DESIGNING THE AIRPORT CITY: AN INTERNATIONAL PERSPECTIVE

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ABSTRACT

DESIGNING THE AIRPORT CITY: AN INTERNATIONAL PERSPECTIVE

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Cities grow and prosper in relation with their transportation hubs. In the past, coastal towns with adequate harbors grew and expanded quickly. In modern times, similar prospects apply to cities with airports which provide competitive advantages for regional and urban development. In addition to being a complex system of facilities, airports are significant stimulators for economic activities in its catchment area. In the last thirty years or so, airports have become clusters of not only transportation-related operational services but also commercial and business activities.

Accordingly, airports have grown into complex and multi-faced mega structures, offering space for longer runways and larger terminals, and accommodating a growing number of functions that have nothing related with aviation. Hence, Aerotropolis defined by Prof. Dr. Kasarda is regarded as an urban cluster with similar features to the traditional metropolitan structure. In its core, Airport City is located which functions as the traditional city center of Aerotropolis.

This thesis focuses on the principles and relationships for land use planning and design of airports and their environs under the umbrella of Airport City concept. It is aimed to underline current design framework of Airport Cities which is found

missing in terms of academic studies. In this context, the Airport City model clarified, and selected cases have been evaluated under certain design principles in order to have an output about design criteria of the Airport City development. The research concludes with inferences regarding existing design guidelines of certain Airport City cases.

Keywords: Airports, urban design, airport planning, Airport City design, Aerotropolis, airport oriented development

ÖZ

HAVAALANI ŞEHİRLERİ'Nİ TASARLAMAK: ULUSLARARASI BİR BAKIŞ

Zamanov, Ayaz

Yüksek Lisans, Kentsel Tasarım, Şehir ve Bölge Planlama Bölümü

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Şehirler ulaşım merkezlerine bağlı olarak büyüme göstermektedirler. Eski zamanlardan beri limanı olan kıyı şehirleri diğer şehirlere göre daha hızlı gelişmişlerdir. O günlere nazaran bugün havaalanları aynı rolü üstlenmiş, şehirlerin bölgedeki rekabet gücünü arttırmışlardır. Kompleks yapıda var olan bu sistemler, ekonomik bağlamda kendi bölgelerinde güçlü birer tetikleyici etmen olarak göze çarpmaktadır. Havaalanlarının son 30 senedeki gelişme durumu incelendiğinde, bu yapıların sadece ulaşıma odaklı büyümeye değil, aynı zamanda ticari ve işletmeye dayali bir gelişmeye uygun bir etmen oldukları saptanmıştır.

Gelişmelere bağlı olarak, havaalanları günümüzde birçok farklı fonksiyonları içeren kompleks yapılar haline geldikleri ve hatta havaalanı odaklı olmayan birçok fonksiyonu içerdikleri görülmektedir. Buna bağlı olarak, günümüz havaalanı odaklı gelişme seneryolarından biri olan Aerotropolis, Prof. Dr. Kasarda tarafından geleneksel şehir merkezi yapısına sahip bir kentsel küme olarak tanımlanmaktadır. Havaalanı Şehirleri kavramı da bu noktada doğmuş ve Aerotropolis adı verilen yapının geleneksel bir şehir merkezi olarak çalışmaktadır.

Tez, var olan Havaalanı Şehirleri konseptli havaalanlarının kentsel tasarım kriterleri altındaki özelliklerini ve arazi kullanım şekillerini inceleyerek ileriye yönelik doğru bir planlama çerçevesi oluşturmayı amaçlamaktadır. Akademik anlamda eksik görülen Havaalanı Şehirleri'nin tasarımı adı altında altı çizilmek istenen nokta, bu tür gelişmelerde hangi tür tasarım kriterlerinin kullanılmış olduğunu ortaya çıkararak nasıl daha iyi bir kentsel doku elde edilebileceğini ortaya çıkarmaktır. Bu bağlamda, Havaalanı Şehirleri konsepti tanımlanmış ve seçilmiş olan tasarım kriterleri altında değerlendirilmiştir. Bu çalışma, analizler sonucunda elde edilmiş çıkarımlarla son bulmaktadır.

Anahtar Kelimeler: Havaalanları, kentsel tasarım, havaalanı planlaması, Havaalanı Şehirleri'nin tasarımı, Aerotropolis, havaalanı odaklı gelişim

To My Family…

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TABLE OF CONTENTS

LIST OF TABLES

TABLES

LIST OF FIGURES

FIGURES

CHAPTER 1

INTRODUCTION

Transport infrastructure has played a vital part in forming urban areas just like towns located at crossroads and along ancient trade routes. Urban form has been affected by transport oriented planning which can be easily seen by analyzing European cities. Seaports in 18th Century, railways in 19th Century, highways and freeways in 20th Century formed most of the cities in order to boost economy and development of the city in upper scales. Even in historic urban models of Ebenezer Howard and Le Corbusier, transportation was the core of their concepts. Today, Prof. John Kasarda defines airports as *"The Way Forward"* for 21st Century as the 5th wave which is driven by a number of innovations that characterize the way we live and work. He also states that speed is the keyword of our current life which means time based competition. All of these reasons made airports to be the major generator of urban development for todays' cities.

1.1 Hypothesis and Main Questions

Airport City concept become clearly a powerful solution for metropolitan cities to boost their economy and urban development. Airports have been seen only as transfer stations and were located to periphery sides of cities since first times. However, today, airports become a major catalyzer for urban and economic growth which gradually made them to be a vital part of cities. The main hypothesis of the thesis is that urban design should have a role in planning an Airport City. Within this scope, this study aims to find the answer of following question: "What should be the design framework for Airport Cities in order to create more urban spaces?" In order to develop such a framework, it is important to analyze Airport City structure in terms of urban design guidelines.

With respect to main question and hypothesis of this study, this thesis aims to respond to the below questions by analyzing four cases which formed under different design principles:

- What are the main design criteria that should be evaluated for Airport City?
- What are the design perspectives for Airport City development?
- Is there a single solution for any case in the world that can be applied?
- What are the essentials in designing an Airport City?
- Do Airport Cities correspond to their main characteristics in terms of design?

Istanbul Sabiha Gökçen International Airport, Frankfurt Airport, Amsterdam Schiphol Airport, Paris Charles de Gaulle Airport and Incheon International Airport have been selected to be analyzed in order to achieve answers for these questions.

1.2 The Structure of the Thesis

The main aim of this study is to present current design framework of Airport Cities which then can be evaluated and improved in terms of urban design. The importance and difficulty of this study starts from the lack of studies that have been done since today in this field. Mostly economic and regional effects of Airport Cities are taken into consideration in various studies. It is hardly tried to concentrate on the discussion of spatial quality of Airport Cities and how it can be improved by looking current examples.

In Chapter 2, which provides a general overview and history of airports, it is tried to be discussed planning and development perspective of airports. Standards have been given in this part which are internationally accepted guidelines for airport planning. Also, land use patterns around airports have been categorized under certain most used land uses and described with conceptual schemes. In addition, this chapter presents general information about Turkish Aviation's history and Turkish government's planning perspective for Airport City in Sabiha Gökçen International Airport case. Because of the current development process of the project, only future plans and concepts of the project has been discussed.

Chapter 3 focuses on the theoretic perspectives of new trends for airport developments, Aerotropolis and Airport City. Drivers, functions and critical factors of these concepts in planning perspective have been discussed in order to define Aerotropolis and Airport City.

Chapter 4 presents general information about selected Airport City cases in order to understand the structure which is in the background of planning those Airport City cases.

Fifth Chapter is the main part of this study that includes detailed analysis of design characteristics for particular cases; Istanbul Sabiha Gökçen International Airport, Frankfurt Airport, Amsterdam Schiphol Airport, Paris Charles de Gaulle International Airport and Incheon International Airport. Three main criteria have been selected in different scales to define Airport City design principles:

- Design structure and scale,
- Movement and mobility characteristics,
- Morphological specifications.

While analyzing cases, mostly Google Earth Pro has been used for satellite images and photos. Spatial analysis are mostly done on satellite images. In order to understand the system of particular Airport City examples, further researches have been done. Conceptual schemes are used to express certain important conditions that are essential for this study.

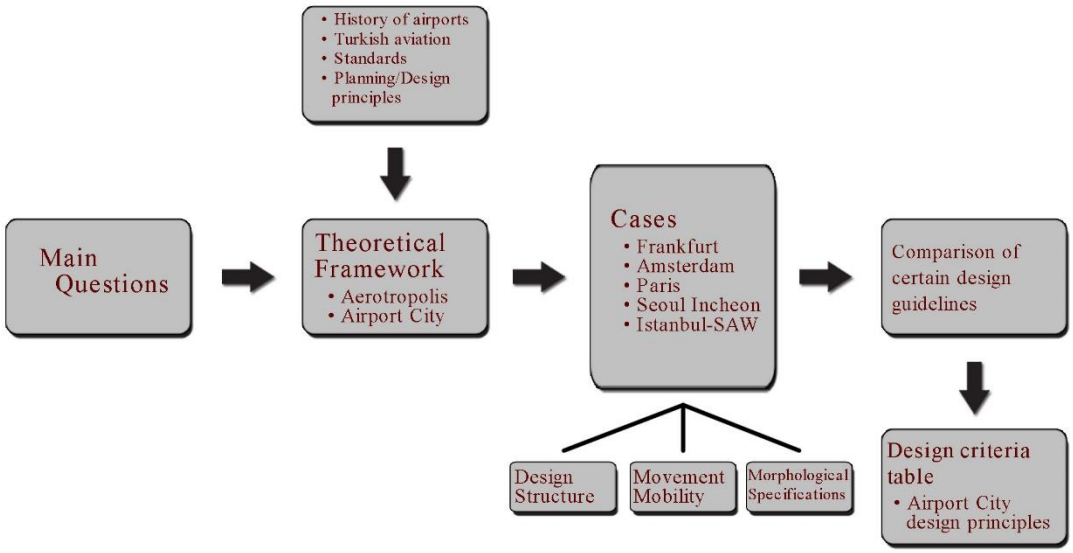


Figure 1: Figure showing the structure of the thesis

In order to understand how city airports become Airport Cities, it is essential to check out passenger and freight statistics. These numbers conclude the importance and visited frequency of the place, which is the airport terminal that made the impact for such developments to exist today. That is why it is important to look at the history of planning process for the airports. After checking the history, concepts that this thesis deals with should be understood; Aerotropolis and Airport City. By giving analysis of Turkish case, it is purposed to inform how Turkish airport planning perspective can be related with the theoretical background of this thesis. Sabiha Gökçen International Airport is an adventitious example of an Airport City so that it cannot be evaluated as a tangible factor like other cases. Figure 2 shows how these steps have been taken to create a design framework for Airport City development.

In final chapter of the thesis, a short summary and findings are provided. After describing main outcomes of the thesis and a discussion on how an ideal Airport

City should be, future research recommendations are given in order to improve studies in this field about Airport City developments.

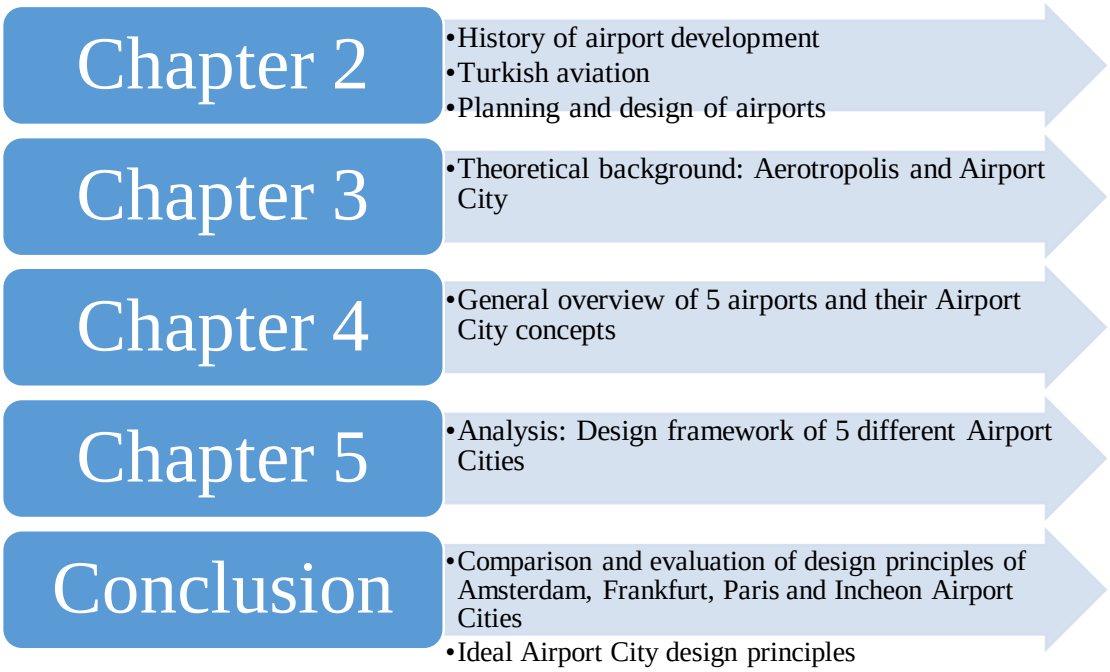


Figure 2: Chapters with definitions of each

1.3 The Research Methodology

Four different cases have been used as a research method for this study. Except Frankfurt Airport, other three cases are categorized as Aerotropolis developments by John Kasarda in 2013. Amsterdam Airport Schiphol, Incheon International Airport and Paris Charles de Gaulle Airport are defined as operational Aerotropolises in Europe and Asia/Pacific (Appendix). Before starting to analyze these airports, it is needed to carefully understand what definitely an 'Airport City' term correspond to. A broad research about Aerotropolis and Airport City terms has been done by not only analyzing books, articles and reports, but all video and audio contexts that can be reachable are also examined. Because of the lack of studies in this field, urban design perspective of Airport City development couldn't be found by only researching this field. As a consequence, it is decided to examine theoretical

framework of Airport City under urban design principles to help to create more healthy spaces around airport terminal.

Istanbul Sabiha Gökçen International Airport has been selected as a Turkish case for Airport City development. In Turkey, there doesn't exist any Airport City development so far, but Sabiha Gökçen International Airport is trying to be transformed into an Airport City. Frankfurt Case has been selected because of the unique planning decisions that were made on old train station. Limited space, that was pushing the limits of design and planning criteria of Airport City, was an important milestone in selection process. Amsterdam case can't be seen as a surprise because it is accepted as the most consciously planned airport under the heading of Airport City concept. Paris Charles de Gaulle Airport has been selected as the third case because of the structure of Airport City that it has. Such a significant and compact campus development is pretty rare to take find and analyze. Last case, Incheon International Airport is the youngest and newly developing example comparing to others. It is unique with the free land that is available for any type of design and planning, and by being constructed on an artificially created piece of land between two islands. Incheon also differs from other cases because of its location, which is located very close to South Korea's capital in Asia.

Case analysis have been done under three main headlines which are believed to cover all important design principles for Airport Cities. This study gives details about Airport City development under the scope of urban design. In this study, satellite images and conceptual schemes are used to simplify the thoughts that are derived from analysis.

CHAPTER 2

FROM CITY AIRPORTS TO AIRPORT CITIES

2.1 Overview of Airports

Flying beyond clouds have been always a dream for humans at the late 19th century. Everything started with the invention of airplane by the so called Wright brothers. They managed to make the first powered, controlled and sustained human flight on December 17, 1903. Interesting point here is that before airports, airplane came first. "Airfield" term wasn't hard to construct and design on those years. Any flat ground with proper wind would have been suitable for those aircrafts (light, with a tail wheel and low engine power). During the development of aircrafts and airports until the end of the 1970s, airports were needed to be selected on the basis of performance and geometrical characteristics of the aircraft (Kazda & Caves, 2007). However, today, these circumstances have been changed and airports started to be the core utilities for cities.

2.1.1 History and Development of Airports

Starting from the 19th century until 1960s, almost all international travel was done by rail or water transportation. Ports and railroad stations were assumed to be the major hubs in the cities. Air transportation shifted to be the most chosen type of transport and played a significant role in the mid-1910s. After 1920s, when the First World War ended, first flights were opened by the air carriers between big metropolitan cities such as Paris, London, and Prague. Regardless of these flights, firms didn't need to build bigger and more usable airports. Airports were functioning in the most common way that they can function such as having just a simple passenger building for passengers and hangars for working on the airplanes.

In the 1930s, Douglas DC-2 and Douglas DC-3 were introduced as the aircrafts which had more capacity to carry passengers and having much bigger size. However, this fact didn't affect airports in a manner of rebuilding them. Runways and terminal capacities were mostly suitable. There were no needs of big changes on airports because mostly business or rich and famous people have been able to use air transport. With respect to this fact, airports haven't fall into any physical change for a long time until new aircrafts been invented.

As I mentioned before, air transportation start with the World War I and after the war, military services made air transportation to be more known and chosen transportation type. Rise in number of aircraft and the needs of military pilot training made airports to become much bigger. More facilities, hangars, workshops and barracks were needed for military pilot training.

If we think about what a war can benefit human life, there is not much more to say. However, wars benefited civil aviation and air transport in a very good manner. After the World War II, in the beginning of 1940s, ground communications were highly damaged but surplus of military aircraft also available to use them for civil aviation. Support of America to rebuild Western European economies with the Marshall Plan allowed civil aviation to build itself much faster. All these factors make civil air transportation to recover quickly and to continue developing to a higher level comparing WWI.

In a short period of time, airports needed to be reconstructed under the needs of aviation and new aircrafts. First affected part of the airports were the runways. As airports were started to be used much more frequently than in the past, runways needed to be more durable, paved and longer depending on the aircraft's needs. With all the developments made to airports, regularity of service started to be important. Therefore, number of runways depending on crosswind have been changed. Airports started to serve more aircrafts in the meanwhile by having more than one runaway with different directions to minimize the effect of crosswind. Consequently, big international airports started to have complex runaway systems to operate more efficiently. Demand on airports increased and terminal facilities were insufficient to meet demand. Other than services required for the processing

of passengers, first non-aeronautical services were constructed, such as toilets, restaurants and duty free shops in the borders of airport. Indeed, the need of such non-aeronautical services and the demand of those services right in the airport terminal were the first steps on the road of Airport City.

Introduction of jet propulsion aircraft has played a significant role in the development of airports. Jets made airports to build up both considering runways (increase in width and strength) and other equipment with technical facilities. Fuel supply system have been changed with the new invention of jet planes which lead to a reconstruction of the fuel farms and introduction of new refueling technologies (Kazda & Caves, 2007). In 1970, new wide body jet aircraft was introduced by the company of Boeing with a model number of B747-100. This model made a big impact on the design of the terminals. Since B747-100 could replace two or three existing aircrafts in total capacity, this case made terminal building capacity under pressure of operating over-capacity. With such a huge aircraft approaching to the gates, it made a need of enlargement of stands, increasing maneuvering areas of the gates which should be suitable for B747s, and other requirements for the terminal building (Kazda & Caves, 2007).

Air transport industry has been changed in time depending on many different factors. One of them was the introduction of wide body aircrafts by Boeing Company which is B747-100. Invention of large aircrafts made a need of a system change inside and outside of airports. Of course, there should be some limits for the expansion of aircrafts and airports. Qualification of airports, which are classified by the projections for upcoming years of certain airport and the city itself, helps us to know which airport should get bigger and which shouldn't. Depending on these analysis, airports were re-designed for the requirements of new wide body aircrafts.

In 1995, new wide body aircraft, Boeing B777-200, with folding wingtips was introduced to meet airlines' passenger demands (less capacity comparing with B747). Airlines had a demand of less seat capacity but more efficient aircrafts from the manufacturers. Boeing 777 have just two engines but it can afford to fly as much as the range that a B777 can fly and B777 is much more efficient in these circumstances. After many measurements and calculations, airport industry marked

a point that an aircraft should fit into 80m box to cope with it economically. According to this restriction, Airbus Company introduced A380 in 2007 which provides seating for 525 people up to 853 people in all-economy class configuration. Airbus explains their new aircraft with these words: *"More-Efficient, cleaner, quieter and smarter – the A380 is a game changer in terms of aircraft performance, cost-efficiency, comfort and sustainable growth."* (Airbus S.A.S, 2015). A380 was a very important milestone for airport industry in terms of demand, airport facilities, airport growth and businesses. It contributed new developments and needs for airports. For example; although Hong Kong have been designed to handle the needs of A380, secondary changes were still needed to tick all the boxes. On the other hand, airports that are designed with much older standards had to have a big change to accept giant aircraft. London Heathrow airport is one of the busiest and well known airports in the world. Denial of A380 would stop passengers to come to London as almost all airlines started to consider A380 in their crew. Heathrow went to a £450 million expense and transformed old gates to accept the new and more demanding aircraft (Kazda & Caves, 2007).

2.1.2 Important Factors of Airport Development

Airports have been places which continuously been changing during their lifetime. Some researchers mention that these changes are caused by new aircraft technologies. However, it is mostly provoked by political and economic developments (Kazda & Caves, 2007). In 1960s, the role of airports and their responsibilities have been changed seriously in Europe. Mostly because of the successful privatization and corporatization of airports in Britain and in some other countries, whole world started to consider airports as the key factors for government policies such as subsidy. Kazda and Caves (2007) mentioned important factors that effected airport development for the years of 1975 to 1992:

1. Possible risk of terrorism and illegal acts,
2. Privatization of airports,
3. Growing deregulation of air transport,
4. Growing environmental issues outside airport developments.

Security is one of the most important issues for the civil aviation. There should be zero risks/mistakes in civil aviation because any mistake caused by security reasons are irrevocable. Kazda and Caves (2007) stated that it is good to know that civil aviation isn't the main focus of terrorism. Terrorists' concern is generally giving damage to "enemy" country. Correspondingly, they chose to act in air transportation to have much more chance to give damage. Possible risk of terrorism on every flight made airport terminal buildings to change their working principles. Many bomb attacks which have been as the true stories in the past appeared to be the reason of separation of the arriving and departing passengers in the airport terminals. This also caused security systems to be supported by much better technical equipment for detecting explosives. After 2005, the amount of people who died by using air transportation observably decreased. For example; total of 3 people died in years of 2005 and 2006 as a result of violating civil aviation laws. When we compare this with 39,189 people killed in car accidents in 2005 in USA (DOT, 2005) or 12,658 people murdered again in the USA in 2005 (NationMaster, 2006), it is obvious that air transportation is much safer than people thought it is. As a result, good news in air transportation sector according to security issues make airports more reliable.

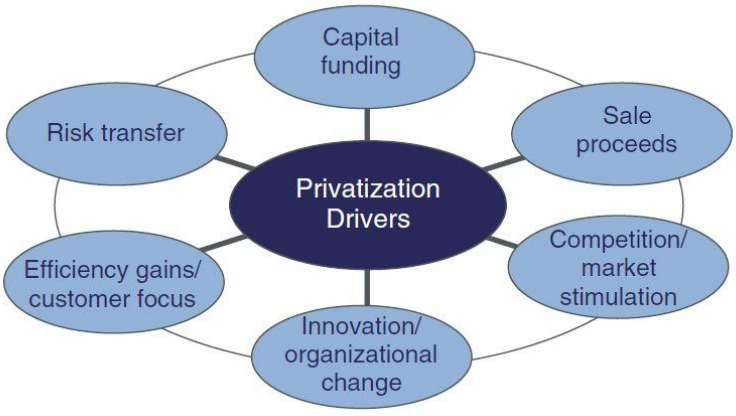


Figure 3: Privatization drivers

Almost all airports have been counted as government funded developments since first airports. In 1986, first *privatization* started in Great Britain. This case meant to

be as a leading fact in airport administration and financing issues in Europe. However, in USA, there is just one commercial service airport owned and operated privately, Branson Airport (Ernico, Boudreau, Reimer, & Beek, 2012). Most people support the idea that focusing on commercial activities decreased the success of interchanges between air and ground transport. However, this fact made developers to concentrate more on services both for the passengers and other visitors of the airport (Kazda & Caves, 2007). Potential benefits of airport privatization mentioned in 'Airport Cooperative Research Program Report 66' (2012) under the title of *'Privatization motivations and drivers'* as follows: (1) usage of the share of private capital for further improvements, (2) get any type of payment for airport benefits, (3) excite air industry in terms of competition, (4) introduction of new ideas to help develop nonairline revenue, (5) efficient operation and maintenance with an improved customer service in long-term, (6) change the possible pressure of debt, capital development, and/or operations to the private sector, (7) decrease in the time of project delivery and construction payments, (8) ease on taking general tax levies, (9) letting private sector to make decisions on airports not depending on political facts (Figure 3).

Deregulation was the third important factor that affected airline industry. It firstly started in USA with the Airline Deregulation Act of 1978. Prof. D. David A. NewMyer (1990) stated in his article that airport developers and managers should be aware of the new global airline situation which will affect relationships between airlines and airports. In fact, after many analyses of the results or impacts of deregulation, Airline Deregulation Act made the situation to become a model for the rest of the world after experiencing the results of deregulation in USA (Federal Aviation Administration, FAA aviation forecasts fiscal years 1987-1998, 1987). Many analyses showed that deregulation act resulted as a dramatic growth in the airline industry since 1978. Starting from 1978 to 1988, in U.S. Domestic Airlines, total departing passengers grew in total of 180,435,000 passengers (Table 1).

Table 1: Total Enplanements - U.S. Domestic Airlines 1978-1988 (Federal Aviation Administration, 1989)

Total Enplanements--U.S. Domestic Airlines 1978-1988

Year	Enplanements	% Change
1978	274,179,000	---
1979	316,863,000	+15.3
1980	296,903,000	-6.3
1981	285,976,000	-3.7
1982	294,102,000	+2.8
1983	317,905,000	+8.1
1984	344,683,000	+8.4
1985	382,022,000	+10.8
1986	418,946,000	+9.6
1987	447,307,000	+6.8
1988	454,614,000	+1.5
Cumulative Growth 1978-1988	+180,435,000	+65.8

According to FAA report, airline industry has gone through noticeable periods in those years. Firstly, expansion appeared noticeably as in total of 30 large air carriers have been existed in 1978 but their number reach to 105 in 1985. Secondly, 61 active air carriers consolidated at the end of 1988. Thirdly, %60.4 of traffic in 1988 was held by only four largest carriers, however it was %52.5 in 1978. Fourthly and lastly, most noticeable period of the deregulation has been counted as when United Airlines declared partnership of a marketing merger with British Airways in specific routes (Federal Aviation Administration, 1989). All these factors, that made airport industry to deregulate itself, changed air transport to process more emancipated. After deregulation, air transport can behave in a more freely accessible market without any capacity or price limitations. This case shifted the number of unique people who have ever traveled by plane to increase with an

immediate effect. Before deregulation, in USA, %70 of total population had never travelled by plane. However, it was reduced to %20 (Kazda & Caves, 2007).

2.2 History and Evolution of Turkish Aviation

2.2.1 Evolution of the Turkish Aviation Industry

Evolution of the Turkish aviation can be defined in two main periods; before and after 1983. In 1983, 2920 numbered Turkish Civil Aviation Law (Türk Sivil Havacılık Kanunu) gave the opportunity for private sector to manage air transportation and airport operations. This law started a new era in Turkish aviation history (Ulaştırma Bakanlığı, 1989). However, before Turkish Aviation Law, Turkish aviation sector was actually a step ahead comparing other countries in the world. Turkey had airplanes, pilots and technicians in Yeşilköy waiting for to be organized to take the first step into aviation.

State Planning Organization (DPT) , in Turkey, defines air transportation sector as follows;

> "*Air transportation sector includes airway management, airport management, air traffic control service, ground control and catering services, education, maintenance, infrastructure and superstructure, coordination and supervision of other aviation activities in terms of international requirements."*

In Turkey, first important milestone in aviation sector has been created in 1911. In this period, war minister Mahmut Şevket Paşa has made many important steps in military aviation. Süreyya Bey has been appointed to build new facilities in the district of Sefaköy which corresponds to North of Atatürk International Airport in Istanbul. First construction included two hangars and a square.

Yeşilköy Hava Mektebi, first aviation organization in Turkey, created the substructure of military aviation also by giving opportunities for professional civil aviation on 3rd of July, 1912. Therefore, an important fundament has been created both for today's Atatürk International Airport and Turkish aviation.

Establishment date of Turkish Airlines hasn't been far away from those days. In 1933, 2186 numbered law stated the new Airway State Management (Hava Yolları Devlet İdaresi) which was served under Ministry of Defense. Thus, Turkish Airlines has been established (THY, 1983). Establishment of Turkish Airlines would lead to the formation of new private airline companies in future.

Since 1970s, Turkish aviation had only 2 important institutions besides military aviation; Turkish Airlines and Turkish Air Association (Türk Hava Kurumu). During those years, there weren't expected any new private airline companies to be built because of the laws and authorities' interpretations and notions. However, in those years, rapid development has made world to use time and speed more efficiently comparing past years. In the end, such progresses made aviation sector to expeditiously grow and to become important transportation mode. Turkish Airlines couldn't handle all operations, as it was a need on those years, except some metropolitan cities (Hoş, 2003). Correspondingly, in 1977, Bursa Airlines has been established by some public and private individuals in Bursa. Nevertheless, because of the non-scheduled flights between Bursa-İstanbul-Bursa, and with lack of operational issues, Bursa Airways bankrupted and closed in 1980 (Keskin). All in all, depending on the development of airlines and other consequences, current status of civil airports shows the need of good air transportation network in Turkey (Figure 4).

Figure 4: Civil airports in Turkey (dhmi.gov.tr)

2.2.2 Deregulation Period

Deregulation of the aviation industry in Turkey has been started in 2002. Ministry of Transport and Communication of Turkey begin to liberalize the aviation sector by allowing the entrance of Fly Airways for direct flights between Istanbul and Trabzon in 2003. Before 2003, however, deregulation process has had an impact more on other industries of the economy rather than aviation.

In terms of such privatizations which have been done in Turkey, as the first example, Ucak Servisi AS was privatized in 1989 (USAŞ, 2013). Ucak Servisi AS, which was an airline catering firm, was owned by the state and, since 1993, share of the company has been processed in İstanbul Stock Exchange. HAVAS, for example, were fully privatized in 1998 which is a ground handling cooperation (Yetişkul & Senbil, 2012). In the case of THY, privatization of state-owned company started in 1990 and in the same year 1.8% of the shares of the company were privatized (Özenen, 2003). 23% and 28.75% of the shares were offered to public in 2004 and 2006, respectively, reducing Privatization Administration's shareholding to 49.12% eventually (OIB, 2012). Important point here is that the structure of THY still remains the same.

Another common and important motive of the government in privatization in Turkey is to enter into a BOT concession arrangement under which a private sector consortium receives a franchise to finance, build, and operate a facility for a fixed period and transfer to the government at the end of the contract. BOT model at airports have started in 1993 with the tender of Antalya Airport International Terminal (AYT), which was transferred in 2007. International Terminal of Atatürk Airport (IST) in Istanbul and 1st and 2nd International Terminals of AYT were the examples which have been built as BOT model and rented with rental agreements after their transfer. The tenders for new projects have also been realized within the same scope such as the construction of a new international terminal building for Milas-Bodrum Airport (BJV). The constructive impacts of the BOT model on the aviation industry and the Turkish economy are stated in SHGM.

2.2.3 Progress of the Passenger Transportation and Freight in Turkey

In 1933, first steps of commercial flights have begun to appear with Ankara-Eskişehir-İstanbul line of flight. However, regular flights kicked off in 1936. In 1937, Izmir-Istanbul, Istanbul-Ankara and Ankara-Adana flights increased the total number of flights by three. Furthermore, Izmir-Ankara flight began to operate in 1939. After 1940, new airports have been built on various places in Turkey which lead to the increase in total flights. Year of 1943 was the first year of the Ankara-Van flight which included East of Turkey into the national air transportation network. With Samsun's entrance into air transportation network, total flight number increased to 22 in 1945 (Taşlıgil, Türkiye'de Havayolu Ulaşımının Gelişimi, 1997).

First international flight from Turkey has flown in 1947 route of Ankara-İstanbul-Atina. As the follow up to Atina flight, in 1951, Nicosia, Beirut and Cairo flights established (THY, 2013). In 1939, total passengers that used air transportation calculated as 399. This number hugely increased when we look at the year of 1943 which was total of 56.911 (Taşlıgil, Türkiye'de Havayolu Ulaşımının Gelişimi, 1997). Following those years, when we look at the passenger numbers by periods of five years, it can be said that Turkish aviation regularly increased its domestic and international passenger numbers (Table 2).

Table 2: Total passengers for Turkish airports in between 1948-2014 (Devlet Hava Meydanları İşletmesi Genel Müdürlüğü, 2016; Taşlıgil, Türkiye'de Havayolu Ulaşımının Gelişimi, 1997)

Total Passengers (1948-2014)			
Year	Total Passengers	Domestic	International
1948	72.262	-	-
1951	111.914	-	-
1956	202.066	-	-
1957	329.880	-	-
1960	713.217	528.846	184.371
1965	977.913	681.623	296.290

1970	2.679.139	1.661.980	1.017.249
1975	4.800.902	2.599.373	2.201.529
1980	3.458.165	1.621.998	1.836.167
1985	6.323.448	3.061.822	3.261.626
1990	13.629.965	5.347.723	8.282.242
1995	27.767.379	10.347.528	17.419.851
2000	34.972.534	13.339.039	21.633.495
2005	55.545.473	20.502.516	35.042.957
2010	102.800.392	50.575.426	52.224.966
2014	165.720.234	85.416.166	80.304.068

In 1985, passenger numbers perceptibly increased because of effectuation of the 2920 numbered civil aviation law (2920 sayılı sivil havacılık kanunu) in 1983. This law allowed private airlines to enter passenger transportation sector which unsurprisingly increased competitiveness in aviation. Except the year 1991, which was the year of the so called Gulf Crisis (Körfez Krizi), increase in aviation sector continued until today (Taşlıgil, Türkiye'de Havayolu Ulaşımının Gelişimi, 1997). Until 1985, difference between the numbers of international and domestic passengers weren't too far away from each other. Starting from 1985, air transportation has been used more on international concept rather than domestically (Figure 5). Beginning from 1990s, tourism was the main factor behind the increase of the passenger numbers. Tourists started to visit Turkey more frequently which concluded a raise in international flights.

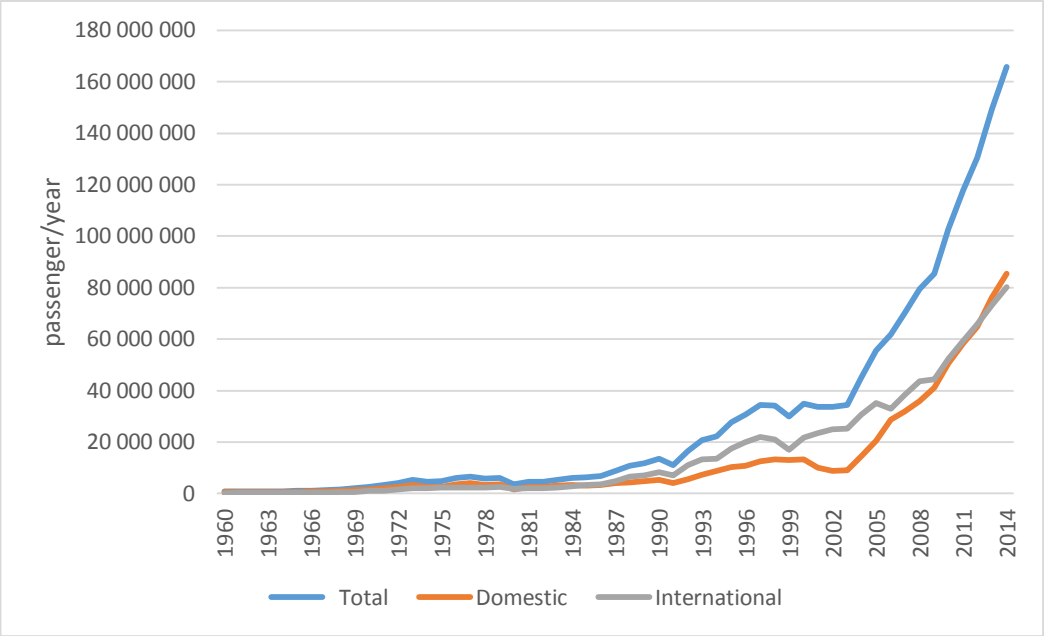


Figure 5: Total passengers in Turkey depending on the years in between 1960-2014 (Devlet Hava Meydanları İşletmesi Genel Müdürlüğü, 2016)

The positive developments in tourism and investment sectors evaluated in the 6th Development Plan which somehow helped THY to increase their service standards and to fulfill all the possible capacities on their flights (DPT, 1990). In the 7th Development Plan, it is also stated that the regions that have possible potentials for tourism and export will be cared specially depending on the airport investments (DPT, 1996).

In consequence of all progresses that have been done in Turkish aviation sector, the share of air transportation in domestic transport was 0,06% in 1950s. This rate increased to 7,82% in 2011. Especially for big investments, such as for airport city development, it is important to consider state as the investor and shareholder of the project. For instance, Ministry of Transport's vision for 2023 is expected as 14% for the share of air transportation in domestic transport. It shows that state would give necessary incentives and investments until 2023 (Ulaştırma Bakanlığı, 2011).

After World War 2, as passenger transportation increased year after year, numbers in freight transportation also increased simultaneously. However, the increase

wasn’t as good as the rates for passenger transportation. The reason lies behind such fact is the high prices for air transportation comparing other opportunities such as road, sea and rail. On the other hand, air transportation becomes more eligible comparing other modes of transport when it comes to the time. Precious gems, masterpieces, electronics, cameras and the products with short service life (medicine, flowers, fruits, eggs etc.) made air freight transportation more selectable. In addition, air freight consisted mostly of posts rather than those products that is mentioned (Tümertekin & Özgüç, 1997).

Turkish air cargo services and facilities developed and increased in the level as other countries in the world. Turkish Airlines started cargo service in 1981 which led other private airlines to support THY since 1984. As the flagbearer of Turkey, Turkish Airlines kept up developments happening around the world and accepted to work with other cargo carriers to share cargo load (Taşlıgil, 2010).

The share of air cargo in Turkish aviation wasn’t different than passenger transportation (Figure 6). Change in air freight transportation shows same characteristics with the history of passenger transportation in Turkey. In 1960s, share of the air cargo in Turkey comparing with other transportation modes was almost zero. In 2010, share of air freight in total freight transport of Turkey was 0,44%. Ministry of Transport’s 2023 predictions are not similar to passenger transport: rate is predicted as 1% (Ulaştırma Bakanlığı, 2011).

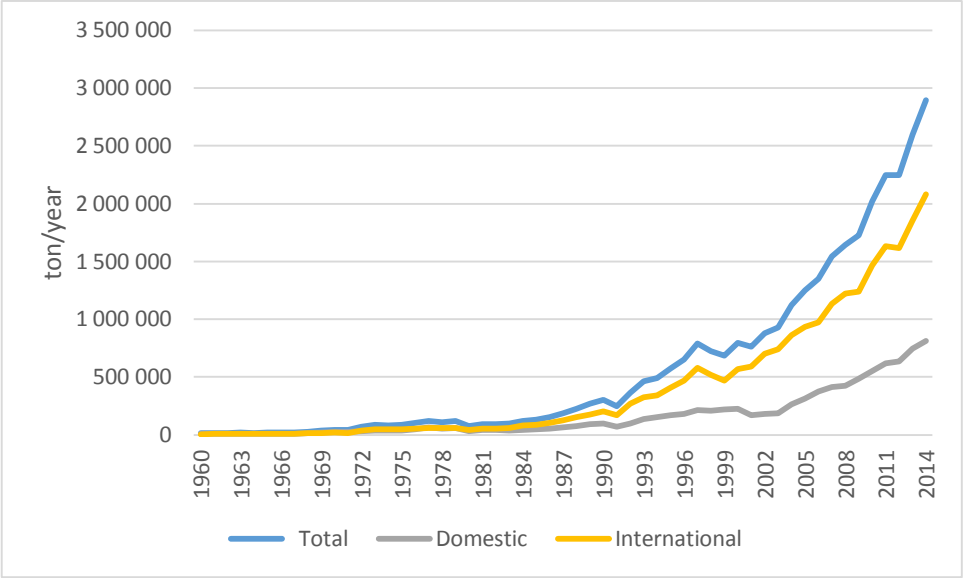


Figure 6: Total freight transportation in Turkey depending on the years in between 1960-2014 (Devlet Hava Meydanları İşletmesi Genel Müdürlüğü, 2016)

Gulf Crisis (Körfez Krizi) affected air transportation temporarily in 1991. In 2001, economic crisis and terrorism decreased numbers both for passenger and freight air transport, especially domestically. Despite all negative influences, Turkish aviation get better and better since 1980s (Table 3). The role of 2920 numbered Turkish Civil Aviation Law (Türk Sivil Havacılık Kanunu) should be underlined in this positive progress (Karaca, 2015).

Table 3: Total air cargo for Turkish airports in between 1960-2014 (Devlet Hava Meydanları İşletmesi Genel Müdürlüğü, 2016)

Total Air Freight (1960-2014)			
Year	Total (ton)	Domestic (ton)	International(ton)
1960	13.002	8.306	4.696
1965	18.414	9.594	8.820
1970	44.039	24.249	19.790
1975	87.642	37.778	49.864
1980	75.442	32.231	43.211

1985	133.082	47.254	85.828
1990	301.403	99.549	201.854
1995	576.920	171.552	405.368
2000	796.627	226.356	570.271
2005	1.249.555	315.858	933.697
2010	2.021.076	554.710	1.466.366
2014	2.893.000	810.858	2.082.142

For all those improvements that have been happened throughout years, air freight consisted largely of baggage. Air cargo was only 28% of all freight that transported through air (Figure 7).

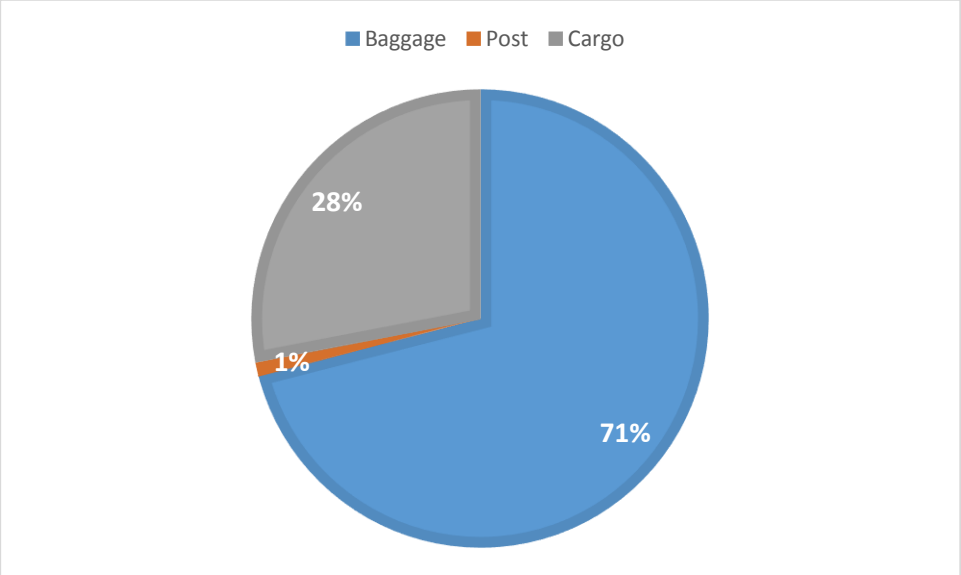


Figure 7: Distribution of payload for air freight in 2012 (Karaca, 2015)

2.3 Standards

2.3.1 ICAO

Civil transportation have a big role in air transportation. Correspondingly, civil aviation seems to be the most powerful force in the progress of modern life. Today's

life is mostly dependent on time in any part of it. If it is asked to discuss why certain standards were needed to handle a healthy and growing air transport system, so the answer should be to use time in an efficient and right way. Every second of time, an airplane takes off or lands somewhere on earth. Standards, known as Standards and Recommended Practices (SARP) which are accepted universally, play a big role on these flows to process accordingly (ICAO, Making an ICAO Standard, 2011).

The need of common rules or requirements for airports had been needed right after the World War II because airports become more settled and used comparing before that time period. In 1944, the Convention on International Civil Aviation, known as the Chicago Convention, established the International Civil Aviation Organization (ICAO) in Chicago. ICAO have been a specialized agency of the United Nations which is responsible for coordinating and regulating international air travel (ICAO, 2015). ICAO accepted Annex 14-Aerodromes to the Convention in 1951. The Annex includes set of standards for airports such as planning, designing and operating airports. According to the developments in air industry, changing aircraft needs and passenger terminal capacities, Annex 14 has been changed and edited in long period (Kazda & Caves, 2007).

Security is one of the most important factors which affected airports in terms of improving facilities or even rebuilding new ones. Creating such standards is one way of taking security threads into control. Specific standards have been set to enhance security at the same level on every corner of the world for airport facilities, ground equipment and procedures. Indeed, these standards should have been accepted by the aviation community to coordinate within the same system.

2.3.2 FAA

Standards have been taken into account seriously by all countries and applied according to ICAO standards mostly. However, some countries wanted to elaborate ICAO documentations to make it more distinctive on their air spaces. Every country has its own strict regulations especially for their military airports. In this respect, USA established an authority called The Federal Aviation Administration (FFA) to improve international standards in aviation in States. FAA is responsible for

establishing the so called federal aviation regulations (FAR), which are necessary for flight operations. FAA official website (2015) states that, between 2001 and 2007, aviation came through one of the safest periods for scheduled flights. Besides the terrorist attacks towards USA, total 11 accidents were occurred in a period of 7 years. In fact, FAA call these numbers as the safest, most reliable, most efficient, and most productive air transportation system in the world.

2.4 Planning Airports

The rapid airport development in the beginning of 1980s caused many airports to exceed their capacities. Increase in volumes of passengers and freight have been continuously grew and this lead to a need of facility expansion. This continuous growth in airport industry couldn't have been welcomed well by community (van Praag & Baarsma, 2005). In United States, many airports are looking forward to expand their capacities depending on the FAA's plan to modernize the National Airspace System over 2025. Airport expansion has been always a concern for governments because of the incompatible land uses around airport. Noise issue has been one of the most sensitive and critical concern in airport development because of noise-sensitive land uses such as hospitals, residential communities and educational institutions. Correspondingly, a study (Kelly, 1997) revealed that airports actually made residential communities to settle around airports, but it caused community members to gain a negative impression about airports. Regardless of such a negative community reaction, airports continue to expand their boundaries to create new employment opportunities by the help of major industrial usages. These industrial workspaces mostly consists of businesses that are mostly dependent on air transportation to increase their profit by reducing transportation costs (Li, Eiff, Laffitte, & McDaniel, 2007). In this manner, increase in employment rate and opportunities that are created by these businesses attract people to settle near airports. It minimizes their time commuted to work from their home. As a result of this circumstance, by constructing more residents, the need of schools, hospitals, commercial developments, churches and other facilities occurring immediately (McMillan, 2004). While population and development increases, it affects air traffic in the same manner. It is fundamental to forecast this development

in a manner of land use around airports to avoid any incompatible land use (Li, Eiff, Laffitte, & McDaniel, 2007).

The rapid growth in airport industry brings problems in terms of airport planning such as exceeding airport capacity, uncontrolled land use developments, environmental issues etc. Increased passenger and cargo traffic making airplanes to move more slowly inside airport fence and it gradually oblique planners to expand airport development. Building a new airport or expanding an existing one is not an easy or short task to do. Airport planning process starts with the risk identification opportunities and it is followed up with an airport strategic plan. There are many components of this plan and it consists of 5 interdependent plans which are categorized in Figure 8 (ACRP Report 20 - Strategic Planning in the Airport Industry, 2009).

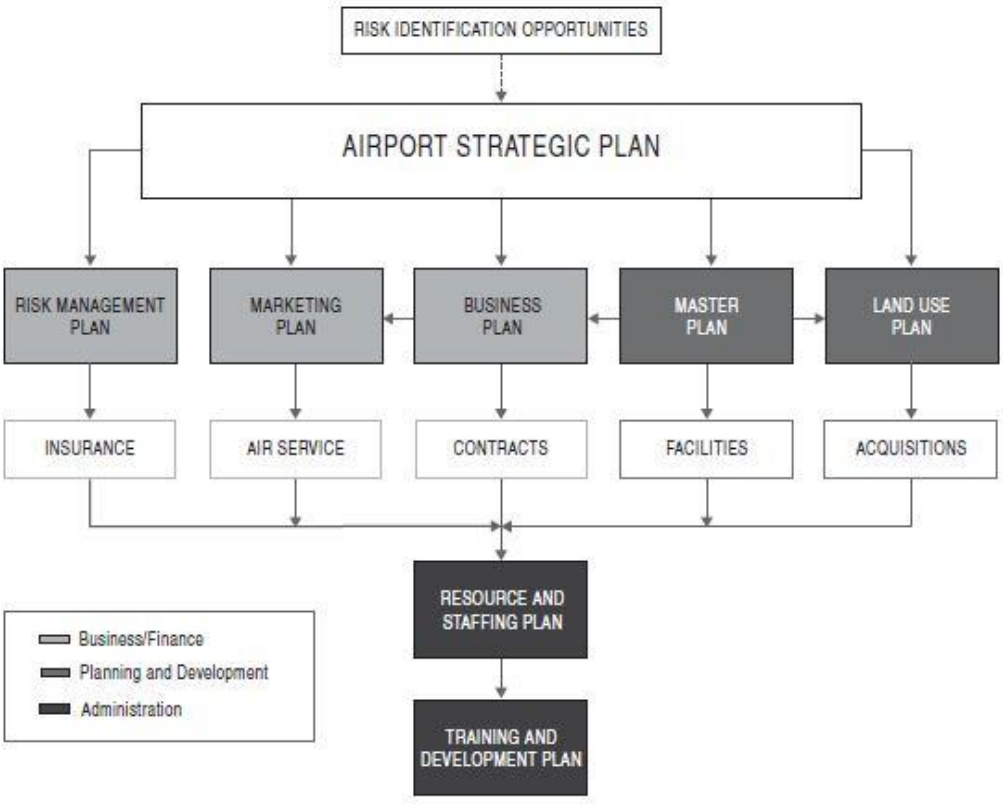


Figure 8: Interrelationship of airport planning processes (ACRP Report 20 - Strategic Planning in the Airport Industry, 2009)

2.4.1 Airport Master Planning

International Civil Aviation Organization (1987) defines master plan as the planner's conception of the certain development for the specific airport. Master plan is basically a graphic representation and written report of the main logic behind the specific airport development. In addition to this definition, Federal Aviation Administration defines the master plan as "the sponsor's strategy for the development of the airport" (Federal Aviation Administration, 2015). FAA mention that the main purpose of a master plan is to describe the whole scheme needed for the future airport development which also should cost-effectively satisfy aviation demand. Besides and in addition to these, the plan also should consider possible socioeconomic and environmental effects which are very important for such a huge development (Federal Aviation Administration, 2015). To sum up, airport master plan is a conceptual plan of the airport's long-term facility development.

Airport master plans should consider all developments which are both in and out of airside. To make it clear, it should involve all the guides as follows;

- Development of facilities,
- Development of land uses in the airport vicinity,
- Determination of impacts of airport construction on the environment,
- Determination of airport ground access (International Civil Aviation Organization, 1987).

As it was mentioned before, master planning is mostly focused on facilities. Strategic planning of airports has much more compressive approach comparing with the master planning. Strategic planning gives a background to master plan about the definition of airport's vision. Master plan clarifies that the facilities are identified and the space is reserved for the sitting according to the vision of the airport (ACRP Report 20 - Strategic Planning in the Airport Industry, 2009). Master Plan of an airport can only be a guideline. Hence, it does not include any program of construction or details of design. Master planning includes also a financial plan which does not include detailed and accurate information about financing such a development. It is hard to estimate detailed financial needs for such a long term

project. It is suggested to estimate costs of construction over short term with accuracy to obtain more economic feasibility (Kazda & Caves, 2007).

Airport master plans are approved by the local governmental agencies or authorities which own and/or operate the airport. Airport master plans need to be updated regularly to measure necessary maintenance, development, expansion, and modernization. These revisions are necessary to meet the demand on airports to give adequate services on a local, regional and national basis (Florida Department of Transportation Aviation Office, 2010).

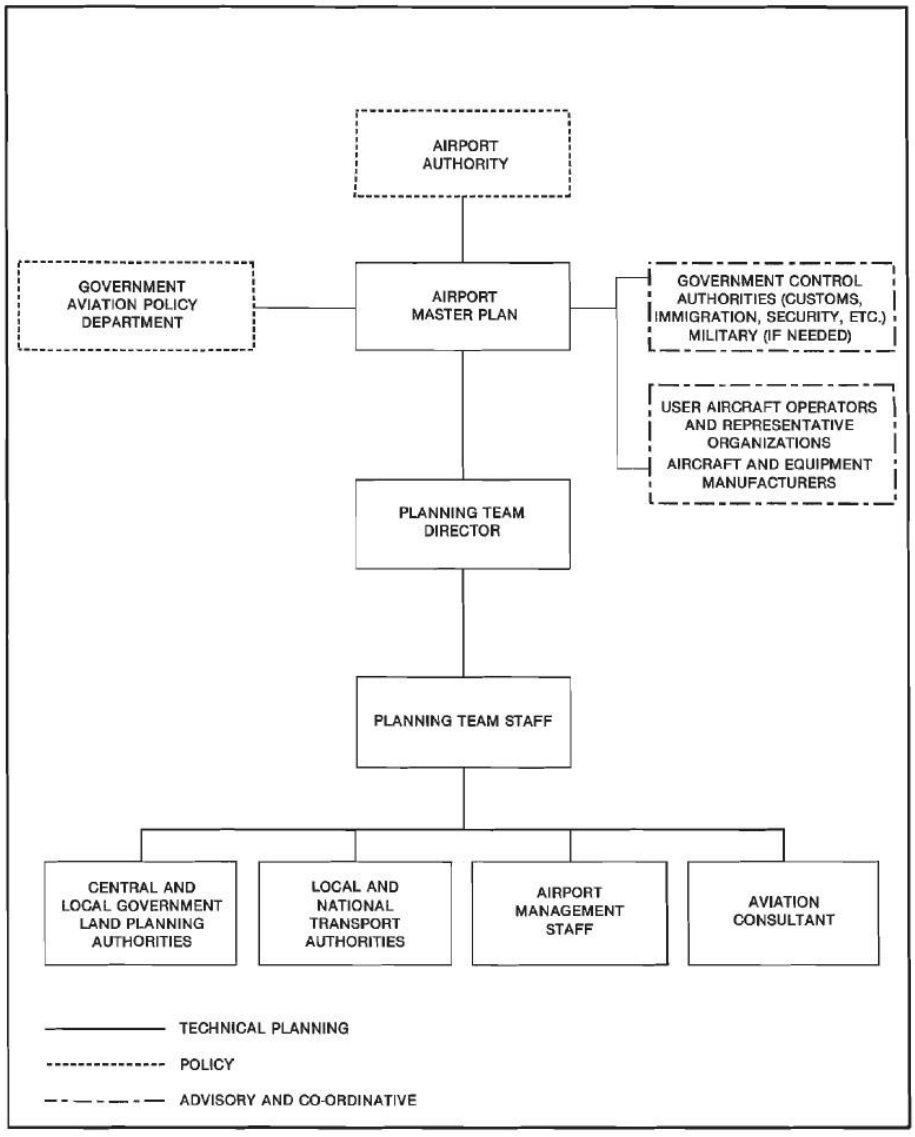


Figure 9: Typical airport master planning organization (International Civil Aviation Organization, 1987)

2.4.2 Land-use Planning

Land-use planning may include on-airport and off-airport components in it. As it is mentioned under 'Airport Master Planning' topic, on-airport land use planning should be included in Master Plan. However, off-airport part of the airport development become crucial in today's new planning concepts, such as Airport City and Aerotropolis. It is important to plan off-airport planning accordingly to sustain a controlled long-term growth and sustainability strategy. It has seen that, in USA, off-airport development have significant impacts on airside development and operations such as capacity planning of airports (Florida Department of Transportation Aviation Office, 2010). Especially, planning both on and off-airport developments should give good results in terms of potential noise impacts and environmental conflicts. Otherwise, off-airport planning cannot be taken under control. It is advised that off-airport planning must be finalized in a coordinated way between local and state governments, local and regional planning agencies, the local populace and other interested stakeholders. Any other land-use plans that have been developed before for the off-airport land should be taken into consideration, also (Florida Department of Transportation Aviation Office, 2010).

Airport land use plans include two extents; on and off-airport land uses. Firstly, on-airport land uses show master plan decisions that are developed by the airport sponsors. Secondly, off-airport land uses are also shown which are developed by surrounding communities. In this step of planning, it becomes very crucial to organize city, regional, state and airport planners in a careful way to obtain good output for such an airport development. The way which runways, taxiways, and approach zones are planned becomes significant to configure the land uses which should be planned around airport borders. Land use planning for an airport is a comprehensive planning. Airport planning, policies and programs must be carried out in a coordination with the objectives, policies and programs of the master plan of airport. It is important to integrate transportation facilities and public services with patterns of residential and other major land uses depending on the size, location and configuration of the airport (Young & Wells, 2004).

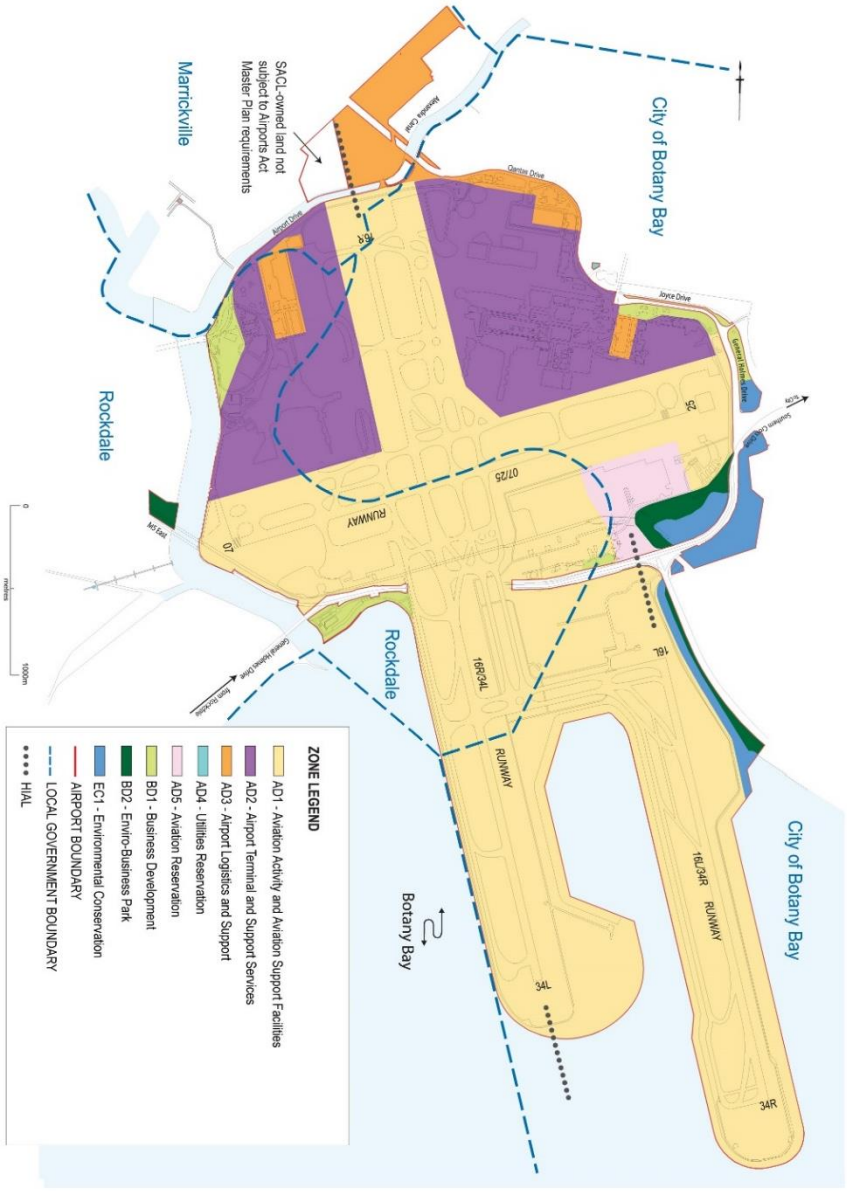


Figure 10: Sydney Airport land-use plan (Sydney Airport Corporation Limited, 2009)

2.4.3 Strategic Planning

Strategic planning is defined as the preparation of a process which explains an organization's strategy or direction of the way they choose to allocate its resources to follow that strategy (Mintzberg, Lampel, Quinn, & Ghoshal, 2013). Since it is generally described as a long-term process, there should be a revision of strategies in certain periods of time. It is accepted that strategic planning is based on the idea

that organization's future can be influenced by the decisions made in the present. That's why strategic planning requires instant revisions to be prepared for any kind of existing or potential challenges that an organization will may have. Every single decision is made for the organization's future visions (ACRP Report 20 - Strategic Planning in the Airport Industry, 2009).

The airport strategic planning process can be defined in four main phases: preplanning, analysis/evaluation, implementation/execution and monitoring (ACRP Report 20 - Strategic Planning in the Airport Industry, 2009). These steps are considered to be the same for all airport strategic plans regardless of airport size or type. For sure, the amount of data to be collected, reviewed, and analyzed may vary depending on organization's size and complexity, the amount of effort and time used in planning process, and the number of stakeholders involved in planning process (ACRP Report 20 - Strategic Planning in the Airport Industry, 2009).

A strategic plan should mention some key elements about the organization's future strategies. In a report of an airport cooperative research program titled as "*Strategic planning in the airport industry"* (2009), some key elements of the strategic planning framework have been described as follows:

- *"A mission statement that identifies the organization's purpose and its core values (a separate values statement may also be created);*
- *A vision statement that portrays the organization's future goal(s);*
- *Identification of the organization's strengths, weaknesses, and opportunities, as well as threats that may affect the organization;*
- *Definition of strategic issues that must be addressed over the course of the strategic plan;*
- *A set of generic and grand strategies, long- and short-term objectives, and action plans that provide a road map for addressing the gaps between the organization's current state and its vision; and*
- *Definition of key performance indicators (measures and targets) to evaluate the progress made toward achieving long- and short-term objectives."*

Figure 11: The airport strategic planning process framework (ACRP Report 20 - Strategic Planning in the Airport Industry, 2009)

Preplanning process is an important part of the airport strategic planning. After preplanning process, strategic planning continues with an evaluation and development part of the mission, vision, values and environment. Defining these significant points leads the process to define the organization's strategic decisions to create competitive advantage over other organizations. Following this, specific short and long term action plans should put on the table for the organization's objectives to be successfully achieved. Finally, performance and evaluation plans should be considered with the key indicators and targets of the plan (Figure 11).

Strategic planning in aviation industry should be flexible and adaptable. Every day, new challenge comes through that certain major airport and it is crucial for an airport to handle those economic challenges. Airline bankruptcies or restructuring, new national regulations, any economic change for low cost carriers or economic slowdowns in region may obligate governing entities to reconsider their flexibility and adaptability about that airport. Correspondingly, the airport strategic planning process must be evaluated in its own uniqueness depending on regions individual characteristics.

2.5 Planning and Design of Airports

Airports are said to be the historically dynamic consequences of todays' cities (Gordon, 2004). With the help of increasing urban population growth, airports emerged from being just an architectural building to a new urban form. In 1920s, first aerodromes have been started to form as city gateways, just like rail and port terminals in 1930s. World War II was an important factor in terms of international air travel. When the war ended, there was a good amount of surplus in terms of airplanes which were successfully survived from war. It helped international air travel to expand rapidly starting from 1950s. After 1960s, new airports have been started to be built outskirts of the cities to substitute older facilities which are either out of capacity or unavailable for use. Since those years, cities were already been affected by the huge increase in population. The result was urban sprawl. That sprawl made cities to disperse by getting closer to the airports which were constructed outskirts of metropolitan areas. Such factors let city planners to find new solutions both for problems according to urban sprawl and how to connect our new city gateways with the core of the city. Robert Freestone (2009) explains Castells' (1996) thoughts about the evolutionary of the airports with these words;

> *"... in his treatise on the rise of informational society introduced the concept of 'spaces of flows', redefining the geography of economic development as less about an amalgam of individual places but more the connections between them. In an increasingly globalized world where flows of goods, people, and services are central, aviation networks help define world connectivity. Increases in routes and traffic have led to the emergence of vital airport hubs and reinforced global city status. Airports are the 'hubs of flows', and have experienced revolutionary change in their operational and strategic environments in the process."*

Airport City is defined by John Kasarda as the airport at the city's heart which also operates as the core of the Aerotropolis. A similar definition was made by Le Corbusier in the 1920s for airport city concept in addition with the existence of the skyscrapers accompanying multi-nodal grand central station. Le Corbusier

mentioned the keyword ‘commerce’ for such an urban form which is highly depended on the speed. He says that *“the city which can achieve speed will achieve success”* (Le Corbusier, 1987).

Today, the best suitable model for airport-led urban development is Kasarda’s ‘aerotropolis’ model. It is defined as the normative urban form (Kasarda, 2000/2001). In this form, the only non-commercial land uses are residential districts. It is crucial to plan and develop such huge investments without letting them to be spontaneous and haphazard. Three important aerotropolis principles are defined (Freestone, 2009);

1. Clustered development rather than ribbon development,
2. High quality design standards,
3. Beautification of airport gateways.

Aerotropolis model is the best described business development concept for airport led urban developments. Successfully planned airport is a driver of a city’s and region’s economic performance (Moore-Wilton, 2007). In spite of economic advantages of aerotropolis model, it is obviously expected from such a huge development to have weaknesses. Such as dependence on a non-renewable energy resources, or over-concentration of critical infrastructure are considered as the weaknesses of aerotropolis model (Charles, Barnes, Ryan, & Clayton, 2007). Apart of these possibilities, unplanned and haphazard developments under the name of aerotropolis may cause urban sprawl and scatter land uses of suburban developments.

Solutions are not given in any type of guide or textbook. Every region and airport has its own planning and design problems which need to be solved. American Planning Association (2006) states that it is crucial to plan these type of airports depending not only on the existing airport planning guidelines but also planning by knowing how to design regional scale facilities and environmental impact concerns related by noise. Airports, such as Bangkok’s Suvarnabhumi, Hong Kong’s Chep Lap Kok, and Seoul’s Incheon, have been using complex solutions for engineering problems to encompass a range of considerations which include design of regional communities and town centers (Freestone, 2009).

Prof. Kasarda, who is known as the pioneer for the aerotropolis concept, states that 'neither the presence of an airport nor planning alone makes for a successful aerotropolis'. The most important part on planning airport city or aerotropolis process is to carry airport planning with urban planning. In addition, the cost of land, control of real estate speculation and designing proper transportation system with accessibility opportunities are the key points in designing such mega projects to achieve successful level of planning (Freestone, 2009).

2.5.1 Land-Use Patterns around Airports

Land use types around airports are categorized in two main levels: residential and commercial activities as primary level, and as the secondary level, compatibility concerns are analyzed by their types of buildings, the density and size of the development, and the geographic location relative to the runway environment (Airport Cooperative Research Program, 2010). Airports are very sensitive structures because each of those specific features affect development types and their compatibility with the environment of the airport.

Building type is defined as the individual building units and their placement with each other on a site. Even building material considered as the crucial decision on building relations. As building types may differ from a modular home to a "big-box" retail store, material of the building should also offer more structural integrity to a building. It is important to choose correct material according to the building type (Airport Cooperative Research Program, 2010).

Density of development is one of the most important factors that should be taken into consideration to build healthy environments. Density is considered as the number of building units per area of land. Sometimes defining density does not enough to relate activities and space. Intensity becomes crucial factor in this case. It defines the number of persons within an area of structure relative to the amount of time they occupy an area (Airport Cooperative Research Program, 2010). Proper decision in these two terms is to limit both density and integrity of an area to reduce the incompatibility issues.

Size and geographic location of the development are also important determining factors for airports. For example; size of a project basically means the land area of the project or development which may differ from 100 m^2 residential structure area to a 1500 ha commercial development. To give more detailed example of what may be needed to take care for such huge development depending on the size is that a large commercial development should need huge parking lots which requires additional water detention areas to accommodate storm water runoff. These areas can contribute wildlife attractants which is dangerous for takeoff and landings. As a result, bigger footprint creates bigger issues for airport developments.

2.5.1.1 Residential

Residential use means anything that includes dwellings which meet housing needs of people. Residential developments are important to be designed carefully because of the potential safety and noise issues. As it is known that airports in the past were constructed at the outskirts of the cities which had enough open spaces. It eventually gave free room for safety reasons to be achieved. However, today, almost every airport is under the risk of over construction because of the population increase and need of accommodation. It is very important to discourage, or at least keep it at a possible minimum level, residential developments near airports.

Table 4: Land use compatibility chart for residential activities (Mead & Hunt, 2004)

Land Uses	Noise Sensitivity	Concentration of People	Tall Structures	Visual Obstructions	Wildlife & Bird Attractants
Single-Family Uses (attached and detached)	I	P	N	P	P
Multi-Family Uses (i.e., two or more principal dwelling units within a single building on the same parcel, apartments such as condominium, elder, assisted living, townhouse-style)					
Low-Rise (1-3 Levels)	I	P	N	P	P
Mid-Rise (4-12 Levels)	I	I	P	I	P
High-Rise (13+ Levels)	I	I	I	I	P
Group Living Uses (i.e., assisted living, group care facilities, nursing and convalescent homes, independent group living)	I	I	P	I	P
Manufactured Housing Parks	I	I	N	P	I

I = Impact; P = Possible Impact; N = No Impact.

While planning airports and their environments, planners should estimate some variables as possible as they can. In the end, calculations and strategies are all estimations. Table 4 shows how different residential land uses been effected by potential concerns. Such tables should guide planners to what they should do and what would be the results of such developments in long term. It is just an overview of topics which gives some starting points for planner to begin evaluation of compatible land uses (Airport Cooperative Research Program, 2010).

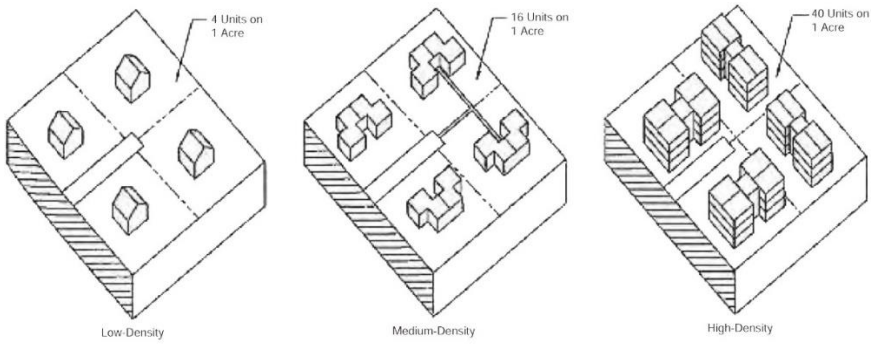


Figure 12: Comparative densities of residential uses (American Planning Association, 2006)

Residential dwellings vary from a single lot rural farmhouse to a multistory high rise apartments (Figure 13). It is crucial to select necessary type of building by considering both density and airport operations. Such as building height and density, there are many factors that should be considered carefully when planning an airport city. Higher densities mean higher concentrations of people having a greater risk. In addition, when densities getting higher, open spaces become more limited. Figure 12 shows how densities can be arranged in 1 Acre of an area. As it is seen in the figure, open spaces getting tighter when we increase density. Such consequences affect development size, also. When it comes to airport operational areas, it is considered that having more of small cluster-type housing projects with sufficient open spaces, rather than several hundred homes with limited open space considering same area of development, is much more compatible. However,

unfortunately, smaller developments are often more sensitive to aircraft noise comparing with the bigger urban developments (Airport Cooperative Research Program, 2010). The reason lies behind the suitability of urban developments with aircraft noise is because they are already noisy places to live in. It doesn't matter when an aircraft lands when you already have a similar noise level in an urban area.

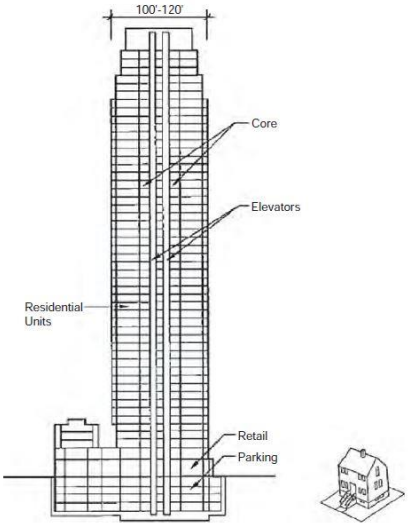


Figure 13: Single lot rural house vs. multistory high rise apartment (Mead & Hunt, 2004)

Geographic location of the development is another issue to talk on. Runways have certain lighting designs which are accepted as a must to have. Any development built around an airport, especially around Runway Protection Zones (RPZs), shouldn't cause visual obstructions for pilots. Figure 14 compares typical linear pattern, which is parallel to the runaway, with a more acceptable parcel layout that gives more variances and modifications to setbacks. Such modified parcel layouts can help to reduce the amount of development within the approach to improve compatibility of land uses around airports (Airport Cooperative Research Program, 2010).

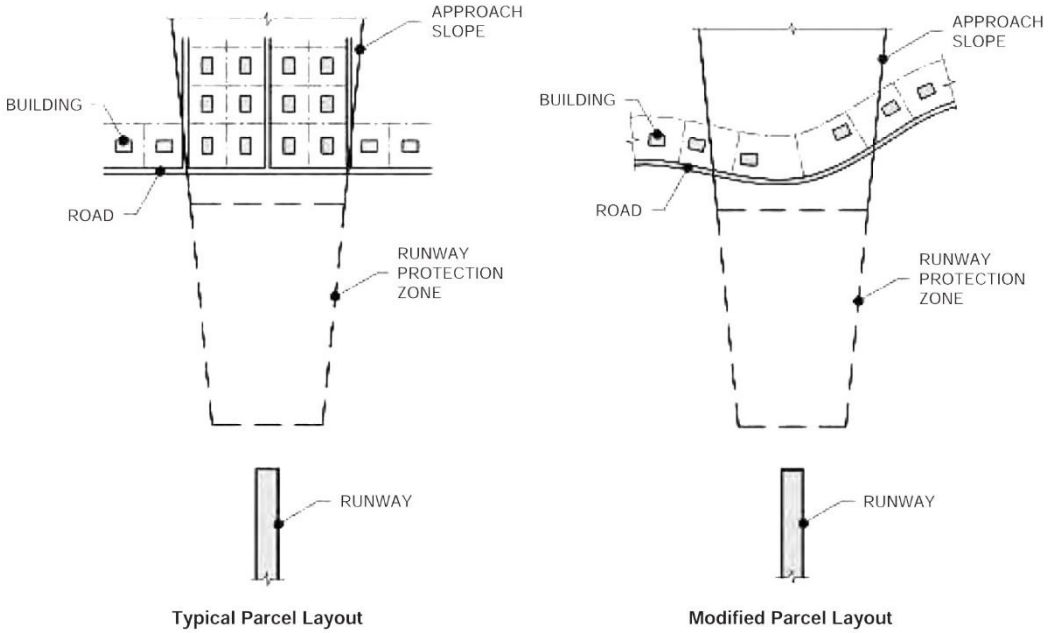


Figure 14: Typical parcel layout vs. modified parcel layout (Mead & Hunt, 2004)

2.5.1.2 Commercial

Planners define commercial use, in general, as the profit based land uses. Indeed, it has many variations so that it sometimes becomes hard to define density because of such mix land uses. It requires specific review and evaluation by planners to determine compatibility with airport operational areas (Airport Cooperative Research Program, 2010). For example; mixed use developments can be given as a good example to solve many different uses in a single area. Upper levels of buildings can serve for residential uses, whereas street levels may serve either for retail or offices (Figure 15). However, since offering mixed uses become popular in today's towns by planners, it shouldn't be forgotten that mixed use has some challenges in defining density. Density differs in every hour of the day depending upon the location of the commercial area. However, when it is mixed with residential use, for example, density starts to differ because of the varying concentrations of people at differing times. As a result, while designing densities, planners should double check the specific types of uses and hours of occupancy (Airport Cooperative Research Program, 2010).

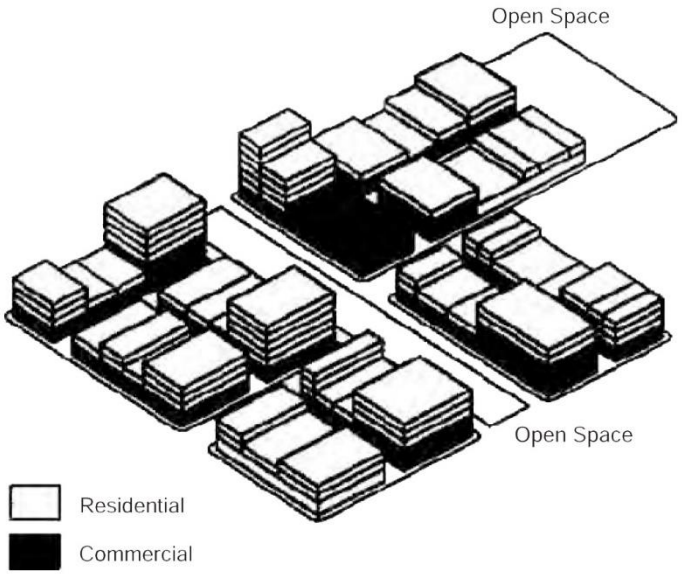


Figure 15: Mixed use layout (American Planning Association, 2006)

Table 5 shows how different commercial activities been effected by potential concerns. Such tables should guide planners to what they should do and what would be the results of such developments in long term. It is just an overview of topics which to begin an evaluation of choosing suitable land use on a case-by-case basis for every community.

Table 5: Land use compatibility chart for commercial activities (Mead & Hunt, 2004)

Land Uses	Noise Sensitivity	Concentration of People	Tall Structures	Visual Obstructions	Wildlife & Bird Attractants
Commercial Activities					
Eating and Drinking Establishments	**I**	**I**	**P**	**P**	**I**
Quick Vehicle Servicing Uses	**N**	**P**	**N**	**P**	**N**
Office Uses (i.e., business, government, professional, medical, or financial)					
Low-Rise (2-3 Levels)	**I**	**P**	**N**	**P**	**P**
Mid-Rise (3-12 Levels)	**I**	**I**	**P**	**P**	**P**
High-Rise (12+ Levels)	**I**	**I**	**I**	**P**	**I**
Retail Uses (i.e., sale, lease, or rent of new or used products)					
Sales-Oriented *Personal Service-Oriented* *Repair-Oriented*	**P**	**P**	**P**	**P**	**P**
Hospitality-Oriented (hotels, motels, convention centers, meeting halls, event facilities)	**I**	**P**	**P**	**P**	**I**
Low-Rise (2-3 Levels)	**I**	**P**	**N**	**P**	**P**
Mid-Rise (3-12 Levels)	**I**	**I**	**P**	**P**	**P**
High-Rise (12+ Levels)	**I**	**I**	**I**	**I**	**I**
Outdoor Storage and Display-Oriented	**P**	**P**	**N**	**P**	**P**
Surface Passenger Services (i.e., passenger terminals for buses, rail services, local taxi and limousine services)	**P**	**I**	**P**	**P**	**P**
Vehicle Repair Uses (i.e., vehicle repair or service shops, alignment shops, tire sales)	**N**	**P**	**N**	**P**	**P**

I = Impact; **P** = Possible Impact; **N** = No Impact.

Commercial developments differ from being a small corner boutique store to a small strip mall, or to a large multilevel shopping mall which requires huge amount of parking space. Every one of those commercial uses have different potential concerns for airport developments. For example; a big shopping mall with a huge parking lot would have a somehow linear lightings to serve for that parking space. For such a reason, the location of those shopping malls and their parking lot should be decided carefully to not to threat safe airport operations. The size of the development becomes important at this point. We can generalize that more open spaces are available when size of the development is smaller. However, when it comes to bigger commercial developments, such as extra water detention ponds starts to put airport operations at risk because of the possible wild life attraction

areas. Therefore, it is important to define development size and general layout of the project by considering given guidelines for airport land uses.

2.5.1.3 Industrial

Industry takes huge roles in any airport oriented development to sustain enough economic necessities. Industrial land uses are categorized as any use created or used in by industrial activities. Today, industrial parks are the most popular development concept for industrial areas. Indeed, they are not like old fashioned industrial land uses. Industrial parks include a mix of industrial businesses, manufacturing facilities, office parks, and even research and development complexes. Consequently, to achieve good economic impact for airport operations, every land use should be evaluated carefully according to airport planning guidelines (Table 6). Above those usages, industrial parks also may include hotels, restaurants, and retail activities depending on the size of the industrial development (Airport Cooperative Research Program, 2010).

Table 6: Land use compatibility chart for industrial/manufacturing activities (Mead & Hunt, 2004)

Land Uses	Noise Sensitivity	Concentration of People	Tall Structures	Visual Obstructions	Wildlife & Bird Attractants
Industrial/Manufacturing Activities					
Industrial Service Uses (i.e., machine shops, tool repair, towing and vehicle storage, building supply yards, etc.)	N	I	P	P	P
Manufacturing and Production Uses (i.e., manufacturing, processing, fabrication, packaging or assembly of goods)					
Technical/Light Manufacturing	P	I	P	I	P
General Manufacturing	N	I	P	I	P
**Heavy Manufacturing*	N	P	I	I	I
Mining and Extraction Uses	N	P	N	I	I
Salvage Operations (i.e., firms that collect, store, and dismantle damaged or discarded vehicles, machinery, appliances, and building material)	N	N	P	P	P
Self-Service Storage Uses (i.e., mini-warehouses/storage facilities)	N	N	N	P	P
Warehouse and Freight Uses (i.e., major wholesale distribution centers, general freight storage, etc.)	N	P	P	P	P
Waste-Related Uses (i.e., recycling centers, sanitary landfills, waste transfer stations, composting, etc.)	N	N	P	I	I
Wholesale Sales Uses (i.e., sale, lease, or rental of products to retailers for industrial, institutional, or commercial business users)	N	N	N	P	P

I = Impact; *P* = Possible Impact; *N* = No Impact

* Heavy Manufacturing typically has excessive smoke, dust, or hazardous waste

In general, industrial and manufacturing activities provide good economic benefits for the community. It also increases the business tax base and employment levels by attracting businesses. By doing so, these usages need to be provided by good transportation systems. Industrial and manufacturing areas need good connections to major transportation arteries such as highways, interstates, railroads, and airports. Inter-modal connectivity is a key point for such usages because today economy depends highly on speed and time.

In a report prepared by Airport Cooperative Research Program (2010), which discusses airport land use capabilities, waste disposal facilities underlined as the category needs special attention while planning. It is mentioned that waste disposal facilities somehow share similar planning requirements with airports; such as locating away from residential areas. However, airports and waste disposal facilities

shouldn’t locate near each other because of the specific guidance issued by FAA. It is also advised that the site shouldn’t exist within 1.5 km if propeller aircraft, or 3 km if turbine engine aircraft approach zones (Worrell & Vesilind, 2012).

Industrial and manufacturing developments may differ from a small hardware repair shop to a large ethanol plant. Each of those uses create different hazards for airport operations. To exemplify such cases; smoke/steam emissions coming through chimney stacks with a wind directing airport landside (Figure 16), or exterior lighting types used by huge factories.

Figure 16: Industrial park near General Mitchell airport (Ryan, 2015)

2.5.1.4 Institutional

Institutional land uses are appeared to be the land uses which has influence in the community. Table 7 describes land use compatibilities of different institutional activities with the airport. Religious assembly uses, hospitals, educational facilities (college and universities, public and private elementary, middle, junior, and senior high schools, religious and military schools), daycare uses, libraries, museums are included in this category. Every circumstance should be taken into consideration while placing these facilities around airports. For example; daycare and health care facilities contain people who are unable to care for themselves, hence any accidental situation may create evacuation difficulties for these usages.

Institutional activities may include different densities in a certain area. It is important to carefully design densities for each usage by considering airport factor. High concentrations of people always involve high level of risk for airport operational and approach areas. Land uses, such as schools, create highly children concentrated densities minimum of 8 hours per day from Monday through Friday. In addition, to compare church with a school, church is a place which is used more temporarily.

Table 7: Land use compatibility chart for institutional activities (Mead & Hunt, 2004).

Land Uses	Noise Sensitivity	Concentration of People	Tall Structures	Visual Obstructions	Wildlife & Bird Attractants
Institutional Activities					
College and Universities	I	I	I	I	I
Community Service Uses (i.e. public, nonprofit, or charitable nature providing a local service to the people)					
General Community Service (i.e., libraries, museums, transit centers, park and ride facilities, etc.)	I	I	P	I	I
Community Service-Shelter (i.e., transient housing)	I	P	N	P	P
Daycare Uses (i.e., childcare centers, adult daycare, preschools, after school programs)	I	I	N	I	I
Detention Facilities (i.e., prisons, jails, probation centers, juvenile detention homes, halfway houses)	I	I	P	I	I
Educational Facilities (i.e., public and private schools)					
General Educational Facilities (i.e., public and private elementary, middle, junior, and senior high schools including religious, boarding, military schools)	I	I	I	I	I
Specialized Education Facilities (i.e., specialized trade, business, or commercial courses, nondegree-granting schools)	I	I	P	P	P
Hospitals (i.e., hospitals, medical centers)	I	I	I	I	I
Religious Assembly Uses (i.e., churches, temples, synagogues, mosques, Masonic, eagles, moose, or elk lodges)	I	I	I	I	P

I = Impact; **P** = Possible Impact; **N** = No Impact

2.5.1.5 Infrastructure

Infrastructural land uses are the usages which include basic utility uses, cellular communication transmission facility uses, parking lots, all types of transportation uses, and utility uses such as solar power generation equipment, wind generators or wind farms (Table 8). One of the most important concern that is prevalent for

today's developments are the cellular communication towers. They have been used for numerous reasons such as; in business parks for advanced communication technologies, or around shopping mall areas, or even along the national highway system to help to improve data usages. On this point, height of these structures create a concern to aircrafts during low level flights, approach zones, and departure operations. Besides physical disadvantages, also electronic interference associated with the operation of cellular communication can be risky enough to damage communications between plane and airport.

Figure 17: Cell towers (www.istockphoto.com, n.d.)

Table 8: Land use compatibility chart for infrastructure activities (Mead & Hunt, 2004).

Land Uses	Noise Sensitivity	Concentration of People	Tall Structures	Visual Obstructions	Wildlife & Bird Attractants
Infrastructure Activities					
Basic Utility Uses (i.e., utility substation facilities, electrical substations, water and sewer lift stations, water towers)	**N**	**N**	**P**	**I**	**I**
Communication Transmission Facility Uses (i.e., broadcast, wireless, point to point, emergency towers and antennae)	**N**	**N**	**I**	**I**	**P**
Parking Uses (i.e., ground lots, parking structures)	**N**	**P**	**I**	**P**	**P**
Transportation Uses (i.e., highways, interstates, local and county roads)	**N**	**P**	**N**	**P**	**N**
Utility Uses (i.e., solar power generation equipment, wind generators, wind farms)	**N**	**N**	**I**	**I**	**N**

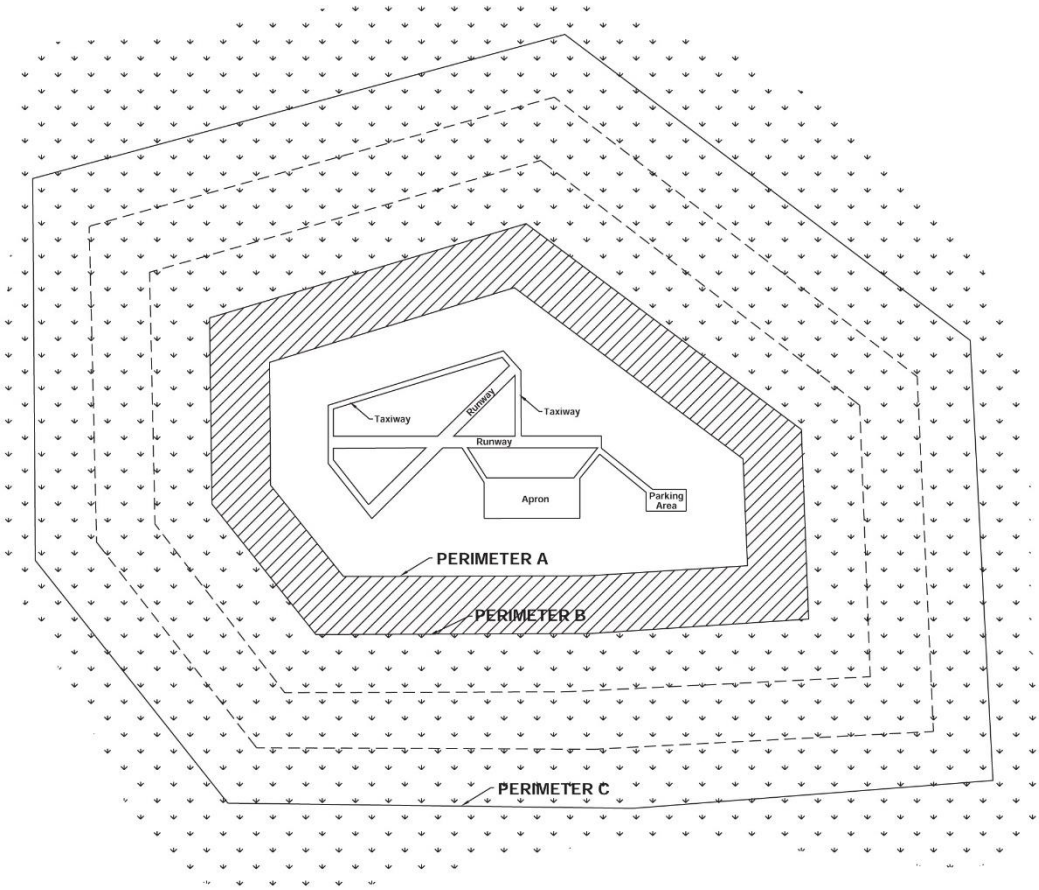
I = Impact; **P** = Possible Impact; **N** = No Impact

2.5.1.6 Agriculture, Open Spaces, Parks and Recreation

Agricultural land uses are generally categorized as the activities that include farming and mining. It doesn't matter that an open space is a manmade or naturally occurring one. Agriculture, parks, recreation or any open space usage would harm airport developments at the least level comparing to others. However, there is a big risk of creating wildlife around and between those areas.

Figure 18: Flock of birds on runway/taxiway

Farms around airports should be taken under control by limiting the type of seeding that can be planted. For example; row crops and orchards may cause hazardous interactions for airplanes. Especially on low-level flights, approaching and departing, such plantations may create bird strikes (Figure 18). Simple reason lying behind such bird attractions is the nutritive and nesting value of those plantations. Figure 19, which is developed by FAA Central Region Airports Division based upon guidance in FAA AC 150/5200-33B, Hazardous Wildlife Attractants on or Near Airports, defines the separation distances around airport which should be taken under control, mitigated, or even avoided. It is important to coordinate airports, local communities, and local farmers to reduce these risks to the minimum level (Airport Cooperative Research Program, 2010).



PERIMETER A: For airports serving piston-powered aircraft, hazardous wildlife attractants must be 5,000 feet from the nearest air operations area.
PERIMETER B: For airports serving turbine-powered aircraft, hazardous wildlife attractants must be 10,000 feet from the nearest air operations area.
PERIMETER C: 5-mile range to protect approach, departure and circling airspace.

Figure 19: Separation distances within which hazardous wildlife attractants should be avoided, eliminated or mitigated.

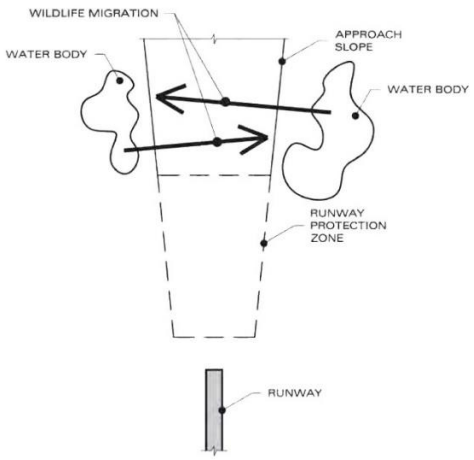


Figure 20: Possible wildlife activities close to the runway (Mead & Hunt, 2004)

Open water also considered as a concern for airports. Puddles are attractive areas for waterfowls, such as geese, because of the possible nesting, feeding, resting, and protection opportunities. As indicated in Figure 20, migration routes use areas which coincide between water bodies. It is important to not intersect migration routes with any airport operational areas such as RPZs, approach or departure zones etc. In a report, prepared by Airport Cooperative Research Program (2010), it is mentioned that the coordination of airports and local natural resource agencies is very crucial to arrange. They continue as follows;

> *"Coordination between airports and local natural resource agencies is essential to allow those agencies to identify specific species of wildlife that are hazardous to that particular airport, as well as develop a management plan to reduce wildlife risks to local airport operations. Distinguishing characteristics of individual airports and the associated wildlife in the area should be identified to address compatibility in a comprehensive manner."*

Agricultural uses, floodplains, water bodies and wildlife preservation areas are affected by different impacts. While noise sensitivity have certain concerns on wildlife preservation areas, floodplains aren't affected by noise at all. All those land uses are evaluated depending on certain concerns in Table 9.

Table 9: Land use compatibility chart for agriculture and open space activities (Mead & Hunt, 2004).

Land Uses	Noise Sensitivity	Concentration of People	Tall Structures	Visual Obstructions	Wildlife & Bird Attractants
Agriculture and Open Space Activities					
Agricultural Uses (i.e., commercial cultivation of plants, livestock production)					
Plant & Animal Related	**N**	**N**	**P**	**N**	**I**
Resident-related (i.e., single-family home, mobile home if converted to real property and taxed)	**I**	**N**	**P**	**P**	**I**
Facility-related (i.e., fuel bulk storage/pumping facility, grain elevator, livestock/seed/grain sales)	**P**	**P**	**I**	**P**	**I**
Floodplains	**N**	**N**	**N**	**N**	**I**
Water Bodies (i.e., open bodies containing water)					
Man-made resources (i.e., mining and extraction, water detention ponds, wetlands)	**N**	**N**	**N**	**I**	**I**
Naturally occurring (i.e., lakes, ponds, prairie pot holes, rivers, streams, wetlands)	**N**	**N**	**N**	**I**	**I**
Wildlife Preservation Areas	**I**	**P**	**N**	**I**	**I**

I = Impact; **P** = Possible Impact; **N** = No Impact

Coming to parks and recreational areas, we can include all passive activities as well as physical ones. Starting from resting on a park bench to fishing, swimming or even hunting can be defined as the recreational activity. Table 10 contains examples of specific types of parks and recreational development.

As it is mentioned before, airport developments should choose cluster type of residential areas with neighborhood park rather than couple of single apartments without any open space. Such singular apartment systems require open spaces out of those neighborhoods which are not planed in terms of airport requirements. For example; Figure 21, an outdoor sports complex, includes incompatible land uses such as large parking areas and limited open spaces with big wetlands.

Table 10: Land use compatibility chart for parks and recreation activities (Mead & Hunt, 2004).

Land Uses	Noise Sensitivity	Concentration of People	Tall Structures	Visual Obstructions	Wildlife & Bird Attractants
Parks and Recreation Activities					
Commercial Recreational Uses (i.e., facilities used for physical exercise, recreation, or culture)					
Outdoor (i.e., campgrounds, tennis/swimming facilities, drive-in theaters, skating rinks, pavilions, amphitheaters)	**I**	**P**	**P**	**I**	**P**
Indoor (i.e., physical fitness centers, health clubs, bowling alleys, skating rinks, billiard halls, arcades, indoor theaters)	**P**	**I**	**P**	**I**	**P**
Golf (i.e., golf driving ranges, outdoor miniature golf, 9+ hole courses)	**I**	**N**	**N**	**P**	**I**
Utility Uses (i.e., amusement/theme parks, fairgrounds, racetracks, sports arenas)	**I**	**I**	**I**	**I**	**I**
Parks (i.e., aquatic, mini, private, sports, neighborhood, school, community)	**I**	**P**	**I**	**P**	**P**
Casino	**N**	**I**	**P**	**I**	**I**

I = Impact; ***P*** = Possible Impact; ***N*** = No Impact

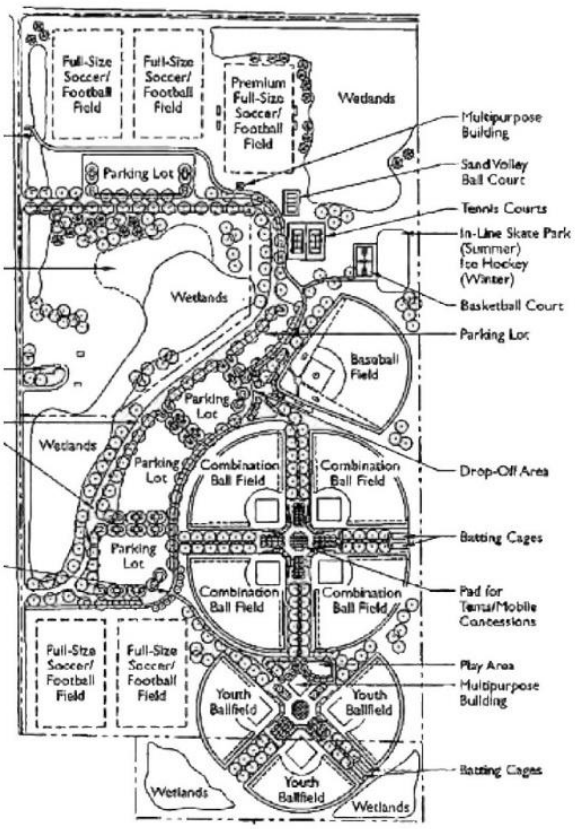


Figure 21: Outdoor sports complex (American Planning Association, 2006).

CHAPTER 3

AEROTROPOLIS AND AIRPORT CITY

3.1 Aerotropolis

In the 1960s, airport construction have managed to come to its peak point with the increased number of jet planes. The leading country to this development was the United States. With the introduction of jet bridge systems to modern airport terminals, people started to be more comfortable by choosing air transportation. Today, most comprehensive aviation system belongs to United States by having more than 18,000 airports in the country (Avjobs Inc., 2015). With huge investments to air industry, airports start to grow their hinterlands up. Not only with passenger transportation, but also freight shipment made a huge impact on the development of airports. Big investors/firms realized that they can grow with the help of air transportation much faster. Time become brilliant, so that the companies using time most efficiently started to make more profit than the others. Actually, time made airports to grow faster. Firms started to locate near airports, people demand easy access to the airports to consume less time on the roads. People started to settle to the closer locations to the airports because of new job opportunities, and most importantly airports start to make their own income by growing with the industry, technology, services etc. Indeed, Aerotropolises started to be formed in time.

Aerotropolis is an urban form which is shaped around an airport city (Kasarda, The Evolution of Airport Cities and the Aerotropolis, 2008). This form is a very similar looking to the traditional metropolis. Basically, it is an area of high density developments stretching up to 25 km in radius from the airport in its core (Menon, 2014). According to Dr. Kasarda (2008), Aerotropolis is made of aviation-oriented businesses and their associated residential developments besides the airport city core. For example; retail, hotel and entertainment centers, set of airport-linked

business parks, industrial and logistics parks, information and communications technology complexes, wholesale merchandise marts and residential developments make this model to operate as a consistent form of development in itself (Figure 22). In addition, its economic impact may also reach up to 95 km from the major airports.

Aerotropolis is counted as a unique 21st century urban form. Such urban form mainly consists of airport edge cities, supported by airport corridor and airport-centric commercial and residential developments. Comparing aerotropolis development with traditional metropolises gives us many similar results. Traditional metropolis consist of a central city and rings of so called commuter-heavy suburbs. On the other hand, Aerotropolis is mainly based on an airport city core, and instead of rings of commuter-heavy suburbs, this urban form needs corridors extending from the center to the periphery supported with clusters of aviation-oriented businesses with mixed-use residential developments (Kasarda, 2010).

Dr. Kasarda is director of the Center for Air Commerce at the University of North Carolina's Kenan-Flagler Business School. He is known as the leading developer of the 'Aerotropolis' concept. He says that transportation is the major factor behind urban and economic development (Kasarda, 1991). Dr. Kasarda defines his statement by explaining five different waves came through. The preeminence of air transportation nowadays is the result of those overlapping waves (Kasarda, 2000). First wave is described as the seaports. Fact that seaports have been built in those years, cities used to be built around seaports. Second wave formed many European cities which is the effect of rivers and canals. Third wave was railroad stations. Especially, Europe is a good example to give on this point. Today, you can travel from any metropolitan city to any other only by using railroad connections. Vehicular transportation is the fourth wave that influenced cities. As the final wave,

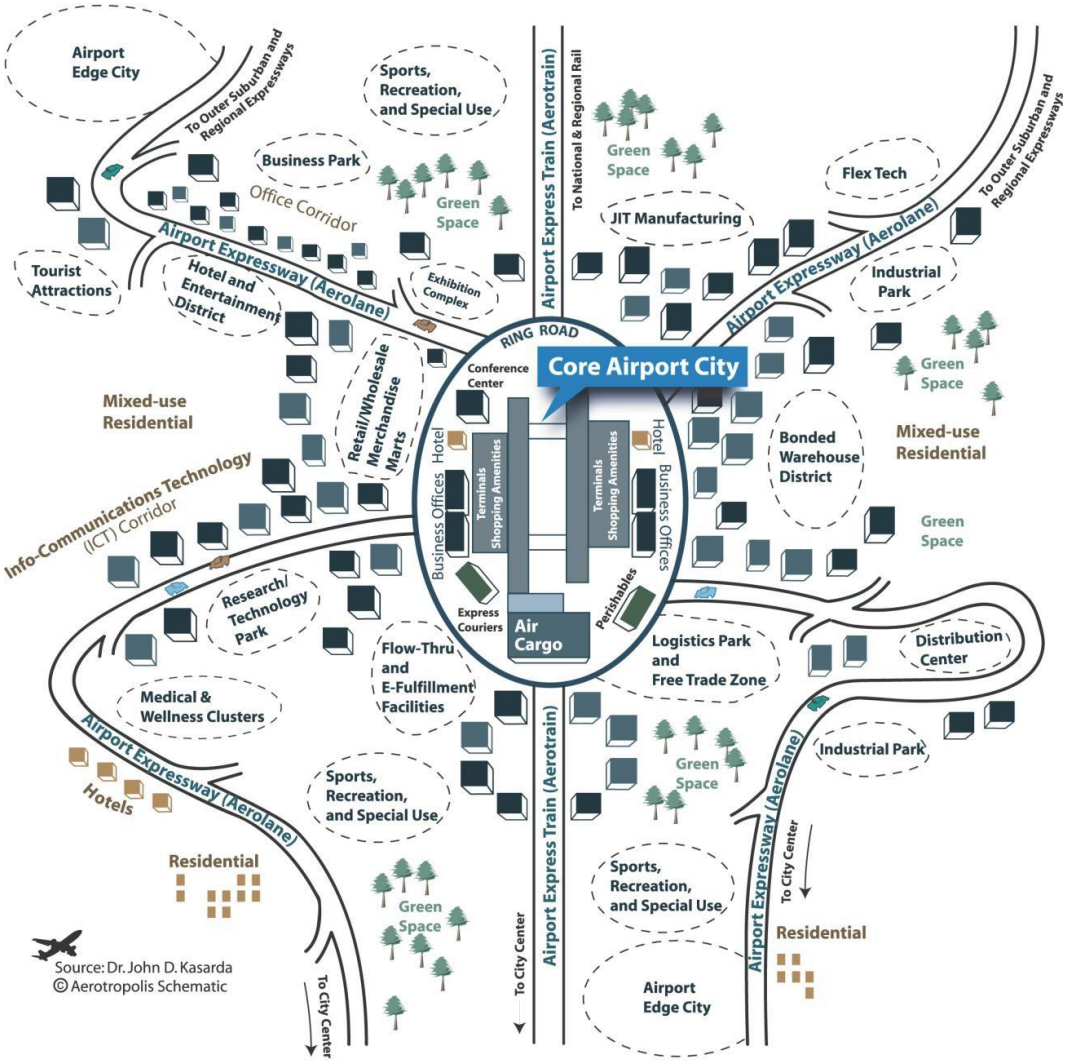


Figure 22: Aerotropolis scheme (Kasarda, 2008)

Dr. Kasarda mentions airports. Airports would be drivers of modern urban development (Kasarda, 2000).

Kasarda's airport development model is being used for today's most of the major airports. Some airports choose to even re-build their system around Aerotropolis model. The reasons lying behind this process are determined by following networks;

- Logistics centers for freight,

- Business centers,
- Shopping and entertainment facilities,
- Accommodation and service providers.

These networks are supported by vehicular roads, which are named as “Aerolanes”, and rail roads, which are also named as “Aerotrains” (Kasarda, 2006; 2000). Some examples of Aerotropolis-like airports are given below;

- Dallas-Fort Worth and Washington Dulles International in USA
- Sao Paulo Viracopas International in Brazil
- Amsterdam Schiphol and London Heathrow in Europe
- Singapore Changi, Hong Kong International and South Korea Incheon in Asia (Kasarda, 2004),
- Kuala Lumpur International Airport considering Malaysia’s new Multimedia Super Corridor (Kasarda, 2005).

Figure 23: Amsterdam Schiphol Aerotropolis, World Trade Center, Corporate Offices and Hotels (Kasarda, 2011)

Aerotropolis development should be considered as an important impact for central business district (CBD) of a city. While creating such a huge development, the impact of Aerotropolis should be taken into consideration. It is not wrong to say that attraction of the Aerotropolis may result in recentralization of demand for commercial rent space from CBD to new urban development around major airport (Charles, Barnes, Ryan, & Clayton, 2007). Kasarda mentions that absolute location of land won't be the case by considering evaluation of land and rental space, rather accessibility to an airport is a more valuable criteria (Kasarda, 2000). Amsterdam's Schiphol airport is a good example for commercial land values. It has seen that commercial land value of land valued higher around outskirts of airport comparing with the CBD or suburban areas of Amsterdam region (Kasarda, 2004). Kasarda supported this fact in his article, titled as *"Logistics and the rise of the Aerotropolis"*, by explaining that vicinity of airports are very likely to have a strong connection in terms of economic and job growth (Kasarda, 2000/2001).

Main factor in Aerotropolis development is speed which become a very important aspect of today's businesses and life. New economies also demand connectivity and agility to use speed efficiently. Aerotropolis consists of corridor and cluster developments. Wide lanes and fast movements gives key characteristics to Aerotropolis. John Kasarda (2008) defines this development as the form which follows function and continues as follows:

> *"Airport expressway links (Aerolanes) complemented by airport express trains (Aerotrains) bring cars, taxis, buses, trucks and rail together with air infrastructure at the multi-modal commercial core (the Airport city). Aviation-linked business clusters and associated residential developments radiate outward from the airport city, forming the greater Aerotropolis."*

If you would ask how Aerotropolises are showing up in today's economy, Dr. Kasarda (2008) answered that question for you. Airports provide a safe and fast connectivity between supplier and customer. In business sector, it is crucial to have fast-paced and globally networked economy. Competitive firms which are using advanced technology with high-speed transportation mainly prefer to use air

transportation. Fast transportation gives more responsive service to customers' unique needs. Such firms should need to build agile production systems to compete in business sector. These systems should provide a good connection between their customers and suppliers by making them to source parts and ship assembled products (Kasarda, 2008). Branded companies such as Apple, Boeing, Lenovo, Nokia and Siemens can't remain unanswered to continuously growing demands for adaptability, consistency and speed. These firms reengineered their systems to be more agile, decent and client responsive. These innovations give many benefits to firms to compete with; such as a fast and predictable delivery with after-sales support of their products. For example; Apple produce iPhone 5 with a complex network which works transnational. Apple succeeded to manage complex networks which include value chain of suppliers, distributors and customers as shown in Figure 24 (Kasarda, 2013).

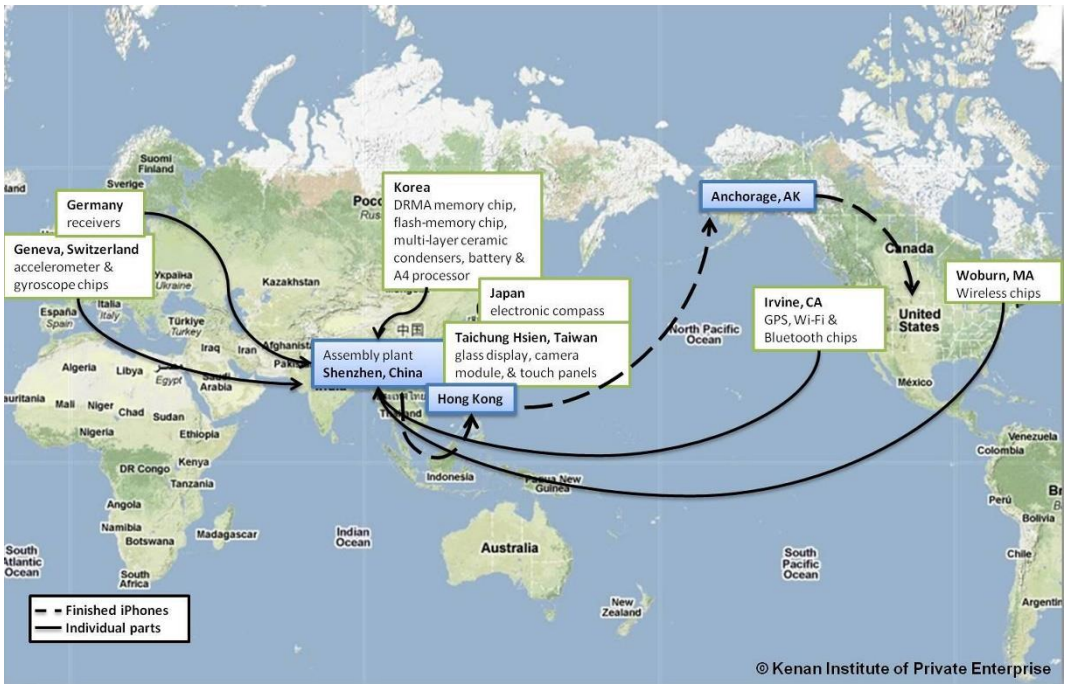


Figure 24: Global Supply Chain of Apple iPhone 5 (Kasarda, 2013)

Aerotropolis counted as an important way of urban development in 21st century. Cities such as Amsterdam, Chicago, Dubai, Hong Kong, Memphis, Paris, Shanghai, and Singapore has made their way to become globally networked. Big firms and

manufacturers, which are seeking for more succession in an economic scale, settle in those cities which already have enough features to carry on competitive level (Kasarda, 2013). If these factors elaborated properly for city developments, Aerotropolis concept should suit perfectly for long term development.

It is found that airport areas attract many businesses such as; service sector, industries which produce time sensitive products, regional corporate headquarters, and conference centers etc. (Kasarda, 2008). Such businesses need time efficiency from their staff and executives because of constant long-distance travel need. This type of work highly depends on accessibility to hub airports. When flight numbers and choices increase, it benefits passengers to spend less money for accommodation in that certain city.

Dr.Kasarda in his article named "The Evolution of Airport Cities and the Aerotropolis" (2008) emphasized that information and communications technology, high-tech industries and all types of commercial services chose to work with air transportation. Kasarda underlines a crucial number about high tech workers which shows that they use air transportation 400 percent more comparing with any type of other workers (Erie, Kasarda, McKenzie, & Molloy, 1999). High tech firms chose to locate along major airport corridors to gain more reliable access to major airport, such as firms already located on the Washington-Dulles Airport access corridor. Many high tech firms coming together and locating on the same corridor makes two different networks to interact with each other simultaneously (Kasarda, 2008). All types of commercial services attract people who travel and also who locally use that location. Today, almost every airport have a hotel which directly service to airport itself. With all of those interactions that I have mentioned before, need of restaurants, hotels, big box retail, entertainment facilities, health, wellness and fitness centers appeared suddenly. As a result, they, let's call it services in general, find their places directly on the airport corridor serving for the airport as a core.

Every new development stimulate a new process. Airport development is a very significant potential for new job offerings. City centers comparing to airports are less effective in new job opportunities. Areas within five miles of major airports are

much stronger in finding new workers comparing to suburbs at same distances from city center (Kasarda, 2008). As new job opportunities grow faster in time, workers demand to settle near their jobs and this fact leads to new residential land development. This potential of fast growth serve the purpose of Aerotropolis development. Air travel is expected to grow %200 to %300 between 2000 and 2030 globally (UK Department for Transport, 2003). Furthermore, air freight traffic will also increase to %40 of the value of produced goods transported internationally (Air Transport Action Group, 2005). As Aerotropolis grows, it affects its region to be wealthier by creating a new brand. The Aerotropolis has progressively turned into an entryway to national and regional financial development (Canaday, 2000). Today, there are many examples of airport centered regional brands such as Amsterdam Airport Area, the O'Hare Area and Dulles (Kasarda, 2008).

3.1.1 Drivers of Aerotropolis

Kasarda (2000; 2006) mentioned many times is his articles that twenty-first century is the age of the fastest. In the eyes of Kasarda, competitive success can be gained by the survival of the fastest. In 1990s, most successful companies have been determined by looking at their transportation services. Companies that employed with high-speed transportation for their services leaded their ages (Kasarda, 2005). JIT (just-in-time production/manufacturing) was a big contribution into service sector. It caused a decrease in total numbers of products in inventory by a result of fast order and delivery services. All of these causes come up with result of the desire to become faster and more responsive. The most important part in choosing air transportation as the main transfer service for a company is to achieve efficient and speedy results in longer distances comparing other transportation modes (Kasarda, 2000/2001). Interest in air transportation embraced new markets for perishable goods, for example cut flowers and foods (Kasarda, 1991).

Air commerce, unarguably, is the most preferable transportation type for long distances for last twenty years, at least. Prof. Kasarda defines air commerce as the "logistical backbone" of todays' new economy (Kasarda, 2000). As new economies created, competitiveness and differentiation needs to be appeared instinctively. Distribution centers and storage areas of certain businesses have been reproducing

persistently around major airports (Kasarda, 2000/2001). Investors may be in a seesaw about the demand for air travel that it may reduce in near future. Researchers argue that despite the growing use of the Internet and other advanced technologies may reduce demand, it won't be enough to see such a huge effect on advantageous services that air transport provide for businesses. Only concern of May and Hill (2002) is about "oil depletion or global warming intensify" as they mentioned in their article. Global mobility won't let air travel demand to decrease in a manner of disappearance.

Demand for aerotropolis and airport city models have been increased depending on the improved telecommunication services (Kasarda, 2000). As a result, we can say that, actual telecommunication services support the progression of long-distance business networks and opportunities. Physical travel cannot be substituted with any electronic communications according to the "compulsion to proximity" for today's part of life (Foresight, 2006).

Aerotropolis model shouldn't be seen as a separately working concept from the city which it belongs to. As a planner, I can say that, every developed model or concept should be considered as a part of urban life. Drivers of aerotropolis mainly lie behind economic and social reasons, rather than critical city problems. Architect of Aerotropolis model, Kasarda (2011), has talked about some non-physical drivers of Aerotropolis in his article called "The Aerotropolis and Global Competitiveness" (Table 11). All those factors made air travel to increase; especially, in terms of trade. Kasarda (2011) attribute this fact in these words:

> *"Already, over a third of the value of all world trade moves by air. This will only increase as global incomes rise and economies shift toward higher-value products that are smaller, lighter and more compact such as microelectronics, pharmaceuticals, medical instruments, aerospace components, and specialty perishables."*

Tourism is considered as from one of the most important drivers of aerotropolis. Tourism sector basically needs three main things in an ordered way to process healthy; transport, leisure and accommodation. These services are now become

overlapped according to May and Hill (2002), and interest groups wanting from government to increase airport capacities and economic investments to take advantage of air travel. Airports and world class hotels have been used in a share of time for both business and/or leisure travelers. Therefore, business travelers have an opportunity to rest between flights in adjacent facilities. As a result of these circumstances, airports are not only transport specific hubs for passengers which also makes sense for aerotropolis development (Charles, Barnes, Ryan, & Clayton, 2007).

Table 11: Drivers of Aerotropolis (Kasarda, 2011)

DRIVERS	EXPLANATIONS
Increase in long-range jet aircraft transportation	• More time-friendly connections for people, products and enterprises world-wide.
New supply chain processes	• Parts and components are manufactured in a half-dozen different countries, assembled in a seventh country and distributed to a multitude of others
The growth of world tourism/Expansion of aviation-intensive producer services	• Consulting, finance, and marketing whose firms are increasingly gravitating to airport areas.
Consumer age	• "Must have it now": Even if people can't, they won't wait for the products, they order from distant locations via the Internet.
Internet	• Web won't move a box. For every iPod ordered in Africa, Germany, or the U.S., an aircraft flies it from China.
Business as a "contact sport"	• Setting up airport-linked enterprise networks and closing the deal still typically requires face-to-face negotiations across borders.

3.1.2 Advantages of Aerotropolis and Needs of Planning

Planning process of cities are mostly lie under the circumstances of solving problems of cities in certain scales. Aerotropolis is an investment rather than a solution for a city. Creating such a potentially attractive location for the business

services sector may harm cities unless it has been developed in accordance with the plan. By creating huge job opportunities for all classes of people, it also provides high level of transportation services both in city and regional scales. Of course, the main focus is businesses, but business also requires some other services such as conference centers, trade representative offices and regional corporate headquarters. Comparing Chicago's O'Hare Airport with Washington D.C.'s Dulles International Airport in terms of advantages that aerotropolis development contribute to a city wouldn't be wrong. Kasarda (2010) mentioned that business travelers benefit from quick access to hub airports. Hub airports provide a good choice of flights comparing to other regional small airports. Such structured planning also gives an opportunity of reducing costs of overnight stays. With respect of these reasons, O'Hare Airport area attracted many office usages and become the second largest office market in the U.S. Midwest. On the other hand, Dulles International Airport become a significant example, showing that how much an aerotropolis development can be powerful up against CBD of a city. That certain airport area contains more Class-A office space than does downtown Washington, D.C. Many high tech firms are locating along major airport corridors of Dulles and O'Hare Airports (Figure 25).

Figure 25: Washington Dulles Airport's highway corridor in Fairfax County (Kasarda, 2010).

Aerotropolis model of development supplies fast transportation and access, both for customers and service providers. Actually, by applying such strong transportation oriented development to a city, it is pretty obvious that all businesses oriented around a need of fast transportation should be placed around that main airport. Firms, such as specializing in information and communications technology and other high tech industries, also with many goods processing sectors, are choosing to get a place in aerotropolis development. These firms consider accessibility as a vital part of their businesses. For example; complete ground to air shipping is an essential part for manufacturer to meet the demand. Fast transportation and access results advantageous 'time definite' production for firms (Kasarda, 2010).

Economic aspects of aerotropolis development are indubitable. Residential growth that aerotropolis creates should need to be fed by necessary mixed and commercial usages, such as restaurants, factory outlets, superstores etc. Besides directly airport related jobs, aerotropolis also creates such commercial work opportunities. Total jobs that aerotropolis development cause is huge. Kasarda (2010) takes into consideration the Memphis International Airport which continues to operate as the world headquarters of FedEx. Airport factor in Memphis example helped to create over 160,000 jobs in its metropolitan area. Memphis region had an annual economic impact of $29 billion in 2007 as a result of having one in four jobs related with the airport in Memphis region. As a second example, Athens International Airport, attracted some large megastores, major factory outlet complex such as IKEA and Kotsovolos (Figure 26). Most important part regarding the relation between citizens and economy of the city is that the majority of shoppers who use these stores are locals. Citizens find newly built expressway corridor extremely useful connection to these mega shopping facilities.

Figure 26: Athens Airport Retail Park (Kasarda, 2010)

As the creator and founder of Aerotropolis model, Kasarda (2010) suggests some planning needs of this model to become more city friendly. He says that the development of aerotropolis has been spontaneous and haphazard. Moreover, he also mentions the ways to make aerotropolis development better. Urban planning with a good infrastructure planning can change our way of living from ancient cities to Aerotropolises. Here are the planning needs which Prof. Kasarda suggests;

- Airport expressway links, which are called as "Aerolanes", and airport express trains, which are called as "Aerotrains", should feed aerotropolis by connecting it to curtain regional business and residential areas.
- Aerolanes play crucial part in aerotropolis development. To prevent any kind of congestion, trucks-only roads should be added to Aerolanes to give more priority to non-freight traffic.
- Distance is not a problem anymore. Instead of distance-cost measurements, time-cost efficiency should be counted as the primary aerotropolis planning metric between key nodes.

- While planning where to locate which business, it is important to evaluate frequency of uses for each business, to maximize time-cost access and minimize congestion.
- Activities, such as manufacturing, warehousing and trucking, should be spatially segregated from white-collar service facilities and airport passenger flows.
- Flight paths generate noise and air pollution. It is important to place sensitive commercial and residential developments outside of high intensity flight paths.
- Along airport transportation corridors, it is important to have sufficient green space to balance the concentration of green. Clusters are more capable of creating green space available between cluster groups, than any other strip development.
- Landmark is one of the five 'Lynch's Five Elements' for the city (Lynch, 1960). Kasarda also supports the idea of putting iconic structures and architectural features to make wayfinding and place making much easier and enhanced.
- Housing areas, which serve for airport area workers and frequent air travelers including also hotels, and residential/commercial communities should be designed to provide necessary local services and a sense of neighborhood.

Aerotropolis development is not a case of solitary progress. It should be considered together with sustainable smart growth. The most important part in planning such a huge development is to know how to build such environment in a best sustainable way. Airport corridors for aerotropolis development matter just like heart of a human. Kasarda (2010) emphasized that new urbanism guidelines are necessary to create healthy mixed-use residential clusters along airport corridors. New urbanism describes design of such terms (Principles of urbanism, n.d.);

- Walkability
- Connectivity
- Mixed-use & Diversity

- Mixed housing
- Quality architecture & Urban design
- Traditional neighborhood structure
- Increased density
- Green transportation
- Sustainability
- Quality of life

On the other hand, some parts of aerotropolis development can be designed to meet improved sustainability with economic efficiency which should benefit both place and region, such as already built Amsterdam Zuidas or New Songdo International Business District.

Kasarda (2010) mentions some other important points about aerotropolis planning and development process. He talks about benefits of global information and communication technology (ICT) networks which may also help to shape the aerotropolis. By letting technology to produce themed electronic public art to welcome air travelers, it is also important to use power of technology to create fastest possible networking to the firms who require it. Transportation system with multi-modal and advanced communications infrastructure should be developed properly. This process drives forward the truth of local time/cost proposition along airport transportation corridors. Depending on aerotropolis concept, it starts to be more advantageous to locate close to the high speed rail line stops rather than locating any other rural place without any strong and direct connection to the major airport. Furthermore, strong connection to major airport of region gives a sufficient access to markets, too. Lastly, Kasarda highlights the significance of local and regional planning in aerotropolis development. He says that it is crucial to adapt already living communities to such a different way of living. Dr.Kasarda (2010) concludes his planning thoughts with these words;

> *"A new approach is required bringing together airport planning, urban and regional planning, and business site planning in a synergistic manner so that future Aerotropolis development will be more economically efficient, aesthetically pleasing, and*

socially and environmentally sustainable. The real question is not whether Aerotropolises will evolve around major airports (they surely will). It's whether they will form and grow in an intelligent manner, minimizing problems and bringing about the greatest returns to the airport, its users, businesses, surrounding communities, and the larger region and nation it serves."

3.2 "Airport City" Concept

Globalization effected cities by creating competitive markets between regions. As I mentioned before, speed become a crucial factor for industries and businesses, as well as for human life. With the technological improvements in communication, finance and mass media, air transportation is attracted by many businesses to become as the major type of transportation. This fact mainly comes from the direct connectivity to major business, cultural and economic centers of the world. As markets have the ability to compete in a global scale, it directly affects regions and metropolises in the same level, either positive or negative way.

"Airport regions are not just molested land" as mentioned by Güller Güller (2003), in their research about how airports are important as interchange nodes and the airports as a city of the 21st century, described the importance of airports one more time. Airports are described as the most characteristic elements of metropolitan areas. To indicate one more time, deregulation and liberalization have took crucial roles in world airline industry since first airport development. Besides other economic and developmental influences, the rise of low-cost airlines and reformation of traditional airlines created attraction on airports (Ashford, Mumayiz, & Wright, 2011). These alliances focused on hub airports to give a central role to these airports to use them as point of interchange. Ashford, Mumayiz and Wright continued describing how today's self-sufficient, so called "Airport Cities" formed;

"Influenced by competition in a deregulated market, giant global alliances thrived, and partnerships between the airline, its hub airport, and local business community and industries turned hub

airports into formidable business, financial, and technology urban centers in their respective regions centered on airports."

This fact concludes a massive advantage of connectivity to competitive intercontinental networks. As a result, such hub airports become highly dependent to those airline alliances in terms of development. As airline alliances develop, both internationally and regionally, it raises a high chance for these airports to become much more dominant in their region.

Until early 1990s, airports have been working only as a facility to change travel mode of passengers and freight. Since inception of deregulation, liberalization and globalization, airports which got good spots in global regions and had opportunity to get larger, busier and more congested, at that point, airports started to become major urban intermodal nodes. By evaluating certain status of airports, researchers, who deal with both ways of planning and economy of airports and cities, have been in a search of new concepts for airport and city planning. It is found that some concepts like "aerotropolis", "airport city" and "airport corridor" can help to create urban and economic development. This process is explained as follows; *"through a synergetic and symbiotic relation between the commercial development on the airport landside and the networks of the airlines at the airport"* (Ashford, Mumayiz, & Wright, 2011). All in all, major hub airports are the crucial part of global city regions with numerous benefits. Ashford, Mumayiz and Wright gave some conditions for airports' success in airport city development:

1. Availability of development space on the airport,
2. Location of the airport within the landside infrastructure networks,
3. The socioeconomic structure of the region,
4. The institutional setting of local government,
5. The planning framework.

All these concepts are highly related with the economic and spatial structure of the region. It is better to understand that structure before dealing with the evolution of airport city itself. 'Global city' term comes as the first characteristically important concept for such economy based developments.

3.2.1 What is a Global City?

A global city, also called as world city, alpha city or world center, is a metropolis which can effort to compete in the global economic system (Ashford, Mumayiz, & Wright, 2011). This concept's origin lies behind geographical and urbanistic studies. Indeed, it is highly relies on region's economic, geographic and strategic conditions. A sociologist Saskia Sassen (1991) has mentioned that a global city have a direct relationship with global affairs through socioeconomic tools, in her book named as *"The Global City: New York, London, Tokyo"*. It is important to understand how a global city differs from any other city in terms of economic, political, cultural and infrastructural characteristics. All these particulars about global cities are mentioned above (Ashford, Mumayiz, & Wright, 2011):

Economic Characteristics

- Based corporate headquarters for multinational corporations,
- International financial institutions,
- Leading law firms,
- Financial conglomerates,
- Stock exchanges influential over world's economy,
- Significant financial capacity/output for city and region,
- Gross domestic product (GDP), stock market indices, and market capitalization,
- Financial service provision, for example, banks, accountancy,
- Costs of living,
- Personal wealth, for example, number of billionaires.

Political Characteristics

- Active influence on and participation in international events and world affairs,
- Hosting headquarters for international organizations,
- A large proper, population of the municipality (the center of a metropolitan area, typically several million) or agglomeration,

- Diverse demographic constituencies based on various indicators, such as population, habitat, mobility, and urbanization,
- Quality-of-life standards or city development,
- Expatriate communities.

Cultural Characteristics

- International, first-name familiarity, whereby a city is recognized without the need for a political subdivision,
- Renowned cultural institutions (often with high endowments), such as notable museums and art galleries, notable opera, orchestras, notable film centers and festivals, a thriving music scene and nightlife, and influential media outlets with an international reach,
- A strong sporting community, including major sports facilities, home teams in major league sports, and the ability and historical experience to host international sporting events such as the Olympic Games, World Cup, and major tennis events,
- Educational institutions, for example, renowned universities with prominent research centers and diverse international student attendance,
- Cities with sites of pilgrimage for world religions and world heritage sites of historical and cultural significance,
- Thriving tourism industry and active round-the-year convention and conference industry,
- City as site or subject in arts, media, television, film, theatre, music, literature, and magazines,
- City as an often repeated historic reference, showcase, or symbolic actions.

Infrastructural Characteristics

- Advanced transportation system that includes several highways connected with the regional highway network and large mass transit network offering multiple modes of transportation (rapid transit, light rail, regional and high-speed rail, ferry, intercity bus, etc.), that provide extensive and popular mass

transit systems, prominent rail usage, road vehicle usage, and major seaports,

- Major international airport(s) that serve as an established hub for several international airlines with significant volume of international passenger traffic and international air cargo activity,
- Advanced communications infrastructure on which modern transnational corporations rely, such as fiber optics, Wi-Fi networks, cellular phone services, and satellite telecommunication,
- Health care facilities and medical research centers, for example, hospitals and medical laboratories,
- Prominent, world-class urban skyline.

Global cities have been defined and categorized by Globalization and World Cities (GaWC) Research Network, which was created in the Geography Department at Loughborough University. These world cities' researchers focus on the external relations of world cities and have been publishing, so called, *"GaWC Research Bulletins"* by having contributions from many scholars, followers and researchers (GaWC, n.d.). Global cities of world have been ranked under certain criteria; business activity, human capital, information exchange, cultural experience, and political engagement (Figure 27).

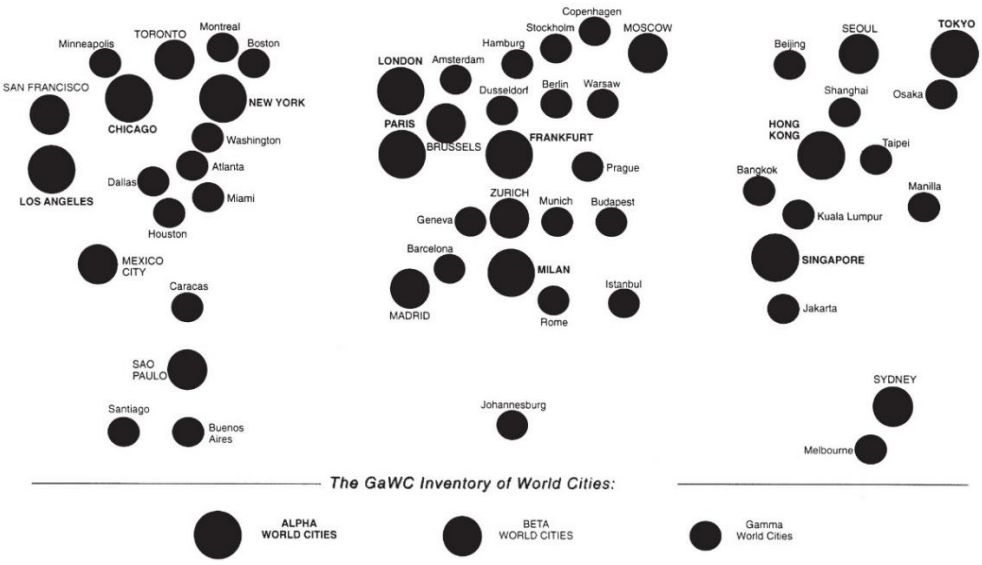


Figure 27: World global cities (Beaverstoc, Smith, & Taylor, 1999)

In this study, it is crucial to define the relationship between global cities and future airport city development. The research which has been done by GaWC network have many implications in projection of future airport cities because of the used evaluation parameters. The relationship between global city and the airport should give some important outcomes for airport city development, such as availability of space, infrastructure, and communities of business and industry surrounding the airport. In Figure 28, red dotted global cities have managed to adopt the airport city concept into their system (Ashford, Mumayiz, & Wright, 2011).

Figure 28: GaWC 2008 ranking of global cities (GaWC, n.d.)

It is interesting that except those four global cities that managed to adopt airport city concept, none of the Alpha ++ global cities have tend to have their distinct airport city. It is most probably because of the fact that having already built, strong sub-systems which are already functioning as a substitute for airport city concept. As a result, the size of the city and the city-airport relationship becomes the most important circumstance to be taken under consideration for the creation of an airport city.

3.2.2 Defining Airport City Model

In the 21st century, airports are experiencing a new and significant evolutionary era, which is called by scholars as the "airport city". Everything has been started with a few European and U.S. airports having success on their duty-free and traditional terminal retail and eateries. The success of such economic dynamics have opened gates to new ideas for airport commercial expansion and diversification (Kasarda, 2008).

Today, major airports attract businesses, commercials and leisure activities mostly. Those airports become regional and multi-modal surface transportation nodes. Airports transform into shopping malls and artistic venues because of their attraction carried by those reasons that are mentioned before. Consequently, it is inevitable for airports to create clusters of hotels; convention, trade and exhibition facilities; corporate offices, retail complexes, and culture, entertainment and recreation centers with such an attractiveness they generate (Kasarda, 2008). This fact shows that airports are out of being just departure locations as they have managed to transform into commercial destinations.

3.2.2.1 What is an Airport City?

In principle, the Airport City is basically a dense cluster of operational. Concept includes airport-related as well as other commercial and business activities on and around the airport platform (Güller Güller, Güller, & Güller, 2003). Airport City concept is explained by John Kasarda (2008) as an "inside the fence" area including terminals, apron, and runways, also with air cargo, logistics, offices, retail and hotels. The airport city is at the core of the aerotropolis serving as the center of a new urban form evolving around many major airports. This concept does not process alone by itself, whereas it helps to detach airport with its surroundings. Strategically, it works in a regional system, by combining transport and land-use planning (Güller Güller, Güller, & Güller, 2003).

Airport cities which are existing today have developed following different paths. However, minority of them have been planned consciously. On the other hand,

airports which have been developed organically to become an airport city have had some reasons depending on (Kasarda, 2013);

- Airport land availability,
- Improved surface transportation access,
- Growing air traveler consumer demands,
- Airport revenue needs,
- New business practices
- Site-specific commercial real estate opportunities.

Not depending on such concepts, airports continue to transform from being only a transportation hub to multimodal and multi-functional commercial developments.

"Airports are the central stations of the 21st century" (Güller Güller, Güller, & Güller, 2003), as mentioned by Güller Güller architecture urbanism in their publication named "From Airport to Airport City". Airports have been spoken highly of their geographical positions in the whole region that they have control on. Airports have a potential of rewriting the geography of the urban territory as Central Railway Stations did in the past. This power of airports mostly depend on the keyword 'accessibility'.

Investments which have been done to solve accessibility issues help to improve connections between airport and its surroundings. Else, it also helps airports to be more crowded places. Importance of improved accessibility is explained in three major ambitions in Figure 29; firstly, improving landside access to a major airport in a top level is the most important part (1). Ground transportation to an airport determines the airport growth. Secondly, to make an airport develop under any concept's circumstances is a very radical decision to take. Building an Airport City is a substantial infrastructural effort both for governments and operators. It is essential to build similar access standards just like any city should need to provide (2). Thirdly, the role of an airport in its region can be determined by looking means of public transportation that is provided. Public transportation is an important necessity for any regional and international interchange node. It is crucial to provide

appropriate means of public transportation to make the airport to cope with the rapid formation of poly-centric metropolitan areas (3).

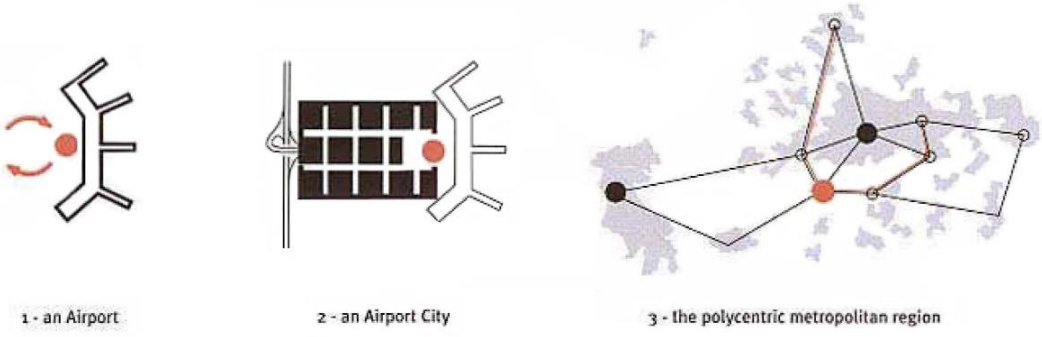


Figure 29: Accessibility of an airport (Güller Güller, Güller, & Güller, 2003)

The passenger terminal of the Airport City is the spatial and functional core of the system. This core functions as the urban central square of a city. Passenger terminal operates as a center offering variety of urban functions. Offices, hotels and exhibition halls are taking places around the terminal which shows a uniformity of a metropolitan central business district. This formation hopefully creates a city-like environment at and around the airport. Such development makes it easy to form Aerotropolis by having sufficient amount of aviation-linked businesses along transportation corridors (Kasarda, 2010).

3.2.2.2 Airport City Functions and Drivers

Airport cities have been evolved on different spatial forms depending on available land required and ground transportation infrastructure. It is explained that all airport cities emerged in response to four basic drivers (Kasarda, 2008):

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."*

Activities that exist at and around airports are classified in three categories based on the extent to which they are related to air traffic (Güller Güller, Güller, & Güller, 2003):

1. *"Core aeronautical activities conducted as part of the technical operation of the airport directly supporting the aeronautical functions.*
2. *Airport-related activities that have direct relation to air freight or air passenger movements. Their competitiveness and/or business revenues are closely tied to the scale of the aeronautical activities.*
3. *Airport-oriented activities choose the airport area because of the airport's image and its typically excellent ground accessibility. The prices of land and surface connectivity, rather than the relation to aeronautical activities, are key factors in determining those activities locating in the airport area."*

The functional schematic of the activities that Güller and Güller mention is depicted in Figure 30.

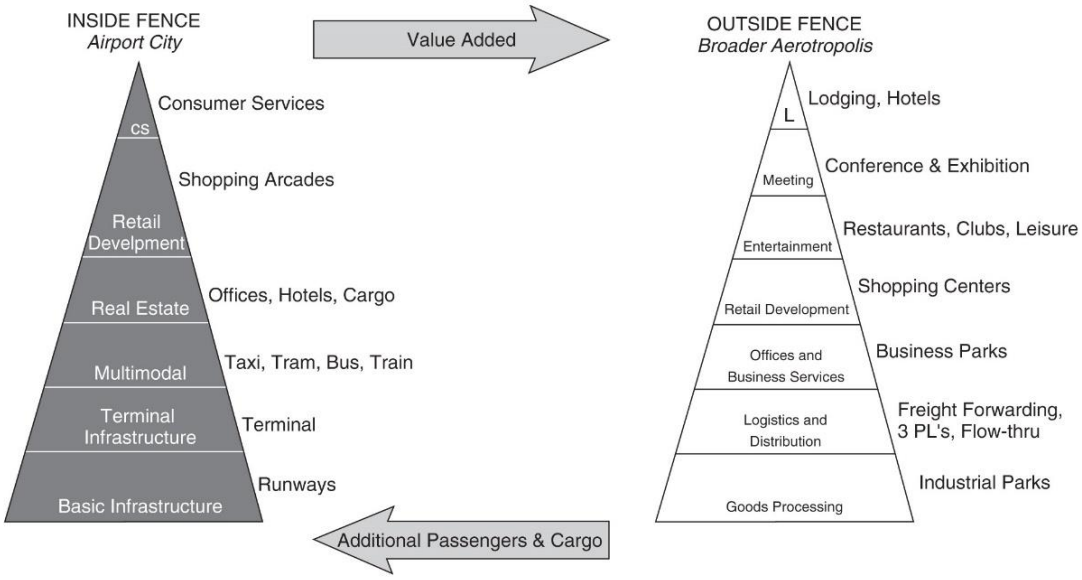


Figure 30: Typical airport city functions schematic, inside and outside airport boundary (Ashford, Mumayiz, & Wright, 2011).

In addition to Güller and Güller's categorization, John Kasarda (2008) have a word to add about airport-area development and activities taking place. Kasarda mentions that along with air traffic patterns, surface connectivity and land price, industrial structure and nearby resident population with commercial demands also plays a crucial role in airport-area development. The nature of local market and boundaries of airport determines the future of airport development. Kasarda continues as follows:

> *"Those airports with limited developable land will see substantial airport-related and airport-oriented commercial development taking place 'outside the fence' and therefore may not benefit directly from the real estate returns. They will, however, benefit from any additional passengers and cargo that such development generates."* (Kasarda, 2010)

Airport cities are liken to urban development, both politically and governmentally. Boundaries of urban development have never been limited except any geographical circumstance, so do airport boundaries. However, in the past, airports weren't expected to be in significant commercial and competitive development roles. Regardless of this idea, airport dependent development won't stop at the formal boundaries of airports (Kasarda, 2010).

Airport development has reached to the level of urban development since airport areas have started to attract businesses, workers, and residents. In the research by the University of North Carolina's Kenan Institute has shown that employment growth near airports has been growing much faster than the metropolitan suburban area in which the airport is located (Kasarda, 2010). This fact shows that those areas are not grasslands anymore. As many businesses having interest on land close to airport, it is more possible to expect an urban metropolitan development and population growth. Airport commercial development includes employee and resident needs in terms of incidental services. These services are generally being provided in large mixed-use residential developments near airports. As a consequence, airport areas have become metropolitan are population growth nodes.

Most common airside and landside airport city commercial activities are as follows (Kasarda, 2008):

- *"Duty-free shops*
- *Restaurants and specialty retail*
- *Cultural and entertainment attractions*
- *Hotels and accommodations*
- *Banks and currency exchange*
- *Business office complexes*
- *Convention and exhibition centers*
- *Leisure, recreation, and fitness*
- *Logistics and distribution*
- *Perishable goods and cold storage*
- *Catering and food service*
- *Free-trade and custom-free zones*
- *Golf courses*
- *Factory outlets*
- *Personal and family services such as health and child care."*

3.2.2.3 Planning Point of View

21st century airports are changing their operational management functions towards concentrating more on non-aeronautical functions. Most of the major airports, such as Paris, London, Frankfurt, Dallas, Schiphol, and Singapore, use commercial real estate divisions to develop land in terms of encouraging commercial development around airport. That multifunctional usages of the land give an opportunity to serve for both aeronautical needs as well as gaining extra profits to airport cities (Ashford, Mumayiz, & Wright, 2011). Such model was not usually used to operate airports a decade or two ago. However, this model become a crucial reason to develop land efficiently to have an income from it instead of leaving land as a grassland.

Airport city is defined as the new paradigm shift from the way airports were managed 20 years ago. This paradigm shift offers new planning approaches for airport planning. It is a must to combine and evaluate innovative management, finance, marketing, and commercial development principles together with the new

strategies. Airport city model should accord with businesses in the way that business do business. Therefore, today, airport master plans are focused more on commercial development and their efficiencies which shows the importance of commercials in such airport development (Ashford, Mumayiz, & Wright, 2011).

Quality and quantity playing important role on airport growth (Güller Güller, Güller, & Güller, 2003). It is crucial to let local and regional authorities to have enough information about valuable development near airports. On the other hand, this information serves for airport operators also. It gives an opportunity for airport operators to access new landside revenues to be utilized in aviation infrastructure. It is important to balance the growth on and off airport area for further success on airport city concept. Today, airport cities have become comparable with actual cities which they are connected to (Figure 31).

Figure 31: Airport area is comparable to the city (Güller Güller, Güller, & Güller, 2003)

Random airport city planning, in terms of land use and infrastructure, has resulted many problems such as traffic congestion, parking shortage, inefficiency of public transport and safety concerns. Ashford, Mumayiz and Wright (2011) stated that after encountered issues, the requirement was comprehensive and integrated

localized infrastructure and urban planning of the airport city. Important part of the planning is to reach the required level of enhanced connectivity, speed, modal compatibility and agility. Implementation of local and regional transport to airport cities ensures that they should grow on a system of time-cost oriented access. Airport cities are not desired to develop on the origin of spatial distances. On this point, urban planner should understand main reason of implementing such concept to that certain urban area and should act according to that. Appropriate multi-modal ground transit systems should be built. Furthermore, to emerge future competitiveness of urban areas, it is crucial to locate commercial facilities coherent with the form and function of the Aerotropolis. Ashford, Mumayiz and Wright (2011) explains further:

> *"... the airport work interactively and proactively with several stakeholders, including airport planners, urban and municipal planning agencies, government agencies, economic development commissions and chambers of commerce and industry, land developers, regional planning organizations, the business community in the vicinity, transport companies, local community groups, and environmentalists."*

They underline the words such as functional synergy, economic efficiency and collaborative development. If these words have an understanding in any development plan of an airport, it is not impossible to make urban and transportation planning concepts socially acceptable and environmentally sustainable for an airport oriented concept. It shouldn't be forgotten that airport city is still in the early stages of evolution.

Challenges of such a huge development are excessive. However, being successful on developing and planning land, especially for airport cities, is possible by getting through a good communication and study of planners and urban designers. It is crucial to identify any potential challenges that may be facing the long-term existence of the airport city. Urban planners and designers' main objective is to position airports as a component of urban setting. Airport terminal areas should be integrated within the society to ensure their adaptation with their environment. Here

comes 4 important factors to be taken under consideration: synergy, governance, sustainability and spatial integration (Ashford, Mumayiz, & Wright, 2011). Sustainability way of the concept, especially for airports, is hard to keep up on high level because it is very difficult for an airport or an airport city to position itself as "green". So the question raised here is that is it enough to make it environmentally sustainable as society expects? Sustainability of an airport may be achieved with a good spatial integration of airport with its environment. Such circumstance is very much related with physical and social connection of an airport to its environment.

Güller&Güller (2003) have underlined topics which take important role on airport and airport city planning process. They called it as *"13+1 recommendations"* which includes accessibility and interchange development, airport city development, innovation and made-to-measure tools, which are listed below:

1. *"Apply the same standards for accessibility in the airport area as in other urban areas.*
2. *Develop the airport station as a second (inter)-national railway station in the region.*
3. *Enhance interchange development at the airport, make it a 'hub in regional public transportation'.*
4. *Focus upon the quality of the interchange node.*
5. *Increase clarity about responsibilities of the authorities involved.*
6. *Be selective: reserve sites for airport-related activities.*
7. *Apply branding: develop marketing strategies (in co-operation) for a specific type of activities.*
8. *Be clear about which areas have development priority: when, where, how much!*
9. *'Airport planning' has to move towards 'urban planning'.*
10. *Compile regional development strategies that assign the airport a specific role.*
11. *Create a permanent forum for airport-related issues.*
12. *Determine an 'Airport Zone': an area of coordinated action.*
13. *Cooperate in the development of real estate throughout the region."*

It is also mentioned that some regions have developed such tools already. However, these are defined as the instruments which are required for a successful integration of Airport City by Güller&Güller (2003). These, so called, 'instruments' are suggested for increasing the advantages that can be obtained from such economic development at airports. Surely, every region has its own characteristics to be evaluated on its own. It is impossible to apply same materials for all airport city concepts. Correspondingly, the thirteen plus one recommendations are not an action package which can be directly be applied to any situation.

3.2.3 Critical Factors of Airport City Development

Airport-centered urban development can mainly be categorized under three interconnected concepts; the aerotropolis (airport-integrated urban economic region), the airport corridor and the airport city. Differences between these concepts are categorized according to geographical scale, business approaches and commercial activities at and around airport. Figure 32 conceptualizes and compares these concepts by their geographical point of view.

Concepts of aerotropolis and airport city have been discussed on previous topics. These concepts were introduced by John Kasarda (1991) as the major airport-driven developments which create a powerful economic engine for cities. It is interesting that the only non-commercial land use in aerotropolis concept is seen as the residential districts which are expected to be located between motorways and away from the main flight paths. The reason lies behind such idea is acceptable as the concept is based on a logistics model of airport city.

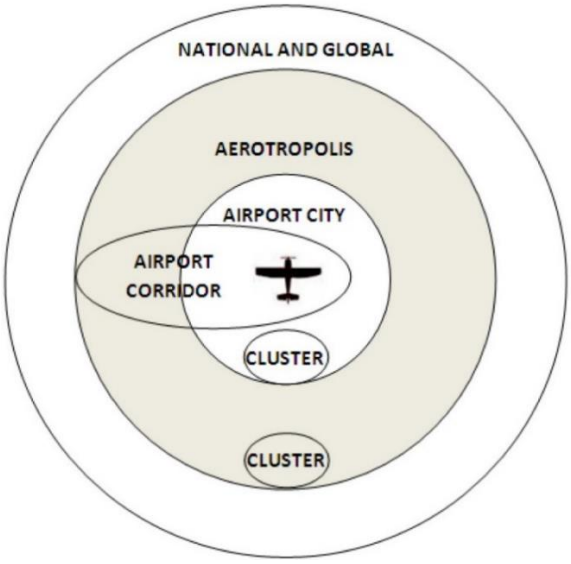


Figure 32: Airport-centered urban development concepts (Peneda, Reis, & Macário, 2010).

Another concept of airport-driven development, *airport corridor,* has been defined by Schaafsma, Amkreutz, Güller (2008) and van der Blonk et al. (2006). Airport corridor is a planned and integrated linear real estate development linking airport with city. Examples of airport corridor developments are existing today; the highway-oriented airport corridor of Denver, the transit-oriented airport corridor of Zurich, or the city-oriented airport corridor of Copenhagen. All of these examples include five different markets effecting functions of airport corridor (Schaafsma, Amkreutz, & Güller, Airport and City: Airport Corridors: Drivers of Economic Development, 2008):

- **Passengers:** airport terminals, hotels, retail;
- **Airport employees:** housing, services;
- **Air cargo:** logistic parks;
- **Business community:** office and technology parks, conference and exhibition facilities, hotels, golf courses, expat housing;
- **Passengers-visitors:** tourism, leisure, entertainment, health, education, theme parks, casinos, clinics, shopping malls, sports stadiums, universities.

Formation of airport corridors are summarized by two different stories: it appeared either in city regions where specific governance structures have been placed for

such corridor development, or by a huge investment guaranteed by public authorities in infrastructure, subsidies and marketing of the corridor. Zurich and Paris cases can be given as examples for first story, and for the second case, Kuala Lumpur, Singapore, Dubai and Hong Kong are the best examples (Schaafsma, Amkreutz, & Güller, Airport and City: Airport Corridors: Drivers of Economic Development, 2008). Such concepts, which affect either positively or negatively the development of airport cities, should be analyzed in order to design airport cities to be able to compete in their region.

Table 12: Aspects of airport city concept. Adopted from (Peneda, Reis, & Macário, 2010).

Urban planners/Architects	**Economists**	**Airport Operators**
• New urban form • A spatial manifestation of the interaction • Airport centered commerce **vs.** real estate development **vs.** multi-modal transportation	• Disregard the urban dimension • Cluster of economic functions at and around the airport	• Business strategy • A marketing tool • Business opportunities created by its own operations • Attracts companies to the airport's territory and surroundings

Aspects of airport city concept differs when it comes to urban planners/architects, economists and airport operators (Table 12). Even some professionals criticize 'city' expression in airport city concept because spatial dimension is ignored and they accept that none of the urban characteristics are needed to be able to create such a development. To exemplify it, Poungias (2009) defines airport cities as *"multifunctional business agglomerations of property projects at airports, such as*

offices, shopping centers, conference and exhibition buildings etc.". He further explains his definition: "*The "city" part of the term refers to the fact that it is only cities of the more traditional kind which bring together such a spectrum of different forms of business."* Such definitions mostly depend on special study area of the researcher. It should be understood that needs of people, living in a community, are a necessity to be met by a 'city'. If you create space for business activities around airport, it is a must to build necessary greenery in order to compensate breathing spaces for workers. Surely, airport city developments are not as the traditional city centers. There is a need of necessary studies to be completed in order to reach the same satisfaction level like city centers. Different specialties, different understandings and different ideas help to create almost flawless worlds.

One of the critical factors for development of airport cities is the variation of similar developments that may help or harm airport city development. It is a sequential process when concepts become similar with each other. Such consequences show that airport environment becomes more attractive so that it increases its territorial impact. Figure 33 basically explains airport business approaches with their spatial impacts in different urban scales.

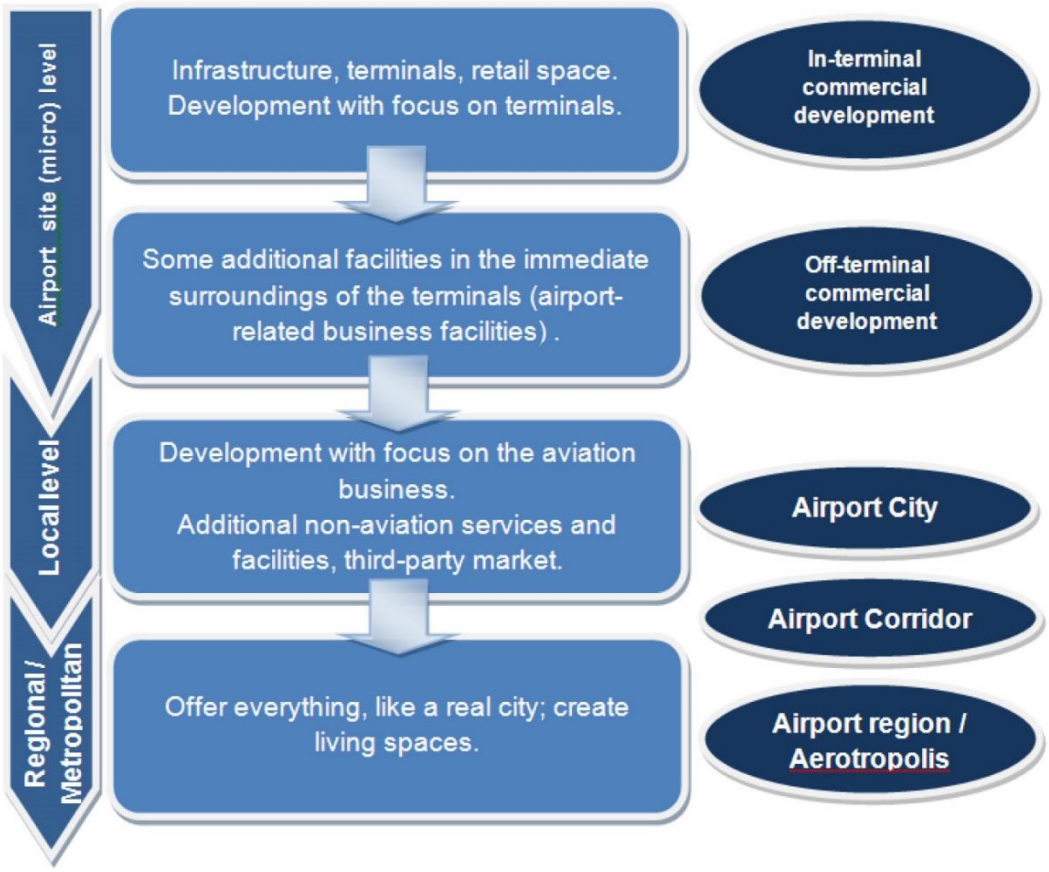


Figure 33: Airport business approaches, development concepts and their spatial impacts (Peneda, Reis, & Macário, 2010).

In a survey, which was conducted by set of civil engineers, the aim was to obtain four most critical factors for airport city development which were obtained from a detailed literature review process. These questions have been asked to individuals who work or do research in the area of airport-centered development. Results showed four main critical factors for the development of an airport city (Peneda, Reis, & Macário, 2010):

1. *Connectivity* of the airport with its environment,
2. The *economic potential* of the hinterland,
3. *Sustainability* status of entire development,
4. Airport operator's *commercial attitude*.

First factor that have been chosen defined as the *connectivity* which includes both physical infrastructure (road and rail) and air connectivity. Strong physical connectivity of the airport city with its surroundings and region is one of the most essential condition to create such concept. Major roads and rail connectivity is the reason how development is clustered and connected (Keast, Baker, & Brown, 2008). Air connectivity that airport creates worldwide is also an important part of the connectivity factor both in numbers and frequency of flights (VERHETSEL & Witlox, 2004). In addition, this circumstance highly depends on the geographical and aviation network position of the airport.

According to Appold and Kasarda (2010), *economic potential of the hinterland* determines the diversity of airport cities in terms of facilities and physical forms. If regions would be categorized into two, low and large production cost regions, results are going to be different. Regions which have low production costs are mostly suitable for export-oriented productions. On the other hand, regions which have large, they create business service supply centers by having well-educated labor forces.

Sustainability is the broadest factor comparing with the others. It includes political, economic, environmental and governmental issues. Mauro Peneda (Peneda, Reis, & Macário, 2010) states major elements that consist in this factor as follows:

- Consideration of airport city developments in national and regional strategic planning,
- The elaboration of comprehensive planning to integrate transport infrastructure and landside development,
- The joint and coordinated development of airside operations and real estate,
- Availability of land for expansion (airside & real estate),
- The engagement of surrounding communities.

Fourth factor, *commercial attitude of airport operator*, depends on how much active management is used, such as corporate organization, aggressive marketing, and pro-active land acquisition. As it is mentioned, it is important to manage such future oriented marketing plans professionally.

CHAPTER 4

GENERAL OVERVIEW OF CERTAIN AIRPORT CITIES

4.1 Sabiha Gökçen International Airport

Sabiha Gökçen International Airport (SAW) is the second airport of Istanbul which was built in Pendik district (Figure 34). It took the name from the world's first combat pilot Sabiha Gökçen. Construction of the airport started in 1998 and finished in January 2001 with the cost calculated as 550 million dollars. Sabiha Gökçen operated by the company named *Malaysia Airports*. Ground services, cargo and security operations conducted by Istanbul Sabiha Gökçen Uluslararası Havalimanı Yatırım Yapım ve İşletme A.Ş. (ISG). Sabiha Gökçen International Airport was selected as the second busiest airport in Turkey.

Figure 34: Location of Sabiha Gökçen Airport in Turkey

Main purpose of building the second airport in Istanbul was a part of Advanced Technology Industrial Park (ITEP) project. ITEP project was the second only in scale of investment to Turkey's South-East Anatolia Project (GAP) in 1980s.

Firstly, airport has been built so to provide logistic support for other phases of the project (Çelebi, 2001).

4.1.1 Location and Characteristics of the Airport

Sabiha Gökçen International Airport is located on the Anatolian side of Istanbul (Figure 35). The Airport occupies an area of 661 hectares in total of 1,300 hectares which is available for ITEP project. It is 95 meters above sea level and 35km away from the city center. Airport is considered as the category of CAT II by the International Civil Aviation Organization (ICAO).

Figure 35: Istanbul districts and location of the airport

Sabiha Gökçen International Airport is open to both international and domestic traffic with a capacity of 3 million per year for international, and half million per year for domestic passengers. Cargo terminal of the airport has 90.000 tons per year capacity. Airports, in Turkey, are generally operated by State Airport Management Directorate of the Ministry of Transport. However, Sabiha Gökçen International

Airport is operated by the Airport Operation and Aviation Industries Company (HEAS), since it is part of the ITEP project. Main shareholder of HEAS is the Defence Industry Office which is defined as the coordinator of the whole ITEP project (İlhan, 2006).

4.1.2 Advanced Technology Industrial Park (ITEP)

In the middle of 1980s, ITEP (İleri Teknoloji Endüstri Parkı) project has been started to be discussed by the authorities in Istanbul. Such projects has already been implemented in other countries such as USA, Germany, Japan, Israel, Finland and France. Prime Minister of Turkey in those years, Turgut Özal, was biggest supporter of the project by offering main idea of ITEP. There were 4 main goals:

- Production of high level technology for air industry,
- Marketing of the manufactured products and creating free trade zone for international relations,
- Institute of Advanced Technology was constituted to support Advanced Technology production with necessary research-development (Ar-Ge) and academic studies,
- Building an airport to support better connections with the new built environment (Erel, 2010).

In October 8th, 1987, with a decision of SSİK (Savunma Sanayii Komitesi Kararı), project has been started to be implemented with the name of İTEP in Kurtköy. In April 20th, 1988, 13 million m^2 of land expropriated for the construction of the project with a decision made by Council of Ministers. For the financial scale of the project, SSDF (Savunma Sanayi Destekleme Fonu) was decided to finance İTEP. Moreover, for the planning, coordination, expropriation and infrastructural investments, SSM (Milli Savunma Bakanlığı - Savunma Sanayi Müsteşarlığı) assigned to be in charge of those investments.

İTEP has a main idea of meeting technological necessities of Turkey's from its own national resources. To do so, it is aimed to increase level of dynamic, scientific and

technologic infrastructure with İTEP project. Such developments are planned to lead following consequences (Erel, 2010);

- Advancements in Turkey's economic and social structure,
- Improving Turkey's competitiveness in world market,
- İTEP would be a leading model in terms of improving nation's technological infrastructure,
- Increase in local and foreign investments,
- İTEP would finance itself,
- To help to meet the need of after-school research-development (Ar-Ge) and education fields in Turkey,
- To increase the capacity of air travel.

The vision of the project was to be the most innovative, most technologic and most export oriented production center of the Turkey. It has planned to be finished in 25 years of a period. First master plan of the project has been prepared between April 1990 and 11th of January 1993 by Raytheon and Aer Rianta.

Figure 36: Master plan of ITEP project

İTEP Master Plan mentions 5 main land uses which are planned to achieve the goal of the project (Yağmur, 2010);

- Industrial Park,
- University and Grad School
- Istanbul Sabiha Gökçen Airport
- Aviation maintenance repair-overhaul center,
- Commercial-Social zone.

4.1.2.1 Elements of ITEP

As it is mentioned before, under the name of ITEP, it was planned to be constructed 5 main elements in order to achieve necessary objectives. For this project, 1,300 hectares of land has been expropriated by SSM as mentioned in Feasibility and Master Plan Study Report.

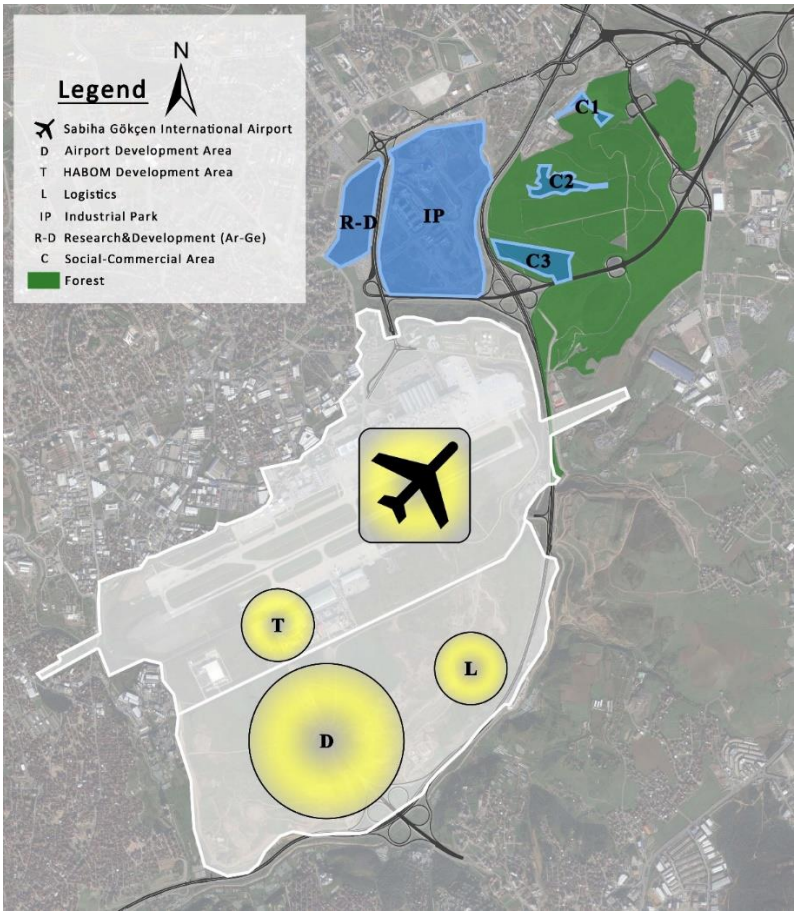


Figure 37: Scheme showing elements of ITEP, adopted from (Yağmur, 2010).

- **Sabiha Gökçen International Airport**

Istanbul Sabiha Gökçen International Airport (SAW) has been constructed as the first element of the ITEP project. The Airport occupies 661 hectares of land as a part of 1,300 hectares which was expropriated by SSM. SAW operates both for domestic and international passenger and cargo transportation since 8th of January, 2001. It was planned to be built in two phases. Phase I was constructed to meet the

capacity of 3.000.000 passengers/year at the International Flights Terminal, and 500.000 passenger/year at the Domestic Flights Terminal. Also, cargo terminal has been built to reach 90.000 tons/year (İlhan, 2006). Some technical numeric data has been given in Table 13 for SAW.

Table 13: Detailed characteristics of SAW (İlhan, 2006).

International Flight Terminal	3.000.000 passenger/year (24.647 m^2)
Domestic Flights Terminal	500.000 passenger/year (2.700 m^2)
Runway	45x3000m
Passenger Apron	45 wide body aircrafts (240.000 m^2)
Cargo Capacity	90.000 tons/year
Category	CAT II

Sabiha Gökçen International Airport is operated under the name of Istanbul Sabiha Gökçen International Airport Investment Development and Operation Inc. (ISG), which is a company founded in partnership by Limak Holding (LIMAK), GMR Infrastructure Limited (GMR), and Malaysia Airports Holdings Berhad (MAHB). ISG has 20 years operation rights of SAW, starting since May 1st of 2008, including the management of the terminal buildings, car park, ground handling, cargo and aircraft refueling operations, the airport hotel and CIP facilities. Since 2014, ISG has been operated under MAHB partnership (ISG, 2016).

Figure 38: Satellite view of SAW (source: Google)

SAW had two terminals which has provided international and domestic service in two separate terminal buildings. After reaching over-capacity passengers, it was decided to be built a new terminal which will serve both for international and domestic under one roof. New terminal was inaugurated on 31st October of 2009 with a capacity of 25 million passengers annually.

- **Industrial Park**

ITEP's industrial park project, named as *'Teknopark İstanbul"*, has been established under the decision of SSİK (Savunma Sanayii İcra Komitesi) in 3 May 1999. Teknopark İstanbul has gained a title of TGB (İstanbul Teknoloji Geliştirme Bölgesi) in 2009. It occupies an area of 355 hectares out of 1.300 hectares which was expropriated for ITEP project. As it was planned for ITEP project to be the most innovative, most technologic and most export oriented production center of the Turkey, the Industrial Park welcomed technology intensive businesses to carry out a mix of knowledge based innovation functions (İlhan, 2006). Generally, main sectors which are aimed to raise Turkey in advanced technology are as follows;

- Aerospace,
- Defense industry,

- Advanced electronics,
- Marine industry,
- Industrial software,
- Advanced materials,
- Energy,
- Health sciences (SSM, 2015).

ITEP Project model has aimed to bring together education, science and industry synergistically together for to produce advanced technology industry. It is crucial to achieve such goals in global economy to be a part of globalization and competition in it.

- **Technology Institute**

The goal of establishing a special purpose University within the ITEP project was to meet qualified and specially trained labor force demand of high tech companies in the Teknokent İstanbul (İlhan, 2006). However, it has seen that the Turkish University System is not suitable to build such a university in usual ways. Under the light of the ITEP project, a special University was planned to be established to provide for specific Ar-Ge activities with the needs of industry.

Teknopark İstanbul has needs of organizational, financial and human resources based establishments which is already available in the universities of Istanbul. After realizing such a point, it was discussed to use existing potential of universities in Marmara Region rather building a new one.

- **Aviation maintenance repair-overhaul center (HABOM)**

Maintenance repair and overhaul center is located at the south-west of the runway and consists of 3 different usages (Figure 39). The area of 372.000 m^2 was reserved for maintenance and distributed as follows; 65.000 m^2 was leased to MyTechnic MRO in 2007, 296.000 m^2 was leased to Türk Hava Yolları Teknik A.Ş. in 2008 by SSM, for to build a maintenance & repair center.

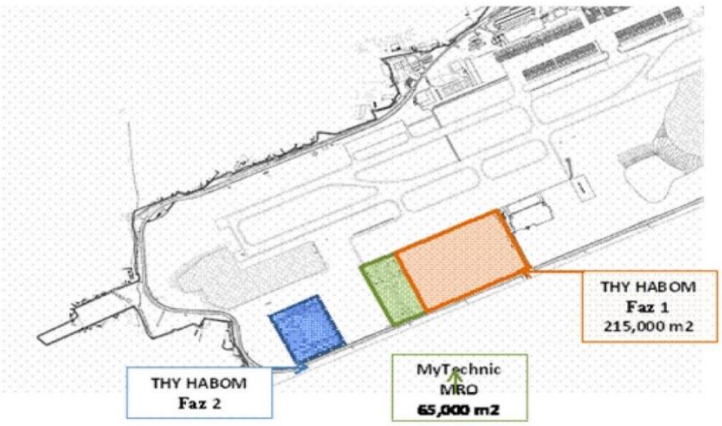


Figure 39: Maintenance repair-overhaul areas (Yağmur, 2010)

- **Social and commercial zone**

Area that have been expropriated for social and commercial zone is about 211 hectares at the northern vicinity of ITEP Project. Social and commercial zone planned to consist of such usages (İlhan, 2006);

- Commercial Area: for retail businesses and professional service sector companies,
- Housing Zone: from apartment to villa housing,
- Hotel Area: includes visitor and conference/fair/exhibition facilities,
- Recreation and Leisure Area: to provide open green areas and facilities.

It is important to build carefully the open spaces and leisure places in such big projects to succeed at all. Space which is provided by this curtain area would give the provision of social and commercial services such as retailing, housing, hotels and leisure areas. Such thoughts are actually forms the image, aims and objectives of the ITEP Project. Also, building such commercial and social areas would gain a specific character to this project.

4.1.3 Sabiha Gökçen Airport as an Airport City

Sabiha Gökçen International Airport has been built as a part of İTEP (Advanced Technology Industrial Park) project in 2001, even though the first master plan has

been completed in 1994. The goal to build an airport was to provide enough investment opportunities in order to finish the whole project. Indeed, project included industrial park, university, airport, aviation maintenance center and commercial/social zone. In consequence of late opening of Sabiha Gökçen Airport rather than expected, some elements and goals has been changed in time depending on the global market demand.

Developers and operators of ITEP have been decided to change the vision of the whole project into so called *"Airport City"* concept. They realized that most of the characteristics of the İTEP project match Airport City concept. One of the most crucial features that an Airport City should have is the accessibility, as well as the geographical location of the airport. Istanbul has an opportunity to reach 111 countries and 3.1 billion people by using only narrow body aircrafts. In addition, Sabiha Gökçen Airport has enough transportation services available for the passengers to access to the city center such as: highway, seaway, railway and public buses (Figure 40).

Figure 40: SAW accessibility opportunities (Özdemir, 2014)

İTEP project includes so many usages that airport city concept requires; offices, businesses, hotels, technology park, conference center, medical centers etc (Figure 41). Turkey is considered as a developing country which means that technology is an important investment area. Technopark would be a good idea to invest in to develop more in technology. There has already been a good demand for such innovations and, as a result, it was planned to be built the largest Technopark in Turkey under the name of İTEP project.

Figure 41: Sabiha Gökçen Airport City components (Özdemir, 2014)

Offices are considered as one of the primary components which Airport Cities require in order to process. Therefore, SAW Airport City project also includes businesses and offices in its periphery. By having airport close to offices and Technopark, the popularity of the location would be improved in time to get enough

demand for such usages. Moreover, İstanbul already has enough potential for office usages. Offices, Technopark and businesses should offer necessary recreational facilities in order to be chosen.

Due to the geographical location of İstanbul, city become popular in case of conferences. It is important to meet sufficient amount of conference halls, convention centers and hotels. Airport City concept, in this case, would be beneficial to meet such necessities. Istanbul already has lack of such facilities on the Asian side, especially lack of four and five star hotels. Apart from hotels and convention centers, location advantage becomes internationally crucial in health sector. With the existence of the airport, easy access to the hospital facilities for patients flown within the country and neighboring countries play a fundamental role.

Every airport city has its own layout and principles. SAW Airport City and İTEP project had been planned to have two milestones; airport and Technopark. Technopark and other usages are planned to be located on the north of the airport (Figure 42). Land which was expropriated for İTEP project was around 1,300 ha, and 127 ha of that land reserved for investment and 142,5ha was reserved as forest area.

Figure 42: Sabiha Gökçen Airport City schematic land use (Özdemir, 2014)

Technopark and hotel, residential, health center are separated by the Kurtköy-Pendik road. On the West side of the Kurtköy-Pendik road, it is planned to be the actual Technopark (İstanbul Teknopark), and in the same cluster, conference center and offices were thought to exist (Figure 43). When it comes to accessibility point of view, municipality plans to build subway which connects Sabiha Gökçen Airport to the Anatolian center of İstanbul; Kadıköy. In addition, it is planned to be built extra mixed use public transport hubs inside Technopark area which will increase the connection between city center and Technopark.

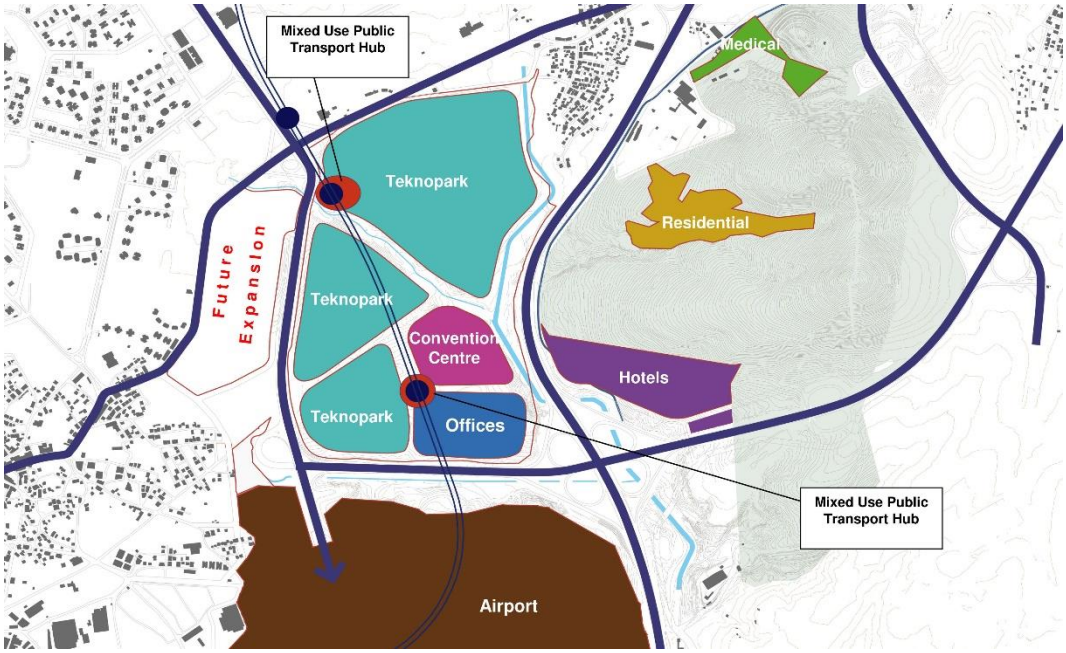


Figure 43: Investment areas schematic land use and transportation nodes (Özdemir, 2014)

Technopark part of the project has been started to be discussed on 12th of February 2009 with an agreement between Savunma Sanayii Müsteşarlığı, İstanbul Ticaret Odası ve İstanbul Ticaret Üniversitesi. Technopark named as *Teknopark İstanbul*. Layout plan of Teknopark İstanbul has been prepared by İTÜ Nova A.Ş. and applied under circumstances of that plan (Figure 44). As the first phase, only 5 buildings has been built. The construction has begun in the early 2012, and still continues. Second phase was determined to add 5 more buildings to this project as shown in Figure 45. Current status of the construction is shown in Figure 46.

Figure 44: Layout of diverse functions; technopark, offices, recreational areas, medical center, hotel, convention center etc. (Özdemir, 2014)

Teknopark İstanbul's master plan shows some clues about the working principles of its own. It is clearly seen that on the West side of the campus, main entrance has been located for cars, which is connected with Havaalanı Yolu. Master plan shows that there would be another entrance on the East side of the campus which will serve as the second entrance. It would have its connection from the Kurtköy-Pendik road. As yet, only connection with Sabiha Gökçen International Airport is seem to be only by Havaalanı Yolu. Teknopark İstanbul is mostly surrounded by forest areas, few residential and industrial areas.

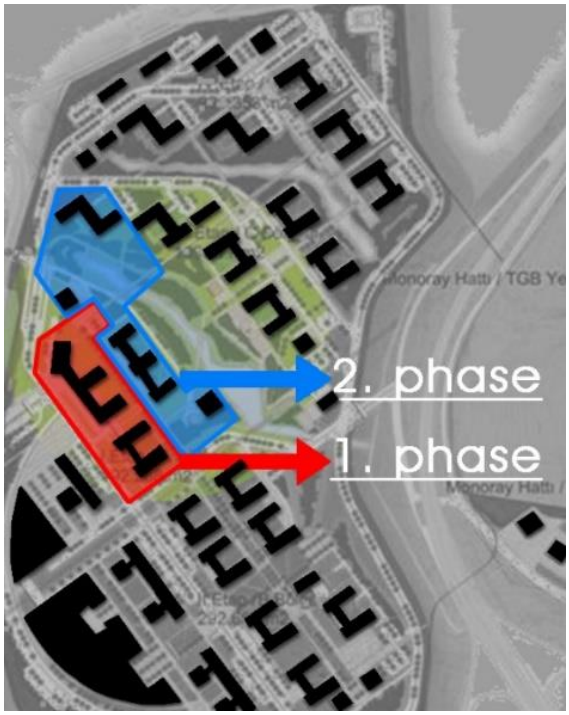


Figure 45: Phases of İstanbul Teknopark

Teknopark İstanbul's pedestrian circulation is designed similar to METU Campus, which gives opportunity for pedestrians to walk through whole campus without thinking about vehicles. Vehicle circulation is separated from pedestrian roads, but minor roads service buildings by using their backyard which gives opportunity for pedestrian circulation between buildings.

Structure forms are selected to be more rectangular than any other form. However, rectangular forms clustered between each other to take a form of 'U', with a fully closed pedestrian bridges (between two rectangular forms). Orientation of buildings selected to be North-East to South-West. It can be easily seen that there are only few buildings which have different form than rectangular ones. On the South-West of the campus, different forms have taken their place to serve as hotel, convention center, exhibition and fair ground. On the other hand, all other rectangular forms mostly serve for same function: offices.

Figure 46: Current construction status of Teknopark İstanbul (retrieved on 01.11.2016)

Airports should be built and developed depending on their location and neighborhood. Sabiha Gökçen International Airport had an opportunity to get an integration to a brand new technopark because of the İTEP project. At this point, it is important to pinpoint the importance of planning. As we can see, even if the actual completion time has been late, the main idea and land that was excavated for İTEP project haven't changed at all. Land uses around airport and İTEP project should be evaluated carefully to ensure how the new community effect already existing layout.

Sabiha Gökçen International Airport's environment is surrounded by residential land uses which is just the half of it. Other half consists of forest and industrial land uses. Residential land uses are located so close to the runway, which is almost 500m away from the start of the runway. When it comes to industrial usages, they are attached to the borders of the airport on North-West side. Turkish regulations state that starting from the first 6.000m of runway threshold, it is forbidden to build any industrial plants which would cause reflections and explosive dangers. Petrol stations, warehouses and any similar land uses are also forbidden inside first 6.000m of flight cone (Sivil Havacılık Genel Müdürlüğü, 2012). However, Sabiha Gökçen International Airport has many diversified industrial formations inside that area.

Open spaces and agricultural land uses are mostly located from the North-East to South-West direction. It is the same direction as the runway is located (Figure 47). It can be said that such situation is on behalf of airport development and should be supported in terms of security reasons and regulations. However, due to the rough terrain of the area, development area and construction conditions are mostly limited.

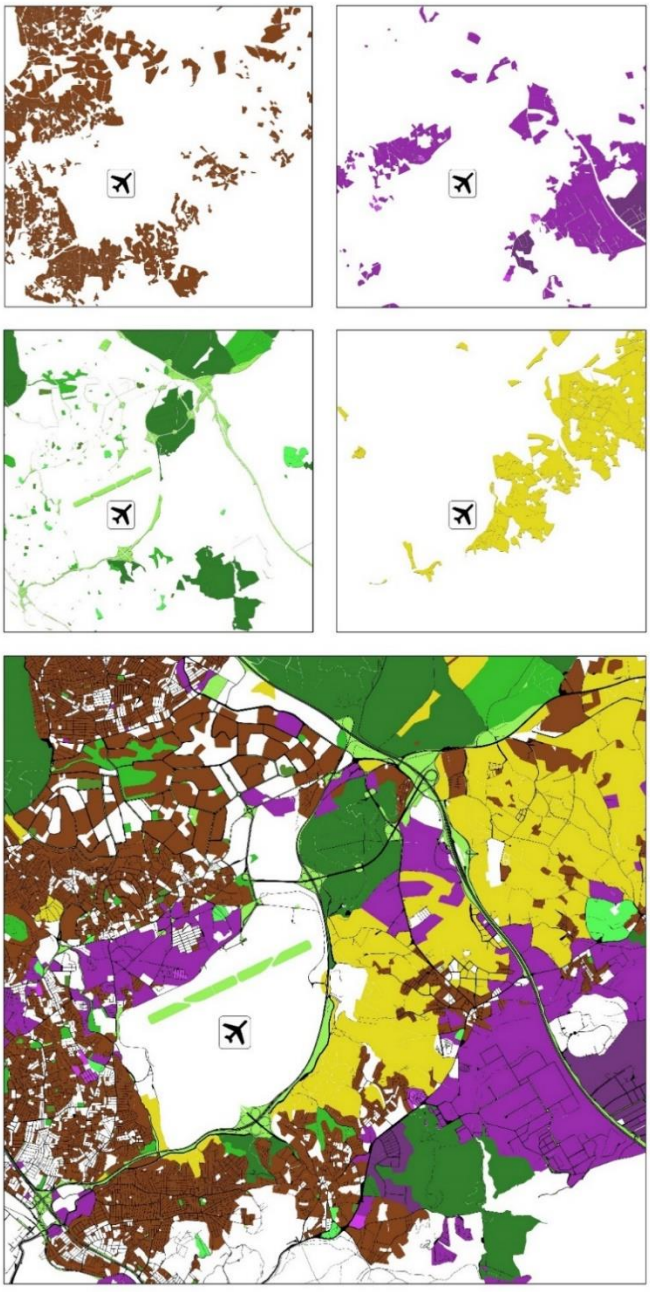


Figure 47: Land uses around SAW; residential/commercial, industrial, green space, agricultural land.

4.2 Amsterdam Airport Schiphol

Amsterdam Airport Schiphol (AMS) is the main international airport of the Netherlands by serving as the hub for KLM and its regional affiliates. It is located 9.1km southwest of Amsterdam which is approximately 20 minutes away from city center of Amsterdam (Figure 48). AMS is deemed as the fifth busiest airport in Europe in terms of passenger volumes. In addition, it is ranked as the fifth busiest airport in Europe in 2015 (Schiphol Group, 2016) in terms of total passengers. AMS is counted as the top airport in Europe in terms of offered alternatives of entertainment, business and accommodation such as restaurants, bars, shops, banks, hotels etc. Amsterdam Airport Schiphol has been nominated as one of the best airports in the world frequently. For sure, the reason which lies behind such story should be a well-planned development contributed to the airport in long term. NACO has continuously been working on the development of this airport since 1960.

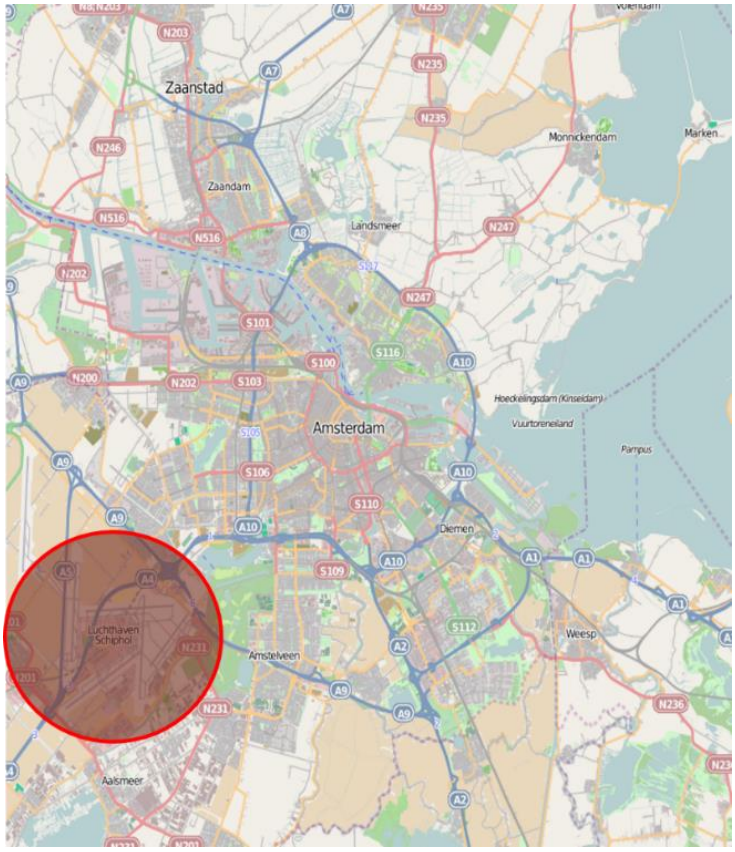


Figure 48: Location of AMS

Amsterdam Airport Schiphol has been counted as the pioneer on implementation of airport city concept, which was quite successful. Schiphol group has implemented different strategies while developing airport city of AMS to make it more of a major economic driver and magnet of airport-centric business development. This process has been named under different names and development strategies since 1980s (Ashford, Mumayiz, & Wright, 2011):

1. *Airport:* Air transport infrastructure built in 1920s.
2. *MainPort*: Major economic driver of the region which has been implemented in 1980s, then re-branded under the name of airport city. The Schiphol Centrum District, Schiphol Plaza, World Trade Center and its CBD skyline has played a crucial role on making that area the most attractive business district in the entire Amsterdam metropolitan area.
3. *Airport City*: Business model for both aviation and non-aviation uses since 1990s to present.
4. *Airport City Corridor*: Airport city development is supported with a corridor of residential and commercial functions which aims to enhance importance of the AMS with society and urban landscape (Schaafsma, 2009).

Many researchers define Amsterdam Schiphol Airport as an important airport city example which was planned with a motto of "creating airport cities". We can understand that the reason, which lies behind AMS, to be the one of the most successful example of an airport city from these words:

> *"Amsterdam Schiphol Airport does not function as any other airport-where passenger and freight change travel modes between land and air. It functions as the duo of a modern multimodal transport hub and a modern city of selective high-valued business, industry (logistics IT and services), and entertainment land uses. The progress of this transformation was natural and logical."* (Ashford, Mumayiz, & Wright, 2011)

From very first development of the airport to now on, Schiphol Group have had many opportunities to consider in positive ways. The most important part on airport city development is to have adequate space available around airport, just like AMS

have had. In addition of space availability, it was very well connected to the road and rail urban networks. It was expected from such regions to have enough density of population depending on the existence of an airport. As population and connection of the airport were successful factors for an airport city development, it was also recognized as part of an open economy. As a consequence of such factors, it wasn't a constrained to build an airport city.

In 1980s, everything started with the vision of *MainPorts* which was a program to improve Netherlands' international trade. Actually, it was government's strategy in national scale to improve the position of the country internationally. Main actors in this strategy have been Port of Rotterdam and Schiphol Airport. Local government chose to work in coordination with Schiphol Airport to build a logistic complex around the airport. According to this partnership, a government commission (Bestuursforum Schiphol) and the Schiphol Area Development Company (SADC) were founded. The National Investment Bank has been invited to participate in this project which resulted as the first successful public-private partnership in airport development (Ashford, Mumayiz, & Wright, 2011). Development aimed to attract logistics and goods companies to create new businesses around Schiphol Airport. It has been successful, but main focus has been changed from logistics to services and from goods to people.

With MainPorts project, it was aimed to attract different businesses to settle around Schiphol Airport. This aim has been successfully achieved, even created a need of new business districts to serve for urban economic development. Government decided to develop a new business district at Zuidas, which is located at the south of the city, 6km away from Schiphol Airport. *Zuidas development* started in 1980s, and continued 1990s onward. After 10 years of development, Zuidas development take attention of the financial and legal sectors because of its perfect location and high connectivity with airport. Zuidas development was a unique place in terms of opportunities of international trade, business, and technology development (Ashford, Mumayiz, & Wright, 2011).

Development planning of Schiphol Airport has had 3 main turning points to indicate; 1967, 1980 and 2000 (Ashford, Mumayiz, & Wright, 2011). After

experiencing high traffic visiting Schiphol Airport, it has been said to expand and develop further both airside and landside of airport. Figure 49 shows runway development during those three important periods. Schiphol Airport City has been expanding during these periods and airport terminal development said to be expanded in two areas of the airport: airport central area and northwest side of the airport (Krul, 2008).

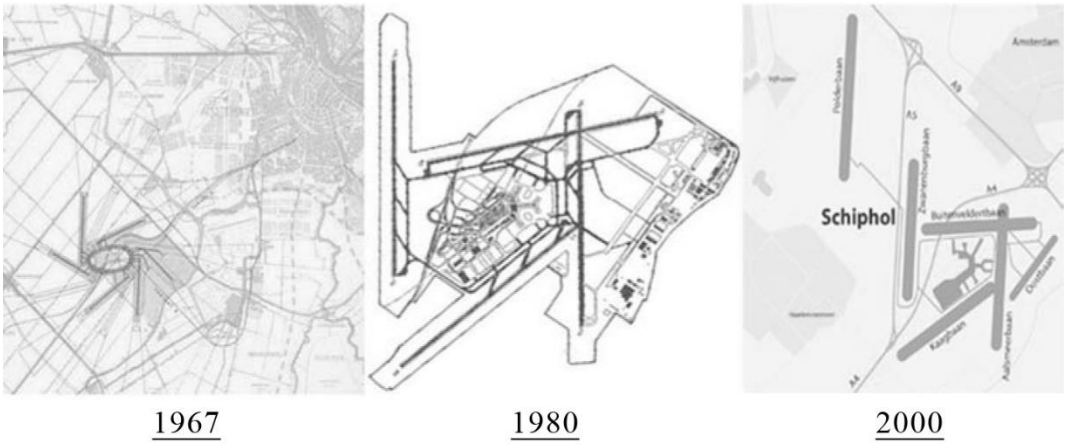


Figure 49: Schiphol Airport runway development from 1967 to 2000 (Ashford, Mumayiz, & Wright, 2011).

In 1998, airport city concept has started to be implemented to Schiphol Airport. Amsterdam Schiphol Airport City development included 600.000 m^2 of offices and almost one million meters of industrial real estate at the airport area. Looking at Schiphol example, 3 main spatial cores are defined which form Amsterdam Schiphol Airport City: *Schiphol Plaza*, *Schiphol Centrum* and *Airport City Proper*.

Starting from *Schiphol Plaza*, the heart of the airport city, it is the first place to welcome passengers, where the terminal and the railway station come together. Airport city concept highly recommends strong transportation connections between airport and the city, also with regional networks. Schiphol Plaza is a square which is covered with a green roof technology. It is served with multistory parking garages and surrounded by a shopping mall, the underground railway station, the food and beverage outlet, two hotels, a casino, and several communication centers (Ashford, Mumayiz, & Wright, 2011). In addition, arriving passengers may use the square

easily after passing passport and customs controls because the square is directly connected to the terminal arrival and departure halls.

Secondly, *Schiphol Centrum* is the place where Schiphol Plaza is connected with the airport hotel, World Trade Center, and parking areas. This part of the airport processes as the core of the airport city by the help of real estate which is connected with a passageway. It can be summarized as the most crowded and used area of activities and flaws which should be designed perfectly to provide perfect connectivity between terminal and entire airport city.

Thirdly, *Airport City Proper*, which includes previous two cores, is defined by Ashford, Mumayiz and Wright (2011):

> *"...high-quality, carefully planned real estate and commercial development that includes the World Trade Center complex, business and commercial office buildings, and hotels. Spatially, Schiphol as a "city" is defined as an urban cluster of areas comprising a "city center" and themed precincts."*

Mainly, Airport City Proper consist of these components:

- Maintenance and Aerospace Exchange,
- Schiphol Cargo World,
- Truck and rail terminals,
- Logistics park,
- Knowledge cluster (universities, research centers, knowledge institutions and private companies),
- Mixed-use development with hotels and a golf course.

Knowledge cluster is a concept that is made for those institutions to study themes of sustainable airport and water management. Schiphol group invested into education and research to prove the airport's environmental sustainability. As a result of those studies, for example, a sound barrier concept against ground noise of aircrafts has been come up with. Schiphol's aim was to encourage such institutions and groups to move their corporations to the airport. Working together

on solutions of airports' environmental problems would benefit not only the case of Amsterdam, but any airport on the world would gain implications from such studies.

Amsterdam Airport Corridor, also called as Zuidas development, is another focus point of the Schiphol Group in terms of developing airport city in Amsterdam. The main objective of Schiphol Group by considering Zuidas area (the Amsterdam suburb) as their project is to increase potentially available spatial connections and functions with Schiphol airport city within the context of same landscape and transportation relations. Indeed, both airport city and airport corridor resulted by serving the same market of businesses. As a result, Amsterdam Airport City took on governance support on Zuidas development by creating a corridor between two important nodes of urban development with an international focus.

Figure 50 generally sums up the current system of the Airport City for Schiphol case. Schiphol Plaza, Zuidas development and city center are represented by a red star, and the connection which connects those focal points to each other. Of course, Airport Corridor plays huge role to provide that connection.

Figure 50: Amsterdam Airport City components and connections (retrieved from Google Earth Pro)

4.3 Frankfurt Airport

Frankfurt Airport is a major international airport located in Southwest of central Frankfurt with a distance of 12km from city center (Figure 51). It is located on a very strategic position where two of the most heavily used motorways intersect with each other, A3 and A5. Frankfurt City Forest surrounds the airport and plays a role of a buffer zone between city center and airport.

The very first base for Frankfurt Airport opened in 1936 as a German commercial airport. Important historic milestone for this airport was happened on 16 November 1909, which was the foundation of world's very first airline, DELAG (German Airship Travel Corporation). In 1952, Frankfurt Airport handled more than 400,000 passengers which then grew gradually after year and year. In 1957, runway was extended from 3,000 meters to 3,900 meters which means that this airside started to grow with a need of jet aircrafts.

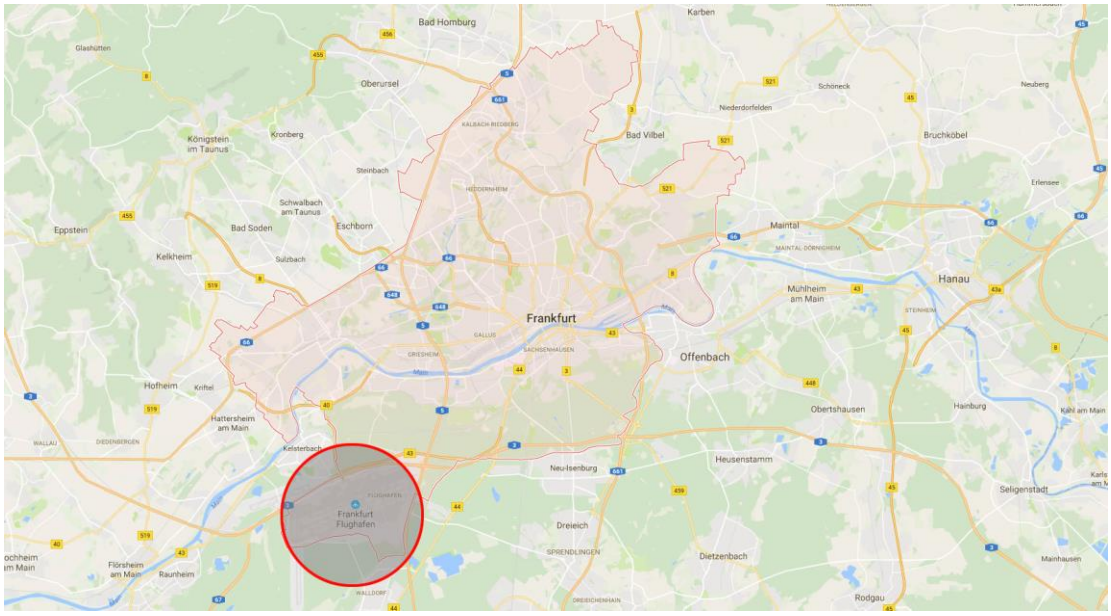


Figure 51: Location of Frankfurt Airport (retrieved from Google Maps)

In 1962, larger terminal was decided to be built with a capacity of 30 million passengers per year. In addition, other runways were also extended and the grow has been continued in following years. In 1970, the world's largest hangar has been

built to accommodate up to six jet aircraft in Frankfurt Airport. 1970s were the years when a new terminal has been started to build with 56 gates with advanced baggage handling systems. New railway station for the airport has also been constructed in those years (Frankfurt Airport station) which was recorded as the first airport railway station in Federal Republic of Germany.

In 1990s, Terminal 2 and the second railway station has been built. With the new terminal, the capacity of airport has been increased to 54 million passengers per year. Second railway station planned to serve primarily for long-distances. In 2005, a large Airbus A380 maintenance facility was built which was the result of Lufthansa's strategies to locate their A380 fleet there.

In 2011, an important strategy changed the look and structure of railway station at Frankfurt Airport which was to modify railway station to be a complex of a large office building with hotels and entertainment centers. It is named as *"The Squaire"* and accepted as the largest office building in Germany.

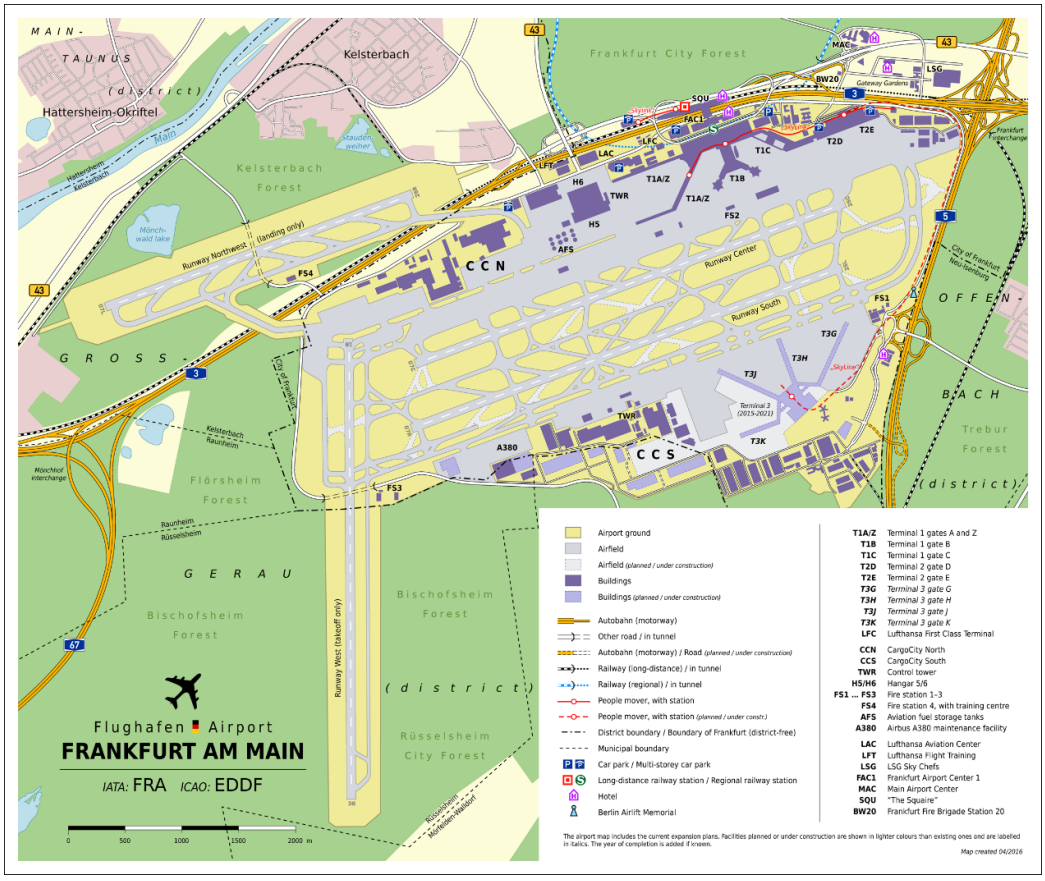


Figure 52: Frankfurt Airport map (Source: www.frankfurt-airport.com)

Frankfurt Airport City is mainly consist of 3 main components; Frankfurt Airport Centers (number 1 in Figure 53), The Squaire (number 2 in Figure 53) and Gateway Gardens (number 3 in Figure 53). Number 1 and 2 are discussed with all characteristics in following chapters. Gateway Gardens can be discussed for creating the most upper scale relations with city center comparing to other two. Gateway Gardens are planned to have transition role between Airport City and city center of Frankfurt as described in Figure 54.

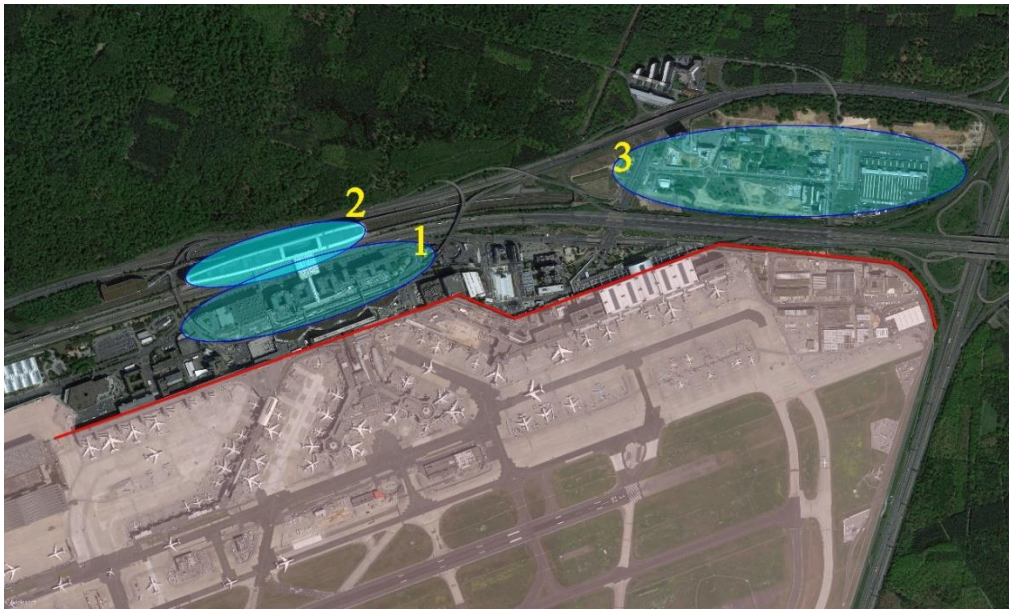


Figure 53: Frankfurt Airport City components (retrieved from Google Earth Pro)

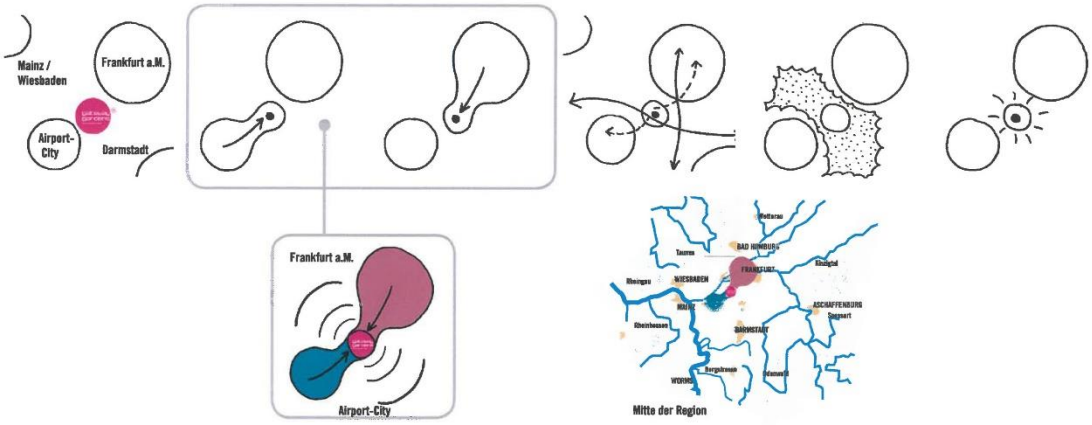


Figure 54: Diagrams showing the structure and functions of Gateway Gardens (Grundstücksgesellschaft Gateway Gardens GmbH, 2016)

4.4 Paris Charles de Gaulle Airport

Paris Charles de Gaulle Airport is the largest airport in France and located at 25km away on the Northeast side of Paris Figure 55. It is the main hub for one of the biggest airlines in the world, Air France, and as well as for SkyTeam alliance. Paris Charles de Gaulle Airport is nominated as the world's ninth-busiest airport and Europe's second-busiest airport in terms of passenger numbers in 2016.

Figure 55: Location of Paris Charles de Gaulle Airport (retrieved from Google Maps)

Paris Charles de Gaulle Airport, which was firstly known as the Aéroport de Paris Nord, has begun to be constructed in 1966. The name, that today the airport has, been given on 8 March 1974 and opened for service on that day. Terminal 1 was constructed as the first terminal for Paris case by having ten floors high circular building design with 7 satellite buildings each with 6 gates. Terminal 3 is located on the opposite side of Terminal 1 and it mostly serves for charter and low-cost airlines. Terminal 2, in fact, is an important place for Air France because it was originally constructed for the needs of the Air France Airlines. In time being, Terminal 2 expanded significantly which now serves for other airlines, too.

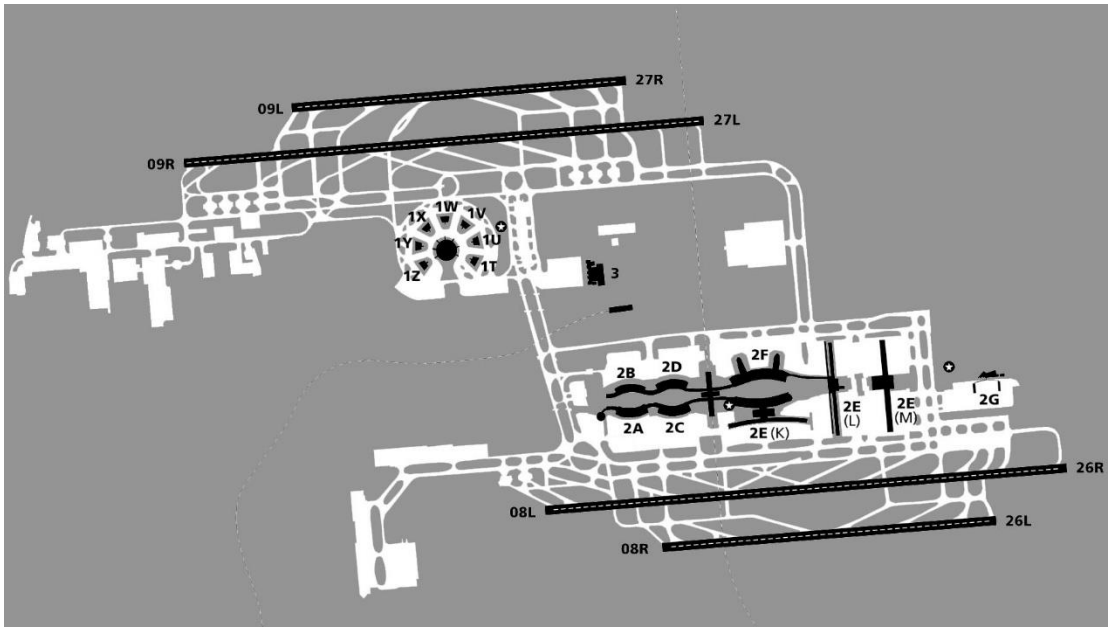


Figure 56: Layout of Paris Charles de Gaulle Airport

Airport City of Paris Charles de Gaulle Airport is named as *"Roissypole"* which consists of complex of office buildings, hotels, shopping centers and a bus station. Airport is connected to city center with A1 motorway which is an extensive connection between Paris and Lille. Rail links are also available for the airport which takes about 45 minutes from city center. In Figure 57, business districts, which have direct relation with the airport, are shown in blue. As it can be seen, businesses mostly located on A1 motorway. Cargo zones are also pointed in orange color in Figure 57 which are also accepted as crucial as business developments for Paris case because of the potential air cargo logistics in the area.

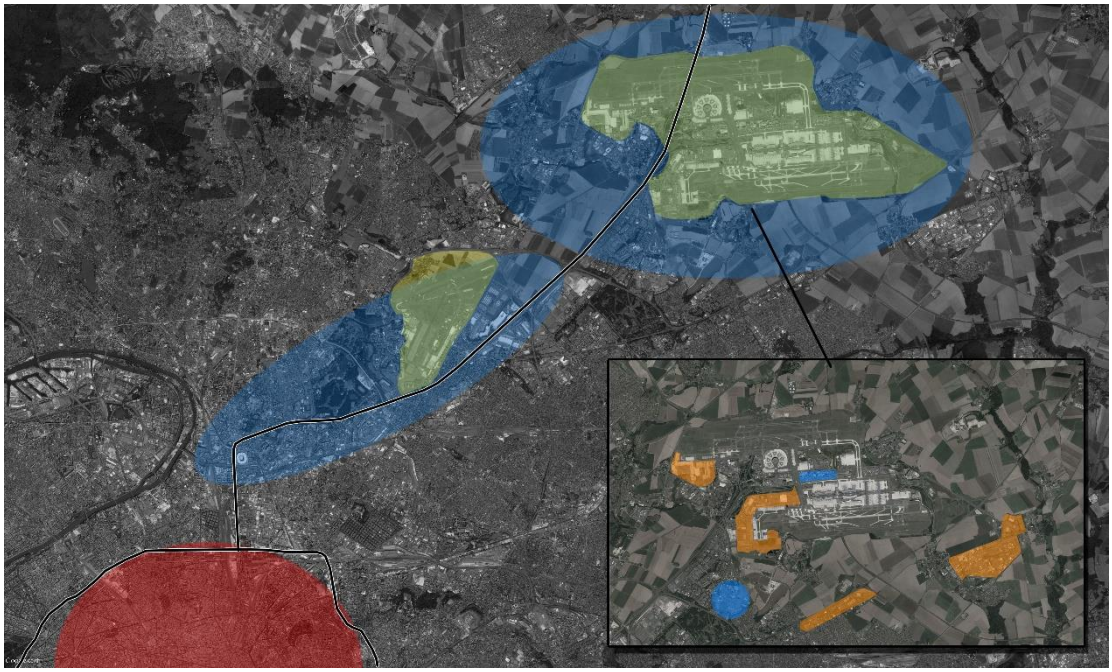


Figure 57: Paris Charles de Gaulle Airport zone, cargo zones, and business districts (retrieved from Google Earth Pro)

4.5 Incheon International Airport

Incheon International Airport is the largest airport in South Korea which also categorized as one of the busiest airports in the world. The airport had many successes throughout its history; being nominated as the world's cleanest, best, fastest in terms of departure and arrival rates, customs processing, duty-free shopping malls and baggage mishandling rates in the world. Incheon International Airport opened in 2001 by replacing the older Gimpo International Airport in Seoul. The airport is located on the West side of Incheon's city center with a distance of 48km (Figure 58). It is built on an artificially created piece of land between two islands, Yeongjong and Yongyu. Incheon International Airport is the hub for two significant airlines; Korean Air and Asiana Airlines.

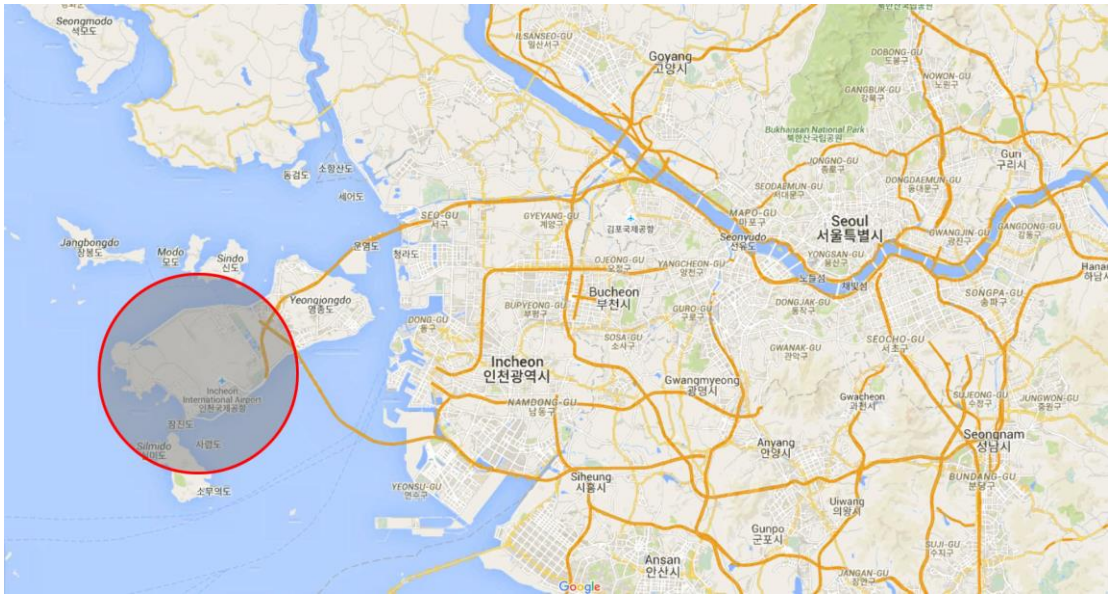


Figure 58: Location of Incheon International Airport (retrieved from Google Maps)

Incheon International Airport was planned to be built in 3 phases. In time, it has been changed due to the increasing demand and planning processes on site. Phase 1 is planned to have a capacity of 30 million passengers per year and 1.7 million tons cargo per year. In addition, two parallel runways and a control tower, an administrative building and a transportation center were important sections for the project. Construction of Phase 2 began in 2002 and concluded in 2008. A third parallel runway and 13 ha cargo terminal were added. Important part of this phase is an additional concourse to the main passenger building was added. Phase 3 and Phase 4 aim to add additional terminals with more passenger capacities for Incheon International Airport. Final Phase estimated to be completed in 2020 which will conclude the construction with a total of two passenger terminals, four satellite concourses, 128 gates, and five parallel runways. In conclusion, Incheon International Airport aims to reach 100 million passengers and 7 million tons of cargo per year.

Airport City components for Incheon International Airport case are located on the same island. However, besides two main International Business Centers (IBC-I and IBC-II), a new smart city called Songdo International Business District took place

on a reclaimed land along Incheon's waterfront. Songdo IBD and IBC zones are shown in Figure 59 with the city center of Incheon.

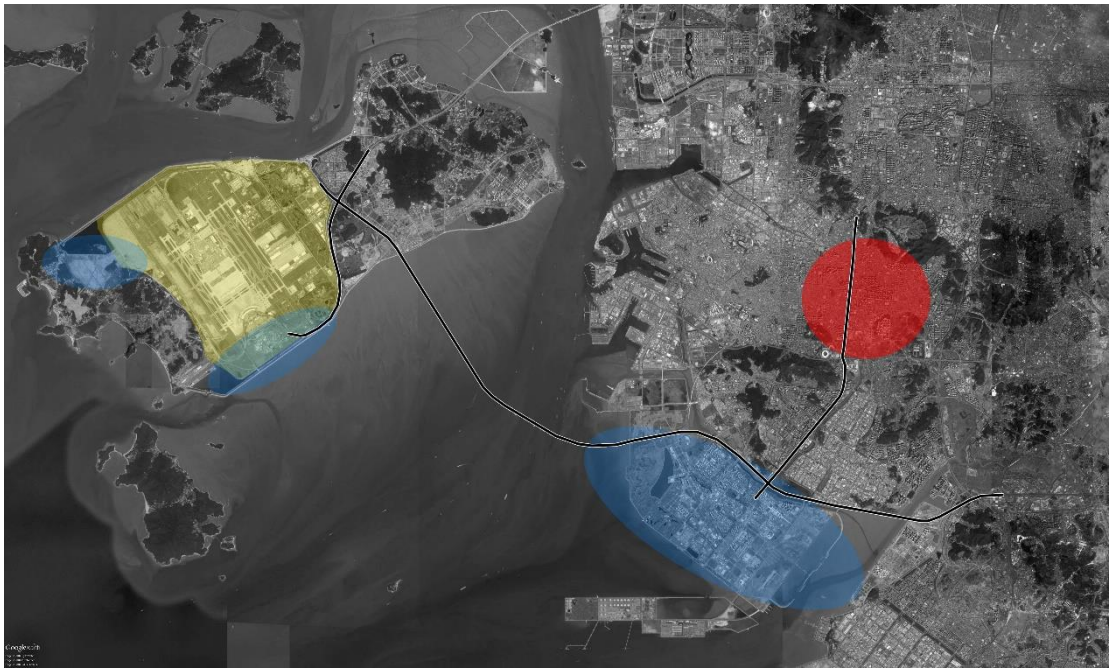


Figure 59: Incheon International Airport, IBC zones and Songdo IBD (retrieved from Google Earth Pro)

Songdo International Business District is connected to the airport by a 12 km reinforced concrete highway bridge (Incheon Bridge). It also has a direct strong connection to city center of Incheon. Songdo IBD's masterplan completed in 2005 and construction started immediately. The main aim and objectives of the project is to develop on of the most sustainable cities in the world by integrating smart city concept. It is mentioned that developing a city-scale living and working environment inspired by the great metropolitan areas of the world would bring unique identity to this project. Kohn Pedersen Fox is the architect and designer of the project who claims that this area has %70 fewer emissions comparing other developments that are comparable to its size.

Figure 60: Songdo International Business District masterplan and a photo showing current development (Gale International LLC, 2015)

All in all, Incheon International Airport is connected to Incheon City center by two different business districts. These developments can be accepted as airport corridors even though large water bodies separate the airport and city center. Songdo IBD and other IBC's can be defined as self-processing complexes in their own but it is obvious that they support to create strong relations between airport and city by the help of advanced transportation solutions.

CHAPTER 5

DESIGN FRAMEWORK OF AIRPORT CITY: A MODAL PROPOSAL

Modern airports are rapidly changing their systems requiring a better basic layout. Airport development is being compared with Central Station development which shows the importance of airports. However, airport planning is a step away from being only a 'technical airport planning'. It is more than an urban planning process, which integrates land-use and transport planning inter-dependently. Correspondingly, Airport City term rises from a place which includes meeting, doing business and shopping along with each other. As a result, it definitely shows how planning an Airport City is a sophisticated process to be handled. I strongly agree with Güller (2003) that there doesn't exist a single solution to apply for all cases of Airport City model. In addition, we shouldn't see all airports becoming Airport Cities as it is impossible for all of them. Besides deciding whether a city should have an airport or an Airport City, spatial quality of the space that will be created with an airport development should be put into consideration.

A detached Airport City model may harm the economic system of the region as Güller (2003) mentions in his article. Underlying causes for such effects are listed as local development strategies and economic structures through its size and development speed. The territory of an Airport City cannot be defined clearly as it doesn't grow in certain borders. The corridor, which corresponds between Airport City and actual city center, is one of the most consistently growing part of the metropolitan area. The line which connects Airport City and main city begins to have a highly concentrated traffic infrastructure. Indeed, such concentration of traffic infrastructure gives a chance to rise several parallel roads and railway lines, even though existence of just an airport. Most significant examples are the Glattal-

Stadt Zurich, the ‘cash-corridor’ Amsterdam, the Llobregat Delta Barcelona or the E-18 corridor in Vantaa.

It is important to analyze prominent cases of Airport Cities to understand these complex systems. Because of the lack of research about such concepts in terms of designing space and its quality, it becomes crucial to determine certain headings which will help to understand both current situation and future needs for these systems. Consequently, 3 main headings decided to be analyzed:

1. Design structure & scale
2. Movement & mobility
3. Morphological specifications

This study aims to analyze prominent cases to understand how such systems should be designed in terms of space and place quality. Firstly, to be able to achieve such implications, it is crucial to understand working principles of each case. What is the role of the Airport City? Why it has been decided to be built under such circumstances and under which expectations? Strategies and ideas of developers of airport become important at this point. Connection between main city center and Airport City center is the most important part to integrate these systems into existing city structure.

As it is said, Airport City doesn’t have any borders to be limited, so it shows how hard is to take the control of the development. However, to achieve better living and working spaces, planning matters the most. As a result, land uses around airport and Airport City becomes crucial. Under the umbrella of aviation codes and standards, land uses around airports should be planned carefully in order to build more sustained and livable spaces. To analyze land uses and spatial forms in and out of Airport City structures, certain sub-headings has been determined such as; form and function, composition and configuration, parking facilities, entrances and transfer points, pedestrian circulation and permeability, connections and concentration, buffers and border connections.

5.1 Scale & Design Structure of Airport City

Cities are constantly growing structures which should be taken under control. Planning plays a huge role either to limit or to extend the city borders. The most important keyword is the scale of a city in the development process. Scale ratios determine a lot for humans because continuity of experience from one scale to another means how an integral part of sense of continuity is. In the end, an Airport City is also a part of the city so that it should be scaled properly according to urban design guidelines.

Istanbul Sabiha Gökçen International Airport is known as the second airport of Istanbul which is located on the Asian side with a distance of 35km from the city center. While Atatürk International Airport functions as the primary one, instead, SAW serves mostly for charter and low-cost airlines. This airport is planned under ITEP project which can be defined as a different version of Airport City concept. Nowadays, it is trying to be converted into an Airport City which will contain certain characteristics of the concept in future.

Figure 61: Satellite image of Istanbul (retrieved from Google Earth Pro)

Sabiha Gökçen Airport's owner is HEAŞ, and it is operated by Malaysia Airports. Airport offers huge amount of industrial activities around it. Istanbul Tuzla Organize Sanayi Bölgesi is one of the biggest organized industrial zones in Istanbul which is located 10km away on the East side of the airport area. On the West side of the airport, however, residential land uses are mostly located with a small amount of industrial zones. ITEP project offered a technopark on the North side of the airport with some additional offices, hotels, convention centers and residential zones. In Figure 62, the zone which Airport City is planned to be integrated physically is represented by yellow color. As it can be seen, the airport terminal doesn't have walkable distance with the indicated zone. If Airport City will require to have strong relations with the airport, additional transportation modes should be integrated.

Figure 62: Circle with a radius of 500 meters, center: Sabiha Gökçen Airport terminal (retrieved from Google Earth Pro)

Frankfurt Airport is the major international airport located in Frankfurt. Frankfurt is accepted as one of the world's leading financial centers. Lufthansa's main hub is also located in Frankfurt Airport which clearly determines how busy and operational the airport is. In order to utilize such options, Airport City concept suits

perfectly to Frankfurt case. Discussion starts when it comes to the design of the Airport City; where and how to build such a system in order to achieve best results in terms of both spatial and business qualities.

Figure 63: Satellite image of Frankfurt (retrieved from Google Earth Pro)

Fraport is the developer and operator of Frankfurt Airport which also have authority on any Airport City development around airport. The airport ground and the surrounding area of Frankfurt Airport offer a large variety of on-airport businesses as well as airport-related businesses; including office spaces, hotels, shopping areas, conference rooms and car parks. Even though the development of an Airport City has significantly accelerated in recent years, free space around airport has been always a problem for this case. In my opinion, such reasons made Airport City to be built closer to main terminal which is a good point for scale issues (Figure 64). Almost all main Airport City components have been built in a circle of 500 meters radius from the main terminal.

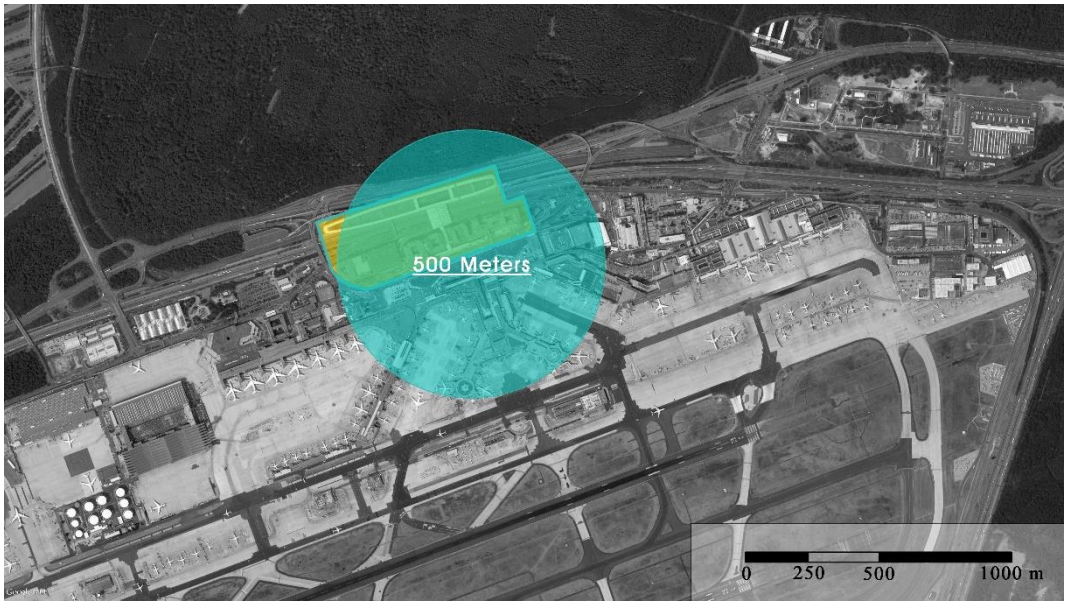


Figure 64: Circle with a radius of 500 meters, center: Frankfurt Airport terminal (retrieved from Google Earth Pro)

Frankfurt Airport is surrounded by Municipal Forest areas which is an important limitation for such a huge development. Nevertheless, Frankfurt Airport has two cargo terminals under the name of *'Cargo City'* (Figure 65). On the other hand, passenger terminals designed inter-connectively with shopping centers, offices and conference halls. Besides those, *The Squaire* has been built as the futuristic building. It is an office building which was built on to the existing rail station. Construction was started in 2006 and completed in 2011. The 9 story building has a 660m length, 65m width and 45m height. The Squaire is linked by pedestrian bridges that provide direct connections to the airport terminal and other office buildings. Between The Squaire and Terminal 1, many office usages have been located. Pedestrian connection includes all those buildings, such as, people can walk from railway station to Terminal 1 in 5 minutes by passing railway station, bridge and office buildings.

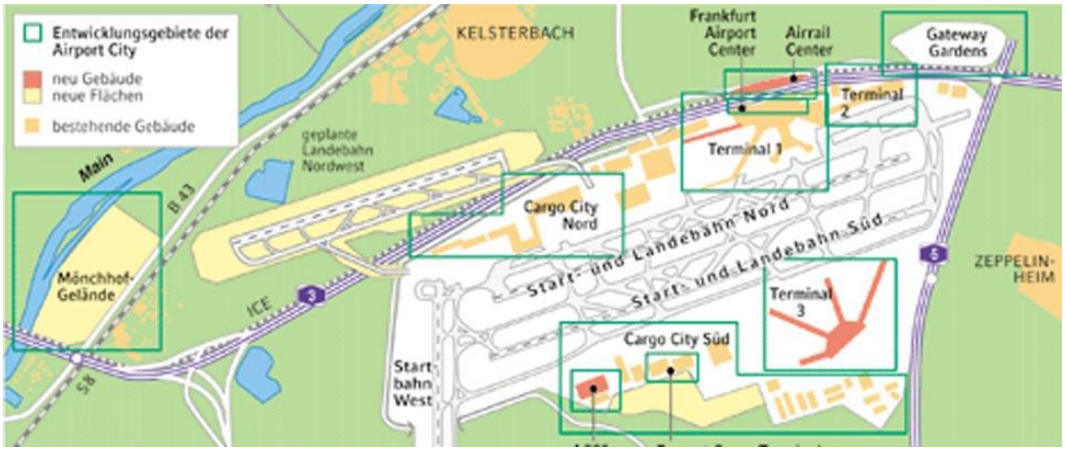


Figure 65: Frankfurt Airport components (Tinnappel, 2007)

Structure of the current Frankfurt Airport City is more like randomly placed rather a planned concentrated campus type. The underlying reason is limited free development space, for sure. However, by upgrading old rail station with 9 story building shows how ready was the current system to be integrated to a more vertically processing system. As a result, limited free space hasn't caused any problems in any terms such as connections, usages or operations.

Amsterdam Airport Schiphol is seen as the best case example for Airport City development by many authorities and researchers. As it is described in Chapter 3, Schiphol Group is the main developer and operator of the airport and Airport City components. Amsterdam Airport hasn't been a haphazard Airport City development from the beginning. In order to understand how successful an Airport City should be, in terms of design, pioneering cases should be analyzed carefully. To take into consideration the Amsterdam case; it can easily be seen that a cluster of buildings has been constructed in a linear form right in front of the terminal building. This linearity continues up to 1 km, starting from Schiphol Plaza up until end of the system. However, when walking distance of a human is the discussion,

it can be seen that just half of them are inside that 500 meters radius circle (Figure 67).

Figure 66: Satellite image of Amsterdam (retrieved from Google Earth Pro)

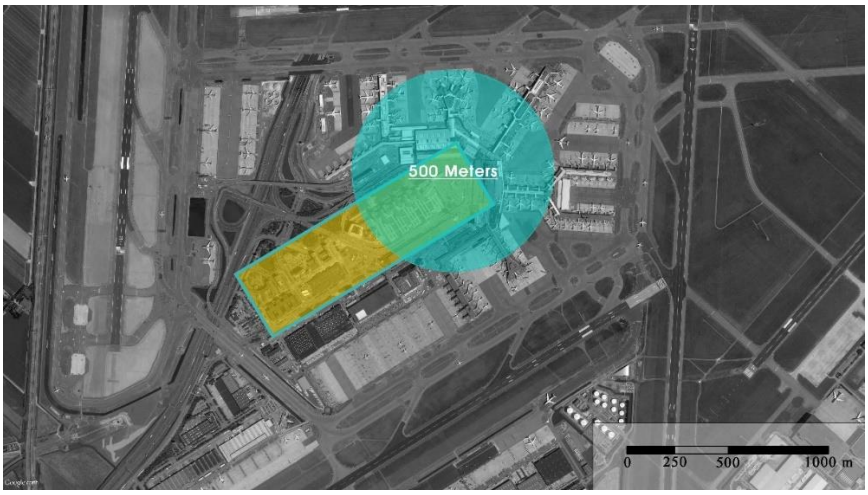


Figure 67: Circle with a radius of 500 meters, center: Amsterdam Airport Schiphol terminal (retrieved from Google Earth Pro)

Amsterdam case is the only case which doesn't have unlimited free space because of the terminal buildings. Terminals came together to form 'U' shape. Airport City components, such as hotels, offices, convention centers, shopping malls etc., are

placed right center of this shape which supports linearity. Even though the system cannot be called as a campus structure, it has strong characteristics to be named so.

Paris Charles de Gaulle Airport has become another case to be analyzed in terms of Airport City development after seeing Aéroports de Paris' (ADP) development progress. Clearly, City of Paris is visited by many tourists, business people and even transit passengers sometimes need to visit Charles de Gaulle Airport to take their second flight. The location of the airport plays critical role at this point. As a result of outstanding statistics, Airport City concept was inevitable for Paris case.

Figure 68: Satellite image of Paris (retrieved from Google Earth Pro)

Paris Charles de Gaulle Airport has three separated terminals away from each other about 2 km by road. Interestingly, ADP located Airport City on middle of Terminal 1 and Terminal 2 which makes it out of 500 meters border (Figure 69). It can be said that Paris case differs from first two cases by the distances from Airport City center to airport terminals.

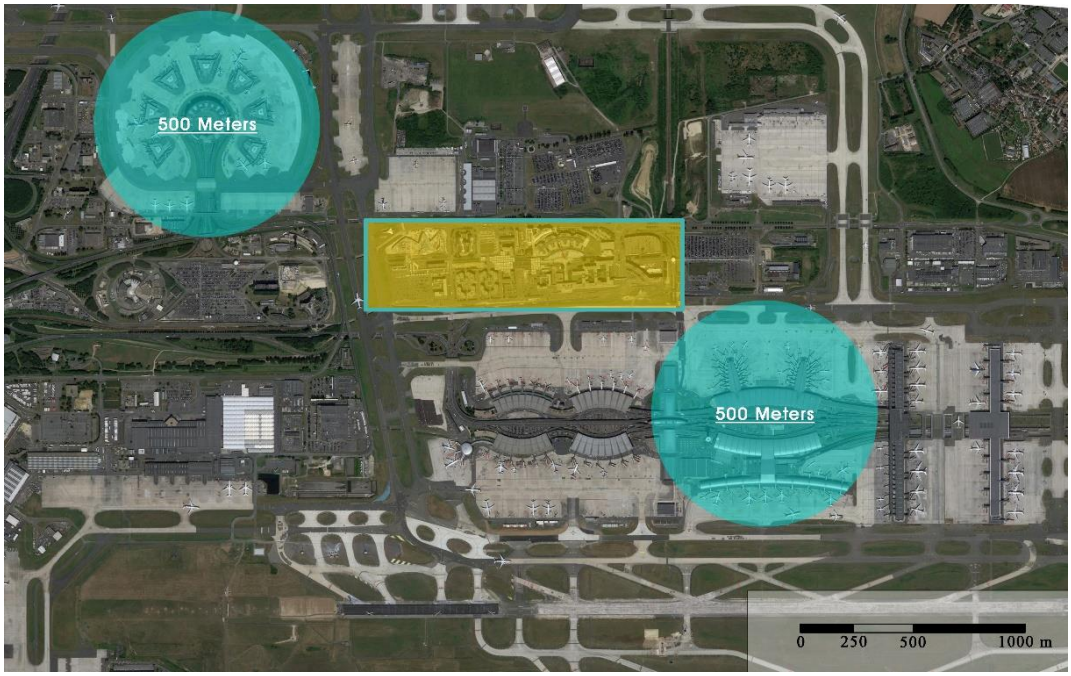


Figure 69: Circle with a radius of 500 meters, center: Paris Charles de Gaulle terminal (retrieved from Google Earth Pro)

Paris Airport City (Roissypole) is the best case example in the category of campus type development. As Figure 69 shows, campus borders are defined and surrounded with roads. In addition, parking spaces are solved by multi-storey car park on the East side of the campus. As a result of decreasing car dependency around and inside campus, a spine which serves only for pedestrians can be built easily. On the center of the system, there is a semi-closed structure which serves as a railway station for Airport City (Roissypole Gare).

Incheon International Airport is the last case which also differs from other cases. Incheon International Airport was set out with ambitious dreams to connect Korea with the rest of the world 15 years ago. Incheon International Airport Corporation (IIAC) has been the owner and operator of the airport since those years. The system that they have designed is placed out of the circle with a radius of 500 meters from the main terminal (Figure 71). In Figure 72, the second phase of not completed part of *'Air City'* can be seen. Even though actual Air City doesn't correspond to

walkability distances considering airport terminal, design structure of the system would correspond to more of a campus development.

Figure 70: Satellite image of Seoul (retrieved from Google Earth Pro)

Incheon International Airport is constructed on an artificially created piece of land between Yeongjong and Yongyu islands. The area between the two islands was reclaimed for the construction project. All in all, since the area was specially created for the airport development, project implemented freely without having any issues for the free land.

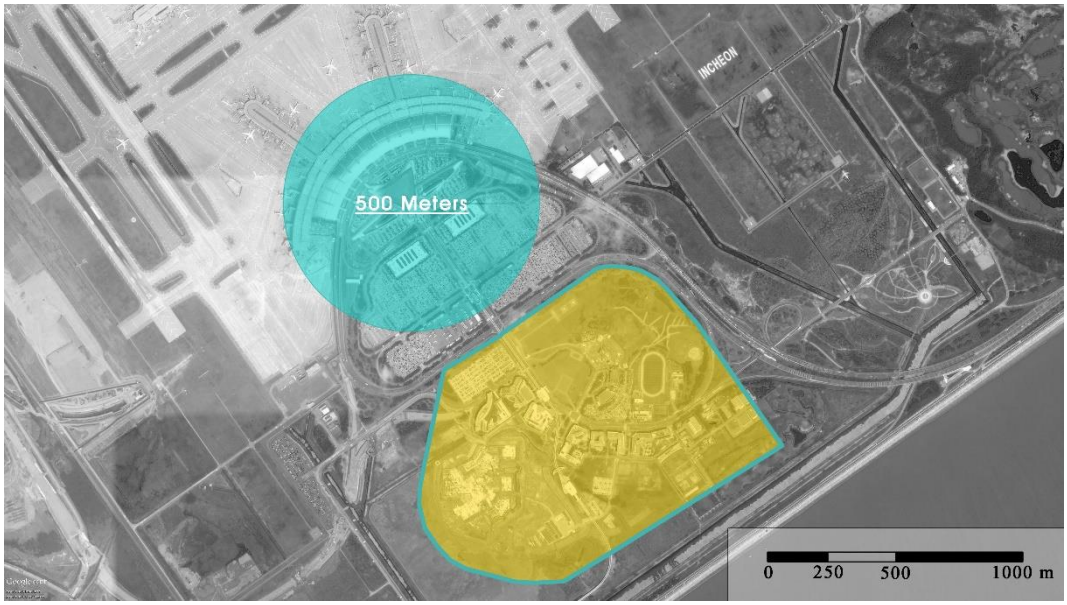


Figure 71: Circle with a radius of 500 meters, center: Incheon International Airport terminal (retrieved from Google Earth Pro)

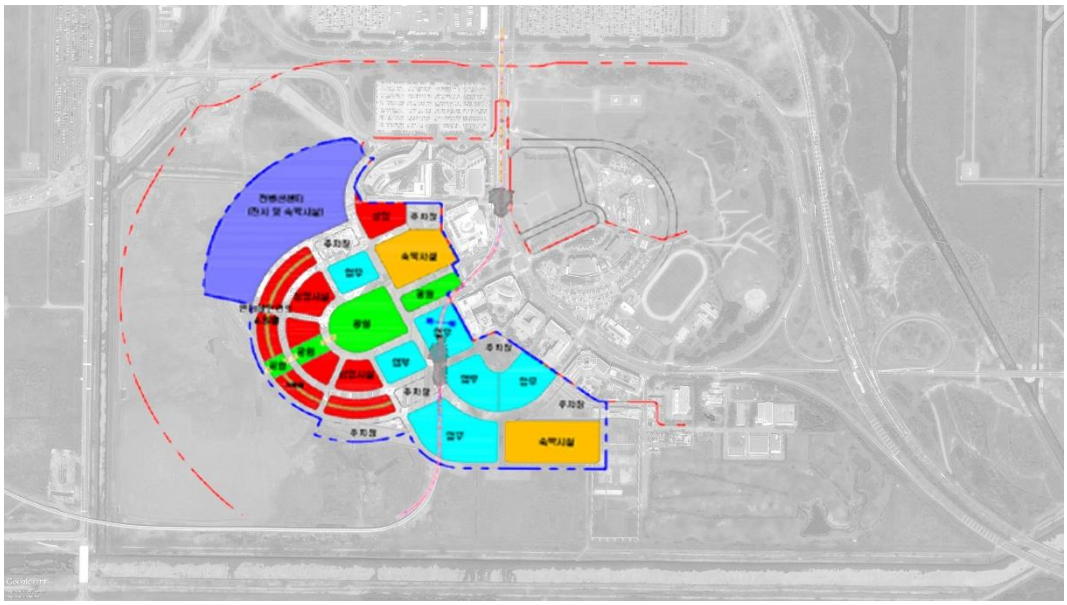


Figure 72: Land use plan of Air City's second phase (IIAC, 2006)

5.2 Movement & Mobility of Airport City

Istanbul Sabiha Gökçen Airport is located between two main arterial roads which are E80 and D100. E80 is the new motorway which connects Ankara to Istanbul, and passes over the Bosporus to connect Asia to Europe by Fatih Sultan Mehmet Bridge. On the other side, D100 is the oldest motorway which had the same task as E80 have today. However, D100 is located on the South of the airport stretching out amongst coastline and it also has underground metro connections above. It is said that metro connection is going to reach up to Sabiha Gökçen International Airport with an airport underground connection in 2017.

Figure 73: SAW and the city center. Yellow lines represent highway connections, black lines represent underground metro lines (retrieved from Google Earth Pro)

Sabiha Gökçen Airport City is currently being planned so that only first phase of the Teknopark Istanbul is finished. While second phase is in process, it can be said that pedestrian circulation will be available only within industrial park borders. It is planned that Teknopark Istanbul would have a monorail connection with the airport terminal which is a must for an Airport City concept. Sabiha Gökçen International Airport terminal is accessible only by highway at the moment. Hence,

a multi-storey car lot serves for passengers which is located just in front and almost the size of terminal.

Frankfurt Airport is located in Southwest of central Frankfurt where two of the most dense motorways intersect (A3 and A5). The airport is centrally located in already densely populated region which is the west-central European megalopolis. By having such a strategic location, strong rail and motorway connections make the airport to become ultimately reachable and significant (Figure 75). The Squaire was named as Airrail Center Frankfurt before it has transformed into a futuristic multifunctional structure. Long-distance trains have an opportunity to stop in this terminal which is located beneath The Squaire. Since long-distance railway station has a direct connection with the airport, it can be said that all those trains which are coming from other cities, or even from other countries, serve directly for airport as well. Other than that, regional trains are also have a stop underground of Airport City of Frankfurt.

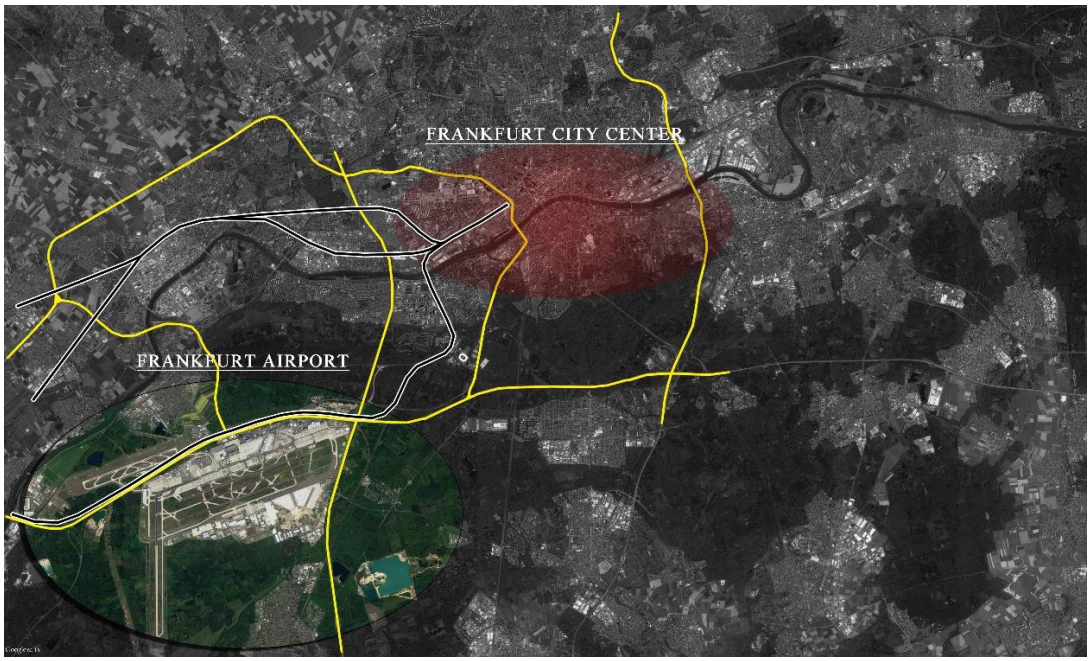


Figure 74: Frankfurt Airport and the city center. Yellow lines represent important connections, black lines represent rail lines (retrieved from Google Earth Pro)

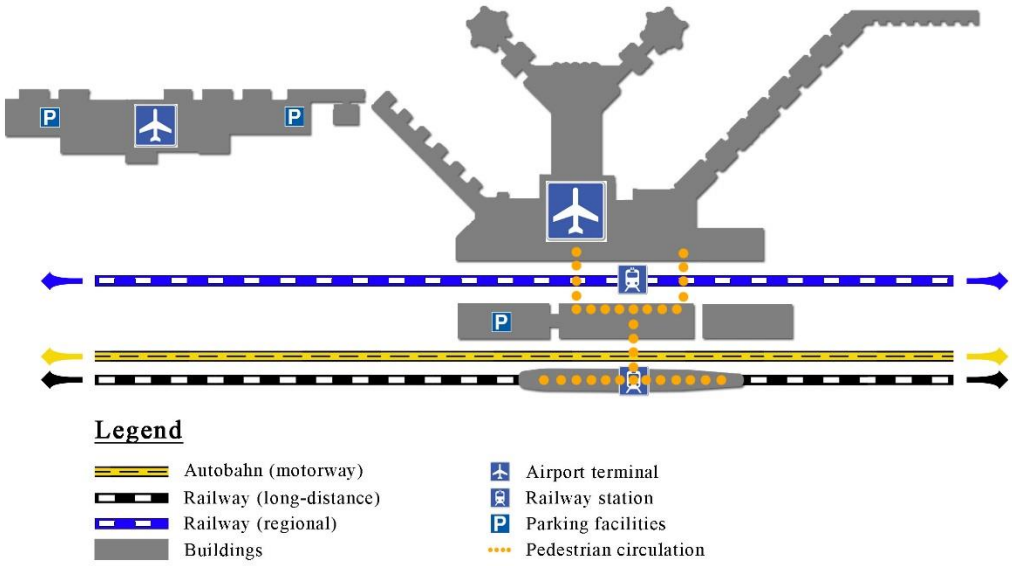


Figure 75: Movement and mobility scheme of Frankfurt Airport

Frankfurt Airport has 2 terminals; Terminal 1 and Terminal 2. In front of the Terminal 1, a cluster of buildings are located. Cluster includes a public multi-storey car park, a hotel, Frankfurt Airport Center and The Airport Conference Center. These buildings are interconnected with each other, and both with Terminal 1 and The Squaire structure. In Figure 76, it can be seen that everything is designed to have strong direct connections with airport terminal. The idea of connecting airport terminal and other structures between each other, and with the main city and region, definitely supports Airport City characteristics of strong connectivity both in upper and smaller scales.

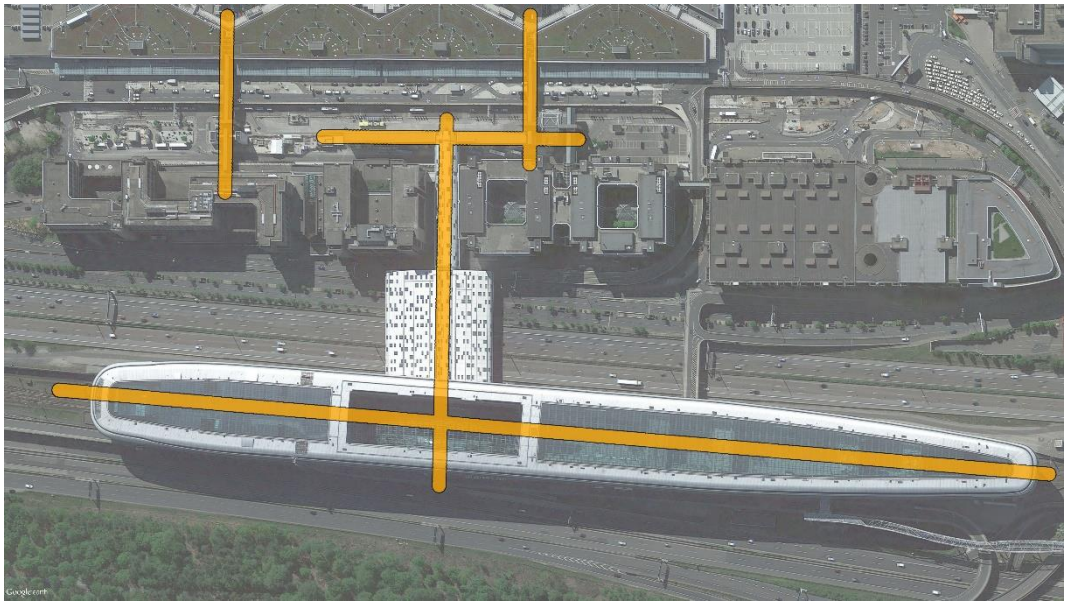


Figure 76: Frankfurt Airport City main pedestrian axes (retrieved from Google Earth Pro)

Amsterdam Airport Schiphol is the fifth busiest airport in Europe in terms of passengers. It has one large terminal split into three large departure halls, which was completed in 1994 and expanded in 2007. Today, Schiphol Group has priority on the development processes on both air side and off-air side buildings. Amsterdam Airport Schiphol has been accepted as one of the best case examples in Europe in terms of development process. The airport constructed and developed under the concept of Airport City since first times. It is important to pinpoint such strategies because the results of analysis demonstrate the characteristics of Airport City which aren't haphazard at all.

Amsterdam Airport Schiphol is located 9 km Southwest of Amsterdam. The airport is connected to the city center by both motorway and railway. Motorway that serves the airport is A4 motorway which is one of the busiest roads in Netherlands connecting Rotterdam to Amsterdam. It also accepted as the Airport Corridor between the airport and city center (Figure 77).

Figure 77: Amsterdam Airport Schiphol, Zuidas and the city center. Yellow lines represent important connections, black lines represent rail lines (retrieved from Google Earth Pro)

Schiphol Airport railway station is a major passenger railway station in region which is located beneath the airport terminal (Figure 78). The current station was opened in 1995 and it connects airport to both Amsterdam city center and to other various cities in the Netherlands, Belgium and France. In the end, it processes as a stop for both long-distance and regional trains. The station has 6 platforms which are accessible via 12 escalators and 3 elevators located in the main concourse of the airport. This place is called as Schiphol Plaza which corresponds to the heart of the airport.

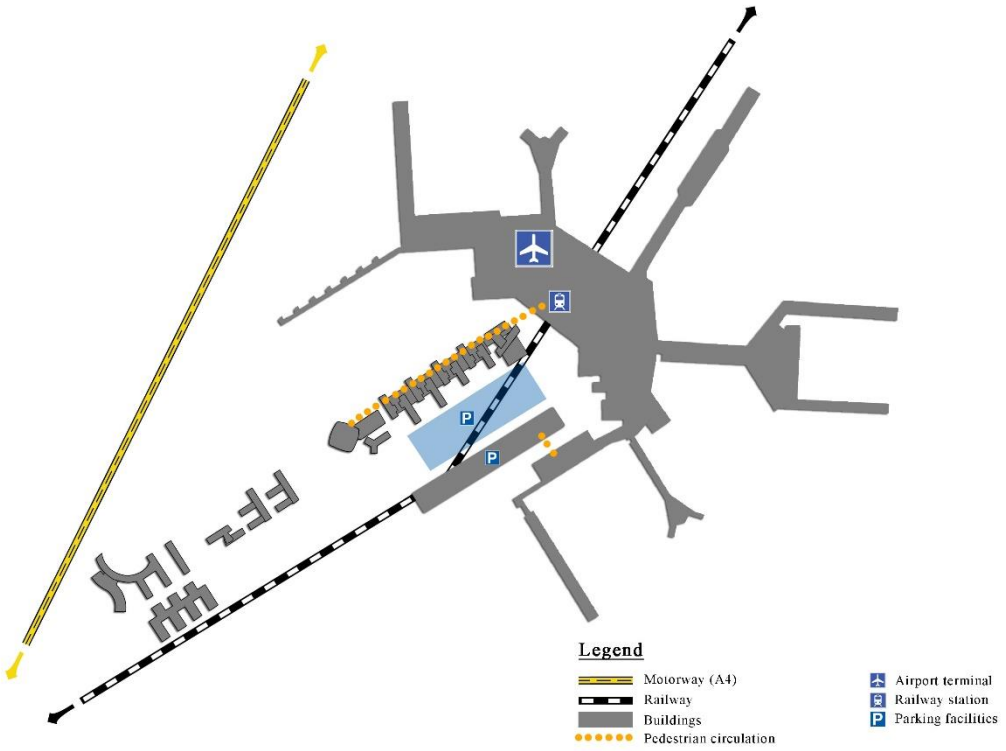


Figure 78: Movement and mobility scheme of Amsterdam Airport Schiphol

Parking facilities have been discussed by public in terms of their consequences whether they create healthy spaces or not. In Amsterdam case, it can be seen that almost half of the space that is available in front of the terminal is left for parking facilities (Figure 79). Of course, such busy airports do need enough car parks to satisfy passengers but parking facilities should be placed necessarily according to their land value. For sure, the land which parking facilities (especially in front of office buildings) cover become more valuable in time. In fact, Schiphol Group has been discussing to rebuild these facilities with more valuable usages which will be integrated into existing Airport City design.

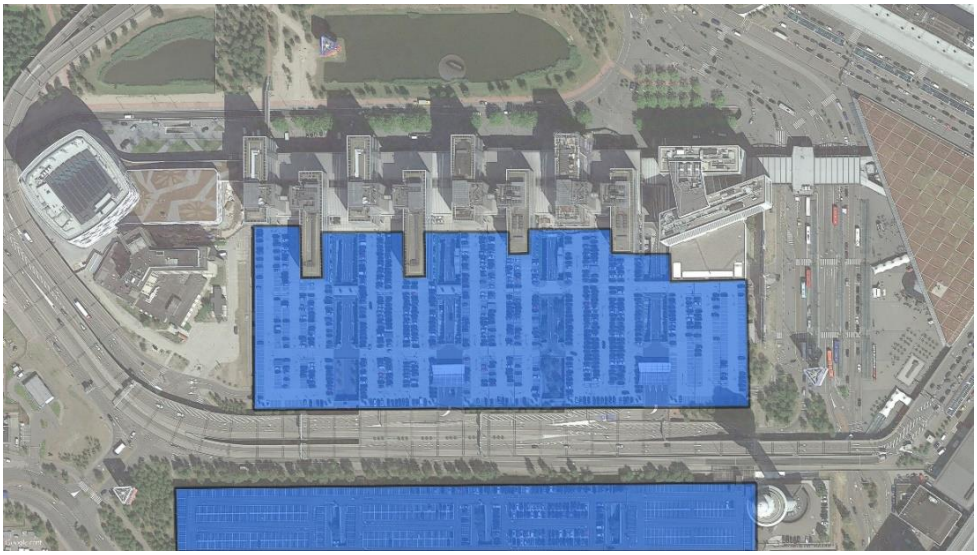


Figure 79: Amsterdam Schiphol Airport short-stay car parking facilities (retrieved from Google Earth Pro)

Airport City of Amsterdam Schiphol Airport is based on a pedestrian spine working both horizontally and vertically (Figure 80). Office buildings that are located right in front of the airport terminal are directly connected by that pedestrian axis to airport terminal. Mentioned fully pedestrian axis begins with Schiphol Plaza and starts to disappear following the service road of the airport after Hilton Amsterdam Airport Schiphol. This distance corresponds to 500 meters starting from Schiphol Plaza.

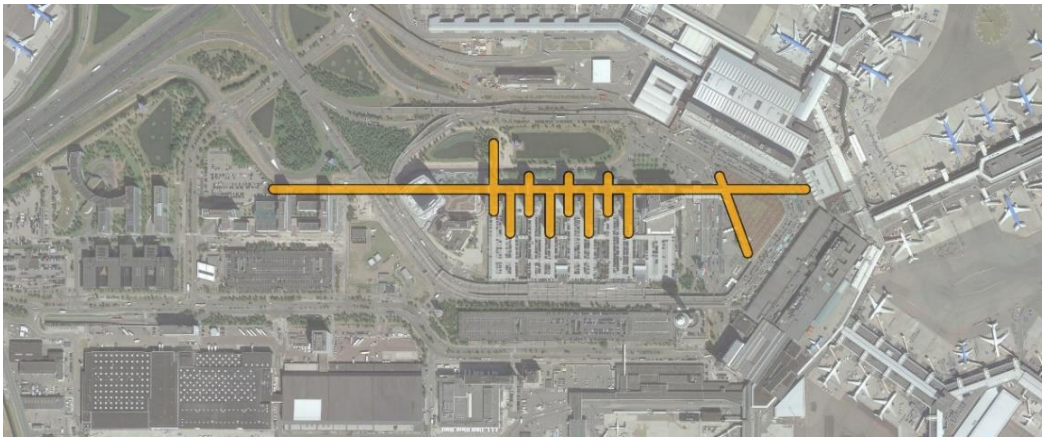


Figure 80: Schiphol Airport City main pedestrian axes (retrieved from Google Earth)

Paris Charles de Gaulle Airport is located at the Northeast of Paris with a distance of 25 km from city center. The airport is served by the *A1 Autoroute* motorway which is the busiest of France's motorways. In terms of accessibility, airport is well served by the transportation network of Paris. Both high-speed (TGV) and suburban trains (RER) access to airport destination by having a station under the main terminal. Almost all terminals are accessible either by walking a short distance or taking CDGVAL airport shuttle train from main railway station in Terminal 2 (for Terminal 1). However, actual Airport City part of the system, where hotels and office buildings are located, exists far from Terminal buildings. Such conditions makes pedestrian connections less with airport terminals. Instead, Airport City is easily reachable from city center by rail and motorway connections. Comparing with previous cases, parking spaces for vehicles in Paris case are generally preferred as open parking lots, rather than multi-storey car parks.

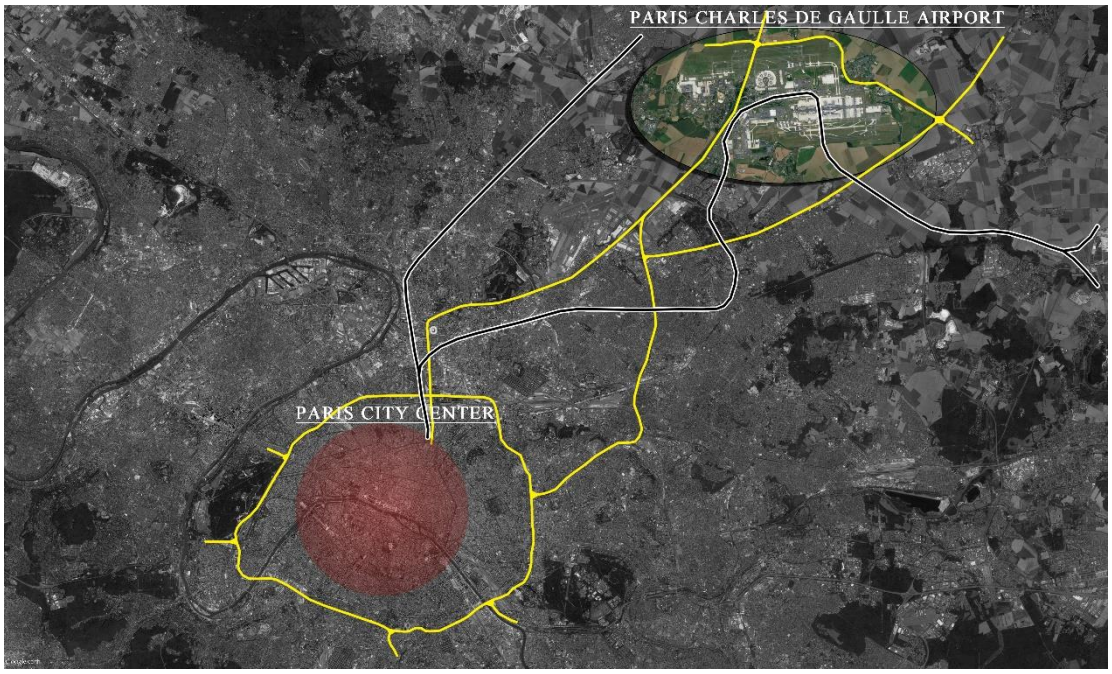


Figure 81: Paris Charles de Gaulle Airport and the city center. Yellow lines represent important connections, black lines represent rail lines (retrieved from Google Earth Pro)

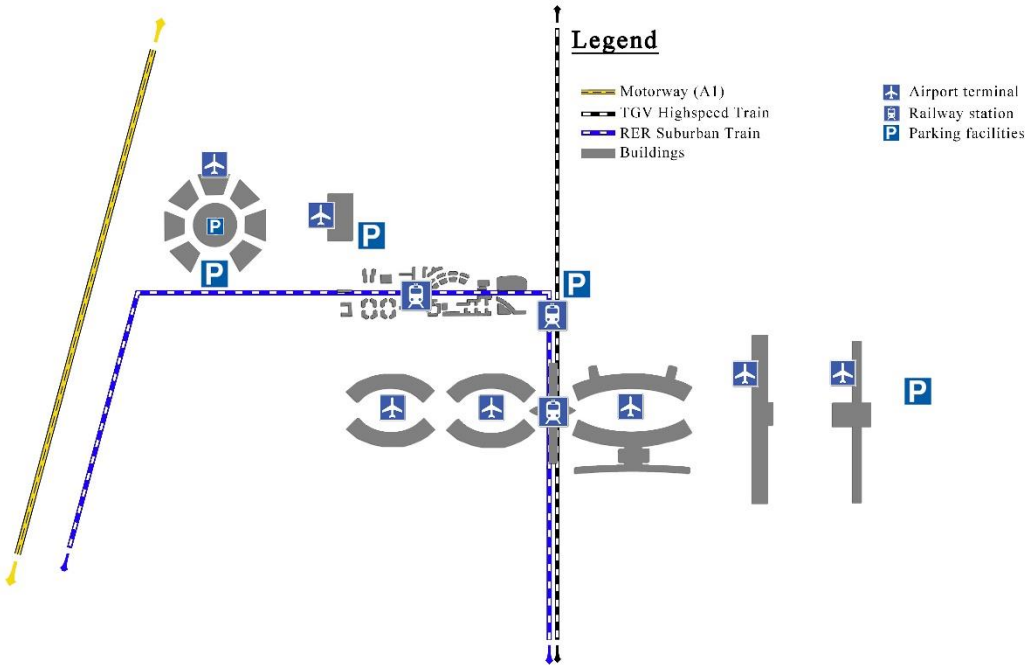


Figure 82: Movement and mobility scheme of Paris Charles de Gaulle Airport

Paris's Airport City is called as *"Roissypole"*, which is defined as the name of an area within Charles de Gaulle airport. It consists of a group of buildings made up of offices, airport hotels, the RER train station, the bus and coach station. It's been built as a campus which has a main pedestrian axis on the middle of the system (Figure 83). Pedestrian axis is supported by perpendicular axis of pedestrian connections to the buildings.

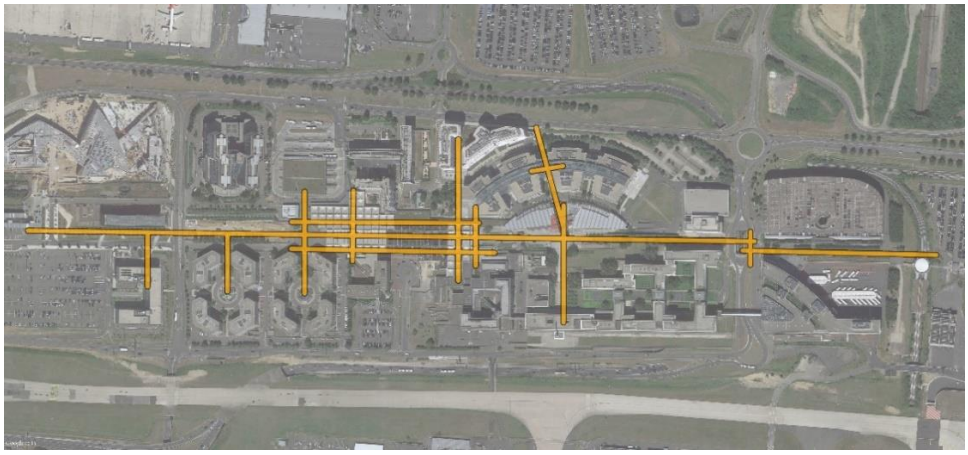


Figure 83: Paris Charles de Gaulle Airport City main pedestrian axes (retrieved from Google Earth Pro)

Incheon International Airport is located on an island which is connected to main land and the city of Incheon by 2 bridges. Motorway which serves the airport is directly connected to those bridges. One of those bridges, The Incheondagyo Bridge, is the longest spanning cable-stayed bridge in South Korea with a length of 12km. Bridge has been constructed to provide direct access to Songdo International Business District which is a new 'smart city' built from scratch on 600 hectares of reclaimed land. Figure 84 shows the connection between the airport and Songdo IBD, and location of the Incheon city center.

Figure 84: Incheon Airport, Songdo IBD and the city center. Yellow lines represent important connections, black lines represent rail lines (retrieved from Google Earth Pro).

The airport is served by commuter and express railways which stop right in the Incheon International Airport Transportation Center. The transportation center is located in front of the airport terminal and it has 5 direct pedestrian connections from the center to terminal (Figure 85). To access hotels and other office buildings, which are the components of Airport City, they have constructed a Maglev Line

(Figure 86). It's been a new transportation method in which the train is levitated 8mm above the rails so that there is no mechanical friction and therefore emits no CO_2, no abrasion of the wheels and no dust. Length of the line is 6.1km and it connects the airport to the last station of the line (Yongyu) in about 12 minutes.

Figure 85: Incheon International Airport Transportation Center

Figure 86: Maglev line and stations

To wrap up Incheon International Airport's movement and mobility characteristics, Figure 87 clearly shows that huge open parking facilities are located in front of the terminal and those parking lots force pedestrians to use Maglev trains to access Airport City of Incheon Airport.

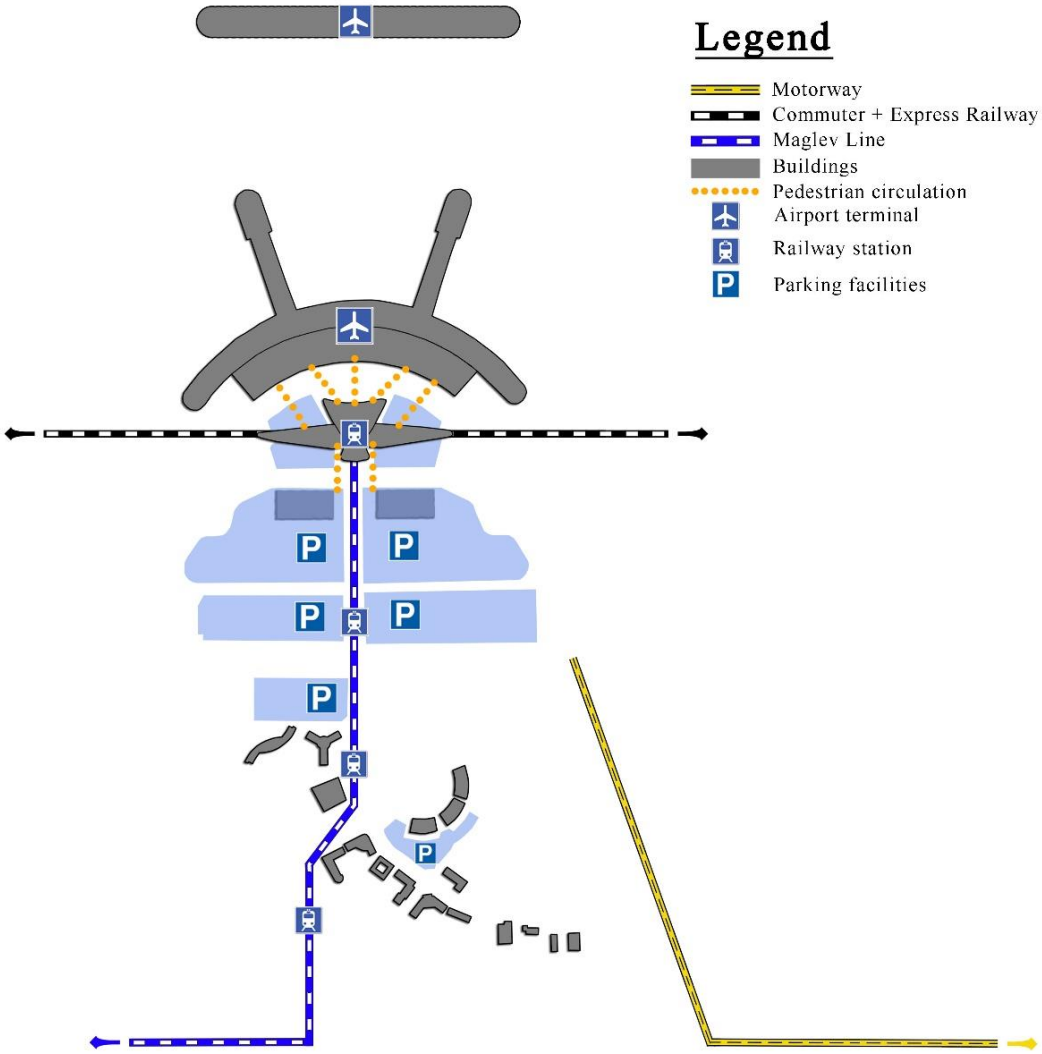


Figure 87: Movement and mobility scheme of Incheon International Airport

5.3 Morphological Specifications of Airport City

Aerotropolis concept has been proposed by Prof. John Kasarda (2000/2001) who is mainly an economist, businessman and urban sociologist. His main research fields were urban form, organizational structure, airport development and regional economic growth. However, the core and heart of the Aerotropolis, Airport City, has left to hands of architects and certain firms to design such important components. Indeed, actual arrangement and functionality of buildings, space, and streets matter a lot for an airport to get into system of such a concept. In order to

understand how a successful airport city can be achieved, it is inevitable to analyze morphology of airport cities in terms of streets, forms and functions, and open spaces. Each case has been analyzed considering these topics.

Istanbul Sabiha Gökçen International Airport City can be analyzed in 3 main parts; Teknopark Istanbul, social/recreational/residential areas and special investment/extension area. Areas that are shown as number 1 in Figure 88 represent the areas that are reserved for social/recreational and residential developments. These areas are embedded into forest zone and separated from Istanbul Teknopark by Kurtköy-Pendik connection. ITEP project reserved an extension zone for any future development marked as number 2 in Figure 88. Because of the lack of information about Zone 1 and 2, it is hard to say anything further about these areas in terms of spatial qualities.

Teknokent Istanbul is located on the North of the airport terminal and currently being constructed (Figure 89). This so called industrial park (shown as number 3 in Figure 88) is going to include convention center, exhibition & fair ground, hotels, recreational areas and offices. Except convention center, exhibition halls and hotels, office uses generally designed more of multi-storey point blocks. In some cases, these forms come together and form linear structures.

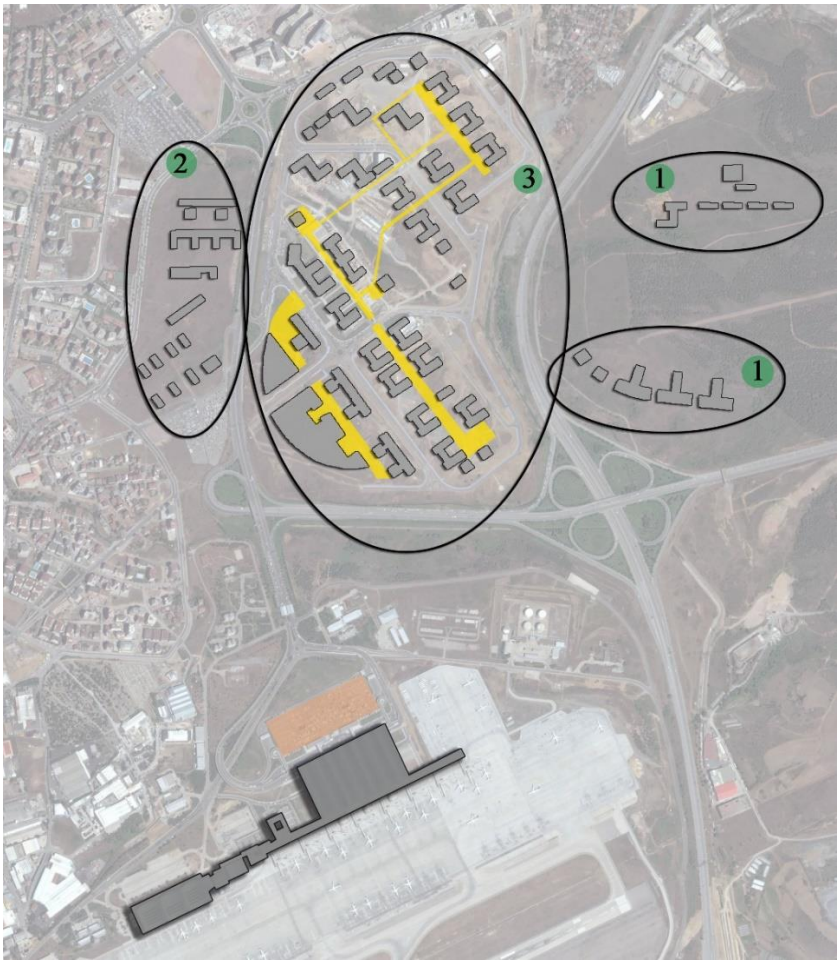


Figure 88: Main units/components of SAW Airport City (retrieved from Google Earth Pro)

Figure 89: Current development of Teknopark Istanbul (Source: teknoparkistanbul.com.tr)

As the second case, Frankfurt Airport has been analyzed. Excluding airport terminal, Frankfurt Airport City can be divided into 4 main units that play huge role in the system (Figure 90). In terms of streets, Frankfurt case doesn't show a real street quality of an urban place. However, probably because of the lack of free space, streets represented like more of closed pedestrian bridges which mostly helps to cross motorways.

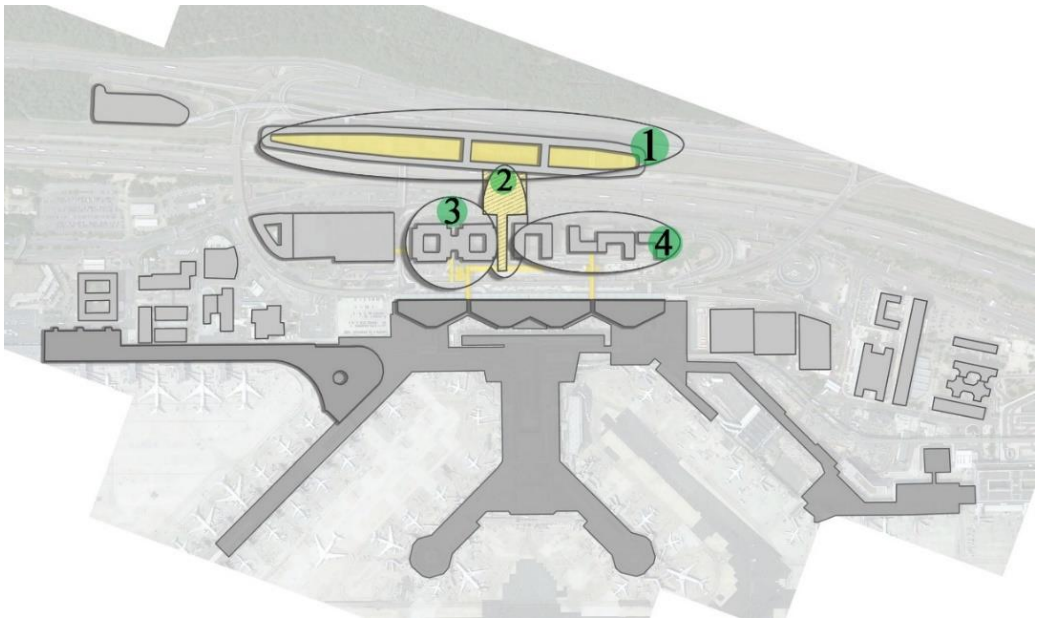


Figure 90: Main units/components of Frankfurt Airport City (retrieved from Google Earth Pro)

Most challenging part of Frankfurt case is the new railway station which become a futuristic structure with a motto of "Discover New Work City" (Figure 91). Building named as the Squaire (shown as number 1 in Figure 90), which is the combination of *square* and *air*. Aim of the project was to construct an office building on the existing railway station which will work as multi-function building. Originally, the building is called as an office building, but it has a railway station beneath, and almost 1/3 of the building is used as hotel. Most importantly, structure which is a landmark for the city, has 13.000 square meters of courtyard, or atrium (about %10 of the building). This area actually generates a pedestrian spine within

building which can be accepted as the most important part of Frankfurt Airport City (Figure 92).

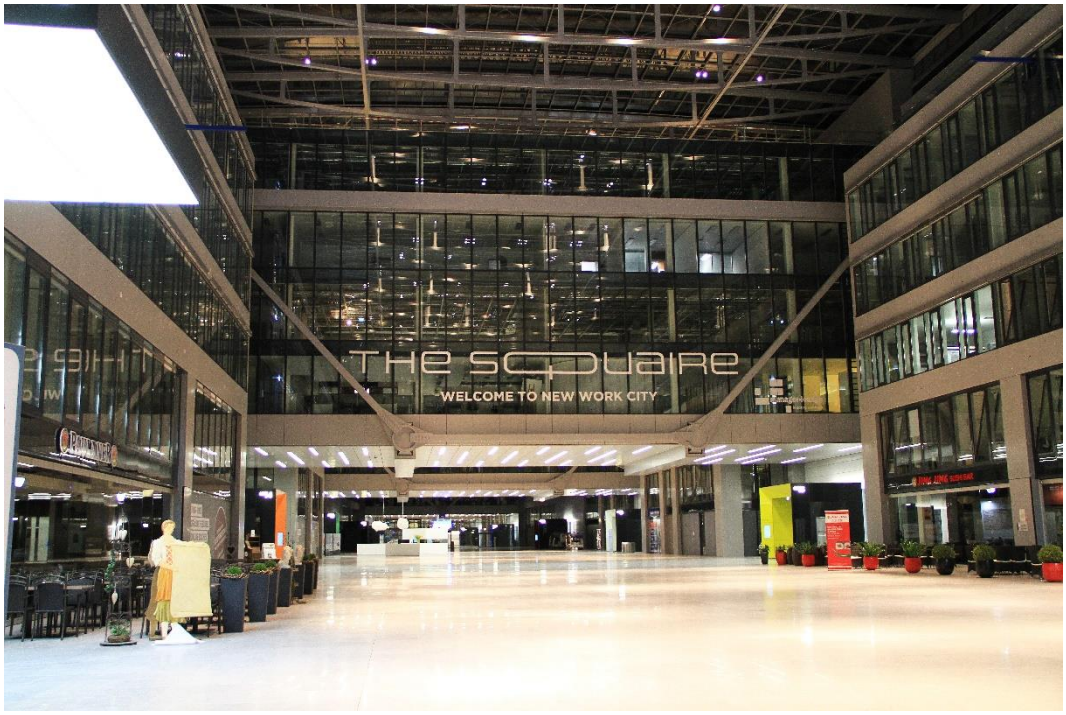


Figure 91: The Squaire: "New work city"

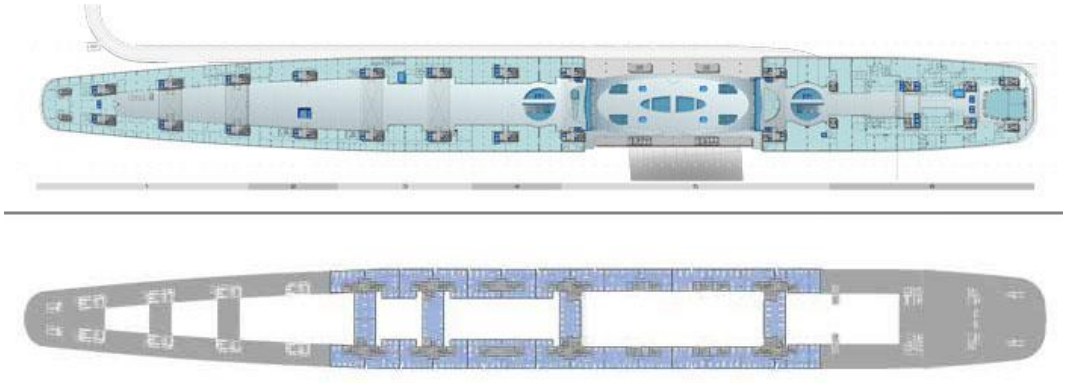


Figure 92: The Squaire floor plans (The Squaire, 2012)

The pedestrian spine of The Squaire is connected with a pedestrian bridge (shown as number 2 in Figure 90) to regional railway station and Frankfurt Airport Center.

Frankfurt Airport Center (shown as number 3 in Figure 90) is also consist of office spaces, conference and seminar rooms. Form of buildings are identical to each other which have courtyards on the middle. In my opinion, the reason that such forms were used in this case is because of lack of free-space. Next to number 3, hotel (shown as number 4 in Figure 90) is located on the other side of the bridge connection. These buildings have direct pedestrian connection between each other.

As the second case, Amsterdam Airport Schiphol is a must analysis to take into consideration. Because of the airport's determined planning history, Airport City wasn't a haphazard strategy for Amsterdam. It is important to understand design considerations of already living pioneer case.

Heart of Amsterdam Airport Schiphol is considered under the roof of Schiphol Plaza (shown as number 1 in Figure 93). It functions as a railway station, and a shopping center as well. Main pedestrian spine starts from this point and continues up to the hotel which is located just before service road of the airport terminal (shown as number 2 in Figure 93). Buildings are mostly rectangular shaped, located perpendicular on the covered walkway. Number 3 shown in Figure 93 starts with a hotel, and end with another hotel. All other buildings (in total 8) are used as offices, mostly by World Trade Center (WTC) Schiphol Airport. More than 64.000 employees working at approximately more than 500 international companies in WTC Schiphol Airport (WTC Schiphol Airport, 2015). WTC has been an important place for firms in order to strengthen their profiles at both the national and international level. That's why it is located on such a crucial location where air, rail and road connections are at a perfect level.

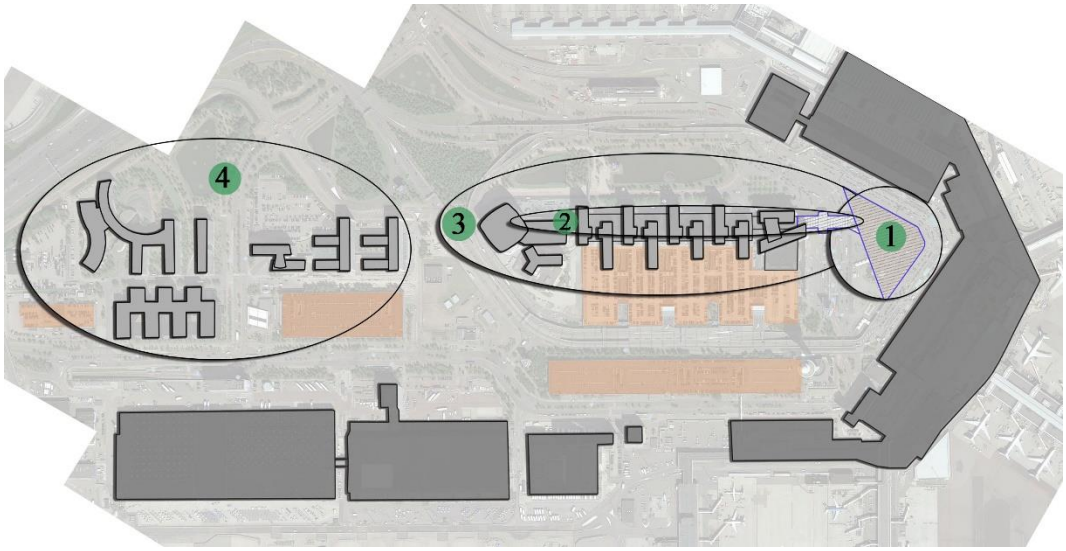


Figure 93: Amsterdam Airport Schiphol analyzed areas (retrieved from Google Earth Pro)

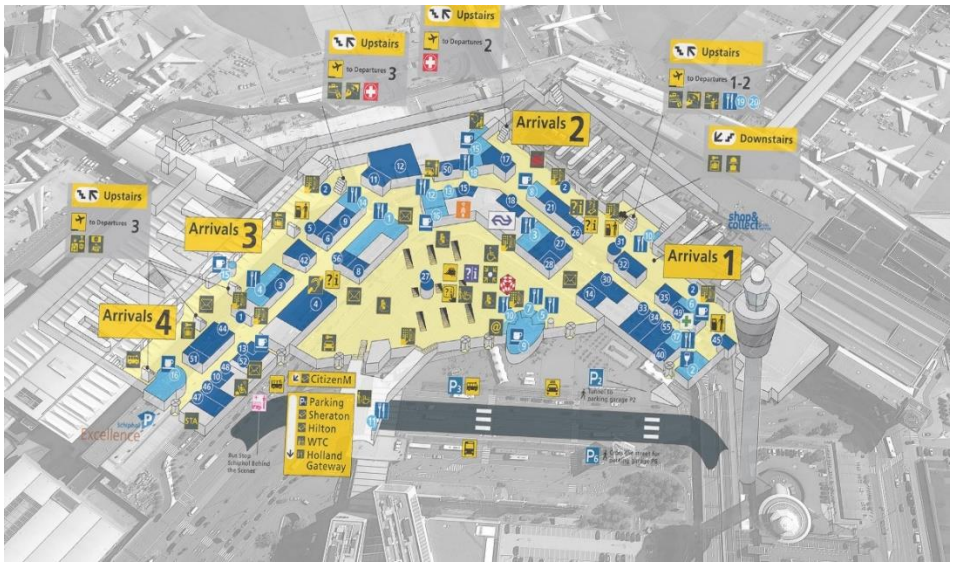


Figure 94: Scheme of Schiphol Plaza (retrieved from Google Earth Pro)

In front of Schiphol Plaza, there is an airport square which is used by cafes, and both arrival and departure passengers. At this square, the famous *"I Amsterdam"* letters located to welcome visitors to the city. It is such a perfect way to make city and airport square memorable by passengers and visitors. Schiphol Plaza has 3 entrances, 2 from square and 1 from bus stop (Figure 95). Indeed, Schiphol Plaza is directly connected to arrival floor of the airport terminal.

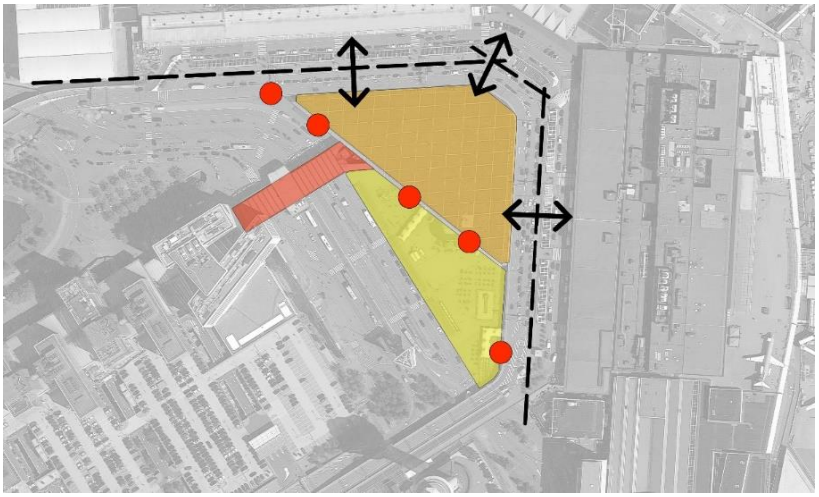


Figure 95: Entrances and connections of Schiphol Plaza (retrieved from Google Earth Pro)

Number 4 shown in Figure 93 consist of couple of office buildings and a multi-storey car park facility. Microsoft and few airlines has located their offices in this part of Amsterdam Airport City. Forms of buildings designed similar to first part of the Airport City office buildings, which are more of a rectangular shape. This part seems to have more open spaces available comparing to first part.

As the third case, Paris Charles de Gaulle airport has been analyzed. The layout of the Airport City (Roissypole complex) shows that a main pedestrian spine is located on the middle of the system and all buildings are connected to that walkway. On the pedestrian spine, railway station takes its place which is named as Aerogare 1 or Aeroport Charles de Gaulle 1 (shown as number 1 in Figure 96). It is possible to reach both terminals by using airport shuttle train from this station.

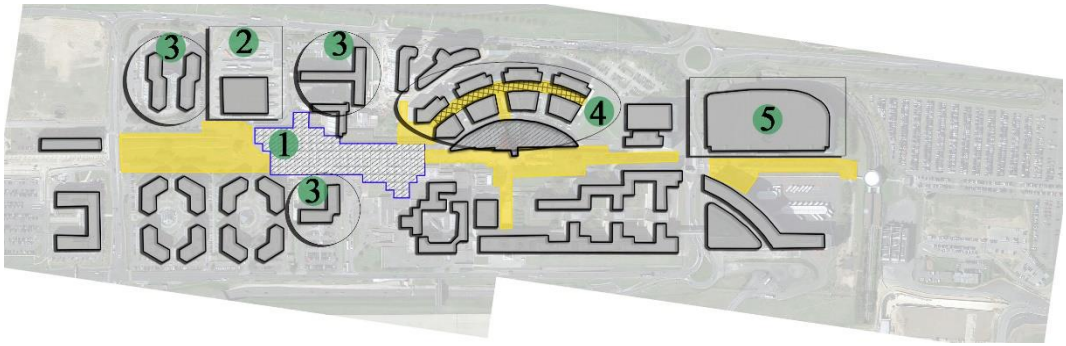


Figure 96: Analyzed areas of Paris Roissy Airport City (retrieved from Google Earth Pro).

Roissypole – Gare Railway station's location has a special importance in the airport system. Other than it is the central station of the airport, station functions as the transfer hub of bus and rail transportation. Number 2 shown in Figure 96 shows the location of the RoissyBus bus station (Figure 97). Bus shuttles connect Terminal 3 to both Terminal 1 and 2, and also the city center of Paris to the airport.

Figure 97: RoissyBus station on the left side, Roissypole Gare railway station on the right side (retrieved from Google Earth Pro).

Number 3 shown in Figure 96 are locations of the hotels that serve for the passengers of Paris airport. They can be accepted inside walking distance of Terminal 3, and also it is important to understand site selection of hotels which are just near bus and rail station of Roissy Airport City.

Figure 98: Inside "Le dome" (retrieved from Google Earth Pro)

Roissypole campus consist of offices, airport hotels and transportation hubs. If office usages wanted to be categorized, other than airline companies' office buildings, *"Le dome"* takes attention with its integration to the main pedestrian spine and architecture. As it can be seen in Figure 99, 8 office buildings came together with a fully closed passage (Figure 98) connecting all buildings to the main pedestrian spine and railway station. Passage concludes how carefully Airport City campus has been planned to have priority on pedestrians.

Roissy Airport City's multi-storey car park is located on the East side of the campus where light-rail railway station is located (shown as number 5 in Figure 96). Paris

Charles de Gaulle airport has enough car park spaces available for both short and long time parking.

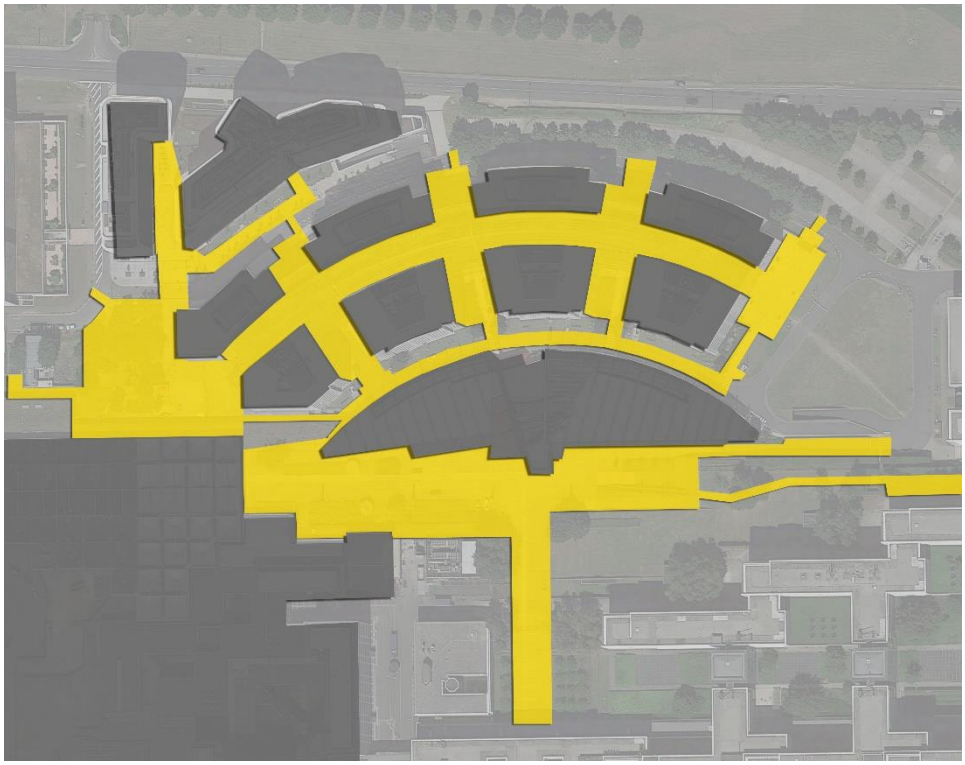


Figure 99: Pedestrian movement of Le Dome (retrieved from Google Earth Pro)

As the last case, Incheon International Airport is analyzed. It can be seen that, comparing to previous examples, construction of Incheon International Airport is not a fully completed one. Consequently, it is hard to say anything about place quality for now. However, there are certain areas that have certain points to mention. To start with, the distance between transportation center (shown as number 1 in Figure 100) and the closest building that is constructed is about 750 meters. In previous cases, walking distance was importantly taken into consideration while placing actual Airport City components. Unfortunately, Incheon case chose to have huge open car parks in front of the airport terminal (shown as number 2 in Figure 100), instead of integrating pedestrian walkways with Airport City.

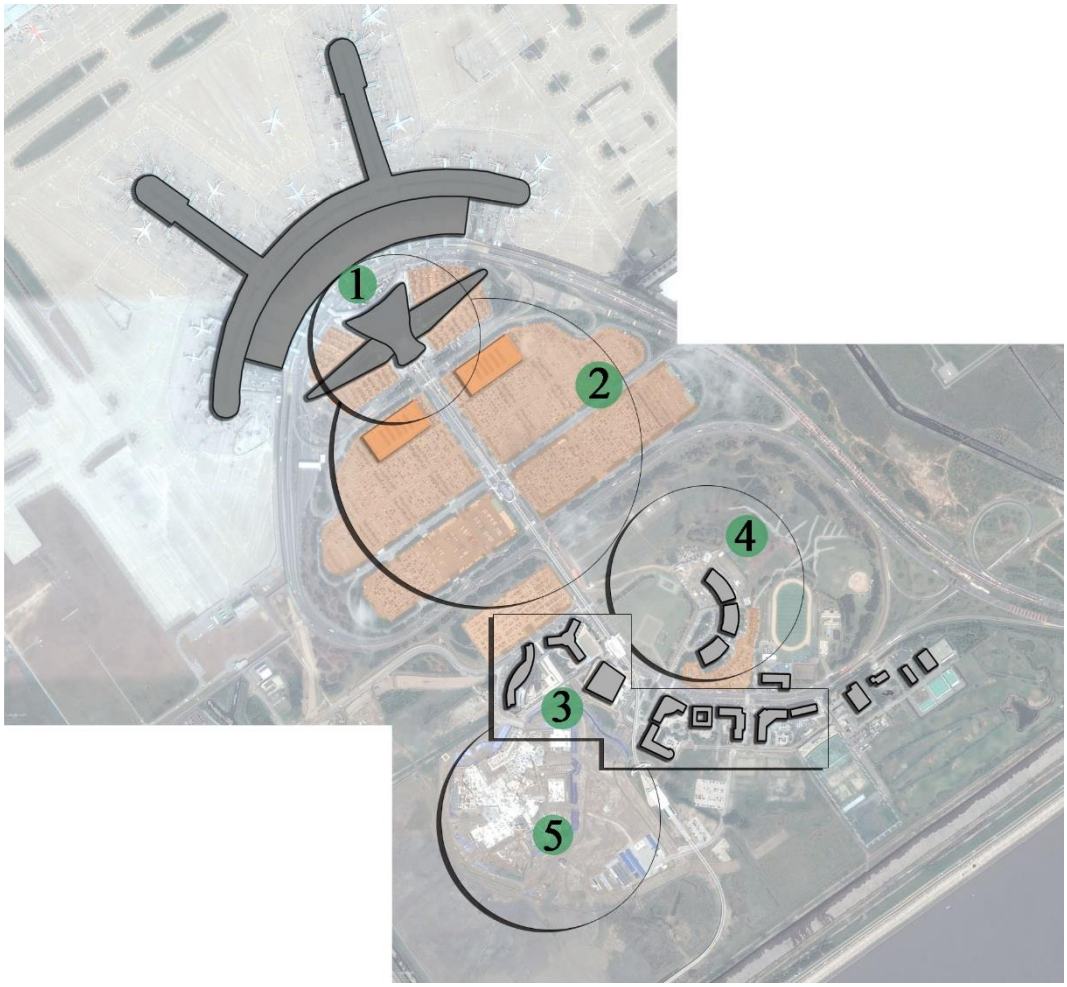


Figure 100: Analyzed areas of Incheon International Airport, Air City and Fashion Island (retrieved from Google Earth Pro)

Number 3 shown in Figure 100 defines the area where hotels, and few shops and restaurants are currently located. As it is known that the airport is still under construction and development process, as first step, hotels have been constructed on the main street (Figure 101) of the system to meet airport's temporary hotel need. On the other side of the main street, shown as number 4 in Figure 100, governmental offices and Incheon International Airport Corp. exist. This area is named as *"Air City"* of Incheon International Airport and it is expected to be the core of the airport city and Aerotropolis. Air City would include a set of multimodal commercial complexes being developed with all the features of a modern metropolitan center: retail areas, office buildings, logistics and high-tech assembly facilities, ICT

functions and leisure activities, a conference and exhibition center, as well as a mixed-use new town. Of course, these developments should be evaluated to have good spatial quality comparing with other examples. With the development of Air City, Fashion Island is expected to be built on the West side of the main street and hotels. It would take about 100 hectares of space. With its second phase, it is planned to be the fashion center of Asia with statue of the art luxury outlets, hotels, and exhibition space. Even Universal Studios announced to construct a $2 billion entertainment complex near the airport.

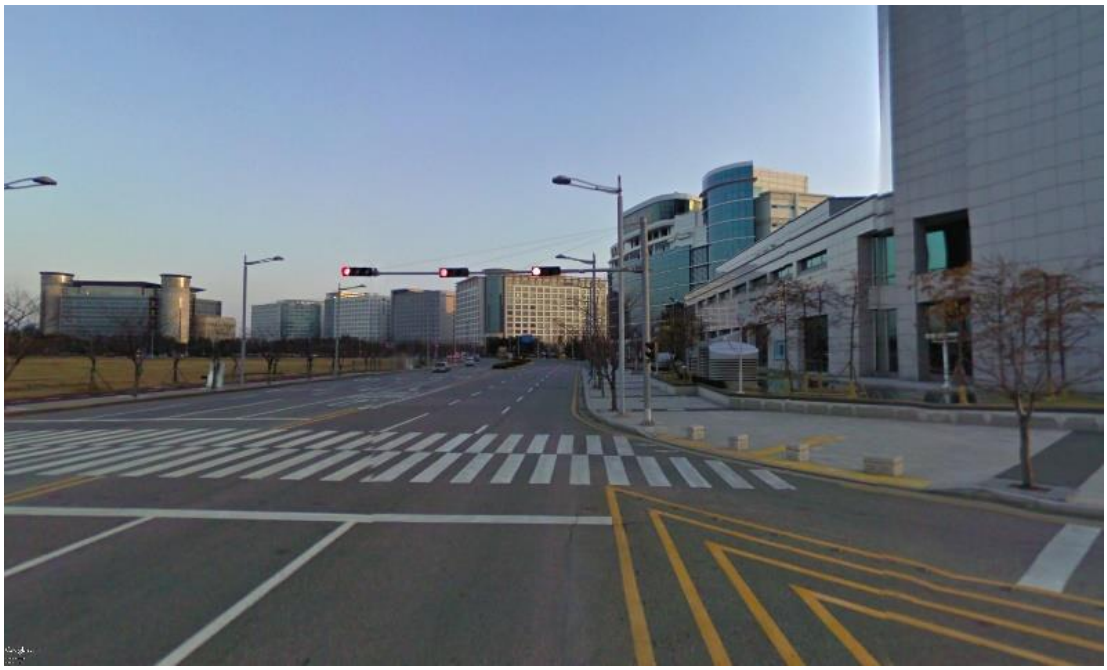


Figure 101: Main Street that serves Air City, hotels and Fashion Island (retrieved from Google Earth Pro)

CHAPTER 6

CONCLUSION

6.1 Summary

The principal aim of this study was to analyze design structure of one of the most trending concepts in urban planning, which is Airport City, and to understand design guidelines of current examples to give further contribution in terms of spatial quality for future developments. The lack of research in this field was the most important motivation to get deep into this study.

The process of this study has been started with the overview of airports. Important factors that led airport development to become part of a city have been discussed with planning and design perspectives. After analyzing history, development of airports and theoretical background, which includes both *'Aerotropolis'* and *'Airport City'* terms, case analysis have been evaluated under the design framework of Airport City. As a consequence, the research presented an idea about the design guidelines of the Airport City to encourage further studies in this field.

The main focus of this study is to understand benefits of Airport City concept for city and airport itself in terms of both strategic and spatial planning. It is aimed to understand how importantly an airport area can be for a city to create good virtual images for passengers in a certain limited space. Most particularly, spatial relationship between Airport City borders and the airport terminal aimed to be clearly understood by analyzing certain cases. In order to understand how to design better Airport City concept in terms of space and place, certain criteria that analyzed for Istanbul, Frankfurt, Amsterdam, Paris and Incheon cases has been compared and interpreted both descriptive and prescriptive perspectives.

6.2 Findings

The main findings of this study are obtained from Chapter 5 which have mainly focused on design framework of Airport City. Five different cities' airports have been analyzed to obtain information about design structure, movement, mobility and morphological specifications. Chapter 5 contains all analysis about Istanbul, Frankfurt, Amsterdam, Paris and Incheon in this perspective. As mentioned in Chapter 5, three main headings defined and main findings are listed in Table 14 by comparing sub-headings between four cases.

Analysis and findings can be analyzed in two ways; either every case can be evaluated in itself, or each sub-heading can be discussed among different cases. Firstly, each case can be defined as;

- Istanbul Sabiha Gökçen Airport City is going to be developed with a distance of 1 km away from terminal building. It is said that terminal and industrial park connection would be supported with monorail. Field typology and spatial setting can be described as a dense campus development. Today, the terminal has only highway and bus shuttle services from the city center. Extensive pedestrian structure, direct pedestrian access between terminal and Airport City, multi-modal intersection of transport network and transfer hub doesn't exist for this case. Parking typology is mostly consist of multi-storey car parks. Teknokent Istanbul's typology and types of buildings are mixed due to different uses, but typology of pedestrian structure is clearly noticeable. It is fully open and almost circulating in every part of the system.
- Frankfurt Airport City is located under 500m walking distance from the airport terminal and it can be defined as a dense building complex. It has all opportunities to access from different transportation modes, such as railway, bus and direct highway access. The area can be seen as a transport hub which allows an extensive availability to change transport mode. However, multi-modal intersection of transport network can't be seen in this case. Mostly, multi-storey car parks preferred to meet demand both for Airport City and terminal usages on distinguished locations. Since the

structure of Airport City consists of to be more of a dense building complex, pedestrian accessibility is on high level to directly connect terminal and other facilities to each other.

- Amsterdam Schiphol Airport City is also located with a distance of 150m from the terminal building. Characteristics of; field typology, spatial setting, major access mode, existence of transfer hub and direct access from highway, parking typology, existence of extensive pedestrian structure and direct pedestrian access between terminal and airport city have been concluded to be almost the same as Frankfurt case. However, when multi-modal intersection of transport network is analyzed, Amsterdam case becomes much stronger. Railway station and airport terminal have direct vertical intersection under the roof of Schiphol Plaza, which also seems to be the heart of Schiphol Airport City. Typology of facility buildings exist as attached point blocks connected by an elevated pedestrian structure.
- Paris Charles de Gaulle Airport City is located between Terminal 1 and Terminal 2, which means more than 1.5km from the center of Airport City, and also 300m close to Terminal 3. Terminal 3 is the budget terminal used by only charter and low-cost carriers. Paris case seems to be slight different comparing first two cases. The main reason is the field typology of Paris Airport City. It looks more likely of a campus development with a dense spatial setting. It is easily accessible from all transportation modes. The campus has an extensive pedestrian spine working on the middle of the whole system by connecting all buildings to each other. Vehicles aren't mostly allowed to this site because buildings are accessible from the rear side. Parking is solved with few multi-storey parking lots and a huge open parking lot just near the Airport City borders. Since the Airport City is far away from both main terminals, it doesn't meet expectations to have direct pedestrian access to terminals. In addition, multi-modal intersection of transport network also doesn't exist on this case. Typology of facility buildings appears to be mixed and building configuration is mostly detached. All facility buildings are attached by an open pedestrian spine.

- Incheon Airport City is the youngest case comparing with others. It is still under construction, but footprints reveal its future. Airport City is located about 1km far away from airport terminal. Building complexes are designed along the main street with a sprawl spatial setting. Airport and Airport City is accessible by railway, highway and bus. Transfer hub exists as a separate building just in front of the airport terminal which creates a multi-modal intersection of transport network for this case. Mostly open car lots has been chosen between airport terminal and Airport City because of the available land. Consequently, because of the huge open parking lots, direct pedestrian access between terminal and Airport City couldn't be created. This circumstance led to not have an extensive pedestrian structure in Incheon case so far. Only small bridged connections between transfer hub and airport terminal exist. Buildings are designed to have detached point block structure.

Each case reveals its unique Airport City design guidelines. Prescriptive or descriptive discussions in design of the Airport City can conclude to define either case model's unique design characteristic, or design characteristics of each case can be evaluated one by one to achieve a better Airport City model. Descriptive explanations are given above and prescriptive definitions can be discussed as;

- Walking distance from terminal building: Walking distance is directly related to the structure of the Airport City. If it is required to have direct relation with airport terminal, walking distance from terminal should be under 500m. On the other hand, limited land also may result in a good pedestrian connections between facilities and terminal.
- Field typology: Building complexes are mostly chosen to be more suitable for Airport City field typology. The reason is because of the land value that the location has is pretty high, which affects the design structure of field.
- Spatial setting: It is wisely to design facilities in more of a compact form than a sprawl development. It may have two reasons; either available land may force it, or variety of facilities may result to have more dense Airport City spatial setting.

- Major access mode between airport & city: Every Airport City should have high standards in terms of accessibility. Each case that was analyzed gave a result of good connections to airport area from railway, bus and highway. This circumstance directly refers to the main characteristic of Airport City; accessibility.
- Transfer hub: Transfer hub in an Airport City means a node where at least two different transportation modes intersect. All cases meet this criteria because it is the milestone to have strong accessibility to the airport area. Transfer hub can be either a building, an open area, or even airport terminal itself.
- Direct access from highway: All European cases, which are analyzed, have been constructed along major highways of Europe. It is important to pre-plan such huge developments to select, for example, correct sites in order to get highway access.
- Parking typology: Highly depends on available land. It can be clearly seen that huge open parking lots can only be used in cases which have enough free spaces to use. On the other hand, wrong placed huge open parking lots cause loss of valuable spaces which should serve more of livable places (e.g. Amsterdam Schiphol Airport). In addition, by placing multi-storey car parks and arranging their facades may give better place quality.
- Extensive pedestrian structure: Most of the cases have extensive pedestrian structure. It seems essential to have strong relationship of pedestrians between both Airport City facilities and the terminal, and between facilities.
- Direct pedestrian access between terminal and Airport City: Direct pedestrian access from terminal to Airport City doesn't seem to be a must, but strong connection between each other is required. It should be provided either with railway or bus shuttles.
- Multi-modal intersection of transport network: Verticality between multi-modal transport networks provide easy access to the airport area. If it doesn't exist, strong pedestrian connection should be provided.
- Typology of facility buildings: It can be seen that different typologies are used in design of Airport Cities. European cases mostly used buildings with

courtyards, but instead, Incheon decided to have point blocks. It couldn't be understood from examples that which typology mostly suits for such development. Paris used mixed typology of facility buildings because it has been constructed as a campus development, so it is acceptable. Likewise, Frankfurt chose to have only courtyards probably because of constricted space. In conclusion, typology of facility buildings highly depends to designer of the system if enough space is available.

- Types of building configuration: Highly depends on available land. Both Frankfurt and Amsterdam cases lack available free land to apply different design approaches. That's why they both must use more of an attached building configuration comparing others that have. On the other hand, there may be another reason lying behind building configurations such as trying to get strong horizontal connections between buildings. These two reasons generally figure out whether to use attached or detached building configuration.
- Typology of pedestrian structure: It is obvious that designing a campus should result with an open pedestrian spine. Likewise, having constricted space with bunch of crowded roads, while trying to build a strong pedestrian connection between buildings, should result pedestrian bridges over roads. Amsterdam Airport City has elevated pedestrian structure which connects all facilities and the airport terminal to each other in one step. The main idea here is to not interrupt the pedestrian flow coming from terminal to airport hotel. All in all, depending on the design, every type can be used to achieve strong connections between certain important nodes.

Table 14: Comparison of different Airport City cases under defined criteria

		FRANKFURT	AMSTERDAM	PARIS	INCHEON	SABİHA GÖKÇEN AIRPORT
DESIGN STRUCTURE	**Walking distance from terminal**	50m-100m	100m-150m	>1500m (metro connection)	>1000m (elevated rail)	>1000m
	Field typology	Building complex	Building complex	Campus	Building complex	Campus
	Spatial setting	Dense	Dense	Dense	Sprawl	Dense
MOVEMENT & MOBILITY	**Major access mode between airport & city**	Railway + Bus + Highway	Railway + Bus + Highway	Railway + Bus + Highway	Railway + Bus + Highway	Bus + Highway
	Transfer hub	✓	✓	✓	✓	×
	Direct access from highway	✓	✓	✓	✓	✓
	Parking typology	Multi-storey car park	Multi-storey car park	Multi-storey + parking lot	Parking lot	Multi-storey car park
	Extensive pedestrian structure	✓	✓	✓	×	×
	Direct pedestrian access between terminal and Airport City	✓	✓	×	×	×
	Multi-modal intersection of transport network	×	✓	×	✓	×
MORPHOLOGICAL SPECIFICATIONS	**Typology of facility buildings**	Courtyard	Point block	Mixed	Point block	Mixed
	Types of building configuration	Attached	Attached	Detached	Detached	Mixed
	Typology of pedestrian structure	Bridge + closed walkway	Elevated	Open	Bridge	Open

6.3 Discussions

Istanbul, Frankfurt, Amsterdam, Paris and Incheon Airport City cases are analyzed under certain criteria and each case concluded with unique design guidelines in Table 14. It is often discussed that should such a concept has certain ideal guidelines or is it better to understand core functions and develop unique designs for each case. At this point, it is essential to study the city and the region that Airport City would function in, and develop new ideas or design guidelines for each case. However, after concluding with such a detailed and characteristically important table (Table 14), fundamentals of Airport City design should be clearer.

Finding ideal Airport City was not the goal of this study, but answering questions such as "Do Airport Cities correspond to their main characteristics in terms of design?" should give some enlightenment in this field. As it is said before, there is no ideal Airport City in the world, however, each case can be ideal by itself in terms of process and goals.

In Table 14, some of the criteria can be accepted as indispensable, such as;

1. Walking distance should be provided between terminal and Airport city. If not, additional rail connections should be available.
2. Major access modes between airport and city should be provided in all modes of transportation; railway (including elevated, underground etc.), highway, shuttle buses etc. This indicates to the essential characteristic of an Airport City: strong connectivity.
3. Transfer hub in or nearby Airport City should be provided. It is important to offer various transportation modes with a strong connection between each.
4. Highway accessibility should be on a high level; both for cargo and passenger flows.
5. Pedestrian accessibility between Airport City components and terminal should be provided. There may or may not exist an extensive pedestrian structure, but connections should be strong.

6. Direct pedestrian access between terminal and Airport City should be provided. The type of the connection is directly related to the walking distance between two (directly related with number 1).
7. Typology of the pedestrian structure should be closed/elevated/bridge if typology of facility buildings mostly consist of point blocks and courtyards and if types of building configuration are mostly attached.

6.4 Concluding Remarks

Airports are not just the ports that people travel to their destination anymore but they are becoming cores of new urban growth areas. It is important to examine these new formations to conclude in better urban connections. Prof. Vasanth K. Bhat (architect and planner), states the importance of Airport Cities with these words;

> *"A gaze into the crystal ball says that just as seaports in the 18th century, railroads in the 19th century and highways in the 20th century spawned the growth of cities and towns, airports will spawn urban growth in the 21st century."* (Karlsruhe Institute of Technology, 2010).

In this study, design characteristics of already living Airport Cities tried to be analyzed and put into categorized table (Table 14) in order to understand design principles for further developments. This study can be a base for further future researches in terms of achieving higher spatial quality around hub airports. Topics like airport-related area development, Airport City spatial planning and design, Airport Corridor design, spatial design of Aerotropolis, Aircity design, role of the airport CBD in metropolitan region lack researches on academic level and should be studied to enlighten these concepts in terms of urban design. Airports should be considered as one of the most important part of the city which would definitely drive attention for discussions on spatial quality of airport terminal and surroundings.

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APPENDIX

Airport at Center of Aerotropolis or Airport City	Aerotropolis or Airport City	Status	Region	ICAO	IATA
Amsterdam Airport Schiphol	Aerotropolis	Operational	Europe	EHAM	AMS
Bangkok Suvarnabhumi Airport	Aerotropolis	Operational	Asia/Pacific	VTBS	BKK
Beijing Capital International Airport	Aerotropolis	Operational	Asia/Pacific	ZBAA	PEK
Belo Horizonte International Airport, Brazil	Aerotropolis	Operational	South America	SBCF	CNF
Chicago O'Hare International Airport	Aerotropolis	Operational	North America	KORD	ORD
Dallas-Ft. Worth International Airport	Aerotropolis	Operational	North America	KDFW	DFW
Dubai International Airport	Aerotropolis	Operational	Middle East	OMDB	DXB
Fort Worth Alliance Airport	Aerotropolis	Operational	North America	KAFW	AFW
Helsinki-Vantaa Airport	Aerotropolis	Operational	Europe	EFHK	HEL
Hong Kong International Airport	Aerotropolis	Operational	Asia/Pacific	VHHH	HKG
Incheon International Airport	Aerotropolis	Operational	Asia/Pacific	RKSI	ICN
Kuala Lumpur International Airport	Aerotropolis	Operational	Asia/Pacific	WMKK	KUL
LA/Ontario International Airport	Aerotropolis	Operational	North America	KONT	ONT
Louisville International Airport	Aerotropolis	Operational	North America	KSDF	SDF
McCarran International Airport	Aerotropolis	Operational	North America	KLAS	LAS
Memphis International Airport	Aerotropolis	Operational	North America	KMEM	MEM
Miami International Airport	Aerotropolis	Operational	North America	KMIA	MIA
Orlando International Airport	Aerotropolis	Operational	North America	KMCO	MCO
Paris Charles de Gaulle Airport	Aerotropolis	Operational	Europe	LFPG	CDG
Piedmont Triad International Airport	Aerotropolis	Operational	North America	KGSO	GSO
Raleigh-Durham International Airport	Aerotropolis	Operational	North America	KRDU	RDU
Shanghai Pudong International Airport	Aerotropolis	Operational	Asia/Pacific	ZSPD	PVG
Singapore Changi Airport	Aerotropolis	Operational	Asia/Pacific	WSSS	SIN
Stockholm Arlanda Airport	Aerotropolis	Operational	Europe	ESSA	ARN
Washington Dulles International Airport	Aerotropolis	Operational	North America	KIAD	IAD
Athens International Airport Eleftherios Venizelos	Airport City	Operational	Europe	LGAV	ATH
Bremen Airport	Airport City	Operational	Europe	EDDW	BRE
Brisbane Airport	Airport City	Operational	Asia/Pacific	YBBN	BNE
Cairo International Airport	Airport City	Operational	Africa	HECA	CAI
Frankfurt Airport	Airport City	Operational	Europe	EDDF	FRA
Frankfurt-Hahn Airport	Airport City	Operational	Europe	EDFH	HHN
Huntsville International Airport	Airport City	Operational	North America	KHSV	HSV
John F. Kennedy International Airport	Airport City	Operational	North America	KJFK	JFK
London Heathrow Airport	Airport City	Operational	Europe	EGLL	LHR
Los Angeles International Airport	Airport City	Operational	North America	KLAX	LAX
Minneapolis-Saint Paul International Airport	Airport City	Operational	North America	KMSP	MSP
Munich Airport	Airport City	Operational	Europe	EDDM	MUC
Philadelphia International Airport	Airport City	Operational	North America	KPHL	PHL
Phoenix Sky Harbor International Airport	Airport City	Operational	North America	KPHX	PHX
Pittsburgh International Airport	Airport City	Operational	North America	KPIT	PIT
Rickenbacker International Airport	Airport City	Operational	North America	KLCK	LCK
Ted Stevens Anchorage International Airport	Airport City	Operational	North America	PANC	ANC
Vancouver International Airport	Airport City	Operational	North America	CYVR	YVR
Vienna International Airport	Airport City	Operational	Europe	LOWW	VIE
Zurich Airport	Airport City	Operational	Europe	LSZH	ZRH

List of operational Aerotropolis and Airport Cities in the world (Kasarda, 2013)

Airport at Center of Aerotropolis or Airport City	Aerotropolis or Airport City	Status	Region	ICAO	IATA
Baltimore-Washington International Airport	Aerotropolis	Developing	North America	KBWI	BWI
Bengaluru International Airport	Aerotropolis	Developing	Asia/Pacific	VOBL	BLR
Clark International Airport	Aerotropolis	Developing	Asia/Pacific	RPLC	CRK
Cleveland Hopkins International Airport	Aerotropolis	Developing	North America	KCLE	CLE
Cochin International Airport	Aerotropolis	Developing	Asia/Pacific	VOCI	COK
Delhi Indira Gandhi International Airport	Aerotropolis	Developing	Asia/Pacific	VIDP	DEL
Denver International Airport	Aerotropolis	Developing	North America	KDEN	DEN
Detroit Metropolitan Wayne County Airport	Aerotropolis	Developing	North America	KDTW	DTW
Dubai Al Maktoum International Airport	Aerotropolis	Developing	Middle East	OMJA	DWC
Durban King Shaka International Airport	Aerotropolis	Developing	Africa	FALE	DUR
Edmonton International Airport	Aerotropolis	Developing	North America	CYEG	YEG
Guangzhou Baiyun International Airport	Aerotropolis	Developing	Asia/Pacific	ZGGG	CAN
Hartsfield-Jackson Atlanta International Airport	Aerotropolis	Developing	North America	KATL	ATL
Hyderabad Rajiv Gandhi International Airport	Aerotropolis	Developing	Asia/Pacific	VOHY	HYD
Indianapolis International Airport	Aerotropolis	Developing	North America	KIND	IND
Jackson-Evers International Airport	Aerotropolis	Developing	North America	KJAN	JAN
Johannesburg-Ekurhuleni OR Tambo International Airport	Aerotropolis	Developing	Africa	FAJS	JNB
Lambert-St. Louis International Airport	Aerotropolis	Developing	North America	KSTL	STL
Milwaukee General Mitchell International Airport	Aerotropolis	Developing	North America	KMKE	MKE
Moscow Domodedovo Airport	Aerotropolis	Developing	Europe	UUDD	DME
Northwest Florida Beaches International Airport	Aerotropolis	Developing	North America	KPFN	PFN
Phoenix-Mesa Gateway Airport	Aerotropolis	Developing	North America	KIWA	AZA
Subic Bay International Airport	Aerotropolis	Developing	Asia/Pacific	RPLB	SFS
Taiwan Taoyuan International Airport	Aerotropolis	Developing	Asia/Pacific	RCTP	TPE
Tocumen International Airport - Panama Panatropolis	Aerotropolis	Developing	South America	MPTO	PTY
Zhuhai Jinwan Airport	Aerotropolis	Developing	Asia/Pacific	ZGSD	ZUH
Abu Dhabi International Airport	Airport City	Developing	Middle East	OMAA	AUH
Barcelona El Prat Airport	Airport City	Developing	Europe	LEBL	BCN
Budapest Ferenc Liszt International Airport	Airport City	Developing	Europe	LHBP	BUD
Charlotte Douglas International Airport	Airport City	Developing	North America	KCLT	CLT
Dublin Airport	Airport City	Developing	Europe	EIDW	DUB
Jeddah King Abdulaziz International Airport	Airport City	Developing	Middle East	OEJN	JED
John C. Munro Hamilton International Airport	Airport City	Developing	North America	CYHM	YHM
Kansas City International Airport	Airport City	Developing	North America	KMCI	MCI
Manchester Airport	Airport City	Developing	Europe	EGCC	MAN
Newark Liberty International Airport	Airport City	Developing	North America	KEWR	EWR
Oslo Airport, Gardermoen	Airport City	Developing	Europe	ENGM	OSL
Paris Vatry Airport	Airport City	Developing	Europe	LFOK	XCR
Warsaw Chopin Airport	Airport City	Developing	Europe	EPWA	WAW

List of developing Aerotropolis and Airport Cities in the world (Kasarda, 2013)