FUTURE OF AIRPORT SECURITY

ACI Asia-Pacific Young Executive of the Year 2020

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Introduction

The Aviation Industry contributes immensely to the World's economy with the overall economic impact of USD 2.7 Trillion in 2018 which is equivalent to 3.6% of the World's GDP. In 2018, around 4.3 billion passengers travelled by Air, 58 Million Tonnes of freight carried by Air, 65.5 Million jobs supported by the industry, 38 Million scheduled commercial flights flown by 1,303 Airline Companies and served by 3,759 Airports.

This high potential and fast-growing industry's strength are well-developed Airport Infrastructure. Airports, being the backbone of the Aviation Industry are a major part of a country's infrastructure and play a prominent role in the economic development of a region, and the nation. They are heavily crowded with passengers and employees and are considered as prestigious assets of a country, hence, they are vulnerable to diverse transgressions, ranging from petty crimes, such as theft of passenger property to complex acts planned by organized criminal groups and terrorists. To protect the Airports from these crimes, the Airport Security should review the existing gaps and strengthen its services timely. Parallelly, the rapidly growing Air traffic demands high level of operational efficiency at Airports coupled with the ever increasing expectations of passenger experience.

This research paper attempts to comprehend the importance of security in Airports through the diagnosis and analysis of the current Airport security situation across the world and highlight the challenges faced. Building on the results from this analysis, the paper addresses present-day challenges faced by Airport Security with references from case studies. Based on these insights, a framework and security solutions are proposed which can be applied commonly at Airports for strengthening the security, increasing the operational efficiency and improving passenger experience. This paper also emphasizes on ACI's smart security initiative by suggesting innovative ways for the "Future of Airport Security".
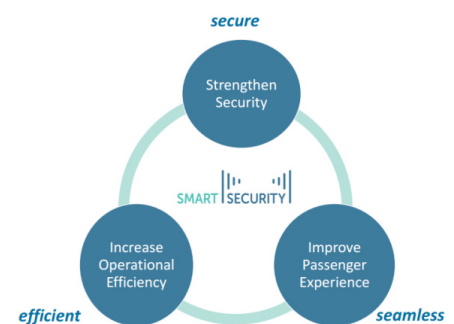
Source: ACI

Security and its criticality in Airports

According to ICAO, Annex17 to the Chicago Convention of International Civil Aviation, Security is defined as **"Safeguarding civil aviation against acts of unlawful interference. This objective is achieved by a combination of measures and human and material resources"**

While Airports control international borders, they facilitate the movement of people and critical cargo across borders as well as within territories. Multiple internal and external stakeholders such as airlines, ground handlers, tenants, passengers, government authorities, local communities, and suppliers do business in and around the airport. They are considered as highly critical infrastructure for the development of a nation. This has led to the attraction of the miscreants and terrorists, who challenge the safety of passengers, employees and critical assets. Attacks on airports give terrorists the symbolic value they seek and guarantee the attention of the international news media.

Furthermore, being gateways of countries, Airports are often the transit points for drug trafficking, human trafficking, transnational organized crime, and Cyber-attacks. Smugglers frequently use airports and commercial aircraft for conducting their trade. 'Drug couriers' often carry narcotics through individuals or in carry-on luggage. Drugs are also smuggled in cargo holds through-checked baggage or loaded as consigned air cargo. Hackers target Airport information technology systems to get highly critical data of passengers to use them for illegal activities. The heavy movement of people in Airports creates window to other crimes comprising of homicide, burglary, aggravated assault, robbery, thefts and auto thefts. Such crimes are often witnessed in many Airports around the world posing a threat to public safety, creating panic locally and across the region.

Case Study: 9/11 attacks

On September 11, 2001, 19 militants associated with the extremist group al Qaeda hijacked four airplanes and carried out suicide attacks against targets in the United States. Two of the planes were flown into the twin towers of the World Trade Center in New York City, a third plane hit the Pentagon just outside Washington, D.C., and the fourth plane crashed in a field in Shanksville, Pennsylvania. Almost 3,000 people were killed during the 9/11 terrorist attacks.

Security Lapse at Airports: 19 terrorists easily smuggled box-cutters and knives through security at three USA East Coast airports and boarded four early-morning flights bound for California

Human Loss	Financial Loss
• 3000 people killed • Citizens of 78 countries perished	• The Stock Market fell 7.1%, or 684 points • New York City's economy alone lost 143,000 jobs a month and $2.8 billion wages in the first three months. • Estimated cost of the World Trade Centre damage is $60 billion • cost to clean the debris at Ground Zero was $750 million

Fallout effect of this event:
The Afghan War in which thousands of security personnel & civilians were killed, expenses of ~ $2.4 Trillion and many more unascertained losses.

Attacks on Ataturk International Airport, 2016. The 9/11 attacks have took the Airport Security to highest levels with advanced sophisticated techniques. However, since then attacks on Airports have continued in some form or the other. Recent attacks in 2016 Ataturk International Airport, consisting of shootings and suicide bombings, have killed 40 people and injured more than 230 people. A variety of threats including radiological, chemical, cyber threats, improvised explosive devices and advanced weaponry in the hands of miscreants is a serious concern for Airport Security today.

Airports are prone to a variety of crimes and these crimes have a colossal impact not only in the region of occurrence but also across the world. In order to avoid "the acts of unlawful interference "the Airports are to be guarded by various Federal & Private Security agencies with sophisticated tools, technology, processes and systems round the clock.

Diagnosis and Analysis of Current Situation of Airport Security

To understand the current situation of Airport Security, both external and internal analysis has been done. Internal analysis is based on Mckinsey 7 S framework and for external analysis key factors that are critical to airport security have been considered.

External Analysis   Internal Analysis

External Analysis	Internal Analysis
☐ **Risks and Threats**	☐ **Services** - Functions & Processes
☐ **Customer Expectations**	☐ **Systems** - Airport Infrastrcuture
☐ **Technology Adoption**	☐ **Staff** - Security Personnel
☐ **Regulatory Policies**	☐ **Strategy** - Vision, Mission & Strategy

External Analysis

Risks and Threat Patterns:

Crimes at many Airports are growing year on year. In the USA, country with highest air traffic, fire arms discovered at security check points in 2018 have gone up by 7% compared to 2017. England and Wales which is also one of the top aviation markets, crimes committed in and around Airports have been doubled from 2015 to 2017. These crimes range from petty crimes to severe terrorist attacks.

Number of Firearms DISCOVERED in USA Airports

Year	2014	2015	2016	2017	2018
Firearms	2212	2653	3391	3957	4239

Source - TSA

AIRPORTS WITH THE MOST CRIMES IN OR NEARBY BETWEEN 2015-2018
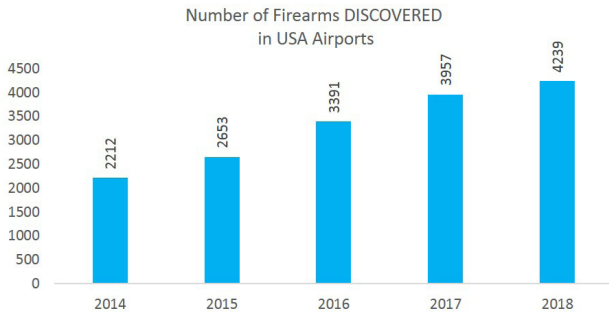
Source: thesun.co.uk
England & Wales

Airport	Crimes
Leeds Bradford	271
Liverpool J.Lennon	433
Manchester	1,632
Birmingham	1,045
Luton	1,648
Stansted	4,640
Heathrow	2,450
London City	271
Gatwick	666
Brighton City	430

1000
Airport Cyber Attacks per month in Europe (Source-EASA)

3 X
Increase in drone incidents in UK in last 3 years (Source - UK Airprox Board)
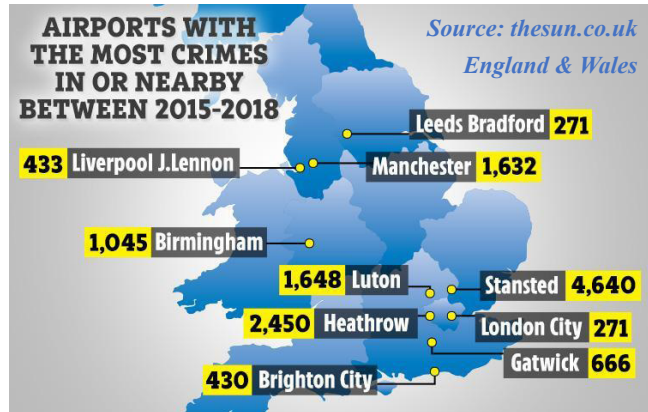
Evolving Threats 2040

- *Implanted Improvised Explosive Devices*
- *Chemical, Biological, Radiological Threats*
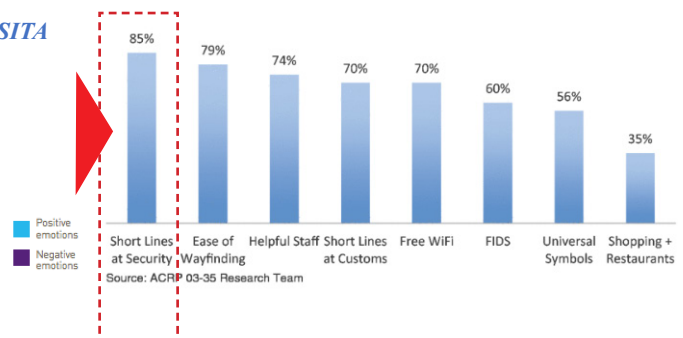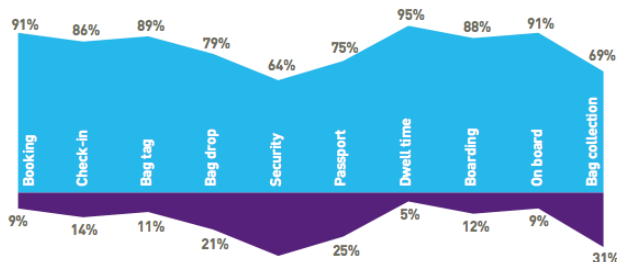- *Cyber and Business Threats*

Source - ACI

In the past few years, there has been several terrorist attacks in and around major international Airports (Eg: Brussels and Istanbul) and public areas. Attacks are launched with more sophistication and technological support. Recent Airport crimes also include Cyber Attacks. Modern Airports are on technologies such as the Internet of things (IoT), Cloud, Artificial Intelligence etc. This also leads to multitude of new vulnerabilities of cyber-attacks. According to a study by the European Aviation Security Agency (EASA), there are ~1,000 Airport Cyber-attacks per month in Europe. **Increase in crime rate is mainly attributable to shifts in risks and threat patterns.**

Understanding the Passenger Needs and Expectations @ Airport Security
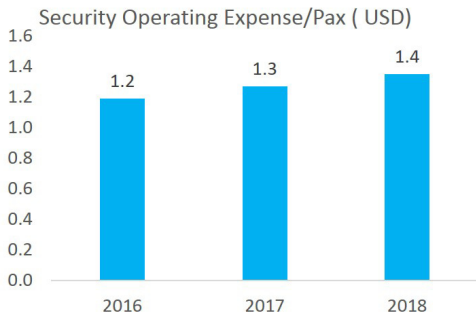
Passengers consist of different age groups, gender, life styles and travel for different purposes. Different segments of passengers have different expectations. Out of all modes of transports, air travel is perceived as more risky; however, passengers' safe travel is built by security procedures at airports. But, a security check is also associated with the highest rate of negative emotions during a passenger's journey – from booking to bag collection at the arrival airport (Source - Sita). Visibly, though security is highly critical in air travel, security measures make travel less convenient. According to Mckinsey, Airport security issues makes up four out of top 10 consumer complaints about airports and top priority is short lines at security. Passengers need **Seamless Travel Experience.** However, data elucidates that investment in Security per pax is stagnant across Top Airports.

Emotional extremes during the journey
% of passengers feeling positive/negative emotions

Source: SITA

Positive emotions: Booking 91%, Check-in 86%, Bag tag 89%, Bag drop 79%, Security 64%, Passport 75%, Dwell time 95%, Boarding 88%, On board 91%, Bag collection 69%

Negative emotions: 9%, 14%, 11%, 21%, 36%, 25%, 5%, 12%, 9%, 31%

Short Lines at Security	Ease of Wayfinding	Helpful Staff	Short Lines at Customs	Free WiFi	FIDS	Universal Symbols	Shopping + Restaurants
85%	79%	74%	70%	70%	60%	56%	35%

Source: ACRP 03-35 Research Team

Positive emotions / Negative emotions

85% pax expect shorter security lines

Security Operating Expense/Pax (USD)

"Investment in Security per pax is stagnant across Top Airports"

Source: Analysis of Financial Statements of Top 10 Airports in the world by Pax Nos

Technology Adoption:

Technology usage by passenger for security activities is lowest when compared to other Airport activities such as Booking, Check-in, Baggage Drop, Boarding etc., Given the raise of cutting edge technologies such as Internet of Things, Artificial Intelligence, Blockchain, Machine learning, there is need of exploring the applicability of these in Airport security functions and making these user friendly to increase the adoption in Passengers. Technology can play a big role to enhance security standards, increase operational efficiency and improve passenger experience.

Usage of Technology
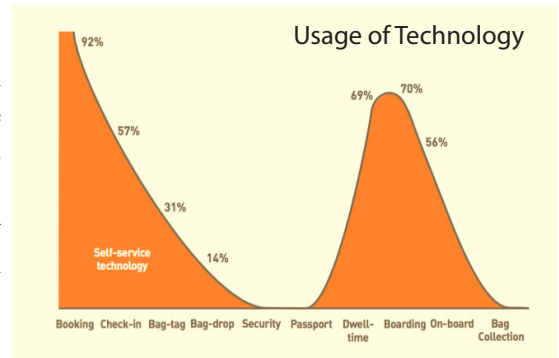
Source: SITA

Regulatory Policies:

The growth of passenger traffic is much higher than the anticipated numbers and security norms are becoming stringent. While Airports explore measures to revamp the infrastructure, policies pertaining to approvals for Airport security projects are causing delay in project execution. As per Ministry of Statistics and Program Implementation, Aviation projects in India have overshot the planned timelines by at least 22%. One of the main factors for the time over runs is **delays in approvals and implementation of Airport/Security infrastructure.** Similar trends can be observed in other countries as well.

Time Over runs in Aviation Projects

122%

Anticipated   Actual
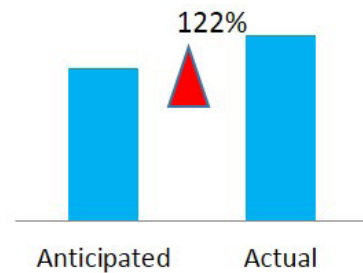
Internal Analysis

Services: Functions of Airport Security:

Source - TSA

Though all functions are critical to the security of an Airport, below three key areas directly impact the Operational Efficiency of Airports and Passenger Experience:
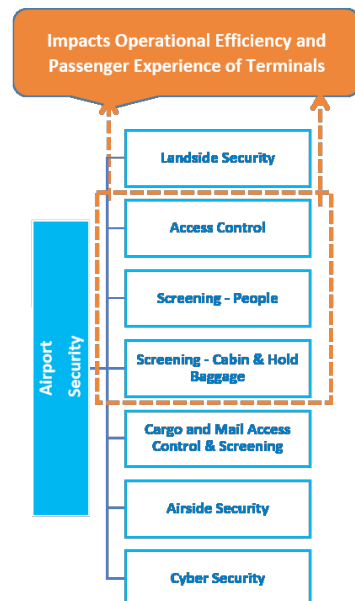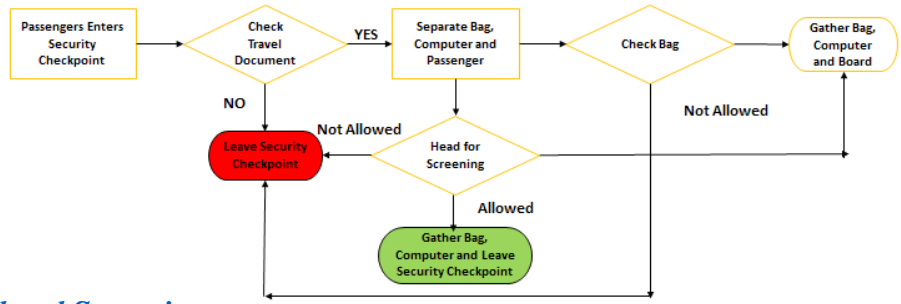
- Access Control – Access roads, Entrance, Security Hold Area & boarding gates
- Screening/Frisking – Passengers, Crew, Airport Staff
- Screening - Cabin Baggage and Check-in Baggage

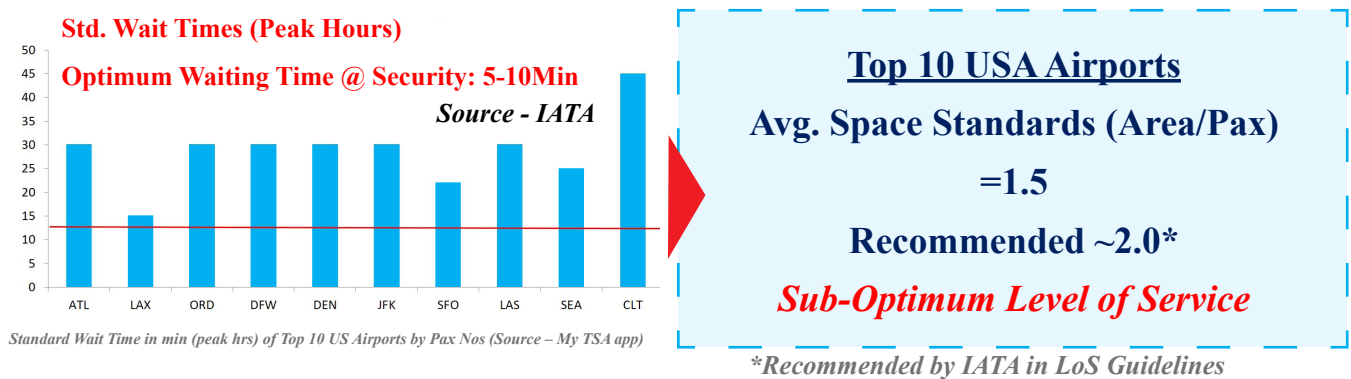## Process Analysis of Access Control and Screening:

Access Control – Present Scenario at Airports

Passengers, Crew and Airport staff is allowed into the Security Hold Area. Typically scrutinised visually for travel documents at the entrance of the Airport (varies from country to country; In India this check is mandatory before entering Passenger Terminal Building). A visual check of the boarding pass against the passenger's travel document at the entry point to the Security Restricted Area (SRA) and an additional visual check of boarding pass at the boarding gates. Even passengers in transfer may also be subject to such controls.

Screening - Present Scenario at Airports

- **Passengers, Crew and Staff:** Screening before SRA by the security person with hand held metal detectors (HHMDs) or walkthrough metal detectors (WTMDs).
- **Cabin Baggage:** Hand luggage or cabin baggage that passengers are allowed to carry along in the aircraft is screened using conventional X-ray units.
- **Check-In Baggage:** ICAO recommends 100% screening of check-in baggage. Checked-In baggage goes through multiple X-Ray automated / Semiautomated or manual screening machines
- **Cargo & Mail:** In many Airports, cargo is screened by the respective cargo terminal operators through x-ray machines

Measuring the Performance of Airport Security at Access Controls and Screening

Std. Wait Times (Peak Hours)
Optimum Waiting Time @ Security: 5-10Min
Source - IATA

Standard Wait Time in min (peak hrs) of Top 10 US Airports by Pax Nos (Source – My TSA app)

Top 10 USA Airports
Avg. Space Standards (Area/Pax)
=1.5
Recommended ~2.0*
Sub-Optimum Level of Service

Recommended by IATA in LoS Guidelines

 The waiting times in security are much higher than prescribed time by IATA, mainly because of congestion at Airports. Actual utilization is much higher than Design Capacity.

Systems: Airport Infrastructure and Security Equipment:

Airport infrastructure plays a crucial role in the Security function. Airlines, passengers and cargo need safe Airport infrastructure for their operations to thrive. Approximately, US$1.2-1.5 trillion is expected to be spent on global Airport infrastructure development up to 2030. It is required to ensure that major Airport expansion projects develop efficient security facilities that balance capacity with demand, while delivering the functionality, levels of service and required operational efficiency.

Generally, the equipment used in the screening of passengers and cabin baggage would include:

- *walkthrough metal detectors (WTMDs),*
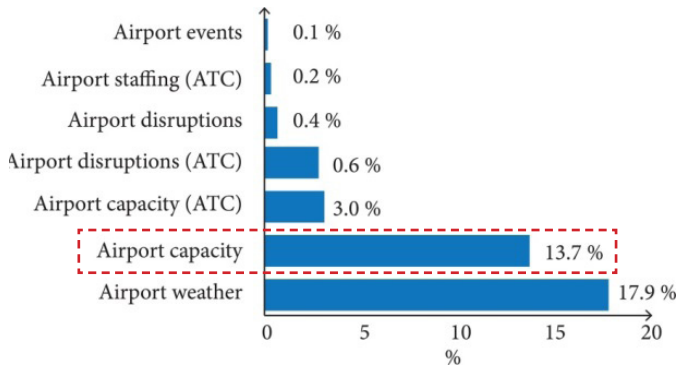- *hand-held metal detectors (HHMDs),*
- *conventional X-ray units,*

- *explosives detection systems (EDS),*
- *explosives trace detection (ETD) systems, or*
- *Explosives vapour detection (EVD) systems.*

However, there is a need for well-planned infrastructure with cutting edge technology enabled equipment to deliver superior passenger experience and increase operational efficiency.

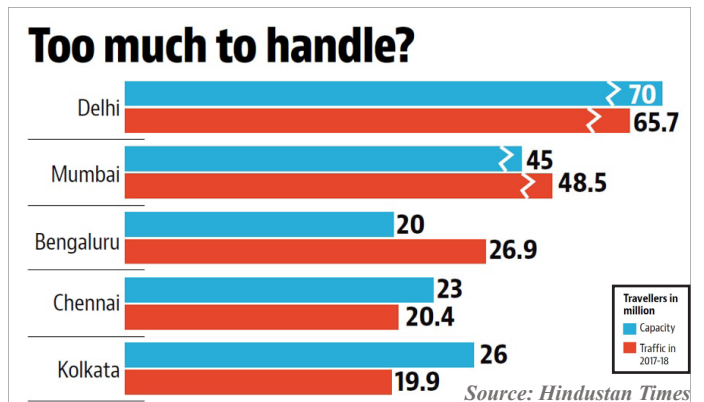## Measuring the Utilization of Airport Infrastructure:

In most of the international Airports highest percentage of delays are attributable to Airport Capacity after Airport Weather. The main bottle neck is security queues. Below illustration shows how major Indian international airports are operating at beyond the actual capacity.

Reasons of Delays at Airports:

Airport events	0.1 %
Airport staffing (ATC)	0.2 %
Airport disruptions	0.4 %
Airport disruptions (ATC)	0.6 %
Airport capacity (ATC)	3.0 %
Airport capacity	13.7 %
Airport weather	17.9 %

Source: Aviation Journal

Utilization of Top 5 Indian Airports:

Too much to handle?

Airport	Capacity	Traffic in 2017-18
Delhi	70	65.7
Mumbai	45	48.5
Bengaluru	20	26.9
Chennai	23	20.4
Kolkata	26	19.9

Travellers in million
Capacity
Traffic in 2017-18

Source: Hindustan Times

Challenge that leads to over utilization of Airports and high Queuing Times:
Growing traffic numbers, both passenger and cargo, are beyond the planned capacity and earlier than anticipated timelines

Passengers (Indian Airports in Millions)

ANTICIPATED CAGR 8-10% | ACTUAL CAGR - 13%

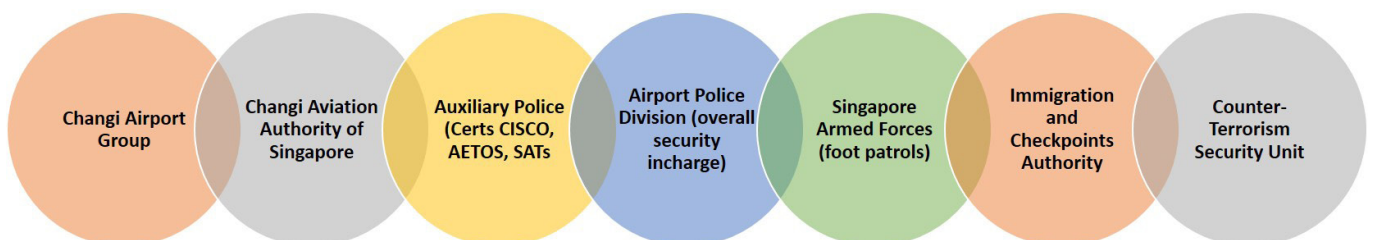| 2014-15	2015-16	2016-17	2017-18	2018-19
190	224	265	309	345
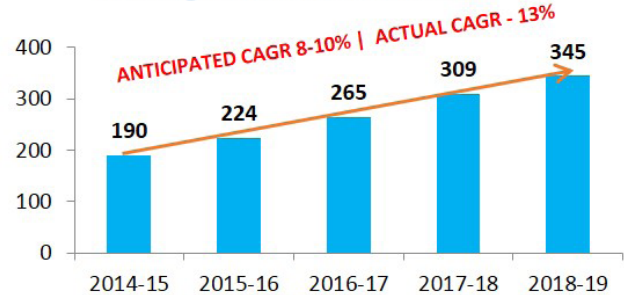
Staff: Airport Security Personnel, Structure and Skills:

Certain countries have agencies that protect all of their airports such as Central Industrial Security Force (India), Transport Security Agency (USA) and Australian Federal Police (Australia). However, in other countries the security functions are the responsibility of the state or local level. The primary personnel will vary and can include:

• A police force hired and dedicated to the airport (Central Industrial Security Force, India)	• Local police department
• Country's airport protection service	• Police dog services for explosive detection, drug detection and other purposes
• Supported by Military, Paramilitary and Security Guards	• Other Agencies such as Customs, Immigration etc work closely with the Airport Security

Many stakeholders are involved in Airport Security and each division of security has its own organizational structure and reporting pattern,

An illustration: Changi International Airport Security where multiple stakeholders are involved:

Changi Airport Group · Changi Aviation Authority of Singapore · Auxiliary Police (Certs CISCO, AETOS, SATs) · Airport Police Division (overall security incharge) · Singapore Armed Forces (foot patrols) · Immigration and Checkpoints Authority · Counter-Terrorism Security Unit

Measuring the Quality of Security Personnel

As per Mckinsey, four out of top 10 passenger complaints are on Security. In Rajiv Gandhi International Airport, (RGIA) Hyderabad, one in four social media complaints are on security. One of the main reasons for them is unfriendly security personnel.

% Complaints in Social Media (2019)

Security 25%

Others 75%

Source: RGIA, India

Airport-security issues make up four of the top ten consumer complaints about airports.

Top complaints by customers after airport travel

Source: Mckinsey & Company

Confusing layout of security-screening checkpoint

Unfriendly security personnel

Lengthy security-screening process

Complete lack of seating after security screening

Total Security Personnel in Indian Airports:

>200,000

1 Security Personnel for every 1500 Passengers (in 2018)

1500

Source: Economic Times, India
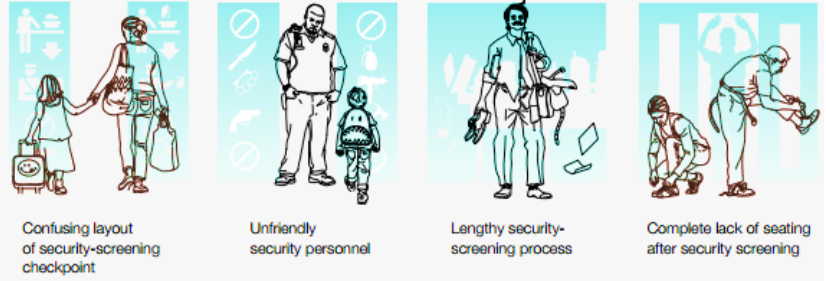
**Challenges that lead to higher complaints on Security:**

- **Lack of coordination between multiple stakeholders of Airport Security**
- **Non-standardization of the service levels of thousands of security personal**

Vision, Mission, Values and Strategy

In the recent years, few of the Airport's Security Agencies have developed their Vision, Mission, Values and Strategy to provide long term solution for safe and secure air travel to the passengers and the movement of Air Cargo. (Eg: Transport Security Agency, USA has developed their strategy for 2018 -2026). They are formulated to have a clear direction on where they want to go and how they want to go. However, policies and strategies by airport security agencies across the world reveals that **many Airports security agencies yet to have a long-term vision and strategic plans.**

Summary of Challenges faced by Airport Security:

From the above external and internal analysis, the challenges faced by Airport Security can be summarized as below:
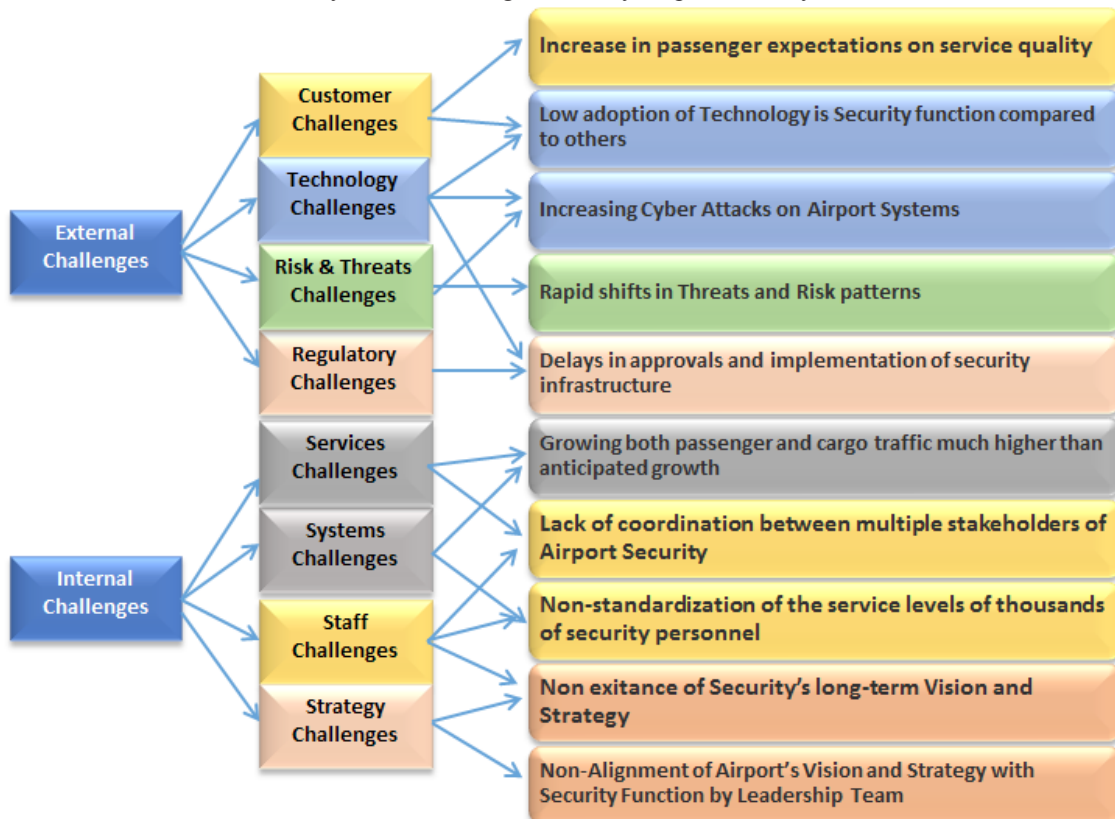
Case studies & Learnings:

The challenges have been addressed by many airports by innovating in terms of technology, process and people. Below are few case studies from which we can learn the approach & methodology and develop a framework to address the current and future challenges.

Case Study: Risk based Security – TSA Pre® Transport Security Agency (TSA), USA

Transport Security Agency (TSA), authorized of security functions of Airports in USA has brought standardization in screening process since its inception. All passengers have to pass through same measure irrespective of their age, gender or occupancy. From this approach, they moved to an intelligence-driven, risk-based strategy. TSA segmented the passenger such as senior citizen over 75 years, children below 12 years, members serving US armed forces, cadets of military academy as low risk category and exempted them from removing shoes, belts, laptops, jackets and 3-1-1 liquid bags. This expedited screening for known and trusted travellers at security checkpoints while focusing resources on high-risk and unknown passengers.

Before

One Size – Fits – All – Approach

- All passengers

Before, travelers had to remove;
- Shoes
- Belts
- 3-1-1 liquids bag
- All outerwear
- Laptop from bag

Risk-Based Security Practice

- TSA Pre© participants including DHS Trusted Travelers
- Seniors 75 & older
- Children 12 & younger
- Members of the US Armed Forces
- Cadets and midshipmen of the U.S Military Academy, Naval Academy, Coast Guard Academy and Air Force Academy, Merchant Marine Academy

Now, most travelers may keep on;
- Shoes
- Belts
- 3-1-1 liquids bag
- Light jacket/outerwear
- Laptop

After

Source: TSA

>1 Million pax experience TSA Pre daily

However, TSA also incorporates unpredictable security measures throughout the airport and no passenger is guaranteed expedited screening. TSA Pre® has expanded to approximately 200 airports with over 400 application centres open nationwide. The TSA plans to continue increasing the population of known and trusted travellers to ensure the most efficient and effective security possible.

Key Learnings: Segmentation of passengers based on risk attributes make airport security easy by reducing congestion and enables security function to allocate resources efficiently. This special treatment also increases technology adoption among customers.

Case Study: Process Innovation at Rajiv Gandhi International Airport, Hyderabad
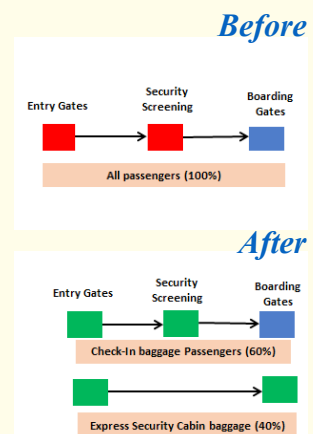
Rajiv Gandhi International Airport (RGIA), Rearrangement of Screening Counters and Express Check-In to address Infrastructure Constraints

GMR Hyderabad International Airport run Rajiv Gandhi International Airport has witnessed unanticipated growth in number of passengers. This led to terminal congestion and long queues at all access controls and security check points. To address congestion, the Airport has taken three key steps:

- Express Security Check
- Reorientation/Relocation of Screening Layout & Self-Check in Counters
- Automatic Tray Retrieval System

In India, at the entry of the terminal building, security personnel verifies the travel documents and allows the passenger into the terminal for check-in, baggage drop and screening. All domestic passengers go through the same process, irrespective of their need of travel. RGIA domestic passengers constitute ~80% of the total traffic. Among them 40% are businesses passengers who don't need baggage drop and require minimal boarding time. Understanding their need, the Airport in coordination with the Central Industrial Security Force & the Bureau of Civil Aviation Security has introduced Express Security facility. This is

Express Security Check + Reorientation + Automatic Tray Retrieval System	
Before	**After**
• All passengers (100%)	• Separate Queues: Cabin Bag passengers (40%); Check in bag Passengers (60%)
• Check-In Counters Inside the terminal building	• Self-Check-in counters just before Express Check-in Gate
• No of Bags with Convention – 130-140 Bags/Hr	• Automatic Tray Retrieval system – 400 Bags/Hr

Cycle Time of a Check-in Bag. Passenger:	Time (in Min)	Cycle Time of a Check-in Bag Passenger	Time (in Min)
Queuing Time @ Entry	5-10	Queuing Time @ Entry	5-10
Queuing Time @Security Check	10-15	Queuing Time @Security Check	Nil
Security Frisking Time	1-2	Security Frisking Time	1-2
Boarding Gates	2-3	Boarding Gates	2-3
Total Cycle Time till Gates	18-30	Total Cycle Time till Gates	8-15

Before

Entry Gates — Security Screening — Boarding Gates

All passengers (100%)

After

Entry Gates — Security Screening — Boarding Gates

Check-In baggage Passengers (60%)

Express Security Cabin baggage (40%)

supported by self-check-in kiosks and where-in the travel document verification and baggage screening are completed at the Terminal building entry itself. This is also reinforced by Automatic Tray Retrieval systems which increases throughput of hand-baggage screening.

Key Learning: Understanding the passenger requirements with respect to security has not only addressed their pain points but also brought efficiency in the entire system. Process innovation can decongest Airports especially when actual growth is above anticipated.

Case Study: Using technology for Seamless Travel at Rajiv Gandhi International Airport, Hyderabad:

Rajiv Gandhi International Airport, Biometric access controls for Seamless Travel:

Biometric access controls such as fingerprint recognition, face recognition, hand/vein patterns, voice recognition, and retina scanning are being used in everyday life. For instance, we use fingerprint for authentication, voice recognition for electronic equipment controls, retina scanning for medical applications and face recognition for access controls. At Hyderabad International Airport, face recognition is being used on trial basis for entry into passenger terminal building.

Passengers are automatically processed based on facial recognition system at check points such as entry point check, entry in to Security Check, aircraft boarding. Additionally this would also facilitate self-bag drop and check-in, using facial recognition to identify pax and data recall. Security personnel scrutinizes the Government Identification proof and gives a unique facial recognition Identification for each passenger. When passenger reaches airport entry gate upon successful verification, the passenger gets checked-in and the e-gate opens. All done in split seconds.

Throughput Time at Entry Gate	
Before	After
• Travel document Verification by security personal • Throughput Time: 2-4 Min	• Biometric verification of travel documents • Check-In on the go • Throughput Time – Fraction of Seconds

Key Learning: Affordable and easily implementable technology will improve the operational efficiency and add to passenger experience immensely.

Case Study: Advanced Screening Techniques by Changi International Airport, Singapore

CT security screening for hand-carry luggage; Changi International Airport Singapore's usage of a new Computed Tomography (CT) security screening equipment to screen hand-carry luggage at the boarding gates before passengers board their flights enables the passengers not take out their electronic devises from Cabin-in luggage during screening. Using advanced 3D screening technology, the new CT screening equipment allows passengers to keep such electronic devices in their hand-carry luggage, thereby saving them time.
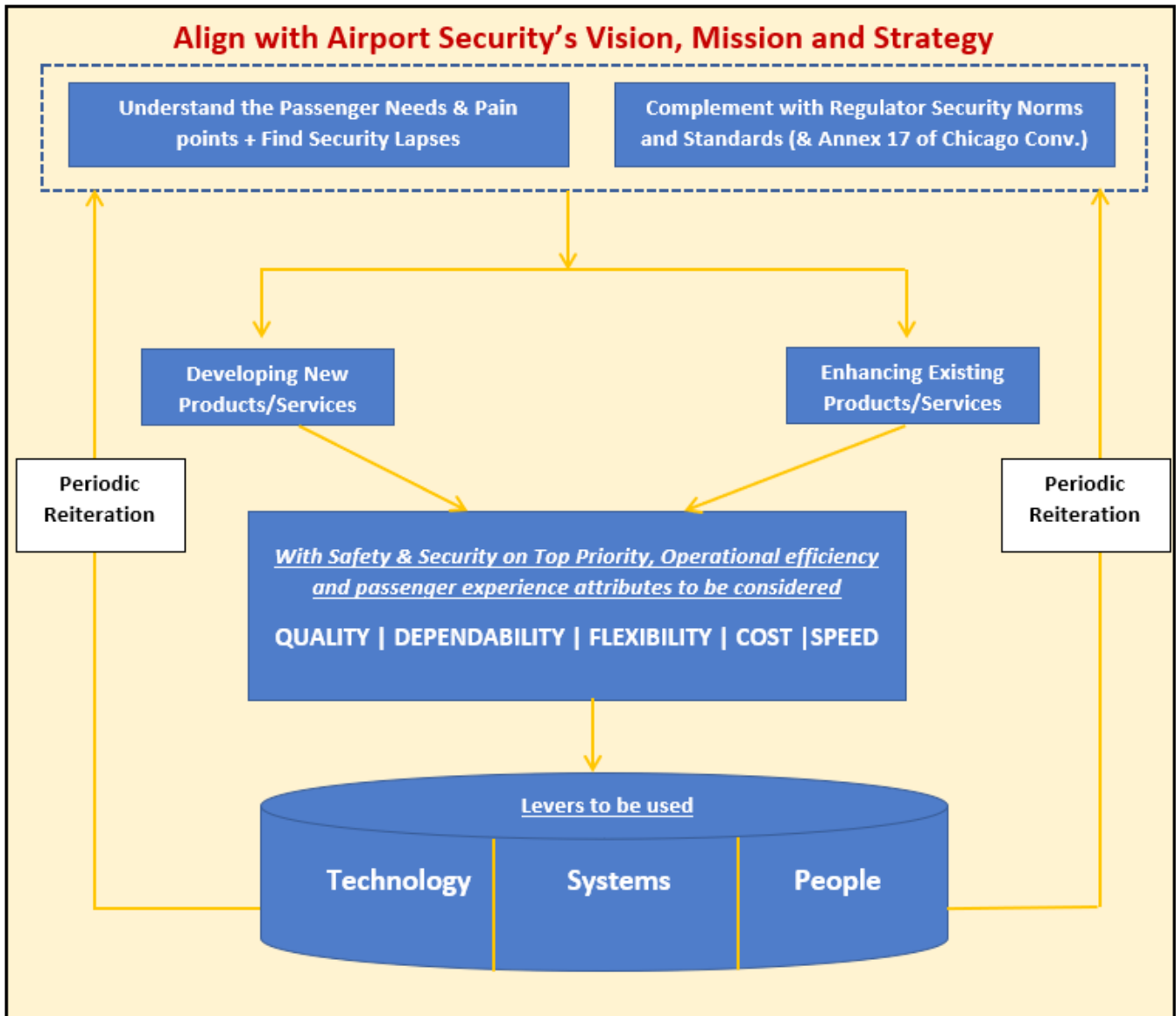
Process time at screening	
Before	After
• Remove electronics from bag and place in separate bin • Process Time for laptop removal and keep on X-Ray conveyor unpacking: 2-3 Min	• No need to remove electronics • Process Time – Nil

Key Learning: Many break-through technologies such as block chain, artificial intelligence, machine learning, computer vision and predictive analytics can be applied in screening equipment for better processing.

Recommendations:

Based on insights from above case studies, recommendations for "Future of Airport Security" cannot be designed in isolation. They must be linked with passengers' needs, security and regulatory requirements. We need to understand the Passenger needs and their priorities from various methods of surveys and align with Security requirements as per international standards to develop new products. Three levers can be used to develop new products or enhance the existing products: Technology, Systems/ Process and People/Staff. This framework should overly on Senior Management's Vision for the Airport.

Framework to be deployed at Airports to address security challenges:

Align with Airport Security's Vision, Mission and Strategy

Understand the Passenger Needs & Pain points + Find Security Lapses

Complement with Regulator Security Norms and Standards (& Annex 17 of Chicago Conv.)

Developing New Products/Services

Enhancing Existing Products/Services

Periodic Reiteration

Periodic Reiteration

With Safety & Security on Top Priority, Operational efficiency and passenger experience attributes to be considered

QUALITY | DEPENDABILITY | FLEXIBILITY | COST |SPEED

Levers to be used

Technology | Systems | People

Application of frame work

Case Study: Body Scanners at Rajiv Gandhi International Airport

Passenger Pain Points (from Survey) & Social Media	Security Lapse with existing system	Regulatory Norms & Requirements
• Waiting times in Queues • Less confidence over screening process • Difficult for differently abled & elder people who use wheel chairs	• Cannot detect Non-Metal Objects • May not scan full body • Possibility of human errors • Direct contact between Security Person & Passenger	• Directive by Bureau of Civil Aviation, India to use Body Scanners at Major Airports • In line with Annex 17 of Chicago Convention clause No 2.5 (Equipment, research and development)

Lever used: Technology	New Product/Solution: Full body scanners

Assessment of Attributes:

The attributes are assessed based on a 5 scale rating, as defined below.

Quality: Unlike metal detectors, full-body scanners can detect non-metal objects, which became an increasing concern after various airliner bombing attempts in the 2000s. The operator would see a generic cookie-cutter-like outline of a person and highlights potential threats of suspicious items if detected and in some cases is located remotely where the operator cannot even see the face of the person being screened.

Dependability: In full body scanners, any anomaly shall be cautioned by the system/computer image but in case of manual scanning using Hand Held Metal Detectors the safety is completely dependent on the security person who scans the passengers

Flexibility: In case of upgrading the system, relocating or rearranging, both metal detectors and full body scanners need same effort. Hence, equal rating.

Speed: Throughput rate of full body scanners are less than a minute but in metal detectors and manual scanning it takes 1-2 min or more. Still, customers prefer seamless journey with in the terminal without stoppages. Hence, rated 4.

| Product (Rating on 5 Scale)	Quality	Dependability	Flexibility	Speed	Cost	Avg. Overall Rating
Manual Scanning with Hand Held Metal Detectors	3	3	4	3	4	3.4
Full body scanners	5	5	4	4	3	4.2

Recommendation: Based on relative rating methodology, the new technology of full body scanners are **24%** more beneficial than existing system and recommended to be installed to address security lapses, passenger needs and regulatory norms

Solutions to address the challenges based on frame work:

Technology based Initiatives:

*Biometric Authentication for **Seamless travel for passengers from entry to boarding**:* Passengers to access check points such as entry point check, entry in to Security Check, aircraft boarding, self-bag drop and check-in. Use facial recognition or fingerprint to identify pax and data recall.

*Biometric Authentication for employees to access landside and Airside to address **risks associated**:* Many airports in the world still uses paper based identification cards and Aerodrome Entry Permits as authentication for entry to terminals or airside for employees. However, these are easily duplicable and prone to stealing and misplacement. Hence, biometric authentication for employees by using finger print or facial recognition can reduce the risk of duplication to a large extent.

Paper based Boarding Pass & Aerodrome Entry Permit

Biometric Access- Fingerprint or Facial Recognition

AI Based Identification
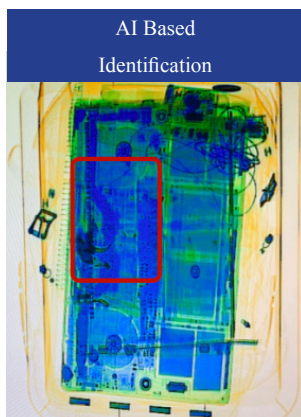
*Advanced screening techniques using Artificial Intelligence (AI) for **better security levels and optimum usage of Infrastructure**- AI can be used in screening machines to highlight any suspicious objects in bags or else automatically pass through screening machine. Implementing this technology along with remote screening techniques not only expedites the screening procedure but also reduces the risks of collusion by removing any contact between the operators and the employees or passenger being screened.

***Block Chain based data Integration** between multiple Security systems/platforms to address **cyber-attacks for data breach -*** A centralized data sharing platform built on Block Chain technology for safe storage and access of data enables the stakeholders such as Airport Security, Immigration, Customs Authorities and Airlines to coordinate well and detect the threat in advance. This data linked with biometrics of passengers shall provide seamless access to all check points for faster clearance.
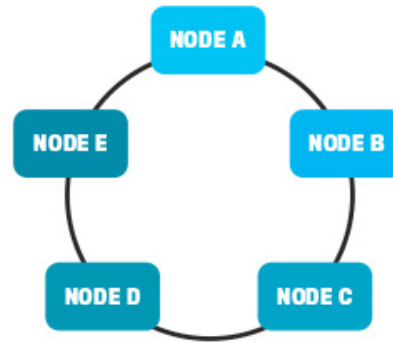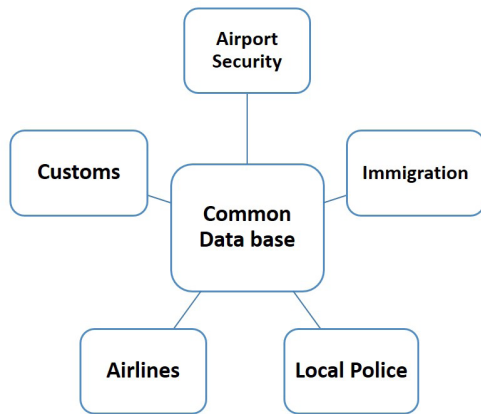

Centralized data storage prone to Cyber Attacks

Decentralized Storage with Block Chain Technology

Usage of predictive analytics and artificial intelligence to Counter terrorism & suicide Bombings: Correlating past terrorist attack patterns with respect to locations, behaviours of terrorists, facial expressions etc., to the data captured in real-time using facial recognition, electrocardiogram sensor and skin temperature etc., at the Airports, the system can predict terrorist activities with high probability and screen those passengers who are perceived as threat separately. This can increase the efficiency of existing system.
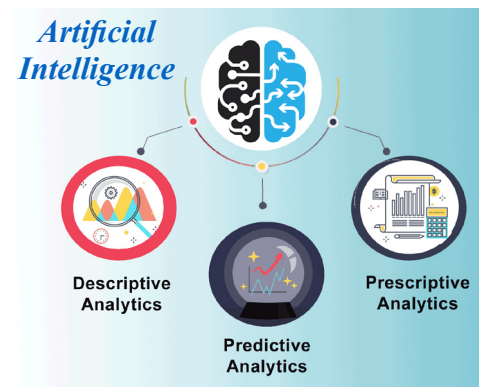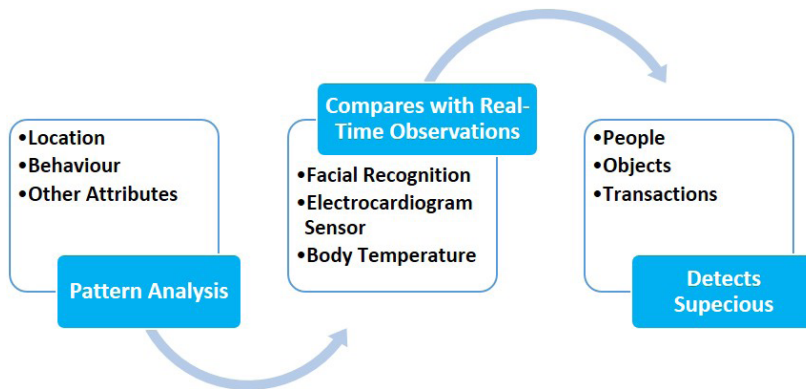
Horizon scanning to understand passenger pain points & threats @ Security*: Horizon Scanning involves searching and mining vast amounts of web and social media data, analysing them in real-time and generating intelligence. This will enable the security agency to predict the threats, understand the passenger pain points and address them efficiently.

Indoor GPS for incident reporting: Airport terminals spread across vast area. There terminal areas could be in several thousands to million square feet. To report any suspicious incidents in such vast areas is very challenging for someone who identifies it. With terminals & airside mapped using GPS systems and enabling geo-tagging mechanism in an Airport mobile applications, reporting such incidents is easier and efficient.
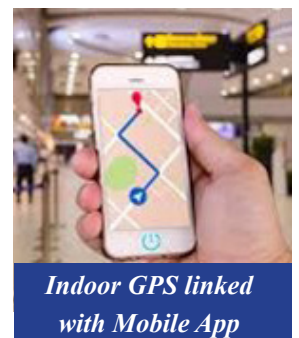
Indoor GPS linked with Mobile App

Real-Time Queue Length Reporting to improve service quality: Use Internet of things (IoT) with sensors to capture the queue length, waiting times and passenger throughput on real time. We can use this data in two ways – 1. Airport security and operations teams can know the real-time situation and take proactive actions. 2. The data posted on real time in social networking sites, website or Airport mobile application enables passengers to be prepared in advance, resulting in low flight no-shows and hassle free travel.

Geo-fencing technology to counter drones and UHD Surveillance to address increasing threats: Define geographical boundaries of airports by geo-fencing technology to neutralize drones automatically. For surveillance, traditional CCTV cameras are blurry and can only do filming and recording. They can be replaced by Ultra High Definition (UHD) Cameras which can record HD filming with motion detection, night vision modes and AI based alerts.

Process/Systems based Initiatives:

Decongest airports *by Off-Airport Check-in with RFID and Geo Tagging:* Self-Baggage drop kiosks in city and before Airport entry gates to enable passengers to drop their luggage at multiple points enabling them to check-in off-airport. Geo tagging of baggage using RFIDs linked to airport mobile application updates passengers about their baggage location/status on real time basis. This facility would reduce the congestion at check-in counters and convert Check-in baggage passengers to Cabin-baggage passengers.


Self-Baggage Drop & Check-In Kiosks in City + RFID Tag

Tracking on Real-Time Basis
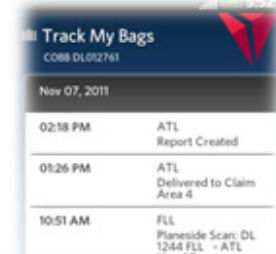
Mobile App for Real Time Updates

Risk Based Approach: *Different Queues for Different Risk rates:* Segmentation of Passengers based on risk rates based on non-compliances and irregularities found with the data captured in the centralized platform/local police database. Based on rating categories create different screening lines; Low, Medium & High. For Instance, Low risk rate people will have less stringent norms and faster security clearances and visa-a-versa with high risk rate passengers.

Low	Nil Non-Compliances
Medium	<10 Non-Compliances
High	>10 Non-Comliances
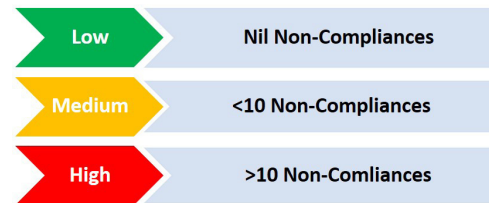
Check-in and Baggage Drop in Public Transit:

Many people commute to Airport using metro trains and buses, Facility for check-in public transport vehicles can enable passengers to do check-in while transiting from their residence to the airport. After reaching airport checked-in baggage in public transit vehicle can be collected by airport security for further screening.

People based Initiatives

Building Operational Efficiency and Passenger Experience culture in Airport Security: An Airport Security should have a long term vision and strategy which should consider the safety and security as top priority and superior operational efficiency and enhanced passenger experience as strategic objectives. Regulators should act swiftly in approving strategic initiatives of agencies as crimes are growing swiftly. Strategic direction for the agency sets sense of belonging, new product development and enhancing the service levels with operational efficiency and passenger experience as DNA.

> *TSA Statergy 2018-2026*
>
> *Vision: an agile security agency, embodied by a professional workforce that engages its partners and the American people to outmatch a dynamic threat*
>
> *Mission: protect United Nation's transportation systems to ensure freedom of movement for people and commerce.*
>
> *Core values: integrity, respect and commitment.*
>
> *Strategic Objectives 1) Imrpove Security and safeguard the Transportation system 2) Accelerate Action 3) Commit to our people*

Augmented reality trainings for *standardization of service levels:* Security personnel should be trained on the usage of latest technologies and soft skills required to interact with passengers. Simulation and augmented reality technologies for training and modelling make them to get trained real time scenarios with personal involvement.

Robotic Policing for *passenger friendly policing:* Robotic polices can patrol the terminals and help finding offenders based on behavioural patterns, caution suspicious left out baggage, facilitate passengers for screening, and addressing their queries.

Draw inspiration from other industries to *improve service levels:* Learn from other industries and try to adopt better approaches from unrelated contexts. Train the security personnel in few service industries such as hotels which are well known for customer experience and make them apply the learned principles at airports.

Conclusion: "One single vulnerability is all an attacker need" - *Window Snyder*

Airport security ensures safety and security of the passengers, employees and the Airport assets. With a minute security lapse there could be disasters which can have massive impact in terms of human and financial losses. Reiteration of security lapses regularly and addressing them can save many lives. In Airport like infrastructure, balancing the passenger needs with respect security with enhanced security levels is a challenge.

Based on external and internal analysis, the highlighted major challenges faced by airport security includes increasing passenger's expectations on service quality, lower adoption of technology, shifts in threats and risk patterns, delays in regulatory clearances, unanticipated passenger growth, complaints on security and non-existence of strategy have to be addressed at the earliest.

To address those challenges, the proposed framework can be used to develop new products/services or to enhance existing products/services. With 'prevention is better than post-mortem' as a motive, management should reiterate the process and treat security to be strategic role more than tactical.

Airports need to strengthen security, increase operational efficiency and improve passenger experience by investing in Research and Development in:

- Cutting edge technology
- Process innovation and
- Personnel services

Adopt various techniques such as surveys to understand passenger pain points, Kaizen principles to find security lapses and without compromising security norms develop new products and services which shall make the Airports safe and efficient. However, technology is growing leaps and bounds so is its adoption for criminal offenses. Though our Airport Security works 24 x7 with at most commitment and dedication, it is everybody's responsibility to support them to keep our airports safe.

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