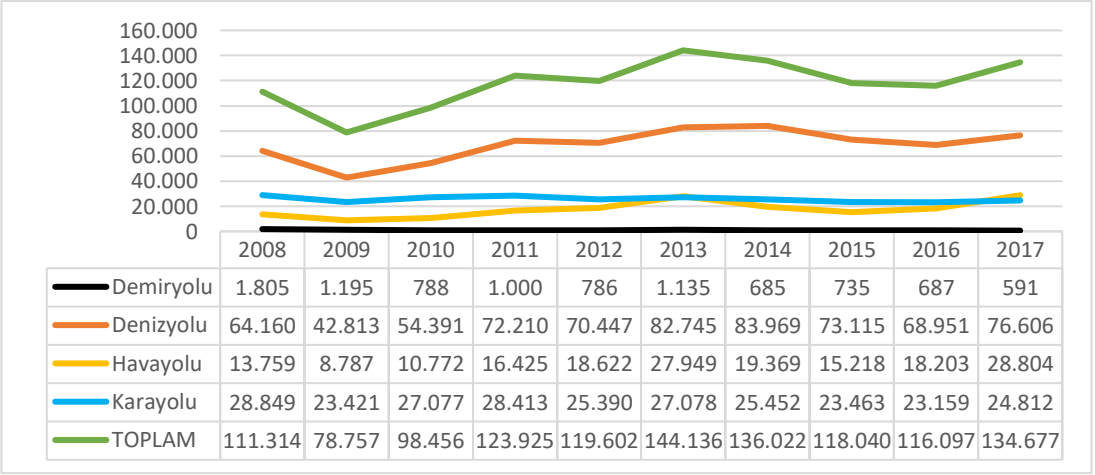
Figure 3.7. Turkey Cargo Statistics by Years (tons) (DHMİ)

Considering that air cargo increases the competitive advantage in international cargo, it is useful to examine the foreign trade statistics of the province closely.



	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
Demiryolu	783	532	500	647	672	631	612	501	382	386
Denizyolu	33.138	22.340	22.254	28.744	30.976	40.433	42.369	38.704	38.162	43.080
Havayolu	8.951	8.350	6.072	6.483	19.394	10.505	11.489	14.519	15.260	14.328
Karayolu	28.097	22.704	23.289	24.621	24.708	26.394	26.963	22.644	21.796	22.046
TOPLAM	73.504	55.540	53.149	61.434	76.621	78.719	82.048	77.010	76.072	81.455

Figure 3.8. Istanbul Export Data by Years and Transportation Types ($ million) (TurkStat)



	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
Demiryolu	1.805	1.195	788	1.000	786	1.135	685	735	687	591
Denizyolu	64.160	42.813	54.391	72.210	70.447	82.745	83.969	73.115	68.951	76.606
Havayolu	13.759	8.787	10.772	16.425	18.622	27.949	19.369	15.218	18.203	28.804
Karayolu	28.849	23.421	27.077	28.413	25.390	27.078	25.452	23.463	23.159	24.812
TOPLAM	111.314	78.757	98.456	123.925	119.602	144.136	136.022	118.040	116.097	134.677

Figure 3.9. Istanbul Import Data by Years and Transportation Types ($ million) (TurkStat)

As can be seen in Figure 3.8 and 3.9, which show the distribution of foreign trade by Istanbul's transport modes, the market share of air transport in foreign trade increased between 2008 and 2017. In the same period, there has been a significant increase in seaway transport and an increase in road transport. Railway transport with a low volume has a stagnant trend.

According to these graphs, exports by air transportation in Istanbul achieved a significant growth curve between 2011-2012 but experienced a rapid decline between 2012-2013. On the other hand, exports by air transportation in Istanbul achieved a significant growth curve between 2009 and 2013, but experienced a decline between 2013 and 2015. Although exports and imports by air transportation have started to grow again since 2015, they have a lower market share compared to the seaway transportation that stands out among the alternatives. Another issue that can be drawn from these graphs is the developments seen in the alternatives of airline transportation in Istanbul. In recent years, there has been a significant improvement in seaway transport and a significant decrease in road transport. With the opening of the new airport in Istanbul, it is estimated that air cargo transportation will become more competitive with seaway transport.

CHAPTER 4

AIR CARGO COMPLIANCE OF PRODUCTION AND CONSUMPTION OF ISTANBUL

A study was conducted to analyze whether production potential in Istanbul suitable for the development of air cargo transportation. A factor that can drive the development of the air logistics sector is the structure of production and consumption in the region where the airport serves.

Whether products import to or export from the region is compatible with air cargo is an important factor that may affect air cargo activities in the region. It is useful to examine closely Turkey's and Istanbul's foreign trade structure to analyse the potential impacts of that factor in the development of air cargo transportation in Turkey and Istanbul scale.

4.1. Determination of Product Groups Compatible With Air Cargo in Turkey

Table 4.1. *Air Cargo Compliance of Imported and Exported Product Groups in Turkey*

Sector	***Air Cargo Compliance***
Food products and beverages	***
Fishery	***
Clothing	**
Textile products	**
Radio, television, communication equipment and apparatus	**
Paper and paper products	**
Leather, suitcase, handbag, saddlery and shoes	**
Agriculture and Livestock	**
Medical instruments; precision optical instruments and clock	**
Office, accounting and information processing machines	**
Printing and publishing; record, cassette etc.	**
Motor vehicles and trailers	*
Not elsewhere classified machinery and equipment	*
Furniture and not elsewhere classified other products	*
Chemicals and products	*

Table 4.1. continued

Rubber and plastic products	*
Not elsewhere classified electrical machinery and equipment	*
Tobacco products	*
Basic metal industry	X
Metal goods industry (excluding machinery and equipment)	X
Other transport material	X
Other non-metallic mineral products	X
Coke, refined petroleum products and nuclear fuels	X
Quarrying and other mining	X
Ores of metals	X
Wood and cork products (except furniture); knitted goods like wicker	X
Waste and scrap	X
Electricity, gas and water	X
Recreational, cultural and sporting activities	X
Forestry and logging	X
Coal, lignite and peat	X
Other business activities	X
Other service activities	X
Crude oil and natural gas	X

*** Very Compatible, ** Compatible, * Less Compatible, X incompatible or very little compatible (It is organized into 4 categories considering the current situation and trends in the air cargo sector.)

The imported and exported product groups in Turkey was examined whether it is compatible with air cargo transportation. Accordingly, it is seen that 18 of the 34 product groups are compatible with air cargo transportation. In other words, there is a potential for air cargo transportation in 18 product groups in Turkey.

4.1.1. Explanations of Product Groups Compatible With Air Cargo

Food products and beverages

Food products and beverages product group include both non-durable and relatively durable products. Air cargo transportation is undoubtedly in the foreground in this product group for long distance transportation because of the low durability of this product group and the fact that delivery processes need to be carried out quickly. Therefore, air cargo demand is expected to increase as the global trade market of the food and beverage sector grows.

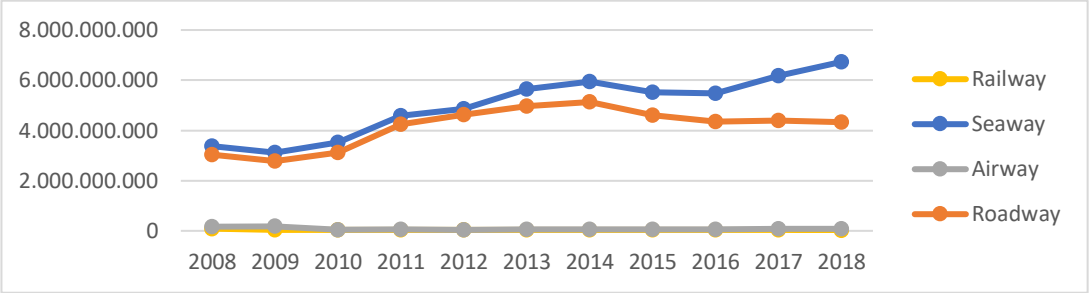


Figure 4.1. Turkey Export Value of Food Products and Beverages by Years and Transportation Modes ($) (TurkStat)

Export value of food products and beverages product group by years and transportation modes shown in the figure above. Data of the figure compiled from TurkStat. Accordingly, the export of this product group with air transport has lower export values than alternative transportation modes such as seaway and roadway. However, it is predicted that the share of air transport will increase significantly in the following years thanks to the product group is highly compatible with air cargo transportation.

Fishery

Fishery product group include both non-durable and perishable products. Therefore, the fishery product group is one of the most important product groups in need of air cargo transportation. Although alternative transportation methods can be used in short distances, it should be noted that air cargo transportation is the only transportation method in long distances. The developments in the fishery sector are expected to have a multiplier effect in the air cargo sector as well.

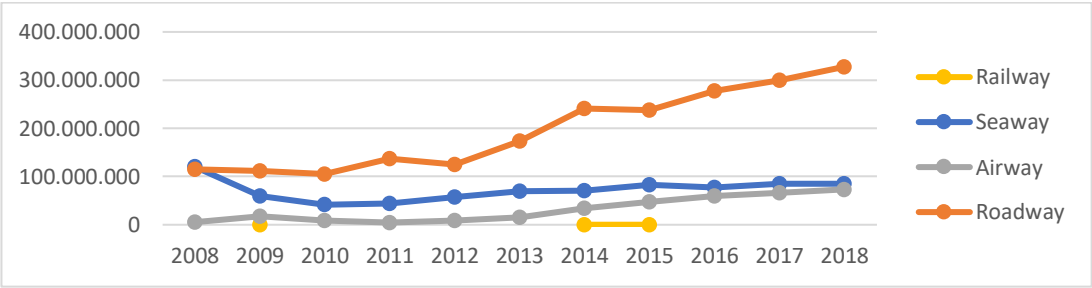


Figure 4.2. Turkey Export Value of Fishery by Years and Transportation Modes ($) (TurkStat)

Export value of fishery product group by years and transportation modes shown in the figure 4.2. Data of the figure compiled from TurkStat. Accordingly, it is seen that roadway transportation is at the forefront in the export of this product group. On the other hand, it has been observed that air transportation has achieved a significant growth trend in recent years and has even reached close values with seaway transportation. It is predicted that the share of air transport will increase significantly in the following years thanks to the product group is highly compatible with air cargo transportation.

Clothing

Clothing product group include durable products. There are many alternative transport methods for transporting the clothing product group. It should be said that air cargo transportation has the potential to develop over long distances thanks to the increasing demand of consumers for the realization of logistics processes in the fastest way. World trade, which grows and deepens spatially with the participation of more and more countries, and fashion industry demands increases the demand for air cargo.

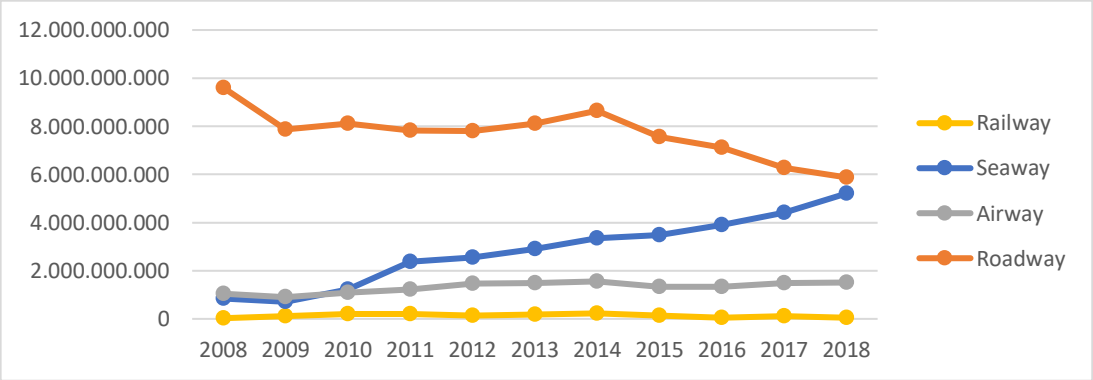


Figure 4.3. Turkey Export Value of Clothing by Years and Transportation Modes ($) (TurkStat)

Export value of clothing product group by years and transportation modes shown in the figure above. Data of the figure compiled from TurkStat. Accordingly, the export of this product group with air transport has lower export values than alternative transportation modes such as seaway and roadway. It is also important that air transport has achieved a growth trend in recent years. It is predicted that the share of

air transport will increase significantly in the following years thanks to the product group is highly compatible with air cargo transportation.

Textile Products

Textile product group include durable products. The development potential of air cargo is mainly in this type of durable product group. There are many alternative transport methods for transporting the textile product group but share of air cargo in transport processes is increasing day by day. Increasing distances in the global production process increase the demand for air cargo transportation.

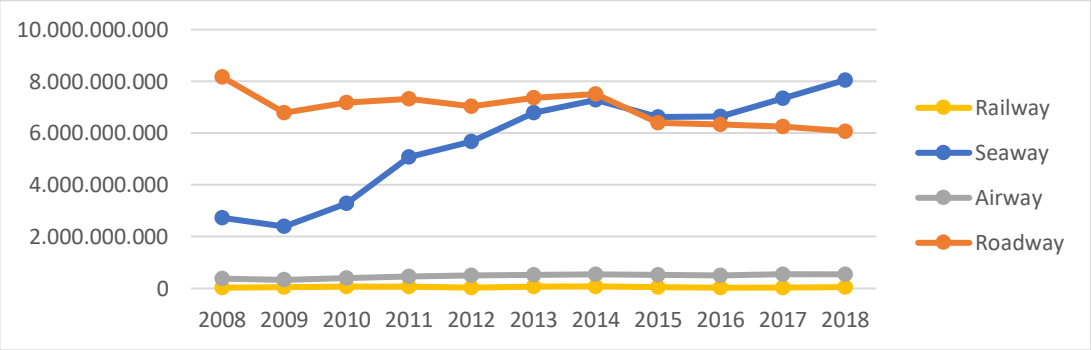


Figure 4.4. Turkey Export Value of Textile by Years and Transportation Modes ($) (TurkStat)

Export value of textile product group by years and transportation modes shown in the figure above. Data of the figure compiled from TurkStat. Accordingly, the export of this product group with air transport has lower export values than alternative transportation modes such as seaway and roadway. It is predicted that the share of air transport will increase in the following years thanks to the product group is compatible with air cargo transportation.

Agriculture and Livestock

Agriculture and Livestock product group include non-durable products and time-sensitive products which need to be transported urgently. In the first category, there are live animals where the transportation cost is insignificant and price flexibility is zero. In the second category, there are products such as fruit, vegetables, cut flowers

where speed and flight frequency gains importance instead of urgency. Logistic processes such as transportation management, insurance, storage are gaining importance due to both group have high risks for transportation. The demand to air cargo transportation, which has the fastest and safest transportation opportunity, is increasing day by day in order to reduce these high transportation risks. Therefore, the developments in the agriculture and livestock sector are expected to have a multiplier effect in the air cargo sector as well.

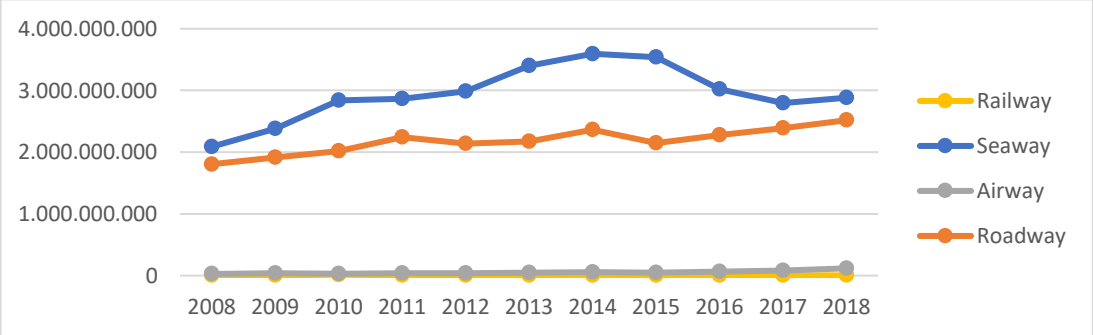


Figure 4.5. Turkey Export Value of Agriculture and Livestock by Years and Transportation Modes($) (TurkStat)

Export value of agriculture and livestock product group by years and transportation modes shown in the figure above. Data of the figure compiled from TurkStat. Accordingly, the export of this product group with air transport has lower export values than alternative transportation modes such as seaway and roadway. It is also important that air transport has achieved a growth trend in recent years. It is predicted that the share of air transport will increase in the following years thanks to the product group is compatible with air cargo transportation.

Paper and paper products

Paper and paper product group include durable products. There are many alternative transport methods for transporting the paper and paper products group. There is a significant potential of air cargo transportation in this product group due to the products in this product group are generally have low weight and large volumes as air cargo pricing is based on weight rather than volume, air cargo transportation becomes

more economical for large volume and low weight durable products. Therefore, air cargo demand is expected to increase as the global trade market of the paper and paper products sector grows.

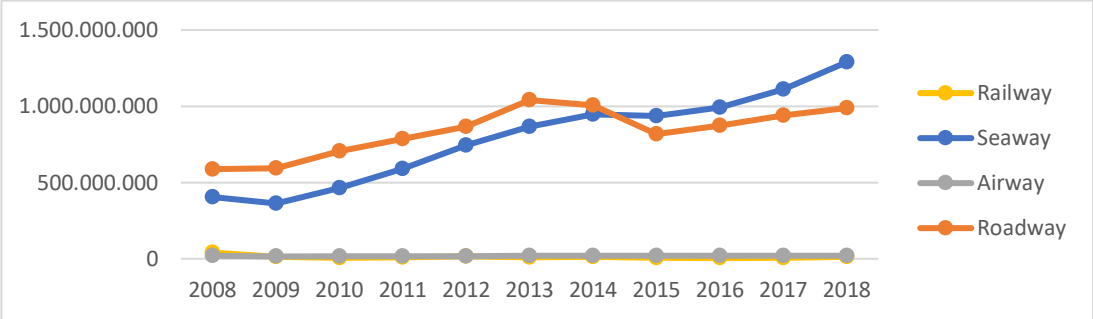


Figure 4.6. Turkey Export Value of Paper and Paper Products by Years and Transportation Modes ($) (TurkStat)

Export value of paper and paper product group by years and transportation modes shown in the figure above. Data of the figure compiled from TurkStat. Accordingly, the export of this product group with air transport has lower export values than alternative transportation modes such as seaway and roadway. It is predicted that the share of air transport will increase in the following years thanks to the product group is compatible with air cargo transportation.

Radio, television, communication equipment and apparatus

Radio, television, communication equipment and apparatus product group include durable products. There are many alternative transport methods for transporting the radio, television, communication equipment and apparatus group. While alternative transportation methods to air cargo transportation stand out in products with low value and low transportation risks, air cargo transportation is generally preferred for products with high value and high transportation risks. Considering that the value of the products in this product group increases with each passing day, it is expected that the demand to air cargo transportation, which has the lowest transportation risks compared to alternatives, will increase in this product group over time.

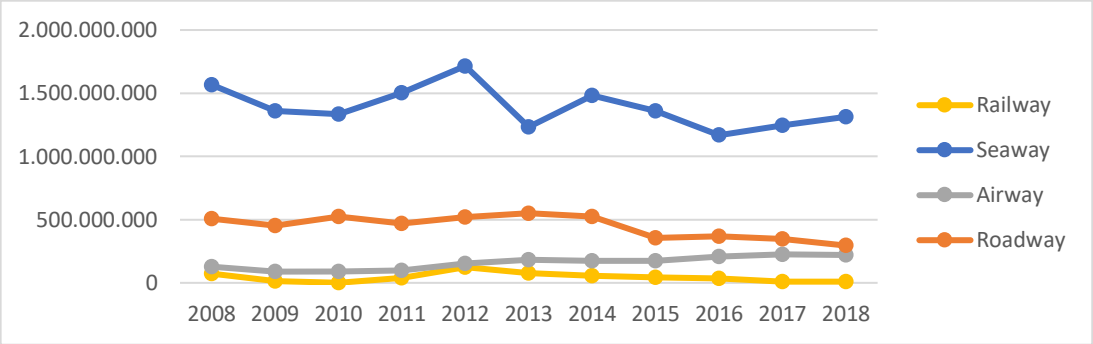


Figure 4.7. Turkey Export Value of Radio, Television, Communication Equipment and Apparatus by Years and Transportation Modes ($) (TurkStat)

Export value of radio, television, communication equipment and apparatus product group by years and transportation modes shown in the figure above. Data of the figure compiled from TurkStat. Accordingly, the export of this product group with air transport has lower export values than seaway transportation. It is also important that air transport has achieved a growth trend in recent years and has approached the value of exports by roadway transportation. It is predicted that the share of air transport will increase in the following years thanks to the product group is compatible with air cargo transportation.

Leather, suitcase, handbag, saddlery and shoes

Leather, suitcase, handbag, saddlery and shoes product group include durable products. Increasing e-commerce sales of the products included in this product group has a direct positive impact on cargo demand. Similar to other durable product groups, there are many alternative transport methods for transporting leather, suitcase, handbag, saddlery and shoes product group. Especially there is an increasing demand for air cargo transportation of products with high value and high transportation risks in this product group. Therefore, air cargo demand is expected to increase as the global trade market of the leather, suitcase, handbag, saddlery and shoes sector grows.

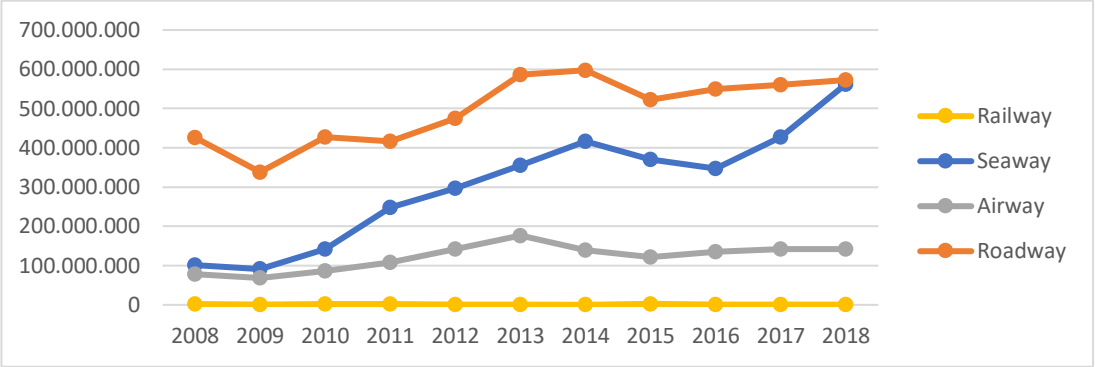


Figure 4.8. Turkey Export Value of Leather, Suitcase, Handbag, Saddlery and Shoes by Years and Transportation Modes ($) (TurkStat)

Export value of leather, suitcase, handbag, saddlery and shoes product group by years and transportation modes shown in the figure above. Data of the figure compiled from TurkStat. Accordingly, the export of this product group with air transport has lower export values than alternative transportation modes such as seaway and roadway. But it is predicted that demand to airway transport will increase in the following years thanks to that the product group is compatible with air cargo transportation.

Medical instruments; precision optical instruments and clock

Medical instruments; precision optical instruments and clock product group include both durable products and time-sensitive non-durable products which need to be transported urgently. The demand for air cargo is increasing in cases of urgency and sensitivity. Air cargo is preferred especially for the transportation of medical supplies where transportation costs are insignificant and price flexibility is zero. On the other hand, there are alternative transport methods for durable products. While alternative transportation methods to air cargo transportation stand out in products with low value and low transportation risks, air cargo transportation is generally preferred for products with high value and high transportation risks. Therefore, it is predicted that air cargo transportation has significant potential to develop in this product group.

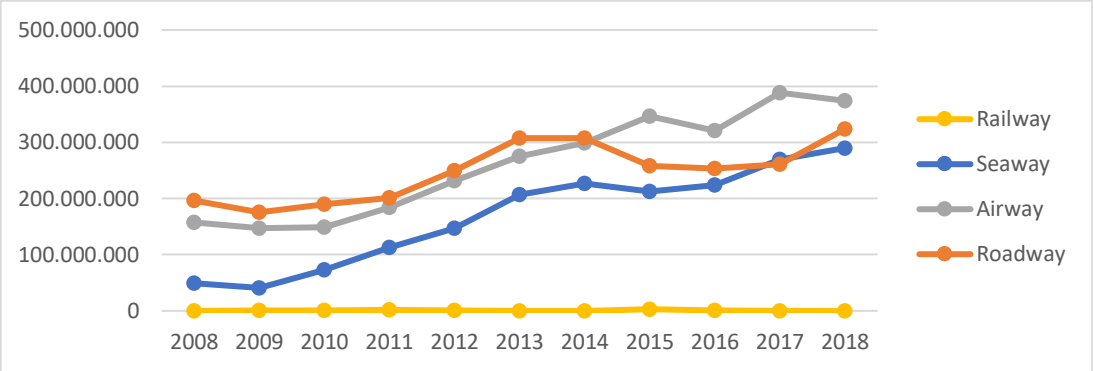


Figure 4.9. Turkey Export Value of Medical Instruments; Precision Optical Instruments and Clock by Years and Transportation Modes ($) (TurkStat)

Export value of medical instruments; precision optical instruments and clock product group by years and transportation modes shown in the figure above. Data of the figure compiled from TurkStat. Accordingly, the export of this product group with air transportation has highest export shares among all transportation modes. It is important that air cargo transportation has the largest share in the transportation of this product group which is highly compatible with air cargo. It is expected that air transportation will maintain its leading position in the transport of this product group in the following years.

Office, accounting and information processing machines

Office, accounting and information processing machines product group include durable products. This product group includes also high value-added electronic products, such as computers, which require special precautions to avoid damage during transport. There are many alternative transport methods for this product group. While alternative transportation methods to air cargo transportation stand out in products with low value and low transportation risks, air cargo transportation is generally preferred for products with high value and high transportation risks. Considering that the value of the products in this product group increases with each passing day, it is expected that the demand to air cargo transportation, which has the

lowest transportation risks compared to alternatives, will increase in this product group over time.

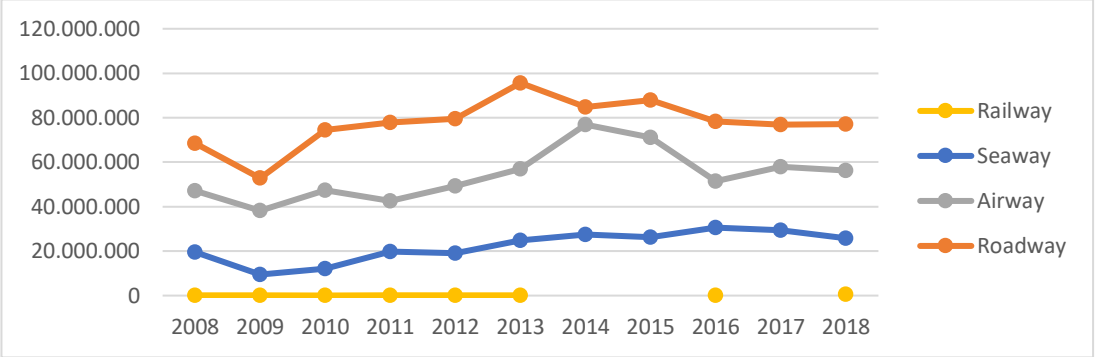


Figure 4.10. Turkey Export Value of Office, Accounting and Information Processing Machines by Years and Transportation Modes ($) (TurkStat)

Export value of office, accounting and information processing machines product group by years and transportation modes shown in the chart figure. Data of the figure compiled from TurkStat. Accordingly, it is seen that airway transportation is the second after the roadway transportation in the export ranking of this product group. According to 2018 data, approximately $60 million of exports were made in this product group. It is predicted that demand to airway transport will increase in the following years thanks to that the product group is compatible with air cargo transportation.

Printing and publishing; record, cassette etc.

Printing and publishing; record, cassette etc. product group include both durable products and time-sensitive products such as newspaper and magazine which need to be transported urgently. The demand for air cargo transportation, which has the possibility of faster and more reliable transportation compared to its alternatives, is generally seen in such time-sensitive products. However, it should be noted that the demand for cargo transportation may also decrease due to the increased demand for electronic versions of the products in this product group.

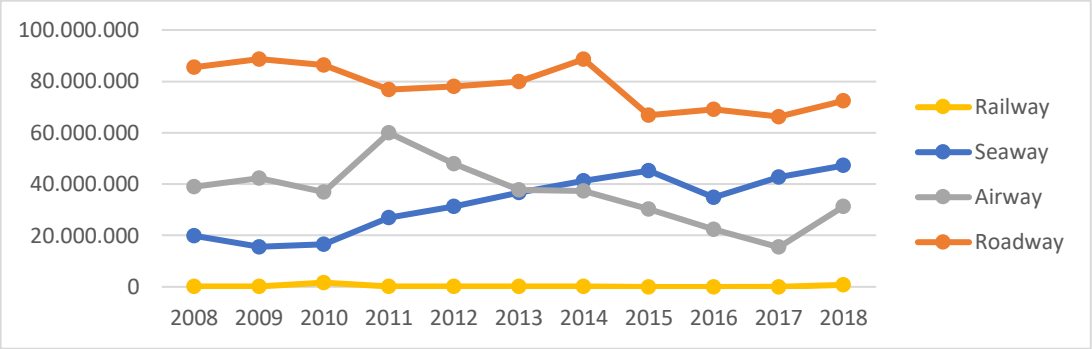


Figure 4.11. Turkey Export Value of Printing and Publishing; Record, Cassette etc. by Years and Transportation Modes ($) (TurkStat)

Export value of printing and publishing; record, cassette etc. product group by years and transportation modes shown in the figure above. Data of the figure compiled from TurkStat. Accordingly, the export of this product group with air transport has lower export values than alternative transportation modes such as seaway and roadway. Although approximately $36 million of exports were made in this product group in 2018. It is predicted that demand to airway transport will increase in the following years thanks to that the product group is compatible with air cargo transportation.

Motor vehicles and trailers

Motor vehicles and trailers product group include durable products. This product group is generally transported by alternative transport methods other than air cargo. Air cargo has come to the fore in recent years as a transportation method for some special and expensive product orders. The developments in luxury vehicle demand are expected to have a positive effect to the air cargo demand as well. Therefore, it can be said that the air cargo sector has potential to develop in this product group.

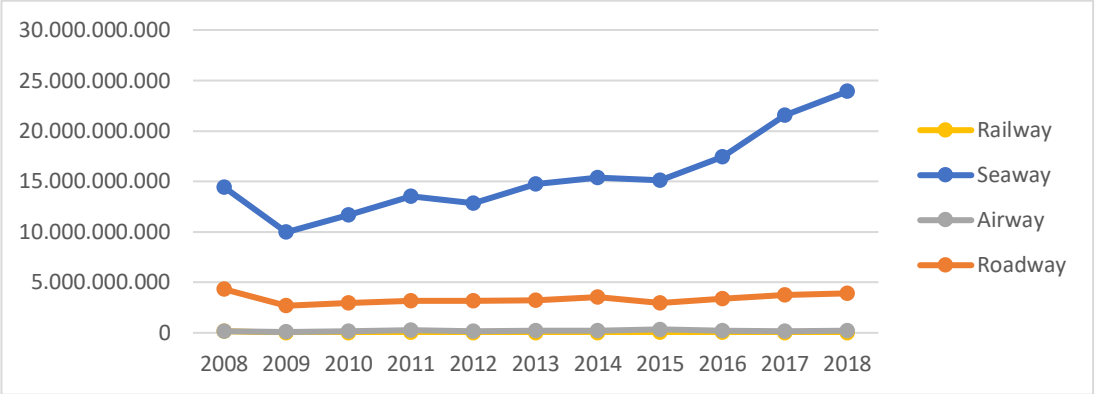


Figure 4.12. Turkey Export Value of Motor Vehicles and Trailers by Years and Transportation Modes ($) (TurkStat)

Export value of motor vehicles and trailers product group by years and transportation modes shown in the figure above. Data of the figure compiled from TurkStat. Accordingly, the export of this product group with air transport has lower export values than alternative transportation modes such as seaway and roadway. It is predicted that demand to airway transport will increase in the following years thanks to that the product group is compatible with air cargo transportation.

Not elsewhere classified machinery and equipment

Not elsewhere classified machinery and equipment product group include durable products. There are many alternative transport methods for this product group. As air cargo pricing is based on weight rather than volume, air cargo transportation becomes more economical for large volume and low weight durable products. Hence air cargo transportation may be preferred in some large volume and low weight products included in the product group. The increase of speed factor importance in international trade is also expected to have a positive effect to air cargo demand in this product group as well.

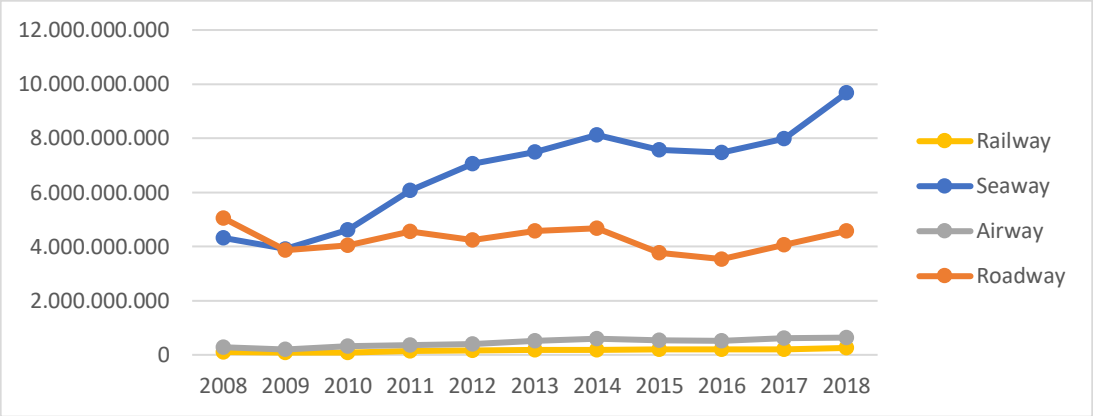


Figure 4.13. Turkey Export Value of Not Elsewhere Classified Machinery and Equipment by Years and Transportation Modes ($) (TurkStat)

Export value of not elsewhere classified machinery and equipment product group by years and transportation modes shown in the figure above. Data of the figure compiled from TurkStat. Accordingly, the export of this product group with air transport has lower export values than alternative transportation modes such as seaway and roadway. It is predicted that demand to airway transport will increase in the following years thanks to that the product group is compatible with air cargo transportation.

Chemicals and products

Chemicals and products product group include both durable products and time-sensitive products which need to be transported urgently. This product group is generally transported by alternative transport methods other than air cargo. There are very strict controls for transportation of chemicals in air transportation because of chemicals are considering as dangerous goods. Transport of such dangerous goods by air is permitted only under special cases and under certain circumstances. Therefore, chemicals and products are a product group with limited air cargo potential.

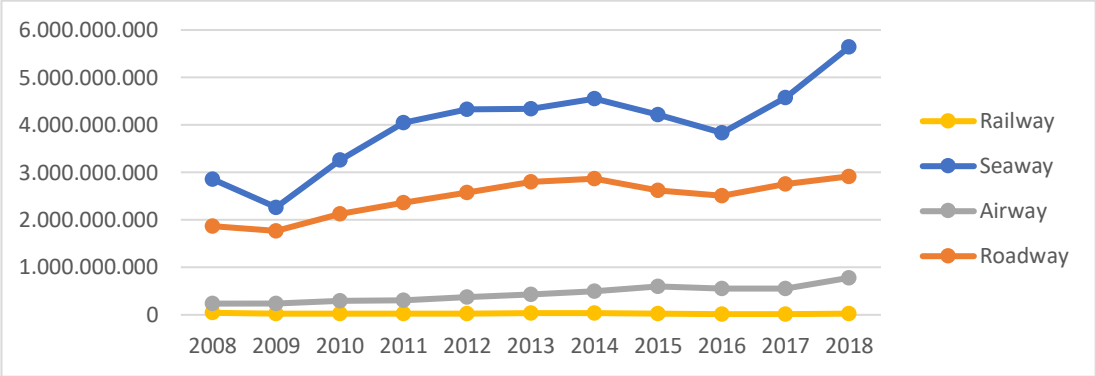


Figure 4.14. Turkey Export Value of Chemicals and Products by Years and Transportation Modes ($) (TurkStat)

Export value of chemicals and product group by years and transportation modes shown in the figure above. Data of the figure compiled from TurkStat. Accordingly, air transport in this product group has an increasing trend over the years but the export of this product group with air transport has lower export values than alternative transportation modes such as seaway and roadway. It is predicted that demand to airway transport will increase in the following years thanks to that the product group is compatible with air cargo transportation.

Furniture and not elsewhere classified other products

Furniture and not elsewhere classified other products group include durable products. There are many alternative transport methods for this product group. While alternative transportation methods to air cargo transportation stand out in products with low value and low transportation risks, air cargo transportation is generally preferred for products with high value and high transportation risks. As the speed factor becomes more important in international trade, especially over long distances air cargo demand will increase in this product group.

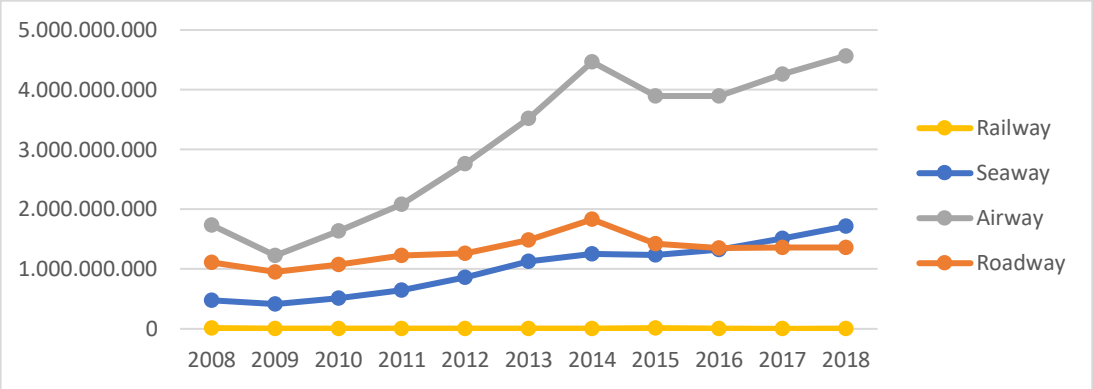


Figure 4.15. Turkey Export Value of Furniture and Not Elsewhere Classified Other Products by Years and Transportation Modes ($) (TurkStat)

Export value of furniture and not elsewhere classified other products group by years and transportation modes shown in the figure above. Data of the figure compiled from TurkStat. Accordingly, the export of this product group with air transportation has highest export shares among all transportation modes. It is important that air cargo transportation has the largest share in the transportation of this product group which is less compatible with air cargo. It is expected that air transportation will maintain its leading position in the transport of this product group in the following years.

Rubber and plastic products

Rubber and plastic products group include durable products. There are many alternative transport methods for this product group. As air cargo pricing is based on weight rather than volume, air cargo transportation becomes more economical for large volume and low weight durable products. Hence air cargo transportation may be preferred in some large volume and low weight products included in the product group. However, it is expected that the demand to air cargo transportation will be limited due to the high transportation costs and low risks in transportation of these products.

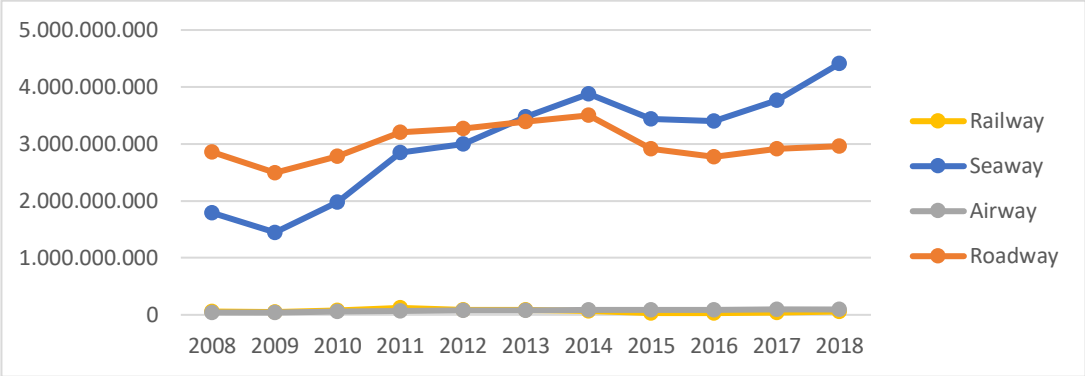


Figure 4.16. Turkey Export Value of Rubber and Plastic Products by Years and Transportation Modes ($) (TurkStat)

Export value of rubber and plastic products group by years and transportation modes shown in the figure above. Data of the figure compiled from TurkStat. Accordingly, the export of this product group with air transport has lower export values than alternative transportation modes such as seaway and roadway. Although it is predicted that demand to airway transport will increase in the following years thanks to that the product group is compatible with air cargo transportation.

Not elsewhere classified electrical machinery and equipment

Not elsewhere classified electrical machinery and equipment product group include durable products. There are many alternative transport methods for this product group. While alternative transportation methods to air cargo transportation stand out in products with low value and low transportation risks, air cargo transportation is generally preferred for products with high value and high transportation risks. Therefore, the value of the products to be transported, the delivery distance of the products and fast delivery demands in this product group affect the demand to air cargo transportation for the transportation of these products.

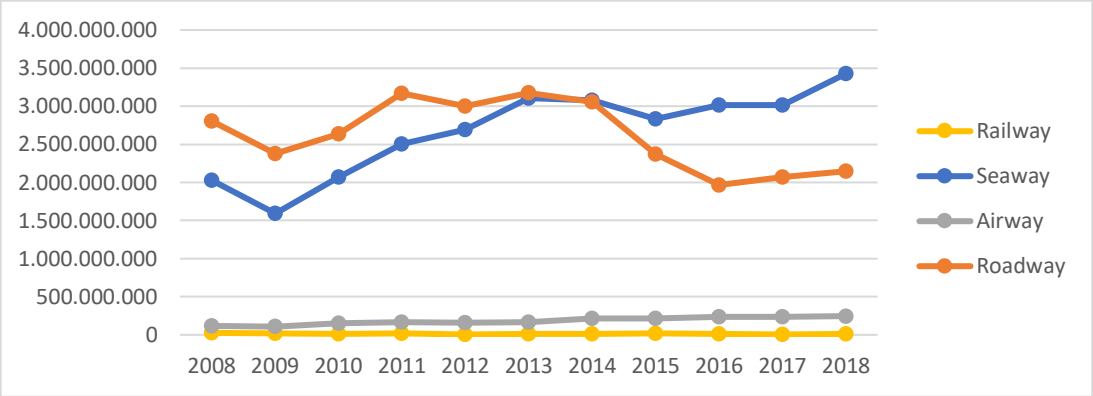


Figure 4.17. Turkey Export Value of Not Elsewhere Classified Electrical Machinery and Equipment by Years and Transportation Modes ($) (TurkStat)

Export value of not elsewhere classified electrical machinery and equipment product group by years and transportation modes shown in the figure above. Data of the figure compiled from TurkStat. Accordingly, air transport in this product group has an increasing trend over the years but the export of this product group with air transport has lower export values than alternative transportation modes such as seaway and roadway. It is predicted that demand to airway transport will increase in the following years thanks to that the product group is compatible with air cargo transportation.

Tobacco products

Tobacco products group include durable products. There are many alternative transport methods for this product group. As air cargo pricing is based on weight rather than volume, air cargo transportation becomes more economical for large volume and low weight durable products. Hence air cargo transportation may be preferred in some large volume and low weight products included in the product group. However, it is expected that the demand to air cargo transportation will be limited due to the high transportation costs and low risks in transportation of these products.

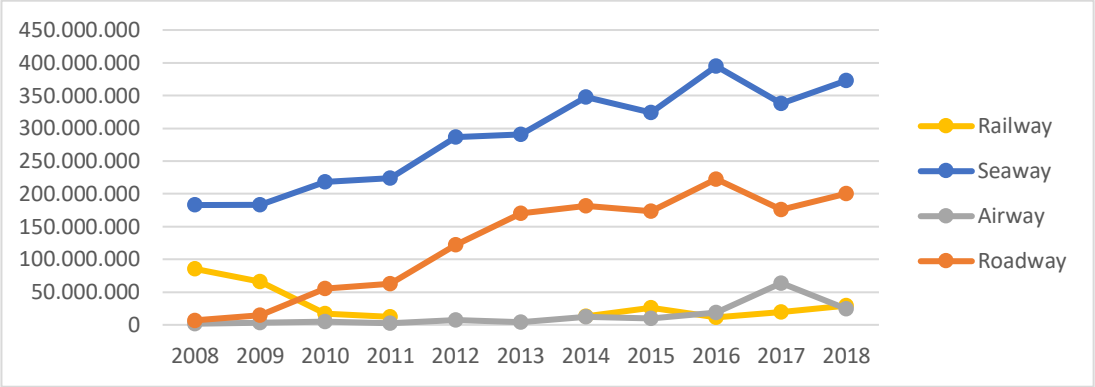


Figure 4.18. Turkey Export Value of Tobacco Products by Years and Transportation Modes ($) (TurkStat)

Export value of tobacco products group by years and transportation modes shown in the figure above. Data of the figure compiled from TurkStat. Accordingly, the export of this product group with air transport has lower export values than alternative transportation modes such as seaway and roadway. Although it is predicted that demand to airway transport will increase in the following years thanks to that the product group is compatible with air cargo transportation.

Table 4.2. *Turkey Air Cargo Transportation Compatible Import and Export Product Groups Foreign Trade Statistics, 2018 ($) (TurkStat)*

Sector	***Air Cargo Compliance***	***Exports***	***Imports***
Food products and beverages	***	11.156.030.672	4.620.441.993
Fishery	***	485.591.843	50.893.220
Textile products	**	14.723.314.109	4.841.336.791
Clothing	**	12.647.529.977	1.589.766.510
Agriculture and Livestock	**	5.522.502.903	9.195.136.789
Paper and paper products	**	2.310.046.200	3.804.365.667
Radio, television, communication equipment and apparatus	**	1.839.130.325	7.104.768.048
Leather, suitcase, handbag, saddlery and shoes	**	1.277.859.326	994.562.560
Medical instruments; precision optical instruments and clock	**	988.149.337	5.178.879.054
Office, accounting and information processing machines	**	159.796.400	2.363.297.194

Table 4.2. continued

Printing and publishing; record, cassette etc.	**	151.809.242	209.143.094
Motor vehicles and trailers	*	28.090.858.382	17.532.897.342
Not elsewhere classified machinery and equipment	*	15.135.009.845	19.025.808.092
Chemicals and products	*	9.361.262.801	33.412.380.536
Furniture and not elsewhere classified other products	*	7.650.905.770	3.018.111.039
Rubber and plastic products	*	7.522.228.956	4.778.135.800
Not elsewhere classified electrical machinery and equipment	*	5.831.525.057	8.507.789.875
Tobacco products	*	626.686.999	164.704.144
OTHERS	X	42.440.375.311	96.654.676.734
GRAND TOTAL		**167.920.613.455**	**223.047.094.482**

*** Very Compatible, ** Compatible, * Less Compatible, X incompatible or very little compatible (It is organized into 4 categories considering the current situation and trends in the air cargo sector.)

As can be seen from the table above, the sectors with the potential for air cargo transportation are also important sectors in terms of foreign trade. Turkey's 74,7% of total export value and 56,7% of total import value are compatible with air cargo transportation. With the developments in the air cargo sector in the coming years, it is seen that there is a significant potential for air cargo transportation in these sectors. The high trade volume of the product groups that are highly compatible with air cargo can be considered as an important advantage for air cargo transportation in Turkey.

Table 4.3. *Turkey Export Distribution According to Transportation Modes of Product Groups Compatible with Air Cargo Transportation, 2018 (TurkStat)*

Sector	***Air Cargo Compliance***	***Railway***	***Seaway***	***Airway***	***Roadway***
Food products and beverages	***	0 %	60 %	1 %	39 %
Fishery	***	0 %	17 %	15 %	67 %
Textile products	**	0 %	55 %	4 %	41 %
Clothing	**	0 %	41 %	12 %	46 %
Agriculture and Livestock	**	0 %	52 %	2 %	46 %
Paper and paper products	**	1 %	56 %	1 %	43 %
Radio, television, communication equipment and apparatus	**	1 %	71 %	12 %	16 %
Leather, suitcase, handbag, saddlery and shoes	**	0 %	44 %	11 %	45 %
Medical instruments; precision optical instruments and clock	**	0 %	29 %	38 %	33 %

Table 4.3 continued

Office, accounting and information processing machines	**	0 %	16 %	35 %	48 %
Printing and publishing; record, cassette etc.	**	0 %	31 %	21 %	48 %
Motor vehicles and trailers	*	0 %	85 %	1 %	14 %
Not elsewhere classified machinery and equipment	*	2 %	64 %	4 %	30 %
Chemicals and products	*	0 %	60 %	8 %	31 %
Furniture and not elsewhere classified other products	*	0 %	22 %	60 %	18 %
Rubber and plastic products	*	1 %	59 %	1 %	39 %
Not elsewhere classified electrical machinery and equipment	*	2 %	64 %	4 %	30 %
Tobacco products	*	5 %	59 %	4 %	32 %
Total of All Sectors		**0** %	**63** %	**8** %	**28** %

*** Very Compatible, ** Compatible, * Less Compatible, X incompatible or very little compatible (It is organized into 4 categories considering the current situation and trends in the air cargo sector.)

Export distribution according to transportation modes of product groups compatible with air cargo transportation is shown in the table above. Accordingly, exports by air cargo transportation rates in many product groups compatible with air cargo in Turkey is low. On the other hand, the high share of air transport in some products group is also remarkable. Furniture and not elsewhere classified other products, medical instruments; precision optical instruments and clock, office, accounting and information processing machines, printing and publishing, fishery and clothing product groups are among the product groups with a high air transportation share. According to 2018 data, only 8% of all products were exported by air transportation. Although the results seem to be negative, there is a significant potential for the development of air cargo transportation in product groups compatible with air cargo. Food products and beverages, textile products and agriculture and livestock product groups are among these product groups with high compatibility with air cargo transportation and low export values by airway transportation. Therefore, the development of infrastructure facilities at international airports such as Istanbul Airport for product groups compatible with air cargo transportation may occur major leaps in exports with air cargo transportation.

4.2. Determination of Product Groups Compatible With Air Cargo in Istanbul

Table 4.4. *Air Cargo Compliance of Imported and Exported Product Groups in Istanbul*

Sector	***Air Cargo Compliance***
Food products and beverages	***
Fishery	***
Clothing	**
Textile products	**
Radio, television, communication equipment and apparatus	**
Paper and paper products	**
Leather, suitcase, handbag, saddlery and shoes	**
Agriculture and Livestock	**
Medical instruments; precision optical instruments and clock	**
Office, accounting and information processing machines	**
Printing and publishing; record, cassette etc.	**
Motor vehicles and trailers	*
Not elsewhere classified machinery and equipment	*
Furniture and not elsewhere classified other products	*
Chemicals and products	*
Rubber and plastic products	*
Not elsewhere classified electrical machinery and equipment	*
Tobacco products	*
Basic metal industry	X
Metal goods industry (excluding machinery and equipment)	X
Other transport material	X
Other non-metallic mineral products	X
Coke, refined petroleum products and nuclear fuels	X
Quarrying and other mining	X
Ores of metals	X
Wood and cork products (except furniture); knitted goods like wicker	X
Waste and scrap	X
Electricity, gas and water	X
Recreational, cultural and sporting activities	X
Forestry and logging	X
Coal, lignite and peat	X
Other business activities	X
Other service activities	X

*** Very Compatible, ** Compatible, * Less Compatible, X incompatible or very little compatible (It is organized into 4 categories considering the current situation and trends in the air cargo sector.)

When the imported and exported product groups in Istanbul are evaluated in terms of air cargo transportation, it is seen that 18 of the 33 product groups are compatible with

air cargo transportation. In other words, there is a potential for air cargo transportation in 18 product groups.

Table 4.5. *Istanbul Air Cargo Transportation Compatible Import and Export Product Groups Foreign Trade Statistics, 2018 ($) (TurkStat)*

Sector	***Air Cargo Compliance***	***Exports***	***Imports***
Food products and beverages	***	2.984.002.045	2.173.704.520
Fishery	***	34.272.206	44.562.654
Clothing	**	9.849.012.060	1.468.528.178
textile products	**	6.737.779.359	2.997.736.973
Radio, television, communication equipment and apparatus	**	1.658.185.431	4.513.118.245
Paper and paper products	**	1.247.910.267	2.304.521.863
Leather, suitcase, handbag, saddlery and shoes	**	844.545.446	878.259.059
Agriculture and Livestock	**	686.292.269	2.254.935.967
Medical instruments; precision optical instruments and clock	**	491.574.653	3.121.923.575
Office, accounting and information processing machines	**	116.499.729	2.159.460.891
Printing and publishing; record, cassette etc.	**	90.216.349	157.219.566
Motor vehicles and trailers	*	14.242.771.988	12.149.820.139
Not elsewhere classified machinery and equipment	*	8.093.194.640	11.239.565.660
Furniture and not elsewhere classified other products	*	4.889.275.430	2.115.797.372
Chemicals and products	*	5.316.735.344	19.419.357.570
Rubber and plastic products	*	3.605.949.561	3.111.831.880
Not elsewhere classified electrical machinery and equipment	*	2.597.834.472	4.794.300.853
Tobacco products	*	249.832.743	35.290.043
OTHERS	X	21.177.802.929	45.489.485.069
GRAND TOTAL		**84.913.686.921**	**120.429.420.077**

*** Very Compatible, ** Compatible, * Less Compatible, X incompatible or very little compatible (It is organized into 4 categories considering the current situation and trends in the air cargo sector.)

As can be seen from the table above, the sectors with the potential for air cargo transportation are also important sectors in terms of foreign trade. Istanbul's 75,1% of total export value and 62,2% of total import value are compatible with air cargo transportation. With the developments in the air cargo sector in the coming years, it is seen that there is a significant potential for air cargo transportation in these sectors.

The high trade volume of the product groups that are highly compatible with air cargo can be considered as an important advantage for air cargo transportation in Istanbul.

Table 4.6. *Shares of Istanbul Air Cargo Compatible Import and Export Products in Turkey's Foreign Trade, 2018 (TurkStat)*

Sector	***Air Cargo Compliance***	***Share of Istanbul export in TR export (same product group)***	***Share of Istanbul imports in TR imports (same product group)***
Food products and beverages	***	26,7	47,0
Fishery	***	7,1	87,6
Clothing	**	77,9	92,4
textile products	**	45,8	61,9
Radio, television, communication equipment and apparatus	**	90,2	63,5
Paper and paper products	**	54,0	60,6
Leather, suitcase, handbag, saddlery and shoes	**	66,1	88,3
Agriculture and Livestock	**	12,4	24,5
Medical instruments; precision optical instruments and clock	**	49,7	60,3
Office, accounting and information processing machines	**	72,9	91,4
Printing and publishing; record, cassette etc.	**	59,4	75,2
Motor vehicles and trailers	*	50,7	69,3
Not elsewhere classified machinery and equipment	*	53,5	59,1
Furniture and not elsewhere classified other products	*	63,9	70,1
Chemicals and products	*	56,8	58,1
Rubber and plastic products	*	47,9	65,1
Not elsewhere classified electrical machinery and equipment	*	44,5	56,4
Tobacco products	*	39,9	21,4

*** Very Compatible, ** Compatible, * Less Compatible, X incompatible or very little compatible (It is organized into 4 categories considering the current situation and trends in the air cargo sector.)

The table above shows the shares of Istanbul air cargo compatible import and export products in Turkey's foreign trade. Most of the sectors with high potential for the air cargo sector have a share of 10% or more in export values. Similarly, most of the sectors with high potential for the air cargo sector have a share of 20% or more in import values.

For example, radio, television, communication equipment and equipment sector in Istanbul has 90.2% export share of the Turkey's export share. According to table considerable share of Turkey’s foreign trade activities, which compatible with air cargo transportation, take place in Istanbul.

It can be said that many product groups which are highly compatible with air cargo transportation and have a high share in the country in terms of foreign trade are located in Istanbul. Therefore, it can also be said that there is a significant potential in terms of air cargo transportation in Istanbul.

Table 4.7. *Istanbul Export Distribution According to Transportation Modes of Product Groups Compatible with Air Cargo Transportation, 2018 (TurkStat)*

Sector	***Air Cargo Compliance***	***Railway***	***Seaway***	***Airway***	***Roadway***
Food products and beverages	***	0 %	67 %	2 %	31 %
Fishery	***	0 %	57 %	17 %	26 %
Textile products	**	1 %	42 %	5 %	52 %
Clothing	**	0 %	39 %	13 %	48 %
Agriculture and Livestock	**	0 %	59 %	5 %	35 %
Paper and paper products	**	1 %	59 %	1 %	39 %
Radio, television, communication equipment and apparatus	**	1 %	78 %	6 %	16 %
Leather, suitcase, handbag, saddlery and shoes	**	0 %	38 %	13 %	49 %
Medical instruments; precision optical instruments and clock	**	0 %	24 %	42 %	34 %
Office, accounting and information processing machines	**	1 %	17 %	27 %	56 %
Printing and publishing; record, cassette etc.	**	1 %	36 %	10 %	54 %
Motor vehicles and trailers	*	0 %	90 %	0 %	10 %
Not elsewhere classified machinery and equipment	*	3 %	70 %	3 %	25 %
Chemicals and products	*	0 %	54 %	11 %	35 %
Furniture and not elsewhere classified other products	*	0 %	11 %	81 %	8 %
Rubber and plastic products	*	0 %	58 %	1 %	40 %
Not elsewhere classified electrical machinery and equipment	*	0 %	50 %	5 %	45 %
Tobacco products	*	0 %	48 %	6 %	46 %
Total of All Sectors		**1** %	**61** %	**12** %	**26** %

*** Very Compatible, ** Compatible, * Less Compatible, X incompatible or very little compatible (It is organized into 4 categories considering the current situation and trends in the air cargo sector.)

Undoubtedly, export-oriented investments substantially contribute to the development of a region. Therefore, it is useful to give importance to export-oriented air cargo activities. Export distribution according to transportation modes of product groups compatible with air cargo transportation is shown in the table 4.7. Accordingly, exports by air cargo transportation rates in many product groups compatible with air cargo in Istanbul is low. On the other hand, the high share of air transport in some products group is also remarkable. Furniture and not elsewhere classified other products, medical instruments; precision optical instruments and clock, office, accounting and information processing machines, fishery and clothing product groups are among the product groups with a high air transportation share.

According to 2018 data, only 12% of all products were exported by air transportation in Istanbul. Although the results seem to be negative, there is a significant potential for the development of air cargo transportation in product groups compatible with air cargo. Food products and beverages, textile products and agriculture and livestock product groups are among these product groups with high compatibility with air cargo transportation and low export values by airway transportation. Therefore, the development of infrastructure facilities at Istanbul Airport for product groups compatible with air cargo transportation may occur major leaps in exports with air cargo transportation.

4.3. Strategic Product Groups Compatible With Air Cargo in Istanbul

Each product group compatible with air cargo transportation may be considered important, but different product groups may come to the fore according to the strategy to be determined. The product groups compatible with air cargo transportation can be examined with 3 important different strategies. In other words, strategic product groups in terms of air cargo transportation can be categorized into three groups;

1) Prominent product groups that compatible with air cargo transportation according to Istanbul's export data,

2) Product groups with current account deficit that compatible with air cargo transportation according to Istanbul's foreign trade data,
3) Product groups that may not be produced or consumed in the country but which have enormous air cargo demand potential.

4.3.1. Prominent Product Groups That Compatible With Air Cargo Transportation According to Istanbul's Export Data

Products groups compatible with air cargo transportation that currently being mostly exported in Istanbul can be evaluated in this category. The substantial transport of these products at present indicates that there is the necessary infrastructure and expertise to transport that product group in Istanbul. Considering from air cargo transportation perspective, the share of air cargo transportation in exports of the these prominent products groups is significant. Developing possibilities for transporting these product groups with air transportation is an important strategy that can increase both the welfare of producers and the demand for air cargo transport. However, it already may be reached at saturation levels and the potential for development in these product groups may be low. In addition, product groups being transported can also be low value added product groups and transporting these product groups may not have significant economic contribution to the country. Top 10 product groups compatible with air cargo transportation in Istanbul and share of air transportation in these product groups are given in the following table.

Table 4.8. *Foreign Trade Statistics of Top 10 Product Groups Compatible with Air Cargo Transportation in Istanbul, 2018 ($) (TurkStat)*

Sector	***Air Cargo Compliance***	***Exports***	***Share of Air Transportation***
Motor vehicles and trailers	*	14.242.771.988	1 %
Clothing	**	9.849.012.060	12 %
Not elsewhere classified machinery and equipment	*	8.093.194.640	4 %
Textile products	**	6.737.779.359	4 %
Chemicals and products	*	5.316.735.344	8 %
Furniture and not elsewhere classified other products	*	4.889.275.430	60 %
Rubber and plastic products	*	3.605.949.561	1 %

Table 4.8. continued

Food products and beverages	***	2.984.002.045	1 %
Not elsewhere classified electrical machinery and equipment	*	2.597.834.472	4 %
Radio, television, communication equipment and apparatus	**	1.658.185.431	12 %

*** Very Compatible, ** Compatible, * Less Compatible, X incompatible or very little compatible (It is organized into 4 categories considering the current situation and trends in the air cargo sector.)

Accordingly, furniture and not elsewhere classified other products, clothing and radio, television, communication equipment and apparatus product groups are the product groups with a high air transportation share. However, the share of air cargo transport in the export of these prominent product groups is mostly low. Although the results seem to be negative, there is a significant potential for the development of air cargo transportation in these prominent product groups compatible with air cargo. Food products and beverages product group and textile products group are among these prominent product groups with high compatibility with air cargo transportation and low export values by airway transportation. Therefore, the development of infrastructure facilities at Istanbul Airport for these prominent product groups compatible with air cargo transportation may occur major leaps in exports with air cargo transportation.

4.3.2. Product Groups With Current Account Deficit and Compatible With Air Cargo Transportation According to Istanbul's Foreign Trade Data

Products groups with current account deficit and compatible with air cargo transportation in Istanbul can be evaluated in this category. The current account deficit basically means that the value of goods and services imported exceeds the value of goods and services exported. In addition, the current account deficit is one of the main factors that adversely affect a country's economy. Therefore, it is important to develop opportunities for both production and transportation of these product groups in order to reduce current account deficit. In this context, developing possibilities for transporting product groups with current account deficit and compatible with air transportation is an important strategy that can decrease the current account deficit of

the Istanbul and it also contribute to the country's economy. It can also increase both the welfare of producers and the demand to air cargo transportation. In addition, the share of air cargo transportation in exports of these products groups with current account deficit is significant. Top 10 product groups with current account deficit and compatible with air cargo transportation in Istanbul and share of air transportation in these product groups are given in the following table.

Table 4.9. *Top 10 Product Groups with Current Account Deficit and Compatible with Air Cargo Transportation in Istanbul, 2018 (TurkStat)*

Sector	***Air Cargo Compliance***	***Current Account Deficit ($)***	***Export Share of Air Transportation***
Chemicals and products	*	14.102.622.226	11 %
Not elsewhere classified machinery and equipment	*	3.146.371.020	3 %
Radio, television, communication equipment and apparatus	**	2.854.932.814	6 %
Medical instruments; precision optical instruments and clock	**	2.630.348.922	42 %
Not elsewhere classified electrical machinery and equipment	*	2.196.466.381	5 %
Office, accounting and information processing machines	**	2.042.961.162	27 %
Agriculture and Livestock	**	1.568.643.698	5 %
Paper and paper products	**	1.056.611.596	1 %
Printing and publishing; record, cassette etc.	**	67.003.217	10 %
Leather, suitcase, handbag, saddlery and shoes	**	33.713.613	13 %

*** Very Compatible, ** Compatible, * Less Compatible, X incompatible or very little compatible (It is organized into 4 categories considering the current situation and trends in the air cargo sector.)

Accordingly, medical instruments; precision optical instruments and clock, office, accounting and information processing machines, leather, suitcase, handbag, saddlery and shoes, chemicals and products, printing and publishing product groups are the product groups with a high air transportation share. It is also important that most of these product groups are highly compatible with air cargo transportation and also the share of air cargo transportation in the export of these product groups is high. Therefore, if import substitution policies are implemented to decrease current account

deficit, a significant increase in demand to air cargo transportation may be seen. In this context, the development of infrastructure facilities at Istanbul Airport for these product groups with current account deficit and compatible with air cargo transportation may occur major leaps in exports with air cargo transportation. In addition, the implementation of such a strategy will also significantly contribute to the national economy. It should be noted that this is the most important strategy for the development of air cargo transportation both in Turkey and Istanbul.

4.3.3. Product Groups That May Not Be Produced or Consumed in the Country but Which Have Enormous Air Cargo Demand Potential

Individuals are influenced by different cultures specific to their geographies, that affect many daily lifestyles such as eating and drinking and dressing, and therefore the consumption habits of individuals may vary according to the geography in which they live. This also has implications on air cargo product groups carried around the world. In this context, countries with high connectivity opportunities and strategically important geographical location, have a potential to become a global transit point for transporting by air cargo of these type product groups which not manufactured or consumed in that country. Istanbul Airport may be suitable for this strategy thanks to its advanced infrastructure facilities and strategically important geographical location.

However, there are also important factors such as the fact that the product groups belonging to this category cannot be clearly defined and that the product groups belonging to this category may be change in line with the changing demands of the individuals over time. Hence, it would be pointless to focus only on the transport of product groups that comply with this strategy, and the possibility of transporting product groups belonging this strategy should be considered as one of the multiplier effects of specialization in the sectors in the other two strategies.

CHAPTER 5

AIR CARGO POTENTIAL INDEX OF ISTANBUL

An index study was conducted to analyze whether existing logistics infrastructure facilities in Turkey are suitable for the development of air cargo transportation and analyze the development potential of the air cargo sector by provinces. In the light of literature researches, 9 cargo indicators which form the basis of the index study and it can direct the development of the air cargo sector in a region have been identified.

Table 5.1. *Cargo Indicators That Can Direct the Development of Air Cargo Sector*

Cargo Indicators	
K_1	Import/Export Point (Over $750.000.000 or not) (2017)
K_2	Possibility of Multimodal Transportation
K_3	Integration with Logistic Hub (Yes/No)
K_4	Integration with Free Zone (Yes/No)
K_5	Airway Transportation Export Value ($) (2017)
K_6	Airway Transportation Import Value ($) (2017)
K_7	Annual Cargo Traffic of Airport located in the province (tonnes) (2017)
K_8	Possibility of Cargo Terminal at Airport located in the province (Yes/No)
K_9	Possibility of providing Air Cargo Service at the airport located in the province

5.1. Indicator Descriptions of Air Cargo Potential Index Study

K_1 : Import/Export Point (Over $750.000.000 or not) (2017)

It was created by using export and import data by provinces. The export / import index points of the provinces were obtained by giving 100 points for import or export value $750 million and above, and 0 points for import or export value less than $750 million.

Firstly, 81 provinces of Turkey are ranked in terms of export and import values from highest to lowest. According to 2017 data, while the average export of 81 provinces was $1.9 billion, the average of imports was $2.6 billion. When the rankings are examined, it is seen that there is an important breaking at $750 million and below. Therefore, $750 million was determined as the breaking point. The provinces are divided into two categories considering whether the foreign trade of the provinces is higher than the breaking point. The data which obtained by using export/import index points of provinces in Turkey are shown in the following figure.

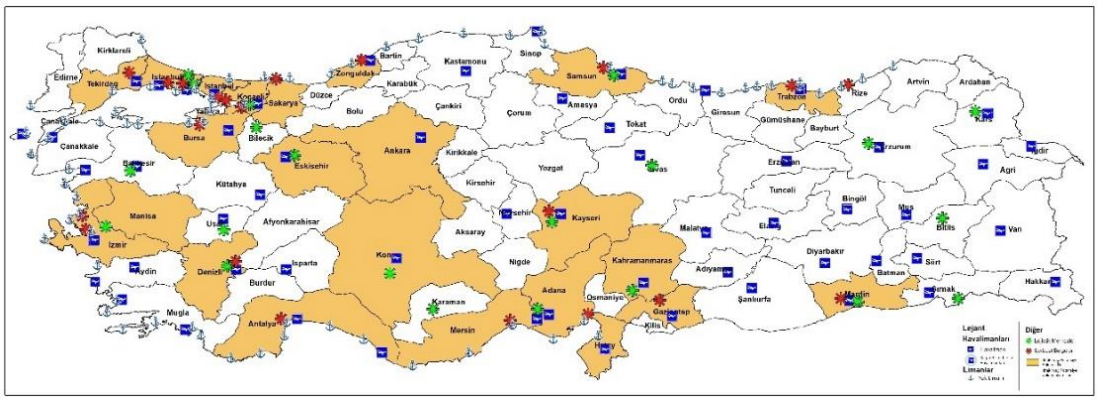


Figure 5.1. Export/Import Index Point Map of Provinces in Turkey (*This figure is created by the author through using TurkStat database)*

As can be seen from the figure, the export or import value in 22 of 81 provinces is over $750 million. In other words, it can be said that a significant amount of goods are exchanged in these provinces and logistics infrastructure facilities are at the forefront in these provinces. Evaluating from the perspective of air cargo, studies aiming to

increase the percentage of air cargo transportation in especially provinces where intensive goods are exchanged may contribute to development of air cargo sector.

K_2 : Possibility of Multimodal Transportation

The number of cargo transportation types in these provinces were determined by analyzing the maritime, highway, airway and railway transportation opportunities in the provinces. The multimodal transportation index points of the provinces were obtained by using the number of cargo transportation types in these provinces. Each type of transportation is evaluated as 25 points and 100 points are given for a province with 4 transportation possibilities.

The multimodal transportation possibilities database has been formed by compiling the data of the air cargo transportation amounts of the provinces carried by seaway, roadway, airway and railway. TCDD Statistical Annuals were examined and the amount of railway cargo transportation of provinces was obtained according to years. The General Directorate of Highways Statistical Annuals were examined and the amount of roadway cargo transportation of provinces was obtained according to years. DHMI Statistical Annuals were examined and the amount of airway cargo transportation of provinces was obtained according to years. The seaway cargo transport amounts of the provinces were obtained by using the seaway cargo statistics interface via the Ministry of Transport and Infrastructure website. The existence of any type of cargo transportation in the province is accepted as an indication that the province has that type of transportation connection. The data which obtained by using multi modal possibilities of provinces in Turkey are shown in the following figure.

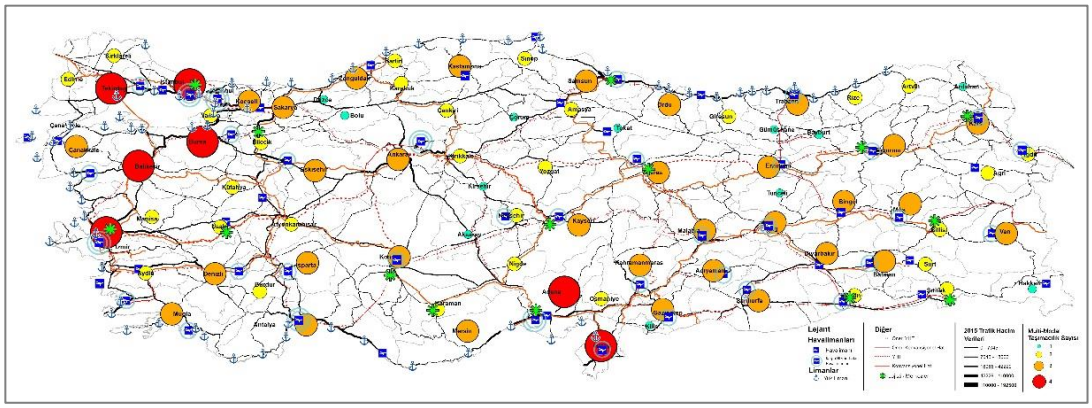


Figure 5.2. Multi-Modal Possibilities of Provinces in Turkey (*This figure is created by the author through using Ministry of Transport and Infrastructure database)*

The provinces with 25 points are shown as blue circle, the provinces with 50 points are shown as yellow circle, the provinces with 75 points are shown as orange circle and the provinces with 100 points are shown as red circle on the figure above. As can be seen from the figure, İstanbul, Tekirdağ, Bursa, Balıkesir, İzmir, Adana and Hatay provinces have come to the fore in terms of multimodal transportation possibilities.

K_3 : Integration with Logistic Hub (Yes/No)

The logistic center integration index points of the provinces were obtained by analyzing the availability of logistics centers in the provinces. 100 points are given if there is a logistics center in the province and 0 points are given if there isn't logistics center in the province. Logistics center database has been created by using obtained logistics hub investments from Ministry of Transport and Infrastructure investment programs and TCDD investment programs. The data which obtained by using logistics center index points of provinces in Turkey are shown in the following figure.

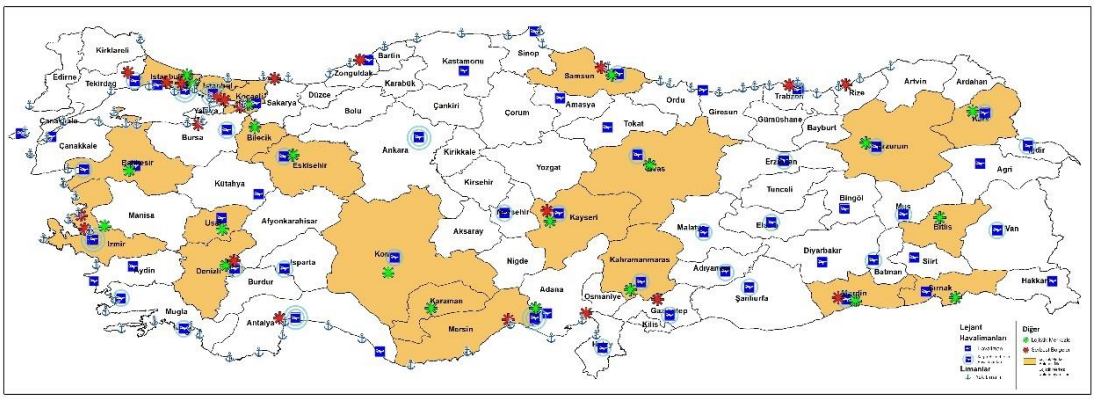


Figure 5.3. The Provinces with Logistics Hubs in Turkey (*This figure is created by the author through using TCDD database)*

As can be seen from the figure, 21 logistics hubs planned to made in Turkey. 8 of 21 logistics hubs started to operate and 6 of 21 logistics hubs are still under construction. 7 of 21 logistics hubs are in the tender / project / expropriation phase. It should be noted that provinces with logistic hubs, which have a major contribution to the efficiency of transport activities, have significant advantages in terms of cargo transportation.

K_4 : Integration with Free Zone (Yes/No)

The free zone integration index scores of the provinces were obtained by analyzing the availability of free zone in the provinces. 100 points are given if there is a free zone in the province and 0 points are given if there isn't free zone in the province. Free zone database was obtained by using the free zones interface via Ministry of Commerce website. The data which obtained by using free zones index points of provinces in Turkey are shown in the following figure.

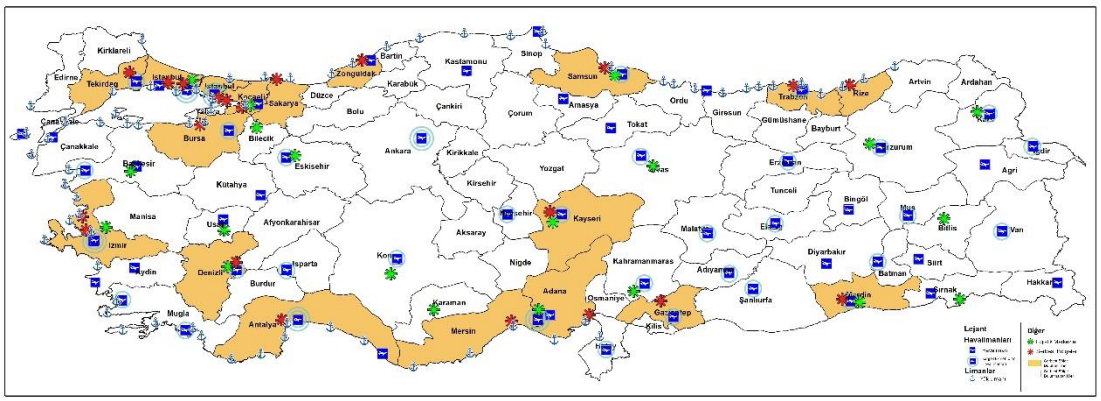


Figure 5.4. The Provinces with Free Zones in Turkey (*This figure is created by the author through using Ministry of Commerce database)*

As can be seen from the figure, the free zones generally located close to the harbor that in the coastal provinces of Turkey. It can be said that export with seaway transportation has an effect on selection the location of free zones in provinces. Integration with free zones is a parameter that can also contribute to the export volumes by air transportation. It should be said that provinces with free zones have significant logistic advantages in terms of export.

8 of the 21 free zones in total are located in Istanbul and its region. Therefore, Istanbul and its region have an important logistic advantage compared to other regions thanks to its proximity to free zones. According to the figure above, İzmir, Denizli, Antalya, Mersin, Adana, Kayseri, Gaziantep, Mardin, Zonguldak, Samsun, Trabzon and Rize provinces have come to the fore thanks to existence of free zones in that provinces.

K_5 : Airway Transportation Export Value ($) (2017)

The airline export index scores of the provinces were obtained by using the export data carried by airway in the provinces. The export values of the provinces carried by air transportation were indexed according to the highest value obtained. Accordingly, the province with the highest export value carried by air transportation has achieved 100 points. The export value database of airway transportation was obtained by using

foreign trade data according to the type of transportation from TurkStat website. The data which obtained by using the export values carried by airway transportation of the provinces in Turkey are shown in the following figure.

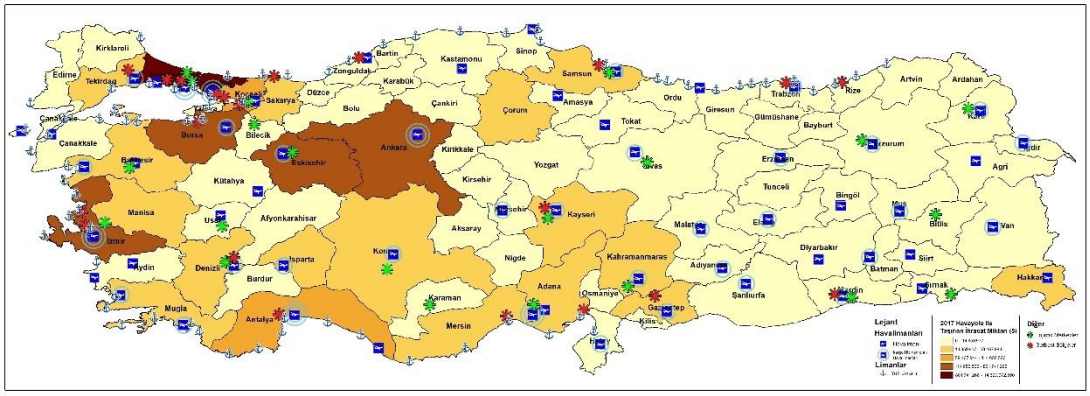


Figure 5.5. Export Values Carried by Airway Transportation of The Provinces (*This figure is created by the author through using TurkStat database)*

As can be seen from the figure, İstanbul, İzmir, Bursa, Eskişehir and Ankara provinces have come to the fore in terms of export values carried by airway transportation. Antalya, Kocaeli, Tekirdağ, Sakarya, Balıkesir, Manisa, Denizli, Muğla, Isparta, Konya, Mersin, Adana, Kayseri, Kahramanmaraş, Gaziantep, Çorum, Samsun and Hakkari provinces have also high values in terms of export values carried by airway transportation. It is also noteworthy that Istanbul has the highest export value carried by air transportation.

K_6 : Airway Transportation Import Value ($) (2017)

The airline export index scores of the provinces were obtained by using the import data carried by airway in the provinces. The import values of the provinces carried by air transportation were indexed according to the highest value obtained. Accordingly, the province with the highest import value carried by air transportation has achieved 100 points. The import value database of airway transportation was obtained by using foreign trade data according to the type of transportation from TurkStat website. The

data which obtained by using the import values carried by airway transportation of the provinces in Turkey are shown in the following figure.

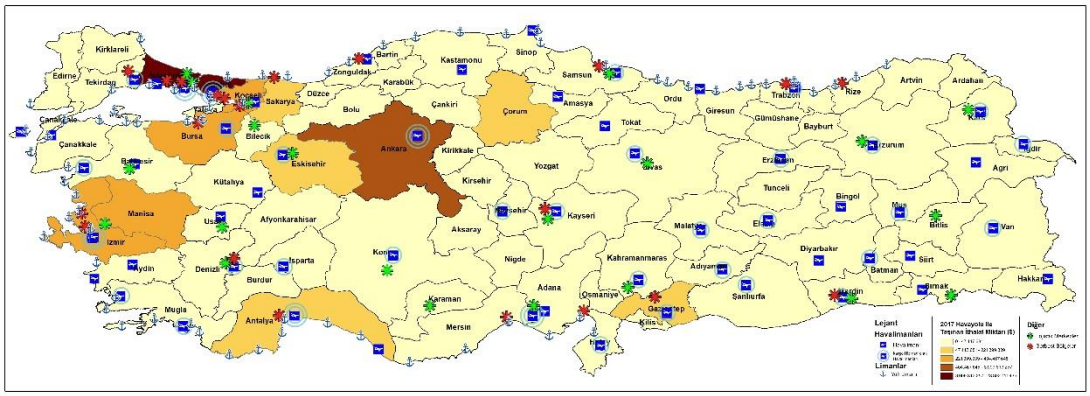


Figure 5.6. Import Values Carried by Airway Transportation of the Provinces (*This figure is created by the author through using TurkStat database)*

As can be seen from the figure, İstanbul, Ankara, İzmir, Manisa, Bursa and Kocaeli provinces have come to the fore in terms of import values carried by airway transportation. Antalya, Sakarya, Eskişehir, Çorum and Gaziantep provinces have also high values in terms of import values carried by airway transportation. It is also noteworthy that Istanbul has the highest import value carried by air transportation.

K_7 : Annual Cargo Traffic of Airport located in the province (tonnes) (2017)

Airport Annual Cargo Traffic Index points were obtained by using the total amount of cargo transported at the airports in the provinces. The airports located in the provinces were indexed according to the highest value obtained in the annual cargo traffic volumes. Accordingly, the province with the highest annual cargo traffic volume has achieved 100 points. The annual air cargo traffic volume database of provinces was obtained by using the annual statistics published by DHMI. The data which obtained by using the annual air cargo traffic of airports in Turkey are shown in the following figure.

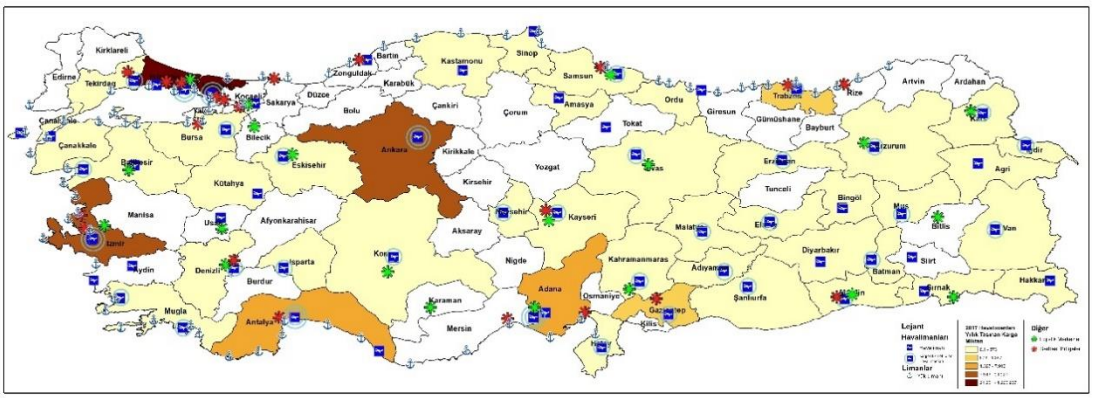


Figure 5.7. Annual Air Cargo Traffic Data of Airports in Provinces (*This figure is created by the author through using DHMI database)*

As can be seen from the figure, Istanbul, Ankara and Izmir provinces stand out in terms of the amount of annual cargo transported by air. Antalya, Adana, Gaziantep and Trabzon provinces have also high values in terms of annual cargo carried by airway transportation. The fact that most of the existing air cargo traffic takes place in Istanbul and that other airports have a very low share compared to Istanbul is also a factor to be considered. It is expected that Istanbul's share in Turkey will increase further with the begin of cargo activities at Istanbul Airport.

K_8 : Possibility of Cargo Terminal at Airport located in the province (Yes/No)

Possibility of Cargo Terminal at Airport index scores of the provinces were obtained by analyzing the availability of cargo terminal at airports in the provinces. 100 points are given if there is a cargo terminal at airports in the province and 0 points are given if there isn't cargo terminal at airports in the province. Database of airports with an air cargo terminal was obtained by using the statistics annuals published by DHMI. Provinces with air cargo terminal in Turkey are shown in the following figure by using obtained data.

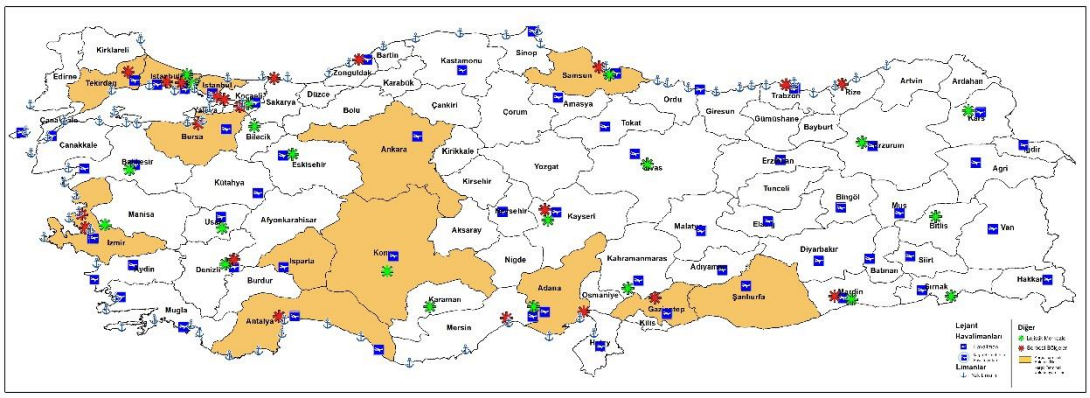


Figure 5.8. Provinces with Air Cargo Terminal in Turkey (*This figure is created by the author through using DHMI database)*

As can be seen from the figure, there are only a few provinces have air cargo terminal in Turkey. Provinces that have an air cargo terminal have significant potential for the development of air cargo transportation. There are two important variables which distinguish air cargo terminals from each other: area (m^2) and technology level used in the terminal. However, no details have been taken down for the index study and it is evaluated whether there is an air cargo terminal only in the provinces. It should be noted that even having an air cargo terminal with a small area and low technology in the province will contribute air cargo transportation in that province.

K_9 : Possibility of providing Air Cargo Service at airport located in the province

Air cargo service index scores were obtained by analyzing the availability of air cargo services at the airports located in the provinces. 100 points are given if there is an air cargo service at the airport and 0 points are given if there is not air cargo service at the airport. Database of the provinces where air cargo service was provided at the airports were obtained by using the statistics annuals published by DHMI. Provinces where air cargo service was provided at the airports in Turkey are shown in the following figure by using obtained database.

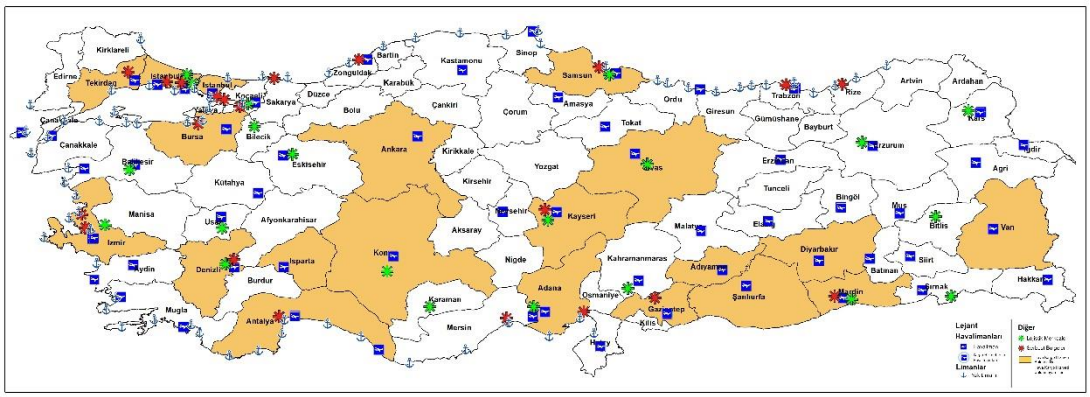


Figure 5.9. Provinces Where Air Cargo Service was Provided at The Airports in Turkey (*This figure is created by the author through using DHMI database)*

As can be seen from the figure, there are many provinces have air cargo service in Turkey. However, this service is providing with limited facilities without cargo facilities at most airports. In other words, most airports have a low level of air cargo service possibility. It should be noted that even providing air cargo service with limited facilities without cargo facilities in the province will increase accessibility to air cargo in that province. Significant leaps may be seen in the air cargo activities of the provinces through developing cargo infrastructures at the airports in the provinces.

5.2. Index Formulations

$$0{,}5\ x\ (Cargo\ Potential\ Score + Air\ Cargo\ Potential\ Score) = Result\ Index\ Score$$

$$Cargo\ Potential\ Score = \ 0{,}25\ x\ (K_1 + K_2 + K_3 + K_4)$$

$$Air\ Cargo\ Potential\ Score = \ 0{,}2\ x\ (K_5 + K_6 + K_7 + K_8 + K_9)$$

$$Result\ Index\ Score$$
$$= 0{,}5\ x\ (0{,}25\ x\ (K_1 + K_2 + K_3 + K_4)) + (0{,}2\ x\ (K_5 + K_6 + K_7 + K_8 + K_9))$$

The above formulations were used for the index. Accordingly, the index has been calculated in three stages as “Cargo Potential Score”, “Air Cargo Potential Score” and “Result Index Score”. Cargo potential scores for 81 provinces were calculated by using K_1, K_2, K_3 ve K_4 indexes. Air cargo potential scores for 81 provinces were calculated by using K_5, K_6, K_7, K_8 ve K_9 indexes. Lastly the results index scores were

calculated for 81 provinces by taking the average of the values obtained in the 1st and 2nd stage. In other words, the results index scores were calculated by evaluating both the air cargo potentials and other cargo potentials of the province and using all the parameters in the table 5.1.

5.3. Evaluation of Index Study Results

Table 5.2. *Top 20 Provinces according to Index Results*

PLACE	PROVINCE CODE	PROVINCE NAME	CARGO POTENTIAL SCORE	CARGO POTENTIAL PLACE	AIR CARGO POTENTIAL SCORE	AIR CARGO POTENTIAL PLACE	RESULT INDEX SCORE
1	34	İSTANBUL	100,0	1	100,0	1	**100,0**
2	35	İZMİR	100,0	2	41,1	3	**70,5**
3	55	SAMSUN	88,9	7	40,1	11	**64,5**
4	16	BURSA	83,3	8	40,7	4	**62,0**
5	1	ADANA	83,3	10	40,2	6	**61,8**
6	59	TEKİRDAĞ	83,3	9	40,1	9	**61,7**
7	7	ANTALYA	72,2	11	40,4	5	**56,3**
8	27	GAZİANTEP	72,2	14	40,2	7	**56,2**
9	42	KONYA	72,2	12	40,1	8	**56,2**
10	20	DENİZLİ	88,9	4	20,1	13	**54,5**
11	38	KAYSERİ	88,9	5	20,1	14	**54,5**
12	6	ANKARA	55,6	20	43,4	2	**49,5**
13	41	KOCAELİ	88,9	3	0,4	21	**44,6**
14	33	MERSİN	88,9	6	0,0	28	**44,5**
15	47	MARDİN	61,1	18	20,0	18	**40,6**
16	26	ESKİŞEHİR	72,2	13	0,6	20	**36,4**
17	46	KAHRAMANMARAŞ	72,2	15	0,0	29	**36,1**
18	61	TRABZON	72,2	16	0,0	30	**36,1**
19	31	HATAY	66,7	17	0,0	32	**33,3**
20	32	ISPARTA	22,2	34	40,1	10	**31,1**

* The complete list can be found in Appendix-A

According to this index study, the first 20 provinces with the highest scores among 81 provinces are shown in the table above. According to the results obtained, Istanbul has the highest score in Marmara Region, İzmir has the highest score in Aegean Region,

Adana has the highest score in the Mediterranean Region, Konya has the highest score in the Central Anatolia Region, Gaziantep has the highest score in Southeast Anatolia Region, Samsun has the highest score in the Black Sea Region and Van has the highest score in Eastern Anatolia Region. It should be given importance to these prominent provinces, especially Istanbul, for development of regional air cargo transportation in Turkey. In addition, Cargo Index, Air Cargo Index and Result Index maps were created by using the results of the index study.

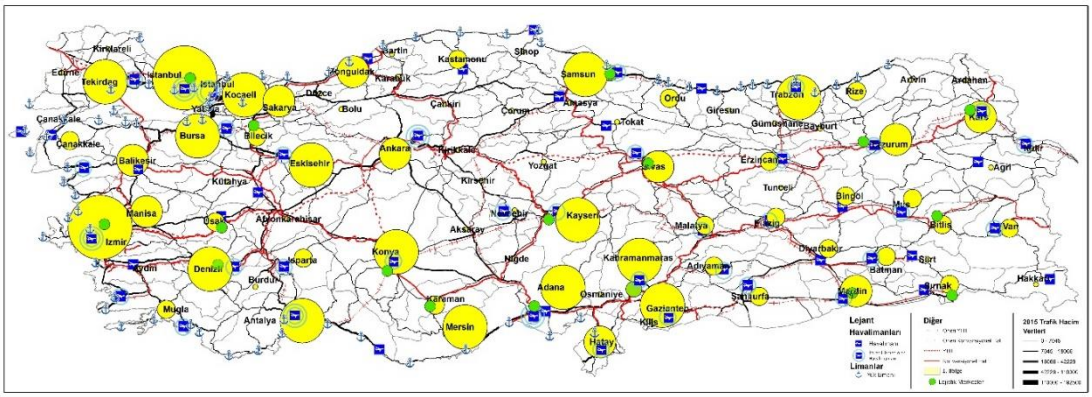


Figure 5.10. Cargo Index Map

The Cargo Index Map above has been created by using the cargo potential index points of the provinces obtained as a result of the index study. As can be seen from figure above, Istanbul and its region stand out as a region with high cargo potential. It can be said that there are high potentials in terms of regional cargo transportation in İzmir-Manisa, Antalya-Denizli, Eskişehir-Ankara-Konya and Mersin-Adana-Kayseri-Kahramanmaraş-Gaziantep-Hatay regions. In addition, there are important cargo potentials in Denizli, Antalya, Konya, Ankara, Eskisehir, Samsun, Trabzon, Kayseri, Sivas, Erzurum, Kars and Mardin provinces.

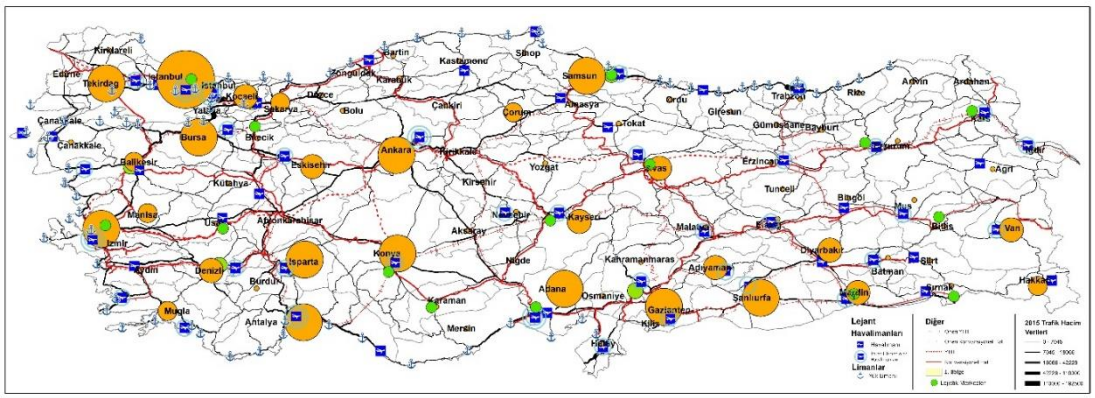


Figure 5.11. Air Cargo Index Map

The Air Cargo Index Map above has been created by using the air cargo potential index points of the provinces obtained as a result of the index study. As can be seen from figure above, Istanbul and its region stand out as a region with high air cargo potential. It can be said that there are high potentials in terms of regional air cargo transportation in İzmir-Manisa, Antalya-Isparta-Denizli, Ankara-Konya-Eskişehir and Adana-Gaziantep-Şanlıurfa regions. In addition, there are important air cargo potentials in Samsun, Sivas, Kayseri, Adıyaman, Diyarbakır, Mardin and Van provinces.

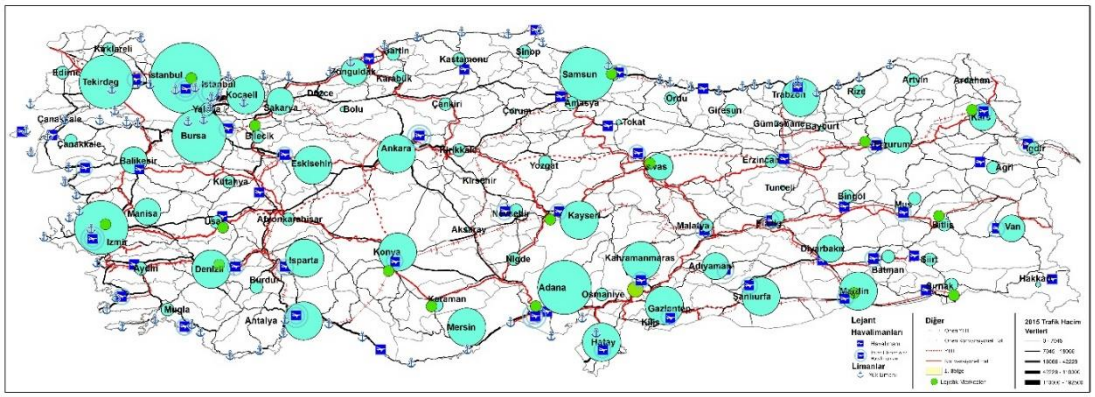


Figure 5.12. Result Index Map

The Result Index Map above has been created by using the result index points of the provinces obtained as a result of the index study. As can be seen from this figure above, Istanbul and its region stand out as a region with high cargo potential. It can

said that there are high potentials in terms of regional cargo transportation in İzmir-Manisa, Antalya-Isparta-Denizli, Ankara-Konya-Eskişehir and Mersin-Adana-Gaziantep-Şanlıurfa-Kahramanmaraş-Mardin-Hatay regions. In addition, there are important cargo potentials in Samsun, Trabzon, Sivas, Kayseri, Adıyaman, Diyarbakır, Erzurum, Kars and Van provinces. It is useful to examine the index data of Istanbul province and its region, which are prominent in 3 stages of the index study.

Table 5.3. *Index Points of İstanbul and Its Region*

PROVINCE NAME	K_1	K_2	K_3	K_4	K_5	K_6	K_7	K_8	K_9
İSTANBUL	100	100	100	100	100,00	100,00	100,00	100	100
BURSA	100	100	0	100	2,45	1,11	0,01	100	100
TEKİRDAĞ	100	100	0	100	0,28	0,15	0,02	100	100
KOCAELİ	100	67	100	100	0,80	1,04	0,00	0	0
SAKARYA	100	67	0	0	0,15	0,30	0,00	0	0
BALIKESİR	0	100	100	0	0,25	0,10	0,00	0	0
BİLECİK	0	33	100	0	0,00	0,00	0,00	0	0
ÇANAKKALE	0	67	0	0	0,01	0,01	0,00	0	0
EDİRNE	0	33	0	0	0,03	0,00	0,00	0	0
YALOVA	0	33	0	0	0,00	0,02	0,00	0	0
KIRKLARELİ	0	33	0	0	0,01	0,01	0,00	0	0

Table 5.4. *Result Index Map of İstanbul and Its Region*

PLACE	**PROVINCE CODE**	**PROVINCE NAME**	**CARGO POTENTIAL SCORE**	**CARGO POTENTIAL PLACE**	**AIR CARGO POTENTIAL SCORE**	**AIR CARGO POTENTIAL PLACE**	**RESULT INDEX SCORE**
1	34	İSTANBUL	100.0	1	100.0	1	**100.0**
2	16	BURSA	83.3	8	40.7	4	**62.0**
3	59	TEKİRDAĞ	83.3	9	40.1	9	**61.7**
4	41	KOCAELİ	88.9	3	0.4	21	**44.6**
5	54	SAKARYA	55.6	19	0.1	24	**27.8**
5	10	BALIKESİR	50.0	22	0.1	25	**25.0**
6	11	BİLECİK	27.8	27	0.0	66	**13.9**
7	17	ÇANAKKALE	22.2	33	0.0	55	**11.1**
8	22	EDİRNE	11.1	48	0.0	44	**5.6**
9	77	YALOVA	11.1	49	0.0	47	**5.6**

According to the result of air cargo index analysis made for Istanbul and other provinces in the region, Istanbul, Bursa and Tekirdağ have the highest 3 scores. The province of Istanbul stands out with a high score in all 3 stages assessment. Istanbul province stands out with a high score both in the cargo potential assessment and in the air cargo potential assessment. The main factor that makes Istanbul stand out in the result index is that it has become a logistic hub in the region today. Bursa, Tekirdağ, Kocaeli and Sakarya provinces in the region are important provinces with high cargo potential where logistics activities are concentrated. In addition, Bursa and Tekirdağ provinces are the cities with high air cargo potential with their developed air cargo infrastructure. Although the provinces of Kocaeli and Sakarya have high cargo potential, they left behind in air cargo potential analysis due to not having sufficient infrastructure facilities for air cargo transportation. In the light of this index study, it can be said that the existing logistics infrastructure is suitable for the development of the air logistics sector in Istanbul. If this potential is well utilized, it can be said that Istanbul can become one of the most important cargo hubs in the globalizing world.

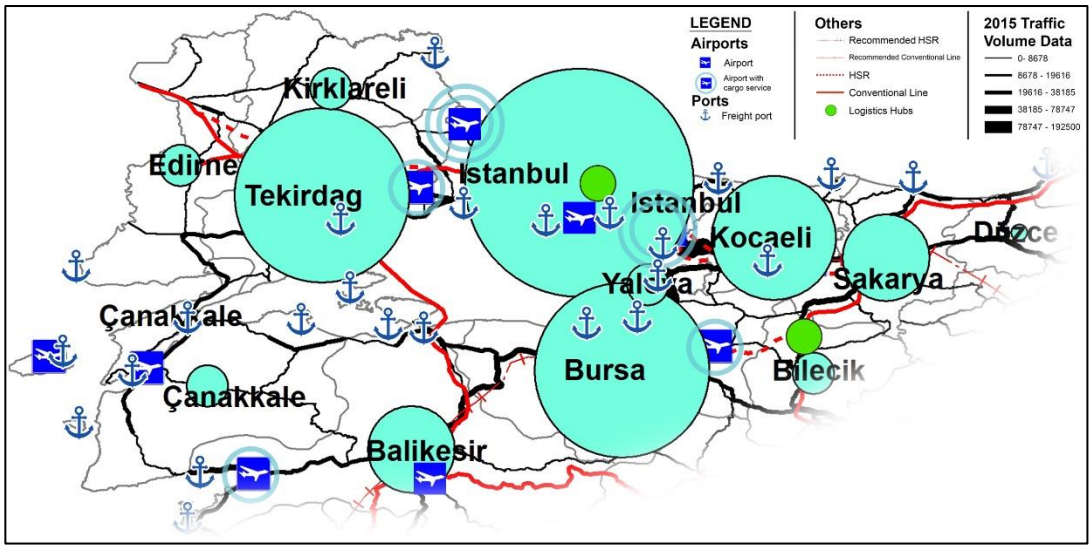


Figure 5.13. Result Index Map of Istanbul and Its Region

CHAPTER 6

ISTANBUL AIRPORT AS A SIGNIFICANT TRANSIT POINT FOR GLOBAL AIR LOGISTICS

It was seen that Istanbul Airport has the goal of becoming a global logistics hub by examining both the state policies and Istanbul Airport strategies. In order for an airport to become a global hub, it is important whether it can be a global transfer point as well as product groups and portable cargo potentials in the region where the airport is located. One of the most important strategies of the pioneering airports in terms of air cargo traffic in the world is to be a transit point for international air cargo transportation.

Istanbul also has the potential to become an important transit point in terms of air cargo in global trade. However, being able to compete with the leading airports in terms of air cargo located in the nearby geography is also very important to achieve this goal. There are the two main parameters which will contribute to the airport becoming a transit point. These are the annual cargo traffic and connectivity of the airport. Firstly, the air cargo traffic data of Istanbul and its potential competitors for the last 10 years have been examined and the data obtained are explained in detail later in the section.

Table 6.1. *Top 20 Airports in The World According to Cargo Traffic Ranking (2018)*

PLACE	**ICAO CODE**	**NAME**	**COUNTRY**	**CARGO TRAFFIC (TON)**
1	VHHH	Hong Kong International Airport	Hong Kong	5.120.811
2	KMEM	Memphis International Airport	U.S.A.	4.470.196
3	ZSPD	Shanghai Pudong International Airport	China	3.768.573
4	RKSI	Seoul Incheon International Airport	Republic of Korea	2.952.123

Table 6.1. continued

5	PANC	Ted Stevens Anchorage International Airport	U.S.A.	2.806.743
6	OMDB	Dubai International Airport	United Arab Emirates	2.641.383
7	KSDF	Louisville International Airport	U.S.A.	2.623.019
8	RCTP	Taiwan Taoyuan International Airport	Taiwan	2.322.823
9	RJAA	Narita International Airport	Japan	2.261.008
10	KLAX	Los Angeles International Airport	U.S.A.	2.209.850
11	OTHH	Hamad (New Doha) International Airport	Qatar	2.198.308
12	WSSS	Singapore Changi Airport	Singapore	2.195.000
13	EDDF	Frankfurt Airport	Germany	2.176.387
14	LFPG	Charles de Gaulle Airport	France	2.156.327
15	KMIA	Miami International Airport	U.S.A.	2.129.658
16	ZBAA	Beijing Capital International Airport	China	2.074.005
17	ZGGG	Guangzhou Baiyun International Airport	China	1.890.561
18	KORD	Chicago O'Hare International Airport	U.S.A.	1.868.880
19	EGLL	London Heathrow Airport	United Kingdom	1.771.342
20	EHAM	Schiphol Amsterdam Airport	Netherlands	1.737.984
	LTBA	**İstanbul Atatürk Airport**	**Turkey**	**1.281.186**

*Compiled from ACI (Airports Council International) and DHMİ database.

According to the table above which shows the world's 20 largest airports in terms of annual cargo traffic, Istanbul Atatürk Airport could not rank in the top 20 with 1.281.186 tons. According to these data, Istanbul Atatürk Airport is far behind the important airports in the sector such as Hong Kong, Incheon and Frankfurt. Istanbul airport has to compete with major airports such as Amsterdam, Frankfurt, Paris, London, Dubai and Doha airports which are located in the nearby geography to become a important hub for air cargo transportation. According to 2018 data, Istanbul airport has lower cargo traffic rather than its potential competitors.

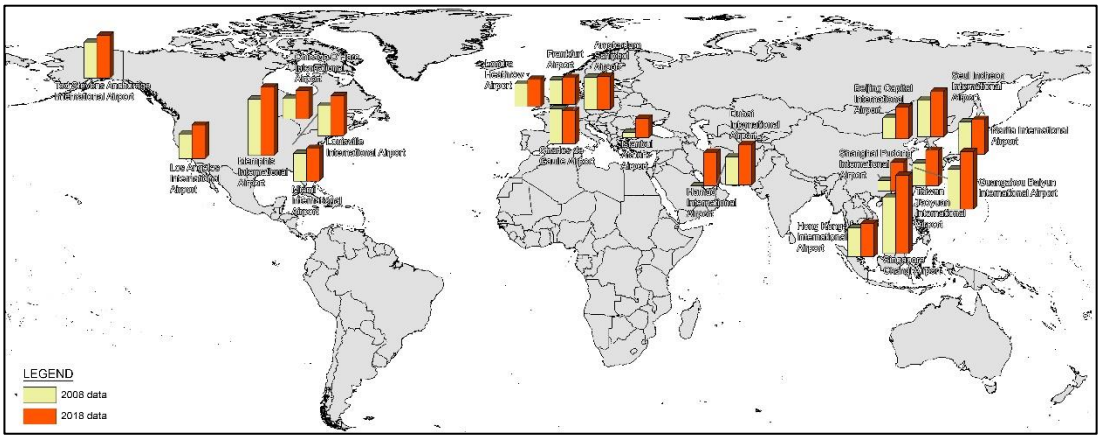


Figure 6.1. World Cargo Traffic Map by 2008 and 2018 data (*This figure is created by the author through using ACI database)*

World cargo traffic map according to 2008 and 2018 data was created by using the ACI data of top 20 airports and Istanbul Atatürk Airport in terms of air cargo traffic. These airports are shown on the figure using bar charts with size proportional to the cargo traffic they have. As can be seen from the figure above, Hong Kong, Memphis and Shanghai Pudong airports stand out with their high cargo traffic.

Evaluating in terms of Istanbul Airport, it can be considered as an advantage that most of the airports on the figure are located in remote geographies compared to Istanbul Airport. Developments in airports located in remote geographies do not directly affect Istanbul Airport's ability to become a transit point. The potential competitors that may affect Istanbul Airport's possibility for being a significant transit point are mostly European and Middle Eastern airports located in the nearby geography. Amsterdam Schiphol, Frankfurt, Paris de Gaulle, London Heathrow, Dubai and Hamad airports, which are located in a nearby geography with significant annual air cargo traffic, may be considered as the most important competitors of Istanbul Airport.

Table 6.2. *Average annual growth rates of World Airports between 2008-2018*

Airport Name	Country	2008 Annual Cargo Traffic	2018 Annual Cargo Traffic	Average Growth Rate
Hong Kong International Airport	Hong Kong	3.660.901	5.120.811	3,41%
Memphis International Airport	U.S.A.	3.695.438	4.470.196	1,92%
Shanghai Pudong International Airport	China	2.603.027	3.768.573	3,77%
Seoul Incheon International Airport	South Korea	2.423.717	2.952.123	1,99%
Ted Stevens Anchorage International Airport	U.S.A.	2.339.831	2.806.743	1,84%
Dubai International Airport	United Arab Emirates	1.824.992	2.641.383	3,77%
Louisville International Airport	U.S.A.	1.974.276	2.623.019	2,88%
Taiwan Taoyuan International Airport	Taiwan	1.493.120	2.322.823	4,52%
Narita International Airport	Japan	2.100.448	2.261.008	0,74%
Los Angeles International Airport	U.S.A.	1.629.525	2.209.850	3,09%
Hamad (New Doha) International Airport	Qatar		2.198.308	15,22%
Singapore Changi Airport	Singapore	1.883.894	2.195.000	1,54%
Frankfurt Airport	Germany	2.111.031	2.176.387	0,31%
Charles de Gaulle Airport	France	2.280.050	2.156.327	-0,56%
Miami International Airport	U.S.A.	1.806.770	2.129.658	1,66%
Beijing Capital International Airport	China	1.367.710	2.074.005	4,25%
Guangzhou Baiyun International Airport	China	685.868	1.890.561	10,67%
Chicago O'Hare International Airport	U.S.A.	1.332.123	1.868.880	3,44%
London Heathrow Airport	United Kingdom	1.486.260	1.771.342	1,77%
Schiphol Amsterdam Airport	Netherlands	1.602.585	1.737.984	0,81%
İstanbul Atatürk Airport	Turkey	349.999	1.281.186	13,86%

* Created by using ACI data.

The average annual growth rates of the top 20 airports and Istanbul Atatürk Airport between 2008-2018 in terms of air cargo traffic are shown in the table above. Accordingly, Doha and Istanbul airports attract attention with their high growth rates. Amsterdam, Frankfurt, Paris, London and Dubai airports, which are among the major

competitors of Istanbul airport, have low growth rates. Therefore, it can be said that especially European airports have experienced a slow development period in terms of air cargo transportation while Middle East airports have experienced significant leaps. It is useful to examine closely the important competitors that may affect Istanbul Airport's possibility for being a significant transit point.

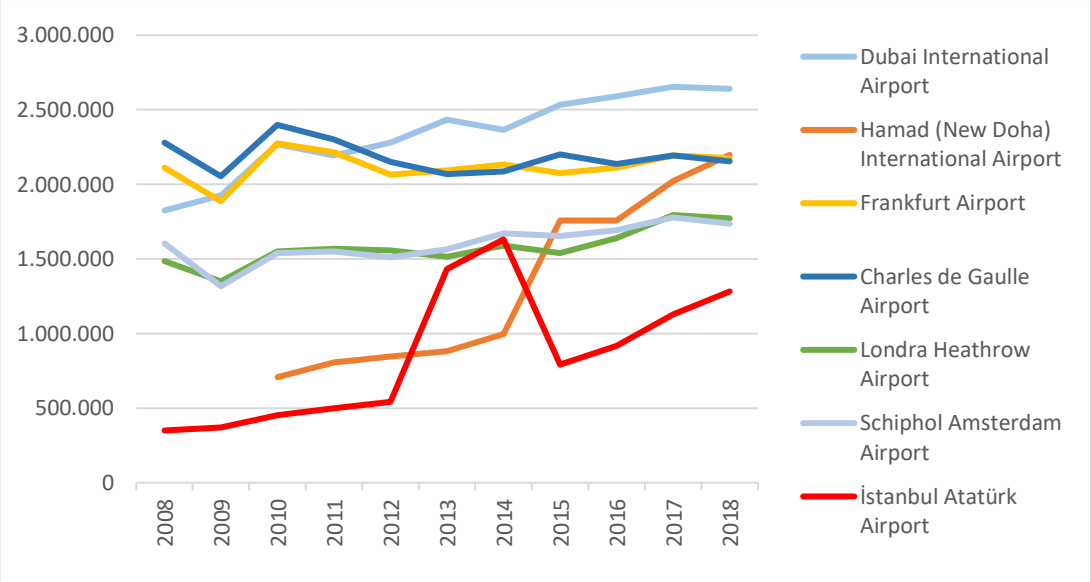


Figure 6.2. The air cargo traffic amount of Istanbul Airport and its potential competitors by years (Compiled from websites of airports)

As can be seen in the graph above, which shows the cargo traffic amount of Istanbul Airport and its potential competitors by years, Istanbul and Hamad airports have achieved a significant growth trend especially since 2015. In the 10-year period, Hamad Airport achieved a significant growth rate as 15.2% and Istanbul Airport achieved a growth rate as 13.9%. In this period, other potential competitors except Hamad Airport achieved a growth rate of 4% and less.

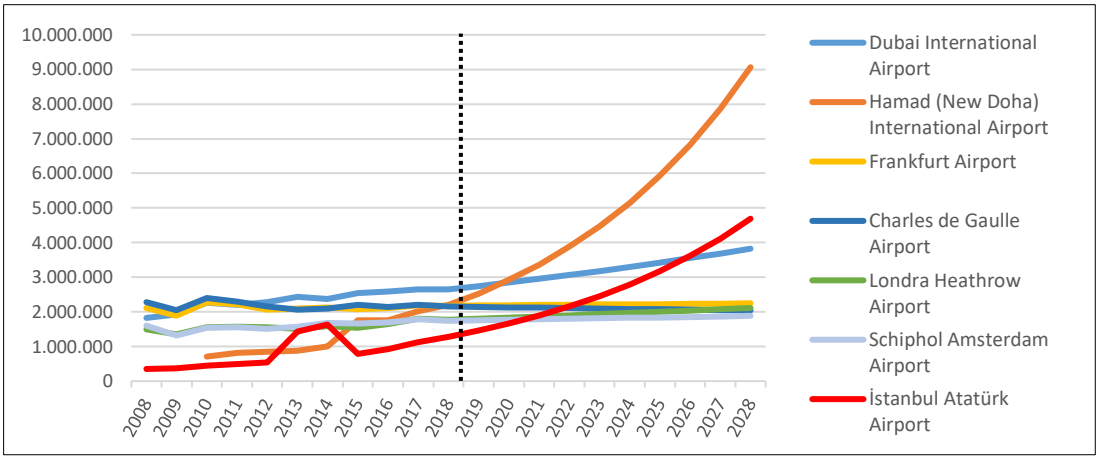


Figure 6.3. Trend Analysis of Istanbul Airport and its competitors

Trend analysis was performed using the data of the last 10 years of airports. In the trend analysis, the average annual growth rates of the airports in the last 10-year period are taken as fixed values. If the current trend continues in the next 10 years, it is thought that the trends shown in the above graph may be experienced at the airports. As can be seen from the graph above, it is foreseen that Istanbul Airport will surpass its potential competitors except Hamad Airport in terms of cargo traffic. If the airport trends shown in the chart are realized, the distribution of cargo traffic in the world in 2028 is expected to be as in the figure below.

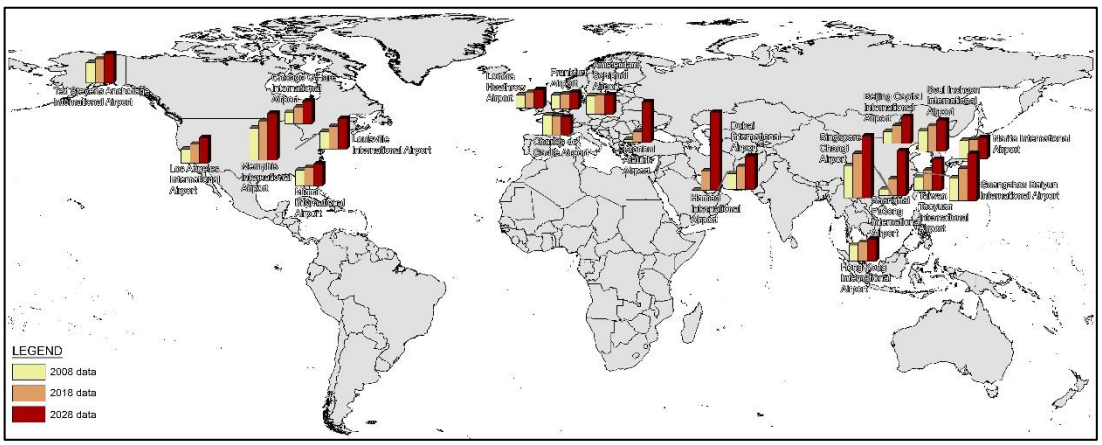


Figure 6.4. World Cargo Traffic Map Forecast for 2028

Another important parameter that will contribute to the airport becoming a transit point is connectivity opportunities. According to ACI, a well-connected airport has

positive externalities such as facilitating tourism and foreign direct investment (ACI, 2019). Evaluating in terms of cargo, it can be said that having good connectivity opportunities at airports will have a direct positive effect on air cargo transportation. Connectivity index studies made by ACI and OAG were used in order to examine the connectivity possibilities of airports.

In the Airport Industry Connection Report study conducted by ACI, world airports were examined with four different index studies, which are direct connection, indirect connection, airport connection and hub connection, and the results obtained from the index studies were evaluated. The index studies are summarized in the following table.

Table 6.3. *Explanations of ACI Index Studies (ACI, 2019)*

Index Name	**Explanations**
Direct Connectivity	These are the direct air services available from the airport – measured not just in terms of destinations, but also factoring in the frequency of flights to the same destination (so for example, an airport with 5 daily flights to another airport, will register a higher score than one with only 4).
Indirect Connectivity	This measures the number of places people can fly to, through a connecting flight at hub airports from a particular airport. For example, if you fly from Cork to a hub airport such as Amsterdam Schiphol, that's a direct flight from to A to B. But with the vast choice of onward destinations you can fly to from there – the large number of available onward connections from these airports expands the range of destinations available from the airport of origin. Indirect connections are weighted according to their quality, based on connecting time and detour involved with the indirect routing. For example, a flight from Manchester to Johannesburg via Paris-Charles de Gaulle will register a higher score than an alternative routing via Doha.
Airport Connectivity	This is the most comprehensive metric for airport connectivity – taking into account both direct and indirect connectivity from the airport in question. Airport connectivity is defined as the sum of direct and indirect connectivity – thus measuring the overall level to which an airport is connected to the rest of the World, either by direct flights or indirect connections via other airports.
Hub Connectivity	Hub connectivity is the key metric for any hub airport big or smaller. Essentially, it measures the number of connecting flights that can be facilitated by the hub airport in question – taking into account a minimum and maximum connecting time, and weighing the quality of the connections by the detour involved and connecting times.

The top 10 airports in Europe according to the results of the direct connectivity index study conducted by ACI are shown in the following table. According to the results, Istanbul airport has a lower direct connectivity index score than its potential competitors in terms of air cargo transportation such as Frankfurt, Amsterdam Schiphol, Charles de Gaulle and London airports on the European Continent. Although the results seem negative, it is also an important achievement that Istanbul Airport ranks 5th among all European airports. Due to the fact that this index is limited to the European Continent, the index study does not include Dubai and Hamad airports which are the other potential competitors of Istanbul in terms of cargo transportation.

Table 6.4. *Top 10 Airport in Europe according to ACI Direct Connectivity Index Study (ACI, 2019)*

Rank	**Airport Name**	**Country**	**Direct Connectivity Index Score**
1	Frankfurt Airport	Germany	5.098
2	Amsterdam Schiphol Airport	Netherlands	4.869
3	Charles de Gaulle Airport	France	4.759
4	London Heathrow Airport	United Kingdom	4.681
5	Istanbul Airport	Turkey	4.474
6	Munich Airport	Germany	4.051
7	Madrid Barajas International Airport	Spain	3.977
8	Sheremetyevo International Airport	Russia	3.740
9	Barcelona–El Prat Josep Tarradellas Airport	Spain	3.452
10	Leonardo da Vinci–Fiumicino Airport	Italy	3.289

The top 20 airports according to the results of the hub connectivity index study conducted by ACI are shown in the following table. Frankfurt, Dallas / Fort Worth and Amsterdam airports stand out with their high connectivity index score. Only Istanbul Airport entered the list from Turkey and it was ranked 6th in the list. It is an important achievement that Istanbul Airport ranks 6th in a list that include all world airports. Therefore, it can be said that Istanbul Airport is one of the world's leading airports in terms of connectivity.

Table 6.5. *Top 20 Airport according to ACI Hub Connectivity Index Study (ACI, 2019)*

Rank	Airport Name	Country	Hub Connectivity Index Score
1	Frankfurt Airport	Germany	78.773
2	Dallas/Fort Worth International Airport	U.S.A.	62.093
3	Amsterdam Schiphol Airport	Netherlands	58.263
4	Charles de Gaulle Airport	France	47.556
5	Hartsfield–Jackson Atlanta International Airport	U.S.A.	44.108
6	Istanbul Airport	Turkey	41.539
7	Denver International Airport	U.S.A.	38.807
8	Munich Airport	Germany	36.058
9	Chicago O'Hare International Airport	U.S.A.	34.656
10	London Heathrow Airport	United Kingdom	33.904
11	Toronto Pearson International Airport	Canada	33.544
12	Dubai International Airport	United Arab Emirates	28.387
13	Newark Liberty International Airport	U.S.A.	27.412
14	Charlotte Douglas International Airport	U.S.A.	25.145
15	Sheremetyevo International Airport	Russia	24.879
16	George Bush Intercontinental Airport	U.S.A.	23.366
17	Madrid Barajas International Airport	Spain	22.933
18	Hamad International Airport	Qatar	20.799
19	Zurich Airport	Switzerland	18.392
20	Shanghai Pudong Airport	China	17.743

The following table shows the ACI Connectivity Index Scores of Amsterdam, Frankfurt, Paris, London, Dubai and Hamad airports that are the important competitors of Istanbul Airport in terms of cargo traffic. Frankfurt, Amsterdam Schiphol and Charles de Gaulle airports achieved high scores in both index studies. Especially it can be said that these three airports are the most important competitors of Istanbul Airport in terms of connectivity opportunities. Istanbul Airport also scored high in both index studies. Istanbul Airport ranks 4th in the hub connectivity index study and 5th in the direct connectivity index study. It is very important that Istanbul Airport surpasses airports with high cargo traffic volumes such as London Heathrow, Dubai and Hamad in hub connectivity index.

Table 6.6. *According to ACI Connectivity index results of Istanbul Airport and potential rivals in terms of cargo transportation*

Rank	Airport Name	Country	Hub Connectivity Index Score	Direct Connectivity Index Score
1	Frankfurt Airport	Germany	78.773	5.098
2	Amsterdam Schiphol Airport	Netherlands	58.263	4.869
3	Charles de Gaulle Airport	France	47.556	4.759
4	Istanbul Airport	Turkey	41.539	4.474
5	London Heathrow Airport	United Kingdom	33.904	4.681
6	Dubai International Airport	United Arab Emirates	28.387	N/A
7	Hamad International Airport	Qatar	20.799	N/A

*Compiled from ACI index studies

In the connectivity index study conducted by OAG, the world airports were examined according to their methodology and the first 50 airports were identified. The methodology used by OAG can be summarized as; the total number of all possible connections between inbound and outbound international flights within a six-hour window at the world's largest 200 airports were calculated (OAG, 2018). According to OAG, the top 50 international megahubs are those airports with the highest ratio of possible scheduled international connections to the number of destinations served by the airport. The top 20 international megahubs that stand out in the results of the index study are shown in the table below. London Heathrow, Chicago O'Hare and Frankfurt airports stand out with their high connectivity index points. Only Istanbul Airport entered the list from Turkey and it was ranked 17th in the list.

Table 6.7. *Top 20 International Megahubs according to OAG (OAG, 2018)*

Rank	Airport Name	Country	Connectivity Index Score
1	London Heathrow Airport	United Kingdom	333
2	Chicago O'Hare International Airport	U.S.A.	306
3	Frankfurt Airport	Germany	302
4	Amsterdam Schiphol Airport	Netherlands	286
5	Toronto Pearson International Airport	Canada	271

Table 6.7. continued

6	Los Angeles International Airport	U.S.A.	257
7	Hartsfield–Jackson Atlanta International Airport	U.S.A.	256
8	Singapore Changi Airport	Singapore	253
9	Charles de Gaulle Airport	France	250
10	Jakarta Airport	Indonesia	249
11	Munich Airport	Germany	237
12	Kuala Lumpur International Airport	Malaysia	233
13	Hong Kong International Airport	Hong Kong	230
14	Suvarnabhumi Airport	Thailand	230
15	Seoul Incheon International Airport	South Korea	216
16	John F. Kennedy International Airport	U.S.A.	207
17	Istanbul Airport	Turkey	205
18	Dubai International Airport	United Arab Emirates	194
19	Miami International Airport	U.S.A.	192
20	Mexico City International Airport	Mexico	181

Table 6.8. *According to OAG Connectivity index results of Istanbul Airport and potential rivals in terms of cargo transportation (OAG, 2018)*

Rank	**Airport Name**	**Country**	**Connectivity Index Score**
1	London Heathrow Airport	United Kingdom	333
2	Frankfurt Airport	Germany	302
3	Amsterdam Schiphol Airport	Netherlands	286
4	Charles de Gaulle Airport	France	250
5	Istanbul Airport	Turkey	205
6	Dubai International Airport	United Arab Emirates	194
7	Hamad International Airport	Qatar	N/A

The table above shows the OAG Connectivity Index Scores of Amsterdam, Frankfurt, Paris, London and Dubai airports that are the important competitors of Istanbul Airport in terms of cargo traffic. Hamad Airport, which is one of the major competitors of Istanbul Airport, was not evaluated in the study by OAG. Istanbul Airport ranks 5th among the competitors in terms of OAG connectivity index point. According to the table, it can be said that London Heathrow Airport is the most important competitor of Istanbul Airport in terms of connectivity.

6.1. Potential Rivals of Istanbul Airport in Terms of Air Cargo Transportation

6.1.1. Amsterdam Schiphol Airport

Amsterdam Schiphol Airport is one of the biggest competitors of Istanbul Airport in terms of air cargo transportation thanks to its advanced cargo infrastructure. Amsterdam Schiphol Airport, the largest international airport in the Netherlands, is located on 2787 hectares area that 16 km from Amsterdam city center. Schiphol Airport and its environs are one of the most important areas of commercial activity in Amsterdam. It should be said that the airport, which has managed to become a global logistics center today thanks to its advanced infrastructure facilities, also directs the development of the city. The airport can be considered as a complex with areas that located on the perimeter of the airport such as offices, industrial areas, storage areas, lorry parks, transportation links. Particularly, location of the air cargo facilities in the vicinity of the airport and the multimodal transportation facilities of the airport significantly facilitate air cargo operations.

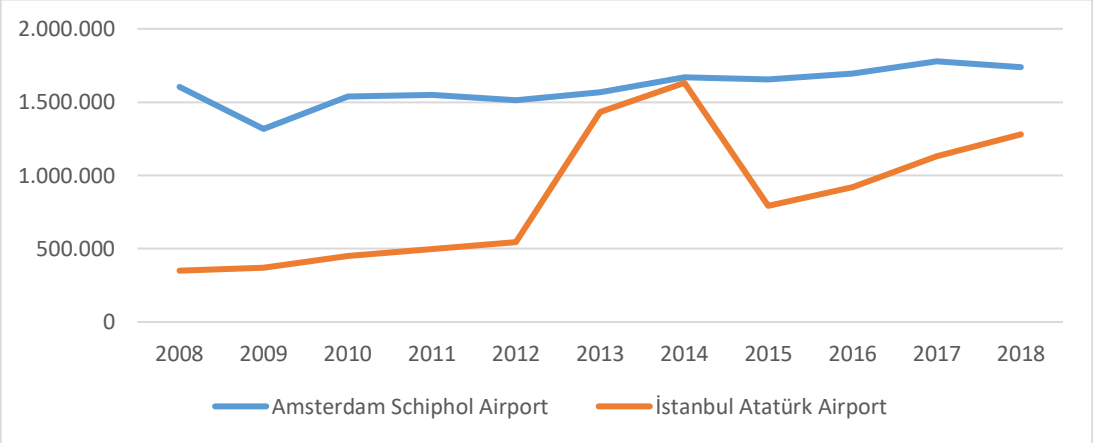


Figure 6.5. Amsterdam Schiphol and Istanbul Atatürk Airport Air Cargo Traffic by Years (Compiled from websites of airports)

As can be seen from the figure above, which shows the cargo traffic of Amsterdam Schiphol and Istanbul Atatürk airports over the years, Amsterdam Schiphol airport has an increasing trend over the years. According the ACI, Amsterdam Schiphol Airport ranked 20th with 1.737.984 tons in the world in terms of annual cargo traffic in 2018.

This airport achieved an average annual growth of 0.81% in cargo traffic between the years 2008-2018. It is also seen that Istanbul Atatürk Airport has close values to Amsterdam Schiphol Airport especially in recent years in terms of annual cargo traffic.

The air cargo volume at Schiphol comprises three 'flows'. The import flow consists of goods which come to Europe from the rest of the world via the Netherlands. The export flow consists of goods which come from the Netherlands or were produced there. The third flow consists of goods which are brought to the Netherlands from other European countries on lorries and leave the EU from there (Schiphol Airport, 2018a). Therefore, Schiphol Airport is also a global transfer point where the hub and spoke approach can be seen most prominently. Products imported from many parts of the world are processed in the facilities around the airport and exported to many parts of the world. Some opportunities of the airport have a significant contribution to making the airport a global hub.

One of the most important opportunity of Amsterdam Schiphol Airport is multi-modal transportation. Schiphol Airport with roadway, railway and seaway transportation links has intensive multimodal transportation activities. Especially the products arrived at the airport, which functions as a gateway of Europe, are transported by roadway to other European countries. Similarly, products coming from European countries with alternative transportation methods to air transportation can be transported by air via Schiphol airport to the outside the European region.

Another important opportunity of Amsterdam Schiphol Airport is the connectivity opportunities of the airport. Schiphol Airport has achieved the 2nd place in both ACI hub connectivity index study and ACI direct connectivity index study. Similarly, it also achieved 4th place in the connectivity index study conducted by OAG. Amsterdam Schiphol Airport now has direct connections to 327 airports in 98 countries. Schiphol's excellent network of destinations and flight frequencies encourages international companies to specifically choose the airport region as a base for their

European distribution centres. More than 50% of Asian and American companies with European distribution centres have chosen the Netherlands as their base (Schiphol Airport, 2018a). The fact that such large international companies choose locations at Schiphol airport directly contributes to the cargo operations at the airport.

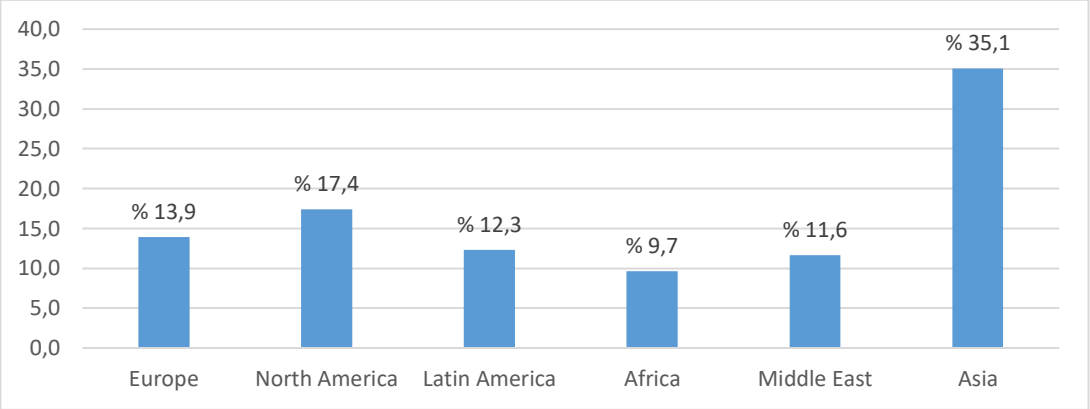


Figure 6.6. Amsterdam Schiphol Cargo Traffic Distribution by Continents,2018 *(Schiphol Airport, 2018b)*

As can be seen from the figure above, one of the most important markets of Schiphol Airport in terms of cargo transportation is Asia. Around 35% of all air cargo volumes travel to and from Asia in 2018. In particular increasing importance of e-commerce goods in recent years has contributed to the tremendous growth of cargo being transported to and from China (Schiphol Airport, 2018a). In addition, Schiphol had 499.444 air transport movements; 3.2% of these flights was carried out with a full-freighter aircraft in 2018. In these cargo aircraft 56% of all cargo to and from Schiphol is transported. The rest is transported in the 'belly' of passenger aircraft. Transporting freight by 'belly' has seen a strong increase in recent years in Schiphol (Schiphol Airport, 2018a).

Schiphol Airport specializes in perishable and urgent transport required product groups such as food products and beverages, agriculture and livestock and pharmaceutical product groups. Cut flowers are the main products transported at Schiphol Airport. About 28% of the total imports at Schiphol are flowers. Imported flowers, of which about 60% are imported from East Africa and South America, are

collected at Schiphol Airport. The flowers gathered in one destination depart again on the same day by air to destinations such as North America and Asia (Schiphol Airport, 2018a).

Schiphol has cargo warehouse space totaling 525.000 m^2, of which 60% has direct access to the cargo aprons. This makes Schiphol one of the few major airports in Europe that is able to continue offering more space to airlines, forwarders and logistics services providers. Examples include Schiphol Logistics Park across from Schiphol-Rijk and Schiphol Trade Park. In this way, Schiphol offers companies the space they need for future growth (Schiphol Airport, 2018a).

Figure 6.7. Amsterdam Schiphol Logistics Infrastructure Map (Amsterdamcarex.com, n.d.)

6.1.2. Frankfurt Airport

Frankfurt Airport is one of the biggest competitors of Istanbul Airport in terms of air cargo transportation thanks to its advanced cargo infrastructure. Frankfurt Airport, the largest international airport in the Germany, is located on 2300 hectares area that 12km from Frankfurt city center (Fraport, n.d.). Frankfurt is the one of the most important cities that host intensive commercial activities in Germany. Frankfurt is home to a powerful mix of industries: it ranks among the top three European financial centers, is a major location of the pharmaceutical and chemical industries, harbors corporate groups active in the international automotive sector, and leads in robotics and automation. Therefore it can be said that Frankfurt Airport connects the economic and logistic powerhouse of Germany with the world (Fraport, n.d.).

Today, Frankfurt Airport is regarded as one of the most important global logistics centers in terms of cargo transportation thanks to its advanced infrastructure facilities. Especially, presence of the advanced air cargo facilities and the multimodal transportation opportunities at the airport significantly facilitate air cargo operations.

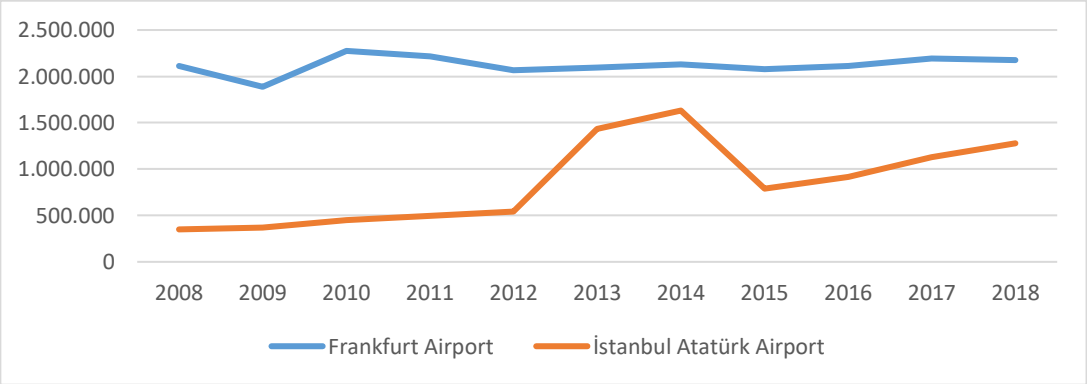


Figure 6.8. Frankfurt and Istanbul Atatürk Airport Air Cargo Traffic by Years (Compiled from websites of airports)

As can be seen from the figure above, which shows the cargo traffic of Frankfurt and Istanbul Atatürk airports over the years, Frankfurt Airport has an increasing trend over the years. According the ACI, Frankfurt Airport ranked 13th with 2.176.387 tons in the world in terms of annual cargo traffic in 2018. This airport achieved an average

annual growth of %0,31 in cargo traffic between the years 2008-2018. In addition, 63% of the airfreight is carried by dedicated cargo planes; 37% travels as belly freight in passenger aircraft (Fraport, n.d.). It is also seen that Istanbul Atatürk Airport has close values to Frankfurt Airport especially in recent years in terms of annual cargo traffic.

One of the most important opportunity of Frankfurt Airport is multi-modal transportation. Frankfurt Airport with roadway and railway transportation links has intensive multimodal transport activities. Frankfurt Airport can be reached in only 18 hours from all European countries by truck and is located right at the busiest highway intersection in Europe, thus optimally linking air and road travel in a way(Fraport, n.d.).

Another important opportunity of Frankfurt Airport is the connectivity opportunities of the airport. Frankfurt Airport has achieved the 1st place in both ACI hub connectivity index study and ACI direct connectivity index study (ACI, 2019). Similarly, it also achieved 3rd place in the connectivity index study conducted by OAG (OAG, 2018). Frankfurt Airport now has direct connections to 360 airports in 111 countries.

There are many international cargo companies that located at the airport thanks to connectivity opportunities of airport. The top global forwarders have settled at Frankfurt Airport Cargo City to benefit from the location of the airport in the heart of Europe. Also The airlines benefit from the high density of forwarders located at airport. Airlines companies also benefit from the high density of forwarders located at the airport (Fraport, n.d.).

The airport has the expertise to carry both durable and non-durable product groups. One of the largest perishables center, modern animal station and storage facilities for dangerous and valuable goods are available at the airport. Perishables goods, live animals, valuable and vulnerable cargo, dangerous goods and e-commerce shipments are the main products carried at the airport (Fraport, n.d.).

There are two area where cargo operations are carried out at the airport named as CargoCity North and CargoCity South. The airport has a 1.490.000 m² area for cargo facilities and there is also 270.000 m² for further development area at CargoCity South area where all facilities are in the immediate vicinity of apron access. In addition, there are also truck parking facilities, customs and further air cargo services in CargoCity South. More than 200 cargo companies, including Kühne & Nagel, DHL Global Forwarders, Panalpina and Nippon Express, are located in these cargo areas. Approximately 12.000 people work in these cargo areas (Fraport, 2017).

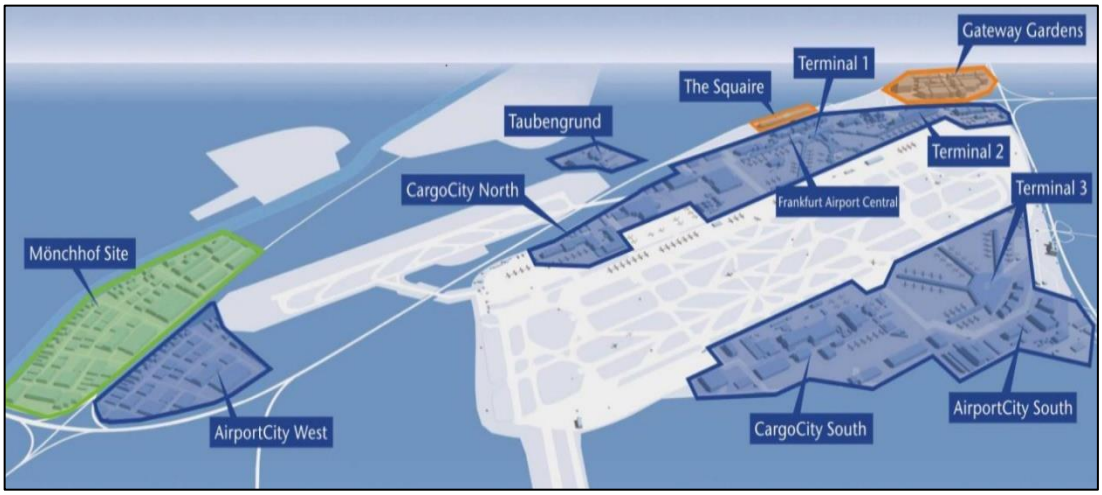


Figure 6.9. Frankfurt Airport Map (Fraport, 2017)

6.1.3. Paris Charles de Gaulle Airport

Paris Charles de Gaulle Airport is also one of the biggest potential rivals of Istanbul Airport in terms of air cargo transportation. Paris Charles de Gaulle Airport, the largest international airport in the France, is located on 3238 hectares area that 25 km from Paris city center. The airport is operated by Groupe ADP under the brand Paris Aéroport (Paris CDG Airport, n.d.-a).

Today, Paris Charles de Gaulle Airport is regarded as one of the most important global logistics centers in terms of cargo transportation thanks to its advanced infrastructure facilities. At the heart of Paris-Charles de Gaulle, “Cargo City” has an annual cargo handling capacity of 3.6 million tonnes. The airport has valuable opportunities for air

cargo transportation such as ability to perform 24/7 operations, 3 million m² area dedicated to cargo activities and a layout plan that enables the high-speed transfer of goods between the public and restricted areas. Paris-CDG has also a total of 79 aircraft parking stands devoted to cargo alone (Paris CDG Airport, n.d.-b). Especially, presence of the advanced air cargo facilities and the multimodal transportation opportunities at the airport significantly facilitate air cargo operations.

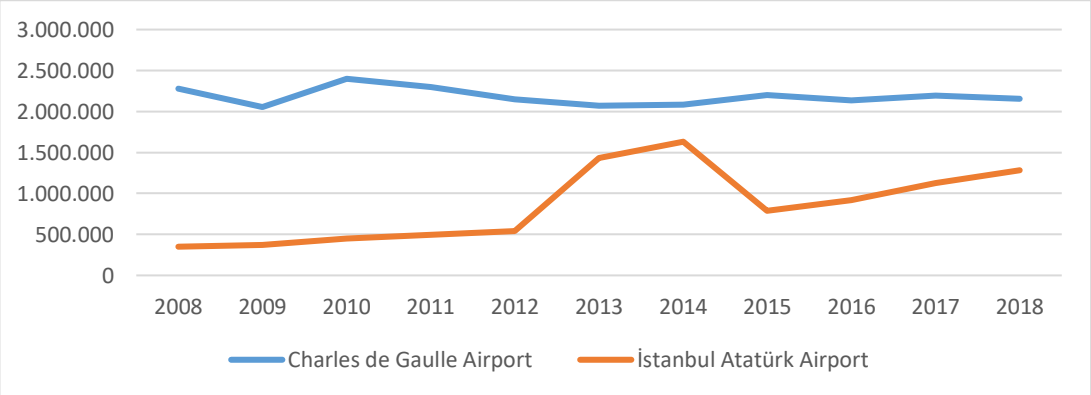


Figure 6.10. Paris-CDG and Istanbul Atatürk Airport Air Cargo Traffic by Years (Compiled from websites of airports)

As can be seen from the figure above, which shows the cargo traffic of Paris Charles de Gaulle and Istanbul Atatürk airports over the years, Paris-CDG Airport has an increasing trend over the years. According the ACI, Charles de Gaulle Airport ranked 14th with 2.156.327 tons in the world in terms of annual cargo traffic in 2018. This airport achieved an average annual growth of -0,56% in cargo traffic between the years 2008-2018. It is also seen that Istanbul Atatürk Airport has close values to Paris-CDG Airport especially in recent years in terms of annual cargo traffic.

One of the most important opportunity of Charles de Gaulle Airport is multi-modal transportation. Charles de Gaulle Airport with roadway and railway transportation links has intensive multimodal transport activities. The airport is located at the crossroads of European trade and at the heart of the continent's market (Paris CDG Airport, n.d.-b). The airport can be seen as an international gateway of Europe due to its proximity to major European cities.

Another important opportunity of the airport is the connectivity opportunities of the airport. Charles de Gaulle Airport is ranked 4th in ACI hub connectivity index study and 3rd in ACI direct connectivity index study (ACI, 2019). Similarly, it also achieved 9th place in the connectivity index study conducted by OAG (OAG, 2018). Charles de Gaulle Airport has a strategic location with a catchment area of 25 million residents within a 200 km radius. The airport is a 2-hour flight distance away from European capitals and major cities. Charles de Gaulle Airport now has direct connections to 329 airports. There are many international cargo companies that located at the airport thanks to connectivity opportunities of airport. The top global forwarders including FedEx have settled at Charles de Gaulle Airport to benefit from the opportunities of the airport. FedEx which has established its European hub at Paris-CDG and expects to see its capacity increase by 40% by 2020 (Paris CDG Airport, n.d.-b).

The airport has the expertise to carry both durable and non-durable product groups. The airport specializes in the transport of luxury goods, perishable goods, e-commerce and pharmaceutical products. 15.000 m^2 of temperature-controlled spaces for pharmaceutical products, one of the largest areas for perishables, modern storage facilities are available at the airport (Paris CDG Airport, n.d.-b).

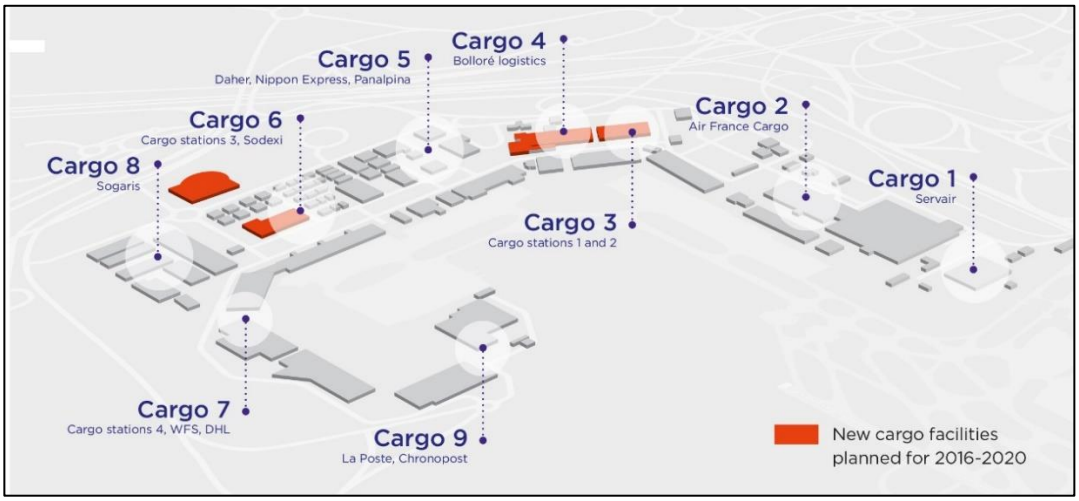


Figure 6.11. Charles de Gaulle Airport Cargo Map (Paris CDG Airport, 2019)

6.1.4. London Heathrow Airport

It can be said that London Heathrow Airport is another one of the biggest potential rivals of Istanbul Airport in terms of air cargo transportation. London Heathrow Airport, the largest international airport in the United Kingdom, is located on 1227 hectares area that 23 km from London city center. The airport is operated by Heathrow Airport Holdings. Today, London Heathrow Airport is regarded as one of the most important global logistics centers in terms of cargo transportation thanks to its advanced infrastructure facilities. Especially, presence of diversified air cargo facilities and the multimodal transportation opportunities at the airport significantly facilitate air cargo operations.

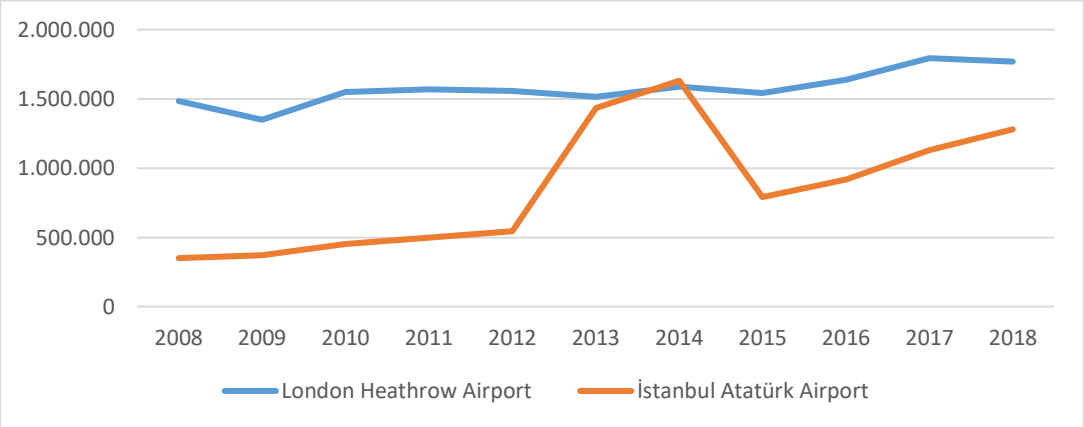


Figure 6.12. London Heathrow and Istanbul Atatürk Airport Air Cargo Traffic by Years (Compiled from websites of airports)

As can be seen from the figure above, which shows the cargo traffic of London Heathrow and Istanbul Atatürk airports over the years, London Heathrow Airport has an increasing trend over the years. According the ACI, London Heathrow Airport ranked 19th with 1.771.342 tons in the world in terms of annual cargo traffic in 2018. This airport achieved an average annual growth of 1,77% in cargo traffic between the years 2008-2018. In addition, 6% of the airfreight is carried by dedicated cargo planes; 94% travels as belly freight in passenger aircraft. It is also seen that Istanbul Atatürk Airport has close values to London Heathrow Airport especially in recent years in terms of annual cargo traffic.

One of the most important opportunity of London Heathrow Airport is multi-modal transportation. London Heathrow with roadway and railway transportation links has intensive multimodal transport activities. London Heathrow can be seen as a gateway of Europe thanks to the advantage that the airport is located in a productive city like London.

Another important opportunity of the airport is the connectivity opportunities of the airport. London Heathrow Airport is ranked 10th in ACI hub connectivity index study and 4th in ACI direct connectivity index study (ACI, 2019). Similarly, it also achieved 1st place in the connectivity index study conducted by OAG (OAG, 2018). London Heathrow Airport now has direct connections to 185 airports in 84 countries. It also attracts attention due to having more than 80 long-haul transportation links. One of the major goals of the airport is to develop long-haul transport activities (Heathrow Airport Limited, 2014).

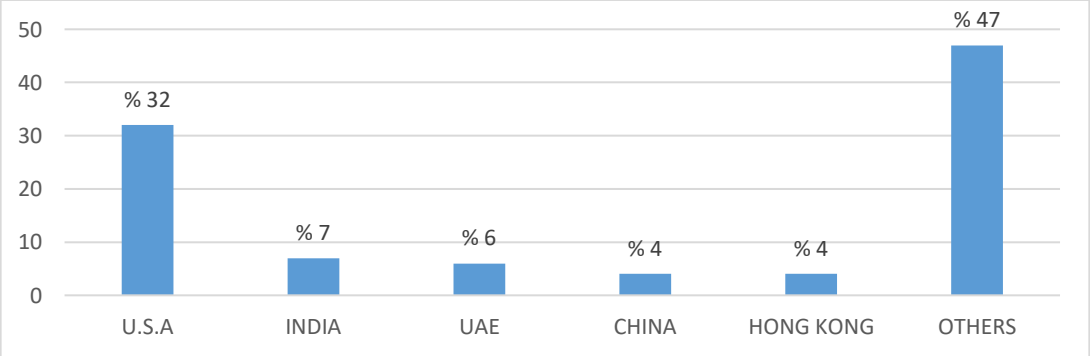


Figure 6.13. London Heathrow Cargo Trade Value Distribution by Countries,2017 (London Heatrow Airport, n.d.-a)

As can be seen from the figure above, one of most important cargo markets of London Heathrow Airport is U.S.A. Around 32% of all air cargo trade volumes travel to and from U.S.A in 2017. It can also be said that Asian countries have a big percentage in Heathrow's cargo trade movements. The airport has the expertise to carry both durable and non-durable product groups. Aircraft engines and parts, machinery parts, precious metals and jewelry, paintings and antiques and pharmaceutical product groups are the main products carried at the airport (London Heatrow Airport, n.d.-a).

According to the evaluations made by the airport operator, the airport is becoming insufficient in terms of capacity and therefore it is lagging behind its major competitors who have managed to become a hub for international transportation. Although there are efforts to expand the airport, the expansion process continues slowly due to environmental concerns over air transport throughout the country. In spite of these, cargo infrastructure works are continuing. It is aimed to increase the cargo capacity to 3 million tons by 2040 with the effect of the starting in operation of the runway 3 that is planned to construct (London Heatrow Airport, n.d.-b).

Figure 6.14. London Heathrow Airport Plan *(spotterguide.net, n.d.)*

6.1.5. Dubai International Airport

Dubai International Airport is also one of the biggest potential rivals of Istanbul Airport in terms of air cargo transportation. Significant improvements have been experienced in aviation activities especially in recent years in the Middle East region that also include Dubai International Airport. Dubai International Airport, the largest

international airport in the United Arab Emirates, is located on 1250 hectares area that 5 km from Dubai city center. The airport is operated by Dubai Airports Company.

Oil-poor Dubai has spent years trying to diversify its economy with core sectors including trade, transport and tourism unlike other cities whose main source of income is oil. Therefore, Dubai International Airport is an important contributor to the Dubai economy, as it employs approximately 90,000 people, indirectly supports over 400,000 jobs and contributes over $26.7 billion to the economy, which represents around 27 per cent of Dubai's GDP and 21% of the employment in Dubai. It is predicted that by 2020, the economic contribution of Dubai's aviation sector will rise to 37.5% of the city's GDP and by 2030, the economic impact of aviation is projected to grow to $88.1 billion and support 1.95 million jobs in Dubai or 44.7% of the GDP and 35.1% of the total employment (Oxford Economics, 2014).

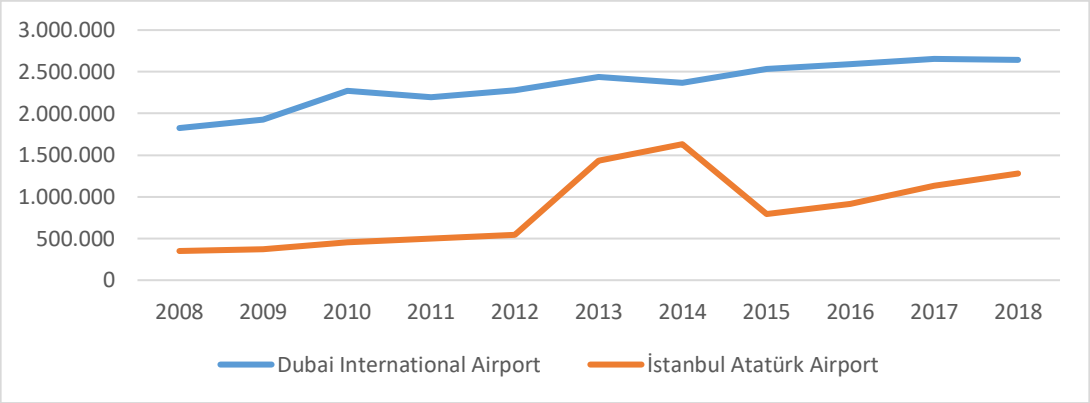


Figure 6.15. Dubai International and Istanbul Atatürk Airport Air Cargo Traffic by Years (Compiled from websites of airports)

As can be seen from the figure above, which shows the cargo traffic of Dubai International and Istanbul Atatürk airports over the years, Dubai International Airport has an increasing trend over the years According the ACI, Dubai International Airport ranked 6th with 2.641.383 tons in the world in terms of annual cargo traffic in 2018. This airport achieved an average annual growth of 3,77% in cargo traffic between the years 2008-2018. It is also seen that Istanbul Atatürk Airport has close values to Dubai International Airport especially in recent years in terms of annual cargo traffic.

One of the most important opportunity of Dubai International Airport is multi-modal transportation. Dubai International Airport has multimodal transport activities thanks to the airport's road connections and proximity to the port. Multi-modal transport activities can be carried out using these alternative transport links. Another important opportunity of the airport is the connectivity opportunities of the airport. Dubai International Airport is ranked 12th in ACI hub connectivity index study (ACI, 2019). Similarly, it also achieved 18th place in the connectivity index study conducted by OAG (OAG, 2018). The airport now has direct connections to more than 220 airports in 94 countries (Dubai Airports, n.d.).

Dubai International Airport has a 35.000 m² cargo facility and it has the capacity to handle 3.1 million tonnes of cargo per year. The airport has the expertise to carry both durable and non-durable product groups. Valuable goods, perishables, plants, animals, e-commerce and pharmaceutical product groups are the main products carried at the airport (Dubai Airports, n.d.). Some opportunities such as ability to carry out 7-24 cargo operations, presence of free zone and large storage areas at the airport significantly facilitate air cargo operations. The airport has more than 200 freight forwarders thanks to the advanced cargo infrastructure of the airport (Dubai Airport, 2011).

Figure 6.16. Satellite Image of Dubai International Airport (*This figure is created by the author through using Google Map)*

6.1.6. Hamad International Airport

Hamad International Airport is also one of the biggest potential rivals of Istanbul Airport in terms of air cargo transportation. Significant improvements have been experienced in aviation activities especially in recent years in the Middle East region that also include Hamad International Airport. Hamad International Airport, the largest international airport in the Qatar, is located on 2200 hectares area that 14 km from Doha city center. The airport is operated by Qatar Airways. Today, Hamad International Airport is regarded as one of the most important global logistics centers in terms of cargo transportation thanks to its infrastructure facilities. Especially, presence of the advanced air cargo facilities and the multimodal transportation opportunities at the airport significantly facilitate air cargo operations.

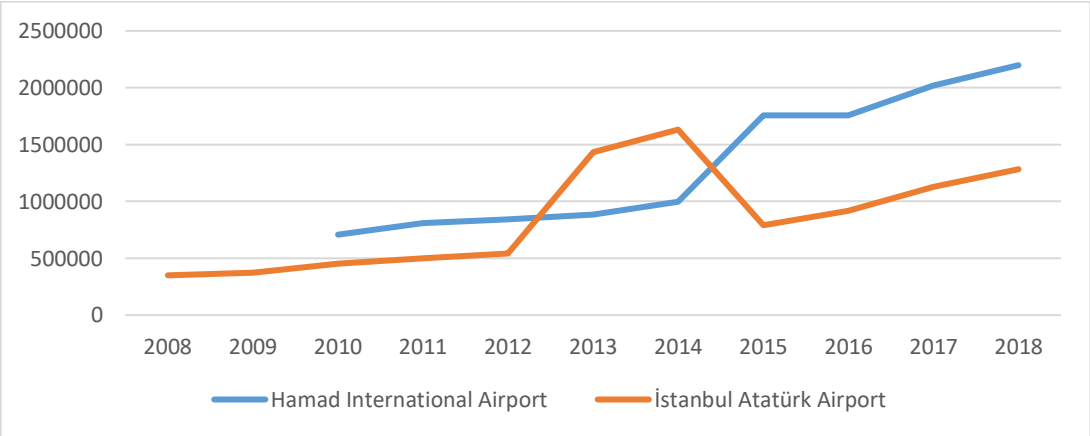


Figure 6.17. Hamad International and Istanbul Atatürk Airport Air Cargo Traffic by Years (Compiled from websites of airports)

As can be seen from the figure above, which shows the cargo traffic of Hamad International and Istanbul Atatürk airports over the years, Hamad International Airport has an increasing trend over the years. It has also passed Istanbul Atatürk Airport in terms of annual cargo traffic through the acceleration it has gained since 2014. According the ACI, Hamad International Airport ranked 11th with 2.198.308 tons in the world in terms of annual cargo traffic in 2018. This airport achieved an average annual growth of 15,2% in cargo traffic between the years 2010-2018.

One of the most important opportunity of Hamad International Airport is multi-modal transportation. Hamad International Airport has multimodal transport activities thanks to the airport's road connections and proximity to the port. Multi-modal transport activities can be carried out using these alternative transport links. Specialized temperature controlled vehicles are used extensively for multi-modal transportation. Sensitive commodities are collected from and delivered directly to the aircraft by specialized temperature controlled vehicles, in an effort to ensure the cool chain process is seamless, thereby eliminating risk to temperature exposure (HIA, 2019). The connection between the port and the airport is also realized through these vehicles. Another important opportunity of the airport is the connectivity opportunities of the airport. Hamad International Airport is ranked 18th in ACI hub connectivity index study (ACI, 2019).

Hamad International Airport has a full capacity for processing 2.5 million tonnes of cargo per year. It has an area of 292.000m^2 for cargo complex area. There is a two-floor cargo terminal incorporates warehouse spaces, automated systems / retrieval systems mezzanine, offices and shops. The split-level terminal has over than 55.000m^2, boasting 11 widebody aircraft stands and 42 loading docks. Additionally, there are 32 landside truck-loading facilities enabling the swift and efficient transfer of cargo in and out of Qatar. The airport with advanced scanning technology ensuring the complete safety and security of the facility, its staff and cargo (Hamad International Airport, n.d.).

Hamad International Airport has also dedicated and specially equipped live animal centre, dangerous goods area and a perishable storage areas (Hamad International Airport, 2014). Especially there is an advanced infrastructure for the transportation of live animals. The live animal centre has over 4.300m^2 and provide temporary accommodation and inspection of live large and small animals, such as horses, camels, dogs, cats, fish and fowl. The facility includes veterinary inspections, a paddock for horses to exercise and much more. The centre provides the animals with a stress-free

journey where they are able to rest and relax before and after the flight, under specialist supervision (HIA, 2019).

Figure 6.18. Satellite Image of Hamad International Airport (*This figure is created by the author through using Google Map)*

6.2. The Comparison of the Istanbul Airport and its Potential Rivals

In a summary manner; In order for Istanbul Airport to become a significant transit point in terms of global air logistics, it needs to be compete with Dubai International, Hamad International, Frankfurt, Charles de Gaulle, London Heathrow and Amsterdam Schiphol airports which are prominent in terms of cargo transportation. Becoming a significant transit point for global air logistics is one of the most important factors that will contribute to the goals of both Istanbul Airport and potential competing airports to become a global logistics hub. It is useful to compare the key features that will enable to reach these goals of both Istanbul Airport and its potential rivals. Hence, the key features of competing airports in terms of cargo transportation were determined and these features were compared with Istanbul Airport's features that will planned to built.

Table 6.9. *Summary Table of Istanbul Airport's Rivals in terms of Cargo Transportation*

	Dubai	**Hamad**	**Frankfurt**	**Charles de Gaulle**	**London Heathrow**	**Schiphol**
S1	3.100.000	2.500.000	N/A	3.600.000	3.000.000	N/A
S2	35.000	55.000	N/A	N/A	N/A	525.000
S3	2.641.383	2.198.308	2.176.387	2.156.327	1.771.342	1.737.984
S4	6^{th}	11^{th}	13^{th}	14^{th}	19^{th}	20^{th}
S5	3,77%	15,22%	0,31%	-0,56%	1,77%	0,81%
S6	12th	18th	1st	4th	10th	2th
S7	Yes	N/A	N/A	N/A	N/A	N/A
S8	Yes	Yes	Yes	Yes	Yes	Yes
S9	Yes	Yes	Yes	Yes	Yes	Yes
S10	Yes	Yes	N/A	Yes	No	N/A
S11	Yes	Yes	Yes	Yes	Yes	Yes
S12	No	No	Yes	Yes	No	Yes
S13	Yes	Yes	No	No	No	Yes
S14	Roadway + Seaway	Roadway + Seaway	Roadway + Railway	Roadway + Railway	Roadway	Roadway + Railway + Seaway

Table 6.10. *Explanations of Summary Table Abbreviations*

Abbreviations	**Explanations**
S1	Annual Cargo Handling Capacity (tonnes)
S2	Cargo Terminal Area (m^2)
S3	Annual cargo traffic in 2018 (tonnes)
S4	ACI World Cargo Ranking Position
S5	Average Annual Growth rate of last ten years
S6	ACI Hub Connectivity Ranking Position
S7	Integration with Free Zone
S8	Various infrastructure possibilities by product groups
S9	Cold Chain Transportation Possibilities
S10	7/24 Cargo Operation Capability
S11	Accessibility to the cargo terminal of cargo vehicles such as trucks
S12	Possibility of railway connection that can carry cargo
S13	Integration with seaway transportation
S14	Possibility of Multimodal Transportation

As can be seen from the tables above, which show the key features of Istanbul Airport's potential rivals, annual cargo capacity of rivals is between 2.500.000 - 3.600.000 tonnes. Schiphol airport stands out with its 525.000 m^2 cargo terminal area.

According to 2018 data, the annual cargo traffic of all potential competing airports is higher than Istanbul Atatürk Airport. Dubai Airport has achieved 6th place in the ACI World Cargo Traffic Ranking, in which Istanbul Atatürk Airport cannot even get into the top 20, thanks to its annual cargo traffic.

Considering in terms of average annual growth rates, Istanbul Atatürk Airport has the highest growth rate with a growth rate of 13.86% after Hamad International Airport that has a growth rate of 15.22%. Frankfurt and Schiphol airports stand out in the Hub Connectivity index by ACI due to their high connectivity opportunities. Dubai International Airport, one of the main competitors, has a free zone like Istanbul Atatürk Airport. There is insufficient information on whether other competing airports have integration with free zones. All competing airports have diversified infrastructure facilities for the transportation of various product groups. Therefore, it can be said that all competing airports have the expertise to carry both durable and non-durable product groups.

There are important opportunities at all airports for transportation of cold chain product groups, which constitute the main demand for air transportation. The ability to operate a 24/7 cargo operation, which is not available in London Heathrow Airport due to environmental concerns, is available at other competing airports. Cargo vehicles such as lorries have access to the cargo terminal at all airports. Frankfurt, Schiphol and Charles de Gaulle airports have railway links that can carry cargo. Dubai, Hamad and Schiphol airports are integrated with seaway transportation. Considering in terms of multi modal transportation, Schiphol Airport is the most convenient airport for multi-modal transportation among competitors thanks to having connections to all modes of transportation.

Today, a significant portion of Istanbul's air cargo operations take place at Istanbul Atatürk Airport. Cargo operations will continue take place from Istanbul Atatürk Airport until the cargo operations start at Istanbul Airport. Cargo operations at Istanbul Atatürk Airport will be stopped after moving cargo operations to Istanbul Airport.

Therefore, the cargo data of Istanbul Atatürk Airport was used as a base for Istanbul Airport through assuming cargo activities will continue in the same way. The commencement date of cargo operations at Istanbul Airport, which is operational in terms of passengers, is also unclear.

Comparison of the Istanbul Airport and its rivals could not be made completely due to limited access to project details of Istanbul Airport. According to the information obtained, the annual cargo capacity of Istanbul airport is planned to be 2.500.000 million tons in the first stage and will reach 5.500.000 million tons when the stages are completed. 1.6 million m^2 area is reserved for cargo facilities (IGA, n.d.). It is stated that there will be infrastructure facilities in this area that will allow the transportation of various product groups. It is planned that there will be operational capability to use temperature controlled special trucks especially for the transportation of cold chain product group (Turkish Cargo, n.d.). In addition, many leading freight forwarders in the world have already requested to rent space at Istanbul Airport (Emlak Kulisi, n.d.) and the facilities to be built are expected to host many freight forwarders thanks to the strategic location and connectivity opportunities of Istanbul.

It is stated that there will be important infrastructures for multi-modal transportation at Istanbul Airport and the connections planned to be made by alternative transportation methods will be completed in stages. In the first stage, it is planned to provide access to the cargo terminal of cargo vehicles such as lorries, and to integrate the airport with railway and seaway when the stages are completed (Turkish Cargo, n.d.). Therefore, it can be said that Istanbul Airport will play an important role in global trade and has a high potential to become a significant transit point thanks to having important features such as integration with all modes of transport, advanced infrastructure facilities for transportation of all types of products and being the most important airport of the province in terms of cargo transportation.

Istanbul Atatürk airport's annual cargo traffic trend analysis results and high rankings in the connectivity analyzes conducted by ACI and OAG are also important

parameters indicating that this potential exists. It is possible that there will be significant leaps in air cargo transportation in Istanbul due to the fact that cargo operations will be moved to Istanbul Airport, which will have advanced infrastructure for cargo transportation, instead of Istanbul Atatürk Airport.

Figure 6.19. Satellite Image of Istanbul Airport (*This figure is created by the author through using Google Map)*

CHAPTER 7

POSSIBLE DEVELOPMENT SCENARIOS FOR AIR CARGO TRANSPORTATION IN TURKEY

A scenario study was conducted to develop possible cargo development scenarios in future. Within the scope of the scenario study, the Systems and Development Planning of Turkish Airports Project by YTM-MATPUM was analyzed and data of the focus group meetings held as part of the project were evaluated from an air cargo perspective. Accordingly, 4 possible scenarios for air cargo transportation were produced. In this section, brief information is given about the long-term study carried out within the scope of this project and 4 possible cargo development scenarios produced by the author using the obtained results from focus group meetings of the project are described in detail.

7.1. Analysing the Systems and Development Planning of Turkish Airports Project

A long term forecast study was conducted by YTM-MATPUM to determine how air transport will be shaped in the 20-year period in Turkey and the World. Within the scope of long-term estimation study, a method that blends both quantitative and qualitative data and analyzes has been adopted. Participation was adopted throughout the study and all stages were completed with the contributions of experts who are closely related to the sector.

Table 7.1. *5 Stages and its basic explanations of the Project (YTM-MATPUM)*

Stages	Explanations
Determination of Priorities	Priorities that will be used in determining trends and creating scenarios have been identified and weighted. Within the scope of the workshop, priorities to be used in air transportation planning were determined.
Determination of External Trends	Social, technological, economic, environmental, political trends and events that may affect the world aviation sector within the next 20 years are identified within the scope of the Workshop.
Creating a Matrix of Meaningful Variables	Using the "Analytical Hierarchy Process" which is one of the Multi Criteria Decision Making Methods, it is determined how important the external tendencies determined in Phase 2 in terms of the priorities determined in Phase 1.
Creating Scenarios	As a result of the studies to be carried out, the variables with high uncertainty and significance were determined and scenarios were created on the axes established within the framework of these studies.
Selecting the Best Forecast Scenario	The scenarios produced were voted by the participants and the best forecast scenario was determined according to the results obtained.

Focus group meetings were conducted in the project with the participation of sector experts. First, a workshop with 84 participants from the aviation sector was held on 15 January 2018 at Ankara Esenboğa Airport. This workshop was conducted in three stages: determination of priorities, determination of variables and creating a matrix of meaningful variables. Turkey's 25 targets for aviation sector has been compiled by examining the national strategic reports by the project team prior to the workshop. The compiled targets are shown in the table below.

Table 7.2. *Turkey's 25 targets for aviation sector (Priorities) (YTM-MATPUM)*

1	Development of regional air transport
2	Increasing international flights from Anatolian airports
3	Development of Border Airports
4	Ensuring Istanbul new airport being an important global hub in world aviation
5	Ensuring a competitive environment between airlines
6	Improvement of Seasonal Tourism Airport
7	Becoming a regional base in Maintenance-Repair-Renovation services
8	Development of seaplane transportation

Table 7.2. continued

9	Improvement of air taxi activities
10	Increasing general aviation activities
11	Improving the Property of a Global Tourism Airport
12	Becoming a regional hub in the field of aviation education
13	Increasing environmentally friendly design and applications
14	Ensuring energy efficiency
15	Integration with other modes of transport
16	Improvement of ground services
17	Development of technological services
18	Categorization of airspace
19	Development of cargo transportation
20	Development of satellite based systems
21	Facilitating of customs procedures
22	Improving the System Integration of IT infrastructures
23	Turning airports into attractions / trade centers
24	Development of helicopter transport and heliports
25	Giving importance to planning and improving coordination

In the determination of priorities stage of the workshop, choosing of the 5 most important priorities from the priority list which consist of Turkey's 25 objectives for aviation sector has been requested from participants. Top 10 most important priorities were determined by gathering the voting results of 84 participants and the determined priorities were weighted according to the votes of the participants. Top 10 most important priorities and its weights according to voting results are shown in the following table.

Table 7.3. *Top 10 most important priorities and its weights according to voting results (YTM-MATPUM)*

Place	**Priorities**
1	Integration with other modes of transport
2	Development of regional air transport
3	Increasing general aviation activities
4	Ensuring Istanbul new airport being an important global hub in world aviation
5	Increasing international flights from Anatolian airports
6	Development of cargo transportation
7	Improvement of Seasonal Tourism Airport
8	Improving the Property of a Global Tourism Airport
9	Development of Border Airports
10	Ensuring energy efficiency

According to the results, the target of development of cargo transportation has achieved high score and ranked 6th in the ranking. Considering this result in terms of cargo transportation, aviation experts in focus groups also pay great attention to the development of cargo transportation similarly to Turkey's strategic reports.

In the determination of external trends stage of the workshop, social, technological, economic, environmental and political trends and events that have the potential / risk to occur in the next 20 years and which may affect the world aviation sector were identified. In the workshop, all participants added the non-listed trends / events that they deemed important to the list of trends which identified by YTM-MATPUM through literature review and expert opinion and explained the possible effects of these added trends on the air transport sector. 41 external trends (variables) that might affect the aviation sector identified within the scope of the study are shown in the table below.

Table 7.4. *41 variables that might affect the aviation sector in future (YTM-MATPUM)*

Becoming widespread of the travelling oriented lifestyle
Emergence of new tourism regions and areas
Increase in business travels
Growth of global trade and service sector
Increase in GDP per capita
Increase in fuel prices
Rapid development of market shares of low-cost airlines (LCC)
Development of information technologies
Development of comfortable and cheap alternative transportation technologies such as high speed train
Increase in air transportation liberalization
New developments in EU-Turkey relations
Emergence of aviation mega cities
Increased security threats and extended processing times accordingly
Development of free trade agreements
Increase in middle class population
Increased political tensions in nearby geography and image problems
Development of e-commerce (for air-cargo)
Increased global political tensions
Emergence of new airport business models
Reduction of flight safety problems
New developments affecting aerospace technology
Increased security costs

Table 7.4. continued

Establishment of new airline alliances
Use of alternative fuels
Starting low-cost airlines (LCC) to make long-haul flights
Development of environmentally friendly alternative transportation technologies
Natural disasters
Aging population
Decrease in global resources
Increased migration rates
Increased new restrictions to reduce emission levels
Increased flexibility in global production
Shift of global economic center to Southeast Asia
Development of long-haul aircraft technologies
Reduction of operational time via robotics and automation technologies
Increased epidemic diseases
Adoption of lifestyle towards environmental awareness
Reduction in aircraft noise limits
Becoming widespread of video-conferencing
Development of 3D printer technologies (for air-cargo)
The rapid growth of the African population

In the creating a matrix of meaningful variables stage of the workshop, the importance of the external tendencies identified in stage 2 in terms of the priorities identified in stage 1 was determined using the Analytical Hierarchy Process Method, which is one of the multi-criteria decision making methods. The importance of the 43 trends in terms of 5 priorities was evaluated by the participants on a scale of 1-5. As a result of these evaluations, a significance index score for each trend was calculated using the following formula.

$$m_j = \sum_i w_i k_{ij}$$

In this formula; w_i Indicates the weight of the criterion i, k_{ij} indicates the significance of trend j in terms of criterion i and m_j indicates the weighted significance level of trend j. Calculated significance indices are shown in the following table, sorted from top to bottom according to the index score.

Table 7.5. *External Trends and its significance index scores (YTM-MATPUM)*

External Trends (Variables)	**Index Scores**
Becoming widespread of the travelling oriented lifestyle	4,05
Emergence of new tourism regions and areas	3,87
Increase in business travels	3,77
Growth of global trade and service sector	3,76
Increase in GDP per capita	3,73
Increase in fuel prices	3,72
Rapid development of market shares of low-cost airlines (LCC)	3,59
Development of information technologies	3,56
Development of comfortable and cheap alternative transportation technologies such as high speed train	3,46
Increase in air transportation liberalization	3,44
New developments in EU-Turkey relations	3,43
Emergence of aviation mega cities	3,42
Increased security threats and extended processing times accordingly	3,37
Development of free trade agreements	3,34
Increase in middle class population	3,33
Increased political tensions in nearby geography and image problems	3,32
Development of e-commerce (for air-cargo)	3,31
Increased global political tensions	3,30
Emergence of new airport business models	3,30
Reduction of flight safety problems	3,24
New developments affecting aerospace technology	3,21
Increased security costs	3,21
Establishment of new airline alliances	3,21
Use of alternative fuels	3,21
Starting low-cost airlines (LCC) to make long-haul flights	3,19
Development of environmentally friendly alternative transportation technologies	3,14
Natural disasters	3,11
Aging population	3,08
Decrease in global resources	3,03
Increased migration rates	2,95
Increased new restrictions to reduce emission levels	2,94
Increased flexibility in global production	2,92
Shift of global economic center to Southeast Asia	2,87
Development of long-haul aircraft technologies	2,83
Reduction of operational time via robotics and automation technologies	2,81
Increased epidemic diseases	2,81
Adoption of lifestyle towards environmental awareness	2,80
Reduction in aircraft noise limits	2,66
Becoming widespread of video-conferencing	2,55
Development of 3D printer technologies (for air-cargo)	2,32
The rapid growth of the African population	2,22
Average	**3,2**

7.2. Air Cargo Scenario Study

Obtained data from the focus group meetings attended by representatives from the sector in "Systems and Development Planning of Turkish Airports" project was analyzed from the perspective of cargo transportation and base data were obtained for the possible cargo development scenarios. According to the focus group meetings results of the project, there are 41 variables that could affect the aviation sector in the following years and these variables were evaluated by the author in terms of air cargo transportation. In accordance with this evaluation, 32 variables that can guide the development of the air cargo sector were identified from the 41 variables that could affect aviation sector. 32 variables that can guide the development of the air cargo sector identified by the author and the significance scoring results of these variables obtained from the project are shown in the table below.

Table 7.6. *32 variable that might affect the global air cargo transportation in future*

External Trends (Variables)	**Index Scores**
Growth of global trade and service sector	3,76
Increase in GDP per capita	3,73
Increase in fuel prices	3,72
Development of information technologies	3,56
Development of comfortable and cheap alternative transportation technologies such as high speed train	3,46
Increase in air transportation liberalization	3,44
New developments in EU-Turkey relations	3,43
Emergence of aviation mega cities	3,42
Increased security threats and extended processing times accordingly	3,37
Development of free trade agreements	3,34
Increased political tensions in nearby geography and image problems	3,32
Development of e-commerce (for air-cargo)	3,31
Increased global political tensions	3,30
Emergence of new airport business models	3,30
Reduction of flight safety problems	3,24
New developments affecting aerospace technology	3,21
Increased security costs	3,21
Establishment of new airline alliances	3,21
Use of alternative fuels	3,21
Development of environmentally friendly alternative transportation technologies	3,14
Natural disasters	3,11

Table 7.6. continued

Decrease in global resources	3,03
Increased migration rates	2,95
Increased new restrictions to reduce emission levels	2,94
Increased flexibility in global production	2,92
Shift of global economic center to Southeast Asia	2,87
Development of long-haul aircraft technologies	2,83
Reduction of operational time via robotics and automation technologies	2,81
Increased epidemic diseases	2,81
Adoption of lifestyle towards environmental awareness	2,80
Reduction in aircraft noise limits	2,66
Development of 3D printer technologies (for air-cargo)	2,32
AVERAGE	**3,18**

* Compiled from YTM-MATPUM database.

A literature research has been conducted about these 32 variables that might affect the scenario development process and uncertainty scores between 1-5 has been determined for each variable by analyzing the probability of occurrence of these variables in the following years (1: Most Certain - 5: Most Uncertain). Variable explanations and uncertainty scores are given in detail in the following section.

7.2.1. Variable Explanations and Uncertainty Points

Growth of global trade and service sector (SS:3,76/US:3)

According to the World Trade Organization (WTO), world trade, which has been declining due to restrictions restricting trade between countries, is expected to capture a new growth trend through free trade agreements between countries (IATA, 2015). Europe, the economic and aviation giant, struggles with political and economic troubles. Even the disintegration of the European Union has come to the fore. The euro's future becomes negative day by day. It is expected that the emergence of possible fragmentation of many currencies and the formation of different free trade blocks will reduce the impact of Europe on global trade (Varoufakis Yanis, Galbraith James K., 2016).

Apart from Europe, there are also major actors of global trade such as the USA and Russia. Especially the USA, has been one of the most important actors in global trade since World War II (The Jakarta Post, 2016). Many developing countries such as

Turkey is trying to increase its role in the global trade by improving their economic relations with these major actors. Developments in Asian countries in recent years have begun to restructure the global trade. Asian countries such as China and India have achieved significant growth trends in recent years and have become new major actors in global trade.

The increasing number of major actors in global trade increases the global competition significantly. In particular, developing countries under the influence of these major actors may be significantly affected by global trade. The emergence of trade wars between the USA and China in recent years can be given as an example. The economic sanctions between the two countries create significant fluctuations in global trade. It is unclear whether these economic fluctuations will occur in the future or how they will affect global trade.

Increase in GDP per capita (SS:3,73/US:3)

2050 'World Economic Order Forecast' report prepared by PwC in 2017 made a comparison in terms of purchasing power parity. According to the report, while the GDP figures of E7 countries (China, India, Brazil, Russia, Indonesia, Mexico, Turkey) are estimated to increase from $40.000 billion to $140.000 billion; GDP figures of G7 countries (USA, Japan, Germany, United Kingdom, France, Italy, Canada) are estimated to increase from $40.000 billion to $60.000 billion. In addition, GDP growth of about 3% is expected in Turkey.

In case Turkey to complete the necessary structural reforms, it is expected to become the world's 13th largest economy in 2050. Turkey will also rank 2nd among E7 countries in terms of purchasing power parity in 2050. However, the model on which these predictions are based ignores short-term cyclical changes, global disasters and political changes that will hinder technological and economic developments (PwC, 2017). Therefore, the increase in GDP per capita remains uncertain.

Increase in fuel prices (SS:3,72/US:3)

The increase in oil prices since 2008 due to the crises in the world economy has been a major threat for the aviation industry. According to the Challenges in Air Transportation by 2035 report published by EUROCONTROL, it is estimated that oil prices tend to increase regularly in the most probable scenario and that oil prices will reach around $145 per barrel by 2035. Although the peak of oil prices and the crisis situation are not expected in this process, the change in prices is still considered as a risk factor. The fuel component, which constitutes 25-35% of the airline's expenses, will have an impact on ticket prices and passenger travel expenses. It is stated that there is a risk that oil prices may show sudden changes in the next 20 years due to the increasing speculation and investment of oil and this risk should be taken into consideration (Eurocontrol, 2013).

Development of information technologies (SS:3,56/US:1)

Air transport system; it is modeled as interactive control loops with several main subsystems, such as aircraft, airline and air traffic management. The impact of information technologies in each of these subsystems is assessed by the performance of these control loops. It appears that information technologies, air transport systems and components have a significant impact on safety, efficiency, capacity, environmental impact and financial performance (Hansman, 2005). In addition, technological advances enable the aviation industry to develop day by day, and digital technologies continue to become an factor that increases the operational efficiency of airlines. The development of information technologies helps the aviation industry to utilize its potential and services in the most efficient way. It also facilitates the implementation and development of global standards and adds value to airlines (iFourTechnolab Pvt. Lti., 2017).

Development of comfortable and cheap alternative transportation technologies such as high speed train (SS:3,46/US:2)

"Challenges in Air Transportation by 2035" report published by EUROCONTROL states that new and more developed high speed train lines will be established among more than 50 cities in the European Union countries between the years 2019 and 2035. In addition, the report states that high speed train connections in the European Union countries will have a negative impact of 0.5% annually on short-haul flights for ranges up to 800 km. In the future, the aviation sector will have a limited chance of competing in the short term in the face of fast trains which provide opportunities such as easy access to the city center, relatively less aggressive security practices, less delays, and greener and more comfortable transportation. Similarly, the competitiveness of air cargo transportation by rail will increase in importance especially in the transportation of durable product groups. As a result, high speed train connections tend to develop continuously, new high speed train connections are being made between cities and improvements in connection times continue. In addition, it is emphasized that these connections will not affect all aviation in Europe in the same way, and the impact on flight demand will be greater in areas where projects are concentrated (Eurocontrol, 2013). As seen in the European example, it is not clear to what extent high-speed trains will affect the aviation sector.

Increase in air transportation liberalization (SS:3,44/US:3)

Different models have been applied in the name of liberalization until now. One of these models is bilateral liberalization agreements mutually signed by states. A multiple agreement system was developed rather than the liberalization between the two airlines through the Open Skies Agreement signed by the US and the EU and underlined the importance of liberalization. A liberalization movement which spreading across the world and covering more areas has started to develop thanks to this agreement (Sungur, 2015). Increased integration between regions through liberalization agreements has led to the need to review airline identification criteria,

airline ownership and control regimes. At the same time, a number of problems arise with the increasing security threats associated with globalization. However, this situation is increasingly addressed at regional level through the establishment of common security policies. It is stated that there is a long way for the full liberalization of international civil aviation but it is also stated that this goal is achievable (Lykotrafiti, 2015). In shortly, political dynamics, security threats caused by globalization and economic instability create uncertainty in terms of the spread of full liberalization in civil aviation.

New developments in EU-Turkey relations (SS:3,43/US:4)

Turkey-EU relations started in 1963 and still continues today. Turkey is one of the countries wishing to join the European Union. The European Union's Customs Union is an option for Turkey to enter the common market. Turkey is envisaged to enter the EU by completing a three-stage process through Customs Union (EU Delegation to Turkey, n.d.). Turkey reports that they are ready for this process but the EU does not take a positive step in this regard (NTV, 2017). The EU's attitude complicates the process and increases the uncertainty of developments. It is often come to the fore that European Union is seeking alternative models instead of making Turkey a full member. However, Turkey stated emphatically that will not accept proposals except full membership (Anadolu Ajansı, 2018). The EU's attitude might push Turkey to make new decisions and take different steps. Therefore, it is assumed that any changes and developments may occur in the following years. The aviation industry is one of the global industries affected by international trade and politics. The attitude of the EU is also reflected in the aviation sector. There is also uncertainty as to what impact the United Kingdom's Brexit referendum will have on the EU. Developments that may arise over time as Brexit may also affect Turkey (Deloitte, 2016).

Emergence of aviation mega cities (SS:3,42/US:1)

The Delivering The Future report published by Airbus reveals significant expectations about the future air industry and city relationship (Airbus, 2011). According to the report, a large proportion of future air transport will take place over mega-cities, whose number will increase in the world. In 2016, Airbus stated that the number of mega-cities has reached 55 and more than 90% of the long-range traffic is realized through these cities. Airbus also estimates that in 2035 there will be 93 aviation mega-cities and the amount of the total number of air passengers will reach %80 through these cities (Airbus, 2016). This estimate can be seen as very important for both the air transportation sector and airports. Considering the fact that air cargo transportation takes place mostly among mega cities, it can be said that the increase in the number of mega cities will have positive effects on air cargo. Uncertainty score of this external trend has been identified as 1 due to the high possibility of an increase in the number of mega cities.

Increased security threats and extended processing times accordingly (SS:3,37/US:3)

The duration and intensity of passenger and cargo security controls at airports increased due to increased security measures as a result of the terrorist attacks of September 11 and onwards. This has a significant impact on flight delays at airports (CSES, 2011). It is observed that new and expensive security technologies prolong the processing time instead of increasing the control point efficiency at the airports (Billy Shallow, 2017). Body scanner introduced at Changi Airport is an example of new technologies. This scanner uses millimeter wave technology to detect metallic and non-metallic substances secreted in the person's body and warns officials if a hidden element is detected (Smith, 2016). There are also concerns that these scanners show every detail of the human body, including body curves, and emit 20 times more radiation than normal scanners (The Independent, 2010). It is expected that the waiting time of the passengers will be reduced with this system, which does not fully reveal

the body curves at Changi Airport and is said to emit the same radiation with a mobile phone, and this is expected to be a pleasant development for all passengers (Smith, 2016). IATA also has a recommendation about that issue. IATA envisages tunnels, each equipped with a range of eye-scanners, x-ray machines, metal detectors and arranged according to 3 different passenger profiles, and expects these tunnels to become widespread at all airports in five to seven years. IATA is also estimated that the waiting time of the passengers will be reduced with this corridor system (IATA, 2011a). In this context, it can be said that there are uncertainties about this external trend.

Development of free trade agreements (SS:3,34/US:3)

In 2008, negotiations were initiated between the three major African economic communities on the Trilateral Free Trade Agreement (TFTA) and the agreement was signed by 27 African countries. In 2015, the African Union decided to establish the African Continent Free Trade Area (CFTA) and by 2017, 54 African Union countries are expected to become members of this region. If the agreement is successful in the region, which will represent 1 billion people and $3 trillion of GDP, intra-African trade is expected to increase by 50% (Cheong, Jansen, & Peters, 2013).

Europe, the economic and aviation giant, struggles with political and economic troubles. Even the disintegration of the European Union has come to the fore. The euro's future becomes negative day by day. According to Yanis Varoufakis & James K. Galbraith, the emergence of possible fragmentation of many currencies and the formation of different free trade blocks will reduce the impact of Europe on global trade. They also believe that the region will remain confused in the coming years as it will have to struggle with the growth problems, high unemployment rates and debt problems that are constantly on the agenda in the medium term (Varoufakis Yanis, Galbraith James K., 2016).

Free trade economy spread through infrastructure agreements after World War II. Nowadays, the increase in conflicts between countries causes institutions such as the

World Trade Organization, which are established to provide trade freedom, have difficulty in doing their jobs. In this respect, some countries have focused on small but important regional and bilateral trade agreements, since no progress has been realized in the global agreements. For example, in line with the strategies adopted by US President Donald Trump, who won the last presidential elections, the US trade policy will be change significantly in the coming period (Chartered Accountants, 2017). Therefore, there is uncertainty about how free trade agreements will develop in the future.

Increased political tensions in nearby geography and image problems (SS:3,32/US:4)

The instability in the Arab world is expected to continue over the next decade and Turkey is also affecting negatively by these developments in the nearby geography. It is not clear how the region will develop but it is certain that Turkey will be affected positively or negatively by this situation. The decrease in trade volumes with countries with political tensions due to instability in the region and migration waves from these countries undoubtedly affect the aviation sector. Airline connections with countries with political tensions are weakening day by day. Despite all the negativity in the region, it is expected that Turkey will become a major regional power in the next 10 years (Stratfor, 2015).

Development of e-commerce (for air-cargo) (SS:3,31/US:1)

E-commerce in the world has grown more than 10 times in the last decade. With the development of e-commerce, new business models emerge and consumption habits of people change. E-commerce is also important for the development of the logistics sector. According to the estimate made by Goldman Sachs Investment Bank, global retail e-commerce volume, which reached $1.6 trillion by 2016, is expected to approach $3 trillion by 2020 (TUSİAD, 2017). While developing countries accounted for 32% of e-commerce volume in 2011, this ratio has risen to 59% today. It is thought that it will reach 64% in 2020. The Asia-Pacific region is now the fastest growing

e-commerce region. By 2020, China's e-commerce market is expected to be larger than the combination of the US, UK, Japan, Germany, the United States and Germany markets. In addition, it is stated that the development in e-commerce is an important potential for supporting growth in air cargo (Boeing, 2017c).

E-commerce is growing rapidly in Turkey as well as all over the world. The changes in the structure of demand (growth potential of internet penetration in countries, increase of young population and technology tendency) and supply (increase in costs in retail sector and contraction of profit margins) also support e-commerce growth. According to the e-intensity index by BCG (The Boston Consulting Group) in 2016, although Turkey rank behind the developed countries, Turkey has also demonstrated that it has significant potential in comparison with developing countries. Research company Euromonitor estimates that retail e-commerce will be 4.3% share of total trade in Turkey in 2021. It also states that this ratio may rise further with improvements (TUSİAD, 2017).

Increased global political tensions (SS:3,30/US:3)

One of the most important issues of the sector that has the potential to affect market dynamics is international relations. The most recent example of this effect is that the US President (Donald J. Trump) forbids citizens of 7 countries to enter the United States on grounds of security measures shortly after taking office. This has affected airlines companies that transport passengers between the countries in question and the United States, and citizens of seven countries have not been able to use these airlines companies (CNN Politics, 2017). In spite of the increasing political tensions due to economic dependence between the major countries, relations can be tried to be kept well. However, there is no guarantee that there won't be conflict in the future. Taking into account the risk of political tension, countries can look for ways to reduce the types of dependence that make them vulnerable to economic coercion and financial sanctions (NIC, 2017). Consequently, there are uncertainties as to where or when political tensions will emerge in the future.

Emergence of new airport business models (SS:3,30/US:3)

Traditionally, many airports in the world are operated by governments or local authorities. Today, despite years of privatization, 50% of the world's airports are still in state ownership and operation. On the other hand, airport privatizations that started in the UK in 1987 have become widespread over the years and many new business models have emerged such as transfer of ownership. In the current practices, it is generally seen that the ownership remains in the state and that the private sector operates as either a construction equivalent period or a rent / profit partnership. Each state has developed different models / applications for the operation of all or part of the airport. The choice of business model depends on the internal legislation of the states and the special conditions of the airports (Qin, 2010).

Although flexibility is perceived as an operational subject, it is an increasingly important feature of airport business management and shapes how business models are developed to tackle challenges. Rapid investments provided by the private sector that do not require government contributions have played an important role in the adoption and support of new business models. In this context, flexibility has brought significant advantages in terms of managing risks and exploiting opportunities. Even though the future is unpredictable, it is possible to create more flexible business models that can cope with changes with new strategies (LeighFisher, 2015).

It is observed that the adoption of the Build-Operate-Transfer model in Turkey. In this model, airports are transferred to private company operation in return for investment or rent. The property always remains in the state. In the European Union countries, private company management is in continuous development. Companies such as the Spanish Ferrovial Group, the Australian-based Macquarie Airports Group and the German-based Fraport AG have started operating a large number of airports. Turkey based TAV is also seen as one of these companies that operates more than one airport (Saldıraner, 2013). As a result, private sector management is a win-win situation and

there are many different business models. It is not clear what developments will occur in the following years.

Reduction of flight safety problems (SS:3,24/US:2)

According to IATA Vision 2050 report, flight safety is expected to remain one of the top priorities for passengers in 2050. The rapid development of aircraft technology and the fact that flight safety related incidents will occur less frequently indicate that this priority may be less on the agenda. Automation and other new technologies make significant improvements in flight safety and continue to reduce the risk factor (IATA, 2011b).

New developments affecting aerospace technology (SS:3,21/US:4)

International organizations such as ICAO, European Union, IATA are developing a set of targets and restrictions to reduce aviation-induced environmental pollution (air, water and noise pollution), emissions causing global warming and consumption of natural resources. Some of these targets and restrictions are provided with more efficient air traffic management and ground services, while most of them are achieved by the fact that aircraft become more efficient in terms of fuel consumption. The technology in self-driving cars leads to a more comfortable attitude towards automation technologies. Automation technologies are also expected to have a significant impact on transportation and logistics. Autonomous driverless technology is also intended for use in aircraft. It is stated that there will be risks for the combination of pilot and non-pilot flights in the same airspace. Drone technology already poses such a risk (IATA, 2018).

New technologies that may affect the aviation industry are likely to emerge over time. Hyperloop technology is seen as one of them. Hyperloop is a new mode of transport that directs people from their starting point to their destination quickly, safely. The passenger or cargo is loaded into the Hyperlow vehicle and delivered by means of an electric vacuum from a low pressure tube. The vehicle achieves airway speed over long distances with ultra-low aerodynamic drift on the stationary platform through

using the magnetic levitation. It is envisaged that this system should be built on columns or placed underground in the tunnel in order to prevent wildlife. Due to the system is completely autonomous and closed, it eliminates the danger of pilot error and weather conditions. The initial investment cost of this means of transport without direct carbon emissions is quite high (hyperloop-one, n.d.). In this context, it can be said that new developments such as Hyperloop technology will emerge over time, but it is unclear how much these developments will affect aviation sector.

Increased security costs (SS:3,21/US:2)

The September 11 incidents and many subsequent attacks to airports made necessary of mandatory security regulations. The aviation sector is much safer today than in 2001. However, these security measures and restrictions imposed many costs (IATA, 2011a). Especially, security costs in air cargo transportation are important. Air cargo includes hold-checked baggage of passengers travelling on a flight, belly hold air freight travelling on a passenger aircraft and freight travelling on dedicated air freighter aircraft. Each of these types of 'cargo' are treated differently for security screening. Generally cargo packages pass through machines that can detect certain materials, liquids, explosives and identify objects that could be a threat (Gillen & Morrison, 2015). Different needs according to cargo types also increase costs significantly. Operating costs constitute 2/3 of the costs at the airport, while security costs constitute 20% of this cost on average (ACI-EUROPE, 2013). In a study requested by the European Commission, total aviation security expenditures for 18 member states were calculated as US $2.7 billion in 2002; in this period until 2011, total aviation security expenditures at European airports reached $7.6 billion and doubled (Gillen & Morrison, 2015). Today, aviation security costs are estimated at about $8 billion annually (IATA, 2011a). As the number of airline passengers and cargo continues to increase, the costs of aviation security systems will continue to increase.

Establishment of new airline alliances (SS:3,21/US:3)

Airline companies are struggling with each other about differentiation, competition for access to large flight networks, and pricing and service quality. The profile and behavior of airline companies is undergoing a certain change, and increasing alliances between companies prevent fragmentation in the market. In OECD countries, even though most of the international agreements limiting cross-border mergers are still in force, mergers between large firms are still in progress. Some small airlines become feeder networks for large companies. Although it is not known which model will be successful, it is seen that there is a trend in the market for more differentiated and segregated business models (IATA, 2011b).

Use of alternative fuels (SS:3,21/US:4)

Today, biofuels obtained from vegetable and animal oils and biomass are allowed to be used in civil aviation by mixing up to 50% with conventional jet fuel. The allowable rate for the use of biofuels obtained by other methods is 10%. There are still many issues that need to be resolved regarding sustainable alternative fuel. For example, sustainable fuels of animal or vegetable origin are also used in other modes of transport since they are not only produced as an alternative to jet fuel. Therefore, a competitive environment is formed and the market price increases due to competition (European Commission, 2016). In addition, in this period when food security is occupying the agenda of the countries and food inflation is constantly increasing, planting of plant resources and agricultural lands for fuel production as an alternative to food is a subject that may attract a lot of reaction (Boeing, 2014).

The Challenges in Air Transportation by 2035 report published by Eurocontrol states that low-carbon alternative fuels are expected to contribute to the reduction of total emissions, but the uncertainty regarding the rate and scale of this development continues. However, although some raw materials and production techniques (eg agricultural waste or municipal waste) offer the possibility to reduce the cost of bio-fuels to the level of conventional jet fuels, the current production capacity of biofuels

is limited and the production costs of biofuels are still high for commercial use. Such cost reductions will depend on both technological learning curves and changes in the price of oil and carbon (Eurocontrol, 2013).

Development of environmentally friendly alternative transportation technologies (SS:3,14/US:2)

While air transportation can be seen as one and unrivaled in long distance transportation, it has competitors in short distance transportation. Additional pressures from environmental regulations such as noise prevention and carbon emission reduction are seen as one of the most important reasons for limited development at short distance transportation (Boeing, 2017a). If high-speed trains that provide more environmentally friendly transportation become widespread, the share of air transport in short-distance transport may be reduced. High-speed train connections are constantly being developed and establishing of high-speed train connections between cities continues (Eurocontrol, 2013). Hyperloop technology, which is currently developing, can be given as an example of alternative transportation. Hyperloop has a system that slowly accelerates using electrical propulsion along a low pressure tube. Hyperloop is being developed as a fast, safe, quiet, environmentally friendly and energy efficient transport method without direct carbon emissions. It is aimed to use Hyperloop technology by 2021 (hyperloop-one, n.d.). There are many such innovative initiatives, but it is unclear how these developments will affect aviation industry in the future.

Natural disasters (SS:3,11/US:3)

The frequency and intensity of weather-related disasters is increasing as a result of climate change. Changing temperatures, weather conditions, changes in rainfall and rising sea levels change hazard levels and increase disaster risks. Heat waves, droughts, floods, cyclones, forest fires and other disasters have more severe consequences for human and natural life. According to UNDP, forecasts for the future reveal that these trends will continue to worsen dramatically as well. These trends pose

threats such as increasing poverty levels around the world, migrating from rural areas and damaging ecosystems at new dangerous and unpredictable levels (UNDP, 2016). The uncertainty of natural disasters stems from both the unpredictability of natural phenomena and the uncertainty of how these events will interact with the environment and people (Hill, Sparks, & Rougier, 2012). According to the Challenges in Air Transportation by 2035 Report published by Eurocontrol, natural disasters are one of the risks that will affect the aviation sector and these risks need to be taken into consideration (Eurocontrol, 2013).

Decrease in global resources (SS:3,03/US:1)

The main driving force of the decrease in global resources is the ongoing economic growth and the increase in the number of middle-income consumers. The depletion of resources and the shift in the geographical supply and demand pattern affect access to key resources. Technological innovations will increase the demand for minerals and metals (such as lithium and rare earth elements) that have not been widely used before. Efforts to expand memberships in trade agreements and other forms of economic integration are important to reduce competition on resources. Significant uncertainties include the global pattern and continuity of economic growth, the future direction and implementation of technological innovations such as "Nanotechnology, biotechnology, information technology and cognitive science" (NBIC) and the changing demand for specific resources. On the supply side, new sources can be found. However, the cost of some reserves to be used may be very high due to environmental reasons. Geopolitical instability may reduce resource competition and hinder new trade agreements that curb international trade (The European Environment Agency, 2010).

Increased migration rates (SS:2,95/US:4)

There are many factors affecting migration. Some of the factors affecting migration have social, political and economic impacts that shape the behavior of migrants. In this case, immigrants can be grouped into three main categories: those who migrate

for human, economic and environmental reasons. Human migrants include asylum seekers and refugees. They usually migrate to countries close to their country of origin. Humanitarian aids has been an important source of income for these immigrants (UNHCR, 2013). The people migrating for economic reasons migrate to find jobs or improve their financial situation. While migrants moved from poorer countries to richer countries in the previous periods, this trend has recently changed (FDI, 2014). Another factor that affecting migration is environmental factors. Ecological factors have the potential to be an important force influencing migration in the 21st century. There may be an increase in migration rates due to ecological degradation. In the future, changes in the ecological environment can create food and water insecurity in various parts of the world. Limited access to food and water resources can force people to migrate to countries where accessibility to these resources more easier (FDI, 2014). There are uncertainties about where and when all this human mobility can occur.

Increased new restrictions to reduce emission levels (SS:2,94/US:2)

According to the European Aviation Environment Report, the transport sector aims to reduce emissions by 20% by 2030 in line with the European Union's targets to reduce greenhouse gas emissions, and air transport will be subject to certain emission standards. The European Union air pollution regulation follows a two-way approach, both by setting local air quality standards and by resource-oriented release controls such as engine emission controls and fuel quality standards. (European Commission, 2016).

Globally, the formation of a regulatory structure for a more sustainable aviation sector is supported. Two important steps have been taken in this context. First, in February 2016, The Committee on Aviation Environmental Protection (CAEP) approved aircraft fuel efficiency standards. These standards will be used in the new certification application starting from 2020 and will become part of the certification process applied to every aircraft in production from 2028 onwards. In addition, the Carbon Offsetting and Reduction Scheme for International Aviation (CORSIA), implemented

by the ICAO Council, is complementary to the air transport community's attainment of 2020 CO2 emissions targets. The current plan for the implementation of CORSIA will begin from a pilot phase from 2021 to 2023, followed by a first phase between 2024 and 2026. Participation in both of these early stages will be voluntary. The next phase from 2027 to 2035 will be mandatory for all ICAO member countries (Boeing, 2017b).

Similarly, The Challenges in Air Transportation by 2035 Report published by Eurocontrol emphasizes that as the effects of climate change are becoming more and more widespread day by day, CO2 emissions globally will become an issue of international political importance and will become an increasingly restrictive factor in the future. In 2011, civil aviation activities accounted for approximately 3.5% of CO2 emissions in Europe. However, political pressures are expected to increase to reduce increased emissions from aviation while other industries are decarbonizing. Within the most likely development scenario, the environmental impacts of aviation are expected to be reduced by technological and operational developments and by stricter standards. As a result, technological, operational and regulatory measures and restrictions as well as CO2 emissions from European aviation are expected to increase at a slower rate than traffic growth (Eurocontrol, 2013).

Increased flexibility in global production (SS:2,92/US:4)

Especially the cargo industry has changed significantly in the last 25 years due to the rapid technological changes. In this process, while the world economy become more global, the market and production organizations developed. New logistics and supply chain concepts have evolved due to reduced fuel and labor costs and zero stock production (Just In Time - JIT) and Destination Assembly Manufacturing trends (ACRP, 2015). Since production is now carried out in different locations rather than in a single factory, transportation has now become an integrative process that strives to be carried out between different locations and work steps. In addition, due to increased the short shelf life of the new products and the increase in the value of the

goods shipped, the demand for rapid transportation and control is increasing as well as transparency in logistics processes (ACRP, 2015).

Although it is clear that global production will become more flexible now, it is not clear where and how this production will be produced. When a company that produces in a country finds a place where it can produce at more cost-effective prices, it can relocate quickly. Therefore, demand for air cargo may change regionally over time with the effect of changes in the regions where global production takes place. Furthermore, the transfer of production outside from the main country can be prevented by political pressure. For example Mr. Trump, President of USA, states that there would be restrictions on the import of Chinese products such as tax increases for the US-based Apple company to produce in the USA instead of China (9to5mac, 2019). Therefore, it is not clear what kind of attitude politicians will take while global trade becomes flexible.

Shift of global economic center to Southeast Asia (SS:2,87/US:2)

Increasing use of ICT (Information and Communication Technologies) in manufacturing and services in Emerging Asia (Southeast Asia, China and India) affects commercial activities and productivity. This has contributed to the improvement of the existing industries and the emergence of new industries branches such as electronics manufacturing and software development in the region. Between 2000 and 2011, there was a significant increase in the share of manufacturing exports that created added value from embodied digital services in most countries of the region. In shortly, technological change and the emergence of the digital economy is an important factor driving economic growth in Emerging Asia. In addition, ASEAN (Association of Southeast Asian Nations), consisting of Vietnam, Thailand, Singapore, Philippines, Myanmar, Malaysia, Laos, Indonesia, Cambodia and Brunei, is the sixth global economic and commercial center worldwide in terms of total GDP. If ASEAN can maintain its strong growth momentum, it is predicted that 10 member

countries will constitute the fourth largest economy in the world by 2050 (ASEAN, 2017).

According to PwC, the changes and shifts in economic forces seen in the last decade are expected to continue in the future. The ratio of China to GDP per capita, which was 16.5% worldwide in 2014, is estimated to be around 19.5% by 2050. India's share of 7% in 2014 is expected to increase steadily to 13.5% in 2050. India is expected to exceed the share of the EU in 2044 and the USA in 2049 in terms of per capita GDP world share. Given the economic growth of India and China, the USA and EU's GDP per capita in the world economy, which is 33% in 2014, is expected to decline to 25% in 2050 (PwC, 2015b). While China's economy is expected to continue to grow to be the largest in the world, India is expected to become the third largest economy in the world by 2050 (PwC, 2017). While there is a possibility that the shift of global economic power towards East and South Asia may be slightly faster or slower than these forecasts, the overall direction of this change is quite clear (PwC, 2015c).

Development of long-haul aircraft technologies (SS:2,83/US:2)

In retrospect, it is seen that the growth in long-range traffic grows faster than short-range traffic. Since the 2000s, long-range traffic has increased by 3.4% annually, while short-range traffic has increased by 2.5%. By 2030, Airbus predicts that more than 700 new city-pairs will be added to the long-distance market. This will result in more than 40% growth in the long-haul flight network which including today's 1,600 cities (Airbus, 2011). Nowadays, with the increase of new long-distance flight routes, the development of long-distance aircraft technologies has become one of the main market strategies by aircraft manufacturers. Aircraft manufacturers like Boeing and Airbus continue to develop new aircraft models to increase comfort, capacity, range and speed over long distances.

On the other hand, work is underway to develop supersonic jets. The 'Boom' supersonic jets with a new aerodynamic design, high-tech engine and 2.6 times faster than other passenger planes that are being developed in the USA, is expected to reduce

travels between Sydney and Los Angeles from 15 hours to 6.5 hours. Similarly, it is expected to reduce travels between Tokyo and San Francisco from 11 hours to 5.5 hours (Boom, n.d.). Airlines such as Japan Airlines, Virgin Atlantic and Delta have already started making plans for the use of supersonic jets over long distances. These technological developments, which are expected to be used in commercial services after the mid-2020s, also herald the new generation of aircraft that will change people's perceptions of long-distance travel (ABC, 2018). As a result, long-distance aircraft technologies are constantly developing and the competitive environment between airlines will be affected by these developments.

Reduction of operational time via robotics and automation technologies (SS:2,81/US:1)

Technology is a key factor in reducing travel stress. For example, new technologies reduce flight delays and lost baggage incidents. Technologies such as the Internet of Things (IoT) and identity tokens help to reduce conflicts during travel. It is thought that by 2025, passengers will move more easily within the airports and will access to the departure gate with a fast, trouble-free entry and security process (Cognizant, 2017a). Therefore, IT (Information Technology) investments are important. It is expected to developing technologies are adopted rapidly in the following years. Considering the need to improve security without compromising customer experience, more than half of airports (52%) are expected to pilot biometric identification document management within 10 years to eliminate manual identity checks and reduce time. It is also foreseen that the airport checkpoints will become fully automatic with minimum number of employees by 2025 (Cognizant, 2017a).

It is planned to use Internet of Things (IoT) technology to monitor passenger volume and flow at the London city airport terminal. It also uses IoT in location-based passenger services, such as flight alerts and pre-ordering for food and beverage purchases prior to arrival at the airport. Airports such as Schiphol, Heathrow, Glasgow have started investing and pre-applying robot technologies for customer support. It is

anticipated that by 2025, face recognition technologies will eliminate security and identification queues (Cognizant, 2017b). As it is seen in the examples, robotic and automation technologies have started to decrease the operation time at the airports and the developments are expected to continue.

Increased epidemic diseases (SS:2,81/US:3)

The fact that people travel more frequently, the globalization of trade, and the greater interconnectedness of countries make epidemics diseases inevitable in the international arena. However, efforts are underway to prepare and control such epidemics (WHO, n.d.). The World Health Organization states that the influenza virus (Influenza), which causes epidemics due to past experiences such as the H1N1 virus that emerged in 2009 in Africa, will continue to emerge and that these epidemics are predictable in this sense. However, it remains unclear where, when and how effective an epidemic caused by this virus will be (WHO, 2011). Similarly, in the Challenges in Air Transportation by 2035 Report published by Eurocontrol, past epidemics such as the H1N1 virus are considered a risk that could adversely affect air transport in the short or long term (Eurocontrol, 2013). Past epidemics have significantly affected air transport between countries and regions most affected by epidemics. Passenger traffic carried by Asia-Pacific airlines decreased by 40% in the months following the SARS outbreak in 2003. IATA estimates that this cost to Asia Pacific airlines was $6 million in revenue loss in 2003. Traffic rate of Mexican passengers declined by 30% after the spread of the pandemic influenza virus in 2009. The effect of Ebola virus in North Africa in 2014 was reported to be less but longer (IATA, n.d.). In view of the above examples, it can be said that epidemic diseases do not affect airway transport in the same way in every route and the effect will be higher in certain routes and the duration of this effect may change.

Adoption of lifestyle towards environmental awareness (SS:2,8/US:2)

Regarding climate change, IATA states that companies or individuals should take actions to reduce greenhouse gas emissions in order to compensate for the harm to the

environment and that people should not exceed this quota by determining the carbon quota for everyone. IATA also stated that this quota limitation should be equivalent to these emissions in whole or in part by providing funding to reduce emissions anywhere. In other words, CO2 emissions generated by traveling by air transport can be compensated or offset by preventing or reducing similar amounts of emissions elsewhere (IATA, 2008). There is no clear indication that the relationship between aviation and the environment will further regulate aviation activities or whether the society is ready for these restrictions yet. Economic benefits remain an obstacle to reducing environmental impacts. It is unlikely that people will change their habits to reduce environmental impact, such as traveling less (Eurocontrol, 2009).

Especially in recent years, efforts to reduce the increasing emissions with global warming have come to the fore. There are arguments that reducing emissions would be more beneficial to future lives than to those living today. In addition, since the costs of emission reductions will often be borne by the current generation, climate change is becoming an ethical debate involving the sharing of resources over generations. In addition, due to the costs of emission reductions will be covered mostly by the current generation, climate change is becoming an ethical debate involving the sharing of resources over generations (Weisbach & Sunstein, 2009). According to Eurocontrol, more regulations (reduction in emission limits, tax, airport capacity limitation, etc.) may be occur to raise environmental awareness (Eurocontrol, 2009). In this context, the impact of this environmental awareness on aviation is not clear.

Reduction in aircraft noise limits (SS:2,66/US:1)

Aircraft noise is one of the most important causes of negative reactions from the society regarding the operation and expansion of airports. Although this is expected to continue in many parts of the world in the near future, limiting or reducing the number of people affected by aircraft noise has become one of ICAO's priorities and objectives. Following the practices that started with ICAO's noise standards certification in air vehicles in 1971, rules and sanctions were introduced to minimize

the inconvenience of air transport to people and other living organisms close to major cities and airports (ICAO, 2016). Eurocontrol stated that there was a significant decrease in noise levels and that in 2013 the average airplane noise levels decreased by about 20 decibels compared to 40 years ago (Eurocontrol, 2013). In addition, aviation noise impacts have been reduced by 75% compared to the 1970s thanks to technological developments and standards introduced by ICAO to aircraft and airports (Carson, n.d.).

Despite the continued increase in air traffic, technological developments are expected to continue to reduce aircraft engine noise. It can be said that the increase in engine by-pass rates and the gradual reduction of older and more noisy aircraft contribute to the reduction of aircraft engine noise. On the other hand, despite technological advances that will reduce noise per flight, the increase in air traffic demand may lead to an increase in the population affected by aircraft noise. This situation may require more restrictive noise reduction methods and implementation of regulatory restrictions such as airport operation noise quotas. More stringent noise certification limits may also be applied to enable technology development and fleet change. Consequently, standards to reduce aircraft noise limits will continue to be revised in line with technological developments (Eurocontrol, 2013).

Development of 3D printer technologies (for air-cargo) (SS:2,32/US:3)

In the recent industry sector strategy and analysis, 41% of air cargo enterprises and 37% of ocean container enterprises are at risk due to 3D printer technologies. Approximately 25% of truck transport is vulnerable due to the decline in goods that begin on air cargo or ships and are transported by road transport. On the other hand, railway enterprises are not at risky as other sectors because the type of transported goods (bulk materials such as coal, cereals and liquids) is not suitable for 3D printer systems (PwC, 2015a). According to the studies of DHL (Deutsche Post DHL Group), advances in 3D printer technologies are expected to affect 2-4% of the transportation volume. Many improvements are also underway to adapt to 3D printer technology.

Transportation processes are accelerated by using end of run services in order to respond to the transportation demands of time-sensitive critical parts faster. As the speed of 3D printing increases, it is highly applicable in end-of runway hubs to enable fast production of parts that need to be put into operation in the shortest possible timeframe (DHL, 2016).

Two different future scenarios are envisaged for the impact of 3D printers on the transport sector. According to the first scenario, it is assumed that each person can easily download, print and use the product of their choice with the printer at home, and then recycle or reuse the material for another product. In this scenario, everyone shares their design and databases and makes them accessible. In other words, everyone shares the design and databases publicly. In the other scenario, although people have adopted 3D printer technologies again, products are printed in standardized and state-controlled printer workshops that supply all kinds of industrial products. The demand for production may increase thanks to easy and cheap production opportunity. Furthermore, there may be density in the transport of products with the effect of this increase (Birtchnell Thomas, Urry John, Cook Chloe, 2013). Considering the different future predictions mentioned above, the development of 3D printer technologies and their impact on the aviation sector is still unclear.

7.2.2. Determining Scenario Axes

The variables having both high significance score (> 3.18) and high uncertainty score (≥ 3) from the variables that may affect development of cargo transportation are included in the process of determination of the scenario axes. The significance and uncertainty scores of variables that might affect development of cargo transportation are shown in the table below.

Table 7.7. *Significance and uncertainty scores of variables*

External Trends (Variables)	**Significance Scores**	**Uncertainty Scores**	**Selected Variables**
Growth of global trade and service sector	3,76	3	1
Increase in GDP per capita	3,73	3	1

Table 7.7. continued

Increase in fuel prices	3,72	3	1
Development of information technologies	3,56	1	0
Development of comfortable and cheap alternative transportation technologies such as high speed train	3,46	2	0
Increase in air transportation liberalization	3,44	3	1
New developments in EU-Turkey relations	3,43	4	1
Emergence of aviation mega cities	3,42	1	0
Increased security threats and extended processing times accordingly	3,37	3	1
Development of free trade agreements	3,34	3	1
Increased political tensions in nearby geography and image problems	3,32	4	1
Development of e-commerce (for air-cargo)	3,31	1	0
Increased global political tensions	3,30	3	1
Emergence of new airport business models	3,30	3	1
Reduction of flight safety problems	3,24	2	0
New developments affecting aerospace technology	3,21	4	1
Increased security costs	3,21	2	0
Establishment of new airline alliances	3,21	3	1
Use of alternative fuels	3,21	4	1
Development of environmentally friendly alternative transportation technologies	3,14	2	0
Natural disasters	3,11	3	0
Decrease in global resources	3,03	1	0
Increased migration rates	2,95	4	0
Increased new restrictions to reduce emission levels	2,94	2	0
Increased flexibility in global production	2,92	4	0
Shift of global economic center to Southeast Asia	2,87	2	0
Development of long-haul aircraft technologies	2,83	2	0
Reduction of operational time via robotics and automation technologies	2,81	1	0
Increased epidemic diseases	2,81	3	0
Adoption of lifestyle towards environmental awareness	2,80	2	0
Reduction in aircraft noise limits	2,66	1	0
Development of 3D printer technologies (for air-cargo)	2,32	3	0

Table 7.8. *Selected variables with high significance and uncertainty scores*

External Trends (Variables)	**Significance Scores**	**Uncertainty Scores**	**Selected Variables**
Growth of global trade and service sector	3,76	3	1
Increase in GDP per capita	3,73	3	1
Increase in fuel prices	3,72	3	1
Increase in air transportation liberalization	3,44	3	1
New developments in EU-Turkey relations	3,43	4	1
Increased security threats and extended processing times accordingly	3,37	3	1
Development of free trade agreements	3,34	3	1
Increased political tensions in nearby geography and image problems	3,32	4	1
Increased global political tensions	3,30	3	1
Emergence of new airport business models	3,30	3	1
New developments affecting aerospace technology	3,21	4	1
Establishment of new airline alliances	3,21	3	1
Use of alternative fuels	3,21	4	1

The variables included in the process of determining the scenario axes are grouped under two main axes: Globalization and Technology. These axes and the variables grouped under them are shown in the table below.

Table 7.9. *Scenario Axes and Variables*

Globalization	**Technology**
Growth of global trade and service sector	Increase in fuel prices
Increase in GDP per capita	Increased security threats and extended processing times accordingly
Increase in air transportation liberalization	Emergence of new airport business models
New developments in EU-Turkey relations	New developments affecting aerospace technology
Development of free trade agreements	Establishment of new airline alliances
Increased political tensions in nearby geography and image problems	Use of alternative fuels
Increased global political tensions	

4 scenarios were created by evaluating all combinations of the two scenario axes. Scenarios vary depending on whether technology and globalization axes are positive or negative. The scenarios are; Golden Age of Air Cargo Transportation (G + T +), Competitive World (G + T -), Self-Enclosed Growth (G - T +) and Crisis Scenario (G - T -). The obtained scenarios in the light of the evaluations are shown in the following figure.

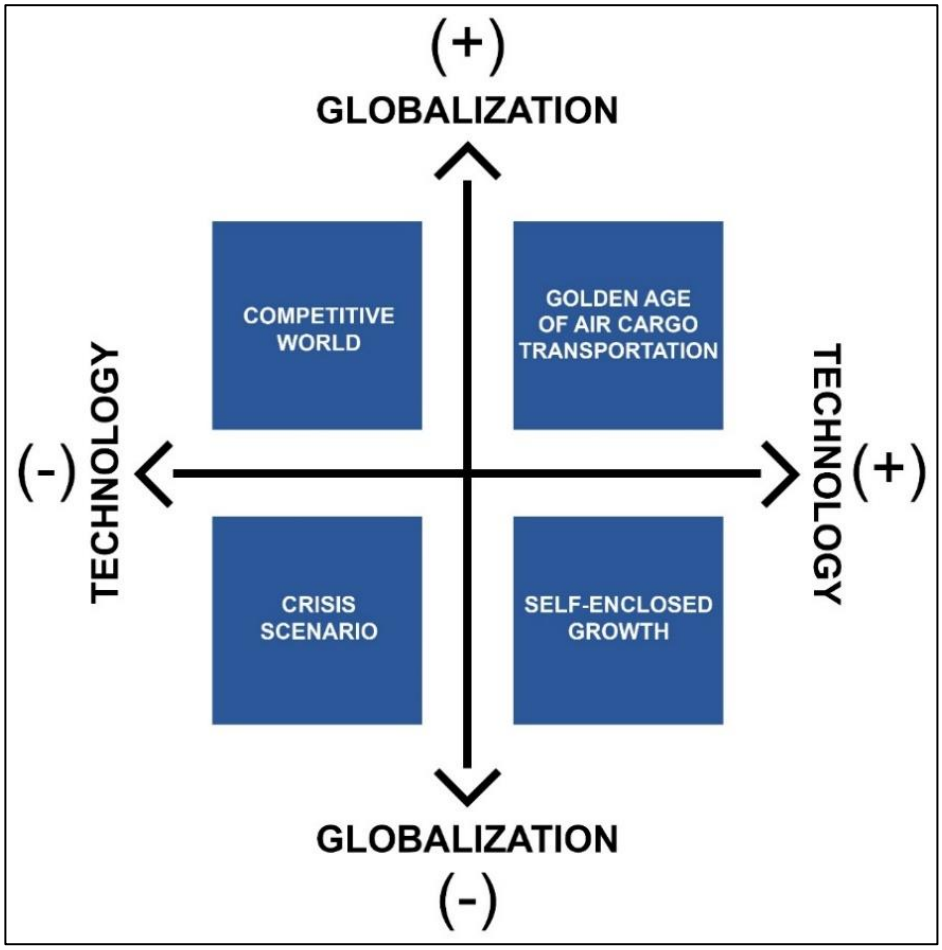


Figure 7.1. Scenario Axes and 4 Scenario

7.2.3. Scenario I : Golden Age of Air Cargo Transportation

According to this scenario, it is assumed that all external trends, which are the components of globalization and technology axes that can shape the future of air cargo transportation, will be positive in terms of air cargo transportation. In other words, there will be a world without political tension, globalization will increases significantly and positive developments in technology will be experienced. Therefore, significant leaps would be seen in the demand for air cargo and the most suitable conditions for the development of air cargo will be available.

According to this scenario, there will be significant positive developments in terms of globalization in the following years. Accordingly, there won't be occur global political tensions that may adversely affect air cargo transport in the following years. The global trade and service sector will grow significantly. GDP per capita will increase. Liberalization will become widespread in civil aviation. Relations between Turkey and the EU will proceed as positive. Free trade agreements will increase and trade relations will be strengthened in the global market. There won't occur political tensions in nearby geography and there won't occur image problems due to that.

Similarly, there will also be significant positive developments in terms of technology in the following years. Use of alternative and lower cost fuels will become widespread. Aircraft fuel efficiency will increase and fuel costs, one of the major cost components of aviation, will also be reduced. Security threats will be reduced thanks to developing technologies and operations for security controls will be performed faster. New business models that will improve cargo activities will emerge. There won't be occur technological developments that could reduce the demand for air cargo transportation. New alliances will be established among international companies to improve air cargo operations.

If this scenario with the most favorable conditions for the development of air cargo transportation is realized, it is expected that air cargo demand at Istanbul Airport will increased significantly thanks to its advanced infrastructure opportunities. Istanbul airport is also expected to become one of the world's major global hubs in terms of cargo transportation in that period when the demand for air cargo transportation is at the highest level.

In this scenario where Istanbul Airport is expected to operate in the most efficient manner, it can be said that the multiplier effects of the air logistics sector such as creating new business opportunities and stimulating the economy will be seen in the most obvious way. In this context, it can also be said that the air logistic sector may make a major contribution to the national economy.

Table 7.10. *External Trends and its Expected Affects according to Scenario I*

Globalization		**Technology**	
Growth of global trade and service sector	+	Increase in fuel prices	+
Increase in GDP per capita	+	Increased security threats and extended processing times accordingly	+
Increase in air transportation liberalization	+	Emergence of new airport business models	+
New developments in EU-Turkey relations	+	New developments affecting aerospace technology	+
Development of free trade agreements	+	Establishment of new airline alliances	+
Increased political tensions in nearby geography and image problems	+	Use of alternative fuels	+
Increased global political tensions	+		

7.2.4. Scenario II : Competitive World

According to this scenario, it is assumed that all external trends, which are the components of globalization axis that can shape the future of air cargo transportation, will be positive in terms of air cargo transportation. On the other hand, it is assumed that all external trends, which are the components of technology axis, will be negative in terms of air cargo transportation. In other words there will be a world without political tension, globalization will increases significantly and there won't be significant advance in technology. In a period of increasing globalization, the main objective will be to take advantage of existing technology in the best way. Therefore, it is expected that there will be a period in which global competition will be at the forefront, and whether airports are successful in this global competition may lead to developments or regressions in air cargo transportation.

According to this scenario, there will be significant positive developments in terms of globalization in the following years. Accordingly, there won't be occur global political tensions that may adversely affect air cargo transport in the following years. The global trade and service sector will grow significantly. GDP per capita will increase. Liberalization will become widespread in civil aviation. Relations between Turkey and the EU will proceed as positive. Free trade agreements will increase and trade relations will be strengthened in the global market. There won't occur political tensions in nearby geography and there won't occur image problems due to that.

On the other hand, there will be negative developments in terms of technology in the following years. Alternative and lower cost fuels suitable for air transport will not emerge and fuel prices, one of the major cost components of aviation, will continue to increase significantly. Security threats will increase and the duration of operations for security checks will be extended. New business models that will improve cargo activities won't emerge. There will be occur technological advances that will provide alternative and lower cost transportation opportunities and reduce the demand for air

cargo transportation. New alliances won't be established among international companies to improve air cargo operations.

In this scenario where competition has become one of the most important factors, there are still sufficient conditions for the development of air cargo transportation, and if that scenario is realized, Istanbul Airport is expected to compete ruthlessly with its competitors located in the nearby geography. It can also be said that Istanbul Airport has a significant potential to compete with its competitors for air cargo transportation thanks to its infrastructure facilities and the availability of suitable areas where capacity can be easily increased in case of need. In the global market where competition is at the forefront, it can be said that Istanbul Airport has a development potential and can become one of the most important hubs for cargo transportation.

Table 7.11. *External Trends and its Expected Affects according to Scenario II*

Globalization		**Technology**	
Growth of global trade and service sector	+	Increase in fuel prices	-
Increase in GDP per capita	+	Increased security threats and extended processing times accordingly	-
Increase in air transportation liberalization	+	Emergence of new airport business models	-
New developments in EU-Turkey relations	+	New developments affecting aerospace technology	-
Development of free trade agreements	+	Establishment of new airline alliances	-
Increased political tensions in nearby geography and image problems	+	Use of alternative fuels	-
Increased global political tensions	+		

7.2.5. Scenario III : Self-enclosed Growth

According to this scenario, it is assumed that all external trends, which are the components of globalization axis that can shape the future of air cargo transportation, will be negative in terms of air cargo transportation. On the other hand, it is assumed that all external trends, which are the components of technology axis, will be positive in terms of air cargo transportation. In other words, there will be a world with political tension, globalization will decreases significantly and there will be significant advance in technology. In a period where globalization decreased and the political tensions increased, the main objective will be to strengthen bilateral relations between countries in order to take advantage of developing technology in the best way. Therefore, the success of the countries in bilateral political relations is expected to lead to developments or regressions in the cargo transportation activities of the airports located in that country.

According to this scenario, there will be significant negative developments in terms of globalization in the following years. Accordingly, there will be occur global political tensions that may adversely affect air cargo transport in the following years. Global trade and service sector won't grow significantly. GDP per capita will not increase significantly. Even GDP per capita may decrease in some regions. Liberalization in civil aviation will slow down. Relations between Turkey and the EU will weaken. Bilateral trade agreements between countries will be made instead of global free trade agreements. In the global market, only trade relations between countries with bilateral agreements will be strengthened. There will occur political tensions in nearby geography and there will occur image problems due to that.

On the other hand, there will be significant positive developments in terms of technology in the following years. Use of alternative and lower cost fuels will become widespread. Aircraft fuel efficiency will increase and fuel costs, one of the major cost components of aviation, will also be reduced. Security threats will be reduced thanks to developing technologies and operations for security controls will be performed

faster. New business models that will improve cargo activities will emerge. There won't be occur technological developments that could reduce the demand for air cargo transportation. New alliances will be established among international companies to improve air cargo operations.

In this scenario where relations with other countries have become one of the most important factors, there are still sufficient conditions for the development of air cargo transportation, and if that scenario is realized, the foreign policy of Turkey will direct the development of air cargo transportation in the country. Therefore, positive bilateral relations with other countries are vital in order to prevent the cargo capacity of Istanbul Airport from being idle. Significant features of Istanbul Airport such as having strategically important location and having advanced infrastructure facilities promote making bilateral trade agreements between Turkey and other countries. Thus, it can be said that Istanbul Airport has a significant potential for the development of air cargo transportation. In this context, it can also be said that Istanbul Airport has the potential to develop in the global market and can become one of the most important hubs for cargo transportation.

Table 7.12. *External Trends and its Expected Affects according to Scenario III*

Globalization		**Technology**	
Growth of global trade and service sector	-	Increase in fuel prices	+
Increase in GDP per capita	-	Increased security threats and extended processing times accordingly	+
Increase in air transportation liberalization	-	Emergence of new airport business models	+
New developments in EU-Turkey relations	-	New developments affecting aerospace technology	+
Development of free trade agreements	-	Establishment of new airline alliances	+
Increased political tensions in nearby geography and image problems	-	Use of alternative fuels	+
Increased global political tensions	-		

7.2.6. Scenario IV : Crisis Scenario

According to this scenario, it is assumed that all external trends, which are the components of globalization and technology axes that can shape the future of air cargo transportation, will be negative in terms of air cargo transportation. In other words, there will be a world with political tension, globalization will decreases significantly and there won't be significant advance in technology. Therefore, significant reductions would be seen in the demand for air cargo and the most unfavorable conditions that can affect the development of air cargo will be available.

According to this scenario, there will be significant negative developments in terms of globalization in the following years. Accordingly, there will be occur global political tensions that may adversely affect air cargo transport in the following years. Global trade and service sector won't grow significantly. GDP per capita will not increase significantly. Even GDP per capita may decrease in some regions. Liberalization in civil aviation will slow down. Relations between Turkey and the EU will weaken. Bilateral trade agreements between countries will be made instead of global free trade agreements. In the global market, only trade relations between countries with bilateral agreements will be strengthened. There will occur political tensions in nearby geography and there will occur image problems due to that.

Similarly, there will be negative developments in terms of technology in the following years. Alternative and lower cost fuels suitable for air transport will not emerge and fuel prices, one of the major cost components of aviation, will continue to increase significantly. Security threats will increase and the duration of operations for security checks will be extended. New business models that will improve cargo activities won't emerge. There will be occur technological advances that will provide alternative and lower cost transportation opportunities and reduce the demand for air cargo transportation. New alliances won't be established among international companies to improve air cargo operations.

If this scenario with the most unfavorable conditions for the development of air cargo transportation is realized, it is expected that air cargo demand at Istanbul Airport will decreased significantly. During this period when the demand for air cargo decreased to the minimum levels, cargo capacity of Istanbul Airport may become significantly idle and the role of Istanbul Airport in the global market may also diminish.

Table 7.13. *External Trends and its Expected Affects according to Scenario IV*

Globalization		**Technology**	
Growth of global trade and service sector	-	Increase in fuel prices	-
Increase in GDP per capita	-	Increased security threats and extended processing times accordingly	-
Increase in air transportation liberalization	-	Emergence of new airport business models	-
New developments in EU-Turkey relations	-	New developments affecting aerospace technology	-
Development of free trade agreements	-	Establishment of new airline alliances	-
Increased political tensions in nearby geography and image problems	-	Use of alternative fuels	-
Increased global political tensions	-		

CHAPTER 8

CONCLUSION

Growing trade trends along with globalization increases the importance of logistics activities and logistics sector day by day. Today, the logistics sector has become one of the most important drivers of global trade. In recent years, development scenarios which mainly focus on production organizations have begun to big change in accordance with rapid changes in information technology. Nowadays goods and services are being to design in any geographical region of the world, produce in a different geographical region and demand from elsewhere of the world. In line with these developments, investments to produce these products are not enough today and the procurement processes of the produced products have come to the forefront. While the scarcity of resources is in the forefront in the economy in the past, the situation has changed in recent years and have emerged markets where there are many cheap and high quality products, product diversity has been provided and competition is increasing. The importance of supply chain management increased due to developments such as increased product diversity, increased short shelf life of products and increased value of goods. Furthermore, the importance of logistics, which is a factor that significantly reduces the transportation costs when properly constructed within the supply chain system, is also increasing day by day.

The logistics sector, which has become one of the fastest growing and largest sectors, has significant effects on the national economies. With the impact of globalization and rapid technological developments in recent years, urbanization rates have increased and societies' unique value judgments and cultures have also changed and societies have started to resemble each other. In line with these developments, it can be said that significant changes have occurred in people's demands and the effects of this change have been seen on the logistics sector. As a reflection of the increase in

urbanization rates, urban regions have increased significantly over the years and the concept of competition, which has gained importance with globalization, has been reflected in these regions as well. As a result, nowadays these regions compete with each other.

Although air logistics still has a small role in the entire logistics sector, it is irreplaceable due to its large efficiency in international trade and modern logistics operations and its role in the transport of small valuable goods. Within the influence of the globalization process, while consumers want to have fast delivery opportunities, and also producers expect fast, safe, secure, high reliability and frequent transportation services to meet the demands of the consumers. For these reasons, air logistics is a very important factor in terms of competition in the global market. Furthermore, the trends such as the flow of products from the manufacturer to the consumer at maximum speed, Zero-Stock Production (JIT) and Mounting at Destination emphasize the importance of air logistics.

The trend of creating hub and spoke networks to provide more efficient consolidation and traffic distribution, especially by establishing direct point-to-point connections between major global cities, is increasingly spreading (Janelle & Beuthe, 1997). The hub and spoke trend means in the simplest way to clustering of transport activities in specific centers and actualizing a efficient distribution between those centers. The spread of this trend is evident in air passenger and in both ground and air-freight transportation. Cities serviced by direct connections are likely to gain appreciable accessibility advantages over other places within national and international urban hierarchies. In the following period, it is predicted that global trade will be realized more among the cities which become global hubs. Therefore, cities seek to extend their competitive presence from regional and national setting to the international domain (Janelle & Beuthe, 1997).

Moreover, the air logistics sector is seen by many countries as a strategic and promising sector with high development potential that can play a big role in the

development of the regions. Considering that important countries such as Germany, the Netherlands, France, the United Kingdom and the United States have given great importance and made huge investments in recent years, the importance of having a hub which capable to direct global trade is increasing day by day. Several researches describe airports as places that stimulate the overall economy, create job opportunities, increase competitiveness of a city or a region at international level. With the impact of the logistics sector developing with globalization, some airports in the world have become a logistics hub. Nowadays these logistics hubs have become important locations that direct global trade, increase accessibility and connectivity to goods and services, increase countries' export potential, and collect and distribute goods on a global scale.

Subject of the thesis is determined through taking into the increasing importance of airports in global trade and the increasing aviation sector investments in Turkey. In this thesis, it is mainly examined in this thesis whether Istanbul could be a global hub in terms of the air logistics sector. The main research question and sub-questions were determined to investigate this issue. In the light of these research questions, a detailed research that constitutes the main body of the thesis was conducted. In the following part of the thesis, the results of the researches for the sub-questions identified are discussed and a general evaluation on the findings of the research was made.

Air Cargo Compliance of Production and Consumption of Istanbul

A factor that can drive the development of the air logistics sector is the structure of production and consumption in the region where the airport serves. A study was conducted to analyze whether production potential in Istanbul suitable for the development of air cargo transportation. Whether products import to or export from the region is compatible with air cargo is an important factor that may affect air cargo activities in the region. When the imported and exported product groups in Istanbul are evaluated in terms of air cargo transportation, it is seen that 18 of the 33 product

groups are compatible with air cargo transportation. In other words, there is a potential for air cargo transportation in 18 product groups.

The sectors with the potential for air cargo transportation are also important sectors in terms of foreign trade. Istanbul's 75,1% of total export value and 62,2% of total import value are compatible with air cargo transportation. With the developments in the air cargo sector in the coming years, it is seen that there is a significant potential for air cargo transportation in these sectors. The high trade volume of the product groups that are highly compatible with air cargo can be considered as an important advantage for air cargo transportation in Istanbul. Most of the sectors with high potential for the air cargo sector have a share of 10% or more in export values. Similarly, most of the sectors with high potential for the air cargo sector have a share of 20% or more in import values. For example, radio, television, communication equipment and equipment sector in Istanbul has 90.2% export share of the Turkey's export share. It can be said that many product groups which are highly compatible with air cargo transportation and have a high share in the country in terms of foreign trade are located in Istanbul. Therefore, it can also be said that there is a significant potential in terms of air cargo transportation in Istanbul.

Undoubtedly, export-oriented investments substantially contribute to the development of a region. Therefore, it is useful to give importance to export-oriented air cargo activities. When Turkey’s export distribution according to transportation modes of product groups compatible with air cargo transportation examined, it has seen that exports by air cargo transportation rates in many product groups compatible with air cargo in Istanbul is low. According to 2018 data, only 12% of all products were exported by air transportation.

Although the results seem to be negative, there is a significant potential for the development of air cargo transportation in product groups compatible with air cargo. Food products and beverages, textile products and agriculture and livestock product groups are among product groups which are high compatibility with air cargo

transportation and have low export volume with air cargo transportation. Especially in these product groups, the development potential of air cargo transportation is high. Therefore, the development of infrastructure facilities at Istanbul Airport for product groups compatible with air cargo transportation may occur major leaps in exports with air cargo transportation.

Each product group compatible with air cargo transportation may be considered important, but different product groups may come to the fore according to the strategy to be determined. The product groups compatible with air cargo transportation can be examined with 3 important different strategies. In other words, strategic product groups in terms of air cargo transportation can be categorized into three groups;

1) Prominent product groups that compatible with air cargo transportation according to Istanbul's export data,
2) Product groups with current account deficit that compatible with air cargo transportation according to Istanbul's foreign trade data,
3) Product groups that may not be produced or consumed in the country but which have enormous air cargo demand potential.

Although all three of these strategies are important, it should be noted that second strategy is the most important strategy for the development of air cargo transportation both in Turkey and Istanbul. Products groups with current account deficit and compatible with air cargo transportation in Istanbul can be evaluated in this category. It is important to develop opportunities for both production and transportation of these product groups in order to reduce current account deficit. In this context, developing possibilities for transporting product groups with current account deficit and compatible with air transportation is an important strategy that can decrease the current account deficit of the Istanbul and it also contribute to the country's economy. It can also increase both the welfare of producers and the demand for air cargo transportation. In addition, the share of air cargo transportation in exports of these products groups with current account deficit is significant.

Accordingly, medical instruments; precision optical instruments and clock, office, accounting and information processing machines, leather, suitcase, handbag, saddlery and shoes, chemicals and products, printing and publishing product groups are the product groups with a high air transportation share. It is also important that most of these product groups are highly compatible with air cargo transportation and also the share of air cargo transportation in the export of these product groups is high. Therefore, if import substitution policies are implemented to decrease current account deficit, a significant increase in demand to air cargo transportation may be seen. In this context, the development of infrastructure facilities at Istanbul Airport for these product groups with current account deficit and compatible with air cargo transportation may also occur major leaps in exports with air cargo transportation. In addition, the implementation of such a strategy will also significantly contribute to the national economy.

Air Cargo Potential Index of Istanbul

Another factor that can drive the development of the air logistics sector is the logistics infrastructure facilities in the region where the airport serves. An index study was conducted to analyze whether existing logistics infrastructure facilities in Turkey are suitable for the development of air cargo transportation and analyze the development potential of the air cargo sector by provinces. It also helped to identify the most appropriate area for air cargo transportation in Turkey. The Result Index Map below has been created by using the result index points of the provinces obtained as a result of the index study. According to the results obtained of the index study, Istanbul has the highest score among 81 provinces. In other words, Istanbul is the province with the highest potential for air cargo transportation in Turkey.

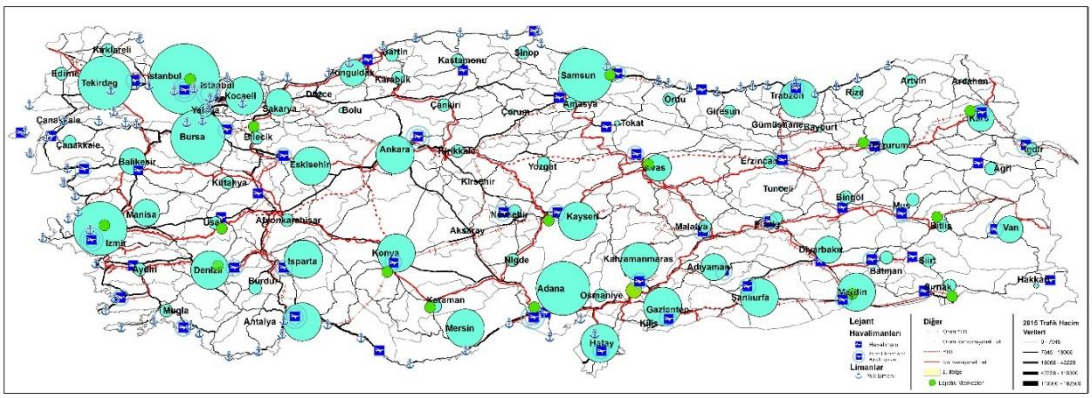


Figure 8.1. Result Index Map

One of the most important factors that can affect the air cargo potential of Istanbul is the developments in surrounding cities of Istanbul. For this reason, it is useful to examine Istanbul and its region closely. When the results of the index are evaluated in terms of the provinces in Istanbul and its region, it has seen that Istanbul, Bursa and Tekirdag have the highest 3 scores in terms of air cargo potential. According to results, Istanbul province stands out with a high score both in the cargo potential assessment and in the air cargo potential assessment. The main factor that makes Istanbul stand out in the result index is that it has become a logistic hub in the region today.

Bursa, Tekirdağ, Kocaeli and Sakarya provinces in the region are important provinces with high cargo potential where logistics activities are concentrated. In addition, Bursa and Tekirdağ provinces are the cities with high air cargo potential with their developed air cargo infrastructure. Although the provinces of Kocaeli and Sakarya have high cargo potential, they left behind in air cargo potential analysis due to not having sufficient infrastructure facilities for air cargo transportation. In the light of this index study, it can be said that the existing logistics infrastructure is suitable for the development of the air logistics sector in Istanbul. If this potential is well utilized, it can be said that Istanbul can become one of the most important cargo hubs in the globalizing world.

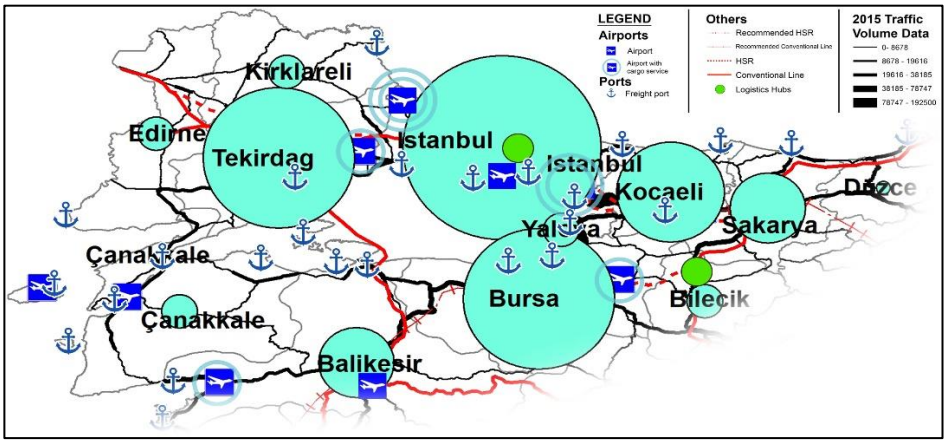


Figure 8.2. Result Index Map of Istanbul and Its Region

Istanbul Airport as a Significant Transit Point for Global Air Logistics

In order for an airport to become a global hub, it is important whether it can be a global transfer point as well as product groups and portable cargo potentials in the region where the airport is located. One of the most important strategies of the pioneering airports in terms of air cargo traffic in the world is to be a transit point for international air cargo transportation. Istanbul also has the potential to become an important transit point in terms of air cargo in global trade. However, being able to compete with the leading airports in terms of air cargo located in the nearby geography is also very important to achieve this goal.

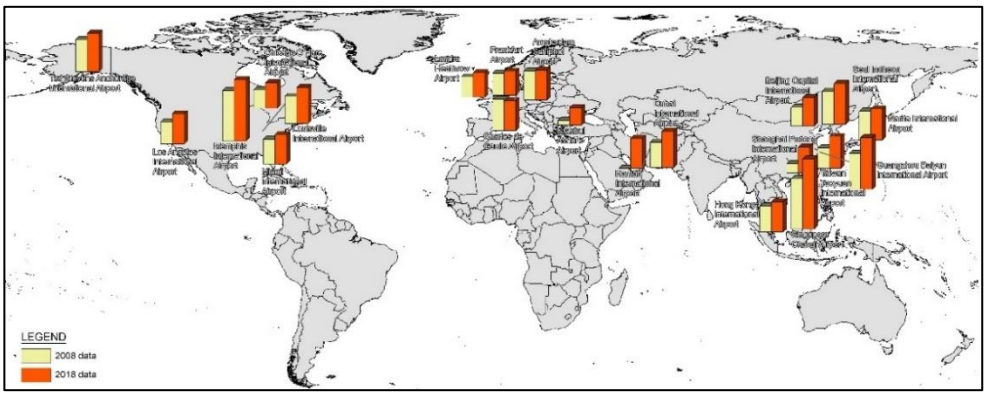


Figure 8.3. World Cargo Traffic Map by 2008 and 2018 data (*This figure is created by the author through using ACI database)*

World cargo traffic map according to 2008 and 2018 data was created by using the ACI data of top 20 airports and Istanbul Atatürk Airport in terms of air cargo traffic. These airports are shown on the figure using bar charts with size proportional to the cargo traffic they have. Developments in airports located in close geographies directly affect Istanbul Airport's ability to become a transit point. The potential competitors that may affect Istanbul Airport's possibility for being a significant transit point are mostly European and Middle Eastern airports located in the nearby geography. Amsterdam Schiphol, Frankfurt, Paris de Gaulle, London Heathrow, Dubai and Hamad airports, which are located in a nearby geography with significant annual air cargo traffic, may be considered as the most important competitors of Istanbul Airport.

A comparison was made between Istanbul Airport and its potential rivals to analyze the potential of Istanbul Airport for being a significant transit point in terms of air cargo transportation. The comparison was made through comparing the key features of airports. According to the comparison, annual cargo capacity of rivals is between 2.500.000 - 3.600.000 tonnes. Schiphol airport stands out with its 525.000 m^2 cargo terminal area. According to 2018 data, the annual cargo traffic of all potential competing airports is higher than Istanbul Atatürk Airport. Dubai Airport has achieved 6th place in the ACI World Cargo Traffic Ranking, in which Istanbul Atatürk Airport cannot even get into the top 20, thanks to its annual cargo traffic.

Considering in terms of average annual growth rates, Istanbul Atatürk Airport has the highest growth rate with a growth rate of 13.86% after Hamad International Airport that has a growth rate of 15.22%. Frankfurt and Schiphol airports stand out in the Hub Connectivity Index by ACI due to their high connectivity opportunities. Dubai International Airport, one of the main competitors, has a free zone like Istanbul Atatürk Airport. There is insufficient information on whether other competing airports have integration with free zones. All competing airports have diversified infrastructure facilities for the transportation of various product groups. Therefore, it can be said that all competing airports have the expertise to carry both durable and non-durable product groups.

There are important opportunities at all airports for transportation of cold chain product groups, which constitute the main demand for air transportation. The ability to operate a 24/7 cargo operation, which is not available in London Heathrow Airport due to environmental concerns, is available at other competing airports. Cargo vehicles such as lorries have access to the cargo terminal at all airports. Frankfurt, Schiphol and Charles de Gaulle airports have railway links that can carry cargo. Dubai, Hamad and Schiphol airports are integrated with seaway transportation. Considering in terms of multi modal transportation, Schiphol Airport is the most convenient airport for multi-modal transportation among competitors thanks to having connections to all modes of transportation.

Today, a significant portion of Istanbul's air cargo operations take place at Istanbul Atatürk Airport. Cargo operations will continue take place from Istanbul Atatürk Airport until the cargo operations start at Istanbul Airport. Cargo operations at Istanbul Atatürk Airport will be stopped after moving cargo operations to Istanbul Airport. Therefore, the cargo data of Istanbul Atatürk Airport was used as a base for Istanbul Airport through assuming cargo activities will continue in the same way. The commencement date of cargo operations at Istanbul Airport, which is operational in terms of passengers, is also unclear.

According to the information obtained, the annual cargo capacity of Istanbul airport is planned to be 2.500.000 million tons in the first stage and will reach 5.500.000 million tons when the stages are completed. 1.6 million m^2 area is reserved for cargo facilities (IGA, n.d.). It is stated that there will be infrastructure facilities in this area that will allow the transportation of various product groups. It is planned that there will be operational capability to use temperature controlled special trucks especially for the transportation of cold chain product group (Turkish Cargo, n.d.). In addition, many leading freight forwarders in the world have already requested to rent space at Istanbul Airport (Emlak Kulisi, n.d.) and the facilities to be built are expected to host many freight forwarders thanks to the strategic location and connectivity opportunities of Istanbul.

It is stated that there will be important infrastructures for multi-modal transportation at Istanbul Airport and the connections planned to be made by alternative transportation methods will be completed in stages. In the first stage, it is planned to provide access to the cargo terminal of cargo vehicles such as lorries, and to integrate the airport with railway and seaway when the stages are completed (Turkish Cargo, n.d.). Therefore, it can be said that Istanbul Airport will play an important role in global trade and has a high potential to become a significant transit point thanks to having important features such as integration with all modes of transport, advanced infrastructure facilities for transportation of all types of products and being the most important airport of the province in terms of cargo transportation.

Istanbul Atatürk Airport's annual cargo traffic trend analysis results and high rankings in the connectivity analyzes conducted by ACI and OAG are also important parameters indicating that this potential exists. It is possible that there will be significant leaps in air cargo transportation in Istanbul due to the fact that cargo operations will be moved to Istanbul Airport, which will have advanced infrastructure for cargo transportation, instead of Istanbul Atatürk Airport.

Possible Development Scenarios for Air Cargo Transportation in Turkey

A scenario study was conducted to develop possible cargo development scenarios in future. Within the scope of the scenario study, the Systems and Development Planning of Turkish Airports Project by YTM-MATPUM was analyzed and data of the focus group meetings held as part of the project were evaluated from an air cargo perspective. Accordingly, 4 possible scenarios for air cargo transportation were produced. 4 scenarios were created by evaluating all combinations of the two scenario axes. Scenarios vary depending on whether technology and globalization axes are positive or negative. The scenarios are; Golden Age of Air Cargo Transportation (G + T +), Competitive World (G + T -), Self-Enclosed Growth (G - T +) and Crisis Scenario (G - T -). Air cargo transportation has the potential to develop in 3 of

the 4 scenarios produced. The best scenario among the possible scenarios for Istanbul Airport to become a global hub in terms of air cargo transportation is Golden Age of Air Cargo Transportation Scenario.

According to this scenario, it is assumed that all external trends, which are the components of globalization and technology axes that can shape the future of air cargo transportation, will be positive in terms of air cargo transportation. In other words, there will be a world without political tension, globalization will increases significantly and positive developments in technology will be experienced. Therefore, significant leaps would be seen in the demand for air cargo and the most suitable conditions for the development of air cargo will be available.

According to this scenario, there will be significant positive developments in terms of globalization in the following years. Accordingly, there won't be occur global political tensions that may adversely affect air cargo transport in the following years. The global trade and service sector will grow significantly. GDP per capita will increase. Liberalization will become widespread in civil aviation. Relations between Turkey and the EU will proceed as positive. Free trade agreements will increase and trade relations will be strengthened in the global market. There won't occur political tensions in nearby geography and there won't occur image problems due to that.

Similarly, there will also be significant positive developments in terms of technology in the following years. Use of alternative and lower cost fuels will become widespread. Aircraft fuel efficiency will increase and fuel costs, one of the major cost components of aviation, will also be reduced. Security threats will be reduced thanks to developing technologies and operations for security controls will be performed faster. New business models that will improve cargo activities will emerge. There won't be occur technological developments that could reduce the demand for air cargo transportation. New alliances will be established among international companies to improve air cargo operations.

If this scenario with the most favorable conditions for the development of air cargo transportation is realized, it is expected that air cargo demand at Istanbul Airport will increased significantly thanks to its advanced infrastructure opportunities. Istanbul airport is also expected to become one of the world's major global hubs in terms of cargo transportation in that period when the demand for air cargo transportation is at the highest level.

Istanbul Airport and Regional Development

Today, the aviation industry has become one of the most important drivers of global trade. Turkey is making significant investments in the aviation sector in order to strengthen its role in global trade. The most important of these is undoubtedly Istanbul Airport. Istanbul airport, which is the largest infrastructure project in Turkey until today, has started to operate instead of Istanbul Atatürk Airport which is the Turkey's main transportation hub in both national and international level.

While there are currently two internationally operating airports such as Sabiha Gökçen and Istanbul Atatürk in Istanbul, the construction decision of a third airport is an important strategy. Turkey has the goal of becoming a global hub for aviation sector. One of the most important parameters in Turkey to achieve this goal is the infrastructure possibilities for aviation sector. Istanbul Airport has been decided to be built through considering that existing airports would not meet the demand for air traffic in the following years due to low infrastructure of the existing airports, limited air traffic capacities and inadequate airport development areas. Therefore, Istanbul Airport is seen as a very important tool to achieve the goal of becoming a global hub for aviation sector.

Within the scope of this thesis, it has been investigated whether Istanbul could be a global hub in terms of the air logistics sector and according to the data obtained in the light of research questions, it has been concluded that Istanbul Airport has a high potential to become a global hub in terms of air logistics sector. In addition, it can also

be said that Istanbul Airport have a potential to become an air logistics hub that direct global trade, increase accessibility and connectivity to goods and services, increase export potential of Turkey, and collect and distribute goods on a global scale. If Istanbul Airport evaluates this potential and becomes a global hub in terms of air cargo transportation, it will undoubtedly have impacts on Istanbul's socio-economic structure and the city's macroform. It will even have a direct impact on the regional development in and around Istanbul.

Considering from socio-economic perspective, Istanbul Airport may stimulate the overall economy, may create job opportunities, may increase competitiveness of Istanbul at international level. The fact that the airport becomes to provide services on a global level will directly affect airport employment, airport revenues and foreign trade volume of the country. It will also have an indirect impact on the external sectors serving the airport. Therefore, increasing employment rates and income amounts will increase the welfare level of the citizens and indirectly improve the quality of life of the citizens. The benefits provided by Istanbul Airport to the economy are not only limited to Istanbul, but will also significant contribute to the national economy. The airport is expected to contribute to export-oriented growth and attract more foreign investors to the region. According to the Istanbul New Airport Economic Impact Analysis report, Istanbul Airport will create between 194 and 225 thousand employment in 2025. The contribution of Istanbul Airport, which is expected to create approximately $3.8-4.4 billion added value, is expected to increase to 4.2% - 4.9% of national income (İGA, 2016).

It can be said that carrying out cargo operations at Istanbul Airport will have also significant impacts on the city's macroform. Logistically important places such as fruit and vegetable markets, organized industrial zones, small industrial zones, logistics centers, storage areas and customs areas have developed unplanned and scattered in Istanbul. The connections between these places are also provided by using roadway infrastructure. Due to Istanbul is divided into two sides by the Bosphorus, roadway freight transportation between these two sides is carried out only with 3rd Bridge, while

railway freight transportation is carried out only with Marmaray. With the commencement of cargo operations at Istanbul Airport, what kind of developments will be experienced in these logistically important places is also important.

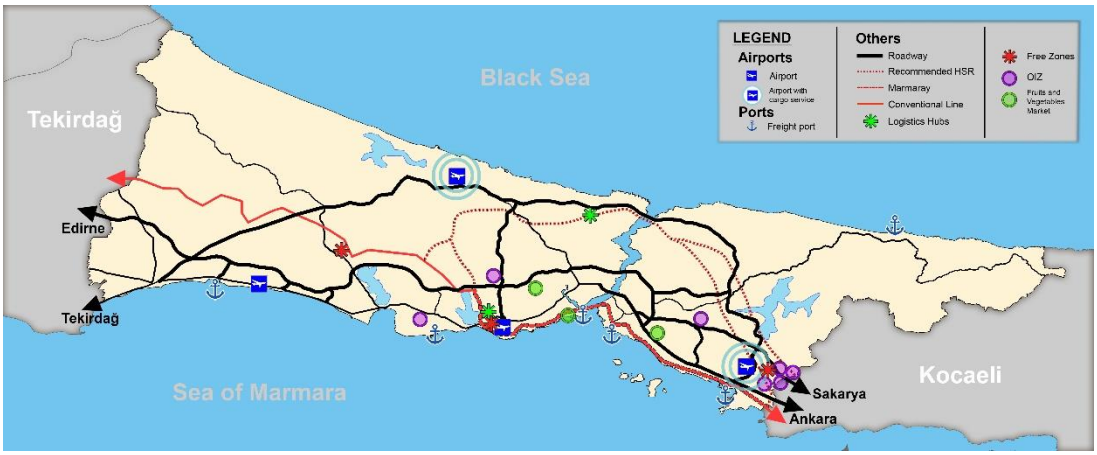


Figure 8.4. Logistics Map of Istanbul

First of all, there is the possibility of relocating of those logistically important places, which have relation with air transportation and which have ability to relocate, to near Istanbul Airport. Relocation of the places such as production areas, storage areas and office areas to near Istanbul Airport due to logistical reasons, can significantly increase settlements in and around the airport. In addition, it can be said that people working in these logistically important places will increase the demand for housing near the airport and the city may begin to grow towards Istanbul Airport due to that reason. Secondly, these logistically important places can maintain their current position and the connections between these places and Istanbul Airport may need to be improved. Especially, the connections of the main freight ports, fruit and vegetable markets, organized industrial facilities towards the airport will need to be strengthened.

In shortly, there are two important possibilities for these logistically important places, such as clustering around the airport and maintaining their current location. Both possibilities have positive and negative aspects and it can be said that both possibilities may affect the city's macroform differently. In the first case, Istanbul's cargo competitiveness can be increased by realizing more efficient logistics operations and

reducing cargo operation costs to minimum levels. However, it should be taken into consideration that the development of the city towards the airport may lead to negative environmental developments. Forests, water basins and agricultural lands near the airport may be adversely affected by the urban developments.

In the second case, Istanbul Airport's competitiveness in terms of air cargo transportation will be significantly reduced due to the significant increase in air cargo operation costs. In addition, urban traffic may increase due to logistically important places didn't relocate to out of the city. Emissions and noise pollution that may be caused by cargo vehicles are also among the factors to be considered. Therefore, quality of life of citizens may also decrease due to increased urban traffic. Considering from regional planning perspective, it can be said that clustering of logistically important places around Istanbul Airport is more beneficial for the development of air cargo activities. Negative factors arising from the clustering of logistics activities can also be minimized by good comprehensive planning.

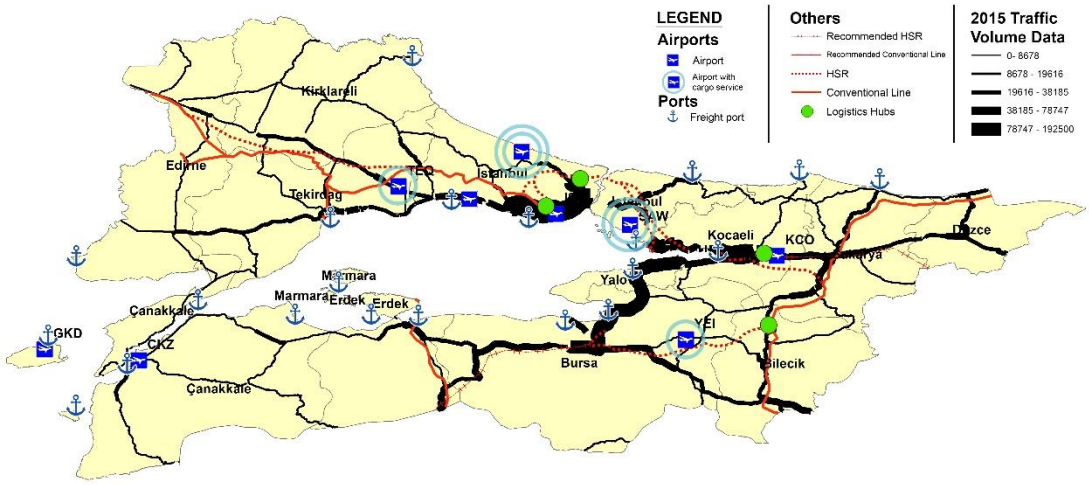


Figure 8.5. Istanbul and Its Regions Map (*This figure is created by the author through using YTM-MATPUM database)*

As it is seen from the figure above, Istanbul region is one of the most important city-region in Turkey where transportation is concentrated. Istanbul is an important logistics region thanks to the advantages of being in a strategically important location. Therefore, logistics strategies to be implemented in Istanbul and its region are of great

importance for the development of the region. The fact that Istanbul Airport has become a global hub for cargo will not only contribute to Istanbul but will also lead to significant improvements in Istanbul's hinterland. The multiplier effect of Istanbul Airport can be seen especially in Tekirdağ, Kocaeli, Yalova, Bilecik and Bursa provinces. It will provide opportunities for the development of export-based companies in the region and may also enable foreign investors to invest these regions. The provinces located in Istanbul's hinterland can also benefit from Istanbul Airport with a comprehensive logistics plan which focused on transporting through logistics hubs where alternative transport methods are integrated. In this way, the competitiveness of this region, that includes provinces with the highest contribution to Turkey's economy, may be increased significantly through a comprehensive logistics plan that provides integration between the region and Istanbul Airport. Therefore, a comprehensive logistics plan including all modes of transport will contribute significantly to the development of the region. In the following years, a mutual relationship may arise between the developments in the region and Istanbul Airport. The developments in the region may also have positive effects on air cargo demand of Istanbul Airport.

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APPENDICES

A. Index Results of All Provinces

PLACE	PROVINCE CODE	PROVINCE NAME	CARGO POTENTIAL SCORE	CARGO POTENTIAL PLACE	AIR CARGO POTENTIAL SCORE	AIR CARGO POTENTIAL PLACE	RESULT INDEX SCORE
1	34	İSTANBUL	100,0	1	100,0	1	100,0
2	35	İZMİR	100,0	2	41,1	3	70,5
3	55	SAMSUN	88,9	7	40,1	11	64,5
4	16	BURSA	83,3	8	40,7	4	62,0
5	1	ADANA	83,3	10	40,2	6	61,8
6	59	TEKİRDAĞ	83,3	9	40,1	9	61,7
7	7	ANTALYA	72,2	11	40,4	5	56,3
8	27	GAZİANTEP	72,2	14	40,2	7	56,2
9	42	KONYA	72,2	12	40,1	8	56,2
10	20	DENİZLİ	88,9	4	20,1	13	54,5
11	38	KAYSERİ	88,9	5	20,1	14	54,5
12	6	ANKARA	55,6	20	43,4	2	49,5
13	41	KOCAELİ	88,9	3	0,4	21	44,6
14	33	MERSİN	88,9	6	0,0	28	44,5
15	47	MARDİN	61,1	18	20,0	18	40,6
16	26	ESKİŞEHİR	72,2	13	0,6	20	36,4
17	46	KAHRAMANMARAŞ	72,2	15	0,0	29	36,1
18	61	TRABZON	72,2	16	0,0	30	36,1
19	31	HATAY	66,7	17	0,0	32	33,3
20	32	ISPARTA	22,2	34	40,1	10	31,1
21	63	ŞANLIURFA	22,2	41	40,0	12	31,1
22	58	SİVAS	38,9	24	20,0	16	29,4
23	54	SAKARYA	55,6	19	0,1	24	27,8
24	67	ZONGULDAK	55,6	21	0,0	46	27,8
25	10	BALIKESİR	50,0	22	0,1	25	25,0
26	45	MANİSA	44,4	23	0,3	22	22,3

27	21	DİYARBAKIR	22,2	42	20,0	15	21,1
28	2	ADIYAMAN	22,2	36	20,0	17	21,1
29	65	VAN	22,2	43	20,0	19	21,1
30	25	ERZURUM	38,9	25	0,0	48	19,4
31	36	KARS	38,9	26	0,0	73	19,4
32	64	UŞAK	27,8	28	0,0	31	13,9
33	70	KARAMAN	27,8	29	0,0	63	13,9
34	73	ŞIRNAK	27,8	31	0,0	64	13,9
35	11	BİLECİK	27,8	27	0,0	66	13,9
36	53	RİZE	27,8	30	0,0	67	13,9
37	13	BİTLİS	27,8	32	0,0	71	13,9
38	48	MUĞLA	22,2	47	0,1	27	11,1
39	72	BATMAN	22,2	44	0,0	33	11,1
40	37	KASTAMONU	22,2	35	0,0	37	11,1
41	44	MALATYA	22,2	38	0,0	43	11,1
42	52	ORDU	22,2	37	0,0	54	11,1
43	17	ÇANAKKALE	22,2	33	0,0	55	11,1
44	23	ELAZIĞ	22,2	39	0,0	60	11,1
45	24	ERZİNCAN	22,2	40	0,0	65	11,1
46	49	MUŞ	22,2	45	0,0	69	11,1
47	12	BİNGÖL	22,2	46	0,0	77	11,1
48	9	AYDIN	11,1	51	0,0	34	5,6
49	15	BURDUR	11,1	53	0,0	36	5,6
50	18	ÇANKIRI	11,1	55	0,0	38	5,6
51	28	GİRESUN	11,1	63	0,0	41	5,6
52	22	EDİRNE	11,1	48	0,0	44	5,6
53	43	KÜTAHYA	11,1	52	0,0	45	5,6
54	77	YALOVA	11,1	49	0,0	47	5,6
55	5	AMASYA	11,1	64	0,0	49	5,6
56	66	YOZGAT	11,1	56	0,0	50	5,6
57	3	AFYONKARAHİSAR	11,1	54	0,0	52	5,6
58	71	KIRIKKALE	11,1	57	0,0	53	5,6
59	78	KARABÜK	11,1	58	0,0	56	5,6
60	39	KIRKLARELİ	11,1	50	0,0	57	5,6
61	56	SİİRT	11,1	67	0,0	58	5,6
62	50	NEVŞEHİR	11,1	59	0,0	59	5,6
63	74	BARTIN	11,1	60	0,0	61	5,6
64	80	OSMANİYE	11,1	62	0,0	62	5,6
65	51	NİĞDE	11,1	61	0,0	68	5,6

66	76	IĞDIR	11,1	68	0,0	70	5,6
67	57	SİNOP	11,1	65	0,0	74	5,6
68	4	AĞRI	11,1	69	0,0	76	5,6
69	8	ARTVİN	11,1	66	0,0	79	5,6
70	19	ÇORUM	0,0	71	0,1	23	0,0
71	30	HAKKARİ	0,0	81	0,1	26	0,0
72	81	DÜZCE	0,0	70	0,0	35	0,0
73	79	KİLİS	0,0	75	0,0	39	0,0
74	14	BOLU	0,0	72	0,0	40	0,0
75	68	AKSARAY	0,0	73	0,0	42	0,0
76	40	KIRŞEHİR	0,0	74	0,0	51	0,0
77	60	TOKAT	0,0	76	0,0	72	0,0
78	62	TUNCELİ	0,0	79	0,0	75	0,0
79	29	GÜMÜŞHANE	0,0	77	0,0	78	0,0
80	75	ARDAHAN	0,0	80	0,0	80	0,0
81	69	BAYBURT	0,0	78	0,0	81	0,0