



Challenges and Proposed Solutions in Modes of Transportation at International Airport Operations; Sabiha Gökçen Airport Sample

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Abstract

The historical development of transportation, dating back to the pre-recorded history, began primarily with the people's access to resources. Later, it diversified with the addition of different modes of transportation, and gained its modern definition of the movement of people, goods and services for a purpose. Development in transport is directly proportional to the level of development of societies, given globalizing world and economy of today. In this context, the main focus of the study is the airport operations, having become one of the main sectors of major economic size in the world, which involve or integrate with almost all modes of transportation (air, waterway and land transportation). Within the scope of the study, the current status of the modes of transportation at Sabiha Gökçen Airport, the second largest airport in Turkey, was identified and the problems encountered in these modes of transportation were addressed. As a result, proposals were presented for the challenges encountered in the integration of all modes of transportation and their individual setting-up.

Keywords: Airport operations, integration, transportation, modes of transportation.

Uluslararası Havalimanı İşletmelerinde Ulaşım Türlerinde Yaşanan Sorunlar ve Çözüm Önerileri; Sabiha Gökçen Havalimanı Örneği

Öz

Kayıtlı tarihten öncesine dayanan ulaşımın tarih içerisinde gelişimi, öncelikle insanların kaynaklara ulaşımı ile başlamış, sonrasında çeşitlenerek farklı ulaşım araçları da eklenmiş, modern dönemde insanların, malların ve hizmetlerin bir amaç uğruna yer değiştirmesi tanımıyla uygun niteliğe dönüşmüştür. Ulaşımındaki gelişmişlik, günümüzde küreselleşen dünya ve ekonomi dikkate alındığında toplumların gelişmişlik derecesi ile doğru orantılıdır. Bu noktadan hareketle, dünya üzerinde başlıca ekonomik büyüklüğe sahip bir sektör durumuna erişen ulaşımın neredeyse tüm türlerini (havayolu, su yolu ve kara ulaşım) içerisinde barındıran veya bu türler ile entegre olan havalimanı işletmeleri bu çalışmanın ana konusunu oluşturmaktadır. Çalışma kapsamında Türkiye'nin 2. büyük havalimanı olan Sabiha Gökçen Havalimanı'nda yer alan ulaşım türlerinin mevcut durumları tespit edilerek, bu türlerde yaşanan sorunlar ele alınmıştır. Sonuç olarak tüm ulaşım türlerinin kendi içerisindeki entegrasyonu ve münferit olarak tesisinde yaşanan sorunlara yönelik çözüm önerileri sunulmuştur.

Anahtar kelimeler: Havalimanı işletmeleri, entegrasyon, ulaşım, ulaşım türleri.

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1. Introduction

Transportation is one of the main factors of development as well as indicating the level of economic development of countries. From the beginning of humanity to the present day, transportation has been a necessity to meet basic needs and also a phenomenon for the masses to have access to goods and services. There are three main modes of transportation, and air transportation, the most high-tech of them, is the main subject of the study.

Air transportation, which enables reaching long distances in short periods, is seen as an attractive option due to the increasing comfort, reliability, and speed provided by its services and advancing technology. So much so that a growing airline network has formed worldwide. Throughout the day, thousands of airplanes participate in air traffic globally, transporting passengers and cargo (Arabacı, 2010). Air transportation is also rapidly developing in our country. According to data from DHMI, there is an increase in the number of people preferring air travel in our country. For places without airports, travelers journey to the nearest airport and continue by road transfer. To promote the proliferation of air transportation in our country, the number of airports is increasing. The number of flight points in our country increased from 26 in 2003 to 58 by 2019 (SHGM a, 2019). The increase in airports not only facilitates transportation but also provides employment to the region where they are located (Erdoğan & Ercoşkun, 2021).

While air transportation is covered within the scope of the study, the other modes of transportation required for this service are also examined, and airport operators, which integrate all these modes of transportation, are scrutinized.

The study focuses on the sample of Sabiha Gökçen Airport in examining the modes of transportation at the airport operations. Problems encountered during the development of modes of transportation at the airports and further problems in their integration were addressed.

The study presents problems related to transportation in Airport Operations, which covers almost all modes of transportation, and solution proposals to these problems.

1.1. Overview of the Concept of Transportation

Transportation is a word of Latin origin, formed by the combination of “trans” (from one place to another) and “portare” (to carry). In English, transportation is also expressed with the word “transport”. In Ottoman Turkish, it corresponds to the words, “münakale”, “münakalat”, “muvasala” (inservient, intermediary), and nowadays, it is expressed with the words “ulaşım”, “nakliye” and “taşımacılık” in Turkish (Tümertekin, 1987).

The history of transportation dates back to times even before recorded history. Initially, people formed footpaths and routes with their desire to hunt animals to meet their food needs. As civilization progressed, agricultural activities and settled life began to emerge. This led to the formation of routes between settlements. In fact, we can consider these routes as the prototype of modern highways. Later on, humans started to use animals as pack animals, which were pivotal in transportation, and interestingly, transportation still relies on animal power in underdeveloped regions. However, when thinking about transportation in the modern sense, it's essential to consider the Industrial Revolution, which began around 150-200 years ago. The Industrial Revolution, the defining epoch of humanity, brought about entirely new effects on societies, shaping people's lifestyles, expectations, consumption patterns, and so forth. Modern transportation began with the replacement of human power by machines. The mass production and travel of goods and services constitute the fundamental factors of modern life, and therefore, the development in these factors can only be possible through the advancement of transportation (Kadiyali, 2016).

Today, the level of development of a society is also measured by the progress in transportation. In other words, the development in transportation forms the dynamism of social development. It is well known that the discovery of railways significantly contributed to the modernization of the transportation system. Although transportation in its modern sense started with the discovery of railways during the Industrial Revolution, motor vehicles also emerged during this era and established

the automobile as a cornerstone of the economy with its production, fuel, and various other aspects. It can be said that thanks to such developments, the concept of modern transportation emerged entirely during this era (Akin & Sultanoğlu, 2006).

The traditional purpose of transportation is to enable people to access goods and services. Transportation is a widely provided service, similar to other public services. It plays a crucial role in various aspects such as economy, utilization of natural resources, the quality and preservation of goods and services, acceleration of agricultural development, tourism, defense, meeting strategic needs, managing vast areas, disaster management, and so on (Zimmerman, 2012).

Transportation is affected by crisis situations, but at the same time, it has the ability to cope with them. While some of the numerous dangers present in daily life affect transportation and its users, others can lead to different outcomes (Zimmerman, 2012).

Today, transportation is not only a field of science but also an indispensable primary infrastructure for all sectors. It has become a sector with significant economic importance worldwide due to the economic value it creates. As civilization advanced and inventions proliferated, people began to move, and besides this movement of people, goods produced in one place were also transported to entirely different locations along with people (Doğan, 2015).

1.2. Modes of Transportation at the Sample of Sabiha Gokcen Airport

The Advanced Technology Industrial Park and Airport Project (ITEP) was planned as a development project aiming to create a dynamic, scientific, technological, and, more importantly, local infrastructure for economic growth, technological development, and global competitiveness, involving the commercialization of technology through effective public and private sector investments (ARUP, 2008). The project, which began in 1987 with the expropriation of the necessary areas and construction works, consists of three main components: an airport, a technopark, and aviation maintenance repair-overhaul centers. A total of 1301 hectares of land were expropriated for the ITEP project, and, the construction of Sabiha Gökçen Airport, one of its most significant elements, was completed in 2000, and the airport is opened to passenger and aircraft traffic in 2001 (SSB, 2024)

1.2.1. Air transportation

When Sabiha Gökçen Airport opened in 2001, it served only to 47,000 passengers. Until 2005 when Pegasus Airlines was acquired by Esas Holding and began to use this airport as a main base for scheduled flights, unscheduled private (charter) flights were conducted during this period (HEAŞ a, 2024) (Figure 1).



Figure-1. Sabiha Gokcen Airport (2001-2009) (Google Earth Image, 2001)

With the commencement of scheduled flights in 2005, it was anticipated that the existing terminal structures would be insufficient due to steady growth. Therefore, in 2007, when the annual passenger count reached approximately 4 million, a build-operate-transfer (BOT) tender was held for the New Terminal and Ancillaries project. The newly established infrastructure capacity quickly filled up due to the increasing demand (Figure 2).



Figure-2. Sabiha Gokcen Airport (2009) (Google Earth Image, 2009)

The New Terminal Building and Ancillaries project was opened in 2009, and since then, significant infrastructure investments have been made at the airport to increase its aircraft and passenger capacity. These investments include additional aircraft parking areas, rapid exit taxiways, and an additional dock block. (SHGM b, 2009)

The construction of the Second Runway project, which began in 2012, was completed and the runway opened on December 25, 2023. This eliminated capacity issues on the air side of the airport, and the terminal capacity, where passenger services are provided, became a bottleneck. As a result, work for a new terminal (Terminal III) has begun to address this issue (Figure 3).



Figure-3. Sabiha Gokcen Airport (2023) (Google Earth Image, 2023)

The rapid and record braking growth of the passenger numbers can bee seen in Figure 4 and Table-1.



Figure 4. Sabiha Gokcen Airport Number of Passengers Annually

Table-1. Sabiha Gokcen Airport Annual Passenger Numbers (DHMI)-2023).

İstanbul Sabiha Gokcen Airport Number of Passangers Annually				
Year	Domestic	International	Total	Change %
2023	17,661,416	19,368,589	37,030,005	▲20%
2022	15,218,165	15,551,563	30,769,728	▲24%
2021	16,122,988	8,845,773	24,968,761	▲47%
2020	11,687,578	5,263,612	16,951,190	▼-52%
2019	21,505,088	14,055,522	35,560,610	▲4%
2018	22,514,048	11,619,569	34,133,617	▲9%
2017	21,056,767	10,329,074	31,385,841	▲6%
2016	20,196,261	9,471,592	29,667,853	▲6%
2015	18,525,649	9,583,089	28,108,738	▲20%
2014	14,955,571	8,539,075	23,494,646	▲27%
2013	11,928,074	6,593,688	18,521,762	▲26%
2012	9,486,469	5,000,773	14,487,242	▲10.0%
2011	8,704,249	4,420,421	13,124,670	▲17.3%
2010	7,435,158	3,694,314	11,129,472	▲71.0%
2009	4,547,673	2,092,285	6,639,958	▲52.3%
2008	2,764,856	1,516,337	4,281,193	▲15.1%
2007	2,528,549	1,191,946	3,720,495	▲27.6%
2006	2,153,561	762,893	2,916,454	▲186.0%
2005	559,824	459,922	1,019,746	▲315.2%
2004	10,323	235,278	245,601	▲56.3%
2003	2,826	154,346	157,172	-

1.2.2. Waterway Transportation

Maritime Transportation

DFDS Pendik Port, located just 12 km away from Sabiha Gokcen Airport by road, has been providing transportation to Italy's Trieste Port since 1994. Air and maritime transportation, which play an important role in freight and cargo transportation, is integrated at these points (Figure 5).



Figure-5. DFDS Pendik Port and Sabiha Gokcen Airport (DFDS, 2024)

Inland Water Transportation

IDO Pendik Ferry Terminal, located just 15 km away from Sabiha Gökçen Airport by road, has been in operation since 1998. The terminal initially operated only between Tuzla-Pendik-Kartal-Kabataş-Karaköy in the morning and evening. However, nowadays, it has become one of the busiest points connecting Yalova to Istanbul via high-speed ferries. Additionally, Bostancı Terminal, which can be integrated with buses, offers ferry services to both the Princes' Islands and many other docks in Istanbul (IDO, 2023). (Figure 6).

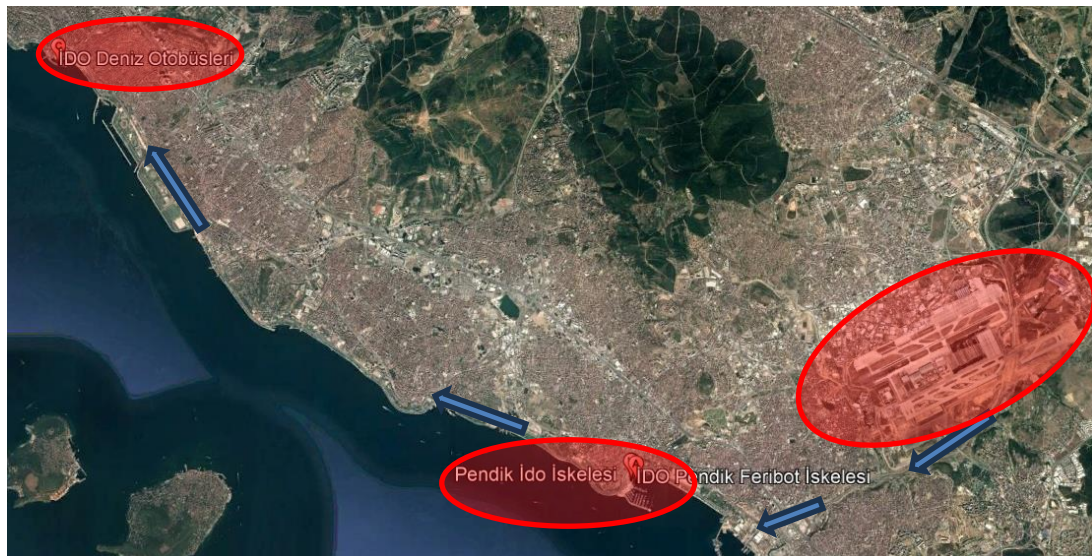


Figure-6. Pendik and Bostancı IDO Terminals and Sabiha Gokcen Airport (IDO, 2023)

1.2.3. Land Transportation

Road Transportation

Sabiha Gökçen Airport is located between two main highways connecting to Istanbul: the O-4 (TEM) to the east and the D100 (E-5) to the west. It is easily accessible from the airport to these two highways using the TEM-E5 link road.

Furthermore, the North Marmara Highway (O-7), opened at the end of 2020, also provides an alternative route for accessing the airport (Figure 7).

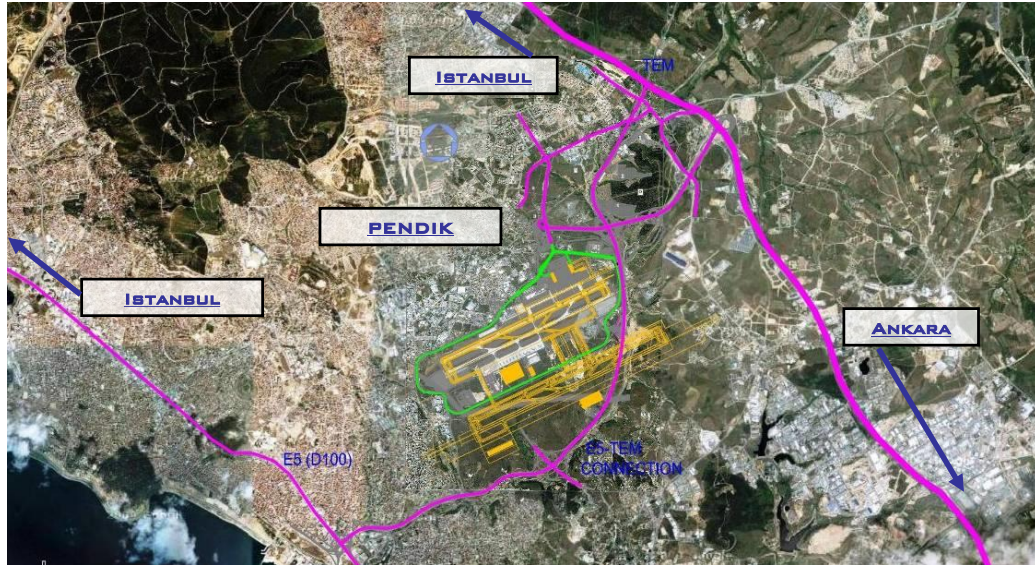


Figure-7. Road Transportation of Airport (ARUP, 2008)

The TEM highway is a toll road with three lanes and serves as the primary access route to the airport. Access to the airport from the TEM highway is provided via the Sabiha Gökçen Airport cloverleaf interchange on the TEM-E5 link road, which has two lanes. Transportation provided from the two-lane E5 highway on the west side of the airport also utilizes the same cloverleaf interchange.

Passengers can reach the airport using private vehicles, taxis, or public transportation (buses) via the aforementioned highways.

SawKoop company operates the transportation from the airport to the city center by taxi.

For public transportation from the airport to the city center, the following İETT bus lines (10 lines) or Havabus services are available.

Due to its location and catchment area, Sabiha Gökçen Airport serves not only to Istanbul but also to Bursa, İzmit (Kocaeli), and Sakarya (Adapazarı) provinces. Regular bus services from the airport to these provinces, which are at a distance of 1.5-hour from the airport by road, have been provided through mutual agreements with the local governments of these provinces. Ulaşımпарк (İzmit) started its passenger transportation services in 2016, followed by Burulaş (Bursa) in 2017, and Havasak (Sakarya) in 2020.

Additionally, since the opening of the new Istanbul Airport in 2019, shuttle services connecting the two airports have been operated by Havaist.

In June 2023, bus services from Balıkesir (BTTBUS) to airport have been started (Figure 8).



Figure-8. Bus Parking at the Airport (Google Earth Image, 2024)

Railway Transportation

Marmaray and Metro

Until 2022, Sabiha Gökçen Airport was accessible only by road. There are planned railway systems and also construction works of some of them continue. Once completed, these lines will provide significant alternatives for the transportation to and from the airport.

The initial planning was made for connecting Marmaray to both Atatürk and Sabiha Gökçen Airports based on a conceptual project prepared by Doğan Engineering and Consultancy company for the General Directorate of Railways, Harbors, and Airports Construction (DLH) Marmaray Regional Directorate in 2005.

In 2008, the status of the railway network was as follows:

- To the southwest of Sabiha Gökçen lies Marmaray, Istanbul's main railway line, extending in east-west direction and connecting Ankara to Istanbul.
- The Kadıköy-Kartal M4 metro line, located on the Asian side of Istanbul and under construction along the E5 highway, connects the west and east on the Anatolian side.
- The Pendik-Sultanbeyli metro line, for which project studies are ongoing by Istanbul Transportation Inc., aims to connect the airport to the Kadıköy-Kartal metro line and Marmaray.

DLH conducted project studies for another metro line which would directly connect the airport to Marmaray, preferably at grade. This line, along with a branch from Marmaray to Atatürk Airport, would ensure the medium to long-term connection of Sabiha Gökçen Airport to Atatürk Airport via a rail system.

The relevant authorities, DLH and Istanbul Transportation Inc., conducted joint efforts for these two significant projects.

The routes of the lines planned by the institutions are shown below (Figure 9).



Figure-9. Rail Lines 2008 (ARUP, 2008)

In meetings held with officials from Istanbul Metropolitan Municipality (İBB) and Istanbul Transportation Inc. in 2009, discussions were conducted regarding the location of the station to be established within the airport for the Pendik-Sultanbeyli Line.

In meetings with DLH in 2010, it was stated that the Marmaray line would be considered independently of the İBB project and its construction would also be carried out independently. Following ongoing discussions, a solution was developed in 2014, which involved only the connection of the Kadıköy-Kartal-Kaynarca metro line to Sabiha Gökçen Airport, with integration with the Marmaray project at Pendik Station in the future (Figure 10).

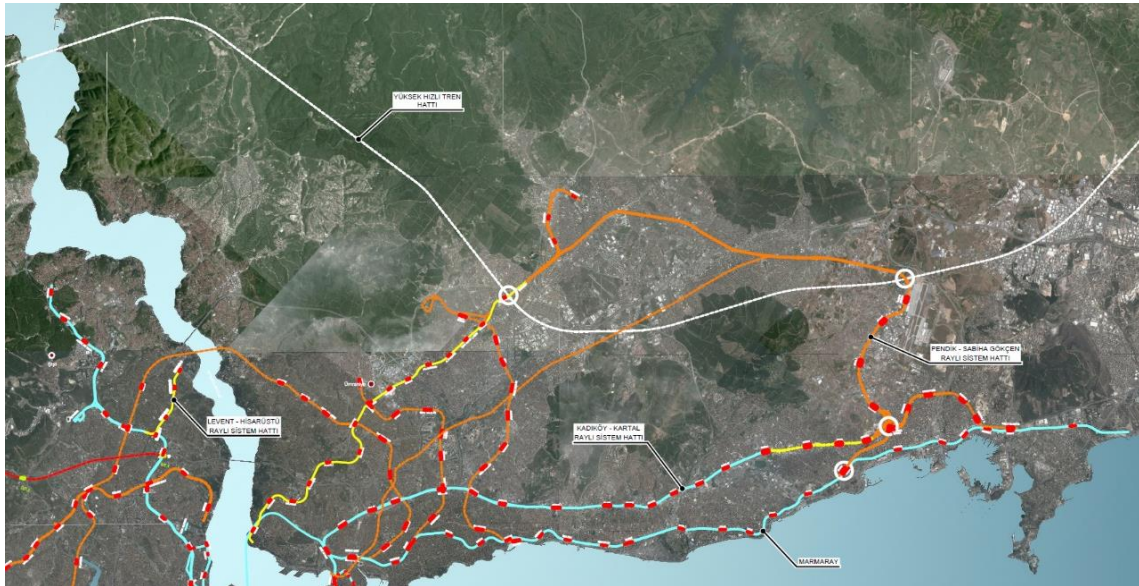


Figure-10. Rail Lines 2014 (DLH, 2014)

In 2014 and 2015, studies were conducted to determine the location of the station within the airport premises, and a final decision was made on its current location. The decision-making process prioritized minimizing the impact on airport operations while ensuring that passengers could reach the terminal building in the shortest distance possible. Additionally, considering construction difficulties, the most ideal location for the station structure was determined.

The Sabiha Gökçen Airport Metro Connection Line was opened on October 2, 2022 (Figure 11).

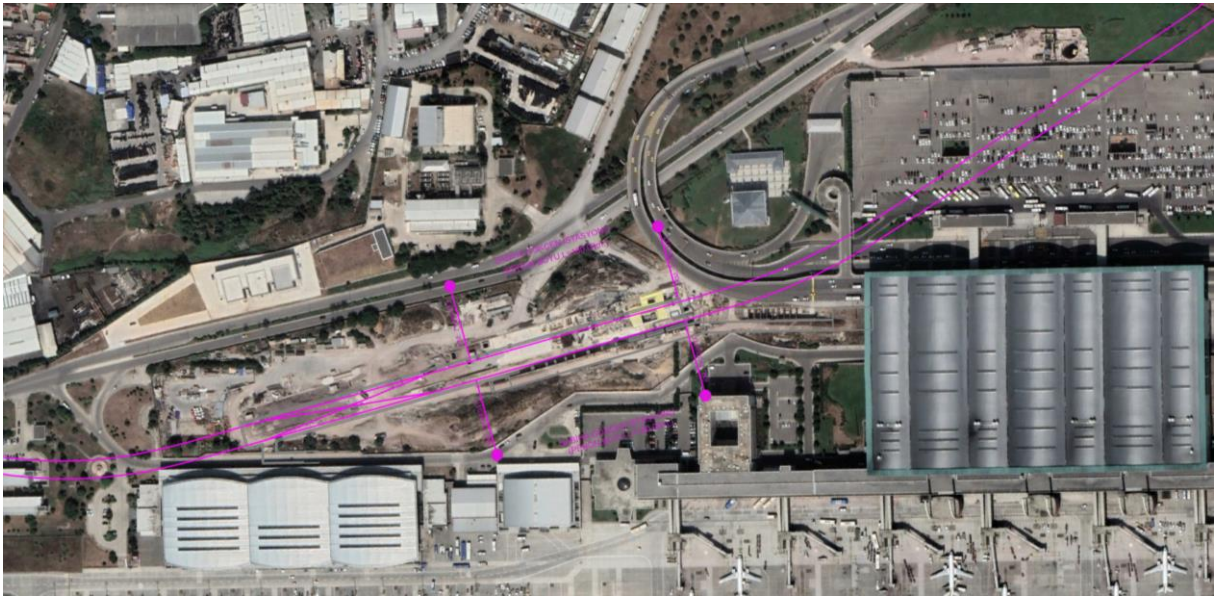


Figure-11. Structure of Sabiha Gökçen Airport Connection Station of Kadıköy-Pendik Line 2021 (AYGM, 2021)

In the fourth quarter of 2019, Istanbul Metropolitan Municipality (İBB) commissioned project studies for the extension of the Çekmeköy-Sultanbeyli Line to the airport under the project titled "Implementation Project Work for the Veysel Karani-Sabiha Gökçen Airport Rail System Line and Kurtköy Depot and Sorting Area Rail System Line." A meeting was organized for this purpose. During the evaluation, it was noted that there was no available space for an additional station considering the ongoing metro connection works by AYGM in the existing terminal area and the operational requirements of the airport. Additionally, it was mentioned in the same meeting that construction of a new terminal was planned between the two runways after the construction of the Second Runway, and it was requested to plan the route of the line accordingly to accommodate a station at this point (Figure 12).



Figure-12. Veysel Karani – Sabiha Gökçen Airport Rail Line 2019 (İBB, 2019)

High-Speed Train

As part of the High-Speed Train Adapazarı-Istanbul North Crossing project commissioned by the Turkish State Railways (TCDD) to the SWS company, the first meeting regarding the Sabiha Gökçen Airport connection was held in 2011. In January 2012, the first alternative settlement plan was prepared and shared with all relevant institutions (Figure 13).

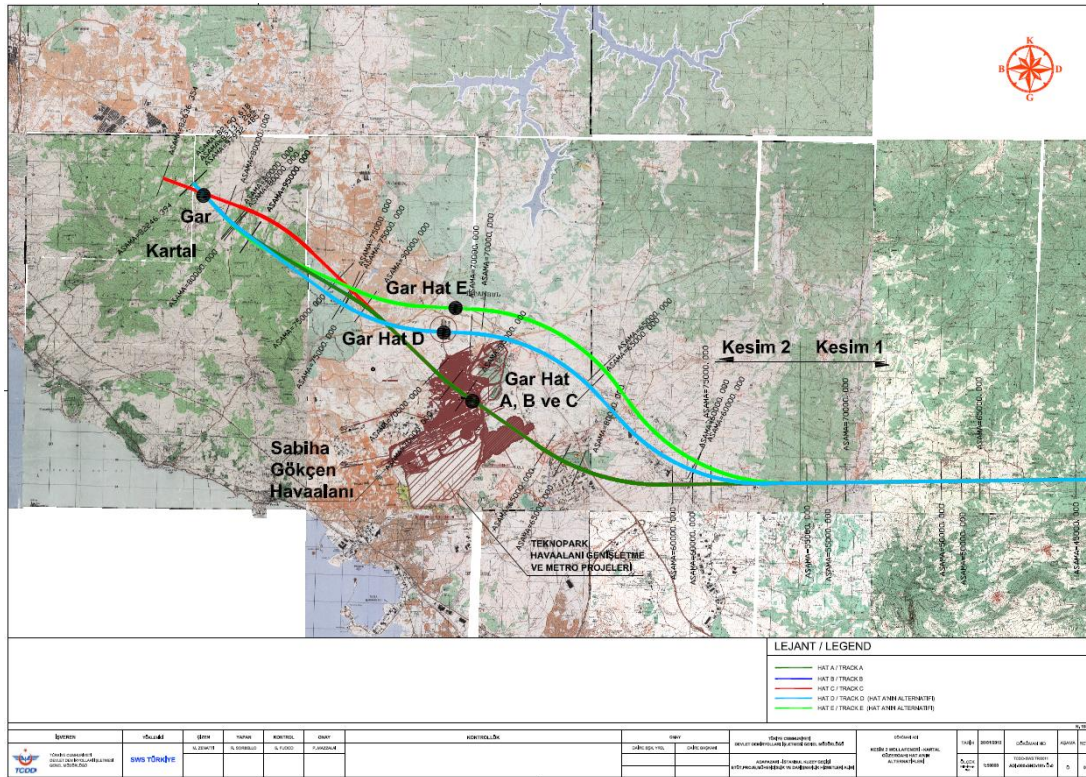


Figure-13. High-Speed Train Adapazarı-Istanbul North Crossing, 2012 (TCDD, 2023)

The station within the airport was initially designed to be situated at-grade on the fuel farm, where fuel tanks that supply fuel to aircrafts are located. However, after assessments concluding that implementation of this design was not feasible, efforts were made on alternative designs where the line was planned entirely as a tunnel and the station was relocated underground. Following these efforts, revision projects were prepared in 2015 (Figure 14).

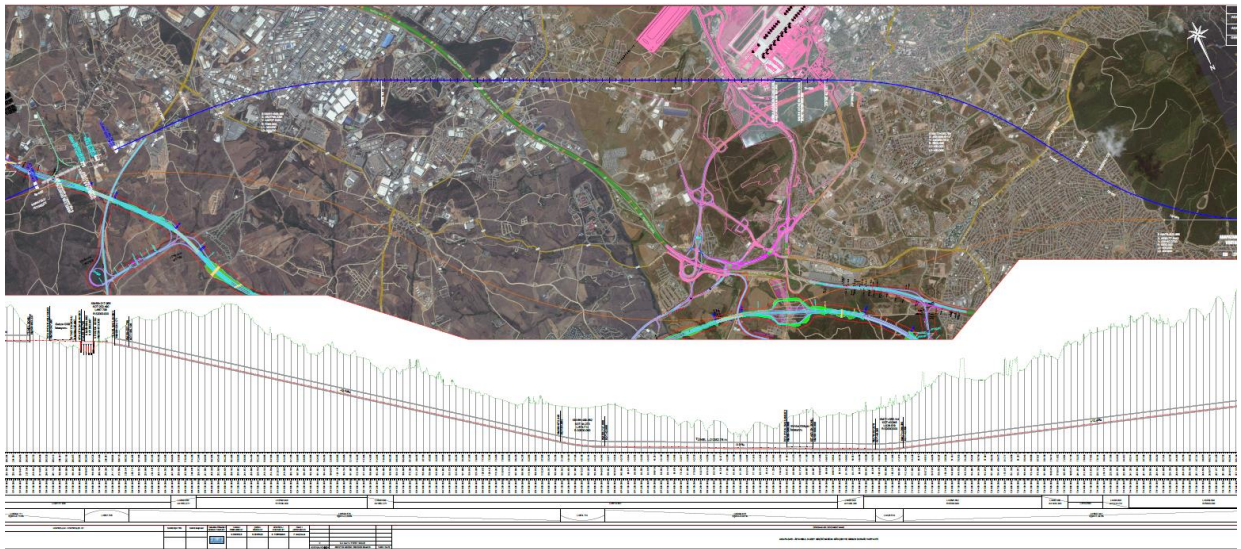


Figure-14. High-Speed Train Sabiha Gokcen Station, 2015 (TCDD, 2023)

Following the analysis conducted by TCDD officials in the revision project, it was decided to abandon the idea of routing the line through the airport due to a significant increase in costs. Instead, a decision was made to establish the station at a location adjacent to the TEM highway to ensure integration with the metro lines (Figure 15).

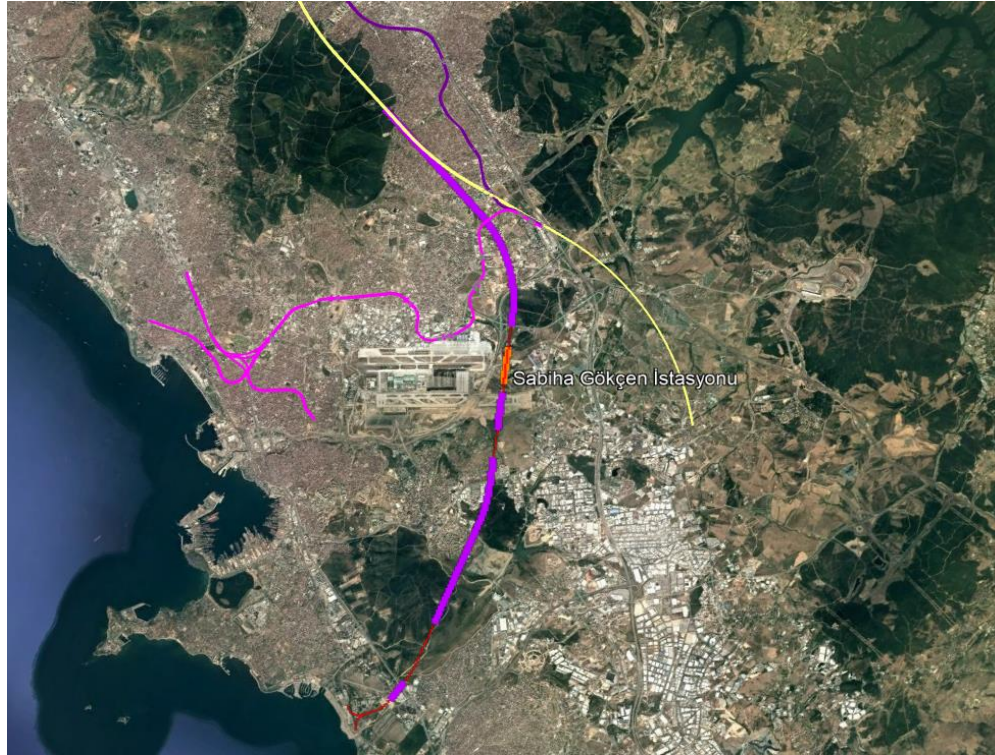


Figure-15. High-Speed Train Sabiha Gokcen Station Revision, 2017 (TCDD, 2023)

Pipeline Transportation

Sabiha Gökçen Airport has a branch of the NATO Pipeline, operated by the Ministry of National Defense (MSB) and carrying fuel from the Tüpraş refinery. This pipeline was used to supply aircraft fuel to the airport. However, due to security issues with the pipeline, its usage was terminated in 2016.

Following the closure of Atatürk Airport, an agreement was reached that the pipeline would no longer be used for supplying aircraft fuel (Jet-A1). As a result, the supply of fuel from the main pipeline was completely discontinued (Figure 16).



Figure-16. Fuel Supply Pipeline (HEAŞ, 2001)

There is a fuel hydrant line extending from the airport to the aircraft parking areas, where aircraft refueling takes place. The fuel hydrant line is configured as a dual pipeline, present in all parking areas to ensure the most efficient and safest refueling operations (Figure 17).

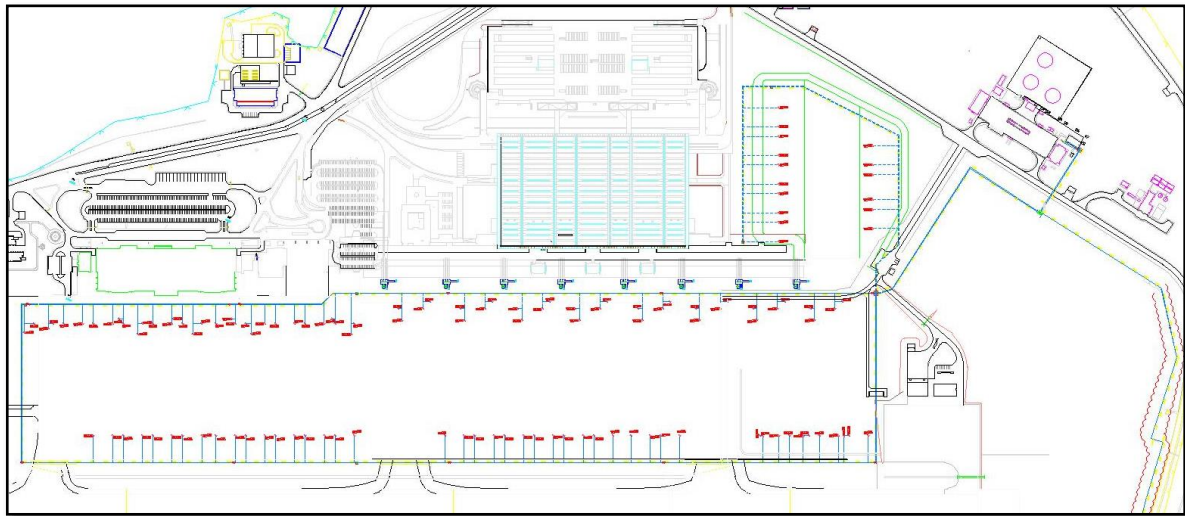


Figure-17. Fuel Hydrant System in the Passenger Apron (HEAŞ, 2014)

2. Material and Method

The first part of the study was dedicated to the literature review about the concept of transportation. The research method chosen was qualitative, specifically interpretive, focusing on evaluating the meaning and presence of a phenomenon. The phenomenon examined in the study was the modes of transportation present in international airport operations. The analysis primarily focused on assessing the problems encountered, especially integration, during the planning and construction of these modes of transportation.

Among qualitative methods, descriptive analysis was adopted. A literature review on concept of transportation was carried out.

Secondary Data was employed for gathering data related to the airport in the study,. Secondary data refers to information collected and stored regularly and in an ongoing manner by governments or private enterprises. The data were obtained from the tasks, meetings, and correspondences conducted during the researcher's tenure at the airport.

3. Findings and Discussion (Problems Experienced in the Modes of Transportation at Sabiha Gokcen Airport)

3.1. Air transportation

The main source of the problem in slot allocation procedures lies in the fact that the hourly airport capacity is planned, approved, and implemented by a single authority. The General Directorate of State Airports Authority (DHMI) is responsible for air traffic and manages both the airport capacity and slot allocation. Airport capacity is not solely related to airspace management but is also directly associated with the physical conditions of the airport and the policies of airlines. Additionally, the hourly capacity is a crucial commercial issue for the stakeholders of the airport. Therefore, it is necessary for the hourly capacity to be planned jointly by the airport authority, the main airline using the airport, and the authorities providing air traffic control, and then submitted to the authority for approval, as in European countries.

It is considered that the fact that the Second Runway project, which was planned as the main solution to the capacity problem mentioned above, has not been completed since 2012, the coordination problems and administrative issues experienced during the process need to be further analyzed in a separate study.

3.2. Land Transportation

Road Transportation

The total traffic capacity around the airport appears to be sufficient to meet the estimated demand. However, it has been identified that there may be potential problems at several points by the year 2028. The following images depict areas with transportation issues.

The location and number of toll booths at the Kurtköy exit of the O4 (TEM) highway have been observed as problematic. It is necessary to increase the number of these toll booths at this exit and/or redirect traffic to the next toll booths (Orhanlı).

This problem tried to be addressed by removing the toll booths and installing Free Passage Automatic Payment System in 2024. However, this solution led to traffic junction along the right lane of highway (Figure 18).



Figure-18. Kurtköy Toll Booths (Google Earth Image, 2023)

The speed of the trumpet interchange at the end of the airport approach road is quite low. If deemed necessary, increasing the radius of the trumpet could provide a solution to increase the capacity of the interchange (Figure 19).



Figure-19. Trumpet Interchange (Google Earth Image, 2023)

The two-lane security entrance at the airport entrance will pose problems in the long-term. It may be necessary to increase its capacity by adding extra lanes to accommodate future traffic expectations (Figure 20).



Figure-20. Main Entrance of the Airport (Google Earth Image, 2024)

The solution to the findings regarding road transportation mentioned above can be achieved through the collaborative efforts of multiple institutions. The access roads to the airport are under the authority of the General Directorate of Highways, while the area beyond the main entrance falls under the responsibility of the airport. Therefore, it is necessary for these institutions to ensure proper coordination. On the other hand, it is also observed that an upper scale Transportation Master Plan, where solutions to the identified and potential future problems are planned, should be prepared in coordination with the relevant institutions.

Railway Transportation

Due to the lack of coordination between institutions inadequate and planning throughout the process, there was a discussion about bringing two separate lines into the airport premises. However, ultimately, it was agreed upon to integrate both the metro and Marmaray with a single line. This process not only resulted in a waste of time and resources but also, due to the absence of a clear project for the rail system before the BOT project, the station could not be constructed directly under

the terminal structure, which was the most ideal location. Instead, due to the foundation piles being installed in the ground during terminal construction, the station structure could only be positioned a certain distance away from the terminal building. It is deemed necessary for both local and central administrations to jointly address rail system projects in coordination, and plan for both the present and the next 20 years using common sense.

4. Conclusion and Suggestions

Transportation systems are crucial components of modern societies, facilitating economic activities, social interactions, and mobility. Transportation can be briefly defined as the movement of people, goods, and services for a purpose, and airports are indispensable infrastructures for transportation with the adoption of the global economy and the inclusion of the most valuable asset, the concept of time.

Airports are autonomous areas subject to national and international regulations, encompassing various modes of transportation.

Being subject to the Civil Aviation Law No. 2920 independently of zoning laws, airports require collaboration with numerous public institutions and private sector stakeholders due to the multiple modes of transportation they accommodate. Locally, they may span multiple municipal boundaries and directly influence numerous municipalities in terms of zoning, particularly due to the necessity of height restriction plans for flight operation safety, which are essential for aviation.

The inadequacy of sequential planning in our country, along with the rapid urbanization driven by infrastructure and superstructure needs, leads to integration problems in modes of transportation.

While airports may prepare their own master plans internally, these plans need to be shared with all relevant institutions at a higher level to ensure collaborative planning, particularly in infrastructure-related areas, primarily transportation.

Transportation spans diverse disciplines, from engineering and urban planning to economics and environmental science. Advances in technology, coupled with effective policy interventions, are essential for creating sustainable and inclusive transportation systems. Future research should focus on integrating technological innovations with robust policy frameworks to address emerging challenges and opportunities in transportation (Forum, 2020)

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Author Contribution and Conflict of Interest Declaration Information

All authors contributed equally to the article. There is no conflict of interest.

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