A PERCEPTION OF TECHNOLOGICAL ADVANCEMENT IN FUTURE AIRPORT INTERIOR SPACES

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***Abstract*—Airports are one of the fastest-growing modes of transportation in the world. Airport demand is growing because of an increase in passengers and planes; hence interiors are essential in addressing the increase in passenger capacity. Over time, internal spatial planning has evolved, and a few spaces have been added to meet the needs and demands of passengers. Technological advances have been developing gradually for the past 50 years compared to the 21st century. Currently, we are living in a technological era with AI-based technologies. The main aim of this journal is to study the past and present state of airport interior spatial transformation and to have a perception of how future interior spatial transformation will evolve with the help of technology.**

Keywords—airport design, interior, technology, future architecture, Spatial transformation

I. INTRODUCTION

The original airport design is difficult to pinpoint because formal airports didn't develop overnight from unofficial locations like the beach where the Wright Brothers first took off in 1903. The first "airports" were mainly designed for supporting technical operations, therefore they consisted of a hangar or workshop and a field where aircraft could take off and landing. Due to a rapid increase in air travel demand among the general population, airport design had to respond quickly. The passenger terminal was quickly developed to a surprisingly complicated yet simple standard. The first passenger terminals were constructed in the 1930s and 1940s with roughly the same plan and in the Art Deco design that was popular at the time.

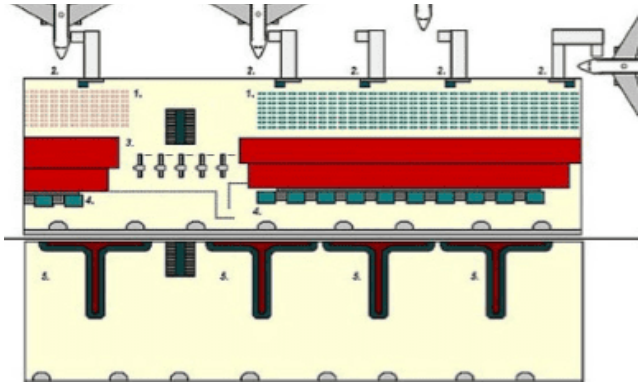

Fig.1. Early airport terminal
(Source-https://en.m.wikipedia.org/wiki/File:Terminal_overview.JPG)

To withstand the rapid increase in passengers and cargo, the terminal is not enough to accommodate the number of users, so the new terminal was designed near the old terminal and works as a combined terminal. Over the years, another terminal also got filled, and then a new concept of multiple terminals was adopted, where the airport had two terminals split based on international or domestic as well as airline traffic.

A. Airport growth

Airports have been expanding at a pace of 4% annually around the globe. The maximum capacity of an airport will be achieved as a result of this expansion in 15 to 20 years, creating the need to build a new airport or several airports in an urban area required.

As an illustration, the new airport in Chennai was moved from Meenambakkam to Tirusulam. To address future demand and land constraints in Tirusulam's existing sites, the design of a new airport in Paranthur was planned.

B. *Demand pattern*

A specific airport's capacity is directly influenced by the city it serves, including its population, revenue, commercial activity, and level of tourism. Due to the consumption of items shipped by air, the population has an impact on goods transportation as well. These and other factors all play a role in the demand for increased air travel.

II. TRADITIONAL SPACES

The primary areas include the lobby, check-ins, immigration, and boarding gates. There are two categories for the interior spaces of the airport. The secondary areas will depend on the terminal's capacity and include amenities like hotels, retail stores, and recreation areas. The airport generates 40–50% of its revenue over time through supplementary spaces.

A. *Lobby*

Lobby for the terminal Passenger ticketing, visitor waiting, baggage check-in and claiming are the activities which are significant to an air passenger and are carried out in

Fig.2.Combined lobby area.

(Source-https://commons.wikimedia.org/wiki/File:Guangzhou_Baiyun_International_Airport_Terminal_1_Departure_Lobby.jpg)

a terminal lobby. These operations generally take place in a single lobby at airports with fewer than 100,000 yearly

enplanements. Separate lobbies for all of them usually appear in larger airports. The amount of waiting rooms for passengers and visitors, the separation of the ticketing and baggage claim lobbies, and the level of congestion all affect the size of the lobby area.

B. *Check-in*

security check; for arrivals, immigration for non-citizens is the only activity that takes place.

- The real check-in: You must confirm the airline to inform them that you want to take the aircraft. (optimum time takes for check-in and baggage drop- 10-20 mins)
- give your luggage to the ground service workers. Once tagged, the luggage will be dispatched. Please make sure your luggage does not exceed the allowable weight and dimension restrictions. When you reach your destination, that will be the next time you see them.
- Before you depart, verify your boarding pass and get ready for the security check. The passenger is prepared for boarding following a comprehensive body check and hand luggage inspection. (optimum time takes for security check - 5-10 mins)

Fig.3.Check-in and baggage drop.
(Source-https://www.timesofisrael.com/tourism-minister-eyeing-ailing-sector-demands-compensation-plan-as-gates-close/)

Fig.4.Security check
(Source-https://abcnews.go.com/US/biometric-scans-checkpoint-future/story?id=46200267)

C. *Airport rental- a critical revenue stream*

The duty-free market got its start when airports needed a different way to make money. When the first duty-free shops debuted in 1947 at Shannon Airport in Ireland. Since then, duty-free, and travel-related retail has grown to be a very profitable global industry and a crucial part of airport funding is based on two major revenue streams: aeronautical revenues from airlines and passenger fees; and commercial earnings from other airport-related operations.

The ACI economics report states that such commercial revenues account for an average of 40.4% of global airport revenues. Duty-free and travel retail are often the two most significant revenue sources among these.

Airports need a waiting room, in the beginning, to handle the influx of passengers before they board the flight. However, in recent decades, there has been an increase in the demand for luxury, leading to the transformation of traditional spaces and the introduction of new ones. example the waiting area has been converted into lounges, which now include a small game room, a buffet, and a work area.

Fig.5. Early airport lounge.
(Source- https://www.thenationalnews.com/world/uk-news/2023/04/26/heathrow-making-a-loss-even-as-passenger-traffic-takes-off/)

D. Immigration on arrival

Fig.6. Arrival Immigration Dubai. (Author)

Immigration, a baggage claim area, and visa on arrival (depending on country regulations) are all present during international arrival. The optimum waiting time is around 5- 10 min.

III. CONVENTIONAL SPACES

Every change made in this era has been driven by technological development, which also applies to the development of airport interior spaces. but most importantly, every development or innovation in the interior has only just begun to be tested, or it depends in part on technology.

A. Self-check-in kiosk

The majority of airports now offer self-check-in kiosks, which are partially used by the general public, and most of the kiosk area is used with airline assistance.

B. Self-baggage drop

The self-bag drop option from Rockwell Collins offers our passengers the services they require to make their travel as simple and hassle-free as possible. Queue times have fallen from 20 minutes to 5 minutes since the first phase of 32 kiosks was put into operation. This, in turn, has caused transaction times to decrease from 2 minutes to 35 to 45 seconds.

Fig.7.Self Check-in
(Source-https://www.aai.aero/en/airports/passengerinfo/pune/Conveniences)

Fig.3. Self-baggage drop
(Source-https://www.businesstraveller.com/business-travel/2021/09/13/heathrow-trials-touchless-bag-drop-technology/)

Fig.8.Face recognition immigration in Japan.

(Source- https://disruptive.asia/automated-facial-recognition-gatest-japan-airports/)

C. *Biometric immigration*

The use of biometrics, e-gates, electronic passports, and automated border control is being implemented to improve the immigration and arrivals experience.

IV. EVOLUTION OF AIRPORT RENTAL SPACES

Previously, the airport's rental properties simply had a café, minibar, and lounge. The significant upgrade only occurs when the number of linked flights increases. Changi Airport and DXB in Dubai are two excellent examples. A greater number of places are required for their needs for leisure, lodging, shopping, and even workspace at DXB, where 40 to 50 percentage of passengers annually are connecting travellers.

Fig.9.VR at Emirates Lounge.
(Source- https://www.futuretravelexperience.com/2018/04/etihad-emirates-aviapartner-virtual-reality-airport-lounges/)

Fig.10. Sleeping pods.

(Source-https://thewest.com.au/news/travel/perth-airports-to-test-sleeping-pods-for-international-travellers-ng-b881045568z)

A. *DXB Dubai International*

- Over 100 airlines and 260 destinations are supported by DXB globally.
- Growth: DXB is among the largest and fastest-expanding passenger and cargo hubs in the world. According to Airports Council International- ACI, DXB is the top airport for foreign travellers.
- The world's largest duty-free airport shopping centre is located at Dubai Airport. The airport breaks yearly sales records every year by almost AED 7 billion!
- Throughout its Terminals are the numerous Duty-Free shops. This gives you access to top-notch shopping, which will keep you occupied while you wait for your connecting flight. Buy everything you can!
- You can rest in the Dubai International Hotel if you're worn out from your lengthy travel. There will be luxurious amenities. This hotel is located at Terminal 1 and has amenities like a meeting room, restaurant, and pool.
  In its Snooze Cube hotel, the hotel also offers modestly sized rooms. You may use the free Wi-Fi, take a shower, and get some shut-eye for only sixteen dollars. The staff will wake you up if necessary, so you don't have to be concerned that you'll miss your connecting flight.

Fig.11.Zen Garden in Dubai International Airport

(Source-https://www.alamy.com/transit-area-dubai-international-airport-united-arab-emirates-image152283501.html)

Fig.12. Aerial view of Changi Airport.

(Source-https://www.archdaily.com/575693/safdie-architects-design-glass-air-hub-for-singapore-changi-airport)

B. *Changi Airport, Singapore.*

A lifestyle gateway for the airport, called Jewel, was unveiled by Changi in April 2019. The enormous structure in the shape of a doughnut is situated between the control tower & terminal 1. The glass and steel dome which makes up Jewel was

constructed over the course of over four years and cost $1.25 billion. Here's a glance inside the facility that makes layovers more enjoyable, which is a mix of a luxury mall and an indoor rainforest.

- The new $1.3 billion complex features a 130-foot indoor waterfall at Singapore's Changi airport.
- Fig.5. Arrival Immigration.
- The glass dome houses the 130-foot-tall indoor waterfall that is the tallest in the world; all the water is collected from rain.
- Additionally, there are 280 stores and restaurants, an IMAX theatre, a grocery store, and a hotel.
- For the seventh year in a row, Skytrax named Changi Airport the best airport in the world.

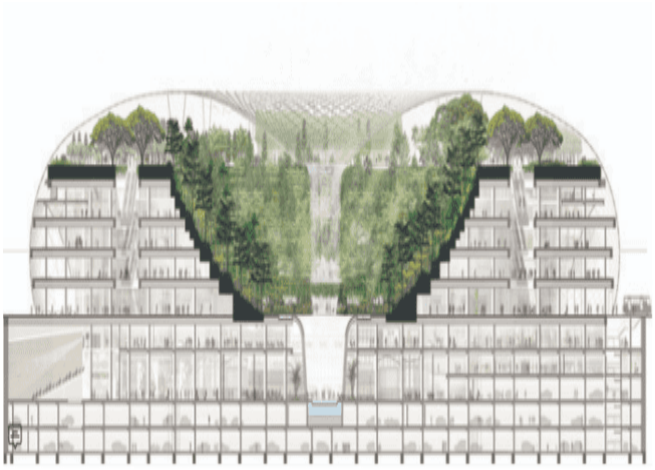

Fig.13. Section of Changi Airport.

(Source-https://www.archdaily.com/575693/safdie-architects-design-glass-air-hub-for-singapore-changi-airport)

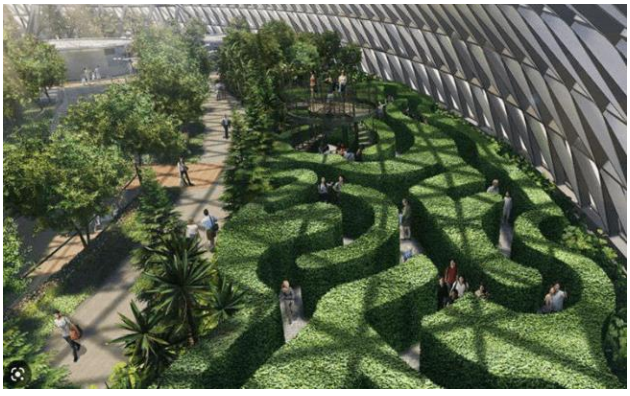

Fig.14. Maze Garden in Changi Airport.

(Source-https://www.forbes.com/sites/bishopjordan/2018/03/24/10-best-airports-in-the-world-singapore-jewel-changi/?sh=76517ce36a0e)

V. RESULTS

A. The Future Airport

The future airport could be more dependent on technologies; for example, the two spaces could be combined to become a hybrid space, which could be more effective in saving space and, more importantly, reduce passenger queuing and minimize the optimum time of all check-ins and even security checks. When a space has frequent movement throughout the process, it could withstand several more years, and the life of the terminal is increased because we don't need to move for the new terminal. It could also contribute to a sustainable environment by making spaces more effective over time.

B. Hybrid kiosk (check in- Baggage drop)

Emirates utilises the hybrid kiosk at DXB Dubai International Airport. Initially, they only used it for flights to Gulf nations; it is not available for flights to China, India, or the United States. They are currently in the trial phase; if it is effective, it may also apply to all airlines, and once it is put into use, the spatial need will be adjusted.

C. Smart gate (immigration)

Biometric scanning, facial recognition technology, and e-passports are all part of smart immigration, enabling smooth transit.

Fig.15. Arrival Immigration.

(Source- https://www.biometricupdate.com/202112/contactless-biometric-immigration-checks-roll-out-in-hong-kong)

Fig.16. Emirates hybrid kiosk.

(Source- https://www.arabianbusiness.com/industries/transport/emirates-says-massive-in-bound-flights-surge-use-digital-check-in)

D. Airport is not just an airport anymore

Airport designs are not just the airport anymore. They have added more leisure spaces focused on improving the passenger experience and entertainment spaces (theatre, mall, hotels, gardens, etc.) during the waiting hours before boarding and the transit passengers waiting for their connecting flights, and it improves the airport infrastructure, and also contributes to the economy of an airport (DXB and Changi airport terminal) .so this kind of passenger-centric amenities has major scope in future airport designs.

VI. CONCLUSION

In the future, the airport could be dependent on technology, and the traditional spaces could be completely faded out or replaced by new technologies. The spatial requirement could be AI-based security systems and hybrid kiosks (a combination of check-in and baggage drop), passenger-assisting robots, and smart gateways for immigration where there is no need for passengers to queue and the spaces will be free-flowing. But this could be more possible when airport operations are controlled under a single domain. This could make airport operations so quick, and it could make the airport more efficient over the years.

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