INNOVATIONS TRANSFORMING FUTURE AIRPORTS

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INTRODUCTION

Airports are constantly evolving especially now when the rate of change is faster than ever. Addressing the need and urgency to adapt to these changing industry dynamics is critical and paramount. Airports globally, on a regular basis, are faced with changing demand, varied operating conditions, rising costs, and workforce shortages coupledwith rising passenger demands.

Digitization is a key element in supporting airports to achieve efficiency. Stakeholders across the ecosystem are working on innovating, backed by advanced technology to solve airport's various pain points and achieve the desired goals and priorities.

These innovations span across landside and airside for passenger processing as well as for operations management with the ultimate aim of making airports more efficient and customer centric.

CURRENT STATE OF AIRPORTS

According to Airports Council International (ACI) data, the total number of global passengers in 2023 is approximately 8.5 billion, marking a 27.2% increase from 2022 or a recovery of 93.8% from pre-pandemic levels in 2019. The top 10 airports, which collectively handle nearly 10% of global air traffic, saw an increase of approximately 20% from 2022 or a marginal gain of 0.7% compared to their 2019 figures. This trend in traffic augurs well for the future of the aviation industry which has seen the darkest of days during the Covid-19 pandemic.

Airports are continuously seeking to innovate and implement changes to improve passenger experience and efficiency. For example, Dubai Airport currently offers Self-Service Check-in kiosks equipped with biometric authentication and automated baggage drop systems to expedite the check-in process and reduce queues. However, as the number of passengers continues to swell, it poses challenges to airports in areas related to capacity, sustainability, seeking investments for growth and adapting to changing technology. The airports of the future will need to reinvent themselves and evolve to cater to the increasing volume of traffic and the ever-changing passenger needs.

NEEDS OF AIRPORTS

Airports have identified certain key needs and priorities as operators work on adapting to the evolving industry landscape. These primarily stem from the aim to minimize inefficiencies and their consequential financial and non-financial impacts. These are largely similar across regions and tiers of airports.

- ## Manage Operations Dynamically
  Airport operators are keen on the ability to dynamically manage processes across the various stakeholders at an airport to handle processes and operations more efficiently in real-time.

- ## Performance Based Airport Management
  Airport operators seek to possess the ability to provide real-time insights into the performance of stakeholders enabling monitoring, assessment of stakeholders and processes to improve accountability and have better visibility.

- ## Predictive/Preemptive Analytics
  Leveraging AI and Big Data to assist in offering greater insights into past events as well as operations in real-time but also offer predictive information to avoid disruptions and incurrences.

- **Robust Physical Cyber Security**
  Robust security ecosystem at the airport including physical and cyber with the ability to autonomously detect incursions and predict instances using AI, Big Data and Video Analytics.

- **Collaborative Decision Making**
  Ability to manage operations across the airport from a single point while incorporating inputs from various stakeholders simultaneously to make tactical and strategic decisions in real-time leading to highly efficient airport operations.

- **Increased Situational Awareness**
  To support real-time and collaborative decision making, visibility across the airport supported by real-time data analytics and having access to the data remotely to multiple stakeholders and decision makers.

- **Increase Capacity Handling Capability**
  Airports are looking for alternate solutions to obtain large-scale investments for infrastructure expansions at least in the short term to support increasing demand with existing infrastructure in high demand.

- **Sustainable Operations**
  Airports globally are keen on becoming sustainable, driven by multiple factors–government regulations, financial pressures and socio-economic. To achieve net-zero operations across 3 scopes, airport operators seek assistance in identifying sources of emissions, measuring them, and addressing them.

- **Seamless Passenger Experience**
  Airports are keen on offering passengers a seamless experience even before arriving at the airport and after departing the airport with minimal time spent at airport processes. This is even more crucial as multiple airports are coming up with increased competition with airlines.

FUTURE AIRPORT INNOVATIONS

AIRSIDE

This is also one of the most complex parts of the airport and one that defines the overall airports' flight handling capacity as well as turn-around times.

Airside is also the one that has a high degree of manual processes, thus making it prone to inefficiencies. With the constant need to increase airport efficiency, the airside is experiencing a whole lot of technological innovations, with the aim to make the airside operations as efficient as possible while supporting operators to increase capacity and reduce costs.

- **Infrastructure to Support Future Fuels**
  The industry is working on deploying aircraft powered by SAF, electric and hydrogen and to support large scale use of these future fuels, airports will need to adapt and develop the required infrastructure to support blending/recharging/refueling. Each type of fuel will require its own different supporting technology and thus having a sustainability plan is essential. Programs such as the Airports of Tomorrow initiative, spearheaded by ACI and the World Economic Forum, are focused on tackling the infrastructure requirements for sustainable aviation. Pittsburgh International Airport (PIT) has been among the first airports to announce plans of manufacturing SAF on its premises, with the possibility of supplying other airports as well.

- **Digital Twin for Airport Operations**
  Airport operators, with the support of technology suppliers, are working on deploying comprehensive Digital Twin solutions that covers not only airside but also Landside and the Terminals. This gives operators the ability to get better real-time insights into operations and processes but also gives operators ability to try out various changes to evaluate impact and to choose the one to be deployed.

- **Autonomous Ground Support Vehicles**
  Given the shortage of workforce and other related issues such as human errors/ inefficiencies, the industry is working on developing and adopting autonomous GSE having the ability to be allocated and managed in real-time. This will aid in increasing efficiency at the airside while also reducing delays and costs linked to it and making GSE operations future proof and resilient.

- ## Robotics for Baggage Handling

  Baggage handling is often a key pain point for airports globally and constant efforts are made to improve it. Technology providers and airports are working on leveraging robotics to aid baggage handlers in loading/offloading baggage which would reduce human intervention and the linked risks and challenges while speeding up operations. Schiphol Airport has begun using robotics in their baggage handling process with the deployment of Cobot Lift. Changi airport is working on deploying Auto-DollyTug which has an auto-loading and release management system that adds bi-directional robotic arms to the body to allow the vehicle to autonomously load and unload the ULD from itself.

- ## Smart Airside Lighting

  Airports, along with airlines, also need to work on becoming sustainable and achieve net-zero by 2050 and to support this goal one of the key factors is reducing power consumption at the airside. Airfield lighting consumes a high amount of energy and thus by deploying adaptive lighting wherein the brightness of the lights can be adjusted in real-time based on need can significantly reduce power consumption. Furthermore, deploying these adaptable lights can also aid in efficient management of aircraft movements to reduce taxi times and increase safety. Smart lighting and reduced energy consumption will be a core feature of future airports. Companies such as ADB Safegate and others are continuously working on innovating airfield lighting to cater to green and safer airports.

- ## Automated Aircraft Docking System

  Docking and parking the aircraft in adverse weather conditions makes the process even more challenging for ground operators as well as pilots. To reduce docking times and incidents, especially with a reduced workforce, technology providers are working on developing fully automated guidance systems, expected to aid in highly efficient docking while offering real-time detailed situational awareness.

- ## Advanced Airside Management

  Technology providers are working on leveraging advanced technology such as AI, Big Data, AR/VR to modernize operations at the airside including aircraft movements, GSE movement, gate allocation, taxing, parking and other activities. Leveraging advanced technology aims to enhance airside operations to support faster turnaround, reduced incidents, and enhanced efficiency while having the ability to adapt in real-time based on predictive analytics and big data. Civil Aviation Department (CAD) and Airport Authority Hong Kong (AAHK) have jointly developed a Digital Apron and Tower Management System (DATMS) supporting a holistic approach in controlling and monitoring airside activities utilizing digital video technology and artificial intelligence (AI).

- ## Sustainable GSE

  Ground support operations contribute to a majority of airport's emissions and thus reducing these emissions is airport operators' top priority. Various efforts are being made to make GSE sustainable such as using electric as well as Hydrogen powered GSE. Combining autonomous GSE with sustainable powered will offer multiple benefits in terms of efficiencies, and cost reductions amongst others. JBT AeroTech has partnered with fuel provider Universal Hydrogen on the development of a hydrogen fuel cell-powered mobile battery charger to aid electrified ground support equipment (GSE) at airports.

LANDSIDE & TERMINAL

The landside area of airports, including everything outside of the secure area, is ripe for innovation as airports seek to improve efficiency, enhance the passenger experience, and reduce environmental impact.

Here are some innovations that could shape the future of airport landside operations:

- ## Multimodal Connectivity

  Airports such as Hong Kong International Airport are in the process of expanding its integration with ferry operators which connect the city to the Chinese Mainland. They are a shining example of inter-modal connectivity. In the future, the implementation of Urban Air Mobility (UAM) concepts, which link city centres with airports, will be seamlessly integrated into modern multi-modal transportation hubs. These UAM systems are likely to extend their connectivity to rail, road and sea networks, further enhancing inter-regional transportation options. The UAE is at the forefront of such integration with the development of vertiports and the planned launch of Urban air taxis expected to commence in 2025.

- ## Smart Parking Solutions

  This solution entails utilizing sensors and data analytics to optimize parking availability, provide real-time updates on space availability, and streamline payment processes. Companies like ParkAssist provide sensor-based parking solutions that detect the presence of vehicles in parking spaces and transmit this information to a centralized platform. Stanley Robotics develops robotic valet systems that autonomously park and retrieve vehicles in airport parking lots. Using a combination of robotics and artificial intelligence, these systems optimize parking space utilization and enhance the overall parking experience for passengers.

- ## Autonomous Vehicles

    Autonomous shuttles for transporting passengers between terminals, parking lots, rental car facilities, and nearby transit stations will be key to improving efficiency and reducing congestion while providing a convenient and eco-friendly transportation option. Navya and EasyMile are some of the companies that manufacture autonomous shuttle buses for transporting passengers within airport grounds.

- ## Biometric Authentication across all touchpoints

    Expanding the use of biometric technology for identity verification and security screening, will allow passengers to move through landside checkpoints more quickly and securely. This will involve facial recognition, iris scanning, or fingerprint authentication. NEC Corporation and Idemia have developed facial recognition systems for identity verification and security screening at airports. CLEAR and Vision-Box provide mobile biometric solutions that enable passengers to undergo identity verification using their smartphones thereby expediting check-in, security screening, and boarding processes at airports. The IATA One ID is another key initiative that presents an opportunity for passengers to streamline their journey by sharing information in advance and adopting a contactless process at the airport based on biometric recognition. Contactless travel aims to provide a consistent and seamless experience for passengers across different airlines, airports, and governmental entities.
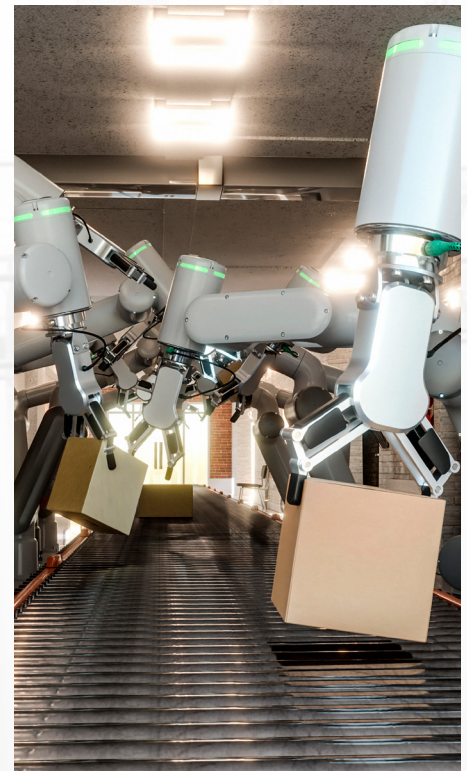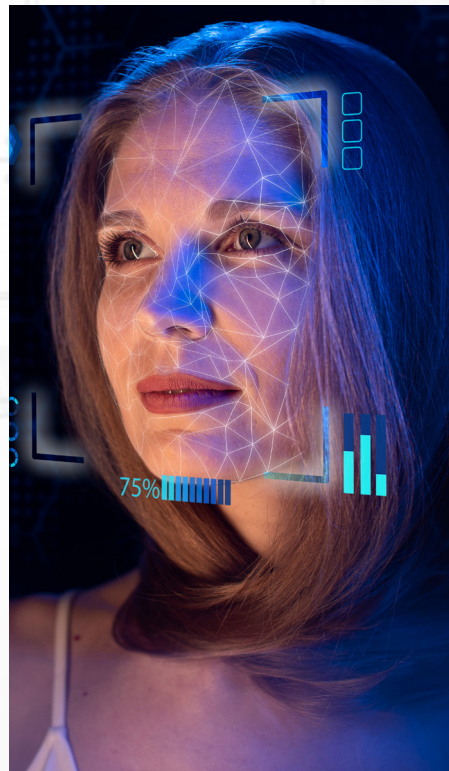
- ## Robotic Assistance

    Deploying robots and automation systems to assist passengers with tasks such as luggage handling, wayfinding, and language translation will be very beneficial. These robots could provide personalized assistance and enhance the overall passenger experience. SITA develops robotic solutions for airports, including autonomous robots equipped with sensors and AI capabilities to perform tasks like cleaning, maintenance, and baggage handling, enhancing operational efficiency and passenger experience.

- ## Use of AI s IOT in Queuing Systems

  Airports will extensively begin implementing virtual queuing systems to reduce wait times and overcrowding in landside areas such as check-in counters, security checkpoints, and baggage claim areas. Passengers will receive real-time updates and notifications on their mobile devices, allowing them to move through the airport more efficiently.
  Delhi Airport has recently implemented 'predictive analysis' to forecast the footfall of passengers within their terminals, allowing for proactive scheduling of manpower for every stage of the passenger journey.

- ## Augmented Reality (AR) Navigation

  Developing AR applications to help passengers navigate landside areas, locate amenities, and access important information such as flight status and gate changes is expected to be a key innovation in passenger experience. IndoorAtlas provides indoor positioning and navigation technology using geomagnetic sensors, enabling AR-based wayfinding applications for airports to guide passengers to their destinations.

These are just a few examples of innovations that could transform the landside operations of airports in the future. As technology continues to evolve and passenger expectations evolve, airports will likely continue to explore new ways to improve efficiency, convenience, and sustainability in landside areas.

AIRPORTS IN THE MIDDLE EAST

The airports in the Middle East are at the forefront of integrating technological innovations into their processes. Hamad International Airport (Doha) was one of the early adopters of digital twin technology by partnering with SITA in 2022. This technology is seeing more uptake from airports across the world due to its benefits to passengers and all airport stakeholders. Dubai Airports is set to adopt SAAB's Integrated Air Traffic Control Suite, which will be deployed at both Dubai International Airport and Al Maktoum International Airport. This technology aims to lessen the burden on ATC personnel by employing AI to assist with departure sequencing while maintaining high safety standards.

Early this year, Sheikh Mohammed bin Rashid Al Maktoum approved a $35 billion new terminal at Al Maktoum International.2 This new-age airport in Dubai has also recently revealed the future adoption of the 'no red lights' concept thereby indicating the implementation of new airport technologies to assist passengers and save time spent in operational processes.

In the Kingdom of Saudi Arabia, King Salman International Airport in Riyadh is scheduled to be one of the biggest in the world, with the capacity to accommodate up to 120 million passengers by 2030. In line with the Kingdom's Vision 2030 objectives, innovation in technology is expected to play a major role with the Airport expected to embrace Robotics & Artificial Intelligence (AI) right from its inception.

To sum up, it is very evident that airports in the region are looking towards cutting-edge technology across various functions with the goal of delivering enhanced passenger experience and highest levels of safety in the air and on the ground.

FUTURE GROWTH OUTLOOK / FROST INSIGHTS

- ## Advances in multi-modal connectivity
  Airports will continue to be drivers of macro-economic development. As cities get more crowded, ensuring seamless connections between different modes of transportation, will be crucial for airports and the city administration to decongest the increased traffic. The implementation of urban eVTOL air taxis and regional advanced mobility solutions in this regard, will be a game changer for airport and aero hubs from a passenger experience and revenue generation perspective.

- ## Carbon Net Zero through SAF
  In order to achieve Net Zero carbon goals, every stakeholder in the aviation supply chain will have to innovate to stay on course. Airports are key stakeholders and will have to consider innovative solutions for supply of SAF to airlines.
  Key partnerships with SAF producers, suppliers and airlines will be critical to their success. Such partnerships are already being formed with several airports leading the way, for e.g. Swedavia, Heathrow, Dusseldorf and Schiphol have initiated measures by setting up Incentive Funds for Sustainable Aviation Fuel (SAF) However such development is skewed towards certain regions and is not consistent.

- ## Collaborative Platforms
  Platforms that support multi-stakeholder collaboration in real-time to support improved decision-making from a single point while having inputs and visibility across the processes and operations will be in great demand. Further, there will be demand for remote accessibility to these platforms to support speedier and more efficient monitoring and response.

- ## Penetration of AI and Big Data
  Solutions that leverage AI and Big Data to provide predictive insights into disruptions, bottlenecks, delays, supported by automated and suggestive process changes dynamically, will be of great importance to airport operators.
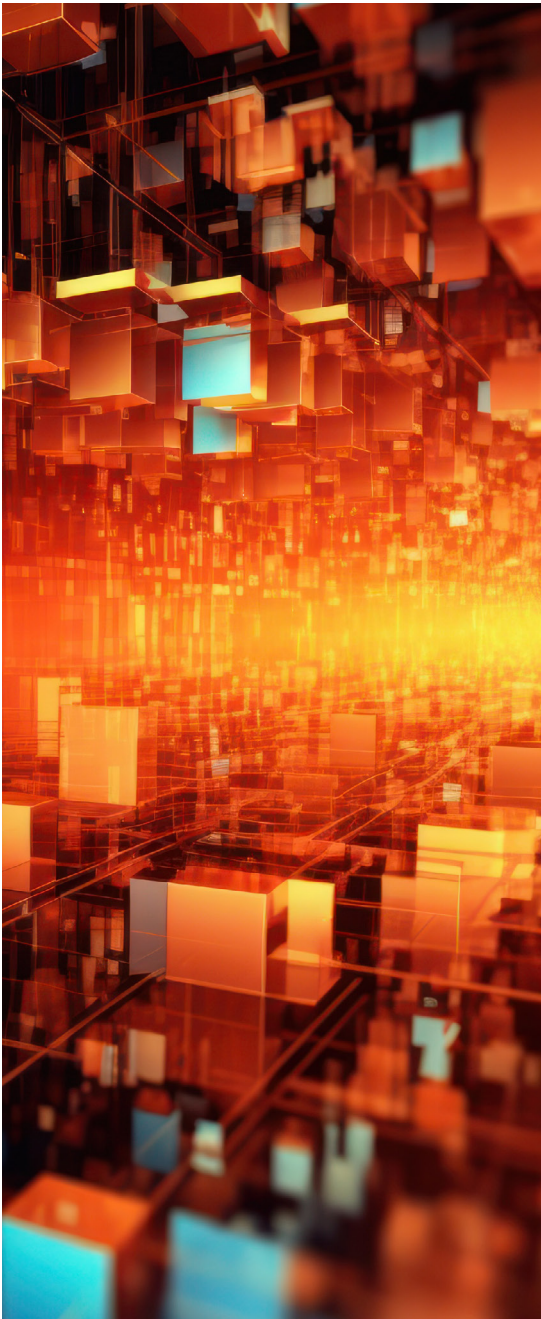
- ## Resource Optimization
  Solutions that empower operators to track and monitor resources such as assets and workforce in real time, while also enabling dynamic allocation based on demand and task type, will become increasingly vital as the workforce becomes scarcer and more expensive.

- ## Increased Biometrics & Automation
  Automation (including contactless biometrics) will be increasingly deployed across the airport for passenger processing as well as operations to reduce inefficacies and manual labor while increasing passenger experience and operational performance.

- ## Focus on Non-aero Revenue
  Airports will continue to look for new revenue streams and enhancie existing ones to increase non-aero revenue. The focus will be on leveraging technology to offer an immersive and customized experience to passengers that leads to augmented spending.

- ## Sustainable & Smart Airports
  Solutions/Technology offering intelligent airport operations to reduce energy consumption such as having the ability to dynamically manage airport assets based on demand will be critical in reducing operations costs but become sustainable as well. Innovations will also be required to support energy storage and generation for various types of airports.

CONCLUSION

The immediate focus of airports is to enhance efficiency, capacity optimization, and passenger experience which will continue to be going forward. Solutions will need to be developed and implemented based on specific airport requirements based on region and tier. As innovative solutions are developed based on next-generation technologies, airports will require support in ensuring that these new solutions are integrated into their existing ecosystem with minimum downtime and investment.

Key focus will be on passenger experience and operational performance as airports struggle with increasing demand and scarce resources, which will lead to considerable investment in automation. Many airports around the world are transforming into more than just transportation hubs. They are becoming destinations in themselves, offering a wide array of recreational activities, dining options, and retail opportunities to enhance the overall travel experience. Innovations in technology are poised to streamline and simplify the cumbersome passenger processes at airports, thereby freeing up valuable time for travelers to indulge in relaxation and leisure activities during their airport experience.

Technology providers will include both large established players offering a comprehensive suite of solutions as well as boutique players offering specialized solutions will continue to innovate to support airport operators in addressing the specific challenges, needs and priorities with the integration of advanced technologies such as artificial intelligence, big data analytics, Internet of Things (IoT), automation, and robotics, the industry will experience rise of Airports 4.0 and sustainable airports.

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airportshow

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