

AEROTROPOLIS
The Age of New Urbanism
(A Case Study of Ahmedabad city, India)

A thesis submitted for partial fulfillment for Masters in Urban
Planning to the School of Design and Environment.
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By
Aanal Agrawal



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Declaration by Student

I, Aanal Agrawal, hereby declare that the work presented herein is original work done by me and has not been published or submitted elsewhere for the requirement of the degree programme. Any literature or work done by other is cited within this thesis and has been given due acknowledgement and listed in the bibliography section.

Yours Sincerely,
Aanal Agrawal
Place: Singapore
May'2017

IJSER

Acknowledgement

I would like to thank my deepest gratitude to my advisor, Professor Li Qiang for his excellent guidance, support and enthusiasm during my journey of this research. I would also like to thank Professor Jeffrey Ho and Professor Jason Ang for guiding me through and helping me to direct in the right direction.

I would also like to thank my friends and family for their support and best wishes.

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Abstract

The aviation sector is one of the most polluting and fastest growing greenhouse gas emitter in the world. While only 7% of the total population has ever travelled through air transport, the costs will be barred by all.

Today, the world is travelling much more be it for business, tourism, leisure or education. The number of flights taking off every day is on the positive ladder and is envisaged to increase to three folds by 2030. With this increasing number of flights, there lies a huge demand for construction of airports, and thereby huge opportunity towards building sustainable airports. The new age of urbanism should thus be carried out with due consideration of airports as well as the surrounding services or infrastructure.

The concept of aerotropolis is the development of airport city around the megacities of the world, with consideration to recent information technologies and with sharp focus of eco-innovation and green economy. The aerotropolis clusters are emerging as transportation hub, key region for business and economic activities, providing services for all age groups and hence providing for self-sustained cities for people to live, work and play. The development of such airport cities will eventually lessen the need to travel to larger distances and green house emissions from its overall activities.

The thesis report here investigates the concept of Aerotropolis and its developmental framework across the globe, as well as how the same contributes towards the global green development. Taking both the successful and unsuccessful case studies of Incheon Aircity (SouthKorea), Schiphol International Airport (Amsterdam), Memphis International Airport (Memphis), and so on, deriving the key learning which could be considered for further development.

India today has 18% of the global population which is tended to increase at large scale in the coming future, which will eventually increase the demand for people to travel. There is substantial scope to apply urban –airport based development theories to the Indian cities. The administrative capital, Delhi and financial capital, Mumbai of India are considered to be the gateway to country, however has no further land for developing cities around airport, however the western region of the country has been strongly influenced in terms of development. The thesis report here focuses on development of eco airport city in Ahmedabad, as a major step towards climate change.

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1. INTRODUCTION

Airports are undoubtedly the driving tools of the new century due to the technological advancements in the aviation industry, the need of transporting people and goods from one place to another which is today the prime component of the globalized world we are living in. Air Transportation is a critical factor in maintaining the current trade demand and supply, meeting the tourism demand and at the same time sustaining the social, political and economical ties between regions. The same has transformed the airports today into the multifunctional transport and commercial hubs which we today call as global international airport cities. (Kasarda, 2010)

As predicted by John. Kasarda, whether planned or not the commercial air passenger traffic is bound to increase from 4.9 billion in 2015 to 13.3. Billion in the coming decade, hence this pattern of growth and development is bound to continue which would further add to the need of developing Aerotropolis. (John D. Kasarda, 2011)

The concept of "Aerotropolis" was coined by Professor John Kasarda, the head of the Centre for Air Commerce at the University of North Carolina. He along with his counterpart Greg Lindsay has published the famous book titled "The Aerotropolis – The Way We'll Live Next". *"The shapes and fates of cities have always been defined by transportation. Today, this means air travel"* (John D. Kasarda, 2011)

Kasarda views airports as the fifth wave of transit oriented development shaping big cities in the same manner as that of previous urban clusters but this time around the airports. As depicted in the figure, the idealized description of Aerotropolis is a sub-regional economy where the Airport city is the anchoring economic associated with a concentrically expanding mix of clustered uses such as warehousing, offices, residential housing, retail, commercial real estate as well as time efficient logistics, industrial and manufacturing activities

and so on. (John D. Kasarda, 2011)

According to Kasarda, that one of the main drivers behind the rising growth of globalization is air travel. The fast air travel has shrunk the Atlantic crossing from four days to merely seven hours; it has converted rich man's indulgence of travel of common man's need. It has positively changed the international consultations to not only between elite classes but between engineers, controllers, firms and governments and so on. All this has led to exchange in skills and knowledge, which has further changed the product cycle of every product.

1.1 BACKGROUND

1.1.1 Problem Statement

There is diversity of concepts for developing an Aerotropolis based on the existing methods used to develop cities around the airport however there is no specific method that constitutes the developing process.

Freestone and baker in their research explains Aerotropolis model as a process of incremental progress that requires closer inspection by experts in order to balance the urban development in close association with the socio-economic needs and requirements of the particular city or region.

The concept of Aerotropolis development leaves itself largely to the qualitative interpretation of each city, especially in India where urbanization and the issues emerging due to the same is the main agenda of the urban planners. The development of a city around an airport will thus need a detailed analysis on the local economies, the need and demand of the surrounding region as well as the local, regional and international connectivity of the airport.

With this context, the development of Aerotropolis at Ahmedabad International

Airport, needs spatial planning and land use management systems for long term planning of the development in close context of the desired vision and targeted budgets. (Hanly, 2015)

1.1.2 Limitations of the Study

Applying different airport urban concepts or Aerotropolis concept to cities of a city requires shared vision, extensive public participation, economic feasibility, as well as extensive analysis so as to determine the market demand and potential, before coming to a conclusion. The nature of this analysis is particularly complex requiring a multidisciplinary team of experts and researchers, therefore being difficult to access by a single researcher.

Further limitations include time, accessibility of spatial documentation which was restricted for confidentiality purposes. A lack of qualitative data sets as well relevant case studies further acted as the hindrance of the study.

1.1.3 Research Question

1. Why is the age of new urbanism around the airport?
2. Determining the position of Aerotropolis – As a concept of initiative towards green development.
3. Recognizing the airport as a catalyst for growth and development in India, and how can the existing spatial and economic frameworks be used to orient the airport led development in the city of Ahmedabad which lies in the western region of India?

1. LITEARTURE REVIEW

2.1 History

Since the beginning of modern history, the transportation merging points or intersections

have been the catalyst for the growth and development of business centers. Looking at the history of the development, we can categorize the development into four main categories each of which has been dominated by the mode of transport used in that stage.

The four periods of transport domination could be defined as water transport, the stage of emerging rail transport, recent times of automobile use and the current period of transport dominated by air.



In the early 18th century, the city in terms of trade and commerce was getting developed in close proximity of the sea ports for the ease of exchange. The communities, people and trade grew where there were natural water bodies and harbors along the ocean shores and at the location of the convergence of main rivers. The transportation on main routes was provided with sailing vessels, boats and canoes. Many of the world cities today exist with strong evidence of influence of water at its core. One of the most common examples of water towns is that of Amsterdam, London, New York, Philippines and so on.

Water Transport

Amsterdam was founded as a fishing village around the thirteen century which was developed around a dam in the Amstel River. The mouth of the river formed a natural harbor which became an important trading exchange point for large to small ships which sailed the products deeper into the city and other regions.

Such cities reveal the commonality of having waterfront as the centre of activities, wherever there was space to park a boat or the place of embarking on or from the ships, entrepreneurs

built facilities to cater to the tourist, travelers, shippers and traders. (Conway, 1994) However, the water town with expansion of cities soon started to change the city form, shape and development.

Rail Transport

As this period of development grew further, the water front areas expanded. With the lack of land around the water areas, the cities started to grow and the demand to transport goods from one place to another increased which resulted in the growth of railroads. New communities flourished around the new rail heads and at the intersection of major rail lines.

At these new rail locations the service facilities developed by entrepreneurs was exactly the same, but the target population was different. The rail stations were generally surrounded by rail road hotel, restaurant & eateries, saloons, laundry service shops and so on. (Conway, 1994)

Automobile based Transport

Another wave of development occurred with the arrival of automobile. The introduction of automobile changed the city growth pattern where the city growth spread to much greater degree than that of the water and rail modes because of the ubiquitous nature of the automobile itself. The automobile made movement from Point A to B much smoother, swifter, quicker and personalized. People no longer had to involve themselves with transfer of vehicles, no transfers, and had to spend minimum time and cost. The period saw the emergence of big shopping malls, office parks, hotels and other automobile related facilities which were developed along the major highways which could easily be accessed using the automobile vehicles. (Conway, 1994)

The current era is however could be defined as the new wave brought with the emergence of air transport. While the automobile is ideal

mode for short distances, the airplane has proven to be efficient for long term travels. The airplane has already become a dominant mode of transport for various Businessman, travelers and traders.

Airports are undoubtedly the driving tools of the new century due to the technological advancements in the aviation industry, the need of transporting people and goods from one place to another which is today the prime component of the globalized world we are living in. Air Transportation is an important factor in maintaining the current market demand and supply, meeting the tourism demand and at the same time sustaining the social, political and economical ties between regions. The same has transformed the airports today into the multifunctional transport and commercial hubs which we today call as global international airport cities. (Kasarda, 2010)

2.2 Aerotropolis

Concept

The concept of "Aerotropolis" was coined by Professor John Kasarda, the head of the Centre for Air Commerce at the University of North Carolina. He along with his counterpart Greg Lindsay has published the famous book titled "The Aerotropolis – The Way We'll Live Next".

As predicted by John. Kasarda, whether planned or not the commercial air passenger traffic is bound to increase from 4.9 billion in 2015 to 13.3. Billion in the coming decade, hence this pattern of growth and development is bound to continue which would further add to the need of developing Aerotropolis. (John D. Kasarda, 2011) *"The shapes and fates of cities have always been defined by transportation. Today, this means air travel"* (John D. Kasarda, 2011)

Kasarda views airports as the fifth wave of transit oriented development shaping big cities

in the same manner as that of previous urban clusters but this time around the airports. As depicted in the figure, the idealized description of Aerotropolis is a sub-regional economy where the Airport city is the catalyst for economic development associated with a concentrically expanding mix of clustered uses such as office use and warehousing, residential housing, retail shops, commercial real estate as well as time efficient logistics, industrial development and manufacturing activities and so on. (John D. Kasarda, 2011)

According to Kasarda, one of the main drivers behind the rising growth of globalization is air travel. The fast air travel has shrunk the Atlantic crossing from four days to merely seven hours; it has converted rich man's indulgence of travel of common man's need. It has positively changed the international consultations to not only between elite classes but between engineers, controllers, firms and governments and so on. All this has led to exchange in skills and knowledge, which has further changed the product cycle of every product. The underlying principle of Aerotropolis, as Kasarda explains in his book, "understands where you are in the product cycle, how much value you add, and at the same time how you can harness speed to raise productivity and cut costs".

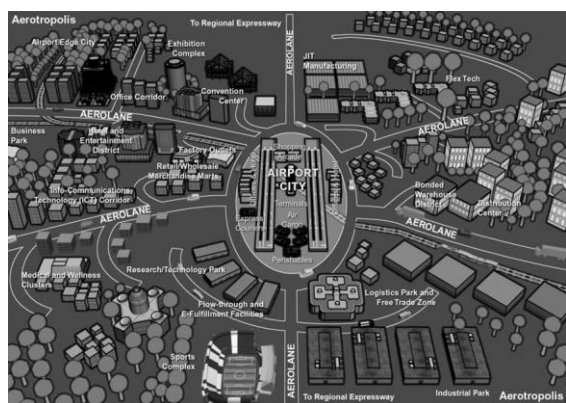


Figure 1 Concept of Aerotropolis as conceptualized by John D. Kasarda in his book "Aerotropolis: The Way We'll Live Next"

Importance of an Aerotropolis

Airports carry a much bigger value than being just an infrastructure for transiting planes, providing commercial and recreational facilities. According to Professor John Kasarda, "The good airline service is a key factor for rapid and organized urban economic development". He explains that airports will shape business sites as well as provide direction to urban development in the new age of urbanism as much as the expressways did in the 20th century, railroads did in the 19th century and seaports in 18th century.



Figure 2 Key Critical Sectors

The development of the airport provides a significant impact to the local and regional economy. Airports are transforming themselves into airport cities and in the process they are having a significant impact on the local and regional economies by providing job opportunities to people of all backgrounds.

With the development of surrounding regions with diverse economic activities, the same attracts diverse professionals from varied backgrounds boosting the overall economy. The airports act as a nodal activity centre for even the non aeronautical services sector which directly or indirectly serves the airports or aeronautical sector making it an important activity centre. An airport is the city's first and last impression. An innovative and distinguished

airport further develops a brand image of a city and thereby acts as a crucial asset for further growth and development of infrastructure and economic development.

Hence today in majority of cities of the world, entire city or functional suburbs are being developed around the airports with the concept of aerotropolis.

Hierarchies of Airport Development

There are varieties of urban related concepts associated with the urban regional and airport centered planning. The most widely used are the 'Airport City', 'Airport Corridor', 'Aerotropolis', 'Airea' and 'AeroScape'.

The **Airport City** is an integration of a well planned airport precinct with real estate development where the core city houses both the aviation and non aviation services and whose economy is highly interdependent. Guller Guller explains that airport city planning is an unusual planning task where it is not only a 'technical airport planning' but it also includes aspects of an urban planning process. (Guller, 2003) The airport city could be both privately and public developed and at the same time could be managed by airport authorities.

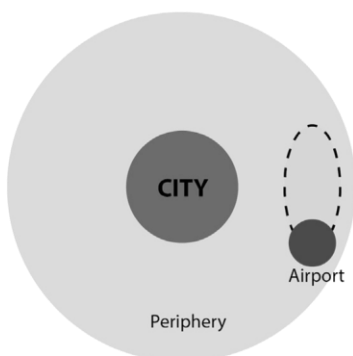


Figure 3 Airport City Conceptual Diagram

As defined by Schaafsma (2008), the **Airport Corridor** is the one which is the part of the

corridor connecting the airport to the host city. The airport corridor acts as a hub for business parks and headquarters, with the sectors of banking, travel agencies and ICT being dominant as compared to the other sectors. Few of the examples of airport corridors can be evident at Amsterdam Airport Schiphol and Zurich Airport.

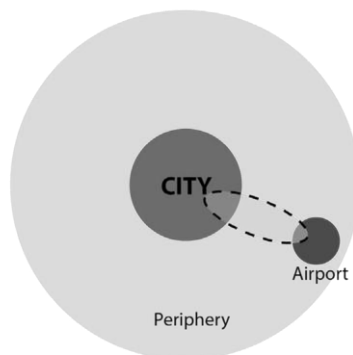


Figure 4 Airport Corridor Conceptual Diagram

An **Aerotropolis** could be defined as a metropolitan sub region where the layout, infrastructure and economy are centered on an airport which serves as a multimodal 'airport city' commercial core. (John D. Kasarda, 2011) (Kasarda, 2013) The regional development of an Aerotropolis can stretch from 2 to 60 kilometers from the main airport core towards the city. Thus the aerotropolis represents a coordination of land use, infrastructural elements, as well as spatial planning outside of the airports which refers to the fact that the aerotropolis extends far beyond the fence of airport.

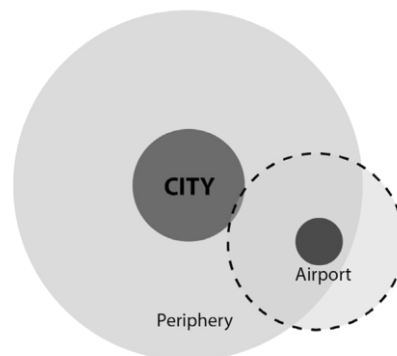


Figure 5 Aerotropolis Conceptual Diagram

The **airea** refers to a much broader metropolitan area rather than just a airport centric development. The airea is an urban fabric comprising of mixed use development which are either directly or indirectly related to the airport as well as each other.

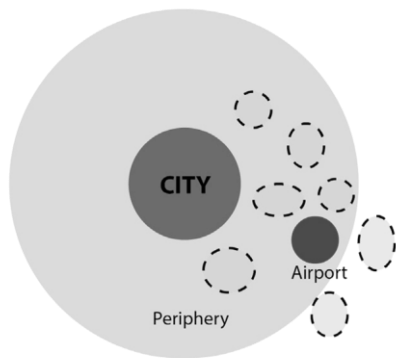


Figure 6 Airea Conceptual Diagram

2. CASE STUDIES

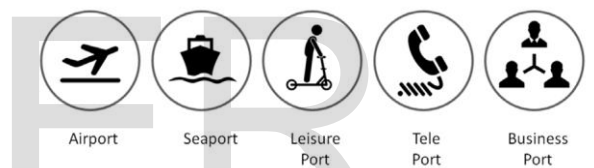
Incheon International Airport

One of the most ambitious airport city and aerotropolis of today is being developed at South Korea's Incheon International Airport. At the core of the aerotropolis is Air City, a set of multimodal mixed use complex is being developed consisting of retail and commercial areas, business parks, high end office buildings, logistics, ICT functional spaces, recreational and leisure activities, exhibition center and conference halls, high tech assembly halls as well as new mixed use residentially dominant towns. All these major facilities are further connected to the main city through public transport (A high speed commuter rail line) as well as expressways for private transport connectivity.

The airport area of Incheon is approximately 15,000 acres which is considerably larger than most of the airport areas in Asia. Its new master plan has mixed use development evolving

through three phases. The first phase which is already developed consisted of Airport Support Community which included aviation related industries, commercial and business services, as well as permanent and temporary housing for employees working at the airport. The second phase focuses on expanding this airport support community into an International Business Hub of about 360 acres comprising of four office complex structures, exhibition and expo facility and international level hotels.

The third and the most ambitious stage is a complete aerotropolis which will be integrated with an extended International Free Enterprise Zone (IFEZ). The IFEZ is being developed and promoted as a "Pentaport" – A combination of seaport, airport, teleport, leisure port and business port.



Yeongjong Island

Yeongjong Island is the Air City with focus on airport oriented facilities, office functions, exhibition facilities, leisure activities, tourism and recreation. The other major key developments include 384 acre water park, 250 acre fashion island and Universal Studios. The fashion island is believed to be developing at a cost of \$1 billion as the fashion Mecca of entire Asia.

Songdo Island

The new Songdo City will act as the second urban growth pole of Incheon Aerotropolis which is being developed from scratch on a completely reclaimed land.

This 1500 acre project is considered to be the world's largest private development project with over 15 million square feet of office and commercial space, providing housing facilities to more than 9000 residences, along with the

facilities of convention centre, luxurious golf course, central green park, a five star medical facility centre and an international school for children.

From the beginning of the Air City project, the Korean government has been actively soliciting private sector participation and foreign investment by providing subsidies.



Figure 7 Incheon International Airport MasterPlan 2050

Schiphol International Airport

Schiphol ranked to be the 14th busiest airport in the world; it is one of the most important European airports. It is also ranked 16th busiest in terms of cargo tonnage and at the same time 6th busiest in terms of international passenger traffic. (Zamanov)

Amsterdam Schiphol Airport is the main international airport of Netherlands, which is located 9.1kms away from the main city that is the municipality of Haarlemmermeer. The facilities and services at Amsterdam Schiphol International Airport are considered to be finest in Europe with wide range of commercial services like restaurants, shops and bars, as well as leisure and tourism activities and so on. The Airport's shopping center stocks a wide range of world class brands, which provides a wide range of choices to the travelers at reduced cost due to duty free shops.

The airport at the same time is very well served in terms of transportation infrastructure. The

train station located underneath the airport; have trains going directly to the city centre as well as the other parts of the city. Along with that, there are direct international trains, the one going to Brussels as well as Paris which stops at the airport station providing the commuters easy access to many cities around.

The airport city of Amsterdam was developed with the main vision of encouraging the development of foreign and local investment, innovation, industrial development as well as global competitiveness. The development has led to creating of new employment opportunities and at the same time retaining existing employment conditions, increasing city's tax base and above all improve the quality of life of people living in the city of Amsterdam.

The developers define Schiphol Airport as a dynamic metropolitan area providing travelers and airline operators all the services possible all throughout the day without going to the main city centre. The airport is developed as an attractive environment for multinational companies, offering a huge variety of high quality real-estate in the form of offices, industrial remises and logistics facilities. (Zamanov)

The four main long term goals on which the aerotropolis is being developed are:

1. Connectivity and network

The main idea is to ensure the future surface and aviation regionally as well as worldwide, such that Amsterdam Airport Schiphol can continue to facilitate the extensive network of frequencies and destinations in the future.

2. Brand Value

The city airport and the surrounding city aims to provide its users that is the passengers, airlines and others an attractive and high quality environment at affordable prices, there continuing its brand image as Europe's

preferred airport.

3. Competitive Marketplace

Providing an attractive working and business environment, and at the same time providing services for shopping, meeting, exhibition and recreational activities.

4. Industrial and Logistics

Developing of industrial complex and logistics hub; taking into consideration the existing and future development trends thereby safeguarding and improving the airport cities competitive position. (Zamanov)

Memphis International Airport

Memphis enjoys its strategic location on the inland waterway system, 640 river miles north of New Orleans and 400 miles south of St. Louis and at the same time processes the 4th largest inland water port in the U.S. Along with this, Memphis is also central in the national rail network, which is served by five class 1 railroads. Given its central location both in terms of surface and water connectivity, Memphis is pivotally positioned in the nation's important nodal point.

The planning area comprises of an approximately 50 square mile target zone surrounding the core Memphis Airport. The airport city boundaries has few key elements which makes it an important landmark in America, including Memphis International Airport, The FedEx World hub, the BNSF terminal, Graceland and many logistics and bio-medical firms.

The Memphis Aerotropolis is built on three main the economic pillars that are logistics, tourism and Medical services. Owing to its image of being America's important distribution center due to its geographic location, its prominence lies in logistics. Tourism is second

key component of the regional economy of Memphis. Memphis today boasts more than 50 tourist destinations. Lastly, medical and health services have been a part of region's economy since decades. The new upcoming industries in Memphis are also getting developed which are directly or indirectly linked to bioscience sector that hold immense potential do Memphis.

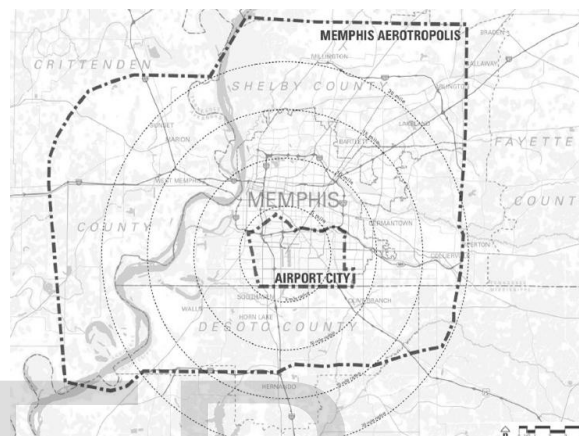


Figure 8 Memphis International Airport location in reference to the core city

Owing to the above reasons, airport linked development is a strong point in Memphis's regional economic, social and physical development. The development around the airport area is predominantly mixed use development where industrial sector and parcels are interspersed with residential areas. The aerotropolis developed around the Memphis International Airport is more organic as compared to the other planned and organized aerotropolis developments.

Memphis Aerotropolis leveraged on the strategy of capturing more benefit from the existing resources. The following were the strategies adopted for its further development:

- Developing the adjoin land parcels to meet the contemporary business needs and at the same time rejuvenating the existing airport area.

- Developing the region's human capital by leveraging on the local labor supply so as to improve the overall employment.
- Increasing the interaction between the land use, transportation planning as well as the economic development thereby increasing the overall functional efficiency of the region and hence achieving the neighborhood livability.
- Providing services and recruiting international firms that will increase the skill ladder up of the entire region.
- Creating of an organization that will establish priorities for action set targets, measurements as well as achieve measurements of the specific area based on the vision set for the area development.

4. PROPOSAL FRAMEWORK

4.1 Background Study

India's promising economic development has led to an overall rise in the income rate of the households thereby leading to an outburst in demand of air travel both nationally and internationally. As per the statistics, the commercial aircrafts in India increased two folds in four years that is from 2004 to 2007 to about 90 million with the annual growth rate of around 25%. In the period of 2013-2014, domestic passenger using the airport reached over 139 million whereas the international passenger volumes rose by 9% to 50.8 million. (Cresswell, 2015)

Some of the major Indian cities which are already experiencing a boom in air passenger traffic are Chennai, Delhi, Bangalore, and Mumbai. Responding to this mushrooming demand, the Ministry for Civil Aviation has decided to plan and develop more than 500 airports operational by 2020. These 500 airports include both small and big cities, which are thought to be developed either by developing on green field site around new airport or by upgrading/extending the existing built airport. (Kasrada, 2008)



Figure 9 Scenario of Airports in India (Source: Airport Authority of India)

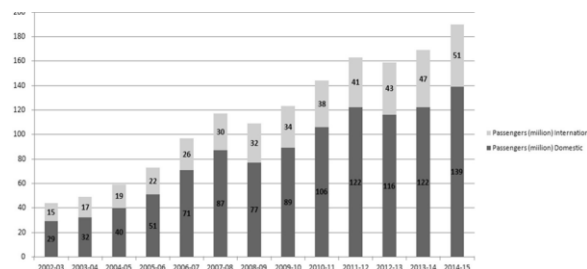


Figure 10 Rate of Domestic and International Passengers in India (Source: Airport Authority of India)

The development of aerotropolis will further help form these developments in terms of aviation linked commercial, business and retail. However, aerotropolis cannot be developed in every small city and ton hence it has to be strategically located such that it receives maximum success rate. One of the key factors determining the success of Aerotropolis is that of air and surface connectivity. Connectivity is further dependent on the economies served by the airport and the frequency of service to those markets.

The two major cities of India, that is Delhi and Mumbai currently have highest number of passenger flows and acts as a gateway to the nation.

Delhi International Airport which spans at over 5000 acres is planned to handle the increasing flow of people in the nation's capital. The latest third terminal is capable of handling 30 million passengers with flexibility of handling more than the projected population.

The departing and transfer passengers will also enjoy a significant complement of commercial

and retail services, as well as leisure and recreational services. Similarly Navi Mumbai International Airport has been passed to be developed into an ultra modern airport with all the modern amenities and facilities of commercial and retail, business and offices as well as recreational services.

However the major problem with the further expansion of aerotropolis in both these cities in that of land availability; which can be solved by determining a city connecting these two cities and at the same time providing equal opportunities for growth and development of economy.

Aviation Scenario in India	Future Aviation Growth – India	Government policy Initiatives support for aviation
<ul style="list-style-type: none"> •World's ninth largest civil aviation Market •Passenger traffic more than 223 million (2015-16) •Last two years have witnessed 12.5% and 17.6% passenger traffic growth •Ranked 4th in the world in terms of Domestic Passenger Volume. •Total freight traffic handled 2.7 MT in 2015-2016. 	<ul style="list-style-type: none"> •India is expected to be third largest aviation market by 2020. •The travel and tourism Industry to grow is estimated to grow US\$270 million by 2023. •The use of advanced air navigation technology is expected to grow in the coming future. •The ministry envisages of developing 100 low cost airports. 	<ul style="list-style-type: none"> •100% of Foreign Direct Investment for Greenfield airports. •Regional Connectivity scheme is launched to cater to the underserved routes. •Plans to make India as one of the biggest MRO hub in the coming future which will further lower the operating cost of the airlines.

Figure 11 Source: Airport Authority of India

4.2 Site Introduction and Analysis

The state of Gujarat has always been leading and has acted as a growth engine of India, housing variety of major industries, many SMEs as well as international companies. The factor of having subsidized rates of setting up business in the state as well as industry friendly environment it has overtime attracted a very vibrant industrial cluster, estates as well as economies. (Quickonomics, 2015)

With the state being one of the leading industrial states in India, with 5% of the nation's population and 6% of the land mass, Gujarat accounts for 7.6% of the country's GDP ranking 4th in the country. (Economist, 2015)

Of all the cities in the state, one of the most promising cities in terms of social, economic, and political development is that of the city of Ahmedabad which is the seventh largest

metropolis in the country and largest in the state. The city is considered to be 'The Manchester of India' owing to its economic and industrial importance in the country.

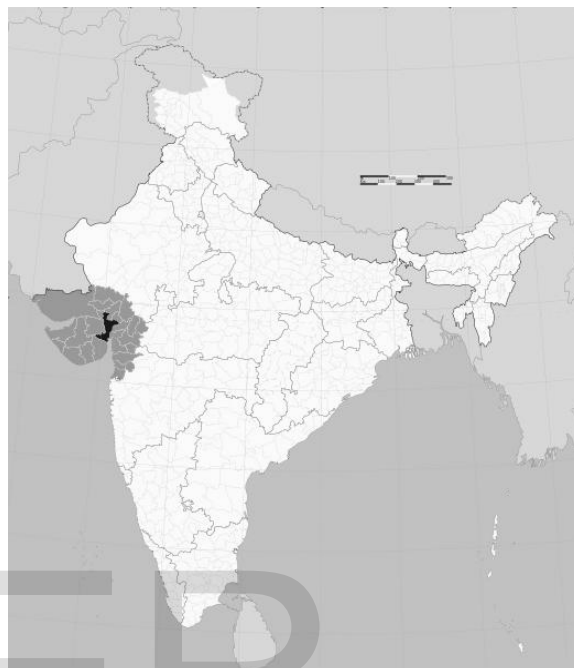


Figure 12 Source: Maps of India

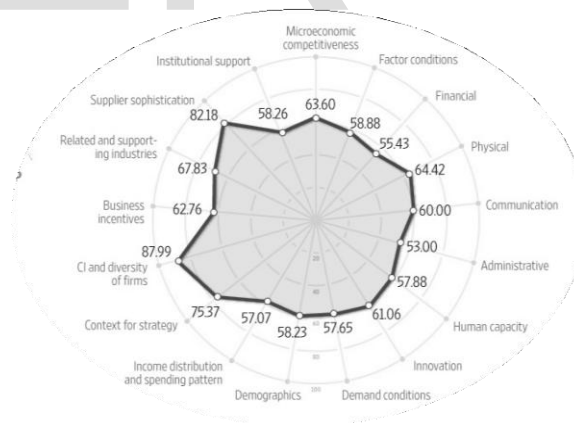


Figure 13 GDP of Gujarat
(<http://www.livemint.com/Politics/XtNLpLNriofzNYBYRI6zsK/Indias-most-competitive-states.html>)

Economy

India's economy will be majorly influenced in the coming decades with the implementation and functioning of Delhi Mumbai Industrial Corridor. The corridor will be connecting two of the

country major cities of Delhi and Mumbai. The main aim of the project is to:

1. Increase the employment opportunities by two folds in a decade.
2. To increase the industrial output in the country by three folds.
3. By doing the above, increasing the region's exports by four folds.

One of the main nodes, in this corridor lies in the city of Ahmedabad which is close to many other economic clusters. Gujarat has the share of around 38% in the entire corridor. As declared by the union finance minister in the budget of 2016-2017, the country's first smart city project that is Dholera Special Investment Region (SIR) and the first international financial hub of GIFT City are two of the key economically boosting infrastructural projects that are upcoming the state of Gujarat.

Both the projects are envisaged to change the economic, social and political face of the city. The zone of influence of both the projects lies in the city of Ahmedabad which will make the city an important future node for further growth and development.



Figure 14 Source: DMICDC Website

Dholera SIR

Dholera Special Investment Region (DSIR) is a newly planned industrial city located south west of the city of Ahmedabad. The region spans over 920 sq. km. of area, which will be developed as a self-sustaining eco- system comprising of economic factors like industries,

logistics and warehousing infrastructure, as well as social infrastructure like health, education and other amenities.

All this services would be further integrated through a sustainable urban transportation system within the region as well as nationally. It is very well connected to the city of Ahmedabad by a major expressway and metro line.

The cluster would be developed into a mixed use development supporting industries, commercial, retail as well as residential development. The major industries supported by DMIC would be Aviation, High-tech industries, defense, Engineering, general manufacturing, Agro and Food Processing, Metallurgy, and Biotechnology etc are some of the key sectors identified taking into consideration the existing industries.

The cluster along with the entire corridor will boost up the employment opportunities, attract new businesses and at the same time increase connectivity in the region.



Figure 15 Source: DMICDC Website

Gujarat International Tech-City

GIFT city is approximately 12 kilometers from the Ahmedabad International Airport which will be developed as a global financial hub for national and international financial services

which will serve as a catalyst for development in terms of Infrastructure, Quality of life, economic growth as well as optimum utilization of land parcels.

The GIFT City has been decided to be developed in three phases each getting developed in the scales of 10 million square feet, 20 million square feet and 30 million square feet respectively in Phase 1, 2 and 3. The commercial zone will basically house several office and retail centers, international hotels and local shopping facilities. The residential cluster will be developed closer to the work space so as to establish to walk to work concept among the people living and working in the city. Along with it, the city will include social infrastructural facilities like that of education, health care as well as recreational facilities. First of its kind in the country, the city is envisaged to house approximately 30, 00,000 people and at the same time will be developed as an international financial CBD conceptualized as global financial and IT service hub.



Figure 16 GIFT City Master Plan (Source: Gujarat Board of Infrastructure)

The two cities of Mumbai and Delhi although being important economic centers in the country, the lack of land availability as well as high infrastructure cost, and the cities would fail to absorb further development around the airports.

The main aim of developing these economic clusters near the city of Ahmedabad is to provide for quality infrastructure so that financial and tech firms, industries as well as other businesses and multinational companies can relocate their operations here from the major cities where infrastructure is inadequate or very expensive.

Ahmedabad



Figure 17 Location of Ahmedabad (Source: Maps of India)

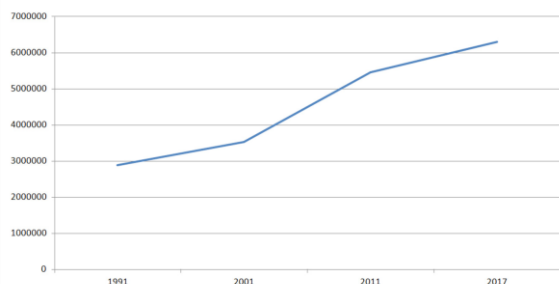
Ahmedabad, the largest city in the state of Gujarat lies on the banks of the river Sabarmati, which enjoys its central position both in terms of geographic as well as economic importance.

The city is well connected by rail, roads as well as airways with all the major important cities of the country. It is the seventh largest city in the country with an area of approximately 190 sq km. The city lies in the north part of the state of Gujarat hence being close to the other states of Rajasthan and Madhya Pradesh.

The city is one of the most industrialized and urbanized city of the state. In 1991, 75% of its population lived in urban areas. In 2001 the population of the city increased to 4.5 million in a decade from 3 million experiencing rapid growth in the population and density in the city area.

The overall economic growth of the city has

been comparatively robust with the increasing growth rate in the manufacturing and service sector industries. Census data for 2011 revealed that 60% of the main workers in the city were concentrated in two activities, 35% in manufacturing sector while 25% in trade and commerce.



The city has predominantly been an industrial city with large scale cotton textile industry as a base to its economy. The entrepreneurial environment in the city has been largely also based to cotton textile industry by founding the industries related to this field. The sector generates nearly half of the employment of industrial sector in the city. Although the city continues to be dominated by the textile industry, the city has also created infrastructure for industrial development in other sectors thereby attracting the other small and medium scale enterprises related to engineering, chemicals, pharmaceuticals as well as medical services.

The new industries that have started gaining prominence in both the state as well as the city are plastic, petroleum, rubber, machinery, metallurgy, medical and health care related services, coal and petroleum and so on. The city today employs more than quarter of the total employment in the state which clearly suggests that the city has large scale scope of attracting and developing new businesses. (Bhatt, 2003)

Ahmedabad International Airport

Ahmedabad's Sardar Vallabhbhai Patel International Airport is located approximately 9 kilometers to the north east of the city with combined facilities of national and international terminals. It is very well connected with frequent flying planes to the other cities like Vadodara, Mumbai, Chennai, Bangalore, Hyderabad, Calcutta, Goa, Pune, Kolkata and Jaipur. The international terminal is also equally well connected to major important countries of the world like USA, France, England, Japan and China.



Figure 18 Ahmedabad Airport and City

At the micro scale, the land area surrounding the airport is under the government authority. The area is occupied by numerous residential and industrial use buildings which are today in dilapidated conditions.

The southern part of the airport is occupied by the military area whereas the eastern part has some of industries related to cotton textiles, metallurgy and machinery and so on. The area surrounding the airport also has two educational institutes which support the people staying in the area.

The current existing industries surrounding the airport are mainly in the field of:

- Textiles and Apparels
- Large Scale Plastic Manufacturing
- Telecommunication Industries
- Logistics and Warehousing

There is also varied different green open space which acts as a buffer zone between the industrial and residential land use.

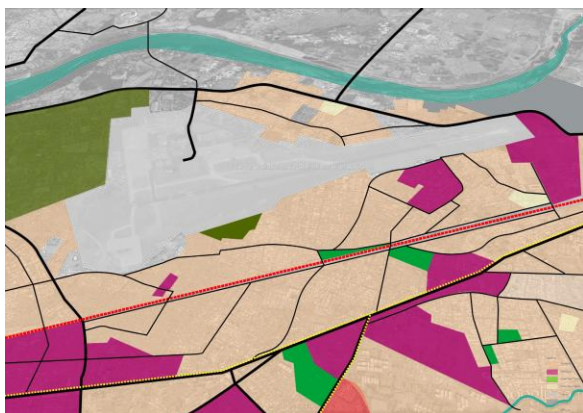


Figure 19 Ahmedabad Airport's surrounding landuse

Site Selection

The key factors taken into consideration for selecting Ahmedabad as the site of intervention for developing the first Aerotropolis in India are:

1. Increasing air passenger and cargo flow

The number of air passengers and cargo flow in Ahmedabad has been constantly on the positive graph owing to the increase in demand and need. Ahmedabad being one of the most important airports in the western region of the nation, the air passenger flow is further envisaged to increase further in the coming decades.

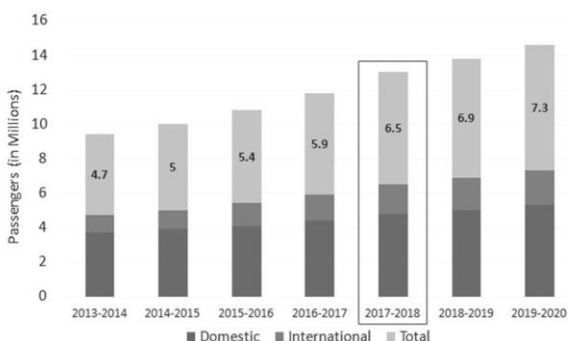


Figure 20 Passenger Traffic flow (Source: AAI)

2. Proximity to GIFT City and DMIC Corridor

Two important economic clusters, first of its kind in the country has been one of the key

factors through which the state predicts to have a boost in terms of population flow, inflow of multinational companies as well as economic gains in the city. Following the trends, the major entry point in the city could be through airport.

3. Land Availability

The land surrounding the Ahmedabad airport is under the government authority thus land acquisition would not be a hurdle for development of aerotropolis which however is a major issue for most of the cities in the country.

4. High Dense Development in the City Core

The core city of Ahmedabad is already a high dense development due to which the government is planning to carry out the further development in the periphery of the city area. The airport is in the periphery of the city, thus the development could be further planned and organized so as to carry forward planned growth around the airport area.

Potential

Connectivity

- The airport is well connected to many major cities of the world. In 2016, the airport handled over 7.3 million passengers and about 150 airplane movement per day, ranking eight busiest in the country.
- The city currently has a BRTS route as well as local railway passing from near the airport which connects directly to the city centre.
- The airport is also well connected in terms of expressways and street network, towards both the main cities of the state that is Ahmedabad, Gandhinagar, Surat, Vadodara, Bharuch and Dholera.

Sustainable Development Context

- The Airport authority is already in plans of expanding the airport in such a manner that it would house the business activities and other commercial and retail services in the airport itself.

- The surrounding land being under the ownership of government, it is possible to have development and thereby avoiding the delay through land acquisition.
- Sustainable development in terms if further development in the airport city will further enhance the built environment in the area.

Economic Potential of the Hinterland

- Strong existing local and regional economies in the city will help to create a strong base for the new developments.
- The large base of skilled and unskilled laborers will help to further make the development more sustainable by generating city and national level employment opportunities.

4.3 Vision and Objectives

Vision

“The aerotropolis to be developed around the Ahmedabad International Airport is envisioned to be a destination for living, working, shopping, playing and learning - a self sustained urban community providing high quality of life. This vision aims to make the development of the aerotropolis as a vital business, optimise the land value, offer to the local residents multiple lifestyle choices and ensure a sustainable operation of the airport city.”

A home for the people

The aerotropolis region will house residential areas offering high quality of living. The population will help the airport city to become self-sustained by creating a critical mass for commercial, retail, business and service provision like health and education. With a generous variety of housing typologies across different precincts in the aerotropolis - providing people with healthy options to choose from.

The master planning of the airport city will be carried out in such a way that it will take into

consideration various aspects to ensure of high quality of life - ranging from education to employment and even open space provision.

A business Hub for 21st Century

The aerotropolis developed will be a modern, vibrant business hub which offers a strategic location with highest accessibility to local, regional an international market via physical and digital connections. The airport city's will act as an employment hub, which will comprise of ample of office space, alongside educational institutes and enabling amenities such as transportation hub. This creates a synergistic core attractive to businesses and investors alike.

Tourism

The aerotropolis will be developed as an important landmark supporting varied tourism related activities. There are a large number of tourism sites already in the state, improving the connectivity to these destinations from the airport will strengthen the tourism in the state.

A hub for Education and Innovation

Development of a knowledge and Creative District will be equipped with an international higher education institute and a training center. Leveraging on the new and existing ecosystem of education, the airport will act as an incubator for start-up businesses and other trading activities.

Development Framework

The development framework for developing of an aerotropolis is focused on the physical and socio-economic aspects which can be fulfilled using the idea of precincts.

The guiding idea is to develop the airport precinct such that it is a self sustainable region where the development carried out are interdependent on another thereby making the precinct lively and active throughout the

day and at the same time encourage interaction among various uses.

The four main precincts in the airport precinct could be further subdivided into economy, tourism, mix use development and Educational services.

Each of the precincts will be further connected through transit network so as to achieve the concept of walk to work.

As shown in the figure 21, the four main precincts are:

1. Economy
2. Tourism
3. Education
4. Mixed Use Development

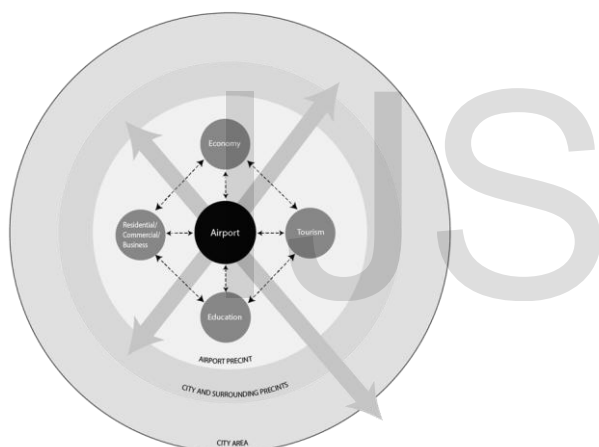
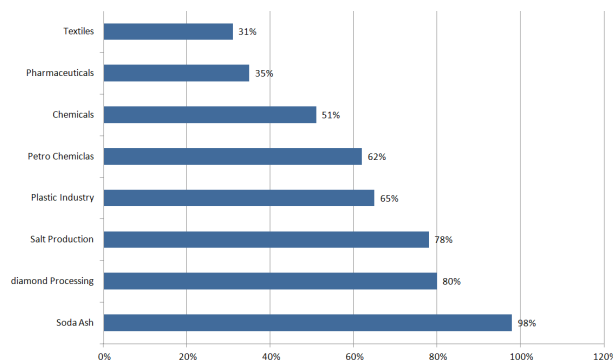


Figure 20 Development Framework

Economy

The city today houses 422 medium and large scale industries with total investment of approximately US\$133,167 million providing employment to around 80,000 people. Similarly the city has around 24,000 small scale industries generating over 10,000 jobs with total investment of over US \$21,000 million. Some of the major small scale industries that are housed in the city are of Chemical, Pharmaceuticals, Engineering, Textiles, paper and Paper products etc.

However the three main booming industries which could be enhanced with further development and the one that could advantage if placed near the airport zone are Gem & Jewellery, Textiles & Apparels and Chemicals & Pharmaceuticals.



India is considered to be the world's largest hub for diamond processing and at the same time is the largest consumer of gold. The global markets for gems and jewellery are estimated to be worth USD 85 million with key markets being in South Africa, USA, Italy and Israel.

Of all the production that is exported from the country, Gujarat accounts for 80% of the total diamonds processed. In short, almost 8 out of 10 diamonds in the world today are processed in the state of Gujarat. The state thus houses several institutes and centers for excellence which offers training to the gems and jewellery industry. At the same time, there is an upcoming special economic zone dedicated to jems and jewellery in Surat which is near to the city of Ahmedabad.

Looking at these factors of potential growth in the field of jems and jewellery, there could be development based on the same. Since large amount of the products are exported through the means of air travel, developing infrastructure supporting the field could be the right direction of moving forward. As

shown by the figure, the state's economy is 80% based on diamond processing.

Some of the basic developments could include Jewellery, special Economic Zone, and Institutes providing training to the artisans, as well as diamond and gold jewellery manufacturing processing centers. With backing on the exiting industries, the new growth should be directed to boost up the industries which has potential but not fully developed to it potential. Such industries are textile and Chemicals which has high potential to be developed and could significantly contribute in the state's economy. As shown by the figure above, each contributes 31% and 51% respectively.

The development oriented towards such sector could be thus in the form logistics and warehousing facilities for storing of drugs, textiles and apparels which could be easily transported further whenever required.

Education

There are varied top ranked and prominent educational institutes in the city providing education in Design, Engineering, Medical, business & Administration and Architecture. The major universities in the city which attract both national and international students are Centre for Environmental planning and technology (CEPT), National Institute of Design (NID), Indian institute of Management (IIM), Nirma Institute of Engineering, Mudra Institute of Communication (MICA) and B.J. Medical College and so on. The existence of such plethora of universities and institutes has further led to the presence of large qualified pool of manpower for various industries.

To support this supply of manpower and young talents, a learning and innovation hub could be developed that will provide infrastructural services and facilities, and enhance this talent and at the same time overcome the problem of brain drain. The learning and innovation hub could be further developed in such a way that it provides infrastructure supporting startup hubs, space for research and experiment and so on.

Medical Tourism

The city today hosts some of the best private hospital in the country such as Apollo Hospital, Sterling hospital, Krishna heart centre and Gujarat cancer society which have the facility and expertise to provide best health care services. At the same time, Ahmedabad is home to the biggest public hospital in Asia named as Civil Hospital.

With the influx of existing medical services and supporting pharmaceutical industries, the government is planning to develop a health care complex which would act like one stop shop for the medical services. The government could develop a MEDICITY in the aerotropolis which would be equipped with all state of the art medical facilities, medical & research institutes and super specialty hospitals. The MEDICITY could also house medical research centers and housing of medical students and staff which would further keep the area active and interactive.



Figure 21: Local Newspaper article showing the government plans to develop medical hub in the state

precincts. As the map shows, the varied precincts that can be developed are:

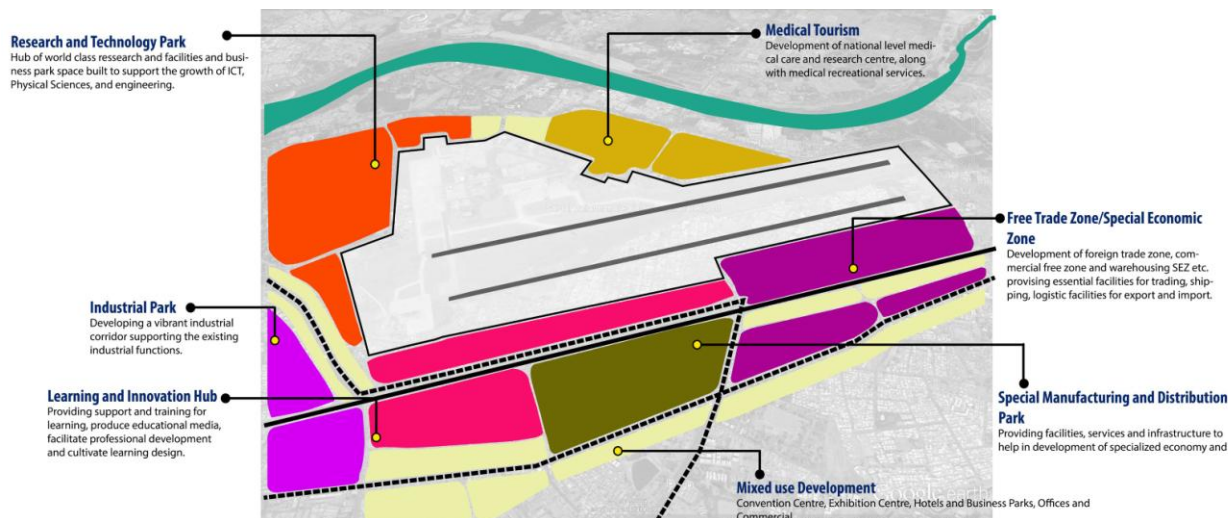


Figure 22 Proposed Aerotropolis Master Plan

Physical Development

The long term plan for the Airport City region is to develop a place for settlement, culture, knowledge and economic transition where technical, social and material flow are complementing the centrally emerging sub-regional economy of the future.

The airport precinct will be a mix of services, facilities and zones so as to promote the interaction of varied facilities and at the same time attract variety of professionals. The key objective is to make the airport and the aerotropolis surrounding it to be attractive to passengers, airline operators, manufactures and supply chain and supporting commercial, retail & business services. Along with the same, investing in supporting public facilities like hotels, exhibitions & convention halls, health and wellness, entertainment, leisure and educational facilities.

For the strategic and planned execution of the airport city, region could be developed in

1. Free Trade Zone/ Special Economic Zone

The free trade zone will be widely developed to attract foreign direct investment (FDI), thereby providing multinational corporations the economic liberty to set up their units in the area. The zone will also allow local industries to set up their units in order to exploit the export based incentives. The major incentives to be provided in the zone will be advanced infrastructure, flexible regulation to accommodate varied economic sectors, convenient location for trading activities and other non-tax incentives. In order to build upon the existing economic background of the city, the free trade zone could house the centers for exhibiting the products related to Jem, Jewellery, textiles and apparels.

2. Learning and Innovation hub

The learning and Innovation hub will act as the brain of the aerotropolis which will be developed in such a way that all spaces are learning spaces and everyone is either a learner or a teacher. The precinct could be developed into a community where teachers, students and entrepreneurs share the same platform. Development of international schools and

and so on.

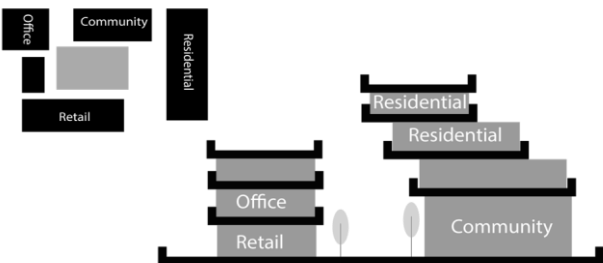
4. Medical Tourism

5. Industrial Park

The Industrial park could also support ramp up industries that can contain different industries at different levels thereby developing infrastructural services which can be shared by varied sector of industries. The industrial park could house warehouses, logistics, distribution centers, chemical plants, food and beverage processors and plastic manufacturing.

6. Mixed Use Development

The mixed development will act as a connecting precinct between all the varied precincts. The



mixed use development will be developed in

3. Research and Technology Park

The research and technology park will be dedicated to enhancing the high technology based businesses and attracting the research communities, which will diversify the economic base of the aerotropolis.

The park will operate as a technology incubator offering space, services and facilities to technology based businesses and entrepreneurs like Labs, offices, Storage and servicing units

such a way that it provides space for residential development, community facilities, office and retail space and services for business development. The area will promote both the vertical and horizontal mixed use development.

Connectivity

The key feature of the airport city will be building on the current transport connections, thereby delivering efficient access and movement of people from one place to the other. Capitalizing on the existing and planned public transport networks and services will help to improve the access that is essential to support the growth and at the same time getting jobs closer to people.

A coordinated approach that will complement the existing proposal will be to strengthen the BRT route by extending the lines towards the main airport terminal and at the same time introducing an integrated airport terminal.

The integrated transport hub would be an integration of both the train and BRTS station which will help to strengthen not only the local connectivity but also the regional connectivity.

The creation of efficient and integrated linkages between each precinct will further make the site more interactive thereby making the entire airport city into a self sustainable precinct.

Here each precinct will act as an individual landmark which will be connected through pedestrian linkage or green corridor.



Figure 24 Connectivity concept - Integrating of Landmarks, Pedestrian and green corridors

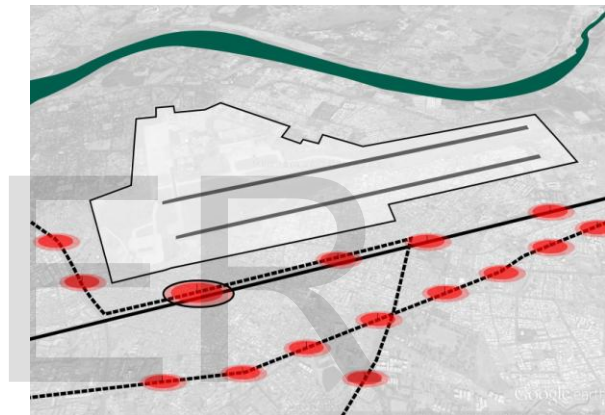


Figure 25 Major Transit stations proposed in the site

5. CONCLUSION

An aerotropolis has over time proved to be a distinctive and a successful city concept which is much more than just a place to get on and off the planes. Although the development of airport cities is still in its earlier stages of evolution, the planning and development are largely based on the existing local and regional development. The new challenge is not of that of developing the airport cities but to design and maintain the future aerotropolis development in such a way that it brings out the optimum returns to all its users and the entire region it caters to.

There have been numerous examples where the airports have turned out to be significant economic nodal points and have revitalized itself into a booming economy catering to the huge area and population. Few of the important examples for the same are Schiphol International Airport (Amsterdam), Memphis International Airport (USA) and Incheon International Airport (Korea). The common aspect in all the three case studies is that already having a strong base of infrastructure and economic structure which helped in further development in the city.

In conclusion, I have tried to understand the basic advantages and challenges of developing an aerotropolis. In terms of advantages Aerotropolis or an airport city becomes a major attraction for kick starting an economy which would further lead to increase in new & existing job opportunities, tourism as well as infrastructure to cater to the same. On the other hand the development of aerotropolis also has lot of challenges to face. The high scale construction and development has a big risk of not being sustainable as the prediction could sometime go wrong. Haphazard development to follow the trend, noise pollution, height restriction and efficient connectivity are also some of the important challenges of the airport city development. The new technologies are however today are focusing on such challenges

which would help to solve these issues in the coming future.

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